King County Department of Natural Resources and Parks

Solid Waste Division

CEDAR HILLS REGIONAL LANDFILL
ENVIRONMENTAL CONTROL SYSTEMS MODIFICATIONS PROJECT
CONTRACT NO. E00286E12

EAST PERCHED ZONES

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORK PLAN

Prepared by
Aspect Consulting, LLC

King County
Department of
Natural Resources and Parks
Solid Waste Division

Waste Prevention · Resource Recovery · Waste Disposal

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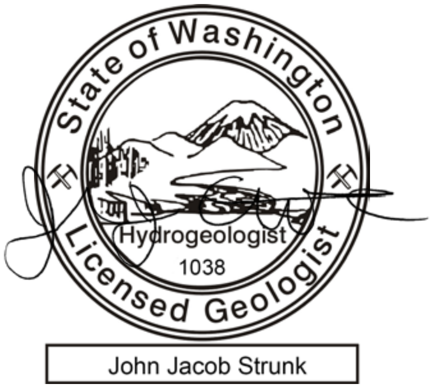

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ACRONYMS AND ABBREVIATIONS

2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
2,4-D	2,4-dichlorophenoxyacetic acid
4,4’-DDE	4,4-dichlorodiphenyldichloroethylene
AECOM	AECOM Technical Services Inc.
amsl	above mean sea level
ARARs	Applicable or relevant and appropriate requirements
Aspect	Aspect Consulting, LLC
beta-BHC	beta-hexachlorocyclohexane
bgs	below ground surface
BHC	benzene hexachloride
BHCC	BHC Consultants
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations [CFR
CHRLF	Cedar Hills Regional Landfill
COC	constituent of concern
COPC	constituent of potential concern
CVOC	chlorinated volatile organic compound
DCA	1,1 dichloroethane
DCE	1,2 cis dicholorethene
DDE	dichlorodiphenyldichloroethylene
Ecology	Washington State Department of Ecology
ECSM	Environmental Control Systems Modifications
EPA	U.S. Environmental Protection Agency
EPZ	East Perched Zones
ESPZ	East Shallow Perched Zone
FS	feasibility study
FSAP	field sampling and analysis plan
HEC	Herrera Environmental Consultants, Inc.
KCEL	King County Environmental Laboratory
KCSWD	King County Solid Waste Division

LEL	lower explosive limit
LFG	landfill gas
MDLs	method detection limits
MFS	Minimum Functional Standards for Solid Waste Handling
mg/L	milligrams per liter
MNA	monitored natural attenuation
MFS	minimum functional standards
MSWH	municipal solid waste handling
MTCA	Washington State Model Toxics Control Act
NESPZ	Northeast Shallow Perched Zone
PCE	perchloroethylene
PDB	passive diffusion bag
QA	quality assurance
QA/QC	quality control and quality assurance
QAPP	quality assurance project plan
QC	quality control
RAOs	remedial action objectives
RCW	Revised Code of Washington
RI	remedial investigation
RPP	rigid porous polyethylene
SAP	sampling and analysis plan
scf	standard cubic feet
scfm	standard cubic feet per minute
SEE	Sweet-Edwards/EMCON
SEPA	State Environmental Policy Act
SKCDPH	Seattle-King County Department of Public Health
SSWA	South Solid Waste Area
SVOC	semivolatile organic compound
TCE	trichloroethene
ug/L	micrograms per liter
UPLs	upper prediction limits
USGS	U.S. Geological Survey
VC	vinyl chloride

VI	vapor intrusion
VOC	volatile organic compound
WAC	Washington Administrative Code
WQC	water quality criterion

1.0 INTRODUCTION

This Remedial Investigation (RI)/Feasibility Study (FS) Work Plan (RI/FS Work Plan) has been prepared to provide the scope of work and objectives for a focused RI/FS at the Cedar Hills Regional Landfill (CHRLF), located in unincorporated King County, Washington (Figure 1). In response to compliance requirements in its 2004 Municipal Solid Waste Handling (MSWH) permit, King County Solid Waste Division (KCSWD) initiated two projects to investigate environmental control systems in the pre-1986 unlined areas of CHRLF. The report from one of those projects *Cedar Hills Regional Landfill Site-Wide Groundwater Wells and Hydrogeologic Report* (CH2M HILL and Udaloy, 2004a) examined hydrogeology to resolve questions regarding the perched groundwater in the East Perched Zones (EPZ) and the South Solid Waste Area (SSWA) perched zone; the report also refined the conceptual site model for the Regional Aquifer. Groundwater monitoring data from the EPZ indicate that concentrations of certain parameters are greater than upper prediction limits (UPLs) derived from CHRLF-specific background wells. These impacts to groundwater quality are suspected to be due to interactions with landfill gas (LFG). When exceedances of the UPLs in the EPZ were confirmed during retesting, state regulations (Washington Administrative Code [WAC] 173-351) required that the nature of the monitoring program at the landfill shift from a detection monitoring program to an assessment monitoring program. Assessment monitoring is required whenever a statistically significant increase over background has been detected for any of the parameters listed in WAC 173-351-990 Appendix I.

An addendum to the hydrogeologic report (Aspect, 2013a) was developed to satisfy conditions of the 2009-2019 MSWH permit, which required an update to the site-wide hydrogeologic report (CH2M HILL and Udaloy, 2004a) including a more detailed investigation of the EPZ.

As a result of the findings of the site-wide hydrogeologic report, the hydrogeologic report addendum, and the assessment monitoring, the Washington State Department of Ecology (Ecology) on behalf of the Seattle King County Department of Public Health (SKCDPH) requested that KCSWD engage in corrective action for perched saturated zones beneath the EPZ at the CHRLF (KCSWD, 2013). Ecology and KCSWD agreed to proceed under the Model Toxics Control Act (MTCA) with an Independent Remedial Action in accordance with WAC 173-340-510 and WAC 173-340-515. Given that the property is an active landfill regulated under WAC 173-351, KCSWD agreed to proceed with the investigation and remedial action, with periodic consultation with Ecology. The agreed-upon schedule for consultation with Ecology was outlined in a letter dated September 12, 2013, from KCSWD to Ecology. This schedule included submittal of an RI/FS Work Plan to Ecology for agency review.

This document represents the Work Plan for the EPZ at the CHRLF. The subject of this investigation is restricted to the EPZ, as indicated in KCSWD's letter of intent to Ecology dated September 12, 2013 (KCSWD, 2013). Other areas of the CHRLF where environmental monitoring data exist are not included within the scope of this RI/FS Work Plan. Figure 2 depicts the CHRLF property features and the general area to be investigated as part of this RI/FS Work Plan. "Site," as defined by MTCA in WAC 173-340-200, is any area where a hazardous substance has been deposited or otherwise comes to be located. The boundaries of the Site will be defined in the RI/FS Report after the constituents of concern (COCs) have been determined, cleanup levels identified, and the extent of contamination defined.

1.1 RI/FS Objectives and Purpose

The RI/FS Work Plan describes the project objectives and organization, functional activities, cleanup alternative evaluation criteria, and quality assurance/quality control (QA/QC) protocols that will be used to complete the RI/FS. The RI/FS Work Plan serves the following purposes:

- Provide an up-to-date summary of completed investigations conducted at CHRLF
- Describe a preliminary conceptual site model explaining contaminant movement through the environment and exposure to potential receptors
- Identify data gaps that require investigation to enable evaluation and selection of a cleanup action
- Provide the rationale for the scope of work to be performed for the RI
- Present detailed methods for sampling and analysis
- Provide an approach and scope of work for the FS
- Provide a summary of the elements to be included in the RI/FS Report, including a schedule for completion of the RI/FS

1.2 RI/FS Work Plan Organization

The RI Work Plan is presented in Sections 2.0 through 8.0. Section 2.0 presents the CHRLF history and background. Section 3.0 defines the physical, historical, and geographical setting of the CHRLF. Section 4.0 discusses previous investigations and cleanup actions. Section 5.0 presents the existing environmental dataset and evaluates its usability in the RI. Section 6.0 describes the preliminary conceptual site model for the EPZ and the potential exposure pathways and receptors. Section 7.0 presents the applicable preliminary screening levels and compares existing environmental data to them to produce constituents of potential concern (COPCs) for the RI. Section 8.0 describes the technical issues pertaining to the RI, RI data gaps to be addressed, and the general approach for the RI/FS. Section 9.0 presents the approach for the FS and the FS data gaps to be addressed. Section 10.0 presents the RI/FS deliverables and the project schedule.

Several appendices provide additional information:

- Appendix A – The Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) that will guide the field work portion of the RI.
- Appendix B – A collection of historical analytical data used to generate the tables contained in this RI/FS Work Plan.
- Appendix C – A collection of maps displaying the spatial extent of individual constituents reported in historical data.

- Appendix D – A collection of time-series concentration plots depicting water level fluctuations in selected monitoring wells.
- Appendix E – The existing infrastructure figures originally presented in the East Main Hill Perched Zones Technical Memorandum (Aspect, 2010b).

2.0 SITE HISTORY AND BACKGROUND

This section describes the landfill history and background.

2.1 Project Location

KCSWD owns and operates the CHRLF located at 16645 - 228th Avenue SE in unincorporated King County near Maple Valley, Washington (Figure 1). The landfill is 920 acres in area, approximately half of which is buffer (described further in Section 3). One of the largest municipal solid waste landfills in the Pacific Northwest, CHRLF serves King County, exclusive of the Cities of Seattle and Milton. Figure 2 depicts an aerial view of CHRLF property features, with existing landfill areas delineated. The portion of the CHRLF that is the subject of this investigation, the “project area” or “EPZ area”, is highlighted in Figure 2. It includes the eastern portion of the CHRLF Main Hill landfill unit, which contains the EPZ, and is bound by MW-87 to the northwest, Stream 3 to the north, the CHRLF east property buffer boundary to the east, Passage Point to the south, and the Main Hill edge of refuse to the west. Figure 3 depicts County owned parcels adjacent to the CHRLF.

2.2 Landfill History

CHRLF has been in operation since 1965. The landfill receives approximately 2,500 tons of refuse daily and more than 800,000 tons of refuse a year. New landfill Areas have been added over time since the landfill began operation. Since 1986, the new landfill units have been lined with a geomembrane supplemented with active landfill environmental control systems. In pre-1986 areas, an active LFG collection system and an improved cover were installed retroactively. At current trends in incoming waste volume, CHRLF is expected to reach its capacity in 2040.

2.2.1 Cedar Hills Landfill Development

Waste filling at CHRLF has occurred in several “Areas,” as delineated in Figures 2 and 3, and are referred to as the South Solid Waste Area, the Southeast Pit, the Main Hill, the Central Pit, Refuse Areas 2/3, Refuse Area 4, Area 5, Area 6, and Area 7. The project area is located along the east side of the Main Hill. Waste filling operations continue in Area 7. Plans to start using Area 8 are under way.

In addition to the landfill and its support facilities, the property includes a landfill gas-to-energy facility owned and operated by Bio Energy Washington LLC (BEW); Passage Point, a transitional residential community; a right-of-way for a natural gas pipeline; and numerous power transmission line rights-of-way.

2.2.2 Development and Operation of Main Hill

Cedar Hills Regional Landfill was approved for solid waste disposal under a permit issued by King County Board of Commissioners in 1960. The Main Hill was constructed in 1961 (AMEC, 2008), began receiving solid waste in 1965, and continued to operate through the mid-1980s (KCSWD, 2010). Waste was placed in the Main Hill prior to enactment of regulations requiring bottom-lining systems (CH2M HILL and UES, 1999). A temporary cover was installed in the 1980s and a permanent geomembrane cover system was installed by 1991 (URS, 2008). Other landfill control systems phased in at the Main Hill include LFG extraction systems, stormwater management systems, leachate collection systems, and a groundwater extraction system.

3.0 SETTING AND LAND USE

This section of the Work Plan describes the setting and land use of the project area and environs. It includes a description of the physical environment, land uses, and landfill existing infrastructure.

3.1 Environmental Setting

The physical characteristics of the landfill environment are described in this section. After overviews of topography, surface drainage, and climate, the text details hydrologic conditions at the landfill site and notes existing uses of groundwater.

3.1.1 Topography and Surface Drainage

CHRLF is located on a northwest-trending upland near McDonald Creek to the north, Issaquah Creek to the east, Cedar Grove channel to the south, and Cedar River to the west. Topography within the EPZ area consists of a relatively flat upland surface at about elevation 640 feet above mean sea level (amsl) that slopes northeastward toward an ephemeral stream referred to as Stream 3 (Figure 4). The mapped trace of Stream 3 extends from about elevation 510 to 490 feet amsl, where it exits at the CHRLF east property boundary. Surface runoff from the east side of the Main Hill Area drains to Stream 3, which is tributary to Issaquah Creek. The Main Hill refuse mound rises up to the west of the EPZ project area to about elevation 780 feet amsl.

Wetlands are present in the flat upland area and adjacent to Stream 3 (Figure 4). The upland wetlands consist of Wetland A and Wetland B, category III wetlands of about 2.2 acres and 1.8 acres respectively. The wetlands receive inflows from direct precipitation and spillage from the non-potable water tanks when the landfill’s dust control trucks are filled (AMEC 2011).

Wetlands A and B drain to an asphalt-lined ditch adjacent to the west side of the wetlands (Figure 4). Wetland B also drains into Wetland A via a culvert passing under the road that separates the two wetlands. Some outflow from the wetlands also occurs as a result of seepage (AMEC, 2011).

3.1.2 Climate

CHRLF lies within the maritime climate of Western Washington, characterized by relatively mild wet winters and dry summers. Mean annual precipitation in CHRLF vicinity is approximately 57 inches (1981-2010, Landsburg climate station located near Maple Valley). Approximately 40% of the average precipitation falls November through January. With a combined average total of about 3 inches of precipitation (usclimatedata.com) July and August are the driest months.

A meteorological station located at CHRLF monitors temperature, wind speed and direction, rainfall, and temperature. These data will be compiled and used during the RI.

3.1.3 Geology

Subsurface conditions in the EPZ have been extensively studied and documented (CH2M HILL and UES, 2004b; Aspect, 2010). Subsurface geologic units identified in the EPZ are briefly summarized below and are presented as cross-sections in Figures 5a through 5c. Cross-section lines and exploration locations are presented on Figure 4. The site-wide hydrogeologic report (CH2M HILL and UES, 2004a) divides the deposits beneath the CHRLF into seven geologic units, referred to as Units A through G, based on geologic origin and relative age. Shallow Unit C and D soils are of primary interest in the EPZ. Unit C consists of glacial till and lacustrine deposits. Unit D consists of alluvial gravels referred to as stratified drift (Unit D). Characteristics of the main geologic units that underlie the EPZ are briefly described below:

- Glacial till (Unit C) – A dense mixture of gravel in a matrix of silt and sand. Weathered till, typically less than 20 feet thick, overlies the more competent, unweathered till in most locations. The weathered till is less dense than the unweathered till and contains scattered roots and other organic matter. The unweathered glacial till has a maximum thickness of about 50 feet. Till underlies the upland and slope areas of the EPZ, but has not been identified in the lower-lying area around Stream 3.
- Glaciolacustrine deposits (Unit C) – Glaciolacustrine deposits generally underlie glacial till in the higher-elevation upland areas of the EPZ. These deposits have a maximum thickness of about 30 feet (Figure 5a). They are differentiated from the till by the presence of fine-grained material.
- Stratified drift (Unit D) – Stratified drift is present at depth throughout the EPZ. Stratified drift includes slightly silty gravels, gravelly silty sands, and gravelly sandy silts. The stratified drift occurs beneath glaciolacustrine deposits, directly underlies glacial till, and is also exposed at the ground surface in the lower elevations surrounding Stream 3.
- Fluvial sands and silts with incised gravel channels (Unit F)–The top of Unit F is variable beneath the EPZ. The Regional Aquifer occurs within the Unit F soils beneath the EPZ.

Predominant soil types at the EPZ distinguish this area from other areas at CHRLF and create conditions conducive for the perched groundwater described in the next section.

3.1.4 Hydrogeology

Collectively referred to as the EPZ, two areas of perched groundwater are addressed by this Work Plan. Both are saturated areas of shallow groundwater of limited lateral and vertical extent east of the Main Hill:

- The East Shallow Perched Zone (ESPZ), located in the vicinity of MW-47 and the groundwater extraction wells EW-12 through EW-29 with groundwater elevations in the range of about 630 to 610 feet amsl
- The Northeast Shallow Perched Zone (NESPZ), located around Stream 3 and monitoring wells MW-30A and MW-62 with groundwater elevations in the range of 520 to 500 feet

Figure 4 depicts the current interpretation of the ESPZ (in blue shading) and the NESPZ (in green shading). The perched groundwater zones have been described in detail elsewhere (Aspect, 2010; Aspect, 2013a). Between the ESPZ and the NESPZ is an area of seasonally saturated till/lacustrine deposits, depicted in yellow shading on Figure 4. The project area contains all three of these hydrogeologic units.

3.1.4.1 East Shallow Perched Zone

The ESPZ occurs within the very low-permeability glaciolacustrine silts that underlie the flat upland area on the east side of the Main Hill. The low-permeability silts impede downward migration of groundwater, resulting in year-round saturation of the shallow till and glaciolacustrine deposits (Aspect, 2013a).

Groundwater moves slowly in the ESPZ because the groundwater occurs within fine-grained units. Groundwater flow is primarily downward with a limited horizontal component that has the potential to flow radially outward from the relatively flatter areas occupied by the wetlands. Essentially, the low-permeability silts store infiltrating precipitation and slowly leak it to the unsaturated stratified drift that occurs beneath the ESPZ, eventually migrating to the Regional Aquifer. The mean hydraulic conductivity within the ESPZ lacustrine deposits is estimated to be 3×10^{-6} cm/sec (Aspect, 2010).

3.1.4.2 Northeast Shallow Perched Zone

The NESPZ lies within silty gravel and silty sand layers that hold groundwater within the stratified drift on the hillside northeast of the closed Main Hill. Groundwater within the NESPZ either moves downward discharging to the Regional Aquifer or moves east-southeast discharging to the Stream 3 near its eastern end (Aspect, 2013a). Groundwater flow towards Stream 3 moves east-northeast and generally parallels the Stream 3 gradient (Figure 6). Water levels in the stream and underlying perched zone fluctuate seasonally in a similar manner, indicating hydraulic connection between groundwater in the stratified drift and Stream 3. The hydraulic conductivity of the stratified drift at MW-102 is estimated to be about an order of magnitude higher than that of the ESPZ glaciolacustrine deposit, at 3×10^{-5} cm/sec (Aspect, 2010). Locally higher hydraulic conductivity of 6×10^{-3} cm/sec was identified in NESPZ monitoring well MW-63 (Sweet-Edwards/EMCON [SEE], 1991).

3.1.4.3 Regional Aquifer

The Regional Aquifer underlies the EPZ at elevations ranging from about 320 feet amsl at the south end of the EPZ area to about 285 feet amsl at the north end. A thick unsaturated zone exists between the base of the EPZ and the Regional Aquifer. The thickness of the unsaturated zone ranges from about 280 feet beneath the ESPZ to about 210 feet beneath the NESPZ. The unsaturated zone consists of stratified drift (Unit D) soils, lacustrine and low-energy fluvial deposits (Unit E), and fluvial sands and silts with incised gravel channels (Unit F). The Regional Aquifer occurs within the Unit F soils beneath the EPZ. Groundwater flow in the Regional Aquifer beneath the EPZ is northwesterly (Aspect, 2011; Figure 7).

3.1.5 Groundwater Use

Groundwater at the CHRLF is not used as a drinking water source. Chapter 12.24 of King County Board of Health Title 12 requires a 1,000-foot setback from a landfill for public water system wells. Figure 3 depicts the 1,000-foot buffer around the landfill and the water supply wells within the vicinity of CHRLF. Four non-potable groundwater wells (NPW-1 through NPW-3 and ATC-1) owned by KCSWD are located within the 1,000-foot buffer. NPW-1 through NPW-3 supply non-potable water for CHRLF maintenance activities. ATC-1 was installed as a non-potable water source for Passage Point, to replace a decommissioned well

(PW-1) (CH2M HILL UES, 2004a); however, this well is not currently operated (KCSWD, 1998). The remaining water supply wells within the vicinity of CHRLF are greater than 1,000 feet from the landfill.

3.2 Current and Future Land Use

Current and potential future land use for the property is as a sanitary landfill. The project area includes the edge of the Main Hill Area refuse and a section of the landfill's 1,000-foot wide buffer. The 1,000-foot-wide buffer zone surrounding the landfill is primarily comprised of a wooded area, which separates landfill activities from surrounding properties (Figure 3). Certain other land uses have been allowed within the buffer area. For example, Passage Point, a residential transitional housing facility, is located on the east side of the landfill area within the buffer (AECOM, 2014). Other current uses in the buffer include leachate aeration ponds and utility easements.

King County identifies the landfill property as a public utility. Its zoning classification is RA-10, a rural area zoned for one dwelling unit per 10 acres. The predominant land use zoning surrounding the CHRLF is RA-5, rural area zoned for one dwelling unit per 5 acres; the landfill is surrounded to the north, east, and west by residential properties. Figure 3 depicts other King County properties in the vicinity of CHRLF. Adjacent to the northeast of the landfill is the RA-5-zoned Log Cabin Reach Natural Area. Adjacent to the south of the landfill is the Queen City Farms Superfund Site, which is zoned as M, mineral property.

3.3 Existing Infrastructure

The existing infrastructure at the CHRLF includes landfill support facilities on the south side of the property, such as the main office building, a fueling station, portable buildings, the BEW LFG plant, two leachate lagoons, and several stormwater lagoons. Additionally, the landfill is developed with groundwater monitoring and extraction wells, LFG extraction wells, and subsurface utilities (including stormwater, sewer, and leachate collection lines), all of which support the monitoring and resource protection infrastructure. These infrastructure elements are discussed further in the following subsections.

3.3.1 Groundwater Monitoring and Extraction Wells

In the project area, as shown on Figure 4, 18 monitoring wells and piezometers have been completed in the shallow perched water-bearing zones and nine monitoring wells have been completed in the Regional Aquifer. In addition, 29 groundwater extraction wells have been installed within the shallow perched groundwater. The following subsections describe these two distinct well networks.

3.3.1.1 Groundwater Monitoring Wells

The existing groundwater monitoring well and piezometer network was installed across the entire CHRLF property during several phases over the lifetime of the landfill, as summarized in Table 1 and depicted in Figure 4. The network of groundwater monitoring wells and piezometers was initially installed for routine monitoring purposes (i.e., to characterize groundwater conditions) and for targeted investigations. Periodically, the network has been used to collect water level and groundwater quality data.

Groundwater quality is sampled quarterly in four monitoring wells (MW-30A, -47, -62 and EB-6) to meet the landfill's permit requirement for detection monitoring. In addition to the routine groundwater monitoring of selected wells, other wells have historically been sampled as part of specific investigations in the EPZ, as described in Section 4.3.

3.3.1.2 Groundwater Extraction Wells

A groundwater extraction system was recommended as part of a study of the MW-30A and MW-47 area (SEE, 1991). Twenty-nine groundwater extraction wells (EW-1 through EW-29) were installed along the east side of the Main Hill in 1993 to intercept impacted groundwater. The locations of the extraction wells are shown on Figure 4. Groundwater extraction wells EW-1 through EW-10 are considered part of the NESPZ and extraction wells EW-11-through EW-29 are considered part of the ESPZ. The extraction system was shut down on July 27, 2010, because it did not meet design performance requirements.

3.3.2 Stream 3 Staff Gages

Two staff gages (SG-4 and SG-5) are located along Stream 3. They provide stage measurements and allow for measurement of subsurface water during low flow periods (CH2M HILL and UES, 2004b).

3.3.3 Landfill Gas Monitoring and Collection Infrastructure

3.3.3.1 Landfill Gas Monitoring

LFG is monitored throughout the project area. Gas probe installations in the project area are summarized in Table 1 and depicted on Figure 4. The LFG monitoring network consists of compliance probes located along the property boundary as well as probes installed in native soils closer to the Main Hill edge of refuse. Within the EPZ area, the compliance probes located near the property boundary include GP-15 through -20 and GP-ATC--6 through -8 (Figure 4). Typical gas probe completions consist of multiple probes completed at various depths to monitor LFG in both shallow and deep soil horizons. Other probes have been installed nearer to the refuse to provide additional LFG characterization data and monitor effectiveness of King County's actions to control gas migration into native soils. These probes include GP-1, -6 through -9, and -55 through -62. Probes GP-55 through GP-62 consist of four shallow and deep gas probe pairs installed to investigate the LFG-to-groundwater pathway in the EPZ and to provide additional monitoring points for LFG in native soils (Aspect, 2010).

3.3.3.2 Landfill Gas Collection

LFG is collected from refuse in the Main Hill through vertical gas extraction wells and through leachate and LFG combination extraction wells (Figure 4). LFG extraction wells have an "E" prefix while dual phase wells have either a "GL" or "DPW" prefix. Figure E-3 in Appendix E presents the layout of the LFG system (extraction wells, collection wells, and lateral connectors) in the project area. The collection wells typically consist of vertical perforated pipes surrounded with a gravel pack. Vacuum is applied to the wells, creating overlapping influence zones to collect LFG generated by the refuse. Gas that collects in the leachate system is withdrawn by the LFG system through lateral connectors. The perforated LFG collectors buried in refuse are connected to a manifold through solid lateral pipes. LFG from the Main Hill is conveyed to a structure known as the North Flare Station by a series of header pipes. The laterals, manifolds, and header are comprised of solid pipe (AMEC-Geomatrix and Herrera Environmental Consultants [HEC], 2011).

Several LFG extraction wells are also located in native soils. In the ESPZ, these extraction wells include the E-29 series and gas probe GP-57 (Figure 4). Probe GP-57 was connected to the extraction system in December 2011.

LFG operation procedures require monitoring of LFG perimeter probes monthly. Data from the perimeter probes are used to evaluate whether LFG is migrating.

3.3.3.3 Leachate Collection

Leachate conveyance facilities are present within the Main Hill and along its east perimeter. Leachate lines throughout the project area are presented in Appendix E, Figure E-2. Principal leachate lines in the project vicinity include the North Main Hill Perimeter Collector and its East Branch. Within the EPZ project area, the North Perimeter Collector – East Branch extends from refuse into native soils. A shallow perimeter collector is present along the east perimeter of the EPZ, extending from south of Cleanout W northward to Cleanout N as presented in Appendix E, Figure E-2. The East Branch is a deeper collection system roughly 20 feet deep that terminates at Cleanout 13. The deeper portion of the North Perimeter Collector resumes at Cleanout 14 and extends southward. Details of the North Perimeter Leachate Collector – East Branch construction are presented in Section 6.2.2.

In addition to these horizontal collectors, vertical leachate extraction wells are located within the Main Hill. Vertical leachate collection wells are indicated by an “SW” or “PSW” prefix.

3.3.4 Other Utilities

Other subsurface utilities within the vicinity of the project area include sewer and water mains, as shown on Figure E-1 in Appendix E. A former drainfield was installed in the area of EW-22 and EW-24; it was associated with the facility currently known as “Passage Point.” The drainfield was decommissioned at some point between 1973 and 1977 (Aspect, 2011).

Water and liquefied petroleum gas lines have generally shallow burial depths (less than 5 feet below ground surface [bgs]). Gravity-flow sewer lines typically have deeper burial depths. Sanitary sewer lines extend south from the east side of the Passage Point facility (Figure E-1) and are remote from the delineated area of impacted groundwater in the EPZ.

4.0 PREVIOUS INVESTIGATIONS AND INTERIM CLEANUP ACTIONS

This section presents an overview of the environmental investigations conducted at the CHRLF since 1983. These investigations have assessed the landfill cover, LFG, leachate collection systems, surface water, geology and hydrogeology, and groundwater quality. Results of the previous investigations are documented in reports listed in Section 11.

Geologic and hydrogeologic conditions identified during the referenced investigations are noted in Section 3.1 (Environmental Setting) of this Work Plan. Summaries of other investigations and interim actions pertinent to the EPZ project area and the RI/FS are summarized in the following subsections.

4.1 Previous Investigations

Elevated readings of specific conductance, concentrations of volatile organic compounds (VOCs), and concentrations of inorganic compounds in monitoring wells MW-30, -30A, and -47 during routine detection monitoring led to an investigation of the MW-30A and MW-47 area in 1991. The investigation (SEE, 1991) included nine monitoring well installations, three soil borings, aquifer testing of MW-63, groundwater quality sampling, and water level monitoring. Post-investigation, a groundwater extraction system was recommended as a preferred alternative to remediate the observed groundwater impacts. The extraction system was installed in 1993 (see Section 4.2.1).

In 2004, the perched groundwater zones adjacent to the unlined portions of the Main Hill, including the EPZ, were evaluated (CH2M HILL/UES, 2004b). As part of the investigation, performance of the groundwater-extraction well system was assessed, staff gages SG-4 and 5 were installed, and the potential influence of engineered facilities on groundwater conditions was analyzed.

In 2007, a Phase I hydrogeologic analysis of the Main Hill perched zone, including the EPZ, evaluated the occurrence and extent of the EPZ as well as groundwater quality (Aspect, 2007). One borehole (EPZ-BH-1) was drilled along the access road to the east property boundary, near the north end of Passage Point. Water level measurements were made in EPZ monitoring wells, 53 gas probes, and 29 groundwater extraction wells. The report noted that LFG could cause groundwater impacts and recommended further investigation of the LFG-to-groundwater pathway as well as the installation of additional monitoring wells.

A Phase II hydrogeologic investigation of the EPZ was completed during 2009 and 2010 (Aspect, 2010b). The Phase II investigation addressed recommendations from the Phase I report (Aspect, 2007) as well as Tasks 2 through 6 of the 2009 to 2019 Municipal Solid Waste Handling Permit (SKCDPH, 2009). The work included further investigation into the LFG-to-groundwater contaminant transport pathway and further delineation of the EPZ extent and of groundwater flow and transport pathways. The work included an LFG survey using temporary direct-push probe explorations, installation of three new groundwater monitoring wells, installation of eight paired gas probes (shallow and deep probes), VOC sampling in LFG probes, and development of utility maps and utility cross sections.

Extensive influence testing on LFG extraction wells in the Main Hill and EPZ area were performed in 2010 (AMEC-Geomatrix/HEC, 2011) to identify areas of LFG extraction well interconnection and areas where interconnection was absent. The variable nature of connectivity between tested areas was attributed to thinning of the refuse around the Main Hill perimeter and the addition of large amounts of fill soil during landfilling operations.

A geophysical survey was performed at several areas of CHRLF in 2012 (AMEC and BHC Consultants, LLC, 2012) using electromagnetic and mise-a-la-mise survey techniques to evaluate existing leachate and LFG systems. The surveyed areas include the Northeast Leachate Collector in the area of Cleanouts 9 through 11 (see Figure E-2 for locations). Two anomalies were identified near the Northeast Perimeter Collector but were considered less likely to indicate leachate leaks than other anomalies; however, a limited investigation of the anomalies was recommended and will be addressed during the RI as discussed in Section 8.2.1.1. The anomalies occurred west of Cleanout 10 and north of Cleanout 11. Other investigations conducted in 2012 include a topographic survey to evaluate settlement of the Main Hill, wetland surveys, LFG well installation, and dual-phase well installation.

4.2 Previous Cleanup Actions

This section presents information on interim cleanup actions conducted in the EPZ project area of the CHRLF from 1993 through the present.

4.2.1 Groundwater Extraction

The 29-well groundwater extraction system operated from October 1, 1993, through July 27, 2010. Evaluations of system performance were made in 2004 and 2006 through 2009. Review of pumping data indicated several wells were dry or had failed (CH2M HILL/UES, 2004b). The extraction wells were rehabilitated through well redevelopment in November 2006 through March 2007 (AMEC-Geomatrix 2008a). Following redevelopment, the wells experienced rapid regrowth of microbial fouling and plugging, which again limited groundwater extraction system performance. The annual target design groundwater production was estimated at 14,700,000 gallons but the system produced approximately 868,000 gallons in 2004/2005 or about 6% of the design volume (AMEC-Geomatrix, 2008a).

Following redevelopment of the extraction wells in 2006 and 2007, the highest producing wells (EW-14, EW-20, and EW-22) were pump-tested. Even the best wells could not sustain flow and did not influence groundwater away from the well because of post-development biofouling (AMEC-Geomatrix, 2009). The pump test results also indicate that the low recovery rates limit the ability of the system to control groundwater migration and that the system does not meet the design requirements (AMEC-Geomatrix, 2009, 2008a). In response to these findings, KCSWD shut down the system on July 27, 2010, and put in place a monitoring program to provide comparison hydraulic gradients under pumping and non-pumping conditions. The groundwater quality at the extraction wells has not been evaluated since shutting down the extraction system.

4.2.2 Landfill Gas Migration Control

Actions taken to control LFG migration in native soils in the EPZ include enhanced gas collection in the vicinity of refuse extraction well SW-3 and connection of gas probe GP-57 to the LFG extraction system.

Well SW-3 was installed as a leachate head reduction well in the eastern central part of the Main Hill (Figures 4 and E3). In August 2007, SW-3 was connected to the LFG header, producing between 11 and 19 standard cubic feet per minute (scfm) gas and reducing methane concentrations in native soil extraction wells E-29C-D and E-29D-D. E-29C-D and E-29D-D are deeper extraction wells paired with shallower wells E-29C-S and E-29D-S, respectively. During the initial LFG extraction from SW-3, methane increased in shallower well E-29C-S, then declined after 1 week of operation. E-29D-S did not have measureable methane and did not exhibit any affects from SW-3 LFG extraction. A video survey of SW-3 indicated methane bubbling up through the casing at 36 feet bgs (the maximum depth of the camera survey; casing damage precluded deeper investigation). A conceptual model indicated that LFG is drawn into SW-3 near the base of refuse; the influence is propagated through an erosional window in the till, affecting the deeper stratified drift and removing methane from the deeper probes completed in native soils approximately 500 feet away (AMEC-Geomatrix, 2008b).

A replacement well E-71, adjacent to SW-3 in 2010, and new well E-70 were installed to improve LFG collection in the Main Hill (Figure 4). LFG extraction well E-71 had a relatively low flow rate (10 scfm) and did not influence SW-3 or E29DD. Two additional casings were installed into the gravel pack of E-71 at 34 and 65 feet bgs to collect shallow LFG. The deeper of these, E-71B, had a potential influence on native soils near well E29DD. E-70 had a high flow rate but did not influence probes outside the Main Hill refuse.

In December 2011, after LFG was detected in native soils in the ESPZ where impacted groundwater is found, GP-57 was connected to the gas extraction system.

4.2.3 Leachate System Modifications

The leachate collection system adjacent to the EPZ project area has not changed significantly since the closure-related activities in the early 1990s.

5.0 EXISTING ENVIRONMENTAL DATA

This section provides a general summary of the existing environmental data collected in the vicinity of the CHRLF EPZ area during past investigations and interim cleanup actions All existing data pertaining to the EPZ project area are compiled on a CD in Appendix B of this Work Plan. This section is not intended to be an exhaustive discussion of the nature and extent of contamination, but rather a summary of available data used to identify data gaps. Existing data for groundwater, surface water, LFG, soil gas, and leachate are presented in Tables 2 through 6. Sample locations are depicted on Figure 4.

5.1 Existing Data

Existing data for groundwater, surface water, LFG, soil gas, and leachate are summarized in the following sections.

5.1.1 Groundwater

Extensive data are available to document groundwater quality up- and downgradient of the EPZ. Information from approximately 37 wells is included in the dataset for the EPZ; however, not all 37 wells were sampled during each sampling event. Approximately 283 groundwater sampling events occurred at various locations within the EPZ project area between 1986 and 2014. Groundwater was analyzed on a routine basis from selected wells for VOCs, dissolved metals, and general chemistry parameters. Other groundwater analyses performed on a less frequent basis include total metals, PCBs, pesticides, and herbicides. The summary presented in Table 2 includes the number of detections; frequency of detections; and the maximum, minimum, and average concentrations. The following significant observations about the analytical constituent categories can be made:

- VOCs – A total of 31 VOCs were detected in at least one groundwater sample. The constituent classes that were detected include predominantly chlorinated compounds, in addition to alcohol-, ketone-, and sulphur-containing compounds. The constituents detected at a frequency of greater than 1% include 1,1-dichloroethane; cis-1,2-dichloroethene (DCE); methylene chloride; trichloroethene (TCE); and vinyl chloride.
- Metals – Calcium, magnesium, and sodium were detected at a frequency of 100% in both the total and dissolved samples. Potassium was detected at a frequency of 100% in the total samples and at a frequency of 99% in the dissolved samples. Metals detected at a frequency greater than 50% in both the total and dissolved samples include barium, iron, and manganese. Arsenic was detected at a frequency greater than 50% in either the dissolved or the total sample.
- Metals that were not detected in either the dissolved or the total samples include antimony, beryllium, cadmium, mercury, silver, and thallium.
- PCBs – Samples from selected locations were analyzed for Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260 during selected sampling events. No PCBs were detected.

- Chlorinated herbicides – The chlorinated herbicides for which samples from selected locations were analyzed during selected sampling events include 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T); 2,4-D (2,4-dichlorophenoxyacetic acid (2,4-D); dinoseb; isodrin; and silvex. Only dinoseb was detected, and only in a single sample.
- Pesticides – Samples from selected locations during selected events were analyzed for 11 pesticides. None of the pesticide compounds were detected in any of the samples.
- General chemistry – Chloride and alkalinity concentrations are important indicators for differentiating impacts due to leachate from those due to LFG. Whereas alkalinity concentrations serve as an indicator of both fugitive leachate (i.e. fugitive leachate is leachate that has escaped capture by the leachate collection system) and migrating LFG, chloride is an indicator of leachate. For example, the presence of chloride and the absence of alkalinity is an indicator of fugitive leachate. General chemistry parameters for which samples are routinely monitored include ammonia, alkalinity, chloride, nitrate as nitrogen, sulfate, total dissolved solids, total organic carbon, total solids, and total suspended solids.

5.1.2 Surface Water

The surface water sampling location pertinent to the EPZ project area, SW-E1, is located near the downstream end of Stream 3 (Figure 4). This location was sampled 89 times between January 2000 and December 2012. Surface water was tested on a routine basis for dissolved metals, and general chemistry parameters. Other analyses performed on surface water samples include total metals, VOCs, pesticides, and herbicides. The summary presented in Table 3 includes the number of detections; frequency of detection; and the maximum, minimum, and average concentrations. The following significant observations can be made:

- VOC – Six samples were analyzed for VOCs. One VOC—acetone—was detected, and in only a single sample.
- Metals –Aluminum, barium, iron, magnesium, manganese, potassium, and sodium were detected at 97% to 99% frequency in the dissolved samples and at 100% frequency in the total samples. The majority of the remaining metals were detected at frequencies less than 10% in the dissolved or total samples.
- Metals that were not detected in either the dissolved or the total samples include antimony, beryllium, cobalt, nickel, silver, thallium, and tin.
- Chlorinated herbicides – Of the four chlorinated herbicides for which surface water samples were analyzed (i.e., 2,4,5-T; 2,4-D; dinoseb; and silvex), only silvex was detected, and in only a single sample.

- Pesticides – The pesticides for which surface water samples were analyzed include endrin, lindane, methoxychlor, and toxaphene. None of these pesticides were detected in any surface water samples.

5.1.3 Landfill Gas

"Landfill gas" or LFG, is a term used to refer to gases (carbon dioxide, methane, trace thiols, and hydrogen sulfide) that are generated in a landfill by the decomposition of organic materials (USEPA, 1991). VOCs are sometimes also present in LFG. LFG has been monitored in compliance probes located along the property boundary, probes in native soils closer to the Main Hill, and at LFG extraction wells. For specific investigations, LFG has also been monitored at selected groundwater extraction wells and groundwater monitoring wells with unsaturated screens. The current routine LFG monitoring includes methane, carbon dioxide, and oxygen in migration monitoring probes along the property boundary perimeter of the landfill.

Historical data are available for 28 shallow fill-weathered till zone LFG sample locations within the EPZ project area. These sample locations include 26 gas probes, EW-20, and MW-104. The 24 deep stratified drift LFG sample locations within the EPZ project area include gas probes and extraction wells. Between October 2009 and January 2014, these locations were typically screened for LFG on 12 occasions, with a maximum of 194 events.

Methane was detected in four of the shallow sample locations (EW-20, GP-58, GP-60, and MW-104) and in 11 of the deep sample locations (see Table 4). For the period 2009-2013, the highest methane concentration detected in shallow sample locations was 16.5% at GP-58, but the average concentration at that location was 8.1%. The highest methane concentration detected in deep sample locations was 80.1% at GP-57, with an average concentration at that location of 49.9%. Methane was also detected at high concentrations in deep probes GP-55 (69.7% maximum) and GP-59 (71.3% maximum). The gas probes with the highest concentrations in the shallow and deep aquifers are all located adjacent to the "EW" extraction wells in the ESPZ.

Carbon dioxide was detected in all of the shallow and deep sample locations, with the exception of EW-20. The pattern of carbon dioxide concentrations is similar to that of methane, with the highest values in the shallow and deep locations adjacent to the extraction wells in the ESPZ.

LFG migration has been identified by elevated methane concentrations in LFG probes located adjacent to the Main Hill along the edge of refuse. These data indicate that LFG is migrating beyond the LFG control system within the shallow fill/till soils and deeper stratified drift beneath the ESPZ.

5.1.4 Soil Gas

"Soil gas" is a term used in Ecology's guidance document (Ecology, 2009) to refer to vapors in subsurface soil (from a variety of sources) having the potential to impact indoor air quality. Soil gas data were collected in October 2009 and January 2010 from six locations in the EPZ—gas probes GP-55, GP-58, GP-59, and GP-60, and extraction wells EW-5 and EW-10 (Aspect, 2010). GP-58 was sampled during only the fall event and EW-10 was sampled during only the winter event. Soil gas samples collected from these points were analyzed only for VOCs. A total of 17 VOCs were detected in the samples. The constituents with a detection frequency of greater than 50% include 1,1-dichloroethane; benzene; cis-1,2-DCE; dichlorodifluoromethane; ethylbenzene; m,p-xylene; toluene; and vinyl chloride. These results are presented in Table 6.

5.1.5 Leachate

Leachate collection points have been monitored routinely at four locations around the CHRLF property. For initial evaluation of existing data, the leachate sampling point MH-46N was used. Located at the north end of the Main Hill near the north stormwater pond and sampled monthly from the upstream side, MH-46N collects raw leachate from the Central Pit, which includes the oldest lined cells at CHRLF. MH-46N is more representative of raw leachate from the Main Hill than PS-2 (the other routine Main Hill leachate sampling point with existing data) because PS-2 historically received other inflows, such as extracted groundwater, in addition to leachate. This indicates the results of the leachate samples collected at PS-2 would be dilute and not actually representative of raw leachate. Therefore, MW-46N provides the only routinely sampled raw leachate location in the EPZ.

A total of 154 samples have been collected from MH-46N (Table 5). Parameters of interest for the previous leachate investigations included VOCs, metals, pesticides, herbicides, PCBs, and general chemistry. The following significant observations of leachate data from MH-46N can be made:

- VOCs – The VOCs detected in the leachate samples with greater than 50% frequency include 1,4-dichlorobenzene; ethylbenzene, toluene, total xylenes, and vinyl chloride.
- Metals – The metals detected with 97 to 100% frequency in leachate samples are arsenic, barium, calcium, total chromium, cobalt, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc. Metals detected in leachate with greater than 50% frequency include aluminum, antimony, copper, and selenium. Beryllium, mercury, silver, and thallium were not detected in any leachate samples.
- Chlorinated herbicides – The chlorinated herbicides for which leachate samples were analyzed include 2,4,5-T; 2,4-D; dinoseb; isodrin; and silvex. All but isodrin were detected in leachate samples. Silvex was detected at a frequency of 34%, while the other compounds were detected at less than 10%.
- Pesticides – Of the 19 pesticides for which leachate samples were analyzed, 4,4-dichlorodiphenyldichloroethylene (4,4'-DDE); beta-hexachlorocyclohexane (beta-BHC); cis-chlordane; delta-BHC; endosulfan I; endrin; heptachlor epoxide; and lindane were detected. Beta-BHC; cis-chlordane; endosulfan I; and lindane were detected more than once.
- PCBs – Selected samples from selected events were analyzed for Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260. All but Aroclors 1016 and 1221 were detected at least one time. Aroclor 1242 was detected in 11 samples at a frequency of 7%. The rest of the Aroclors were only detected once.

- Chloride – Chloride was detected at a frequency of 93%. The detected concentrations of chloride ranged from 0.021 mg/L to 7,700 mg/L, with an average detected concentration of 1,985 mg/L.

5.2 Data Usability

Data review and analysis is performed by KCSWD personnel. Historical data up to 2012 at the CHRLF were collected, analyzed, and reviewed under a sampling and analysis plan and quality assurance project plan developed by KCSWD in 1999 and updated in 2007. Data collected in 2012 through the present were collected, analyzed, and reviewed pursuant to the existing *Environmental Monitoring SAP For Cedar Hills Regional Landfill* (Aspect, 2013b; herein referred to as the CHRLF Environmental Monitoring SAP). All historical data collected at the CHRLF for groundwater, surface water, LFG, and leachate are presumed to be of good, usable quality because of the sample collection and handling procedures, laboratory quality assurance and quality control (QA/QC) and data validation procedures in place (KCSWD, 1999; KCSWD, 2007; Aspect, 2013b). All historical data pertinent to the EPZ will be carried forward for use in the RI/FS. However, the extraction well data were collected in 2007 and may not be representative of existing conditions, given the construction of the extraction wells with long screen intervals; the age of the data; and the fact that samples were collected from extraction wells during active pumping. The effect of active pumping on sample concentrations is unknown. Future environmental data will be collected pursuant to the existing CHRLF Environmental Monitoring SAP and the EPZ RI/FS Work SAP (Appendix A).

6.0 PRELIMINARY CONCEPTUAL SITE MODEL

A preliminary conceptual site model for the EPZ was developed to evaluate potential pathways by which receptors can be exposed to COPCs. The conceptual model for affected environmental media in the EPZ addresses the following items:

- Source medium
- Transport mechanism
- Exposure medium
- Exposure location
- Exposure mechanism
- Potential human or ecological receptors

The results of the RI will be used to refine this conceptual site model for the EPZ and support the FS. Refinement of the EPZ conceptual site model will include an evaluation to determine whether ecological receptors may be affected by the EPZ. The revised conceptual site model will provide the basis for identification of the constituents of concern and cleanup levels for the FS.

The preliminary site model is described below, followed by more detailed descriptions of contaminant sources and pathways.

6.1 Summary of Preliminary Conceptual Site Model

A preliminary conceptual site model was developed from the existing data. Presented in Figure 8, the model depicts the potential sources, the affected media, and transport pathways, and includes the following components:

- East Shallow Perched Zone

- The ESPZ consists of low-permeability lacustrine silt and glacial till units that impede downward groundwater recharge, resulting in a laterally discontinuous area of year-round saturation. Recharge to these zones occurs via infiltration of direct precipitation and seepage from adjacent wetlands.
- LFG migrates from the refuse mass into native soils in the area of the ESPZ. The LFG contains VOCs that dissolve into groundwater. Redox processes related to LFG may also cause naturally occurring metals in soils to dissolve into groundwater.
- LFG migrates predominantly through the stratified drift and to a lesser extent in the shallow unsaturated zone overlying the ESPZ. VOC concentrations in the shallow LFG are relatively depleted compared to those in the deeper LFG. The deep LFG, whose migration is blocked throughout much of the ESPZ by the presence of low-permeability lacustrine silts and perched

groundwater, may contact groundwater via preferential pathways such as dry extraction wells and other landfill infrastructure or through zones of higher permeability within the soils.

- Impacted groundwater in the ESPZ migrates predominantly vertically downward through a thick unsaturated zone above the Regional Aquifer. This unsaturated zone provides for attenuation of COPCs, and reduces potential from impacts on groundwater quality in the Regional Aquifer. Groundwater within the Regional Aquifer is monitored by several monitoring wells downgradient of the ESPZ.
- Horizontal groundwater movement in the ESPZ is very slow (on the order of 1 to 2 feet/year) because of the low-permeability properties of the till/lacustrine unit. Several dry extraction wells surrounding the ESPZ indicate that saturated horizontal flow is limited. Thus, groundwater migrating beyond the low-permeability till/lacustrine unit drains into the underlying and more permeable stratified drift.
- Leachate impacts to the ESPZ were indicated by elevated chloride in the 1990s, although no current ongoing leachate signatures have been identified.

- Northeast Shallow Perched Zone

- The NESPZ occurs in the vicinity of Stream 3. Perched water in this zone occurs within stratified drift, where downward infiltration is apparently slowed by siltier, less permeable zones.
- There appears to be little hydraulic connection between the ESPZ and the NESPZ. The NESPZ is north of the ESPZ and these areas are separated by a seasonally unsaturated zone. Groundwater migrating from the higher elevation ESPZ appears to migrate vertically downward. Some limited horizontal connection between the zones could occur at relatively shallow depths within more permeable layers of the glacial till.
- Surface water in Stream 3 is at a higher elevation than the perched water table and is in a losing condition; seasonally high groundwater levels may create a gaining condition in Stream 3[1].
- Groundwater quality impacts to the NESPZ are attributed to historical influences from leachate and possibly LFG.

- Potential leachate sources in the NESPZ include the North Perimeter Collector- East Branch, a half-perforated pipe; if its capacity were exceeded, the collector could potentially cause a release. In addition, leachate facilities in the area around EW-7 (where elevated chloride has been documented historically) may also be a potential leachate source.

[1] When a stream is in a losing condition, surface water contributes to groundwater. Under gaining conditions, groundwater contributes to surface water.

6.2 Potential Sources of Contamination and Contaminant Migration Pathways

LFG and landfill leachate are the primary sources of contamination. Their migration pathways are described in the following sections.

6.2.1 Landfill Gas

LFG was identified as a potential source of groundwater impacts to the ESPZ (Aspect, 2007, 2010). VOC-impacted groundwater when VOC vapors are expelled from the refuse and comingle with LFG. VOCs in the migrating gas can dissolve into the soil porewater that subsequently migrates to the water table. VOCs can also dissolve directly into groundwater at the gas-groundwater contact (Walter et al., 2003).

Two LFG migration pathways have been identified (Aspect, 2010): the shallow pathway through the weathered till and fill overlying the perched groundwater, and the deeper pathway in the unsaturated stratified drift underlying the glaciolacustrine and till deposits. Methane concentrations in shallow and deep soil gas are presented on Figures 9 and 10, respectively. The shallow unsaturated zone overlying the perched groundwater zones is not a significant pathway through which LFG can impact the perched groundwater (Aspect, 2010). Methane was generally not detected; carbon dioxide concentrations indicate that the methane oxidizes and mixes with aerobic soil before reaching these shallow unsaturated zones.

An analysis of VOCs in LFG was performed to evaluate potential partitioning of VOCs from LFG into groundwater. VOCs are generally absent at shallow depth probes, beneath both the NESPZ and the ESPZ. In contrast, VOC concentrations were detected in two of the deeper stratified drift gas probes, (GP-55 and GP-59, around groundwater extraction well EW-25 and groundwater monitoring well MW-47, respectively). LFG from gas probe GP-55 contained PCE, TCE, DCE and VC as well as other compounds. LFG in GP-59 contained primarily VC. These analyses indicate LFG beneath the ESPZ has the potential to function as an ongoing source of water quality impacts (Aspect, 2010).

The stratified drift underlying the ESPZ has been identified as a pathway for LFG migration. After entering into the permeable native stratified drift below the refuse, the LFG moves preferentially via more permeable pathways through the overlying till cap. Where possible, it migrates upward into the low-permeability glaciolacustrine soils by diffusion or through available preferential permeable pathways. Preferential pathways are present at greater distance from the source, such as in the more permeable stratified drift to the northeast. Preferential pathways may also occur within the glacio-lacustrine/till units. For example, preferential pathways may occur in areas of seasonally dry wells, particularly in the groundwater extraction wells that have long sand packs.

6.2.2 Leachate

Landfill leachate impacts can be inferred when chloride concentrations in groundwater are higher than background values. The impacts to groundwater in the NESPZ are likely attributed to a historical leachate source, as indicated by historically elevated chloride concentrations evident in the NESPZ groundwater dataset (Appendix D, Figure D-2). The maximum leachate impact to this area occurred in late 1992 and declined through 1999. Stable chloride concentrations since that time indicate that cover and leachate system improvements have controlled this historical leachate source (Aspect, 2011). For comparison, fresh groundwater in many areas of Washington contains less than 10 mg/L of chloride (USGS, 2000). The chloride concentrations in MW-29, MW-30A, and MW-47 have all stabilized at concentrations less than 10 mg/L. These low levels appear to be attributable to fresh, un-impacted groundwater.

Time-series plots (Appendix D, Figure D-1) indicate that while leachate and LFG impacts have historically affected monitoring well MW-47, leachate impacts (represented by chloride concentrations) have dissipated, while ongoing LFG effects (persistent alkalinity) are evident.

6.2.2.1 North Perimeter Leachate Collector – East Branch Source and Pathways

In the unlined Main Hill, a perforated leachate collector, referred to as the North Perimeter Collector- East Branch, was constructed around the north perimeter in 1979 to control shallow groundwater adjacent to the unlined Main Hill (CH2M HILL and UES, 2004b). According CH2MHill and UES (2004b), the Main Hill Perimeter Collector and side-slope leachate collectors (which includes the North Perimeter Collector- East Branch) were installed to convey liquids occurring either in the shallow native soils adjacent to the unlined Main Hill or within the refuse of the Main Hill. The Main Hill Perimeter Collector receives groundwater from the side-slope collectors and groundwater flowing beneath the liner from the north. Because the Main Hill is unlined, it was assumed that any groundwater flow generated in proximity to the Main Hill Perimeter Collector was leachate or had the potential to become leachate. Therefore the intent of the Main Hill Perimeter Collector was to collect the associated groundwater and convey it for treatment as leachate.

In 1984, a section of the collector, referred to as the East Branch, was replaced in the NESPZ. This collector extends from beneath refuse into native soil. The replacement collector consisted of a gravel-bedded, 8-inch-diameter pipe slotted on its top half, installed in a trench with a 60-mil high-density polyethylene liner on the trench bottom and approximately 1.5 feet up the sidewalls (AECOM, 2014). Geophysical anomalies were identified in the vicinity of the North Perimeter Leachate Collector that may indicate potential leachate leaks, although no groundwater impacts have been attributed to this line. There are two general scenarios for which, leachate and groundwater would comingle, as follows:

1. Some portions of the collector located within areas where groundwater elevations appear to be above the 1.5-foot trench liner, either seasonally or otherwise. Where the North Perimeter Leachate Collector is located below the water table and assuming that the system is intact, it would be expected to act as a sink collecting and conveying groundwater via downstream facilities to PS-1A. However, if the flows through the collector are impeded (by blockage, pipe discontinuity, or high downstream liquid levels), leachate levels would rise within the trench and potentially comingle with groundwater.
2. Other sections of the collector, predominately the northern/western portions of the reach, are located beyond the perched zones. In this case, leachate could infiltrate vertically into underlying soils when the capacity of the half-slotted pipe is exceeded.

6.2.2.2 EW-7 Area Leachate Source and Pathways

The chloride concentration measured in NESPZ upgradient monitoring well MW-29 (i.e., local background) is less than 10 mg/L. An anomalously high chloride concentrations of 84 mg/L was identified at extraction well EW-7 in 2007 (Geomatrix, 2007; Figures 11 and 12). Concentrations of chloride that are substantially elevated above background are an indication of leachate impacts.

6.2.2.3 ESPZ Groundwater Migration Pathways

The extremely low permeability of the ESPZ results in a relatively stagnant groundwater body with long residence times and slow flow velocities. As discussed in Section 3.1.4, groundwater flow is primarily downward with a limited horizontal component that has the potential to flow radially outward from the relatively flatter areas occupied by wetlands in this area. Both horizontal and vertical groundwater flow rates in the ESPZ have been estimated at less than 2 feet/year.

Given the slow groundwater velocities, groundwater quality impacts in the ESPZ could be expected to have long residence times. Likewise, water quality impacts would be expected to migrate slowly in a vertical direction into the unsaturated stratified drift and downward through a thick unsaturated zone. This unsaturated zone provides for attenuation of COCs, protecting groundwater quality in the Regional Aquifer. The Regional Aquifer flows to the northeast beneath the EPZ. Horizontal migration of water quality impacts toward the northeast is also a potential contaminant migration pathway, albeit to a much lesser extent than the vertical migration pathway.

6.2.2.4 NESPZ Groundwater Migration Pathways

Groundwater within the NESPZ moves downward discharging to the Regional Aquifer and moves eastward parallel to Stream 3, or discharges into Stream 3 near its eastern end during periods of higher groundwater levels.

6.3 Exposure Pathways and Receptors

An exposure pathway describes the mechanisms by which human or ecological exposure to a contaminant can occur under current conditions, assuming no remedial action or protective control is in place. To be considered complete, an exposure pathway has the following characteristics:

- An identified source of contaminants
- A mechanism for contaminant release and transport from the source
- An exposure route through which contact with the contaminant can occur
- A receptor that can be exposed to the contaminant

An exposure pathway is considered complete if a human or ecological receptor can be exposed to a contaminant via that pathway.

A qualitative evaluation of potential exposure pathways was conducted for this RI/FS Work Plan to assess whether exposure pathways are potentially complete from sources to human receptors. An evaluation for ecological receptors will be completed during the RI/FS.

The RI will consider potential exposure risks to receptors via contaminants from the project area transported in groundwater, surface water, leachate, and LFG. The RI will focus on filling data gaps associated with characterizing and confirming exposure pathways considered most likely to be complete based on EPZ project area-specific conditions. Potential exposure pathways for each medium are summarized in the following subsections.

6.3.1 Groundwater

Assuming the existing land uses will continue into the future, the following current and future potential exposure pathways for groundwater are potentially complete:

- Inhalation by building occupants (current and future structures) of indoor air contaminated—via vapor intrusion (VI)—by the volatilization of contaminants in shallow groundwater
- Direct contact with contaminated groundwater by workers during excavation or other construction-related activities, if no worker protection controls are in place
- Direct contact with contaminated groundwater by workers during use of non-potable groundwater for CHRLF operations
- Ingestion by residents of contaminated groundwater in drinking water wells
- Direct exposure of aquatic ecological receptors (if any) in Stream 3 if groundwater contaminants migrate and discharge to surface water
- Consumption by humans of aquatic ecological receptors (if any) contaminated by discharges of contaminated groundwater to surface water

6.3.2 Leachate

Fugitive leachate may impact groundwater and is addressed as part of the groundwater pathway. Direct exposure to leachate may occur during facility operations and maintenance activities, but these activities are performed with worker protection controls in place. One leachate exposure pathway was identified: direct contact with fugitive leachate by workers during excavation and construction-related activities, if no worker protection controls are in place.

6.3.3 Landfill Gas

Assuming the existing land use will continue as the potential future land use, the following current and future exposure pathways for LFG are potentially complete:

- Inhalation by building occupants (current and future structures) of indoor air contaminated—via vapor intrusion (VI)——by volatile contaminants originating from fugitive LFG
- Direct contact from explosions in buildings and confined spaces
- Inhalation by workers of air contaminated by fugitive LFG vapors during excavation, confined space entry, and construction-related activities, if no worker protection controls are in place

7.0 PRELIMINARY SCREENING OF DATA

Preliminary screening levels (PSLs) were developed to identify constituents of potential concern (COPCs) for conducting the RI. PSLs were developed for groundwater, surface water, and LFG, environmental media for which a large dataset exists from prior investigations and routine landfill detection monitoring program activities.

The PSLs for groundwater, surface water, and LFG are based on potentially applicable screening levels identified from available and pertinent chemical-specific federal and Washington State applicable or relevant and appropriate requirements (ARARs), including those listed in the CHRLF Municipal Solid Waste Handling Permit.[1] These numerical ARARs are compiled in Table 7 for groundwater and in Table 8 for surface water. In addition to listing all PSLs for groundwater and surface water, Tables 7 and 8 also identify the most stringent PSL that was used for preliminary screening of existing data. Exceedances of the most stringent PSL for each medium was used to derive the COPCs. Cleanup standards applicable to the EPZ project area will be identified during the RI/FS process and documented in the CHRLF EPZ Cleanup Action Plan.

7.1 Preliminary Screening Levels

For groundwater, PSL values were obtained from the following chemical-specific ARARs for Washington State:

- State Primary Maximum Contaminant Levels (WAC 246-290-310) that are protective of the human health ingestion pathway
- State MTCA groundwater cleanup levels (WAC 173-340-740) using Methods A, B (standard formula values) that are protective of the human health ingestion pathway[2]

For surface water, PSL values were obtained from the following chemical-specific ARARs for the US and Washington State:

- National Recommended Water Quality Criteria (pursuant to Section CFR 33, Section 304[a]) human health and freshwater aquatic life criteria
- Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A) that are protective of human health ingestion pathway and ecological health pathway (freshwater standards)

[2] Water Quality Standards for Groundwaters of the State of Washington (WAC 173-200) is not applicable during cleanup actions under MTCA.

- Washington State MTCA surface water cleanup levels (WAC 173-340-730) using Method B (standard formula values) that are protective of human health ingestion pathway and ecological health pathway (freshwater standards)

For LFG, PSL values were obtained from Washington State Criteria for Municipal Solid Waste Landfills operating criteria (WAC 173-351-200).

For soil gas, PSL values were obtained from the State MTCA air cleanup levels (WAC 173-340-740) using Methods B (standard formula values) that are protective of the human health inhalation pathway, in addition to Guidance for Evaluating Soil Vapor Intrusion in Washington State (Ecology 2009) and related screening level updates (Ecology, 2010; Ecology, 2012a and 2012b; Ecology, undated).

7.2 Preliminary Constituents of Potential Concern

A step-wise screening process was used to evaluate preliminary COPCs. This process is summarized as follows:

3. Compare data to most stringent PSL
4. Evaluate number of exceedances of PSL
5. Screen exceedances for single detections and those that only occurred more than 10 years ago
6. Tally the remaining exceedances as preliminary COPCs.

For the purpose of screening existing data with PSLs to identify preliminary COPCs, the most stringent PSL for each constituent and each medium was compared to historical data summaries in Tables 2 through 6. For groundwater, the most stringent PSL is largely driven by MTCA Method B, except where a VI groundwater screening level is available.

Existing data for groundwater, surface water, and LFG within the EPZ project area were screened against their respective most stringent PSLs. Summary results of the screening are presented in Tables 2, 3, and 4. The resulting COPCs are discussed in the preceding subsections. Preliminary COPCs are tallied in Table 9. Constituents that exceeded their PSL at least twice during the past 10 years (2004 to 2014) are considered COPCs for the RI. This rationale for including the past 10 years of data is based on the need to provide a dataset with sufficient history to capture the 2007 sampling events of the EW wells and the 2009 sampling events of MW-102 and -103, and to eliminate potentially anomalous exceedances (i.e., those occurring only once).

Although some constituents for which landfill samples were historically analyzed were not detected, the laboratory method detection limit (MDLs) exceeded the corresponding most stringent PSLs. See Table 7 for a summary of groundwater PSLs compared to MDLs. MDLs exceeding corresponding PSLs is not a data quality issue (see Section 5.2). The issue of MDLs exceeding PSLs will be further evaluated in the RI during cleanup level selection.

7.2.1 Groundwater

For groundwater, constituent concentrations and PSLs are summarized in Table 2, with the number of exceedances. The distribution of COPC exceedances in groundwater in the EPZ is depicted on Figures 13 (VOCs) and 15 (metals) and in Appendix C. The distribution of COPC exceedances in the Regional Aquifer is depicted on Figures 14 (VOCs) and 16 (metals). Maps displaying the spatial extent of individual VOC and metal exceedances are included in Appendix C. The evaluation of existing groundwater data for the EPZ indicated that 25 constituents exceed the most stringent PSL: dissolved arsenic, beryllium, cadmium, iron, lead, manganese, mercury, and thallium; total arsenic, iron, and manganese; fluoride; nitrate as nitrogen; nitrite as nitrogen; total dissolved solids; benzene; 1,1-dichloroethane; 1,2-EDC; 1,2-dichloropropane; acrylonitrile; bromodichloromethane; chloroethane; chloroform; cis-1,2-DCE; methylene chloride; TCE; and vinyl chloride. However, for many of these constituents, the laboratory MDL was greater than the corresponding PSL; the number of exceedances may be artificially low. The following constituents with more than one exceedance in the last 10 years will be carried forward and evaluated in the RI as COPCs:

- Metals (arsenic, iron; lead; and manganese)
- VOCs (benzene; 1,1-dichloroethane; 1,2-EDC; cis-1,2-DCETCE; and vinyl chloride)
- Geochemical/conventional parameters (fluoride, nitrate as nitrogen, nitrite as nitrogen, and total dissolved solids)

7.2.2 Surface Water

Surface water is routinely sampled at the CHRLF to meet waste handling permit requirements, including surface water sampling point SW-E1 in the project area. SW-E1 has been sampled 89 times from January 2000 to December 2012. The data and the number of PSL exceedances are summarized in Table 3. Because only one surface water sampling location is located within the EPZ project area, maps depicting the spatial extent of exceedances were not developed. The evaluation of existing surface water data indicates that concentrations of five dissolved metals exceed the most stringent PSL more than once in the last 10 years: arsenic, cadmium, copper, iron, and lead. The same is true for total iron and lead. All six metals will be retained as COPCs for surface water, as summarized in Table 9.

7.2.3 Landfill Gas

Methane concentrations exceeded the 5% lower explosive limit (LEL) (the PSL for LFG as per WAC 173-351-200) in shallow probe, GP-58, and at four deep sample locations, EW-7, EW-11, GP-55, and GP-57. The distribution of methane in LFG in the EPZ project area is depicted on Figures 9 and 10. Methane is retained as a COPC for LFG.

7.2.4 Soil Gas

In shallow soil gas monitored in 2009 and 2010, two VOCs exceeded the corresponding shallow PSLs: benzene and vinyl chloride. For deep soil gas, six VOCs exceeded the corresponding deep PSLs: 1,1-

dichloroethane; benzene; o-xylene; PCE; TCE; and vinyl chloride. Several of these soil gas COPCs are also groundwater COPCs.

7.2.5 Leachate

Constituents that have been detected in the leachate include metals, VOCs, PCBs, chlorinated herbicides, and pesticides. Constituents with a detection frequency greater than 50% include metals (aluminum, antimony, arsenic, barium, calcium, total chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, selenium, sodium, vanadium, and zinc) and VOCs (ethylbenzene; toluene; total xylenes; 1,4-dichlorobenzene; and vinyl chloride). Four leachate constituents detected at more than a 50% frequency are also groundwater COPCs: arsenic, iron, manganese, and vinyl chloride.

8.0 DATA GAPS AND REMEDIAL INVESTIGATION APPROACH

The scope of work for the RI includes assessment of data gaps with regard to characterization of impacted media. Characterization during the RI should be sufficient to support evaluation and selection of remedial alternatives. The assessment of data gaps during the RI considers the following:

- Hydrogeology
- Existing utilities
- COPCs detected in prior investigations at concentrations exceeding PSLs
- Constituents in prior investigations reported as non-detect where the laboratory PQLs exceeded PSLs
- Potential exposure pathways
- Additional data requirements to facilitate evaluation of cleanup alternatives in the FS

Data gaps identified in the draft Data Gap report (AECOM, 2014) and pertaining to the EPZ project area were grouped into categories, as summarized in the following subsections. The full discussion of each of the following data gaps is presented elsewhere (AECOM, 2014). The methodologies targeted for investigating these data gaps are described in Section 8.2 Remedial Investigation Approach).

8.1 Data Gaps

Data gaps are presented by medium. Groundwater data gaps are noted first, followed by those for surface water and then those for leachate.

8.1.1 Groundwater

The EPZ groundwater data gaps are as follows:

- Current extent of groundwater impacts in the EPZ
- Effect of the groundwater extraction system on removal of contaminant mass and groundwater quality in the EPZ; extraction wells were last sampled in 2007, preceding the system shutdown in in 2010
- Relationship between groundwater extraction and impacts to groundwater quality from LFG
- Potential for impacted groundwater to naturally attenuate and the estimated time frame for attenuation
- Current groundwater hydrologic conceptual model including the extent of saturation in the EPZ project area
- Current potential for groundwater to contribute VOCs to shallow soil as soil gas

8.1.2 Surface Water

There are no known surface water data gaps at this time. However, surface water will be evaluated during the RI as a function of contaminated groundwater migration.

8.1.3 Landfill Gas

The LFG data gaps are as follows:

- Reason for LFG migration in the EPZ project area despite many gas extraction wells and probes
- Potential LFG migration through the perforated North Leachate Collector pipe
- Current potential for landfill gas to contribute VOCs to shallow soil gas

8.1.4 Leachate

Leachate data gaps are as follows:

- Characterization of raw leachate
- Potential for North Leachate Perimeter Collector-East Branch located outside of refuse footprint to transmit leachate into soil and groundwater
- Potential for leachate facilities in the vicinity of EW-7 to act as a source to transmit leachate into native soil and groundwater

8.2 Remedial Investigation Approach

This section presents the approach for the RI and a description of the specific work elements, organized by medium. The approach for the RI includes three phases of field investigation to address the data gaps identified above and to refine the preliminary conceptual site model. A summary of the data gaps by matrix and the corresponding RI work elements designed to fill them is presented in Table 10. The scope of work is designed to provide information sufficient to support the evaluation and selection of technically feasible cleanup alternatives. The following subsections provide the scope of work for the approach of the entire RI field program.

RI WORK ELEMENTS SCHEDULE

RI Activity	Activity Duration
Groundwater level monitoring; stream gaging	1 week
Deployment of PDB and RPP samplers	
Required PDB and RPP sampler equilibration	2 weeks
Collection of PDB and RPP samplers; collection of low-flow groundwater samples	2 weeks
Stream sampling and gaging	
Leachate sampling	
Wellhead reconfiguration for soil gas sampling	
Required wellhead gas equilibration	2 weeks
Soil gas sampling	2 weeks (weather-dependent)
Leachate system evaluation and camera work	1 week
LFG system evaluation	2 weeks
2nd groundwater sampling event	2 weeks
3rd groundwater sampling event	2 weeks
4th groundwater sampling event	2 weeks

Specific field data collection procedures for groundwater, surface water, soil gas, and leachate samples are presented in the Sampling and Analysis Plan (SAP) contained in Appendix A of this Work Plan. Details on the performance of RI work elements for LFG and LFL infrastructure are presented in the AECOM Field Sampling and Analysis Plan (FSAP) (AECOM, 2014), produced under separate cover.

8.2.1 Field Program

The RI field program will focus on obtaining additional information for groundwater, surface water, leachate, and soil gas. The proposed sampling locations for the RI are shown on Figure 17. The SAP in Appendix A presents the schedule for completing the initial round of data collection.

8.2.1.1 Groundwater

RI work elements addressing data gaps for groundwater are described below. The rationale for monitoring well, extraction well, and piezometer selection for the RI is based on addressing data gaps. Extraction wells were selected for groundwater monitoring to evaluate existing groundwater conditions. Groundwater from the extraction wells has not been evaluated since the July 27, 2010, shutdown of the extraction well pumps. These data will be used to evaluate the total mass removal by the groundwater extraction system, to evaluate the pump system's effectiveness, and to evaluate groundwater conditions in the EPZ in the vicinity of the extraction wells. Mass removal evaluation will include an assessment of the extraction well flow measurement and the associated uncertainties. Other monitoring wells selected for the RI will be used to evaluate existing groundwater conditions in locations where historically high concentrations of COPCs were detected or where data are warranted to define the extent of contamination. EB-1 and EB-2 were selected for groundwater monitoring to provide analytical data to evaluate whether leachate from the perforated west branch of the North Perimeter Leachate Collector trench is impacting groundwater in this area. Additional groundwater sampling of EW-7 will be performed to confirm chloride levels in the EW-7 vicinity. If chloride levels are found to be increasing, additional investigation of the leachate facilities will be performed to identify a source. The North Perimeter Leachate Collector will also be investigated because review of construction documentation for this line indicated it could be a potential source of leachate and/or landfill gas transfer (AECOM, 2014).

The initial groundwater sampling work will be conducted during two phases: 1) deployment of passive sampling equipment and comprehensive groundwater level monitoring, and 2) collection of samples. The phased approach was selected because the passive sampling equipment requires a 2-week equilibration period

- Collect groundwater level readings from selected monitoring points within the EPZ, including monitoring wells, gas probes, groundwater extraction wells, and gas extraction wells, as listed in Table 11. Water level measurements will be taken at locations south of the project area (i.e. Secondary Water Level Locations depicted on Figure 17) as a contingency. These secondary data may be used if this area is found to be impacted during the RI or additional data are necessary to evaluate flow paths and the site conceptual model.
- Collect groundwater samples from the following monitoring wells, extraction wells, and piezometers completed in perched groundwater of the EPZ, as indicated in Table 12:
    - MW series – 30A, 47, 50, 62, 102, 103, and 104
    - EB series – 1, 2, and 6
    - EW series – 2, 6, 7, 8, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, and 29
- Groundwater samples will be collected using one or more collection methods including passive diffusion bags (PDB), rigid porous polyethylene samplers (RPP), and conventional low-flow pumps. PDB and RPP samplers will be used in selected wells only (see Table 12) as a means to evaluate this technology. For those wells deployed with the PDB and RPP samplers, conventional low-flow samples will also be collected for comparison purposes. The theory behind PDB and RPP samplers is that they rely on free movement of the aquifer through the sampler and passively collect the groundwater sample. VOCs and metals will diffuse across the passive sampler until the concentration within the sampler equilibrate with concentrations in the surrounding groundwater. The advantage of using passive samplers is the limited disturbance they cause to the surrounding aquifer, the absence of purge water for disposal after the event, time efficiency, and cost efficiency. In wells where PDB and RPP samplers are scheduled for deployment, any dedicated pump equipment will be removed prior to sampler deployment unless the well diameter is large enough to

accommodate both the dedicated pump equipment and the passive samplers. Any pumps removed for the passive samples will be reinstalled after the passive samples have been collected in order to also collect conventional low-flow samples.

- Groundwater samples will be analyzed by the King County Environmental Lab (KCEL) for WAC 173-351-990 Appendix I and II parameters, in addition to selected project-specific monitored natural attenuation (MNA) parameters.

The RI approach also includes three follow-up groundwater sampling events on a quarterly schedule to evaluate potential seasonal trends in groundwater concentrations and to provide additional data points for a robust statistical evaluation of the data. All seven of the MW monitoring wells, and selected EB piezometers and EW extraction wells will be included in those sampling events. Selection of the EB piezometers and EW extraction wells will be made based on the analytical results from the first round of data collected for this RI.

8.2.1.2 Surface Water

RI work elements related to addressing groundwater data gaps also include surface water sampling from Stream 3. The surface water elements of the RI will be conducted concurrently with the groundwater sample collection. Specifically, the following tasks will be conducted:

- Measure the stream water level using the staff gages at SG-4 and SG-5 at the time of groundwater level measurements (Figure 4). If the stream stage is below the level of the staff gauge, then water level measurements will be taken from the accompanying piezometer using a water level meter.
- Collect a surface water sample at station SW-E1.
- Analyze surface water for WAC 173-351-990 Appendix I and II parameters (samples will be analyzed by the KCEL).

8.2.1.3 Landfill Gas

RI work elements related to LFG will include evaluating the integrity and effectiveness of the existing LFG and landfill leachate infrastructure. The LFG field program, to be implemented following the procedures outlined in AECOM's FSAP; (AECOM, 2014), will include the following elements:

- Install LFG probes into the material surrounding a selected perforated horizontal LFG collector pipe to evaluate static pressure (vacuum) and the rate of vacuum dissipation along the length of the pipe.
- Install LFG probes perpendicular to the horizontal LFG collector pipe at increasing distances to calibrate the relationship between vacuum and zone of influence of the horizontal collectors.
- Review existing zone of influence testing results for the east side of the landfill.
- Select either an existing LFG well or probe operated by the LFG collection system as a point of vacuum application.

Results from the latest KCSWD routine LFG monitoring will also be used in the RI dataset. Additional investigations of LFG include detailed review of previous east side ZOI testing and well field influence testing (Data Gap 1, Table 10). Effectiveness of horizontal collectors will be evaluated through a field testing program of one horizontal collector (Data Gap 12, Table 10). The potential interaction of LFG in the North Leachate Perimeter Collector will be evaluated through field testing LFG levels at the upstream end of the East Branch (Data Gap 8, Table 10). Detailed methodology for work elements identified as data gaps 1, 8 and 12 in Table 10 are provided in the FSAP (AECOM, 2014).

8.2.1.4 Soil Gas

The potential for exposure to contaminants of concern via the vapor intrusion pathway will be evaluated using the methods and VOC screening levels specified in Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2009). VOCs in shallow soil gas (where VI is a potential concern) can migrate from the landfill exclusively in the vapor phase. In areas where perched groundwater is impacted by VOCs, volatilization from groundwater is another potential source of VOCs in shallow soil gas. The potential for perched groundwater to serve as a significant VOC source will be evaluated by directly sampling soil gas above the water table and comparing VOC concentrations detected in soil gas to MTCA Method B soil gas screening levels. The data collected will also be evaluated to determine whether VOC concentrations correlate with methane concentrations, in which case methane could potentially be used as a surrogate for soil gas VOCs in the future.

Evaluation of the VI pathway will consider historical sampling results as well as results of the current investigation. To supplement the historical soil gas dataset, the following existing monitoring locations will be sampled in the current investigation:

- GP-56, -58, -60, and -62 – These probes have relatively shallow screens (in the range of 6 to 18 feet bgs) and are situated along the landfill's edge where VOCs have been detected in perched groundwater. GP-56 and GP-62 have never been sampled for VOCs. GP-58 was sampled on one occasion (October 2009), in which benzene was detected at a concentration marginally above its MTCA Method B soil gas screening level. GP-60 was sampled on two occasions, in October 2009 and January 2010. Benzene and vinyl chloride concentrations were of potential concern in the October 2009 sample but those compounds were not detected in January 2010.
- GP-ATC-5 (deeper screen interval[3]) and GP-8 – These probes, which have never been sampled for VOCs, are located farther from the landfill's edge, north of the ESPZ. They roughly form a line with GP-55, a deep probe along the landfill's edge where the highest VOC concentrations have been detected in soil gas. This configuration may allow evaluation of VOC concentration decline

[3] The shallow-screened probes at GP-ATC-5 and GP-ATC-7 will not be sampled because their top-of-screen depth is less than the 5 feet bgs minimum recommended in Ecology guidance. This minimum top-of-screen depth is essential for minimizing the likelihood of diluting the soil gas sample with atmospheric air.

with increasing distance from the landfill, as well as preliminary assessment of VI potential in onsite structures.

- EB-6, GP-ATC-7 (deeper screen interval[3]), MW-102, and MW104 – These probes and wells are also located farther from the landfill's edge and have never been sampled for vapor-phase VOCs. These probes will provide additional information on distribution of VOCs and their decay with distance from the refuse margin.
- GP-15 through GP-20 – Soil gas will be sampled at these probe locations along the eastern edge of the property. Absence of methane in these probes for the past year (period of evaluation for this work plan) suggest that VOC concentrations in soil gas at these locations will likely not represent a VI concern. However, this supposition needs to be confirmed. Each location has multiple gas probes installed at different screen intervals – four at GP-15 and three at each of the other five locations). At each location, the probe with the shallowest screen interval (top-of-screen at 6.5 feet bgs in all cases) will be sampled to evaluate near-surface conditions. A second sample will also be collected at each location to evaluate conditions at depth. The deeper screen interval to be sampled at each location will be determined by monitoring for methane using the GEM-2000 multi-gas meter. (Monitoring for methane using the GEM-2000 is standard practice during purging prior to soil gas sampling; refer to Section 2.6.2 of the SAP.) If methane is detected, the screen interval with the highest detection will be sampled. If methane is not detected in any of the three deeper probes at GP-15, the intermediate screen interval (GP-15C) will be sampled for VOCs. If methane is not detected in either of the two deeper probes at locations GP-16 through GP-20, the deepest screen interval (i.e., the probe with the "C" designation) will be sampled.

A soil gas sample will be collected at each probe location (22 samples total) in a 6-liter Summa canister and analyzed for VOCs using EPA Method TO-15.

8.2.1.5 Leachate

Raw leachate that is representative of the unlined portion of the Main Hill will be sampled from MH-17N (channel that conveys flow from north Main Hill located in southwest corner of manhole) and FS-3 (from influent pipe), if sufficient flow is present. MH-17N and FS-3 are tributaries of PS-2 and their locations are depicted on Figure 17. MH-17N conveys raw leachate from the Main Hill and FS-3 conveys raw leachate from the North Main Hill. Historically these two monitoring structures also conveyed groundwater from the extraction wells, but since termination of groundwater extraction, the structures only convey raw leachate. MH-46N was not selected as the leachate sampling point because it receives leachate from the Central Pit and may not reflect raw leachate quality from the Main Hill adjacent to the EPZ project area. Specific conductance will be monitored in each of these wells and a sample will be collected from the well with the higher specific conductance. A total of four sample events will be made from the Main Hill raw leachate sample location. Results from the latest KCSWD routine leachate monitoring will also be used in the RI dataset. Specifically, the following tasks will be conducted:

- Measure the static water level using a water level tape in each leachate sampling point.

- Measure pH and specific conductance.
- Collect a leachate sample from the manhole (MH-17N) and the flow meter vault (FS-3, influent pipe), if sufficient volume is present.
- Analyze leachate samples for a truncated list of analytes from WAC 173-351-990 Appendix I and II parameters (samples will be analyzed by the KCEL).

In addition, the integrity of the leachate collection system and the presence of leachate within the collection system will be evaluated. This process will include camera verification of the North Perimeter Leachate Collector. (Data Gap 8, Table 10). Additional field elements to address leachate and LFG data gaps related to the leachate collection system may be added after review of the initial camera results.

9.0 FEASIBILITY STUDY APPROACH

9.1 Feasibility Study Approach

The FS will be conducted in accordance with the provisions of MTCA, as established in WAC 173-340-350(8). The purpose of an FS is to develop and evaluate cleanup alternatives to enable selection of a cleanup action for a site in accordance with WAC 173-340-360. Ecology may elect to adopt a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) presumptive remedy approach to development of landfill site remedial alternatives. Under the presumptive remedy approach, remedial actions include LFG control, surface water management, leachate and groundwater control, and environmental monitoring. The presumptive remedy will be considered to focus the FS alternatives analysis. The results of the FS will be documented in the draft RI/FS Report and will provide a basis for preparation of a draft Cleanup Action Plan.

9.1.1 Establish Cleanup Standards

Cleanup standards will be established in the FS to evaluate the sufficiency of cleanup action alternatives to meet the remedial action objectives (RAOs; see Section 9.1.4). MTCA requires the establishment of cleanup standards, which consist of cleanup levels, points of compliance, and ARARs, per WAC 173-340-700(3). In accordance with WAC 173-340-350(9), cleanup levels will be established for hazardous substances in each medium and for each pathway where a release has occurred. For the RI/FS report evaluation to determine COCs for the cleanup action, the MDL will be used as the surrogate PSL, but for now the PSLs presented in Tables 7 and 8 will be used. Remediation levels may be developed, if appropriate, in accordance with WAC 173-340-355.

Cleanup standards and results of the RI will be used to identify the COPCs to be carried forward as COCs for use in the FS and ultimately for selection of the site remedy in the Cleanup Action Plan. MTCA requires evaluation of cleanup action alternatives that meet the cleanup levels at both standard and conditional points of compliance; the points of compliance will be established in the FS. The point of compliance specified in WAC 173-351 (i.e., 150 meters from refuse boundary) will be considered in developing the points of compliance.

9.1.2 Identify ARARs

MTCA requires that all cleanup actions comply with applicable local, state, and federal laws, which are defined as "legally applicable requirements and those requirements that the department determines…are relevant and appropriate requirements." The applicable local, state, and federal laws will be identified in the FS, and the compliance requirements of potentially applicable laws and regulations will be evaluated. Ecology will make the final determination as to whether the requirements have been appropriately identified and are legally applicable or relevant and appropriate.

The starting point for ARARs is regulations (WAC 173-340) that address implementation of a cleanup and define cleanup standards under the MTCA statute (RCW 173.105D). While ARARs specific to cleanup alternatives will be defined during the FS, other potential ARARs may need to be considered, including the following:

- Solid Waste Landfill Closure Requirements (WAC 173-304 and 351)
- State Water Pollution Control Act (RCW 90.48)
- Water Resources Act (RCW 90.54)
- Applicable surface water quality criteria published in the water quality standards for surface waters of the State of Washington (WAC 173-201A)
- Applicable surface water quality criteria published under Section 304 of the Clean Water Act
- Applicable surface water quality criteria published under National Toxics Rule (Chapter 40 in the Code of Federal Regulations [CFR]. Part 131)
- Washington State Hazardous Waste Management Act (RCW 70.105)
- State Dangerous Waste Regulations (WAC 173-303)
- Solid Waste Management-Reduction and Recycling (RCW 70.95)
- Minimum Standards for Construction and Maintenance of Wells (RCW 173-160)
- Washington Clean Air Act (RCW 70.94)
- Puget Sound Clean Air Agency Regulations (http://www.PSLleanair.org)
- Occupational Safety and Health Act , 29 CFR Subpart 1910.120
- Washington Industrial Safety and Health Act (RCW 49.17);
- Archaeological and Cultural Resources Act (RCW 43.53)
- Archaeological and Historic Preservation Act (RCW 43.334)
- State Environmental Policy Act (SEPA; RCW 43.21C, WAC 197-11, and WAC 173-802)

9.1.3 Delineate Media Requiring Remedial Action

The results of the RI will be used to identify and delineate the areas and volumes of affected media to be included in the evaluation of cleanup action alternatives.

9.1.4 Develop Remedial Action Objectives

Remedial action objectives will be presented in the FS report as the basis for the evaluation of cleanup action alternatives. The RAOs will identify the goals to be achieved by a cleanup alternative that meets cleanup standards and provides adequate protection of human health and the environment. The RAOs will be action-specific (to achieve environmental protection independent of a chemical criterion), media-specific (to achieve a cleanup level), or both.

9.1.5 Develop and Screen Cleanup Action Alternatives

The objective of the FS process is to develop a reasonable range of cleanup action alternatives for detailed analysis.

9.1.5.1 Initial Screening of Alternatives

MTCA allows for an initial screening of cleanup action alternatives, when appropriate, to reduce the number of alternatives carried forward to the detailed analysis. MTCA stipulates that cleanup action alternatives may be eliminated from further consideration in the FS if they consist of one or both of the following:

- Alternatives that, based on a preliminary analysis, obviously do not meet the minimum requirements specified in WAC 173-340-360 (including clearly disproportionate costs), making a more detailed analysis unnecessary
- Alternatives or components that are not technically possible

Preliminary cleanup alternatives will be subjected to an initial screen to determine whether they can be eliminated appropriately from further evaluation in the FS. The alternatives eliminated from further evaluation will be identified and the rationale for elimination provided.

9.1.5.2 Detailed Screening and Analysis of Alternatives

A cleanup action alternative may consist of a combination of remediation technologies or regulatory mechanisms and will be identified for further evaluation based on the initial screening. The cleanup action alternatives developed for further evaluation will protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route, as required by WAC 173-340-350.

After the initial screening process of preliminary cleanup alternatives, the FS will focus on evaluating feasible, site-specific alternatives that pass the initial screening. The approach of the FS will be to use MFS (WAC 173-304) as a starting point and a relevant and appropriate requirement for defining the MTCA remedy for the CHRLF. The applicability of Criteria for Municipal Solid Waste Landfills (WAC 173-351) will also be considered. After MFS was promulgated at the state level, EPA defined in more detail the presumptive remedy for solid waste landfills undergoing cleanup under the CERCLA. EPA issued a directive (OSWER Directive 9355.3-11) establishing containment as the presumptive remedy on CERCLA municipal landfills. The framework for the remedy was then presented in a manual, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (USEPA 1991).

9.1.5.3 Presumptive Remedy

The FS will use ideas from EPA's presumptive remedy to refine the MTCA remedial action for the CHRLF, while treating MFS and WAC 173-351 as key ARARs, as applicable. The remedies described in the FS will follow the concepts in MTCA, MFS, WAC 173-351, and EPA's guidance, and will use the term "presumptive remedy" to remind the reader of the large body of knowledge regarding solid waste landfills and their long-term care.

9.1.5.4 Disproportionate Cost Analysis

MTCA defines a permanent solution as one in which cleanup standards can be met without further action. To determine whether a cleanup action alternative is permanent to the "maximum extent practicable," MTCA requires that a disproportionate cost analysis (DCA) be conducted (WAC 173-340-360(3)(b)). A comparative analysis of the cleanup action alternatives is conducted using the following evaluation criteria:

- Protectiveness – Overall protectiveness of human health and the environment
- Permanence – The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances
- Cost – The cost to implement the alternative
- Effectiveness over the long term – The degree of certainty, the reliability of the alternative, the magnitude of residual risk, and the effectiveness of controls
- Management of short-term risks – The risk to human health and the environment associated with implementation of the cleanup action alternative
- Technical and administrative implementability – Technical feasibility of the cleanup action alternative, and administrative and regulatory requirements
- Consideration of public concerns – Degree to which the community has concerns regarding the alternative and the extent to which the alternative addresses those concerns

The FS will evaluate how each of the alternatives meets the MTCA requirements for a cleanup action. The evaluation will provide the basis for selection of a preferred cleanup action alternative. In accordance with MTCA, preference will be given to the cleanup action alternative that uses permanent solutions to the maximum extent practicable. If the preferred cleanup action alternative is clearly the most permanent, a DCA may not be conducted. KCSWD may provide a recommendation in the FS for a preferred cleanup action alternative.

9.2 Feasibility Study Data Gaps

If data gaps are identified during the FS, then a pilot-scale treatability study or design testing may be warranted. Its objective would be to generate sufficient information for further evaluation of probable cleanup action alternatives and final selection of a cleanup action. Results of the pilot-scale treatability study would be presented in an addendum to the FS.

10.0 SCHEDULE AND REPORTING

10.1 Schedule

Implementation of the scope of work described in this RI/FS Work Plan will commence within 30 days of Ecology's approval of the RI/FS Work Plan. The field work for the RI will take approximately 70 days to complete based on the following mobilization schedule detailed in the RI Work Elements Schedule table (see Section 8.2).

Field work will be followed by period of approximately 45 days during which analytical results would be generated; 30 days is the standard turn-around time for KCEL plus two weeks for data uploads and QC checks by KCSWD. The standard turn-around time for the TO-15 analytical laboratory is 5 business days. The RI/FS Report will be drafted based on the first quarter of newly collected data. A draft RI/FS Report will be submitted to Ecology 180 days after approval of the RI/FS Work Plan. Groundwater sampling will continue quarterly for 1 year, with results from quarters 2, 3, and 4 submitted as an addendum to the RI/FS Report.

10.2 Reporting

This section summarizes the elements that will be included in the RI/FS Report in accordance with the guidance provided in WAC 173-340-350 and WAC 173-340-840. The RI/FS Report will consist an RI section and an FS section. The RI section of the report will present the existing environmental data, including the data collected for the purpose of the RI. The RI will also summarize the sources of contamination, the nature and extent of contamination, and a refined conceptual site model of exposure pathways. The data will be presented in both tabular and map form.

The FS section of the report will establish the cleanup standards (cleanup levels, points of compliance, and ARARs) protective of human health and the environment. Constituents of concern will also be identified. The cleanup action alternatives will then be evaluated under the MTCA remedy selection requirements, as described in the previous section of this RI/FS Work Plan.

The draft RI/FS Report will be submitted to Ecology for review. Revisions based on Ecology's review comments will be incorporated into a final RI/FS Report submitted to Ecology for approval.

11.0 REFERENCES

Relevant Previous Investigation Reports (these documents present environmental data collected at CHRLF)

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Supplemental References

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Aspect, 2013b, Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill, prepared for King County Department of Natural Resources and Parks, Solid Waste Division, December 31, 2013.

Kerfoot, H.B., Baker, J.A., and Burt, D.M., 2004, Geochemical Changes in Ground Water Due to Landfill Gas Effects, Groundwater Monitoring and Remediation 24, no.1, Winter 2004, p 60-65.

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Tables

Table 1 - Summary of EPZ Explorations

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Well(s)	Installation Date	Installed By/Reference[1]	Regional Aquifer Characterization
Soil Borings/Geoprobe Explorations			
EPZ-BH-1	Jun-06	Aspect 2007	Evaluate extent of perched zones to the east/characterize hydrogeology
EPZ-BH-2 through 15	Aug-09	Aspect 2010	Provide data on thickness of shallow fill/till soils/collect LFG data for siting permanent probes
East Perches Zones Monitoring Wells and Piezometers			
MW-23	May-83	SEA	Likely installed during initial site characterization activities. Dry well decommissioned January 2009.
MW-29, 30	Jun-83	SEA	Installed during initial site characterization actitvities
MW-30A	Sep-89	SEE	Replaces MW-30 which was decommissioned during 1989 final closure of Main Hill.
MW-47	May-85	SEA	Installed as part of Cedar Hills Site Development Plan Project
MW-50	Jun-85	SEA	
MW-62 and 63	Feb-90	SEE 1991	Installed as part of first extensive investigation of EPZ by SEE 1991. MW-62 was intially referred to as MW-60. MW 63 was initally referred to as MW-61.
EB-1 through EB-5, EB-5S	June, July 1990	SEE 1991	Installed as part of first extensive investigation of EPZ by SEE 1991.
EB-6, EB-7	Nov-90	SEE 1991	Installed as part of first extensive investigation of EPZ by SEE 1991.
MW-102 through 104	Jan-09	Aspect 2010	Evaluation of extent of perched zones and area of impacted groundwater
Regional Aquifer Monitoring Wells			
MW-67 and 68	Apr-93	CH2M Hill/UES 2004	Regional Aquifer Characterization
MW-75	Sep-99	CH2M Hill/UES 2004	Regional Aquifer Characterization
MW-80	Feb-01	CH2M Hill/UES 2004	Regional Aquifer Characterization
MW-81	Oct-00	CH2M Hill/UES 2004	Regional Aquifer Characterization
MW-87	Nov-00	CH2M Hill/UES 2004	Regional Aquifer Characterization
MW-91	Jan-02	CH2M Hill/UES 2004	Used for aquifer testing of Regional Aquifer
MW-93	Jun-02	CH2M Hill/UES 2004	Regional Aquifer Characterization
MW-99	Aug-02	CH2M Hill/UES 2004	Regional Aquifer Characterization/Replaced MW-44
Groundwater Extraction Wells			
EW1 through EW-29	May to October 1992	HLA 1993	Groundwater remediation
Gas Probes			
GP-1	May-85	SEA	
GP-7,8,15, 16,17,18,19,20	March -July 1988	SEE	
GP-ATC-5 through 8	Oct-86	SEA	
GP-55 through GP-62	Oct-09	Aspect 2010	Provide data on fugutive LFG, assess potential for LFG impacts on groundwater
LFG Extraction Wells			
E-29A through E-29D	NA	NA	Boring logs have not been located.

[1] Installation reference not available where no date is noted.

SEA = Sweet Edwards Associates

SEE = Sweet Edwards Emcon

HLA = Harding Lawson Associates

UES = Udaloy Environmental Services

Table 2 - Groundwater Data Summary and Preliminary Screening

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Group	Total or Dissolved	Analyte	Number of Sampled Locations	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Available Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Preliminary Screening Level (Minimum of ARARs from Table 7)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Number of NonDetects with Reporting Limit Above the Prelimiary Screening Level	Date of Last Screening Level Exceedace	Number of Samples Since Last Screening Level Exceedance
Metals	D	Aluminum	15	526	08-Apr-92	01-Feb-08	176	33%	28-Jan-08	6400	20	203.7	µg/L	16000	0	0%	0		
Metals	D	Antimony	18	911	22-Jan-90	24-Jul-14	26	3%	28-May-03	5	1	1.9	µg/L	6	0	0%	0		
Metals	D	Arsenic	37	1066	06-Nov-86	24-Jul-14	437	41%	24-Jul-14	66	1	3.5	µg/L	0.058	437	41%	629	24-Jul-14	
Metals	D	Barium	37	1067	06-Nov-86	24-Jul-14	992	93%	24-Jul-14	200	1	11.9	µg/L	2000	0	0%	0		
Metals	D	Beryllium	19	969	08-Apr-92	24-Jul-14	2	0%	23-Aug-93	19	1	10.0	µg/L	4	1	0%	0	23-Aug-93	918
Metals	D	Cadmium	19	1044	06-Nov-86	24-Jul-14	10	1%	18-Apr-08	10	2	3.6	µg/L	5	1	0%	0	06-Nov-86	1042
Metals	D	Calcium	37	992	08-Apr-92	24-Jul-14	992	100%	24-Jul-14	260000	26	30229.6	µg/L						
Metals	D	Chromium (Total)	37	1067	06-Nov-86	24-Jul-14	12	1%	15-Jan-09	40	5	12.0	µg/L	50	0	0%	0		
Metals	D	Cobalt	37	992	08-Apr-92	24-Jul-14	24	2%	20-Nov-13	21	3	6.7	µg/L						
Metals	D	Copper	37	1067	06-Nov-86	24-Jul-14	82	8%	16-Apr-14	120	2	8.7	µg/L	320	0	0%	0		
Metals	D	Iron	37	1067	06-Nov-86	24-Jul-14	920	86%	24-Jul-14	55000	6	1604.1	µg/L	300	480	45%	0	24-Jul-14	
Metals	D	Lead	37	1067	06-Nov-86	24-Jul-14	35	3%	10-Jan-11	18	1	4.3	µg/L	15	2	0%	35	09-Jul-07	384
Metals	D	Magnesium	37	992	08-Apr-92	24-Jul-14	990	100%	24-Jul-14	75000	1280	15666.3	µg/L						
Metals	D	Manganese	37	1066	06-Nov-86	24-Jul-14	773	73%	24-Jul-14	14000	1	447.8	µg/L	50	618	58%	0	24-Jul-14	
Metals	D	Mercury	37	1067	06-Nov-86	24-Jul-14	18	2%	1-Jun-07	3	0.1	0.4	µg/L	2	1	0%	0	26-Jul-89	1040
Metals	D	Nickel	37	1050	26-Jul-88	24-Jul-14	23	2%	20-Nov-13	70	10	18.9	µg/L	100	0	0%	0		
Metals	D	Potassium	37	992	08-Apr-92	24-Jul-14	987	99%	24-Jul-14	24000	320	1745.5	µg/L						
Metals	D	Selenium	37	1067	06-Nov-86	24-Jul-14	315	30%	24-Jul-14	11	1	2.4	µg/L	50	0	0%	0		
Metals	D	Silver	19	1044	06-Nov-86	24-Jul-14	2	0%	21-Jul-93	20	3	11.5	µg/L	80	0	0%	0		
Metals	D	Sodium	37	992	08-Apr-92	24-Jul-14	992	100%	24-Jul-14	350000	1200	10831.1	µg/L						
Metals	D	Thallium	19	970	22-Jan-90	24-Jul-14	5	1%	18-Nov-94	50	1	10.8	µg/L	0.16	5	1%	965	18-Nov-94	883
Metals	D	Tin	15	526	08-Apr-92	01-Feb-08	2	0%	10-Jul-97	36	10	23.0	µg/L	9600	0	0%	0		
Metals	D	Vanadium	37	992	08-Apr-92	24-Jul-14	103	10%	7-Jul-14	61	2	5.0	µg/L	80	0	0%	0		
Metals	D	Zinc	37	1067	06-Nov-86	24-Jul-14	341	32%	30-Apr-14	3300	2	59.6	µg/L	4800	0	0%	0		
Metals	T	Antimony	15	78	09-Apr-13	24-Jul-14	0	--	--	--	--	--	µg/L	6			0		
Metals	T	Arsenic	15	78	09-Apr-13	24-Jul-14	39	50%	24-Jul-14	106	1.17	14.1	µg/L	0.058	39	50%	39	24-Jul-14	
Metals	T	Barium	15	78	09-Apr-13	24-Jul-14	78	100%	24-Jul-14	72	1.45	13.0	µg/L	2000	0	0%			
Metals	T	Beryllium	15	78	09-Apr-13	24-Jul-14	0	--	--	--	--	--	µg/L	4			0		
Metals	T	Cadmium	15	78	09-Apr-13	24-Jul-14	0	--	--	--	--	--	µg/L	5			0		
Metals	T	Calcium	15	78	09-Apr-13	24-Jul-14	78	100%	24-Jul-14	147000	5670	31893.5	µg/L						
Metals	T	Chromium (Total)	15	78	09-Apr-13	24-Jul-14	1	1%	16-Jul-13	12	12	12.0	µg/L	50	0	0%	0		
Metals	T	Cobalt	15	78	09-Apr-13	24-Jul-14	4	5%	24-Jan-14	11.4	3.08	5.4	µg/L						
Metals	T	Copper	15	78	09-Apr-13	24-Jul-14	8	10%	7-Jul-14	15.1	2.11	5.6	µg/L	320	0	0%	0		
Metals	T	Iron	15	78	09-Apr-13	24-Jul-14	72	92%	24-Jul-14	43200	10	4108.2	µg/L	300	42	54%	0	24-Jul-14	
Metals	T	Lead	15	78	09-Apr-13	24-Jul-14	2	3%	24-Jan-14	4.42	2.17	3.3	µg/L	15	0	0%	0		
Metals	T	Magnesium	15	78	09-Apr-13	24-Jul-14	78	100%	24-Jul-14	74500	1490	17093.1	µg/L						
Metals	T	Manganese	15	78	09-Apr-13	24-Jul-14	67	86%	24-Jul-14	2820	1.1	390.0	µg/L	50	54	69%	0	24-Jul-14	
Metals	T	Mercury	15	78	09-Apr-13	24-Jul-14	0	--	--	--	--	--	µg/L	2			0		
Metals	T	Nickel	15	78	09-Apr-13	24-Jul-14	2	3%	20-Nov-13	19.5	13.3	16.4	µg/L	100	0	0%	0		
Metals	T	Potassium	15	78	09-Apr-13	24-Jul-14	78	100%	24-Jul-14	5320	430	1746.6	µg/L						
Metals	T	Selenium	15	78	09-Apr-13	24-Jul-14	6	8%	24-Jul-14	1.2	1.06	1.1	µg/L	50	0	0%	0		
Metals	T	Silver	15	78	09-Apr-13	24-Jul-14	0	--	--	--	--	--	µg/L	80			0		
Metals	T	Sodium	15	78	09-Apr-13	24-Jul-14	78	100%	24-Jul-14	44300	4090	10490.8	µg/L						
Metals	T	Thallium	15	78	09-Apr-13	24-Jul-14	0	--	--	--	--	--	µg/L	0.16			78		
Metals	T	Vanadium	15	78	09-Apr-13	24-Jul-14	11	14%	7-Jul-14	21.1	2.05	4.4	µg/L	80	0	0%	0		
Metals	T	Zinc	15	78	09-Apr-13	24-Jul-14	10	13%	7-Jul-14	28.3	4.25	11.7	µg/L	4800	0	0%	0		
Conventionals	N	Ammonia as Nitrogen	37	1060	06-Nov-86	24-Jul-14	390	37%	24-Jul-14	7.8	0.01	0.2	mg/L as N						
Conventionals	N	Alkalinity (Total)	36	901	13-Apr-95	24-Jul-14	901	100%	24-Jul-14	960	4	134.1	mg/L as CaCO3						
Conventionals	N	Chemical Oxygen Demand	15	574	06-Nov-86	01-Feb-08	78	14%	18-Jan-08	110	5	16.7	mg/L						
Conventionals	N	Chloride	37	1063	06-Nov-86	24-Jul-14	1047	98%	24-Jul-14	84	0.749	5.7	mg/L	250	0	0%	0		
Conventionals	N	Coliform, Total	16	572	06-Nov-86	28-Oct-11	157	27%	4084400%	500000%	100%	12160%	CFU/100mL						
Conventionals	N	Fecal Coliform	14	408	06-Nov-86	28-Oct-11	14	3%	4084400%	3600%	1%	712%	CFU/100mL						
Conventionals	N	Fluoride	15	605	6-Nov-86	1-Feb-08	56	9%	18-Oct-06	6.4	0.01	0.5	mg/L	0.64	12	2%	478	18-Oct-06	26
Conventionals	N	Halides, Total Organic (TOX)	15	566	06-Nov-86	01-Feb-08	132	23%	8-Jan-07	1400	0.02	20.2	mg/L						
Conventionals	N	Nitrate + Nitrite	15	546	06-Nov-86	01-Feb-08	356	65%	18-Jan-08	600	0.005	8.4	mg/L as N						
Conventionals	N	Nitrate as Nitrogen	37	1037	06-Nov-86	24-Jul-14	652	63%	24-Jul-14	117	0.01	2.4	mg/L as N	10	23	2%	0	20-Nov-13	36
Conventionals	N	Nitrite as Nitrogen	15	565	06-Nov-86	27-Jan-06	67	12%	27-Jan-06	4.9	0.006	0.2	mg/L as N	1	2	0%	0	27-Jan-06	
Conventionals	N	Sulfate	37	1062	06-Nov-86	24-Jul-14	1042	98%	24-Jul-14	530	0.13	24.5	mg/L						
Conventionals	N	Total Dissolved Solids	33	1021	18-Apr-90	24-Jul-14	1019	100%	24-Jul-14	1500	29	206.4	mg/L	500	75	7%	0	07-Jul-14	
Conventionals	N	Total Organic Carbon	19	1040	06-Nov-86	24-Jul-14	441	42%	7-Jul-14	592	0.26	8.0	mg/L						
Conventionals	N	Total Solids	33	1028	26-Jul-88	24-Jul-14	1026	100%	24-Jul-14	3680	15	245.4	mg/L						
Conventionals	N	Total Suspended Solids	33	1026	26-Jul-88	24-Jul-14	771	75%	24-Jul-14	2720	1	39.4	mg/L						
BTEX	N	Benzene	37	1365	06-Nov-86	24-Jul-14	46	3%	1-Jun-07	5	0.2	1.5	µg/L	0.8	27	2%	68	01-Jun-07	556
BTEX	N	Ethylbenzene	19	1342	06-Nov-86	24-Jul-14	3	0%	24-Jan-95	0.47	0.22	0.3	µg/L	70	0	0%	0		
BTEX	N	Toluene	37	1365	06-Nov-86	24-Jul-14	40	3%	15-Apr-13	16	0.2	1.2	µg/L	640	0	0%	0		
BTEX	N	m,p-Xylenes	15	283	04-Jan-11	24-Jul-14	0	--	--	--	--	--	µg/L						

Table 2 - Groundwater Data Summary and Preliminary Screening
East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Group	Total or Dissolved	Analyte	Number of Sampled Locations	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Available Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Preliminary Screening Level (Minimum of ARARs from Table 7)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Number of NonDetects with Reporting Limit Above the Prelimiary Screening Level	Date of Last Screening Level Exceedace	Number of Samples Since Last Screening Level Exceedance
BTEX	N	o-Xylene	16	961	06-Nov-86	24-Jul-14	4	0%	21-Nov-94	1	0.39	0.8	µg/L	1600	0	0%	0		
BTEX	N	Total Xylenes	19	1053	13-Jul-87	30-Dec-11	4	0%	3-Feb-10	2.69	0.552	1.4	µg/L	1000	0	0%	0		
VOCs	N	1,1,1,2-Tetrachloroethane	19	1265	08-Apr-92	24-Jul-14	21	2%	23-Mar-10	0.2	0.2	0.2	µg/L	1.7	0	0%	4		
VOCs	N	1,1,1-Trichloroethane	19	1342	06-Nov-86	24-Jul-14	17	1%	25-Jul-94	1.5	0.23	0.6	µg/L	200	0	0%	0		
VOCs	N	1,1,2,2-Tetrachloroethane	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L	0.22			89		
VOCs	N	1,1,2-Trichloroethane	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L	0.77			88		
VOCs	N	1,1-Dichloroethane	37	1365	06-Nov-86	24-Jul-14	281	21%	7-Jul-14	170	0.23	17.9	µg/L	7.7	101	7%	1	28-Jul-05	720
VOCs	N	1,1-Dichloroethene	19	1342	06-Nov-86	24-Jul-14	12	1%	1-Dec-99	6.1	0.31	1.0	µg/L	7	0	0%	1		
VOCs	N	1,1-Dichloropropene	15	590	08-Apr-92	01-Feb-08	0	--	--	--	--	--	µg/L						
VOCs	N	1,2,3-Trichloropropane	19	1261	28-Apr-92	24-Jul-14	0	--	--	--	--	--	µg/L	0.0015			1261		
VOCs	N	1,2-Dibromo-3-chloropropane	19	1265	08-Apr-92	24-Jul-14	0	--	--	--	--	--	µg/L	0.055			1265		
VOCs	N	1,2-Dibromoethane (EDB)	18	1171	13-Apr-95	24-Jul-14	0	--	--	--	--	--	µg/L	0.01			1171		
VOCs	N	1,2-Dichlorobenzene	37	1289	22-Jan-90	24-Jul-14	2	0%	1-Jun-07	4.7	0.6	2.7	µg/L	600	0	0%	0		
VOCs	N	1,2-Dichloroethane (EDC)	37	1365	06-Nov-86	24-Jul-14	83	6%	24-May-07	5	0.2	1.8	µg/L	0.48	61	4%	58	23-Jan-07	591
VOCs	N	1,2-Dichloropropane	37	1365	06-Nov-86	24-Jul-14	81	6%	23-Jan-07	2.6	0.2	0.9	µg/L	1.2	26	2%	1	02-Mar-93	1255
VOCs	N	1,3-Dichlorobenzene	15	575	22-Jan-90	01-Feb-08	0	--	--	--	--	--	µg/L						
VOCs	N	1,3-Dichloropropane	14	496	13-Apr-95	01-Feb-08	0	--	--	--	--	--	µg/L						
VOCs	N	1,3-Dichloropropene	15	515	20-Nov-92	25-Feb-05	0	--	--	--	--	--	µg/L	0.44			10		
VOCs	N	1,4-Dichloro-2-Butene	18	1171	13-Apr-95	24-Jul-14	0	--	--	--	--	--	µg/L						
VOCs	N	1,4-Dichlorobenzene	37	1352	04-Feb-88	24-Jul-14	2	0%	1-Jun-07	6.5	0.93	3.7	µg/L	8.1	0	0%	1		
VOCs	N	2,2-Dichloropropane	14	496	13-Apr-95	01-Feb-08	1	0%	12-Apr-04	1.4	1.4	1.4	µg/L						
VOCs	N	2-Butanone	19	1342	06-Nov-86	24-Jul-14	10	1%	29-Jan-03	15	4.15	7.3	µg/L	4800	0	0%	0		
VOCs	N	2-Chloroethyl Vinyl Ether	15	603	06-Nov-86	01-Feb-08	0	--	--	--	--	--	µg/L						
VOCs	N	2-Hexanone	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L						
VOCs	N	4-Methyl-2-pentanone	37	1365	06-Nov-86	24-Jul-14	2	0%	31-May-07	6	4.1	5.1	µg/L	640	0	0%	0		
VOCs	N	Acetone	37	1365	06-Nov-86	24-Jul-14	98	7%	6-Jan-14	460	4	20.1	µg/L	7200	0	0%	0		
VOCs	N	Acetonitrile	18	578	13-Apr-95	22-Dec-09	0	--	--	--	--	--	µg/L						
VOCs	N	Acrolein	15	603	06-Nov-86	01-Feb-08	0	--	--	--	--	--	µg/L	4			603		
VOCs	N	Acrylonitrile	16	1194	06-Nov-86	24-Jul-14	1	0%	21-Jan-10	0.1	0.1	0.1	µg/L	0.081	1	0%	829	21-Jan-10	354
VOCs	N	Allyl Chloride	14	496	13-Apr-95	01-Feb-08	0	--	--	--	--	--	µg/L	2.1			492		
VOCs	N	Bromochloromethane	19	1185	08-Apr-92	24-Jul-14	0	--	--	--	--	--	µg/L						
VOCs	N	Bromodichloromethane	19	1342	06-Nov-86	24-Jul-14	2	0%	3-Jul-91	1.5	1.5	1.5	µg/L	0.71	2	0%	1340	03-Jul-91	1280
VOCs	N	Bromoethane	15	645	08-Apr-92	16-Dec-08	0	--	--	--	--	--	µg/L						
VOCs	N	Bromoform	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L	5.5			1		
VOCs	N	Bromomethane	19	1288	06-Nov-86	24-Jul-14	1	0%	6-Jun-02	0.91	0.91	0.9	µg/L	11	0	0%	0		
VOCs	N	Carbon disulfide	19	1342	06-Nov-86	24-Jul-14	19	1%	27-Oct-10	1.6	0.21	0.6	µg/L	800	0	0%	0		
VOCs	N	Carbon tetrachloride	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L	0.62			88		
VOCs	N	Chlorobenzene	37	1365	06-Nov-86	24-Jul-14	7	1%	17-Oct-11	6.7	0.2	1.5	µg/L	100	0	0%	0		
VOCs	N	Chloroethane	37	1365	06-Nov-86	24-Jul-14	94	7%	14-Apr-14	24	0.2	3.6	µg/L						
VOCs	N	Chloroform	19	1342	06-Nov-86	24-Jul-14	4	0%	17-Oct-11	4.35	0.2	1.4	µg/L	1.4	1	0%	1	14-Oct-11	210
VOCs	N	Chloromethane	19	1338	06-Nov-86	24-Jul-14	71	5%	4-Jan-11	1.9	0.2	0.4	µg/L						
VOCs	N	cis-1,2-Dichloroethene (DCE)	37	1352	04-Feb-88	24-Jul-14	299	22%	7-Jul-14	180	0.21	19.9	µg/L	16	72	5%	0	31-May-07	564
VOCs	N	cis-1,3-Dichloropropene	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L						
VOCs	N	Dibromochloromethane	19	1338	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L	0.52			84		
VOCs	N	Dichlorodifluoromethane	36	1191	13-Apr-95	24-Jul-14	95	8%	7-Jul-14	46	0.22	8.6	µg/L	1600	0	0%	0		
VOCs	N	Isobutyl alcohol	14	494	13-Apr-95	01-Feb-08	0	--	--	--	--	--	µg/L	2400			0		
VOCs	N	Methacrylonitrile	15	560	07-Jan-93	01-Feb-08	0	--	--	--	--	--	µg/L	0.8			505		
VOCs	N	Methyl Methacrylate	14	496	13-Apr-95	01-Feb-08	0	--	--	--	--	--	µg/L	11000			0		
VOCs	N	Methylene chloride	19	1342	06-Nov-86	24-Jul-14	167	12%	12-Jul-13	52	0.22	4.9	µg/L	5	37	3%	1	18-Nov-94	1178
VOCs	N	Methyliodide	19	1201	08-Apr-92	24-Jul-14	0	--	--	--	--	--	µg/L						
VOCs	N	Propionitrile	14	496	13-Apr-95	01-Feb-08	6	1%	16-Apr-04	150	87	109.3	µg/L						
VOCs	N	Styrene	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L	100			0		
VOCs	N	Tetrachloroethene (PCE)	37	1331	18-Apr-90	24-Jul-14	9	1%	31-May-07	1.5	0.2	0.5	µg/L	5	0	0%	1		
VOCs	N	trans-1,2-Dichloroethene	37	1322	06-Nov-86	24-Jul-14	49	4%	23-Jan-07	3	0.21	0.7	µg/L	100	0	0%	0		
VOCs	N	trans-1,3-Dichloropropene	19	1342	06-Nov-86	24-Jul-14	0	--	--	--	--	--	µg/L						
VOCs	N	Trichloroethene (TCE)	37	1365	06-Nov-86	24-Jul-14	156	11%	4-Apr-14	23	0.2	1.7	µg/L	0.54	124	9%	60	04-Apr-14	13
VOCs	N	Trichlorofluoromethane	19	1265	08-Apr-92	24-Jul-14	5	0%	14-Apr-08	0.33	0.21	0.3	µg/L	2400	0	0%	0		
VOCs	N	Vinyl acetate	19	1342	06-Nov-86	24-Jul-14	1	0%	22-May-92	0.5	0.5	0.5	µg/L	8000	0	0%	0		
VOCs	N	Vinyl chloride	37	1365	06-Nov-86	24-Jul-14	191	14%	7-Jul-14	26	0.011	5.9	µg/L	0.029	184	13%	142	07-Jul-14	
PCBAro	N	Aroclor 1016	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
PCBAro	N	Aroclor 1221	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
PCBAro	N	Aroclor 1232	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
PCBAro	N	Aroclor 1242	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
PCBAro	N	Aroclor 1248	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
PCBAro	N	Aroclor 1254	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.044			76		
PCBAro	N	Aroclor 1260	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.044			76		

Group	Total or Dissolved	Analyte	Number of Sampled Locations	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Available Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Preliminary Screening Level (Minimum of ARARs from Table 7)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Number of NonDetects with Reporting Limit Above the Prelimiary Screening Level	Date of Last Screening Level Exceedace	Number of Samples Since Last Screening Level Exceedance
Chlorinated Herbicides	N	2,4,5-T	13	341	13-Apr-95	27-Jan-05	0	--	--	--	--	--	µg/L	160			0		
Chlorinated Herbicides	N	2,4-D	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	70			0		
Chlorinated Herbicides	N	Dinoseb	15	408	07-Jan-93	27-Jan-05	1	0%	19-Apr-00	2.6	2.6	2.6	µg/L	7	0	0%	0		
Chlorinated Herbicides	N	Isodrin	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Chlorinated Herbicides	N	Silvex	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	50			0		
Pesticides	N	4,4'-DDD	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.36			3		
Pesticides	N	4,4'-DDE	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.26			3		
Pesticides	N	4,4'-DDT	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.26			3		
Pesticides	N	Aldrin	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.0026			408		
Pesticides	N	Alpha-BHC	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.014			408		
Pesticides	N	Beta-BHC	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.049			3		
Pesticides	N	cis-Chlordane	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Pesticides	N	Delta-BHC	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Pesticides	N	Dieldrin	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.0055			408		
Pesticides	N	Endosulfan I	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Pesticides	N	Endosulfan II	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Pesticides	N	Endosulfan Sulfate	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Pesticides	N	Endrin	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	2			0		
Pesticides	N	Endrin Aldehyde	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L						
Pesticides	N	Heptachlor	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.019			408		
Pesticides	N	Heptachlor Epoxide	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.0048			408		
Pesticides	N	Lindane	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.08			3		
Pesticides	N	Methoxychlor	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	40			0		
Pesticides	N	Toxaphene	15	408	07-Jan-93	27-Jan-05	0	--	--	--	--	--	µg/L	0.08			408		
Other	N	Chloroprene	14	497	13-Apr-95	01-Feb-08	0	--	--	--	--	--	µg/L	160			0		
Field Parameters	N	ORP	14	134	15-Jan-04	24-Mar-06	134	100%	24-Mar-06	66	-87.5	-17.7	mVolts						
Field Parameters	N	pH	20	1407	06-Nov-86	14-Aug-14	1401	100%	14-Aug-14	8.9	-7.1	6.9	pH Units						
Field Parameters	N	Specific Conductance	20	1415	06-Nov-86	14-Aug-14	1409	100%	14-Aug-14	5900	8.3	291.7	uS/cm						
Field Parameters	N	Temperature	20	1368	15-Dec-86	14-Aug-14	1362	100%	14-Aug-14	70.8	0.38	10.7	deg C						

Notes:

Significant digits are presented as reported in KCSWD data base output. The laboratory analytical method dictates the number of significant digits when reporting concentrations; therefore, significant digits can vary widely.

Table 3 - Stream 3 SW-E1 Surface Water Data Summary and Preliminary Screening

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Group	Total or Dissolved	Analyte	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Available Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Preliminary Screening Level (Minimum of ARARs from Table 8)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Number of Non-Detects with Reporting Limit Above the Prelimiary Screening Level
Metals	D	Aluminum	89	28-Jan-00	10-Dec-12	87	98%	10-Dec-12	7600	31	347.1	µg/L				
Metals	D	Antimony	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	1000			0
Metals	D	Arsenic	72	28-Jan-00	10-Dec-12	3	4%	13-Jul-10	3.44	1	1.9	µg/L	0.098	3	4%	69
Metals	D	Barium	89	28-Jan-00	10-Dec-12	88	99%	10-Dec-12	56	2.15	5.5	µg/L				
Metals	D	Beryllium	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	270			0
Metals	D	Cadmium	89	28-Jan-00	10-Dec-12	2	2%	20-Dec-04	2	2	2.0	µg/L	0.37	2	2%	87
Metals	D	Calcium	89	28-Jan-00	10-Dec-12	88	99%	10-Dec-12	28000	3500	5506.3	µg/L				
Metals	D	Chromium (Total)	89	28-Jan-00	10-Dec-12	1	1%	25-Feb-05	6	6	6.0	µg/L	57	0	0%	0
Metals	D	Cobalt	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L				
Metals	D	Copper	89	28-Jan-00	10-Dec-12	8	9%	3-Dec-07	9.4	2	5.0	µg/L	3.5	5	6%	0
Metals	D	Iron	89	28-Jan-00	10-Dec-12	88	99%	10-Dec-12	3400	14	249.6	µg/L	1000	5	6%	0
Metals	D	Lead	89	28-Jan-00	10-Dec-12	4	4%	3-Dec-07	7	1	2.8	µg/L	0.54	4	4%	85
Metals	D	Magnesium	89	28-Jan-00	10-Dec-12	88	99%	10-Dec-12	5400	864	1306.8	µg/L				
Metals	D	Manganese	89	28-Jan-00	10-Dec-12	86	97%	10-Dec-12	1970	1	86.4	µg/L				
Metals	D	Nickel	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	49			1
Metals	D	Potassium	87	28-Jan-00	10-Dec-12	84	97%	10-Dec-12	1900	310	509.5	µg/L				
Metals	D	Selenium	72	28-Jan-00	10-Dec-12	1	1%	13-Mar-07	1.4	1.4	1.4	µg/L	5	0	0%	0
Metals	D	Silver	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	0.32			89
Metals	D	Sodium	89	28-Jan-00	10-Dec-12	86	97%	10-Dec-12	4500	1500	2646.5	µg/L				
Metals	D	Thallium	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	0.22			89
Metals	D	Tin	89	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L				
Metals	D	Vanadium	89	28-Jan-00	10-Dec-12	3	3%	3-Dec-07	10	5	7.3	µg/L				
Metals	D	Zinc	89	28-Jan-00	10-Dec-12	24	27%	27-Oct-10	36	4	11.4	µg/L	32	1	1%	0
Metals	T	Aluminum	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	2160	72.2	302.2	µg/L				
Metals	T	Antimony	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	1000			0
Metals	T	Arsenic	24	21-Jan-10	10-Dec-12	1	4%	13-Jul-10	3.52	3.52	3.5	µg/L	0.098	1	4%	23
Metals	T	Barium	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	30.3	2.49	6.9	µg/L				
Metals	T	Beryllium	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	270			0
Metals	T	Cadmium	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	0.37			24
Metals	T	Calcium	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	10500	3670	4978.8	µg/L				
Metals	T	Chromium (Total)	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L				
Metals	T	Cobalt	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L				
Metals	T	Copper	24	21-Jan-10	10-Dec-12	1	4%	16-Dec-10	2.73	2.73	2.7	µg/L	3.5	0	0%	0
Metals	T	Iron	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	2370	37	301.3	µg/L	1000	2	8%	
Metals	T	Lead	24	21-Jan-10	10-Dec-12	2	8%	10-Dec-12	2.27	1.04	1.7	µg/L	0.54	2	8%	22
Metals	T	Magnesium	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	2340	882	1155.3	µg/L		0	0%	
Metals	T	Manganese	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	1820	4.44	162.7	µg/L		0	0%	
Metals	T	Mercury	72	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	0.012			72
Metals	T	Nickel	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	49			0
Metals	T	Potassium	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	648	300	445.0	µg/L				
Metals	T	Selenium	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	5			0
Metals	T	Silver	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	0.32			24
Metals	T	Sodium	24	21-Jan-10	10-Dec-12	24	100%	10-Dec-12	3610	2360	2651.7	µg/L				
Metals	T	Thallium	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L	0.22			24
Metals	T	Tin	24	21-Jan-10	10-Dec-12	0	--	--	--	--	--	µg/L				
Metals	T	Vanadium	24	21-Jan-10	10-Dec-12	1	4%	16-Dec-10	3.33	3.33	3.3	µg/L				
Metals	T	Zinc	24	21-Jan-10	10-Dec-12	4	17%	10-Dec-12	18.6	7.67	11.6	µg/L	32	0	0%	0
Conventionals		Ammonia as Nitrogen	89	28-Jan-00	10-Dec-12	21	24%	18-Jun-12	0.83	0.01	0.1	mg/L as N				
Conventionals		Alkalinity (Total)	69	26-Dec-01	10-Dec-12	69	100%	10-Dec-12	44.4	1.5	16.3	mg/L as CaCO3				
Conventionals		Biochemical Oxygen Demand	37	28-Jan-00	18-Apr-12	5	14%	13-Jul-10	9.3	3	5.8	mg/L				
Conventionals		Chemical Oxygen Demand	89	28-Jan-00	10-Dec-12	62	70%	10-Dec-12	220	5	13.9	mg/L				
Conventionals		Chloride	88	28-Jan-00	10-Dec-12	86	98%	10-Dec-12	3	1.1	1.9	mg/L	230000	0	0%	0
Conventionals		Fats/Oils/Grease (Non-Polar)	1	22-Feb-10	22-Feb-10	1	100%	22-Feb-10	1.86	1.86	1.9	mg/L				
Conventionals		Fluoride	37	28-Jan-00	18-Apr-12	0	--	--	--	--	--	mg/L				
Conventionals		Halides, Total Organic (TOX)	34	28-Jan-00	27-Oct-10	2	6%	22-Feb-10	0.17	0.02	0.1	mg/L				
Conventionals		Hardness	81	28-Jan-00	10-Dec-12	81	100%	10-Dec-12	81	12.8	20.0	mg/L				

Group	Total or Dissolved	Analyte	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Available Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Preliminary Screening Level (Minimum of ARARs from Table 8)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Number of Non-Detects with Reporting Limit Above the Prelimiary Screening Level
Conventionals		Nitrate + Nitrite	87	28-Jan-00	10-Dec-12	85	98%	10-Dec-12	23	0.02	1.1	mg/L as N				
Conventionals		Nitrate as Nitrogen	89	28-Jan-00	10-Dec-12	86	97%	10-Dec-12	3.4	0.02	0.9	mg/L as N				
Conventionals		ortho-Phosphorus	81	28-Jan-00	10-Dec-12	27	33%	10-Dec-12	0.21	0.01	0.0	mg/L				
Conventionals		Phosphorus	81	28-Jan-00	14-Jun-11	69	85%	14-Jun-11	2.13	0.01	0.1	mg/L as P				
Conventionals		Sulfate	89	28-Jan-00	10-Dec-12	86	97%	10-Dec-12	13	0.239	2.5	mg/L				
Conventionals		Total Dissolved Solids	55	16-Nov-05	10-Dec-12	55	100%	10-Dec-12	350	2	49.4	mg/L				
Conventionals		Total Kjeldahl Nitrogen	89	28-Jan-00	10-Dec-12	49	55%	10-Dec-12	40	0.13	1.4	mg/L as N				
Conventionals		Total Organic Carbon	88	28-Jan-00	10-Dec-12	87	99%	10-Dec-12	10	1.42	3.3	mg/L				
Conventionals		Total Solids	89	28-Jan-00	10-Dec-12	89	100%	10-Dec-12	380	2	60.4	mg/L				
Conventionals		Total Suspended Solids	71	28-Jan-00	10-Dec-12	57	80%	10-Dec-12	250	1	11.8	mg/L				
BTEX		Benzene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	23			0
BTEX		Ethylbenzene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	6800			0
BTEX		Toluene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	19000			0
BTEX		o-Xylene	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
BTEX		Total Xylenes	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,1,1,2-Tetrachloroethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,1,1-Trichloroethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	930000			0
VOCs		1,1,2,2-Tetrachloroethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	6.5			0
VOCs		1,1,2-Trichloroethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	25			0
VOCs		1,1-Dichloroethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,1-Dichloroethene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	23000			0
VOCs		1,1-Dichloropropene	4	10-Mar-03	17-Jan-06	0	--	--	--	--	--	µg/L				
VOCs		1,2,3-Trichloropropane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,2-Dibromo-3-chloropropane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,2-Dibromoethane (EDB)	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,2-Dichlorobenzene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	4200			0
VOCs		1,2-Dichloroethane (EDC)	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	59			0
VOCs		1,2-Dichloropropane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	44			0
VOCs		1,3-Dichlorobenzene	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		1,3-Dichloropropane	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		1,4-Dichloro-2-Butene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		1,4-Dichlorobenzene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	21			0
VOCs		2,2-Dichloropropane	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		2-Butanone	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		2-Chloroethyl Vinyl Ether	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		2-Hexanone	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		4-Methyl-2-pentanone	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Acetone	6	10-Mar-03	15-Jan-08	1	17%	15-Jan-08	100	100	100.0	µg/L				
VOCs		Acetonitrile	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Acrolein	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Acrylonitrile	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	0.4			6
VOCs		Allyl Chloride	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Bromochloromethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Bromodichloromethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	28			0
VOCs		Bromoethane	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Bromoform	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	220			0
VOCs		Bromomethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	960			0
VOCs		Carbon disulfide	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Carbon tetrachloride	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	4.9			0
VOCs		Chlorobenzene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	5200			0
VOCs		Chloroethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Chloroform	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	55			0
VOCs		Chloromethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		cis-1,2-Dichloroethene (DCE)	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		cis-1,3-Dichloropropene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Dibromochloromethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	20			0

Table 3 - Stream 3 SW-E1 Surface Water Data Summary and Preliminary Screening

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Group	Total or Dissolved	Analyte	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Available Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Preliminary Screening Level (Minimum of ARARs from Table 8)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Number of Non-Detects with Reporting Limit Above the Prelimiary Screening Level
VOCs		Dichlorodifluoromethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Isobutyl alcohol	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Methacrylonitrile	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Methyl Methacrylate	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Methylene chloride	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	3600			0
VOCs		Methyliodide	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Propionitrile	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
VOCs		Styrene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Tetrachloroethene (PCE)	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	100			0
VOCs		trans-1,2-Dichloroethene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	32000			0
VOCs		trans-1,3-Dichloropropene	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Trichloroethene (TCE)	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	13			0
VOCs		Trichlorofluoromethane	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Vinyl acetate	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L				
VOCs		Vinyl chloride	6	10-Mar-03	15-Jan-08	0	--	--	--	--	--	µg/L	3.7			0
Chlorinated Herbicides		2,4,5-T	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L				
Chlorinated Herbicides		2,4-D	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L				
Chlorinated Herbicides		Dinoseb	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L				
Chlorinated Herbicides		Silvex	87	28-Jan-00	10-Dec-12	1	1%	16-Mar-09	1.4	1.4	1.4	µg/L				
Pesticides		Endrin	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	0.0023			87
Pesticides		Lindane	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	0.045			0
Pesticides		Methoxychlor	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	8.1			0
Pesticides		Toxaphene	87	28-Jan-00	10-Dec-12	0	--	--	--	--	--	µg/L	0.0002			87
Other		Chloroprene	3	10-Mar-03	19-Jan-05	0	--	--	--	--	--	µg/L				
Field Parameters		Dissolved Oxygen	88	28-Jan-00	10-Dec-12	88	100%	10-Dec-12	12.3	2.1	8.0	mg/L				
Field Parameters		pH	89	28-Jan-00	10-Dec-12	89	100%	10-Dec-12	8.2	4.9	6.5	pH Units				
Field Parameters		Specific Conductance	90	28-Jan-00	10-Dec-12	90	100%	10-Dec-12	110	38	52.6	uS/cm				
Field Parameters		Temperature	89	28-Jan-00	10-Dec-12	89	100%	10-Dec-12	13.8	2.8	8.1	deg C				
Field Parameters		Turbidity	90	28-Jan-00	10-Dec-12	90	100%	10-Dec-12	61	0.76	3.9	NTU				

Notes:

Significant digits are presented as reported in KCSWD data base output. The laboratory analytical method dictates the number of significant digits when reporting concentrations; therefore, significant digits can vary widely.

Did not correct metals for hardness.

Table 4 - Landfill Gas Data Summary and Preliminary Methane Screening

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Interval	Location	Sample Date Range[1]	Number of Samples for Methane in Soil Gas	Number of Detections of Methane in Soil Gas	Max Detected Methane Concentration (% of total volume)	Average Methane Concentration (% of total volume)	Number of Methane Detections Above 5%
Shallow	EW-20	9/11/2009 - 1/19/2010	3	1	0.2	0.1	0
Shallow	GP-15A	7/22/2013 - 12/10/2013	4	0	0	0	0
Shallow	GP-15C	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-16A	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-16B	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-17A	8/22/2013 - 9/18/2013	2	0	0	0	0
Shallow	GP-17B	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-18A	2/14/2013 - 10/15/2013	6	0	0	0	0
Shallow	GP-18B	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-19A	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-19B	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-20A	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-20B	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-21A	1/29/2013 - 12/10/2013	10	0	0	0	0
Shallow	GP-21B	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-56	10/22/2009 - 12/10/2013	14	0	0.1	0	0
Shallow	GP-58	10/23/2009 - 12/10/2013	16	12	16.4	8.1	12
Shallow	GP-60	10/23/2009 - 12/10/2013	16	11	10.7	2.2	2
Shallow	GP-62	10/20/2009 - 12/10/2013	15	0	0	0	0
Shallow	GP-ATC-1D	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-ATC-1S	6/13/2013 - 9/18/2013	4	0	0	0	0
Shallow	GP-ATC-3D	3/12/2013 - 9/18/2013	4	0	0	0	0
Shallow	GP-ATC-3S	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-ATC-6D	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-ATC-6S	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-ATC-8D	1/29/2013 - 12/10/2013	12	0	0	0	0
Shallow	GP-ATC-8S	2/14/2013 - 12/10/2013	11	0	0	0	0
Shallow	MW-104	2/5/2009 - 9/10/2009	3	1	0.3	0.1	0
	Shallow Interval Totals:		***288***	***25***	***16.4***	***0.4***	***14***

Notes

[1] Data shown is for the most recent year available.

Significant digits are presented as reported in KCSWD data base output. The laboratory analytical method dictates the number of significant digits when reporting concentrations; therefore, significant digits can vary widely.

Table 4 - Landfill Gas Data Summary and Preliminary Methane Screening

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Interval	Location	Sample Date Range[1]	Number of Samples for Methane in Soil Gas	Number of Detections of Methane in Soil Gas	Max Detected Methane Concentraiton (% of total volume)	Average Methane Concentraiton (% of total volume)	Number of Methane Detections Above 5%
Deep	EW-10	9/10/2009 - 1/19/2010	4	2	4.5	1.2	0
Deep	EW-11	9/11/2009 - 10/22/2009	3	3	16.3	11.2	2
Deep	EW-3	9/11/2009 - 10/23/2009	5	2	0.7	0.2	0
Deep	EW-5	9/11/2009 - 1/19/2010	5	4	11.6	4.9	2
Deep	EW-7	9/11/2009 - 10/23/2009	4	2	7.2	2.2	1
Deep	GP-15D	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-16C	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-17C	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-18C	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-20C	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-21C	2/14/2013 - 11/14/2013	5	0	0	0	0
Deep	GP-55	10/21/2009 - 12/10/2013	17	6	69.7	14.5	6
Deep	GP-57	10/20/2009 - 1/31/2014	194	192	80.1	49.9	187
Deep	GP-59	10/23/2009 - 12/10/2013	16	5	71.3	9.2	3
Deep	GP-61	10/20/2009 - 12/10/2013	17	0	0	0	0
Deep	GP-6A	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-6C	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-6D	1/29/2013 - 12/10/2013	12	1	0.8	0.1	0
Deep	GP-6E	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-6F	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-6G	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep	GP-7	1/29/2013 - 12/10/2013	12	1	1.9	0.2	0
Deep	GP-8	1/29/2013 - 12/10/2013	12	2	0.8	0.1	0
Deep	GP-9	1/29/2013 - 12/10/2013	12	0	0	0	0
Deep Interval Totals:			***438***	***220***	***80.1***	***3.9***	***201***

Notes

[1] Data shown is for the most recent year available.

Significant digits are presented as reported in KCSWD data base output. The laboratory analytical method dictates the number of significant digits when reporting concentrations; therefore, significant digits can vary widely.

Table 5 - Leachate Pump Station MH-46N Data Summary

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Group	Analyte	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units
Metals	Cyanide (total)	154	13-Jan-00	12-Dec-12	41	27%	12-Dec-12	5.69	0.02	0.3	mg/L
Metals	Aluminum	150	13-Jan-00	12-Dec-12	131	87%	8-Aug-12	68000	30	943.0	µg/L
Metals	Antimony	150	13-Jan-00	12-Dec-12	107	71%	2-Dec-09	7	1	2.5	µg/L
Metals	Arsenic	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	210	17	105.8	µg/L
Metals	Barium	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	740	24	473.7	µg/L
Metals	Cadmium	150	13-Jan-00	12-Dec-12	20	13%	26-Jun-08	4	2	2.9	µg/L
Metals	Calcium	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	330000	6900	80592.0	µg/L
Metals	Chromium (Total)	150	13-Jan-00	12-Dec-12	149	99%	12-Dec-12	170	71	103.9	µg/L
Metals	Cobalt	150	13-Jan-00	12-Dec-12	146	97%	12-Dec-12	43	18	31.3	µg/L
Metals	Copper	150	13-Jan-00	12-Dec-12	119	79%	11-Jul-12	100	2	23.0	µg/L
Metals	Iron	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	7100	1930	3270.7	µg/L
Metals	Lead	150	13-Jan-00	12-Dec-12	7	5%	6-May-09	3	1	1.3	µg/L
Metals	Magnesium	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	1100000	11000	92700.7	µg/L
Metals	Manganese	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	860	280	457.0	µg/L
Metals	Nickel	150	13-Jan-00	12-Dec-12	149	99%	12-Dec-12	290	19	174.2	µg/L
Metals	Potassium	143	13-Jan-00	12-Dec-12	143	100%	12-Dec-12	4900000	11000	540153.8	µg/L
Metals	Selenium	150	13-Jan-00	12-Dec-12	115	77%	2-Dec-09	430	1	145.4	µg/L
Metals	Sodium	150	13-Jan-00	12-Dec-12	150	100%	12-Dec-12	11000000	14000	1283013.3	µg/L
Metals	Tin	150	13-Jan-00	12-Dec-12	2	1%	13-Jun-12	96	22	59.0	µg/L
Metals	Vanadium	150	13-Jan-00	12-Dec-12	149	99%	12-Dec-12	300	85.6	170.7	µg/L
Metals	Zinc	150	13-Jan-00	12-Dec-12	147	98%	12-Dec-12	740	4.9	52.0	µg/L
Conventionals	Ammonia as Nitrogen	152	13-Jan-00	12-Dec-12	152	100%	12-Dec-12	2000	21	884.4	mg/L as N
Conventionals	Alkalinity (Total)	154	13-Jan-00	12-Dec-12	154	100%	12-Dec-12	10000	330	4067.6	mg/L
Conventionals	Biochemical Oxygen Demand	154	13-Jan-00	12-Dec-12	144	94%	12-Dec-12	990	10	137.5	mg/L
Conventionals	Chemical Oxygen Demand	154	13-Jan-00	12-Dec-12	149	97%	12-Dec-12	4500	210	1759.1	mg/L
Conventionals	Chloride	150	13-Jan-00	12-Dec-12	139	93%	5-Sep-12	7700	0.021	1984.5	mg/L
Conventionals	Coliform, Total	151	13-Jan-00	12-Dec-12	86	57%	12-Dec-12	500000	1	23426.2	CFU/100mL
Conventionals	Fats/Oils/Grease (Non-Polar)	110	13-Jan-00	11-Mar-09	36	33%	29-Jan-09	11	1	4.9	mg/L
Conventionals	Fats/Oils/Grease (Total)	144	13-Jan-00	12-Dec-12	129	90%	11-Jul-12	11000	1	112.0	mg/L
Conventionals	Fecal Coliform	153	13-Jan-00	12-Dec-12	12	8%	12-Dec-12	130000	1	12646.5	CFU/100mL
Conventionals	Fluoride	151	13-Jan-00	12-Dec-12	30	20%	12-Dec-12	24	0.06	4.8	mg/L
Conventionals	Halides, Total Organic (TOX)	130	13-Jan-00	15-Dec-10	125	96%	15-Dec-10	3200	0.77	28.4	mg/L
Conventionals	Nitrate + Nitrite	154	13-Jan-00	12-Dec-12	145	94%	12-Dec-12	6.1	0.02	1.1	mg/L as N
Conventionals	ortho-Phosphorus	154	13-Jan-00	12-Dec-12	153	99%	12-Dec-12	33	0.06	3.4	mg/L
Conventionals	pH	119	13-Jan-00	02-Dec-09	119	100%	2-Dec-09	8.26	7.1	7.4	pH Units
Conventionals	Phosphate	77	13-Jan-00	14-Dec-11	77	100%	14-Dec-11	12400	0.04	462.3	mg/L
Conventionals	Sulfate	151	13-Jan-00	12-Dec-12	93	62%	12-Dec-12	430	0.076	17.9	mg/L
Conventionals	Sulfide	86	26-Sep-05	12-Dec-12	72	84%	12-Dec-12	715	0.038	98.5	mg/L
Conventionals	Sulfur	68	13-Jan-00	23-Aug-05	65	96%	23-Aug-05	150	1.5	10.5	mg/L
Conventionals	Total Kjeldahl Nitrogen	152	13-Jan-00	12-Dec-12	151	99%	12-Dec-12	1600	30	768.3	mg/L as N
Conventionals	Total Organic Carbon	143	13-Jan-00	14-Dec-11	143	100%	14-Dec-11	1140	8.6	518.9	mg/L
Conventionals	Total Suspended Solids	154	13-Jan-00	12-Dec-12	149	97%	12-Dec-12	1600	1.1	58.6	mg/L
Conventionals	Total Volatile Solids	153	13-Jan-00	12-Dec-12	148	97%	12-Dec-12	1790	1	306.3	mg/L
BTEX	Benzene	152	13-Jan-00	12-Dec-12	74	49%	11-Jul-12	13	1.6	4.5	µg/L
BTEX	Ethylbenzene	152	13-Jan-00	12-Dec-12	144	95%	12-Dec-12	160	1.5	65.4	µg/L
BTEX	Toluene	152	13-Jan-00	12-Dec-12	88	58%	8-Aug-12	22	2.6	10.5	µg/L
BTEX	m,p-Xylenes	12	11-Jan-12	12-Dec-12	12	100%	12-Dec-12	55.8	26.1	40.2	µg/L
BTEX	o-Xylene	152	13-Jan-00	12-Dec-12	138	91%	12-Dec-12	170	2.5	38.3	µg/L
BTEX	Total Xylenes	139	13-Jan-00	14-Dec-11	138	99%	14-Dec-11	320	26	141.6	µg/L
VOCs	1,1-Dichloroethane	152	13-Jan-00	12-Dec-12	19	12%	11-Mar-09	1.9	0.77	1.2	µg/L
VOCs	1,2-Dichlorobenzene	152	13-Jan-00	12-Dec-12	54	36%	3-May-12	5	1.1	2.9	µg/L
VOCs	1,2-Dichloroethane (EDC)	152	13-Jan-00	12-Dec-12	3	2%	24-Feb-09	0.47	0.33	0.4	µg/L
VOCs	1,2-Dichloropropane	152	13-Jan-00	12-Dec-12	10	7%	24-Feb-09	0.42	0.25	0.3	µg/L
VOCs	1,3-Dichlorobenzene	152	13-Jan-00	12-Dec-12	3	2%	5-Nov-08	10	0.21	3.5	µg/L

Table 5 - Leachate Pump Station MH-46N Data Summary

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

Group	Analyte	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units
VOCs	1,4-Dichlorobenzene	152	13-Jan-00	12-Dec-12	84	55%	12-Dec-12	25	4.33	12.1	µg/L
VOCs	2-Butanone	152	13-Jan-00	12-Dec-12	15	10%	10-Aug-11	1000	4.4	116.8	µg/L
VOCs	2-Hexanone	152	13-Jan-00	12-Dec-12	1	1%	8-Oct-09	485	485	485.0	µg/L
VOCs	4-Methyl-2-pentanone	152	13-Jan-00	12-Dec-12	1	1%	21-Aug-07	12	12	12.0	µg/L
VOCs	Acetone	152	13-Jan-00	12-Dec-12	68	45%	14-Nov-12	790	17	85.2	µg/L
VOCs	Acetonitrile	152	13-Jan-00	12-Dec-12	9	6%	14-Dec-11	168	100	118.8	µg/L
VOCs	Acrylonitrile	152	13-Jan-00	12-Dec-12	1	1%	7-Apr-10	5.2	5.2	5.2	µg/L
VOCs	Carbon disulfide	152	13-Jan-00	12-Dec-12	5	3%	24-Feb-09	0.31	0.21	0.2	µg/L
VOCs	Chlorobenzene	152	13-Jan-00	12-Dec-12	52	34%	14-Dec-11	4.9	1	2.7	µg/L
VOCs	Chloroethane	152	13-Jan-00	12-Dec-12	13	9%	24-Feb-09	1.5	0.45	0.8	µg/L
VOCs	Chloromethane	152	13-Jan-00	12-Dec-12	4	3%	3-May-12	3.2	0.22	1.7	µg/L
VOCs	cis-1,2-Dichloroethene (DCE)	152	13-Jan-00	12-Dec-12	21	14%	11-Mar-09	2.8	0.82	1.4	µg/L
VOCs	Methyl Methacrylate	152	13-Jan-00	12-Dec-12	4	3%	4-May-11	7.82	2.38	5.9	µg/L
VOCs	Methylene chloride	152	13-Jan-00	12-Dec-12	48	32%	14-Nov-12	320	2.8	57.6	µg/L
VOCs	Propionitrile	152	13-Jan-00	12-Dec-12	2	1%	14-Dec-05	4.6	3.6	4.1	µg/L
VOCs	Styrene	151	13-Jan-00	12-Dec-12	22	15%	13-Jan-10	24	2.1	6.8	µg/L
VOCs	Tetrachloroethene (PCE)	152	13-Jan-00	12-Dec-12	4	3%	14-Dec-05	17	12	14.8	µg/L
VOCs	trans-1,2-Dichloroethene	152	13-Jan-00	12-Dec-12	13	9%	24-Feb-09	0.67	0.32	0.5	µg/L
VOCs	trans-1,3-Dichloropropene	152	13-Jan-00	12-Dec-12	1	1%	21-Oct-08	0.3	0.3	0.3	µg/L
VOCs	Trichloroethene (TCE)	152	13-Jan-00	12-Dec-12	1	1%	18-May-06	4.6	4.6	4.6	µg/L
VOCs	Vinyl acetate	152	13-Jan-00	12-Dec-12	1	1%	14-Dec-05	8.6	8.6	8.6	µg/L
VOCs	Vinyl chloride	152	13-Jan-00	12-Dec-12	140	92%	12-Dec-12	36	0.02	5.6	µg/L
PCBAro	Aroclor 1232	152	13-Jan-00	12-Dec-12	1	1%	13-Jan-10	0.551	0.551	0.6	µg/L
PCBAro	Aroclor 1242	152	13-Jan-00	12-Dec-12	11	7%	12-Dec-12	0.503	0.125	0.2	µg/L
PCBAro	Aroclor 1248	152	13-Jan-00	12-Dec-12	1	1%	10-Sep-09	0.0704	0.0704	0.1	µg/L
PCBAro	Aroclor 1254	152	13-Jan-00	12-Dec-12	1	1%	12-Jan-11	0.011	0.011	0.0	µg/L
PCBAro	Aroclor 1260	152	13-Jan-00	12-Dec-12	1	1%	12-Jan-11	0.015	0.015	0.0	µg/L
Chlorinated Herbicides	2,4,5-T	152	13-Jan-00	12-Dec-12	6	4%	5-Sep-12	26	1.6	6.6	µg/L
Chlorinated Herbicides	2,4-D	152	13-Jan-00	12-Dec-12	1	1%	21-Feb-06	5	5	5.0	µg/L
Chlorinated Herbicides	Dinoseb	152	13-Jan-00	12-Dec-12	11	7%	15-Dec-08	3.5	1	2.0	µg/L
Chlorinated Herbicides	Silvex	152	13-Jan-00	12-Dec-12	51	34%	7-Oct-10	9.7	1	2.9	µg/L
Pesticides	4,4'-DDE	152	13-Jan-00	12-Dec-12	1	1%	26-Sep-07	0.042	0.042	0.0	µg/L
Pesticides	Beta-BHC	152	13-Jan-00	12-Dec-12	3	2%	15-Dec-08	0.14	0.076	0.1	µg/L
Pesticides	cis-Chlordane	152	13-Jan-00	12-Dec-12	2	1%	29-Jan-09	0.03	0.027	0.0	µg/L
Pesticides	Delta-BHC	152	13-Jan-00	12-Dec-12	1	1%	5-Nov-08	0.041	0.041	0.0	µg/L
Pesticides	Endosulfan I	152	13-Jan-00	12-Dec-12	6	4%	11-Mar-09	0.27	0.043	0.1	µg/L
Pesticides	Endrin	152	13-Jan-00	12-Dec-12	1	1%	15-Dec-08	0.18	0.18	0.2	µg/L
Pesticides	Heptachlor	152	13-Jan-00	12-Dec-12	1	1%	26-Dec-07	0.054	0.054	0.1	µg/L
Pesticides	Heptachlor Epoxide	152	13-Jan-00	12-Dec-12	1	1%	18-Jul-08	0.1	0.1	0.1	µg/L
Pesticides	Lindane	152	13-Jan-00	12-Dec-12	7	5%	11-Mar-09	0.058	0.015	0.0	µg/L
Field Parameters	Specific Conductance	155	13-Jan-00	12-Dec-12	155	100%	12-Dec-12	15000	99.5	10206.5	uS/cm
Field Parameters	Temperature	119	13-Jan-00	12-Dec-12	119	100%	12-Dec-12	31.4	12.5	25.7	deg C

Notes:
Significant digits are presented as reported in KCSWD data base output. The laboratory analytical method dictates the number of significant digits when reporting concentrations; therefore, significant digits can vary widely.

Table 6 - Soil Gas Data Summary and Preliminary Screening

East Perched Zones RI/FS Work Plan - CHRLF, King County, WA

SHALLOW SOIL GAS

Analyte	Number of Sampled Locations¹	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Air Cleanup Level (MTCA Method B)	Prelim. Shallow Soil Gas Screening Levels (MTCA Method B Air x 10 Dilution)²	Number of Exceedances of Shallow Gas Screening Level	Exceedance Frequency (%)	Date of Last Screening Level Exceedance	Number of Samples Since Last Screening Level Exceedance	Number of Non-Detects with Reporting Limit Above the Shallow Gas Screening Level
1,1,1-Trichloroethane	2	3	29-Oct-09	19-Jan-10							ug/m3	2290	22900					0
1,1,2 - Trichlorotrifluoroethane	2	3	29-Oct-09	19-Jan-10							ug/m3	13700	137000					0
1,1-Dichloroethane	2	3	29-Oct-09	19-Jan-10							ug/m3	1.56	15.6					1
1,1-Dichloroethene	2	3	29-Oct-09	19-Jan-10							ug/m3	91.4	914					0
1,2-Dichlorobenzene	2	3	29-Oct-09	19-Jan-10							ug/m3	91.4	914					0
1,2-Dichloroethane (EDC)	2	3	29-Oct-09	19-Jan-10							ug/m3	0.0962	0.962					3
1,2-Dichloropropane	2	3	29-Oct-09	19-Jan-10							ug/m3	0.25	2.5					3
1,3-Dichlorobenzene	2	3	29-Oct-09	19-Jan-10							ug/m3							
2-Butanone	2	3	29-Oct-09	19-Jan-10							ug/m3	2290	22900					0
Acetone	2	3	29-Oct-09	19-Jan-10	1	33%	29-Oct-09	23	23	23	ug/m3	14200	142000	0	0%			0
Benzene	2	3	29-Oct-09	19-Jan-10	2	67%	29-Oct-09	40	4.2	22.1	ug/m3	0.321	3.21	2	67%	29-Oct-09	1	1
Bromomethane	2	3	29-Oct-09	19-Jan-10							ug/m3	2.29	22.9					1
Carbon disulfide	2	3	29-Oct-09	19-Jan-10							ug/m3	320	3200					0
Chlorobenzene	2	3	29-Oct-09	19-Jan-10							ug/m3	22.9	229					0
Chloroethane	2	3	29-Oct-09	19-Jan-10							ug/m3	4570	45700					0
Chloroform	2	3	29-Oct-09	19-Jan-10							ug/m3	0.109	1.09					3
Chloromethane	2	3	29-Oct-09	19-Jan-10							ug/m3	41.1	411					0
cis-1,2-Dichloroethene (DCE)	2	3	29-Oct-09	19-Jan-10							ug/m3							
Dichlorodifluoromethane	2	3	29-Oct-09	19-Jan-10							ug/m3	45.7	457					0
Ethylbenzene	2	3	29-Oct-09	19-Jan-10	2	67%	19-Jan-10	14	5.4	9.7	ug/m3	457	4570	0	0%			0
m,p-Xylenes	2	3	29-Oct-09	19-Jan-10	2	67%	19-Jan-10	14	12	13	ug/m3							
Methylene chloride	2	3	29-Oct-09	19-Jan-10							ug/m3	250	2500					0
o-Xylene	2	3	29-Oct-09	19-Jan-10	2	67%	19-Jan-10	6.3	6.1	6.2	ug/m3	45.7	457	0	0%			0
Tetrachloroethene (PCE)	2	3	29-Oct-09	19-Jan-10							ug/m3	9.62	96.2					0
Toluene	2	3	29-Oct-09	19-Jan-10	3	100%	19-Jan-10	59	12	29.67	ug/m3	2290	22900	0	0%			
trans-1,2-Dichloroethene	2	3	29-Oct-09	19-Jan-10							ug/m3	27.4	274					0
Trichloroethene (TCE)	2	3	29-Oct-09	19-Jan-10							ug/m3	0.37	3.7					3
Vinyl chloride	2	3	29-Oct-09	19-Jan-10	1	33%	29-Oct-09	35	35	35	ug/m3	0.28	2.8	1	33%	29-Oct-09	1	0

¹ Shallow soil gas sampling locations include gas probes GP-58 and GP-60.

² A 10-fold dilution factor is applied to the MTCA Method B Air cleanup levels for these shallow-screened (i.e., less than 15-foot depth) sampling locations, in accordance with Ecology guidance.

DEEP SOIL GAS

Analyte	Number of Sampled Locations	Number of Samples (excluding Field Dups)	First Sample Date	Most Recent Sample Date	Number of Samples with Detected Concentrations	Detection Frequency (%)	Last Sample Date with Detected Concentration	Maximum Detected Concentration	Minimum Detected Concentration	Average Detected Concentration	Units	Air Cleanup Level (MTCA Method B)	Prelim. Deep Soil Gas Screening Levels (MTCA Method B Air x 100 Dilution)	Number of Exceedances of Preliminary Screening Level	Exceedance Frequency (%)	Date of Last Screening Level Exceedance	Number of Samples Since Last Screening Level Exceedance	Number of Non-Detects with Reporting Limit Above the Prelimiary Screening Level
1,1,1-Trichloroethane	4	7	29-Oct-09	19-Jan-10							ug/m3	2290	229000					0
1,1,2 - Trichlorotrifluoroethane	4	7	29-Oct-09	19-Jan-10							ug/m3	13700	1370000					0
1,1-Dichloroethane	4	7	29-Oct-09	19-Jan-10	5	71%	19-Jan-10	480	120	322	ug/m3	1.56	156	4	57%	19-Jan-10		0
1,1-Dichloroethene	4	7	29-Oct-09	19-Jan-10	1	14%	29-Oct-09	83	83	83	ug/m3	91.4	9140	0	0%			0
1,2-Dichlorobenzene	4	7	29-Oct-09	19-Jan-10							ug/m3	91.4	9140					0
1,2-Dichloroethane (EDC)	4	7	29-Oct-09	19-Jan-10							ug/m3	0.0962	9.62					5
1,2-Dichloropropane	4	7	29-Oct-09	19-Jan-10	1	14%	19-Jan-10	5.4	5.4	5.4	ug/m3	0.25	25	0	0%			5
1,3-Dichlorobenzene	4	7	29-Oct-09	19-Jan-10							ug/m3							
2-Butanone	4	7	29-Oct-09	19-Jan-10							ug/m3	2290	229000					0
Acetone	4	7	29-Oct-09	19-Jan-10							ug/m3	14200	1420000					0
Benzene	4	7	29-Oct-09	19-Jan-10	4	57%	19-Jan-10	1800	49	679.75	ug/m3	0.321	32.1	4	57%	19-Jan-10		1
Bromomethane	4	7	29-Oct-09	19-Jan-10							ug/m3	2.29	229					0
Carbon disulfide	4	7	29-Oct-09	19-Jan-10	2	29%	19-Jan-10	95	3.6	49.3	ug/m3	320	32000	0	0%			0
Chlorobenzene	4	7	29-Oct-09	19-Jan-10							ug/m3	22.9	2290					0
Chloroethane	4	7	29-Oct-09	19-Jan-10							ug/m3	4570	457000					0
Chloroform	4	7	29-Oct-09	19-Jan-10							ug/m3	0.109	10.9					5
Chloromethane	4	7	29-Oct-09	19-Jan-10							ug/m3	41.1	4110					0
cis-1,2-Dichloroethene (DCE)	4	7	29-Oct-09	19-Jan-10	5	71%	19-Jan-10	8600	120	2394	ug/m3							
Dichlorodifluoromethane	4	7	29-Oct-09	19-Jan-10	7	100%	19-Jan-10	1100	160	350	ug/m3	45.7	4570	0	0%			
Ethylbenzene	4	7	29-Oct-09	19-Jan-10	4	57%	19-Jan-10	27000	100	8230	ug/m3	457	45700	0	0%			0
m,p-Xylenes	4	7	29-Oct-09	19-Jan-10	5	71%	19-Jan-10	49000	6.6	11831.32	ug/m3							
Methylene chloride	4	7	29-Oct-09	19-Jan-10	4	57%	19-Jan-10	1700	44	621	ug/m3	250	25000	0	0%			0
o-Xylene	4	7	29-Oct-09	19-Jan-10	2	29%	19-Jan-10	5000	980	2990	ug/m3	45.7	4570	1	14%	19-Jan-10		0
Tetrachloroethene (PCE)	4	7	29-Oct-09	19-Jan-10	4	57%	19-Jan-10	1700	37	626.75	ug/m3	9.62	962	1	14%	19-Jan-10		0
Toluene	4	7	29-Oct-09	19-Jan-10	5	71%	19-Jan-10	15000	12	3794.2	ug/m3	2290	229000	0	0%			0
trans-1,2-Dichloroethene	4	7	29-Oct-09	19-Jan-10	4	57%	19-Jan-10	730	4.7	316.18	ug/m3	27.4	2740	0	0%			0
Trichloroethene (TCE)	4	7	29-Oct-09	19-Jan-10	2	29%	19-Jan-10	2800	940	1870	ug/m3	0.37	37	2	29%	19-Jan-10		3
Vinyl chloride	4	7	29-Oct-09	19-Jan-10	6	86%	19-Jan-10	7900	3.1	2624.68	ug/m3	0.28	28	5	71%	19-Jan-10		0

[1] Deep soil gas sampling locations include gas probes GP-55 and GP-59 and extraction wells EW-5 and EW-10.

[2] A 100-fold dilution factor is applied to the MTCA Method B Air cleanup levels for these deep-screened (i.e., greater than 15-foot depth) sampling locations, in accordance with Ecology guidance.

CAS	Analyte	Units	Ground Water, Method A, Table Value	Ground Water, Method B, Most Restrictive Standard Formula Value	WAC 246-290-310 MCLs	Minimum of ARARs	MDL
Metals							
7429-90-5	Aluminum	µg/L		**16000**		16000	2
7440-36-0	Antimony	µg/L		6.4	**6**	6	0.3
7440-38-2	Arsenic	µg/L	5	**0.058**	10	0.058	0.1
7440-39-3	Barium	µg/L		3200	**2000**	2000	0.05
7440-41-7	Beryllium	µg/L		32	**4**	4	0.1
7440-43-9	Cadmium	µg/L	**5**	8	**5**	5	0.05
7440-47-3	Chromium (Total)	µg/L	**50**		100	50	0.2
7440-48-4	Cobalt	µg/L					0.05
7440-50-8	Copper	µg/L		**320**	1300	320	0.4
7439-89-6	Iron	µg/L		11000	**300**	300	10
7439-92-1	Lead	µg/L	**15**		**15**	15	0.1
7439-96-5	Manganese	µg/L		2200	**50**	50	0.1
7439-97-6	Mercury	µg/L	**2**		**2**	2	*
22967-92-6	Methylmercury	µg/L		**1.6**	2	1.6	*
7440-02-0	Nickel	µg/L		320	**100**	100	0.1
7782-49-2	Selenium	µg/L		80	**50**	50	0.5
7440-22-4	Silver	µg/L		**80**	100	80	0.05
7440-28-0	Thallium	µg/L		**0.16**	2	0.16	0.04
7440-31-5	Tin	µg/L		**9600**		9600	*
7440-62-2	Vanadium	µg/L		**80**		80	0.075
7440-66-6	Zinc	µg/L		**4800**	5000	4800	0.5
Conventionals							
	Alkalinity (Total as CaCO3)	mg/L					1
7664-41-7	Ammonia as Nitrogen	mg/L					0.01
16887-00-6	Chloride	mg/L			**250**	250	0.05
16984-48-8	Fluoride	mg/L		**0.64**	2	0.64	0.02
	Nitrate + Nitrite	mg/L					0.01
14797-55-8	Nitrate as Nitrogen	mg/L		26	**10**	10	0.01
14797-65-0	Nitrite as Nitrogen	mg/L		1.6	**1**	1	0.01
14808-79-8	Sulfate	mg/L			**250**	250	0.1
	Total Dissolved Solids	mg/L			**500**	500	10
7440-44-0	Total Organic Carbon	mg/L					0.5
	Total Suspended Solids	mg/L					0.5
VOCs							
630-20-6	1,1,1,2-Tetrachloroethane	µg/L		**1.7**		1.7	0.2
71-55-6	1,1,1-Trichloroethane	µg/L	**200**	16000	**200**	200	0.2
79-34-5	1,1,2,2-Tetrachloroethane	µg/L		**0.22**		0.22	0.2
79-00-5	1,1,2-Trichloroethane	µg/L		**0.77**	5	0.77	0.2
75-34-3	1,1-Dichloroethane	µg/L		**7.7**		7.7	0.2
75-35-4	1,1-Dichloroethene	µg/L		400	**7**	7	0.2
96-18-4	1,2,3-Trichloropropane	µg/L		**0.0015**		0.0015	0.2
96-12-8	1,2-Dibromo-3-chloropropane	µg/L		**0.055**	0.2	0.055	0.2
106-93-4	1,2-Dibromoethane (EDB)	µg/L	**0.01**	0.022	0.05	0.01	0.2
95-50-1	1,2-Dichlorobenzene	µg/L		720	**600**	600	0.2
107-06-2	1,2-Dichloroethane (EDC)	µg/L	5	**0.48**	5	0.48	0.2
78-87-5	1,2-Dichloropropane	µg/L		**1.2**	5	1.2	0.2
542-75-6	1,3-Dichloropropene	µg/L		**0.44**		0.44	0.2
106-46-7	1,4-Dichlorobenzene	µg/L		**8.1**	75	8.1	0.2
78-93-3	2-Butanone	µg/L		**4800**		4800	2
108-10-1	4-Methyl-2-pentanone	µg/L		**640**		640	2
67-64-1	Acetone	µg/L		**7200**		7200	2
75-05-8	Acetonitrile	µg/L					5
107-02-8	Acrolein	µg/L		**4**		4	*
107-13-1	Acrylonitrile	µg/L		**0.081**		0.081	*

CAS	Analyte	Units	Ground Water, Method A, Table Value	Ground Water, Method B, Most Restrictive Standard Formula Value	WAC 246-290-310 MCLs	Minimum of ARARs	MDL
107-05-1	Allyl Chloride	µg/L		**2.1**		2.1	*
71-43-2	Benzene	µg/L	5	**0.8**	5	0.8	0.2
75-27-4	Bromodichloromethane	µg/L		**0.71**	80	0.71	0.2
75-25-2	Bromoform	µg/L		**5.5**	80	5.5	0.2
74-83-9	Bromomethane	µg/L		**11**		11	0.2
75-15-0	Carbon disulfide	µg/L		**800**		800	0.2
56-23-5	Carbon tetrachloride	µg/L		**0.62**	5	0.62	0.2
108-90-7	Chlorobenzene	µg/L		160	**100**	100	0.2
75-00-3	Chloroethane	µg/L					0.2
67-66-3	Chloroform	µg/L		**1.4**	80	1.4	0.2
74-87-3	Chloromethane	µg/L					0.2
156-59-2	cis-1,2-Dichloroethene (DCE)	µg/L		**16**	70	16	0.2
124-48-1	Dibromochloromethane	µg/L		**0.52**	80	0.52	0.2
74-95-3	Dibromomethane	µg/L		**80**		80	0.2
75-71-8	Dichlorodifluoromethane	µg/L		**1600**		1600	*
100-41-4	Ethylbenzene	µg/L	700	800	**70**	70	0.2
78-83-1	Isobutyl alcohol	µg/L		**2400**		2400	*
80-62-6	Methyl Methacrylate	µg/L		**11000**		11000	*
1634-04-4	Methyl tert-butyl ether (MTBE)	µg/L	**20**	24		20	*
75-09-2	Methylene chloride	µg/L	**5**	22	**5**	5	0.2
100-42-5	Styrene	µg/L		1600	**100**	100	0.2
127-18-4	Tetrachloroethene (PCE)	µg/L	**5**	21	**5**	5	0.2
108-88-3	Toluene	µg/L	1000	**640**	1000	640	0.2
156-60-5	trans-1,2-Dichloroethene	µg/L		160	**100**	100	0.2
79-01-6	Trichloroethene (TCE)	µg/L	5	**0.54**	5	0.54	0.2
75-69-4	Trichlorofluoromethane	µg/L		**2400**		2400	0.2
108-05-4	Vinyl acetate	µg/L		**8000**		8000	0.2
75-01-4	Vinyl chloride	µg/L	0.2	**0.029**	2	0.029	0.01
108-38-3	m-Xylene	µg/L		**1600**		1600	0.2
106-42-3	p-Xylene	µg/L		**1600**		1600	0.2
95-47-6	o-Xylene	µg/L		**1600**		1600	0.2
	Total Xylenes	µg/L	**1000**	1600	10000	1000	0.2
PCBs							
12674-11-2	Aroclor 1016	µg/L		**1.1**		1.1	*
11097-69-1	Aroclor 1254	µg/L		**0.044**		0.044	*
11096-82-5	Aroclor 1260	µg/L		**0.044**		0.044	*
1336-36-3	Total PCBs	µg/L	0.1	**0.044**	0.5	0.044	*
Chlorinated Herbicides							
93-76-5	2,4,5-T	µg/L		**160**		160	*
94-75-7	2,4-D	µg/L		160	**70**	70	*
94-82-6	2,4-DB	µg/L		**130**		130	*
75-99-0	Dalapon	µg/L		240	**200**	200	*
1918-00-9	Dicamba	µg/L		**480**		480	*
88-85-7	Dinoseb	µg/L		16	**7**	7	*
94-74-6	MCPA	µg/L		**8**		8	*
93-65-2	MCPP	µg/L		**16**		16	*
93-72-1	Silvex	µg/L		130	**50**	50	*
Pesticides							
72-54-8	4,4'-DDD	µg/L		**0.36**		0.36	*
72-55-9	4,4'-DDE	µg/L		**0.26**		0.26	*
50-29-3	4,4'-DDT	µg/L	0.3	**0.26**		0.26	*
309-00-2	Aldrin	µg/L		**0.0026**		0.0026	*
319-84-6	Alpha-BHC	µg/L		**0.014**		0.014	*
319-85-7	Beta-BHC	µg/L		**0.049**		0.049	*
57-74-9	Chlordane	µg/L		**0.25**	2	0.25	*
60-57-1	Dieldrin	µg/L		**0.0055**		0.0055	*

CAS	Analyte	Units	Ground Water, Method A, Table Value	Ground Water, Method B, Most Restrictive Standard Formula Value	WAC 246-290-310 MCLs	Minimum of ARARs	MDL
72-20-8	Endrin	µg/L		4.8	**2**	2	*
76-44-8	Heptachlor	µg/L		**0.019**	0.4	0.019	*
1024-57-3	Heptachlor Epoxide	µg/L		**0.0048**	0.2	0.0048	*
58-89-9	Lindane	µg/L	0.2	**0.08**	0.2	0.08	*
72-43-5	Methoxychlor	µg/L		80	**40**	40	*
8001-35-2	Toxaphene	µg/L		**0.08**	3	0.08	*
Dioxins/Furans							
1746-01-6	2,3,7,8-TCDD	µg/L		**0.00000067**	0.00003	0.00000067	*
19408-74-3	1,2,3,7,8,9-HxCDD	µg/L		**0.000014**		0.000014	*
Nitroaromatics/Nitroamines							
99-35-4	1,3,5-Trinitrobenzene	µg/L		**480**		480	*
118-96-7	2,4,6-Trinitrotoluene	µg/L		**2.9**		2.9	*
88-72-2	2-Nitrotoluene	µg/L		**0.2**		0.2	*
99-08-1	3-Nitrotoluene	µg/L		**0.8**		0.8	*
99-99-0	4-Nitrotoluene	µg/L		**2.7**		2.7	*
2691-41-0	HMX	µg/L		**800**		800	*
121-82-4	RDX	µg/L		**0.8**		0.8	*
479-45-8	Tetryl	µg/L		**16**		16	*
Other							
106-99-0	1,3-Butadiene	µg/L		**0.013**		0.013	*
100-44-7	alpha-Chlorotoluene	µg/L		**0.26**		0.26	*
79-11-8	Chloroacetic Acid	µg/L		**16**		16	*
75-07-0	Acetaldehyde	µg/L					*
126-99-8	Chloroprene	µg/L		**160**		160	*
115-29-7	Endosulfan	µg/L		**96**		96	*
75-21-8	Ethylene Oxide	µg/L		**0.14**		0.14	*
7782-41-4	Fluorine	µg/L		**480**		480	*
110-00-9	Furan	µg/L		**8**		8	*
74-90-8	Hydrogen Cyanide	µg/L		**4.8**		4.8	*
75-29-6	Isopropyl Chloride	µg/L					*
67-56-1	Methanol	µg/L		**16000**		16000	*
608-93-5	Pentachlorobenzene	µg/L		**13**		13	*

Notes
Shading indicates the lowest screening level.
Shading indicates the MDL is higher than the lowest screening level.
* Only included MDL value for constituents pertinent to the RI analytical program.
MCL = Maximum Contaminant Level
MDL = Method Detection Limit
CAS = Chemical Abstracts Services Registry Number
Screening criteria obtained from Washington State Department of Ecology's CLARC database.

CAS	Analyte	Surface Water, Method B, Most Restrictive Standard Formula Value (µg/L)	Surface Water ARAR - Aquatic Life - Fresh/Acute - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - Ch. 173-201A WAC (µg/L)	Minimum of ARARs (µg/L)
Metals					
7440-36-0	Antimony	**1000**			1000
7440-38-2	Arsenic	**0.098**	360	190	0.098
7440-41-7	Beryllium	**270**			270
7440-43-9	Cadmium	40	0.82	**0.37**	0.37
16065-83-1	Chromium (III)	240000	180	**57**	57
18540-29-9	Chromium (VI)	490	15	**10**	10
7440-50-8	Copper	2900	4.6	**3.5**	3.5
57-12-5	Cyanide (total)	1600	22	**5.2**	5.2
7439-89-6	Iron			**1000**	1000
7439-92-1	Lead		14	**0.54**	0.54
7439-95-4	Magnesium				
7439-95-5	Manganese				
7439-97-6	Mercury		2.1	**0.012**	0.012
7440-02-0	Nickel	1100	440	**49**	49
7782-49-2	Selenium	2700	20	**5**	5
7440-22-4	Silver	26000	**0.32**		0.32
7440-28-0	Thallium	**0.22**			0.22
7440-66-6	Zinc	17000	35	**32**	32
Conventionals					
16887-00-6	Chloride		860000	**230000**	230000
VOCs					
71-43-2	Benzene	**23**			23
100-41-4	Ethylbenzene	**6800**			6800
108-88-3	Toluene	**19000**			19000
71-55-6	1,1,1-Trichloroethane	**930000**			930000
79-34-5	1,1,2,2-Tetrachloroethane	**6.5**			6.5
79-00-5	1,1,2-Trichloroethane	**25**			25
75-35-4	1,1-Dichloroethene	**23000**			23000
95-50-1	1,2-Dichlorobenzene	**4200**			4200
107-06-2	1,2-Dichloroethane (EDC)	**59**			59
78-87-5	1,2-Dichloropropane	**44**			44
542-75-6	1,3-Dichloropropene	**34**			34
106-46-7	1,4-Dichlorobenzene	**21**			21
107-13-1	Acrylonitrile	**0.4**			0.4
75-27-4	Bromodichloromethane	**28**			28
75-25-2	Bromoform	**220**			220
74-83-9	Bromomethane	**960**			960
56-23-5	Carbon tetrachloride	**4.9**			4.9
108-90-7	Chlorobenzene	**5200**			5200
67-66-3	Chloroform	**55**			55
124-48-1	Dibromochloromethane	**20**			20
75-09-2	Methylene chloride	**3600**			3600
127-18-4	Tetrachloroethene (PCE)	**100**			100
156-60-5	trans-1,2-Dichloroethene	**32000**			32000
79-01-6	Trichloroethene (TCE)	**13**			13
75-01-4	Vinyl chloride	**3.7**			3.7
PCBs					
12674-11-2	Aroclor 1016	**0.003**			0.003
11097-69-1	Aroclor 1254	**0.0001**			0.0001
1336-36-3	Total PCBs (Sum of Aroclors)	**0.0001**	2	0.014	0.0001

CAS	Analyte	Surface Water, Method B, Most Restrictive Standard Formula Value (µg/L)	Surface Water ARAR - Aquatic Life - Fresh/Acute - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Fresh/Chronic - Ch. 173-201A WAC (µg/L)	Minimum of ARARs (µg/L)
Pesticides					
72-54-8	4,4'-DDD	**0.0005**	1.1	0.001	0.0005
72-55-9	4,4'-DDE	**0.00035**	1.1	0.001	0.00035
50-29-3	4,4'-DDT	**0.00035**	1.1	0.001	0.00035
309-00-2	Aldrin	**0.000081**	2.5	0.0019	0.000081
319-84-6	Alpha-BHC	**0.0079**			0.0079
319-85-7	Beta-BHC	**0.028**			0.028
57-74-9	Chlordane	**0.0013**	2.4	0.0043	0.0013
60-57-1	Dieldrin	**0.000086**	2.5	0.0019	0.000086
115-29-7	Endosulfan	58	0.22	**0.056**	0.056
72-20-8	Endrin	0.19	0.18	**0.0023**	0.0023
76-44-8	Heptachlor	**0.00013**	0.52	0.0038	0.00013
1024-57-3	Heptachlor Epoxide	**0.000065**			0.000065
58-89-9	Lindane	**0.045**	2	0.08	0.045
72-43-5	Methoxychlor	**8.1**			8.1
8001-35-2	Toxaphene	0.00045	0.73	**0.0002**	0.0002

Notes
Shading indicates the lowest screening level.

Group	Analyte	Groundwater	Surface Water	Landfill Gas	Soil Gas
Metals (dissolved)	Arsenic	x	x		
Metals (dissolved)	Cadmium		x		
Metals (dissolved)	Copper		x		
Metals (dissolved)	Lead	x	x		
Metals (dissolved)	Iron	x	x		
Metals (dissolved)	Manganese	x			
VOCs	Benzene	x			x
VOCs	1,1-Dichloroethane	x			x
VOCs	1,2-Dichloroethane (1,2-EDC)	x			
VOCs	cis-1,2-Dichloroethene (cis-1,2-DCE)	x			
VOCs	o-Xylene				x
VOCs	Tetrachloroethene (PCE)				x
VOCs	Trichloroethene (TCE)	x			x
VOCs	Vinyl chloride	x			x
Geochemical	Fluoride	x			
Geochemical	Total Dissolved Solids	x			
Geochemical	Methane			x	
Geochemical	Nitrite as Nitrogen	x			
Geochemical	Nitrate as Nitrogen	x			

Media	Data Gap	RI Work Plan Elements	
		Data Collection Task	Work Plan & SAP Figure References
Groundwater	Current nature and extent of impacts to the EPZ	Collect samples from select monitoring wells, piezometers, and groundwater extraction wells for analysis of Appendix I & II parameters.	Figure A3 of Appendix A.
Groundwater	Effect of groundwater extraction system on contaminant removal. Calculate mass removal. Evaluation relationship between groundwater extraction system and LFG impacts.	Collect samples from select monitoring wells, piezometers, and groundwater extraction wells for analysis of Appendix I & II parameters.	Figure A3 of Appendix A.
Groundwater	Potential for groundwater contaminants to naturally attenuate	Analyze groundwater samples for MNA parameters	Figure A3 of Appendix A.
Groundwater	Refinement of perenially saturated area boundaries in the EPZ.	Water level readings from select monitoring wells, gas probes, and groundwater and gas extraction wells.	Figure 15 and Figure A2 of Appendix A.
Landfill Gas	Reason for LFG migration in the EPZ despite gas extraction wells in the area.	Detailed review of previous east side ZOI testing to develop testing program. Well field influence testing to evaluate interactions between extraction facilities in the EPZ.	See AECOM 2014 FSAP
Landfill Gas	Effectiveness of current horizontal LFG Collectors	Install LFG probes in backfill of one horizaontal collector. Collect static pressure data (vacuum) to define vacuum dissipation and LFG collection rates. In addition install probes perpendicular to trench at varying distances to evaluate ZOI. Data could be used for design of future horizontal collectors.	See AECOM 2014 FSAP
Soil Gas	Potential for impacted groundwater and fugitive landfill gas to contribute VOCs to shallow soil as soil gas.	Collect VOC soil gas samples from select gas probes and analyze for TO-15 constituents.	Figure 15 and Figure A4 of Appendix A.
Groundwater/Landfill Gas/Leachate	Evaluate North Leachate Perimeter Collector East Branch for evidence of LFL/LFG interaction with groundwater in the NEPZ.	Analyze groundwater samples from EB-1 and EB-2 for chloride and alkalinity concentrations. Test LFG levels at the upstream end of East Branch. Perform camera inspection.	Figure E-2 of Appendix E. Figure 15 and Figure A3 of Appendix A, and AECOM 2014 FSAP
Groundwater/Landfill Gas/Leachate	Evaluate evidence of LFL indicators at EW-7	Analyze groundwater samples from EW-7 to evaluate if localized LFL is impacting this area of historically elevated chloride in groundwater.	Figure 15 and Figure A3 of Appendix A.
Leachate	Characterize raw leachate	Collect leachate samples from MH-17N and FS-3.	Figure 15 and Figure A3 of Appendix A.

Note: adapted from AECOM (2014) *Data Gap Report - Draft Final*

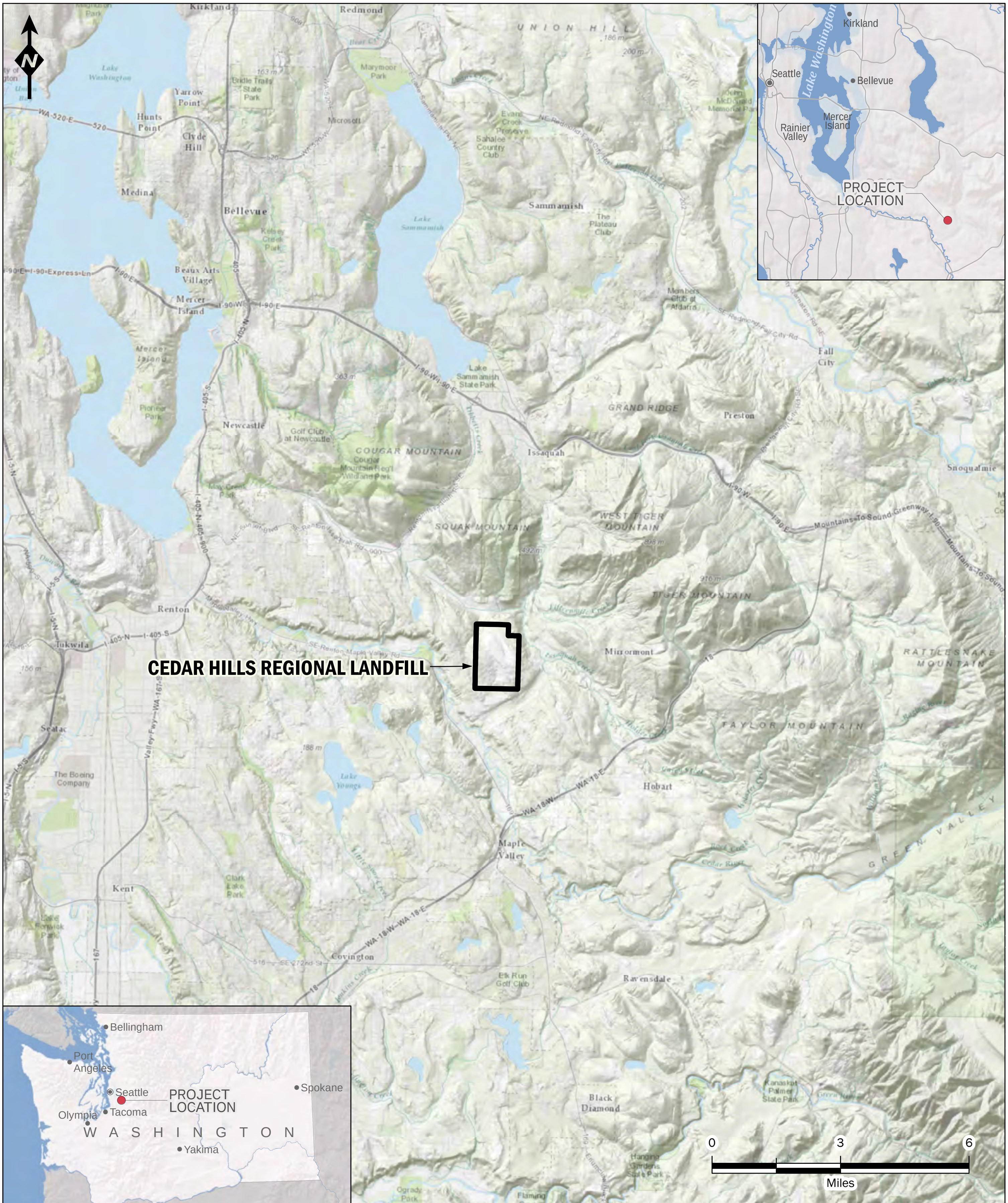
Monitoring Wells	Gas Probes		Groundwater Extraction Wells	Gas Extraction Wells
MW-29	GP-1A	***GP-13A***	EW-1	E-29D
MW-30A	GP-1B	***GP-13B***	EW-2	E-29C
MW-47	GP-2A	***GP-13C***	EW-3	E-29B
MW-48	GP-2B	***GP-13D***	EW-4	E-29A
MW-50	***GP-3***	***GP-14A***	EW-5	***E-61S***
MW-62	***GP-4A***	***GP-14B***	EW-6	***E-61D***
MW-63	***GP-4B***	GP-15A	EW-7	***E-62***
MW-102	***GP-5A***	GP-15C	EW-8	***E-63***
MW-103	***GP-5Ba***	GP-15D	EW-9	***E-64***
MW-104	***GP-5Bb***	GP-16A	EW-10	***E-65***
EB-1	***GP-5Bc***	GP-16B	EW-11	
EB-2	***GP-5Bd***	GP-16C	EW-12	
EB-3	GP-6A	GP-17	EW-13	
EB-4	GP-6B	GP-18	EW-14	
EB-5	GP-6C	GP-19	EW-15	
EB-5s	GP-6D	***GP-45S***	EW-16	
EB-6	GP-6E	***GP-45L***	EW-17	
EB-7	GP-6F	***GP45d***	EW-18	
	GP-6G	***GP-ATC-1S***	EW-19	
	GP-6H	***GP-ATC-1D***	EW-20	
	GP-7	***GP-ATC-2***	EW-21	
	GP-8	***GP-ATC-3S***	EW-22	
	GP-9	***GP-ATC-3D***	EW-23	
	GP-11A	***GP-ATC-4***	EW-24	
	GP-11B	***GP-ATC-5S***	EW-25	
	GP-11C	***GP-ATC-5D***	EW-26	
	GP-11D	GP-ATC-6S	EW-27	
	GP-12A	GP-ATC-6D	EW-28	
	GP-12B	GP-ATC-7	EW-29	
	GP-12C	GP-ATC-8S		
	GP-12D	GP-ATC-8D		

Bold italics indicate secondary water level location.

Location ID	PDB Sample	RPP Sample	Conventional Low Flow or Grab Sample	Soil Gas Samples
Groundwater				
MW-62	X	X	X	
MW-30A	X	X	X	
MW-47	X	X	X	
MW-50			X	
MW-102	X		X	X
MW-103	X		X	
MW-104	X		X	X
EB-1			X	
EB-2			X	
EB-6	X	X	X	D
EW-2			X	
EW-6			X	
EW-7			X	
EW-8			X	
EW-9			†	
EW-10			†	
EW-11			†	
EW-12			†	
EW-13			†	
EW-14			X	
EW-15			X	
EW-16			X	
EW-17			X	
EW-18			X	
EW-19			X	
EW-20	X	X	X	
EW-21			X	
EW-23			X	
EW-24			X	
EW-25	X	X	X	
EW-26			X	
EW-27			X	
EW-29			X	
Surface Water				
SW-E1			X	
Leachate				
MH-17N & FS-3			X	
Soil Gas				
GP-8				X
GP-15				S & M1, M2, or D
GP-16				S & M or D
GP-17				S & M or D
GP-18				S & M or D
GP-19				S & M or D
GP-20				S & M or D
GP-56				S
GP-58				S
GP-60				S
GP-62				S
GP-ATC-5				D
GP-ATC-7				D
Analytes:	Appendix I VOCs	Appendix II Metals	Appendix I & II Constituents; *MNA parameters	TO-15 VOCs

Notes:
PDB = Passive diffusion bag sampler
RPP = Rigid Porous Polyethylene sampler
Appendix I & II constituents are defined in WAC 173-351-990
MNA parameters = ethane and ethene; methane; nitrate/nitrite
* MNA parameters will only be analyzed in groundwater samples.
† Low-flow groundwater samples will only be collected if sufficient water is present.
X = Sample to be collected. Sample point has only one screened interval.
S = Sample to be collected from the shallow screened interval.
M or D = Sample to be collected from either the middle or the deep screened interval, whichever exhibits the highest methane. If no methane is detected, select the deep screened interval for sample collection.
M1, M2, or D = Sample to be collected from either one of the two middle or the deep screened interval, whichever exhibits the highest methane concentration. If no methane is detected, select the M2 intermediate screen interval (GP-15C).
D = Sample to be collected from the deep screened interval.

Figures



King County

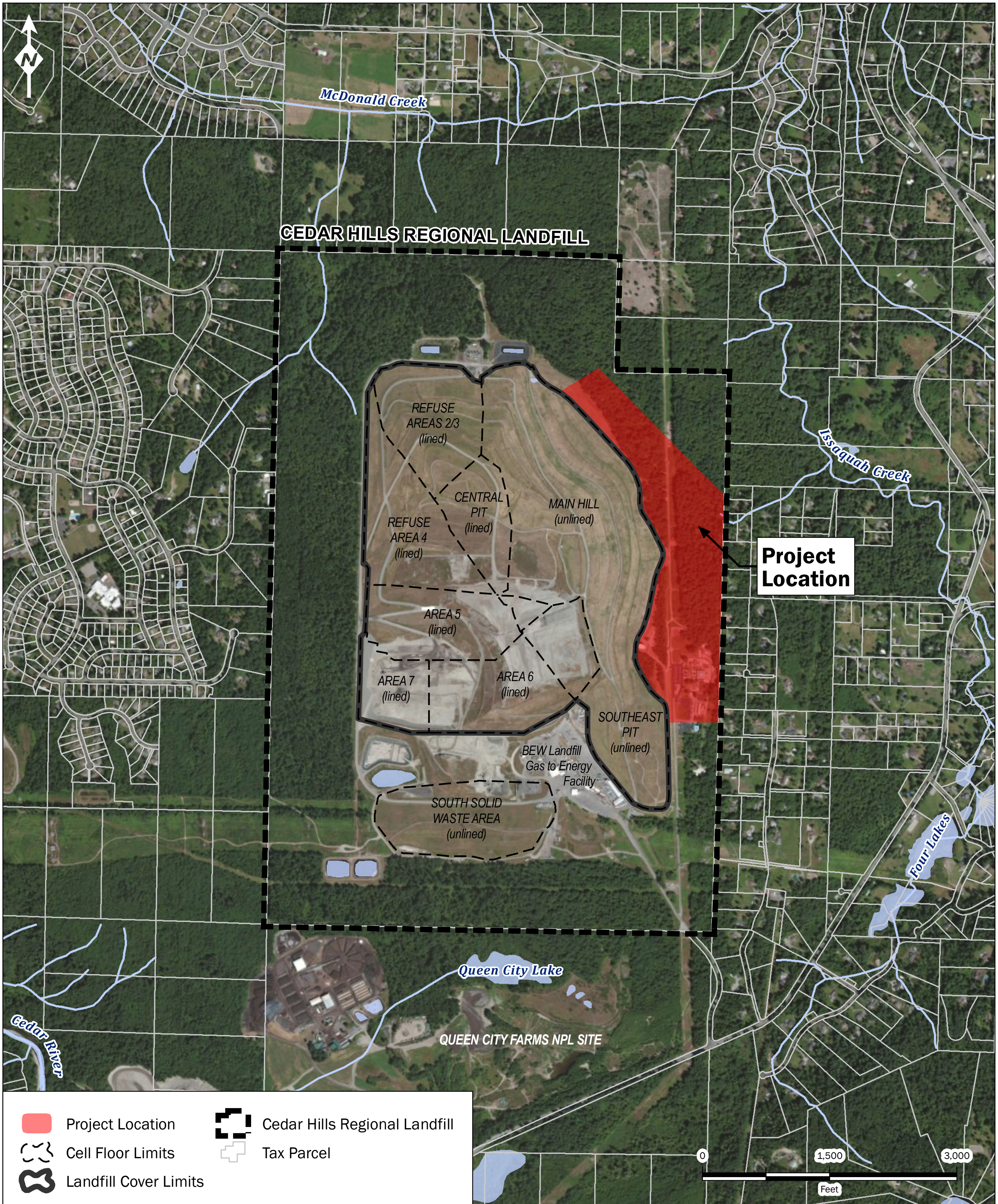
Aspect CONSULTING

Project Location Map

Cedar Hills Regional Landfill

King County, Washington

DATE: Oct-2014	PROJECT NO. 130088
DESIGNED BY: KSL/RAA	
DRAWN BY: KSL/RAA	FIGURE NO. 1
REVISED BY: - - -	



King County

Aspect CONSULTING

Cedar Hills Regional Landfill Property Features

Cedar Hills Regional Landfill

King County, Washington

DATE: Apr-2015	PROJECT NO. 130088
DESIGNED BY: KSL/RAA	
DRAWN BY: KSL/RAA	FIGURE NO. 2
REVISED BY: PPW	

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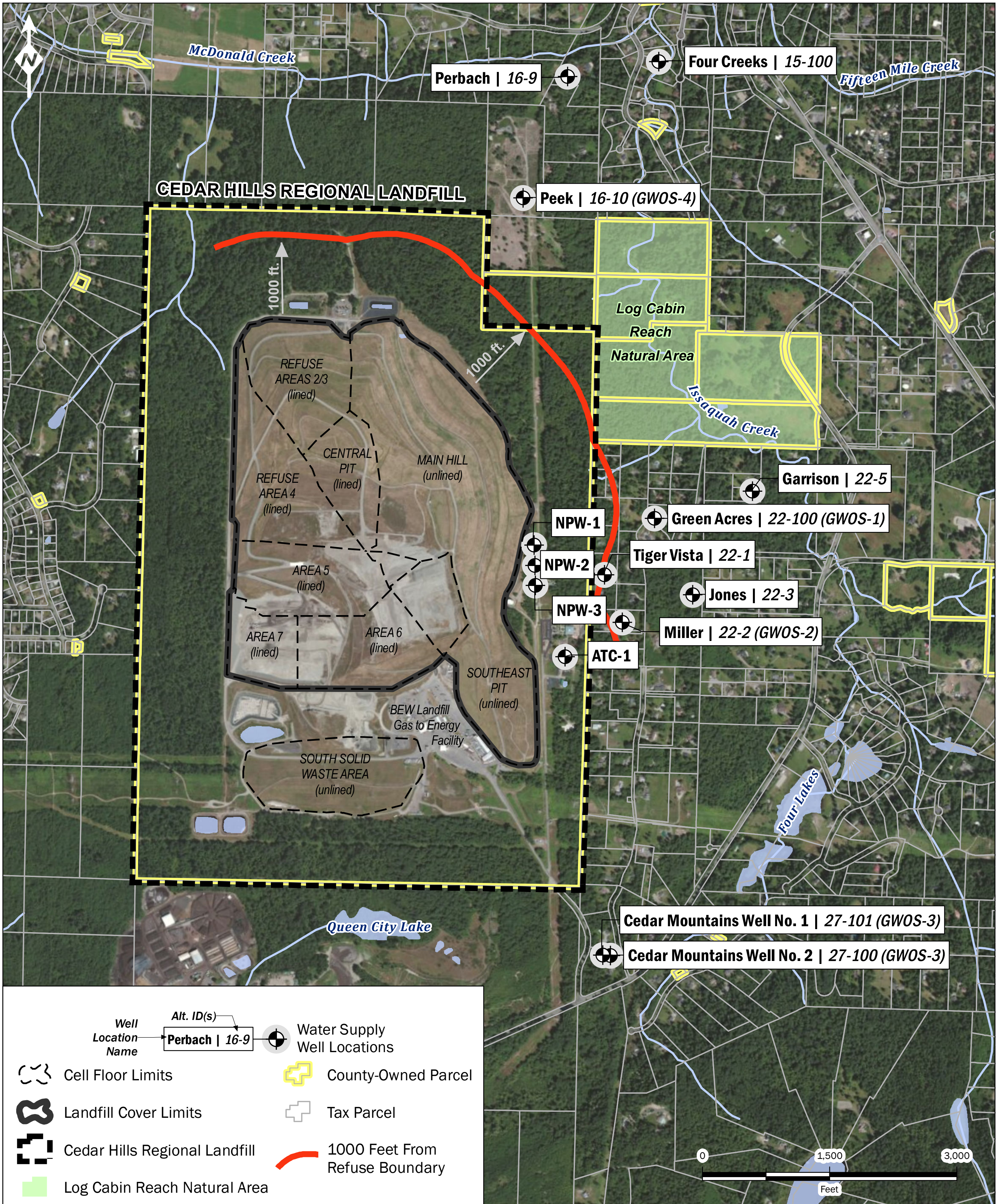

King County

Aspect CONSULTING

Water Supply Wells & King County Parcels

Cedar Hills Regional Landfill

King County, Washington

DATE: Apr-2015	PROJECT NO. 130088
DESIGNED BY: KSL/RAA	
DRAWN BY: KSL/RAA	FIGURE NO. 3
REVISED BY: PPW	

Stream 3
Stream 4
E1
E1'
E2
E2'
E3
E3'
Wetland A
Wetland B
MW-81
MW-99
MW-106
MW-85
MW-22P
MW-63
MW-67
MW-62
MW-102
MH-17N
MW-104
MW-103
MW-93
MW-47
MW-68
MW-50
MW-30A
MW-80
MW-75
MW-91
MW-29
MW-87
MW-64
MW-48
MW-54
MW-60
MW-100
PS-2
FS-3
EB-1
EB-2
EB-6
EB-7
GP-22
GP-21
GP-20
GP-19
GP-18
GP-17
GP-16
GP-15
GP-13
GP-12
GP-46
GP-47
GP-48
Perched Zone Monitoring Well
Perched Zone Piezometer
Groundwater Extraction Well
Regional Aquifer Monitoring Well
Gas Probe
Gas Extraction/Dual-Phase/Leachate Well
Staff Gage
Staff Gage with Piezometer
Surface Water Monitoring Station
Leachate Sampling Point
Borehole/Geoprobe (Decommissioned)
Non-Potable Water Well
East Shallow Perched Zone
Northeast Shallow Perched Zone
Seasonally Saturated Till/Lacustrine Unit
"?" Indicates Less Certainty in Zone Boundary
Cross Section
Streams
Approximate Extent of Wetland Area
Project Location
Landfill Cover Limits
Property Boundary
0
200
400
Feet
Aspect CONSULTING
King County
EPZ Features and Monitoring Locations
Cedar Hills Regional Landfill
King County, Washington
DATE: Dec-2014
DESIGNED BY: KSL/RAA
DRAWN BY: KSL/RAA
REVISED BY: - - -
PROJECT NO. 130088
FIGURE NO. 4

Legend

Monitoring wells and piezometers. Range in water level for period of record.

Other wells - (gas probe, extraction wells). One or more water levels measured in 2006 (or as indicated). Green box indicates length of sand packs in EW's.

Dry — No water indicated above 1.75' of the bottom of the well during 2006 measurements.

Black font indicates monitoring wells and piezometers.

SCALE:
1" = 20' (Vert)
1" = 200' (Horiz)

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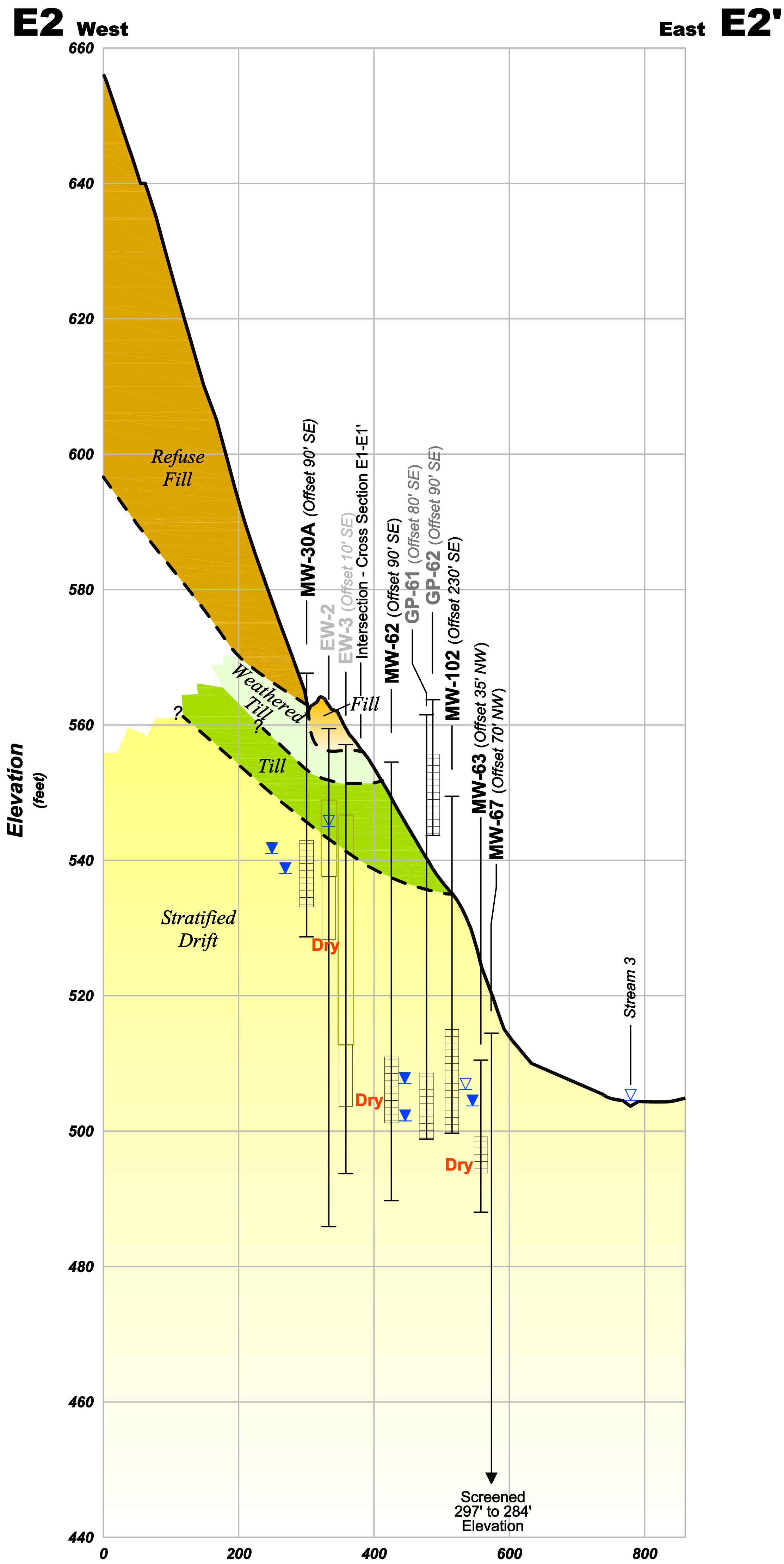
King County

Cross Section E1 - E1'

Cedar Hills Regional Landfill

King County, Washington

DATE:	OCT 2014
DESIGNED BY:	EWM/JSL
DRAWN BY:	PMB
REVISED BY:	SCC
PROJECT NO.	130088
FIGURE NO.	5a



Legend

Monitoring wells. Range in water level for period of record.

Other range wells - (gas probe, extraction wells). Water level measured in 2006 (or as indicated). Green box indicates length of sand packs in EW's.

Dry No water indicated above 1.75' of the bottom of the well during 2006 measurements. Both water level and dry indicates goes dry seasonally.

Black font indicates monitoring wells and piezometers.

SCALE:
1" = 20' (Vert)
1" = 200' (Horiz)

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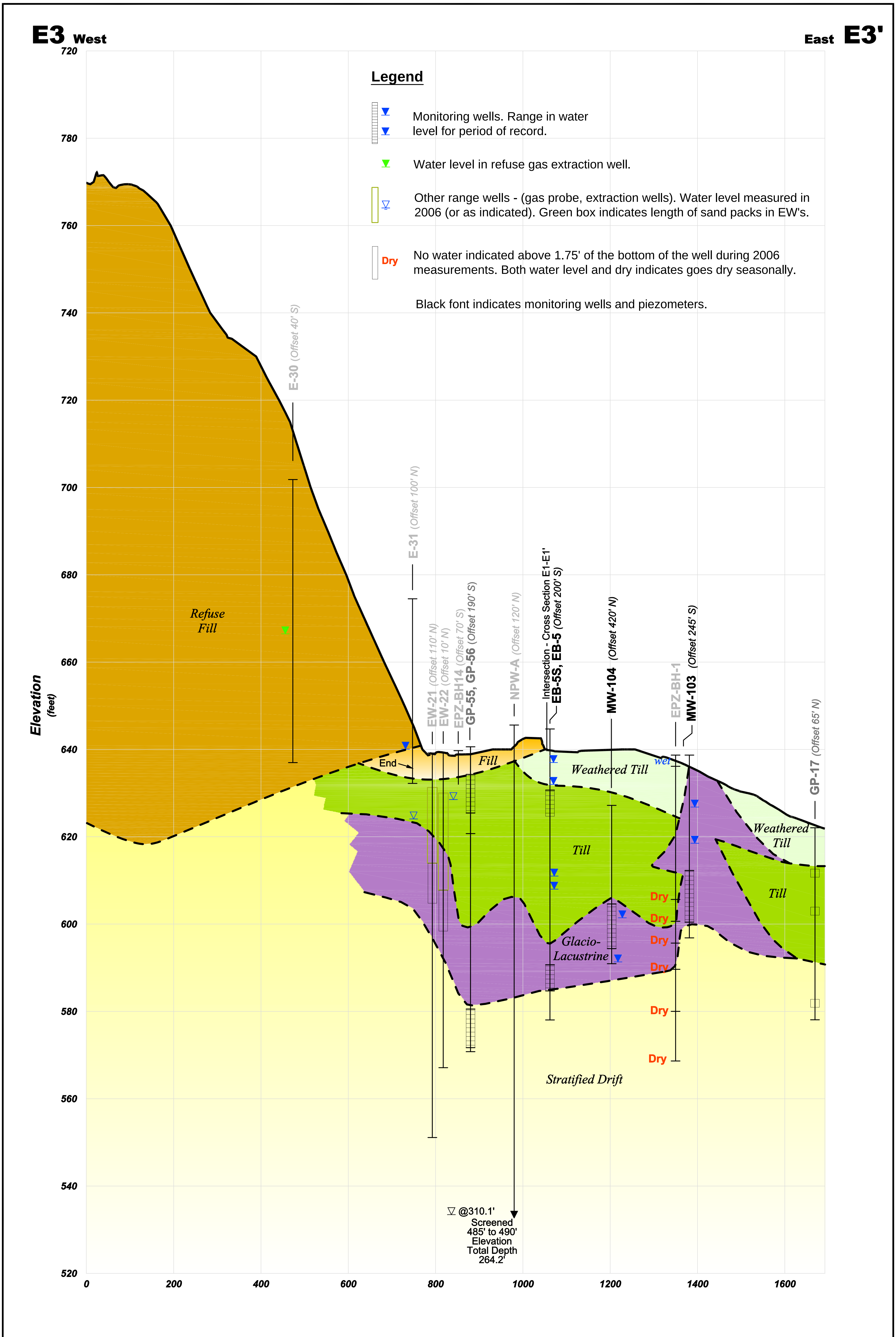
King County

Cross Section E2 - E2'

Cedar Hills Regional Landfill
King County, Washington

DATE: OCT 2014	PROJECT NO. 130088
DESIGNED BY: JTL/JSL	
DRAWN BY: PMB	FIGURE NO. 5b
REVISED BY: SCC	

CAD Path: Q:\Cedar Hills\2014-09 Cross Sections\040122-33.dwg Section EE2 (11 x 17) | | Date Saved: Oct 20, 2014 10:56am | | User: scudd



SCALE:
1" = 20' (Vert)
1" = 200' (Horiz)

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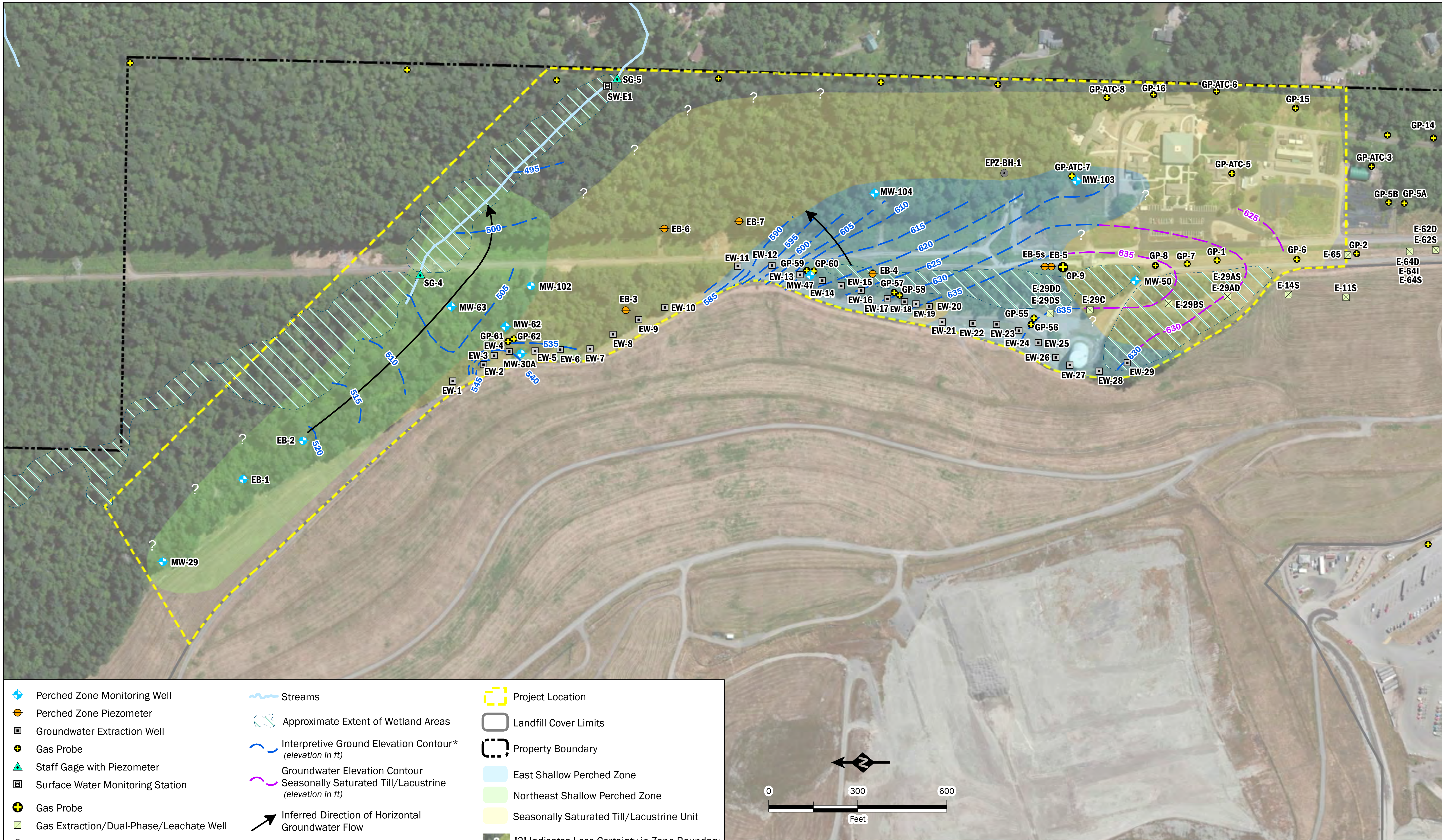
King County

Cross Section E3 - E3'

Cedar Hills Regional Landfill
King County, Washington

DATE:	OCT 2014	PROJECT NO.	130088
DESIGNED BY:	EWM/JSL		
DRAWN BY:	PMB	FIGURE NO.	5c
REVISED BY:	SCC		



Perched Zone Monitoring Well
Perched Zone Piezometer
Groundwater Extraction Well
Gas Probe
Staff Gage with Piezometer
Surface Water Monitoring Station
Gas Probe
Gas Extraction/Dual-Phase/Leachate Well
Borehole (Decommissioned)

Water level measurement points contributing to potentiometric surface interpretation are labeled.

Streams
Approximate Extent of Wetland Areas
Interpretive Ground Elevation Contour* *(elevation in ft)*
Groundwater Elevation Contour Seasonally Saturated Till/Lacustrine *(elevation in ft)*
Inferred Direction of Horizontal Groundwater Flow

Project Location
Landfill Cover Limits
Property Boundary
East Shallow Perched Zone
Northeast Shallow Perched Zone
Seasonally Saturated Till/Lacustrine Unit
"?" Indicates Less Certainty in Zone Boundary

***Note:** *Groundwater elevation contours are based on December 2006 data (when groundwater extraction wells were shutdown) and June 2009 data for MW-102, MW-103, and MW-104.*
Water levels in LFG, dual phase extraction wells, and groundwater extraction wells may not be representative of true groundwater levels.

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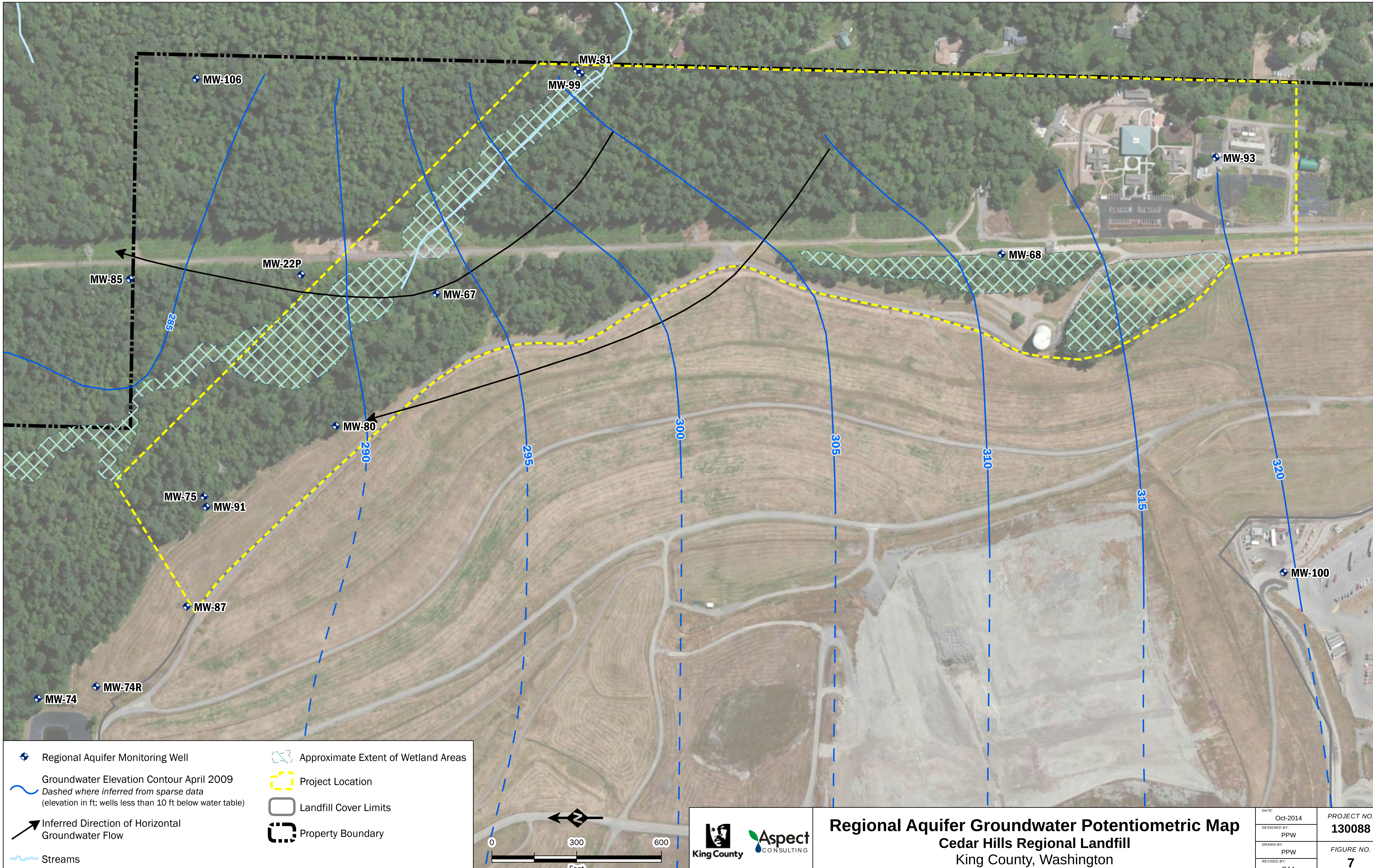
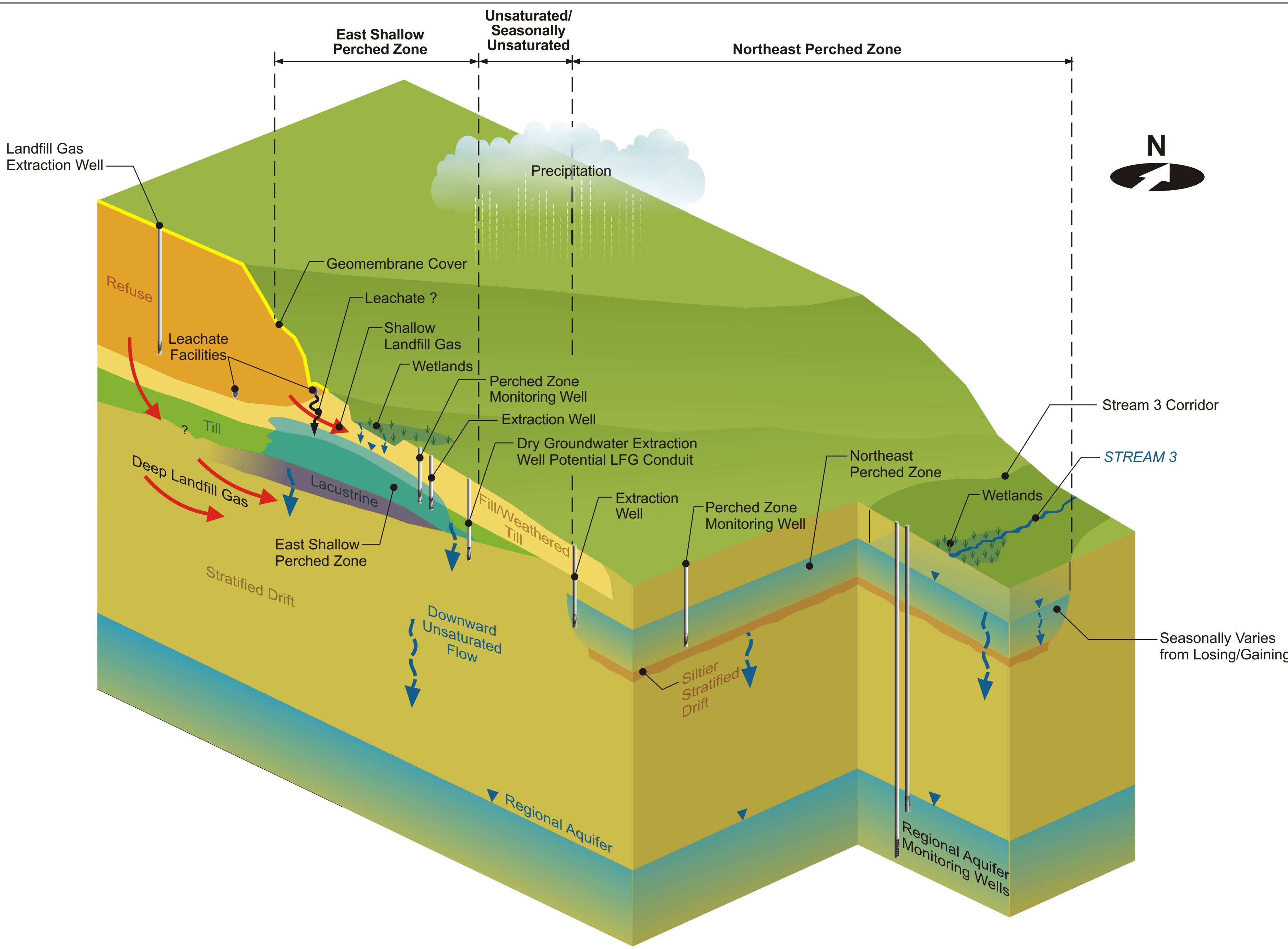
East Perched Zones Groundwater Potentiometric Map
Cedar Hills Regional Landfill
King County, Washington

DATE:	Oct-2014
DESIGNED BY:	PPW
DRAWN BY:	PPW
REVISED BY:	RAA
PROJECT NO.	130088
FIGURE NO.	6



Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



King County

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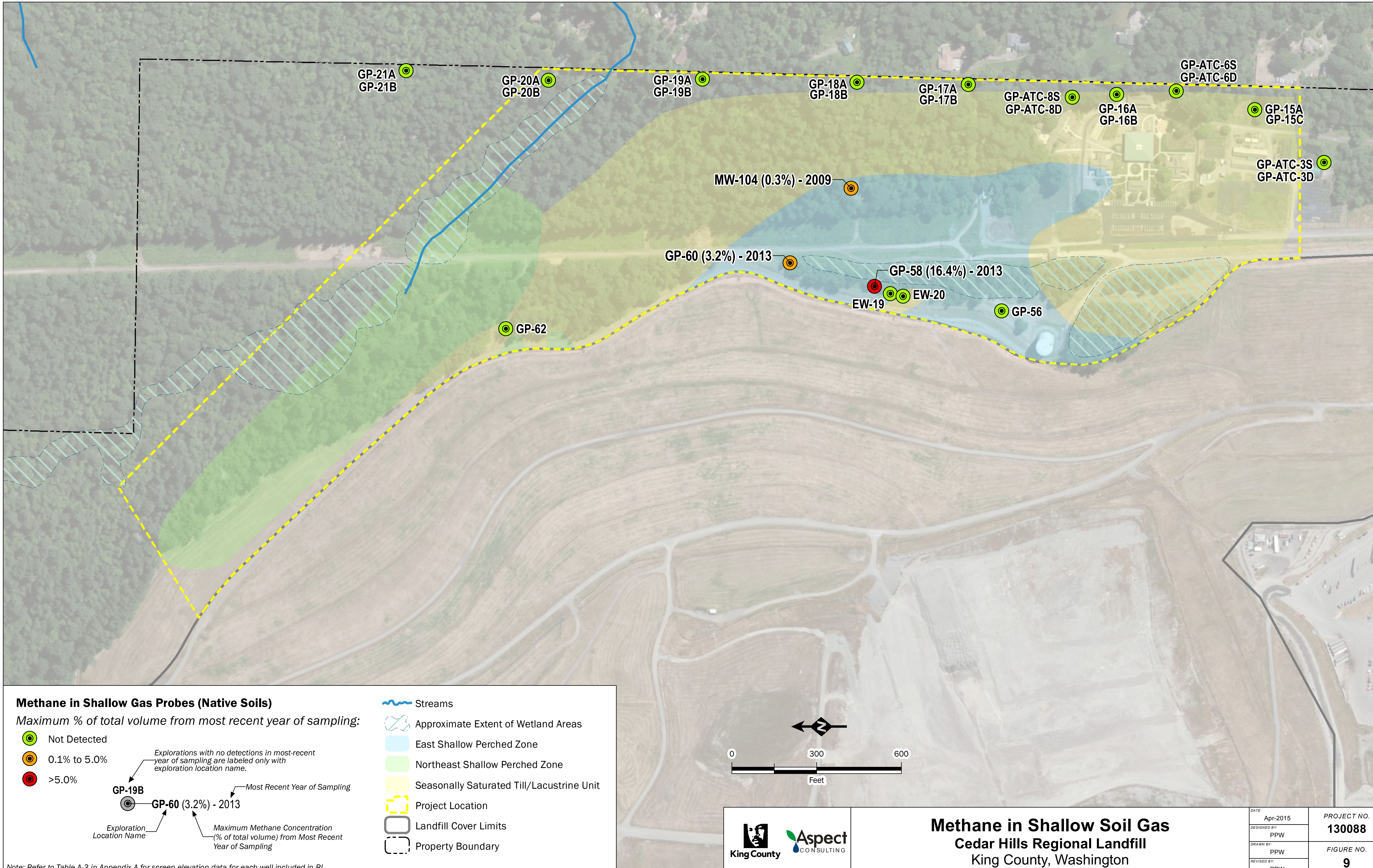
Preliminary Conceptual Site Model

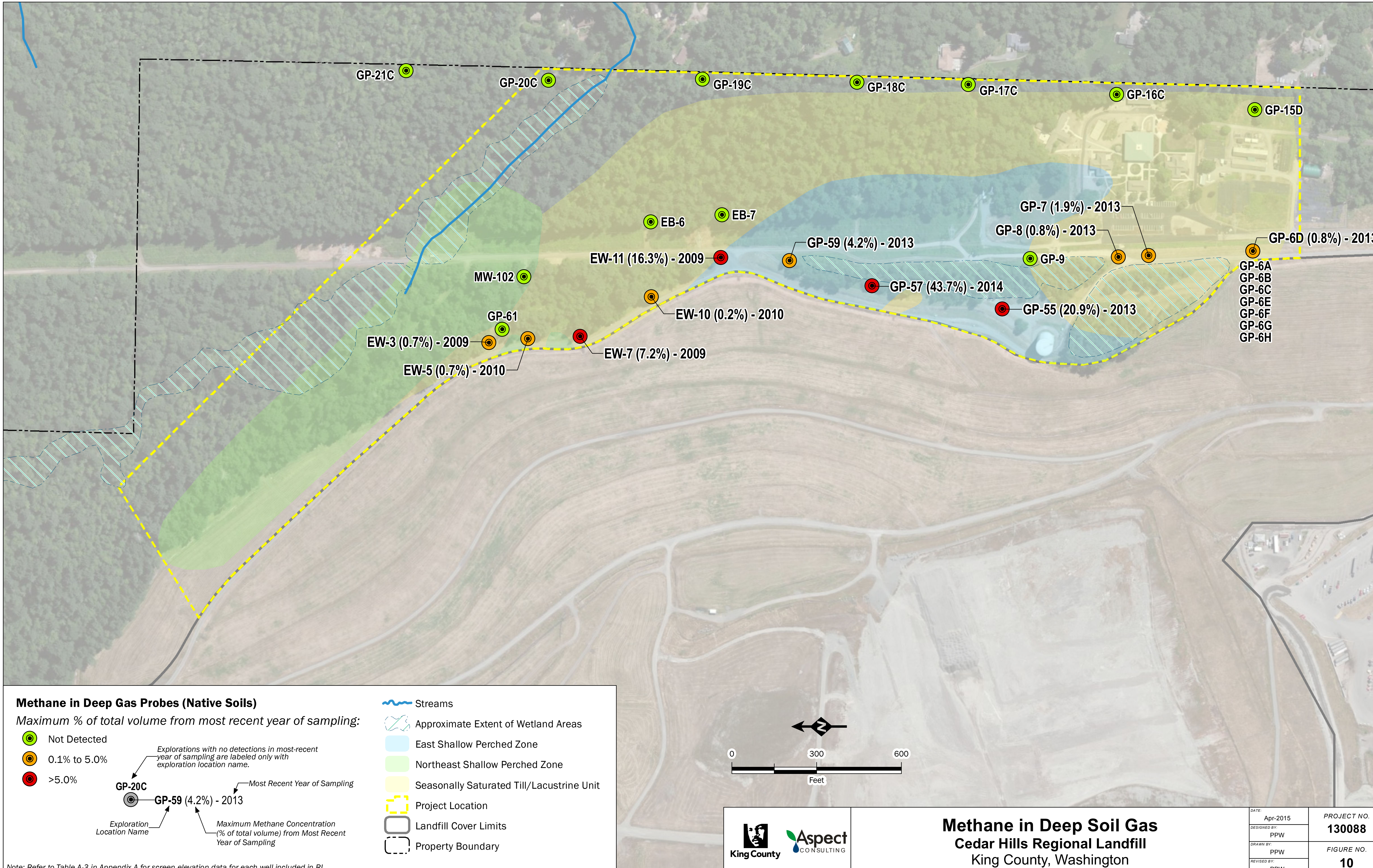
Cedar Hills Regional Landfill

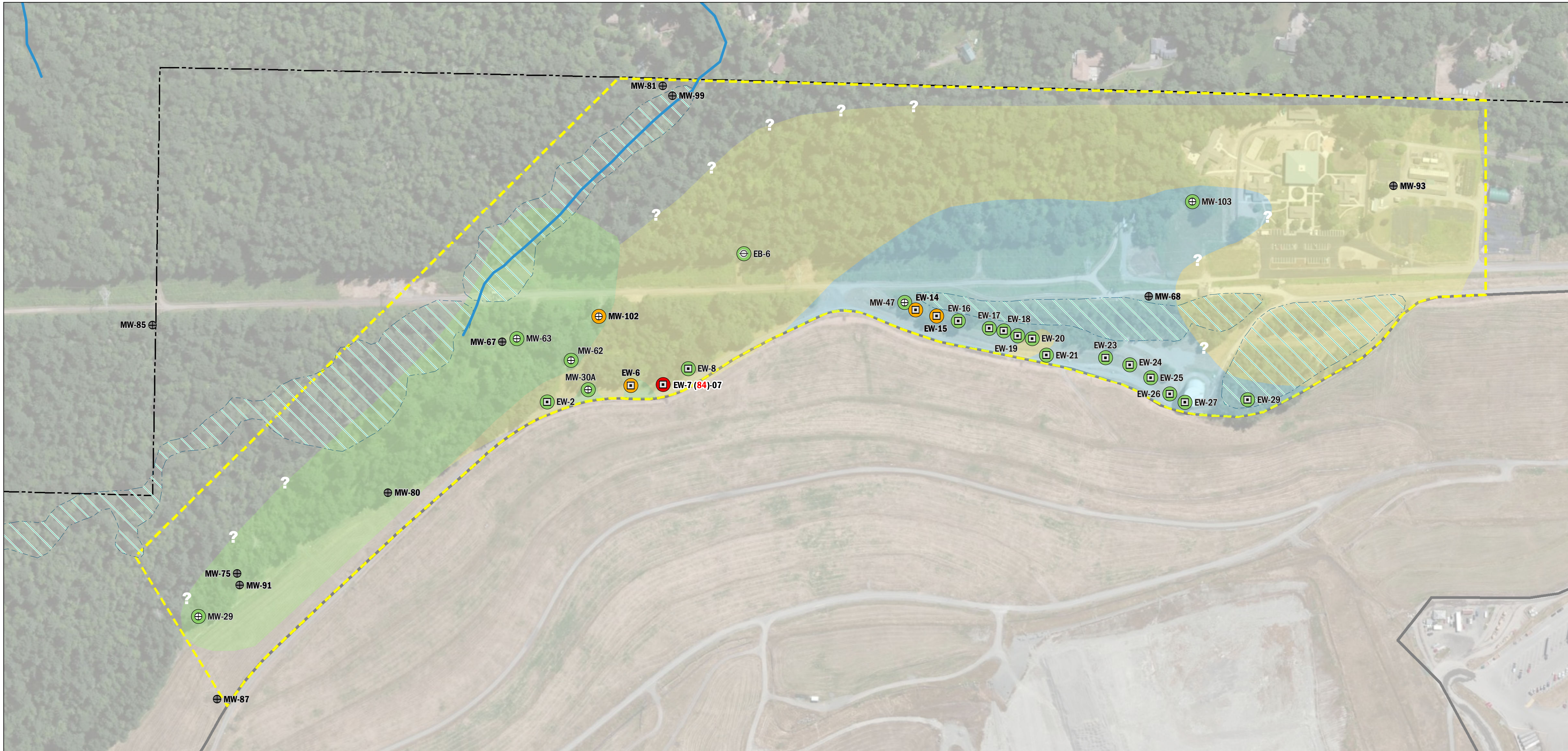
King County, Washington

DATE:	Oct-2014	PROJECT NO.	130088
DESIGNED BY:	RAA		
DRAWN BY:	RAA	FIGURE NO.	8
REVISED BY:	RAA		



Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


GP-21C
GP-20C
GP-19C
GP-18C
GP-17C
GP-16C
GP-15D
EB-6
EB-7
GP-7 (1.9%) - 2013
GP-8 (0.8%) - 2013
GP-6D (0.8%) - 2013
GP-59 (4.2%) - 2013
EW-11 (16.3%) - 2009
GP-9
GP-6A
GP-6B
GP-6C
GP-6E
GP-6F
GP-6G
GP-6H
MW-102
GP-57 (43.7%) - 2014
GP-55 (20.9%) - 2013
EW-10 (0.2%) - 2010
GP-61
EW-3 (0.7%) - 2009
EW-5 (0.7%) - 2010
EW-7 (7.2%) - 2009
Methane in Deep Gas Probes (Native Soils)
Maximum % of total volume from most recent year of sampling:
Not Detected
0.1% to 5.0%
>5.0%
Explorations with no detections in most-recent year of sampling are labeled only with exploration location name.
GP-20C
GP-59 (4.2%) - 2013
Most Recent Year of Sampling
Exploration Location Name
Maximum Methane Concentration (% of total volume) from Most Recent Year of Sampling
Note: Refer to Table A-3 in Appendix A for screen elevation data for each well included in RI
Streams
Approximate Extent of Wetland Areas
East Shallow Perched Zone
Northeast Shallow Perched Zone
Seasonally Saturated Till/Lacustrine Unit
Project Location
Landfill Cover Limits
Property Boundary
N
0
300
600
Feet
King County
Aspect CONSULTING
Methane in Deep Soil Gas
Cedar Hills Regional Landfill
King County, Washington
DATE:
Apr-2015
DESIGNED BY:
PPW
DRAWN BY:
PPW
REVISED BY:
PPW
PROJECT NO.
130088
FIGURE NO.
10



Maximum Concentration in Groundwater for Most Recent Sampling Year:

- Chloride Concentration 0 to 10 mg/L
- Chloride Concentration 10+ to 50 mg/L
- Chloride Concentration > 50 mg/L

(No wells exceed the PSL of 250 mg/L)

Exploration Type

- Groundwater Extraction Well
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well

SAMPLE LOCATIONS WITH CHLORIDE CONCENTRATION ABOVE 50 mg/L:

EW-7 (84)-07

Exploration Location

Chloride Concentration in (mg/L)

Two-Digit Sample Year

SAMPLE LOCATIONS WITH CHLORIDE CONCENTRATION LESS THAN 50 mg/L:

Exploration Location → MW-75

- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary
- East Shallow Perched Zone
- Northeast Shallow Perched Zone
- Seasonally Saturated Till/Lacustrine Unit
- "?" Indicates Less Certainty in Zone Boundary

Note: Refer to Table A-3 in Appendix A for screen elevation data for each well included in RI

King County

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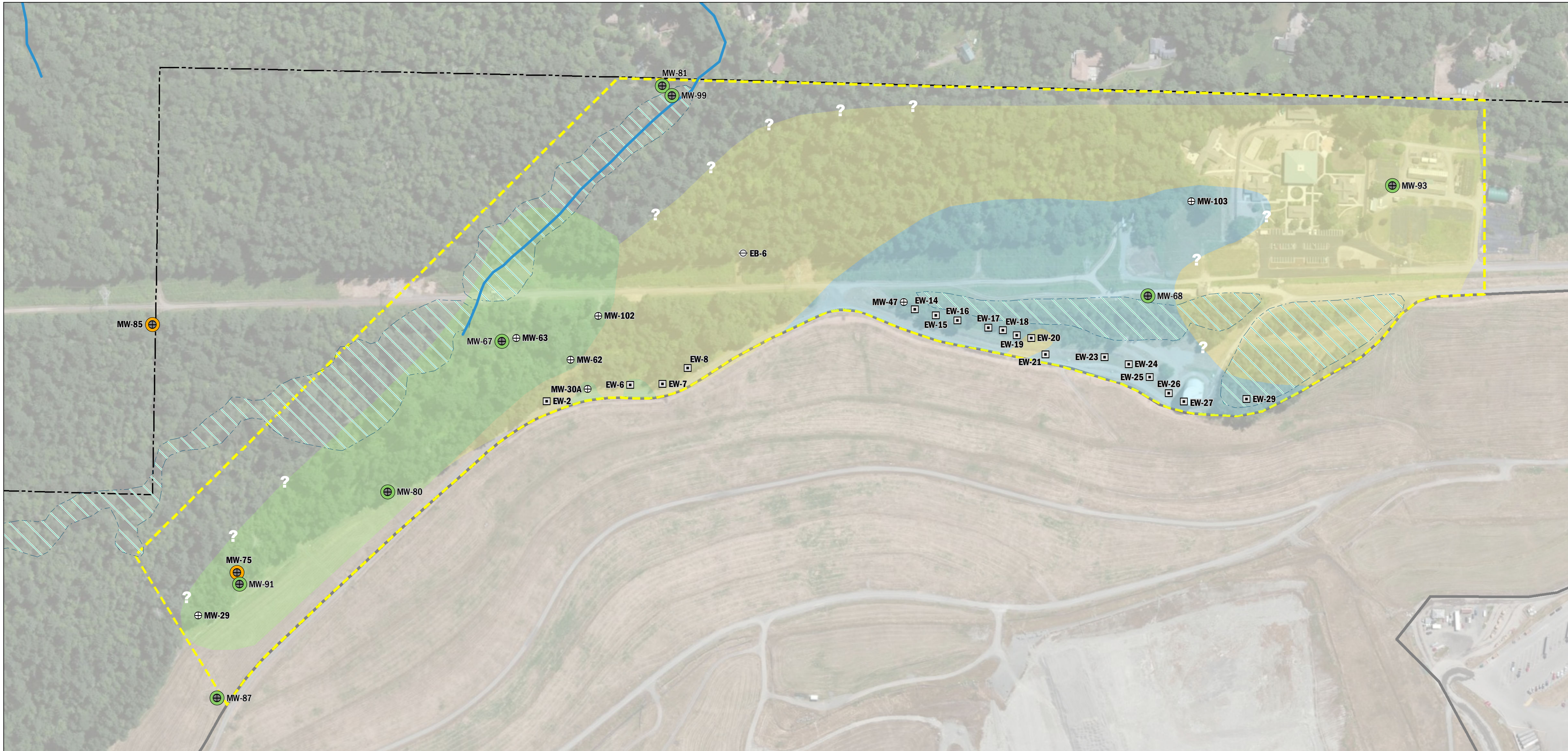
Chloride in Shallow Perched Zone Groundwater

Cedar Hills Regional Landfill

King County, Washington

DATE:	Apr-2015
DESIGNED BY:	PPW
DRAWN BY:	PPW
REVISED BY:	PPW / RAP
PROJECT NO.	130088
FIGURE NO.	11



Maximum Concentration in Groundwater for Most Recent Sampling Year:

- Chloride Concentration 0 to 10 mg/L
- Chloride Concentration 10+ to 50 mg/L

(No wells exceed the PSL of 250 mg/L)

Exploration Type

- Groundwater Extraction Well
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well

SAMPLE LOCATIONS WITH CHLORIDE CONCENTRATION ABOVE 50 mg/L:

EW-7 (84)-07

Exploration Location

Chloride Concentration in (mg/L)

Two-Digit Sample Year

SAMPLE LOCATIONS WITH CHLORIDE CONCENTRATION LESS THAN 50 mg/L:

Exploration Location MW-75

- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary
- East Shallow Perched Zone
- Northeast Shallow Perched Zone
- Seasonally Saturated Till/Lacustrine Unit
- "?" Indicates Less Certainty in Zone Boundary

Note: Refer to Table A-3 in Appendix A for screen elevation data for each well included in RI

King County

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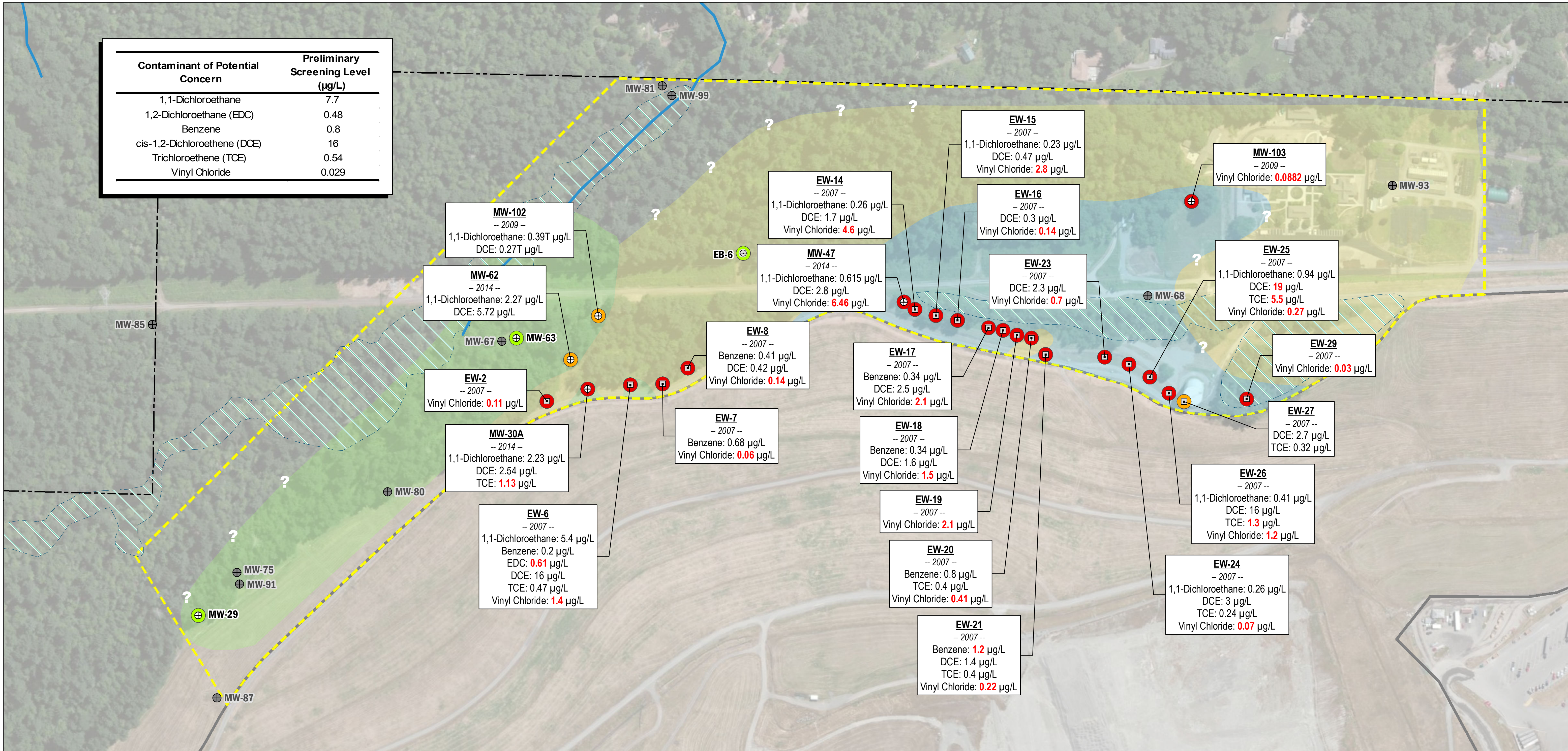
Chloride in Regional Aquifer Groundwater

Cedar Hills Regional Landfill

King County, Washington

DATE: Apr-2015	PROJECT NO. 130088
DESIGNED BY: PPW	
DRAWN BY: PPW	FIGURE NO. 12
REVISED BY: PPW	

Contaminant of Potential Concern	Preliminary Screening Level (µg/L)
1,1-Dichloroethane	7.7
1,2-Dichloroethane (EDC)	0.48
Benzene	0.8
cis-1,2-Dichloroethene (DCE)	16
Trichloroethene (TCE)	0.54
Vinyl Chloride	0.029



Volatile Organic Compounds (VOCs) in Groundwater

Contaminants of Potential Concern (COPCs): Most Recent Year of Sampling

- One or More Detected Above Preliminary Screening Level
- One or More Detected, No Preliminary Screening Level Exceedances
- No Detections

Exploration Type

- Groundwater Extraction Well
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well

Exploration Location Name
Last Year of Sampling

EW-21
-- 2007 --
Benzene: 1.2 µg/L
DCE: 1.4 µg/L
TCE: 0.4 µg/L
Vinyl Chloride: 0.22 µg/L

List of VOCs with the maximum detected concentration for each in the most-recent year of sampling.

VOCs not detected at a given sampling location in the most-recent year of sampling are not listed.
Red, bold text indicates Preminary Screening Level exceedance

- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary
- East Shallow Perched Zone
- Northeast Shallow Perched Zone
- Seasonally Saturated Till/Lacustrine Unit
- "?" Indicates Less Certainty in Zone Boundary

Note: Refer to Table A-3 in Appendix A for screen elevation data for each well included in RI

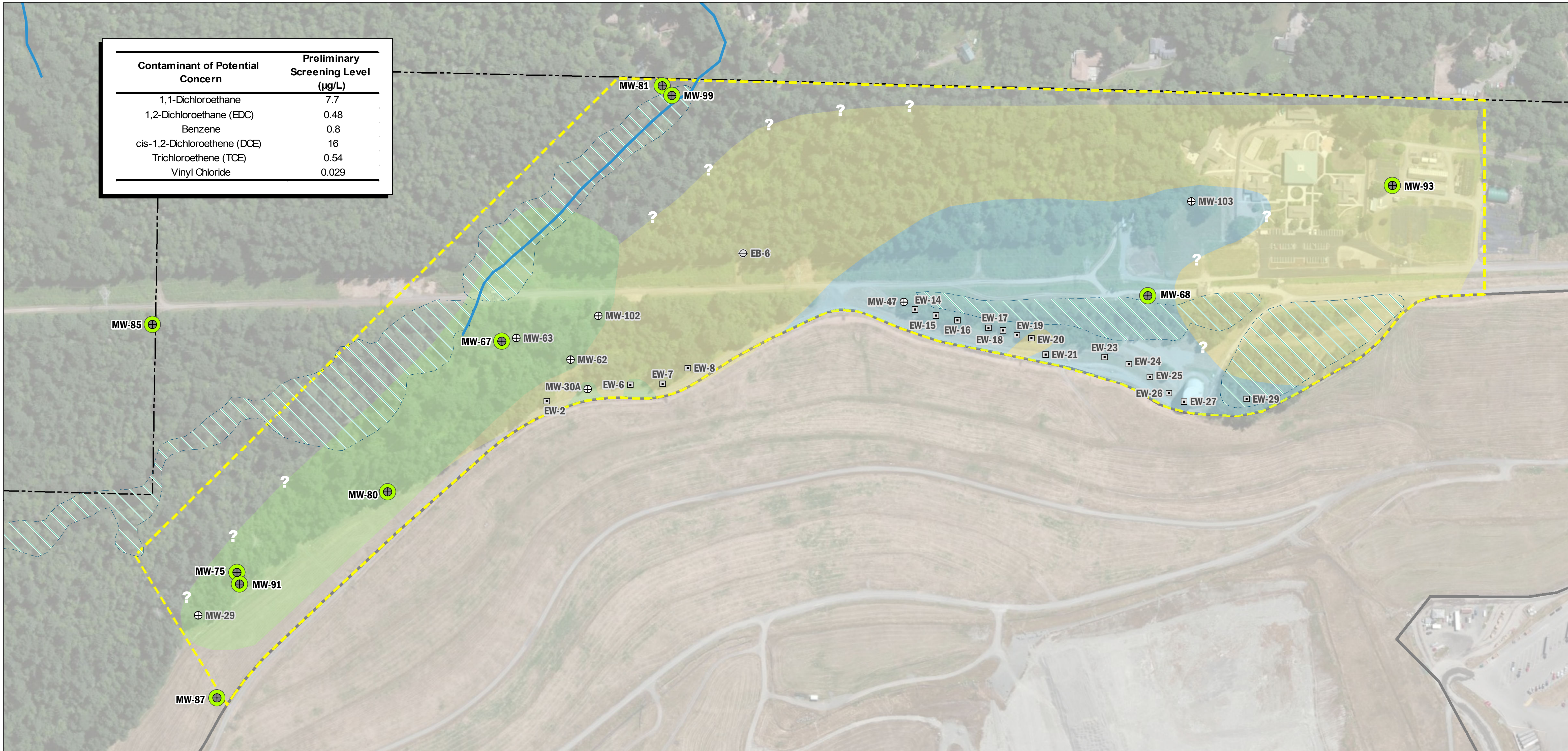
King County | Aspect CONSULTING

Extent of VOCs in Shallow Perched Zone Groundwater

Cedar Hills Regional Landfill
King County, Washington

DATE:	Apr-2015
DESIGNED BY:	PPW
DRAWN BY:	PPW
REVISED BY:	PPW
PROJECT NO.	130088
FIGURE NO.	13

Contaminant of Potential Concern	Preliminary Screening Level (µg/L)
1,1-Dichloroethane	7.7
1,2-Dichloroethane (EDC)	0.48
Benzene	0.8
cis-1,2-Dichloroethene (DCE)	16
Trichloroethene (TCE)	0.54
Vinyl Chloride	0.029



Volatile Organic Compounds (VOCs) in Groundwater

Contaminants of Potential Concern (COPCs): Most Recent Year of Sampling

- One or More Detected Above Preliminary Screening Level
- One or More Detected, No Preliminary Screening Level Exceedances
- No Detections

Exploration Type

- Groundwater Extraction Well
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well

- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary
- East Shallow Perched Zone
- Northeast Shallow Perched Zone
- Seasonally Saturated Till/Lacustrine Unit
- "?" Indicates Less Certainty in Zone Boundary

Note: Refer to Table A-3 in Appendix A for screen elevation data for each well included in RI

King County

Aspect CONSULTING

Extent of VOCs in Regional Aquifer Groundwater

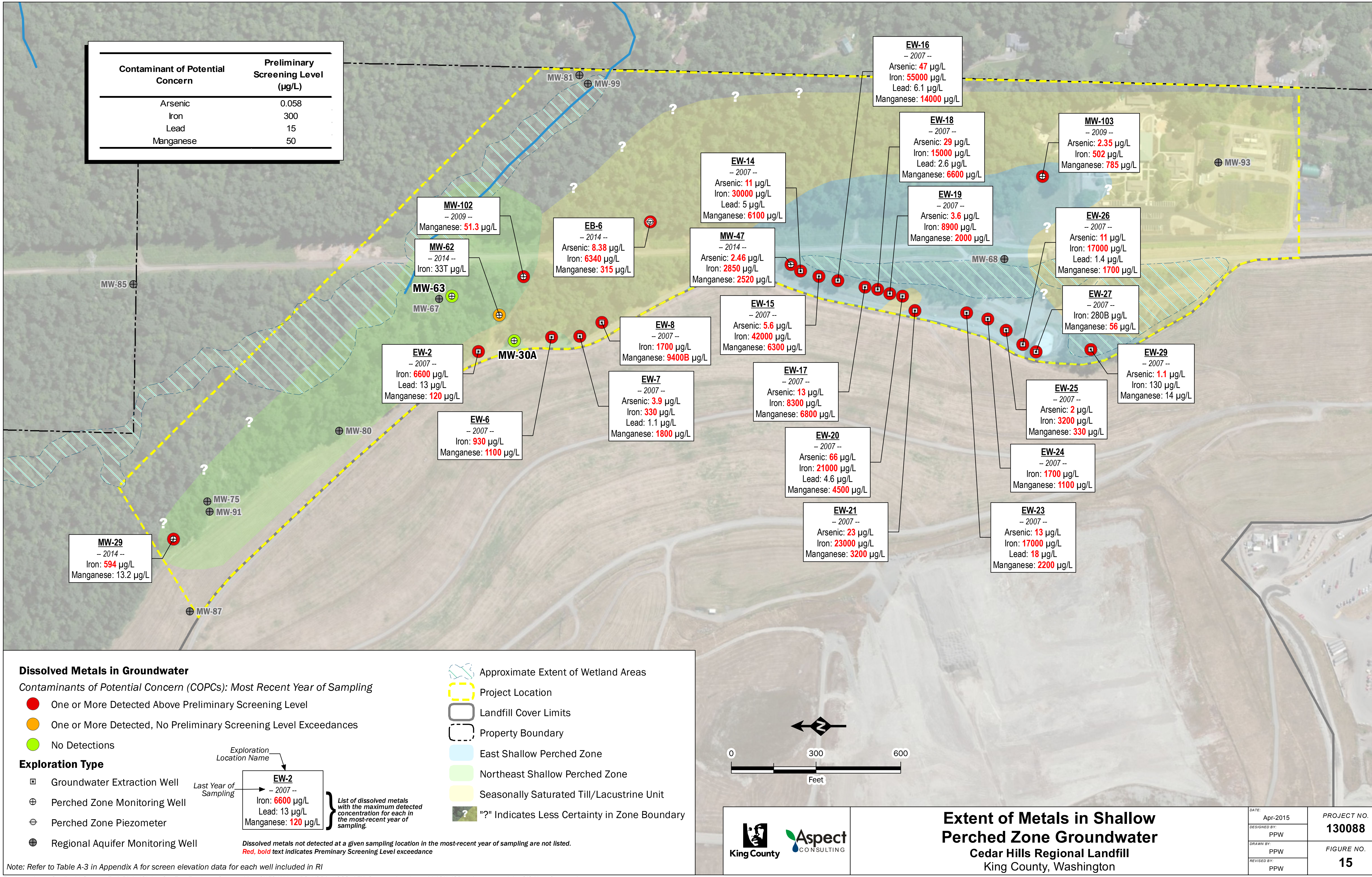
Cedar Hills Regional Landfill

King County, Washington

DATE: Apr-2015
DESIGNED BY: PPW
DRAWN BY: PPW
REVISED BY: PPW

PROJECT NO. 130088

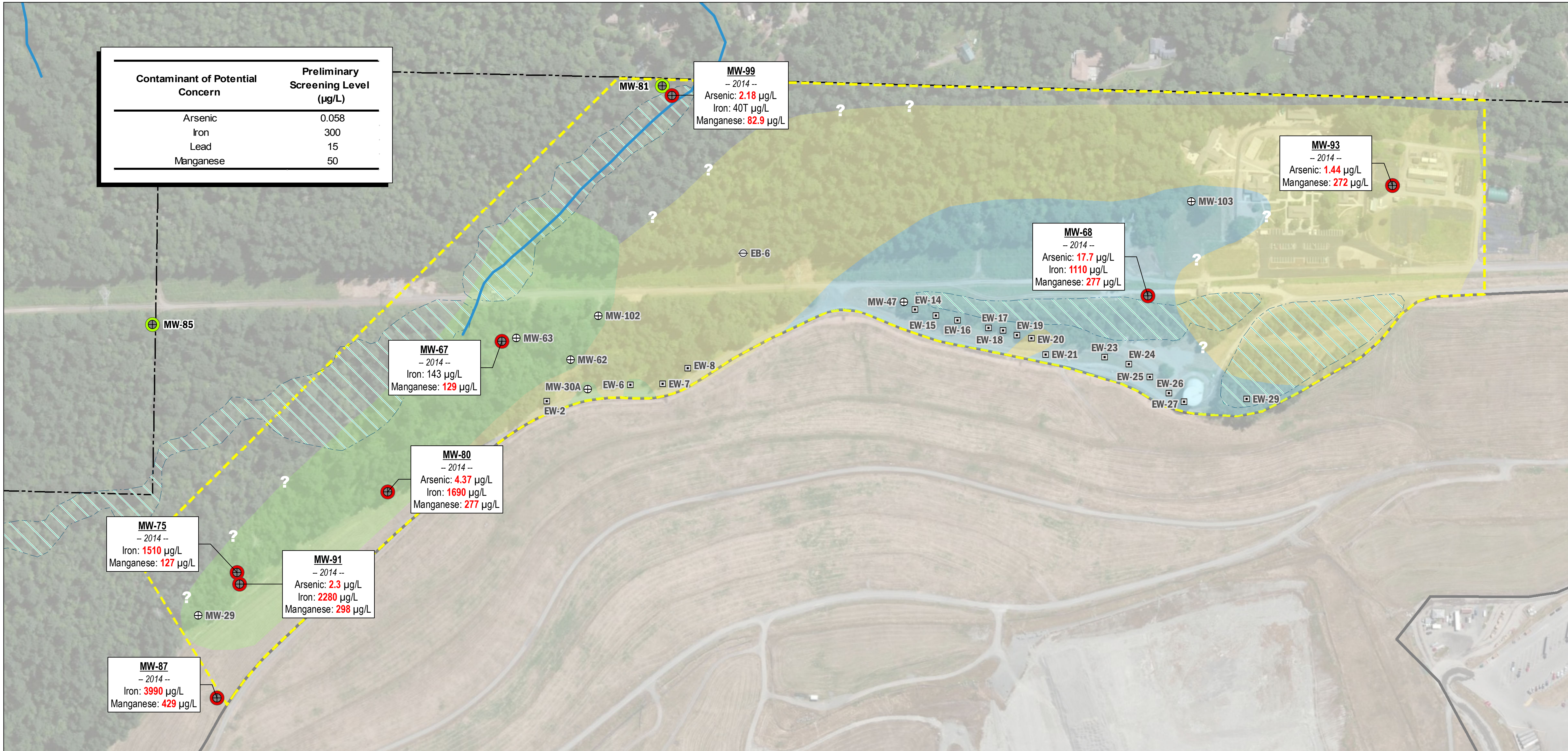
FIGURE NO. 14



Extent of Metals in Shallow Perched Zone Groundwater

Cedar Hills Regional Landfill

King County, Washington



Contaminant of Potential Concern	Preliminary Screening Level (µg/L)
Arsenic	0.058
Iron	300
Lead	15
Manganese	50

Dissolved Metals in Groundwater

Contaminants of Potential Concern (COPCs): Most Recent Year of Sampling

- One or More Detected Above Preliminary Screening Level
- One or More Detected, No Preliminary Screening Level Exceedances
- No Detections

Exploration Type

- Groundwater Extraction Well
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well

Exploration Location Name

Last Year of Sampling

MW-99
-- 2014 --
Arsenic: 2.18 µg/L
Iron: 40T µg/L
Manganese: 82.9 µg/L

List of dissolved metals with the maximum detected concentration for each in the most-recent year of sampling.

Dissolved metals not detected at a given sampling location in the most-recent year of sampling are not listed.
Red, bold text indicates Preminary Screening Level exceedance

- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary
- East Shallow Perched Zone
- Northeast Shallow Perched Zone
- Seasonally Saturated Till/Lacustrine Unit
- "?" Indicates Less Certainty in Zone Boundary

Note: Refer to Table A-3 in Appendix A for screen elevation data for each well included in RI

King County

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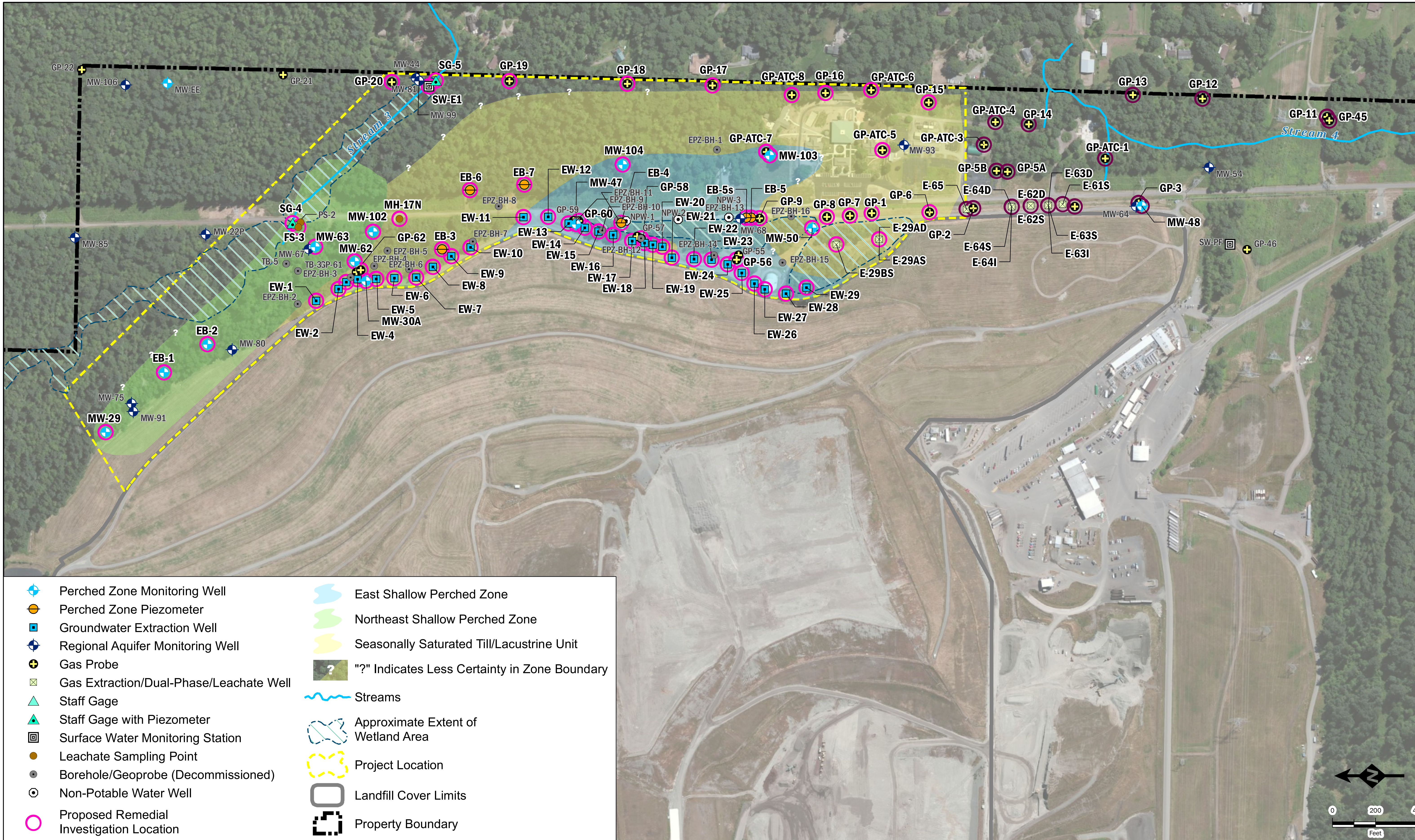
Extent of Metals in Regional Aquifer Groundwater

Cedar Hills Regional Landfill

King County, Washington

DATE:	Apr-2015
DESIGNED BY:	PPW
DRAWN BY:	PPW
REVISED BY:	PPW
PROJECT NO.	130088
FIGURE NO.	16



Perched Zone Monitoring Well
Perched Zone Piezometer
Groundwater Extraction Well
Regional Aquifer Monitoring Well
Gas Probe
Gas Extraction/Dual-Phase/Leachate Well
Staff Gage
Staff Gage with Piezometer
Surface Water Monitoring Station
Leachate Sampling Point
Borehole/Geoprobe (Decommissioned)
Non-Potable Water Well
Proposed Remedial Investigation Location
Secondary Water Level Location

East Shallow Perched Zone
Northeast Shallow Perched Zone
Seasonally Saturated Till/Lacustrine Unit
"?" Indicates Less Certainty in Zone Boundary
Streams
Approximate Extent of Wetland Area
Project Location
Landfill Cover Limits
Property Boundary

Note: *The secondary water level information will be utilized based on results of the nature and extent evaluation. Only explorations within the study area are shown.*

Aspect CONSULTING

King County

Proposed Remedial Investigation Locations

Cedar Hills Regional Landfill

King County, Washington

DATE: Apr-2015	PROJECT NO. 130088
DESIGNED BY: KSL/RAA	
DRAWN BY: KSL/RAA	FIGURE NO. 17
REVISED BY: - - -	