# FINAL SUPPLEMENTAL CLEANUP ACTION PLAN AND SCHEDULE

## EAST LANDFILL AREA OF CONCERN
## ALCOA/EVERGREEN VANCOUVER SITE

**5701 NW Lower River Road**
**Vancouver, Washington**

June 2011

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## Acronyms and Abbreviations

| | |
|---|---|
| µg/L | micrograms per liter |
| Alcoa | Alcoa, Inc. |
| AOC | area of concern |
| ARAR | applicable and relevant or appropriate requirement |
| bgs | below ground surface |
| CD | Consent Decree |
| CFR | Code of Federal Regulations |
| cm | centimeter |
| CMP | Compliance Monitoring Plan |
| cy | cubic yard |
| DCA | disproportionate cost analysis |
| Ecology | Washington State Department of Ecology |
| GC/MS | gas chromatography/mass spectrometry |
| IAWP | Interim Action Work Plan |
| MCL | maximum contaminant level |
| mg/kg | milligram per kilogram |
| MTCA | Model Toxics Control Act |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyls |
| PLP | potentially liable persons |
| POC | point of compliance |
| PQL | Practical Quantification Limit |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| RCW | Revised Code of Washington |
| RI | Remedial Investigation |
| SCAP | Supplemental Cleanup Action Plan |
| SEPA | State Environmental Policy Act |
| Site | Alcoa Inc./Evergreen Aluminum LLC Site |
| TCE | trichloroethylene |
| TZ | transition zone |
| TZW | transition zone water |
| USC | U.S. Code |
| UCL | Upper Confidence Limit |
| WAC | Washington Administrative Code |

# 1 INTRODUCTION

This Supplemental Cleanup Action Plan (SCAP) presents the cleanup action that will constitute the final remedy to address releases of trichloroethylene (TCE) or other contaminants above applicable cleanup levels from the East Landfill at the Alcoa Inc. (Alcoa)/Evergreen Aluminum LLC Site (Site) in Vancouver, Washington. The East Landfill groundwater is the last exposure pathway of concern that requires final action at the Site. Other East Landfill exposure pathways (e.g., direct contact with contaminated materials) were addressed by previous remedial actions completed in 2003/2004 per Agreed Order DE03 TCPIS-5737 between Alcoa and the Washington State Department of Ecology (Ecology).

The 2008 Cleanup Action Plan (Site-wide CAP; Ecology 2008) addressed the following four areas of concern (AOC): polychlorinated biphenyl (PCB) impacted sediments, the Crowley parcel, dike underground storage tanks, and the former soluble oil lagoon area. To date, all cleanup actions required by the Site-wide CAP have been certified complete by Ecology.

This SCAP was developed by Ecology from information presented in the *Remedial Investigation/Feasibility Study for the Alcoa/Evergreen Vancouver Site* (RI/FS; Anchor Environmental 2008), the 2008 Site-wide *Final Cleanup Action Plan and Schedule* (Ecology 2008), and the *Transition Zone Water Investigation Summary Report East Landfill Area of Concern* (TZW Report; Anchor QEA 2010). It was prepared in accordance with the requirements of the Model Toxics Control Act (MTCA), Chapter 70.105D Revised Code of Washington (RCW), administered by Ecology under the MTCA Cleanup Regulation, Chapter 173-340 Washington Administrative Code (WAC).

The SCAP was available to the public for review and comment from October 5, 2010 to December 6, 2010. At the end of the public comment period, Ecology carefully considered concerns expressed regarding the planned remedial action for the East Landfill groundwater and issued a summary and response to the comments received. The SCAP was revised in response to public comment. The final SCAP will be implemented pursuant to an amendment to Consent Decree (CD) No. 09-2-00247-2 between Ecology and Alcoa entered in Clark County Superior Court.

The final cleanup action chosen for the East Landfill AOC consists of the landfill cover to minimize the movement of contaminants from the landfill, institutional controls to control how the land and groundwater are used, and ongoing monitoring of the groundwater to ensure the landfill cover continues to function as designed. This remedy is protective of human health and the environment. Ecology considered a variety of remedies and concluded that the selected remedy provides treatment and source removal to the maximum extent practicable. A detailed description of Ecology's selected cleanup action is provided in Section 4.

## 1.1 Purpose and Scope

MTCA is the primary state law that governs the cleanup of contaminated sites. MTCA regulations define the process for the investigation and cleanup of contaminated sites. MTCA regulations specify criteria for the evaluation and conduct of a cleanup action, as well as soil and groundwater standards. The cleanup action must protect human health and the environment, meet state environmental standards and regulations in other laws that apply, and provide for monitoring to confirm compliance with Site cleanup standards. Specifically, Ecology has determined that WAC 173-303 (Dangerous Waste Regulations), WAC 173-350 (Solid Waste Handling Standards), RCW 90.48 (Water Pollution Control), and RCW 43.21C (State Environmental Policy) are applicable to the East Landfill AOC. Additionally, WAC 173-160 (Minimum Standards for Construction and Maintenance of Wells) is a relevant and appropriate regulation if new wells are required at the East Landfill AOC.

This SCAP outlines the steps and procedures for conducting the environmental cleanup of the East Landfill AOC consistent with MTCA. Consistent with the requirements of WAC 173-340-380, this document provides the following information:

- A general description of the proposed cleanup action developed in accordance with WAC 173-340-350 through -390, including any required institutional controls (Section 4)
- A summary of the types, levels, and amounts of hazardous substances remaining on a site and the measures that will be used to prevent migration and contact with those substances (Section 4)
- A preliminary determination by Ecology that the proposed cleanup action will comply with WAC 173-340-360 describing how cleanup actions are selected (Section 1.3)
- A summary for the rationale for selecting the proposed alternative and a brief summary of other cleanup action alternatives evaluated (Section 5)
- Cleanup standards for each chemical of concern and affected medium (Section 3)
- The schedule for implementation of the cleanup action plan (Section 6)
- Applicable state and federal laws (Section 3)

Pursuant to WAC 173-340-710(9) (e), Alcoa has the continuing obligation to determine whether permits, approvals, or other substantive requirements are required to implement the remedy. In the event that Ecology or Alcoa become aware of additional permits, approvals, or substantive requirements that apply to the remedial action, each party shall promptly notify the other parties of this knowledge. Ecology shall make the final determination on the application of any additional substantive requirements at the Site.

## 1.2 Applicability

The cleanup levels and actions presented in this document are site-specific and should not be considered as setting precedent for other similar sites. Potentially Liable Persons (PLPs) cleaning up sites independently, without Ecology oversight, may not cite numerical values of cleanup levels specified in this document as justification for cleanup levels in other unrelated sites. PLPs that are cleaning up other sites under Ecology oversight must base cleanup levels and cleanup standards on site-specific regulatory considerations and not on numerical values contained in this SCAP.

## 1.3 Declaration

In accordance with WAC 173-340-360(2) (a), the selected cleanup actions meet the threshold requirements, are protective of human health and the environment, comply with applicable state and federal laws, and provide for compliance monitoring. Furthermore, the selected remedy is consistent with the preference of the State of Washington as stated in RCW 70.105D.030 (1) (b) for permanent cleanup solutions.

The selected remedy for surface water and groundwater complies with cleanup standards for TCE and vinyl chloride, provides for adequate compliance monitoring and complies with state and federal laws governing cleanup activities. Groundwater at or near the East Landfill AOC is affected by the contaminants originating from the East Landfill. Water treatment technologies using groundwater pump and treat systems and reactive barriers were examined and were not practical for this Site. Groundwater natural attenuation, monitoring, source control (capping), and institutional controls are the chosen remediation strategies for the Site.

## 1.4 Administrative Record

The documents used to make the decisions discussed in this SCAP are part of the administrative record for the Site. The entire administrative record for the Site is available for public review by appointment at Ecology's Industrial Section in Lacey, Washington. To review or obtain copies of the above documents, contact Mr. Paul Skyllingstad, Ecology's Site Manager at (360) 407-6949.

# 2 SITE BACKGROUND

This section of the SCAP describes background information and Site conditions relevant to the cleanup of the East Landfill AOC. A detailed description of the Alcoa historical Site use, history, and prior cleanup actions are found in Sections 2.2 to 2.4 of the Site-wide CAP (Ecology 2008).

## 2.1 Site Location and Ownership

The Site is located on NW Lower River Road on the northern shore of the Columbia River at River Mile 103.3 in Clark County. It is approximately 3 miles northwest of downtown Vancouver, Washington, and approximately 3 miles west of Interstate 5. The operating facilities, which were demolished in 2008 and 2009, covered approximately 208 acres of industrial property. The Site is now owned by the Port of Vancouver, is used as a bulk material handling facility, and is bordered on the north by NW Lower River Road, on the east by the existing Port of Vancouver terminal, on the south by the Columbia River, and on the west by multiple industrial property owners. The current land uses in the general vicinity of the property are mixed use industrial and agricultural. The project location and surrounding area are shown in Figure 2-1.

The East Landfill is located in the southeast corner of the Site and consists of approximately 5 acres of land adjacent to the Columbia River. Figure 2-2 illustrates the location of the East Landfill AOC in relation to the Site.

## 2.2 Site Hydrogeology

The 2008 RI/FS (Anchor 2008) and TZW Report (Anchor QEA 2010) provide a detailed description of the hydrogeology of the Site, including the East Landfill area. Four upland hydrogeological zones were identified for the Site: the Shallow, Intermediate, Deep, and Aquifer.[1]

[1] This unit was previously identified as the Troutdale Formation but has subsequently been redefined by the U.S. Geological Survey as the Unconsolidated Sedimentary Aquifer. The Troutdale Formation lies below the Unconsolidated Sedimentary Aquifer (Swanson et al. 1993).

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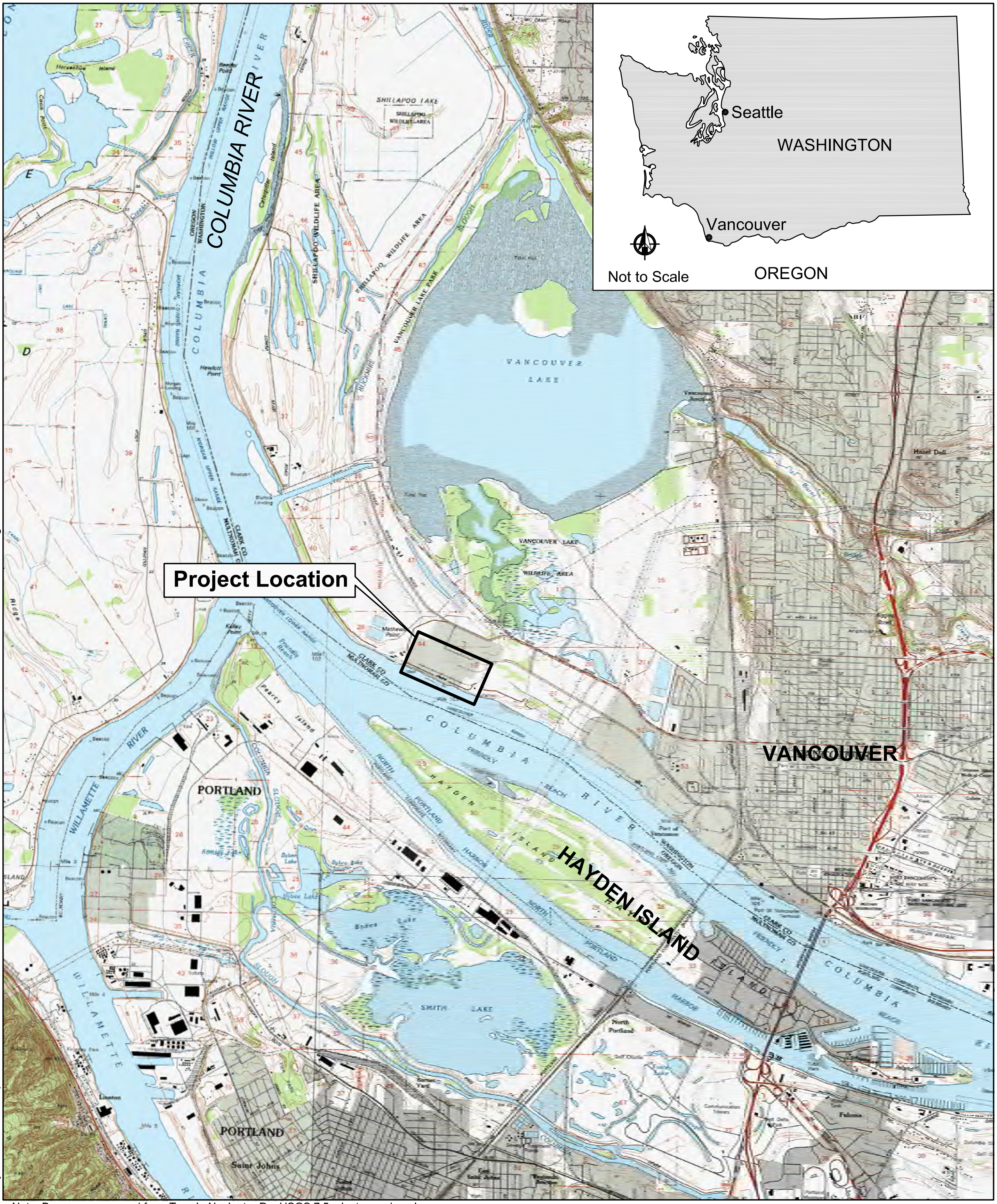


Note: Base map prepared from Terrain Navigator Pro USGS 7.5 minute quadrangle maps of Linnton, Sauvie Island, and Vancouver, Washington, and Portland, Oregon.

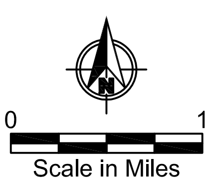


**Figure 2-1**
Vicinity Map
East Landfill AOC SCAP
Vancouver, Washington

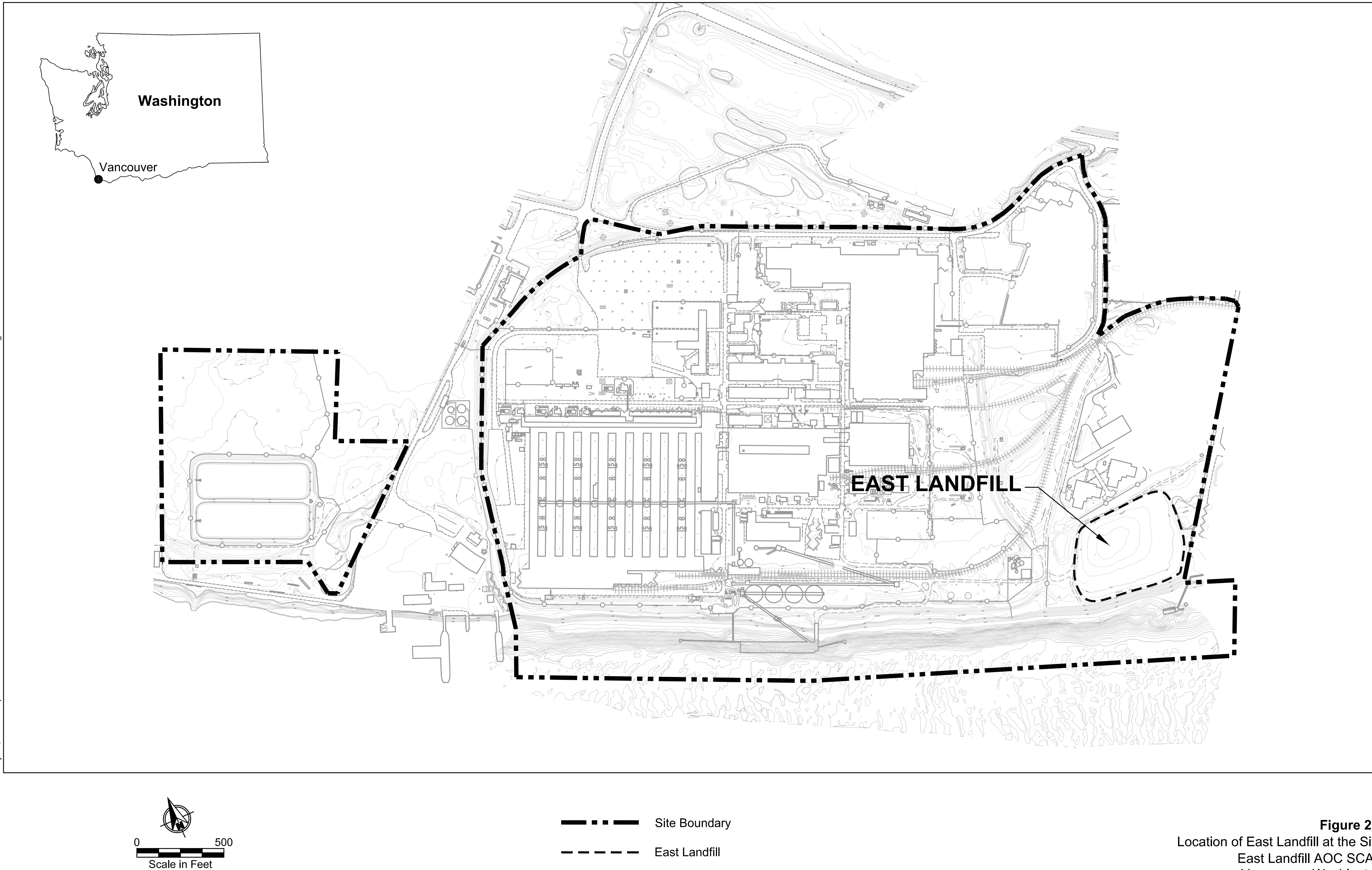


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**Figure 2-2**
Location of East Landfill at the Site
East Landfill AOC SCAP
Vancouver, Washington

The Shallow Zone consists primarily of fill and is the uppermost zone in the upland portion of the Site. The Shallow Zone is recharged primarily by infiltration of precipitation. The closed East Landfill waste material is within the Shallow Zone, as shown on the Site model on Figure 2-3. The engineered cap placed over the East Landfill waste material prevents infiltration of precipitation into the waste. Groundwater levels in monitoring wells screened in the Shallow Zone fluctuate widely from the wet season to the dry season and several of the area Shallow Zone monitoring wells dry up during late summer and fall. The Shallow Zone is not hydraulically influenced by Columbia River fluctuations. Groundwater in the Shallow Zone migrates downward into the underlying Intermediate Zone.

The Intermediate, Deep, and Aquifer Zones are alluvial sands, silts, and clays that were discussed in the 2008 RI/FS based on their hydrogeologic properties. These zones are shown on the Site model on Figure 2-3. All three zones are directly connected to the Columbia River. There are three well clusters located immediately adjacent to the East Landfill that are screened within each of the three water-bearing zones (refer to Figure 2-4). Groundwater in the Intermediate, Deep, and Aquifer Zones is recharged primarily by lateral inflow from upland off-site recharge zones, to a lesser degree by downward infiltration of groundwater from shallower zones, and to a minor extent by Columbia River water during high river tides and seasonal flooding. All three zones discharge on a net daily basis directly to the river in the vicinity of the East Landfill.

The subsurface profiles also show the River Alluvium that underlies the Columbia River riverbed. Groundwater discharges from the Intermediate, Deep, and Aquifer Zones into the river through the River Alluvium. The zone of sediment porewater located just below the mudline that is influenced both by groundwater discharging from the uplands and by river water that infiltrates into the sediments is defined as the Transition Zone (TZ). River water periodically infiltrates into the transition zone water (TZW) under the hydraulic influences caused by river tidal fluctuations and by advection induced by river currents near the mudline. TZW is generally defined as the zone where groundwater and surface water are intermixed. The depth of mixing in the TZ is not constant and fluctuates depending upon many factors, including sediment permeability, river stage, and groundwater levels.

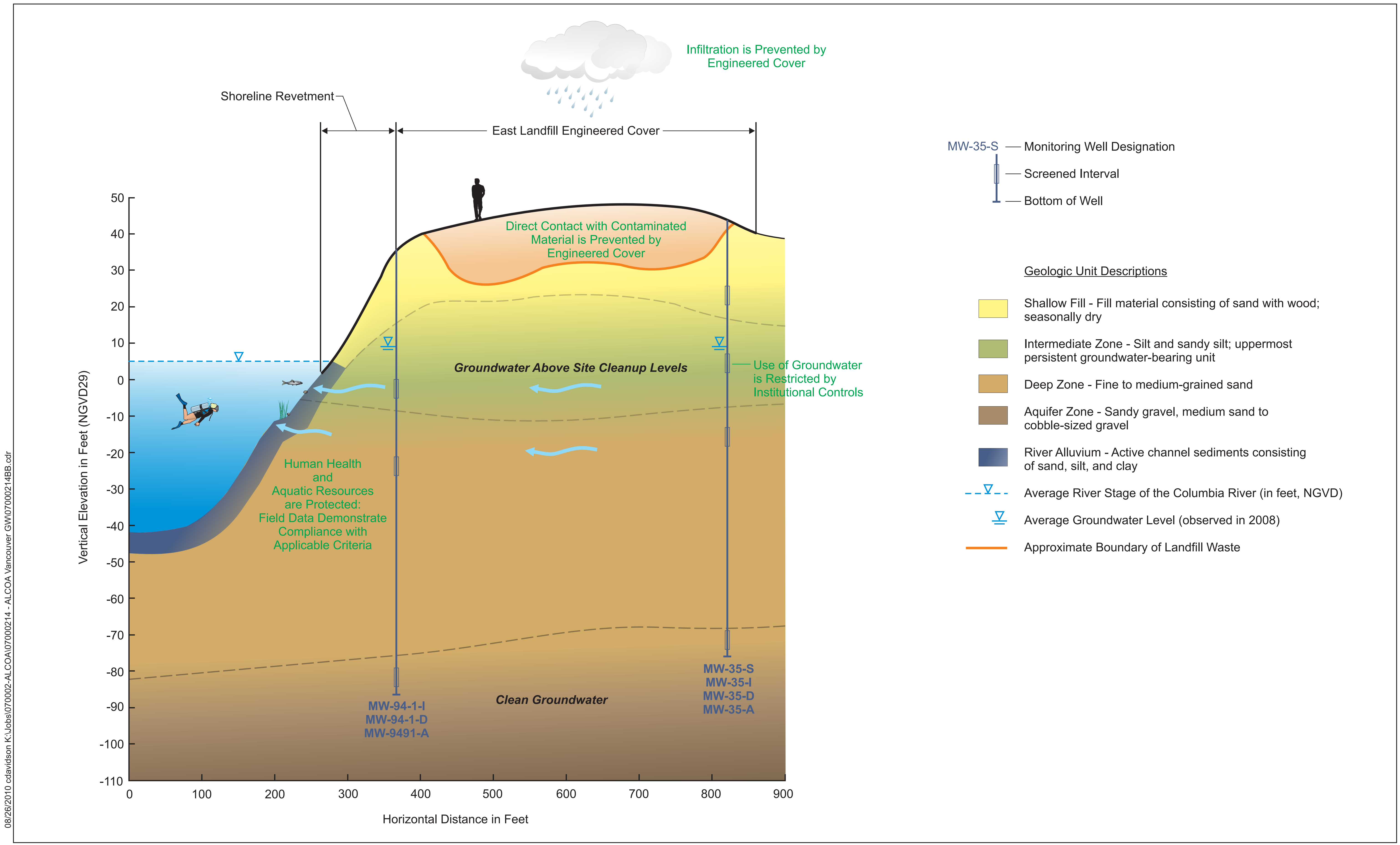


**Figure 2-3**
East Landfill Exposure Pathways and Site Controls
East Landfill Groundwater AOC CAP
Vancouver, Washington

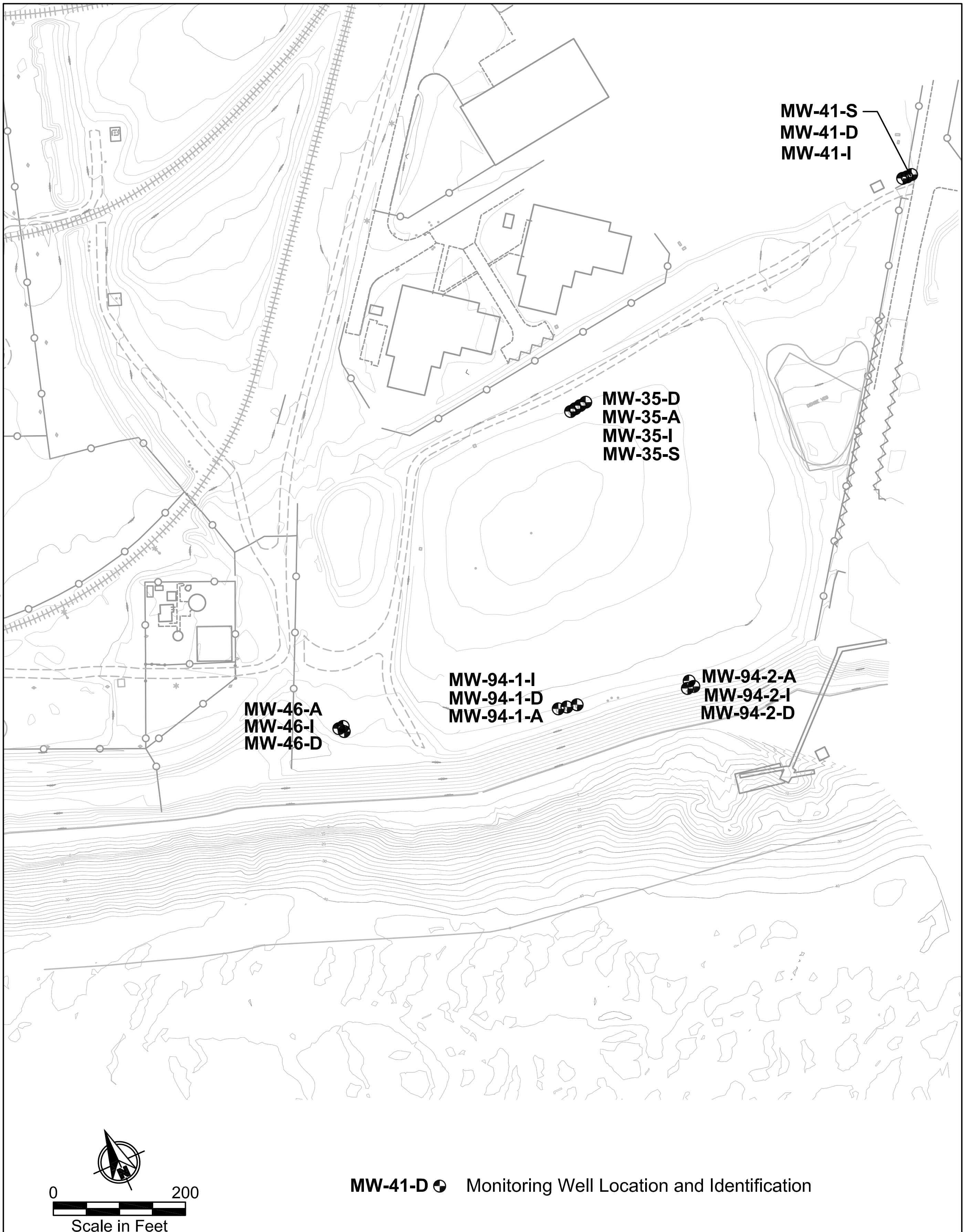


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**Figure 2-4**
East Landfill Groundwater Monitoring Network
East Landfill AOC SCAP
Vancouver, Washington

## 2.3 Nature and Extent of Contamination

During the 1940s, the area now beneath the East Landfill was filled with dredge sands from the Columbia River. During early plant operations, the East Landfill was filled with miscellaneous industrial solid waste, construction debris, steel wire, cable, metal piping, alumina, scrap aluminum, and carbon bake oven furnace brick. Investigations of the East Landfill indicated that these materials were located in the top 15 to 20 feet of the soil and had a total volume of approximately 150,000 cubic yards (cy).

In 1990, Ecology issued an Agreed Order (DE90-I053) requiring Alcoa to conduct a focused Remedial Investigation (RI) with the purpose of determining the sources of TCE in Site groundwater. Hart Crowser prepared a RI work plan (Hart Crowser 1990), which served as the scope of work required by the 1990 Agreed Order. The goal of the RI was to assess the nature and extent of TCE in soil and groundwater based on laboratory analysis of soil from test pits and groundwater samples from wells. Accordingly, Hart Crowser conducted three field investigations on behalf of Alcoa from 1991 to 1993. These investigations characterized the horizontal and vertical extent of TCE-impacted media through the installation of additional monitoring wells, excavation of test pits, advancement of borings, and collection of groundwater and soil samples.

Soil samples collected from the East Landfill indicated the presence of lead, cyanide, fluoride, PCBs, TCE (and its degradation products), and polycyclic aromatic hydrocarbons (PAHs). Groundwater samples also identified TCE (and its degradation products) and PAHs. At the time, concentrations of TCE and PAHs exceeded MTCA Method A industrial site soil cleanup levels and the MTCA Method A groundwater cleanup levels within the footprint of the landfill. The RI concluded that the East Landfill contained approximately 150,000 cy of waste materials and that an estimated 57,000 cy of this material likely exceeded the then-current MTCA industrial site soil cleanup levels for TCE (0.03 milligrams per kilogram [mg/kg]), PAHs (20 mg/kg), and PCBs (10 mg/kg) (Ecology 2003).

In 2003, Ecology issued a second Agreed Order (DE03 TCPIS-5737) and an Interim Action Work Plan (IAWP) pertaining to the East Landfill requiring Alcoa to take remedial action to consolidate and isolate waste and contaminated soil beneath an engineered cap. The 2003 Agreed Order also required Alcoa to armor the shoreline adjacent to the East Landfill to ensure the long-term stability of the riverbank and engineered cap. Work commenced on the project in late 2003 and was completed in 2004. The results of groundwater monitoring of TCE and other volatile organic compounds since the completion of source control measures at the East Landfill demonstrate the following:

- The East Landfill waste is no longer a significant source of contamination to groundwater.
- The concentrations and mass of TCE in groundwater are reduced. Residual TCE is degrading into vinyl chloride and ultimately to non-toxic chemicals.

TCE concentration in groundwater in the Intermediate Zone has dropped an estimated 88% since 2001, and several wells that previously contained TCE above the cleanup levels are now in compliance with MTCA Method A groundwater cleanup levels. Since 2008, one well interval (MW-94-1-I) exceeded the TCE Method A cleanup level. In the MW-94-1 well cluster, from 1994 to 2010, concentrations of TCE dropped from 4,200 micrograms per liter (µg/L) to below 500 µg/L in the Intermediate Zone and from 2,400 µg/L to below 5 µg/L in the Deep Zone. The monitoring data for vinyl chloride demonstrate a general downward trend in concentration; however, as vinyl chloride is a degradation product of TCE, some short-term increases in vinyl chloride concentrations occurred during the monitoring time period. Vinyl chloride levels decreased from 660 µg/L to levels below 100 µg/L in two monitoring wells that border the Site adjacent to the Columbia River. Vinyl chloride concentrations are expected to fluctuate throughout the degradation process.

To characterize groundwater as it flows from the East Landfill toward the riverbed, Alcoa initiated a TZW investigation in December of 2008. TZW is defined as the sediment porewater just below the mudline that is influenced both by groundwater discharging from the uplands and by river water that infiltrates into the sediments. The field investigation was initiated in December 2008 and was completed in January 2009.

The study consisted of a series of field measurements to characterize the groundwater discharge zone adjacent to the East Landfill and to subsequently measure concentrations of TCE and its degradation products in porewater and surface water. The goal of the study was to collect data to determine if various surface water criteria are exceeded at points along the groundwater to surface water pathway. The results indicated that sediment porewater concentrations were below chronic surface water criteria for protection of aquatic organisms, but further monitoring is necessary to determine if surface water concentrations at the ground water/surface water interface are below the most restrictive surface water criteria protective of human health. Details of the study are presented in the TZW Report (Anchor QEA 2010).

The 2008-2009 TWZ investigation included the following activities:

- Collection of real time water levels in groundwater and the Columbia River.
- Determination of groundwater discharge rates adjacent to the East Landfill.
- Collection of discrete groundwater samples using Trident probes in the sediments at discharge zones along the East Landfill Columbia River boundary.
- Collection of groundwater using passive samplers called peepers at three discharge zones.
- Collection of sediment samples at the discharge zone locations.
- Collection of surface water samples in the Columbia River.

The water and sediment samples were analyzed for TCE and vinyl chloride. A Trident probe sampler was used to determine temperature and conductivity at 33 stations across the Site.

Additional Trident probe samplers were used at ten sample stations to collect samples at 14 inches below the mudline in areas of groundwater discharge. Three passive peeper samplers were also placed in areas of groundwater discharge for a period of 30 days.

The Trident probe samples provided an indication of groundwater conditions at 14 inches below the mudline at the time of the sample event. The samples showed levels of TCE and vinyl chloride ranging from non-detect to 110 µg/L and from 0.07 to 400 µg/L, respectively. Peeper samples were collected at 0 to 5 inches and 5 to 10 inches below the mudline. The peeper samples showed that TCE levels in groundwater over 30-day equilibrium conditions were non-detect and vinyl chloride levels ranged from non-detect to 0.26 µg/L at 0 to 5 inches below the mudline and from non-detect to 12 µg/L at 5 to10 inches below the mudline. Surface water sampling showed no TCE in the water column at 0 to 6 inches above the mudline. Vinyl chloride levels in the surface water samples were also not detected except for one sample collected above a discharge area. This sample showed vinyl chloride at 0.046 µg/L, which is above the surface water cleanup level.

## 2.4 East Landfill AOC Conceptual Site Model

The current Site conditions and conceptual site model are based on a detailed review of the nature and extent of contamination on the Site, the exposure pathways and receptors, and fate and transport processes of various Site contaminants in the environment. Figure 2-3 graphically depicts the various exposure pathways and the controls implemented, as required, to protect human health and the environment.

Exposure through direct contact with contaminated soil and waste has been controlled through the construction of the engineered cap. Exposure to the remaining TCE and vinyl chloride in groundwater beneath the landfill is significantly limited. Per the 2003 Agreed Order, deed restrictions prohibit extraction of groundwater and require long-term maintenance of the engineered cap. In addition, WAC 173-160-171 (Minimum Standards for Construction and Maintenance of Wells) prohibits installation of a drinking water well within 1,000 feet of an established landfill. Therefore, the potential direct exposure to affected Site groundwater is limited to personnel performing long-term compliance monitoring. These personnel are professionals trained in hazardous substance awareness and are provided with supplemental guidance prior to entering the Site in the form of a Site-specific Health and Safety Plan.

In terms of overall risk to human health and the environment from the other remaining exposure pathway (i.e., groundwater to surface water), the following observations can be made:

- All observed concentrations of TCE in the TZW are below the surface water chronic criterion (200 µg/L) derived for protection of aquatic organisms present in the biologically active zone (0 to 4 inches below the mudline).

- All of the observed concentrations of TCE in surface water are below the most restrictive recommended surface water criterion (2.5 µg/L) for protection of human health with respect to direct ingestion of water and aquatic organisms.[2]
- All observed concentrations of vinyl chloride in the TZW are below the surface water chronic criterion (960 µg/L) derived for the protection of aquatic organisms present in the biologically active zone (0 to 4 inches below the mudline).
- Fifteen of sixteen observed concentrations of vinyl chloride in surface water (0 to 6 inches above the mudline) are below the Clean Water Act Section 304(a) surface water standard (0.025 µg/L) for protection of human health with respect to direct ingestion of water and aquatic organisms[2]. One sample exceeded this criterion. The concentration of vinyl chloride in this sample was 0.046 µg/L. The $95^{th}$ percentile upper confidence limit (UCL) for this data set is 0.017 µg/L.

[2] These criteria are based on drinking 2 liters per day of water and consuming 54 grams per day of fish.

# 3 CLEANUP REQUIREMENTS

This section of the SCAP describes the cleanup requirements that must be met by the remediation of the East Landfill AOC. Consistent with MTCA requirements, this section designates cleanup standards for Site contaminants for the respective affected media and identifies all Applicable or Relevant and Appropriate Requirements (ARARs) including local, state, and federal laws.

## 3.1 Remedial Action Objectives

The general remedial action objectives (RAOs) for the East Landfill AOC include:

1. Protection of human health and the environment by preventing direct contact with contaminants of concern in impacted media (i.e., soil, waste, raw materials, sediment, and groundwater).
2. Protection of groundwater resources by reducing or controlling migration of contaminant-bearing water from landfill waste and impacted soil to underlying groundwater.
3. Protection of human health and the environment from potential exposure due to ingestion of Site groundwater.
4. Ensuring quality of current and future beneficial uses of surface water resources through groundwater monitoring.

As discussed in Section 2.4, exposure to contaminants at the East Landfill AOC are controlled or prevented by the engineered cap described in the 2003 Interim Action Work Plan required by Agreed Order No. DE 03 TCPIS-5737 (Ecology 2003). Effectiveness of the engineered cap has been demonstrated through post-cleanup monitoring and supplemental investigations. The RAOs listed above include the long-term goals for protection of human health and the environment. As discussed in Section 4, long-term monitoring and maintenance and institutional controls are necessary to ensure these goals continue to be met in the future.

## 3.2 Cleanup Standards and MTCA Procedures

MTCA regulations provide three methods for determining cleanup standards for a contaminated site. The standards provide a uniform, state-wide approach to cleanup that can be applied on a site-by-site basis. The two primary components of the standards—cleanup levels and points of compliance (POC)—must be established for each site. Cleanup levels are established at a level where a particular hazardous substance does not threaten human health or the environment. POCs designate the location on the site where the cleanup levels must be met.

Cleanup levels for all Site media were developed following procedures described in the MTCA regulations. The sections below describe the methodology used to develop cleanup levels based on MTCA Method A procedures and ARARs.

The MTCA Cleanup Regulations (Sections 173-340-720, -730, and -740 WAC) establish procedures to develop cleanup levels for groundwater and soil. The MTCA Method A procedure is applicable to sites with relatively few hazardous substances. For this Site, cleanup levels based on this method for groundwater were derived through selection of the most stringent concentration presented in the following sources:

- Concentrations listed in WAC Tables 173-720-1, -740-1, and -745-1.
- Concentrations established under ARARs.
- Concentrations protective of the environment and surface water beneficial uses.

## 3.3 Applicable or Relevant and Appropriate Requirements

Many environmental laws may apply to a cleanup action. In addition to meeting MTCA cleanup standards as described above, a cleanup action must meet cleanup standards and environmental standards set in applicable laws. The cleanup action must also comply with elements of other applicable environmental reviews and permitting requirements. Although a cleanup action performed under formal MTCA authorities (e.g., a consent decree) would be exempt from the procedural requirements of certain state and local environmental laws, the action must nevertheless comply with the substantive requirements of such laws (RCW70.105D.090; WAC173-340-710). Potentially applicable federal, state, and local laws that may impact the implementation of final remedial actions at the East Landfill AOC are listed below.

### *3.3.1 Federal Requirements*

Potential federal requirements are specified in several statutes, codified in the U.S. Code (USC), and regulations promulgated in the Code of Federal Regulations (CFR).

- Clean Water Act (33 USC Section 1251 et seq.; including the National Toxics Rule and National Pollutant Discharge Elimination System requirements)
- Safe Drinking Water Act (including Drinking Water Standards and Health Advisories)
- Resource Conservation and Recovery Act (RCRA)
- Federal Clean Air Act (42 USC 7401 et seq.)
- Protection of Wetlands, Executive Order 11990 (Appendix A of 40 CFR Part 6)
- National Historic Preservation Act (36 CFR 800)
- National Environmental Policy Act Review

### *3.3.2 Washington State and Local Requirements*

MTCA (Chapter 70.105D RCW) authorized Ecology to adopt cleanup standards for remedial actions at sites where hazardous substances are present. The processes for identifying, investigating, and cleaning up these sites are defined and cleanup standards are set for groundwater, soil, surface water, and air in Chapter 173-340 WAC. In addition to MTCA, other potential state requirements are specified in several statutes, codified in the RCW, or are regulations promulgated in the WAC.

- State Environmental Policy Act (SEPA) (RCW 43.21C; WAC 197-11)
- Washington State Water Pollution Control Act (Chapter 90.48 RCW; Chapters 173-200 and 173-201A WAC)
- Washington State Shoreline Management Act (Chapter 90.58 RCW; Chapter 173-14 WAC)
- Washington State Clean Air Act (RCW 70.94; WAC 173-400, -403)
- Washington State Solid Waste Management – Reduction and Recycling Act (Chapter 70.95 RCW; Chapter 173-350 WAC)
- Washington State Hazardous Waste Management Act (Chapter 70.105 RCW; Chapter 173-303 WAC)
- Water Resources Act of 1971 (Chapter 90.54 RCW)
- State Historic Preservation Act (Chapters 27, 34, 44, and 53 RCW)
- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC)

## 3.4 Soil Cleanup Levels and Point of Compliance

The current and future Site use plans include industrial storage and light, medium, and heavy industrial operations, and meet the requirement of a “traditional industrial use” under the MTCA regulations (WAC 173-340-745). Thus, industrial use is the appropriate basis for development of Site-specific soil cleanup levels under MTCA. The MTCA Method A Soil Cleanup Level for Industrial Properties for TCE, 0.03 mg/kg, is based on protection of groundwater for drinking water use, using the procedures described in WAC 173-340-747(4). Establishing a cleanup level based on protection of groundwater is also protective of the soil-to-vapor pathway for volatile organic compounds (such as TCE). Direct contact with hazardous substances is prevented by the engineered cap and institutional controls, which isolate and contain the affected media. This physical barrier also prevents plants or wildlife from being exposed to contamination.

The POC for direct contact with soils extends from the ground surface to the reasonable estimated depth of potential future soil excavations (e.g., to accommodate deep foundations or similar facilities), which can extend to 15 feet below ground surface (bgs) or deeper (*see* WAC 173-340-740(6)(d)). As set forth in WAC 173-340-740(6)(f), for MTCA cleanup actions that involve containment of hazardous substances (such as the East Landfill), soil cleanup levels will typically not be met at the standard POC in soils shallower than 15 feet bgs. In these cases, a cleanup action consisting of engineered covers, such as the East Landfill engineered cap, may be determined to comply with cleanup standards, provided that:

- The selected remedy is permanent to the maximum extent practicable using the procedures in WAC 173-340-360;
- The cleanup action is protective of human health and the environment;
- The cleanup action is demonstrated to be protective of terrestrial ecological receptors under WAC 173-340-7490 through -7494;
- Institutional controls are put in place under WAC 173-340-440 that prohibit or limit activities that could interfere with the long-term integrity of the containment system;
- Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-430 are designed to ensure the long-term integrity of the containment system; and
- The types, levels, and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the cleanup action plan.

Ecology has determined that the final cleanup action (described in Section 4) meets the requirements of WAC 173-340-740(6)(f); therefore, the East Landfill AOC is in compliance with the soil cleanup standards required by this SCAP.

## 3.5 Groundwater Cleanup Levels and Point of Compliance

Future Site uses will continue to be industrial and there are no plans to extract water from the shallow water-bearing layers. Additionally, existing water supply regulations effectively preclude this potential exposure pathway and previous groundwater pumping studies indicate insufficient yield (less than 0.5 gallons per minute) is available to efficiently recover impacted shallow groundwater (Hart Crowser 1994). However, consistent with MTCA procedures for determining potable water sources, potential drinking water uses were considered in the development of groundwater cleanup levels. Because the East Landfill AOC has few groundwater contaminants, Method A was used to develop site-specific cleanup levels.

Final cleanup levels were selected as the most stringent of the Method A WAC 173-720-1 table values and ARARs. The primary ARARs for groundwater in this case include the Federal Drinking Water Standards and Health Advisories (EPA 2002) and the State Primary Drinking Water Regulations (WAC 246-290). Because of the proximity of the Site to the Columbia River, the National Recommended Water Quality Criteria (EPA 2006), which establishes criteria for protection of surface water resources, is also an ARAR. For TCE and vinyl chloride, the human health surface water criteria were determined to be the most stringent. Surface water data collected were evaluated using standard MTCA compliance methods and appear to be below the most restrictive recommended criteria based on conditions greater than the reasonable maximum exposure at the Site. Table 3-1 lists the screening levels relevant to the East Landfill AOC.

**Table 3-1**
**Relevant Screening Levels and Criteria**

| Chemical of Potential Concern | Relevant Screening Level or Criterion | Protection Basis |
|---|---|---|
| TCE | 1 µg/L | Practical Quantification Limit |
| | 5 µg/L | MTCA Method A Standard Value and Federal/State Drinking Water MCL* |
| | 2.5 µg/L | Protection of human health with respect to direct ingestion of water and aquatic organisms Clean Water Act Section 304a |
| | 2.7 µg/L | Protection of human health with respect to direct ingestion of water and aquatic organisms 40 CFR 131.36 |
| | 30 µg/L | Protection of human health with respect to direct ingestion of aquatic organisms only |
| | 200 µg/L | Surface water criteria for protection of aquatic organisms |
| Vinyl Chloride | 0.02 µg/L | Practical Quantification Limit |
| | 2 µg/L | Federal Drinking Water MCL |
| | 0.2 µg/L | MTCA Method A Standard Value and State Drinking Water MCL |
| | 0.025 µg/L | Protection of human health with respect to direct ingestion of water and aquatic organisms Clean Water Act Section 304a |
| | 2.0 µg/L | Protection of human health with respect to direct ingestion of water and aquatic organisms 40 CFR 131.36 |
| | 2.4 µg/L | Protection of human health with respect to direct ingestion of aquatic organisms only |
| | 930 µg/L | Surface water criteria for protection of aquatic organisms |

* MCL = maximum contaminant level

As defined in the MTCA regulations, the standard point of compliance for groundwater extends from the uppermost level of the saturated zone to the lowest depth that could be potentially affected by Site releases (WAC 173-340-720(8)). However, site-specific conditional POCs for groundwater cleanup levels may also be considered. For the East Landfill AOC, an engineered cap and institutional controls have been implemented to prevent exposure to groundwater beneath the landfill. Therefore, it is appropriate to demonstrate compliance with groundwater cleanup levels based on drinking water maximum contaminant levels (MCLs) at conditional POC wells located along the shoreline, down gradient from the respective source areas in accordance with WAC 173-340-720(8)(c). Table 3-2 lists the cleanup levels and point of compliance for groundwater.

**Table 3-2**
**Groundwater Cleanup Levels and Points of Compliance**

| Chemical of Concern | Groundwater Cleanup Level | Protection Basis | Point of Compliance |
|---|---|---|---|
| TCE | 5 µg/L | Human Health: MTCA Method A Standard Value and State MCL | Shoreline Monitoring Wells |
| TCE | 200 µg/L | Aquatic Resources | Biologically Active Zone in the Sediment at the Groundwater/Surface Water Interface |
| Vinyl Chloride | 0.2 µg/L | Human Health: MTCA Method A Standard Value and State MCL | Shoreline Monitoring Wells |
| Vinyl Chloride | 930 µg/L | Aquatic Resources | Biologically Active Zone in the Sediment at the Groundwater/Surface Water Interface |

## 3.6 Surface Water Cleanup Levels and Point of Compliance

In accordance with WAC 173-340-730, surface water cleanup levels must be at least as stringent as the criteria established under WAC 173-201A, Section 304 of the Federal Clean Water Act, and the National Toxics Rule (40 CFR Part 131). In addition, for surface water resources that may potentially be used as a drinking water source, criteria set forth in WAC 173-340-720 of MTCA must also be considered. For TCE and vinyl chloride, Section 304 of the Federal Clean Water Act Water Quality Criteria is the most stringent surface water criteria.

In the MTCA regulations, the point of compliance for surface water cleanup levels is the point or points at which hazardous substances are released to surface waters of the state [WAC 173-340-730(6)]. At this Site, the POC will be measured in the water column as close as technically possible to the groundwater/ surface water interface in the Columbia River without disturbing the sediment. Table 3-3 lists the cleanup levels and point of compliance for surface water.

**Table 3-3**
**Surface Water Cleanup Levels and Points of Compliance**

| Chemical of Concern | Surface Water Cleanup Level | Protection Basis | Point of Compliance |
|---|---|---|---|
| TCE | 2.5 µg/L | Human Health: MTCA Method A Standard Value and CWA Section 304a | At the groundwater/surface water interface in the river |
| Vinyl Chloride | 0.025 µg/L | Human Health: MTCA Method A Standard Value and CWA Section 304a | At the groundwater/surface water interface in the river |

# 4 PROPOSED FINAL CLEANUP ACTION

This section presents the proposed final cleanup action for the East Landfill AOC, discusses consistency with future Site uses, and outlines the long-term requirements for monitoring and institutional controls.

## 4.1 East Landfill AOC Final Cleanup Action

The final cleanup action for the East Landfill AOC consists of source control through contaminant isolation (i.e., completed in 2004 as an interim action), natural attenuation of residually contaminated media (i.e., groundwater), and long-term groundwater monitoring until cleanup standards are achieved.

Source control activities were completed in 2004 under the direction of Ecology by the 2003 Agreed Order and IAWP. The source control activities included the engineered cap and shoreline stabilization, which prevents contact with hazardous substances contained within the landfill and is selected as a primary component of the final remediation action for the East Landfill. Per the IAWP, approximately 150,000 cy of waste were consolidated within the East Landfill. Approximately half of that material contains concentrations of TCE, PAHs, or PCBs above MTCA Method A cleanup levels for industrial properties.

The interim action source control was designed to be consistent with the final cleanup for the Site (Ecology 2003). Per the requirements of WAC 173-340-430, an interim action may constitute the cleanup action for a site if it is subsequently shown to comply with WAC 173-340-350 through -390. Section 5 summarizes the studies that document compliance with these sections of the MTCA regulation.

Since construction of the engineered cap, exposure to contaminated media by direct contact has been eliminated and concentrations of TCE in groundwater have been significantly reduced and continue to decline. Institutional controls, as discussed in Section 4.4, are a requirement of the final cleanup action to ensure the long-term integrity of the landfill cap. The presence of TCE degradation products (e.g., vinyl chloride) in groundwater demonstrates that natural attenuation is an ongoing process. Natural attenuation will be monitored over the restoration timeframe necessary to meet groundwater cleanup standards at the Site.

The projected restoration timeframe for TCE in all groundwater to be below the 5 μg/L cleanup level is approximately 35 years (Anchor 2008). Once monitoring demonstrates that concentrations of TCE and vinyl chloride have reached cleanup levels (*see* Table 3-2), the groundwater restriction will be lifted, and the respective section in the title notice will be modified. No additional remedial action shall be required for the East Landfill AOC when monitoring demonstrates that the engineered cap is functioning as designed (subject to the reopeners in Section XVIII (B) of the Consent Decree (Covenant Not to Sue)). Groundwater compliance monitoring will be performed in accordance with Section 4.3. Performance of the cap will be evaluated using the results from down gradient monitoring well clusters (i.e., MW 94-1, MW 94-2).

Preliminary TZW and surface water column sampling performed adjacent to the East Landfill produced observed concentrations of TCE in the adjacent TZW and surface water below the TZW groundwater and surface water cleanup level established for the Site. For vinyl chloride, 15 of 16 surface water samples and all TZW groundwater samples collected to date were below cleanup levels established for the Site. TZW and surface water monitoring will be used to demonstrate compliance with the groundwater and surface water cleanup levels at the applicable POC. If this compliance monitoring demonstrates that cleanup levels for groundwater and surface water have been achieved, further monitoring will not be necessary. If this monitoring demonstrates that cleanup levels have not been achieved, compliance monitoring will continue until these levels are met.

Because of the risk to divers collecting samples in the river, it is preferable to establish a conditional POC for long-term monitoring at the shoreline wells. After successful completion of TZW compliance monitoring described in Section 4.3, Ecology may approve a conditional POC in the shoreline wells based on the observed correlation between TCE and vinyl chloride levels at the shoreline wells and the groundwater/surface water interface. If a correlation between the shoreline wells and the groundwater/ surface water interface cannot be demonstrated, additional TZW monitoring may be required. The frequency and type of compliance monitoring will be determined after the additional TZW monitoring has been completed.

The source control and monitored natural attenuation alternative was chosen because it achieves the RAOs, is permanent to the maximum extent practicable, and provides for a reasonable restoration timeframe as determined under WAC 173-340-360. It is consistent with the expectations set forth in MTCA for the development of cleanup alternatives. Overall, this alternative addresses potential risks to human health and the environment, reduces the restoration timeframe to the extent practicable, provides for use of natural processes to reduce concentrations and toxicity of contaminants of concern, and provides for monitoring prior to final compliance with cleanup levels throughout the Site.

Additional details of the rationale for selection of this alternative are provided in Section 5.

## 4.2 Consistency with Site Use

Ecology understands that the Port of Vancouver plans to use the East Landfill area for light cargo storage (e.g., light-wheeled vehicles). In order to support this site use, the upper layer of the engineered cap shall be expanded and modified to maximize the working area and to resist regular vehicle traffic and other erosive forces associated with the proposed development. Plans describing the grading modifications shall be submitted to Ecology for approval prior to modification of the landfill cap. The plans shall also indicate what other improvements (e.g., fencing and drainage) are necessary and how the geosynthetic liner within the engineered cap will be protected during construction.

## 4.3 Monitoring

The Site-wide CAP (Ecology 2008) sets forth the long-term monitoring and maintenance for all Site AOCs and incorporates the groundwater monitoring requirements from Alcoa's July 2001 *Groundwater Monitoring Plan for the Former Vancouver Operations* (IT Corporation 2001) and Alcoa's June 2006 *Groundwater Monitoring and East Landfill Maintenance Plan* (Anchor 2006). These two plans ensure performance and compliance with WAC 173-340-410 at the East Landfill AOC.

Groundwater compliance monitoring shall be based upon cleanup standards identified in Table 3-2 to determine when long-term cleanup goals are met. Compliance with groundwater standards based on MCLs will be evaluated at each of the wells noted in Table 4-1, which is a subset of the plan established in the 2008 Site-wide CAP.

**Table 4-1**
**East Landfill Groundwater Monitoring Well List and Schedule**

| Well Identification | Zone | Analytical Frequency | |
|---|---|---|---|
| | | PAHs/PCBs | Volatile Organic Compounds |
| MW-35 | S | Annual | Quarterly |
| MW-35 | I | Annual | Quarterly |
| MW-35 | D | Annual | Quarterly |
| MW-35 | A | Annual | Quarterly |
| MW-41 | S | Annual | Quarterly |
| MW-41 | I | Annual | Quarterly |
| MW-41 | D | Annual | Quarterly |
| MW-46 | I | Annual | Quarterly |
| MW-46 | D | Annual | Quarterly |
| MW-46 | A | Annual | Quarterly |
| MW-94-1 | I | Annual | Quarterly |
| MW-94-1 | D | Annual | Quarterly |
| MW-94-1 | A | Annual | Quarterly |
| MW-94-2 | I | Annual | Quarterly |
| MW-94-2 | D | Annual | Quarterly |
| MW-94-2 | A | Annual | Quarterly |

Footnotes:
"Annual" event scheduled for second month of fourth quarter each year.
"Quarterly" event scheduled for second month of each quarter each year.
PAHs/PCBs = polycyclic aromatic hydrocarbons/polychlorinated biphenyls
S = Shallow; D = Deep; I = Intermediate; A = Aquifer

To demonstrate compliance with groundwater in the TZ and surface water cleanup standards that are protective of both human health and aquatic resources, Alcoa shall prepare and submit a Compliance Monitoring Plan (CMP) for Ecology's approval. The CMP shall include the means and methods for collecting both surface water samples at the groundwater/surface water interface and TZW samples within the biologically active zone (0 to 5 inches below the mudline) for five events targeted at low, median, and high Columbia River stages. Alcoa will be required to conduct the TZW monitoring using passive peeper samplers. Peeper samplers will be positioned within the biologically active zone in the sediment and as close as technically possible to the groundwater/surface water interface in the river above the mudline without disturbing the sediment, such that sufficient water can be collected from the peeper apparatus that is representative of the two intervals of interest (i.e., 0 to 5 inches below the mudline and 0 to 6 inches above the mudline). At the end of the five compliance monitoring events, Alcoa shall submit a final report for Ecology's review and approval.

### 4.4 Institutional Controls

In conjunction with compliance and performance monitoring, institutional controls are required to limit or prohibit activities that could interfere with the integrity of the cleanup action or result in exposure to hazardous substances. In March 2009, Alcoa filed a restrictive covenant that includes the East Landfill AOC and describes the condition of the property, declares that a cleanup was completed at the Site, restricts the disturbance of the engineered landfill caps, prohibits the modification of the caps without prior written approval by Ecology, and controls the extraction of groundwater from the Site. Ecology reviewed and approved the restrictive covenant prior to recording it. The restrictive covenant requires owners of the Site to notify all lessees or property purchasers of the use restrictions. The restrictive covenant also requires the owner to make provisions for continued monitoring and operation and maintenance of the remedial action prior to conveying title, easement, lease, or other interest in the Site.

# 5 RATIONALE FOR SELECTING CLEANUP ACTION

This section provides Ecology's rationale for selecting the final cleanup action for the East Landfill AOC. It is based on review and consideration of a series of remedial investigations and characterizations, feasibility studies, interim cleanup actions, and groundwater monitoring. The selected cleanup action meets the minimum threshold requirements set forth in WAC 173-340-360(2) and is permanent to the maximum extent practicable. This section also includes a summary of the other remedial alternatives that were considered for cleanup of the East Landfill AOC. This section is introduced with a general summary of the MTCA requirements for selection of cleanup actions.

## 5.1 Minimum Requirements for Cleanup Actions

WAC 173-340-360(2) defines the minimum requirements that all remedial alternatives must achieve in order to for selection as a final cleanup action at a site. In this WAC section, MTCA identifies specific criteria against which alternatives are to be evaluated, and categorizes them as either "threshold" or "other" criteria. All cleanup actions must meet the requirements of the threshold criteria. The other MTCA criteria are considered when selecting from among the alternatives that fulfill the threshold requirements. This section provides an overview of these regulatory criteria. The consistency of each alternative with these criteria is then discussed in the subsequent sections.

### *5.1.1 Threshold Requirements*

The MTCA threshold requirements for a selected cleanup action are as follows:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Provide for compliance monitoring

### *5.1.2 Other MTCA Requirements*

Other requirements for evaluating remedial alternatives for the selection of a cleanup action include:

- Use of permanent solutions to the maximum extent practicable (WAC 173-340-360(3)). MTCA specifies that when selecting a cleanup action, preference shall be given to actions that are "permanent solutions to the maximum extent practicable." The regulations specify the manner in which this analysis of permanence is to be conducted. Specifically, the regulations require that the costs and benefits of each of the project alternatives be balanced using a "disproportionate cost analysis."

- Provide for a reasonable restoration timeframe (WAC 173-340-360(4)). MTCA places a preference on those alternatives that, while equivalent in other respects, can be implemented in a shorter period of time. MTCA includes a summary of factors that can be considered in evaluating whether a cleanup action provides for a reasonable restoration timeframe.
- Consider public concerns (WAC 173-340-360). Ecology considers public concerns by making draft copies of remedial decision documents available for review and comment.

The overall protectiveness that a cleanup alternative provides depends on its ability to meet cleanup standards for Site chemicals of concern. A cleanup standard consists of a cleanup level and the point at which the required concentration must be demonstrated. The selected cleanup action for the East Landfill AOC is compliant with cleanup standards and ARARs (identified in Section 3) within a reasonable restoration timeframe to the maximum extent practicable. The following sections discuss the various studies Ecology used to select the components of this selected final cleanup action.

## 5.2 Studies Supporting the 2003 Interim Action

Per the requirements of the 1990 Agreed Order, Alcoa completed a Feasibility Study to evaluate remediation options for the East Landfill (Hart Crowser 1994). Eight remedial options that met the minimum threshold requirements of a MTCA cleanup action were developed and reviewed. The cleanup remedies were designed to protect human health and the environment through the management of the most significant risks posed by the landfill areas and associated potential contamination. These risks included potential contaminant discharges to surface waters such as the Columbia River, impacts to groundwater, and direct contact with waste and contaminated soil and groundwater. In terms of the soil remediation, the goals were to reduce, eliminate, and/or control direct contact exposure to workers within the top 15 feet of the soil, inhalation exposures, and constituent migration from the soil to the groundwater. The objectives of the remediation in the context of groundwater were to protect workers, aquatic life, and human health.

The remedial options as presented in the Focused Feasibility Study included (Hart Crowser 1994):

- Alternative One: No Action. This alternative did not satisfy MTCA requirements. Natural processes would require an extensive time to achieve cleanup levels without source control.
- Alternative Two: Containment. An Engineered RCRA cap would be placed over the East Landfill and monitoring would occur.
- Alterative Three: Off-Site Disposal of Hot Spot Soils with Containment. Soil hot spots exceeding the indicator chemical cleanup levels in the landfill would be excavated to an

off-site disposal facility. An Engineered RCRA cap would be placed over the East Landfill.

- Alterative Four: Off-Site Disposal of All Soils Exceeding Indicator Chemical Soil Cleanup Levels. All soils exceeding the indicator chemical cleanup levels in the landfill would be excavated to an off-site disposal facility.
- Alternative Five: Stabilization of Hot Spot Soils with Containment. Hot spot soils from the East Landfill exceeding the soil cleanup levels would be excavated and asphalt would be incorporated into them. The excavated material would be transported to the East Landfill and an asphalt cap (RCRA equivalent) would be placed over the East Landfill.
- Alternative Six: Thermal Treatment/Incineration of Hot Spot Soils with Containment. Hot spot soils from the East Landfill exceeding the soil cleanup levels would be excavated. On-site thermal treatment and incineration with on-site landfill disposal of ash would be conducted. An engineered RCRA cap would be placed over the East Landfill.
- Alternative Seven: Thermal Treatment/Incineration of All Soils Exceeding Indicator Chemical Soil Cleanup Levels. All soils in the East Landfill exceeding cleanup levels would be excavated and treated with on-site thermal treatment or incineration and on-site disposal of the ash.
- Alternative Eight: Thermal Treatment/Incineration of All Soils Exceeding Indicator Chemical Cleanup Levels and Groundwater Pump and Treat. All soils in the East Landfill exceeding cleanup levels would be excavated and treated with on-site thermal treatment or incineration and on-site disposal of the ash. Residually contaminated groundwater would be pumped and treated ex situ.

In 2003, Ecology selected a containment source control activity and groundwater monitoring as the most practicable interim remedy for the East Landfill. Performing the encapsulation of the East Landfill waste above Site groundwater (refer to Figure 2-3) and isolating the waste from infiltration under the Agreed Order prior to final Site-wide closure accelerated the degradation of TCE-impacted groundwater. Monitoring data collected verified that source control activities were effective and that natural attenuation of residual TCE in groundwater is occurring.

### 5.3 Supplemental Studies and Practicability Evaluations

In 2008, an RI/FS was conducted in support of Site-wide cleanup prior to the sale of the Alcoa and Evergreen properties to the Port of Vancouver (Anchor 2008). This report summarized the groundwater monitoring data that were collected after construction of the East Landfill engineered cap. As discussed in Section 2.3, these data demonstrate that the engineered cap has been an effective source control measure, as maximum concentrations of TCE have decreased in the Intermediate and Deep Zones.

Although TCE levels persist above the groundwater cleanup level, the reductions in the concentrations of TCE and the production of degradation products (e.g., vinyl chloride) demonstrate that:

- Natural attenuation/degradation of TCE is occurring.
- The landfill is no longer impacting groundwater, as the source of TCE has been effectively isolated.

As previously stated, based on the post-source control groundwater monitoring and supplemental field investigations, the interim remedy provides sufficient source control to protect human health and the environment through the various potential exposure pathways. Limited TZW monitoring in 2008 indicated that TCE is below cleanup levels while the TCE degradation product, vinyl chloride, was found to be above the surface water criteria in one of sixteen samples collected (although the 95% UCL is 0.017 µg/L). Compliance monitoring at the groundwater/surface water interface in the Columbia River or in shoreline groundwater monitoring wells adjacent to the East Landfill will be conducted to confirm and demonstrate that surface water resources are protected.

In 2008, Alcoa examined additional site alternatives and performed a disproportionate cost analysis (DCA) to determine if the additional remedial actions could be practicably implemented to reduce the groundwater restoration timeframe beneath the East Landfill. Specifically, the DCA considered the practicability of treating residually contaminated groundwater beneath the East Landfill to meet the requirements of WAC 173-340-430. The MTCA regulation defines the procedure by which an interim action may be demonstrated to serve as the final cleanup action for a site. Accordingly, the DCA followed the procedures in WAC 173-340-360(3)(e) – the primary test to determine if a remedial alternative uses permanent solution to the maximum extent practicable. The 2008 analysis evaluated in situ zero valent iron technology and groundwater pump and treatment as final groundwater treatment alternatives.

The specific alternatives for groundwater restoration considered in the 2008 disproportionate cost analysis included:

- Alternative One: Monitored Natural Attenuation. This option would consist of long-term monitoring to document the natural attenuation process, as well as institutional controls to prevent the use of Site groundwater.
- Alternative Two: Groundwater Pump and Treatment. This option would consist of installing and operating a groundwater recovery system to remove impacted groundwater from the Intermediate and Deep Zones, focusing primarily on the Intermediate Zone. Horizontal wells would be required to preserve the integrity of the landfill cap. Groundwater pumped from these formations would be treated using a combination of activated carbon absorption and reverse osmosis prior to discharge to the Columbia

River, although a small volume of reject water from the reverse osmosis system would require disposal at an off-site facility.

- Alternative Three: In-Situ Groundwater Treatment. This option would also consist of installing and operating a system of horizontal wells; however, in this alternative the wells would serve as injection points. Zero valent iron and nutrients would be used to break down TCE using reductive dechlorination.

A summary of the DCA evaluation including environmental benefit scores for each alternative is provided in Table 5-1. The DCA concluded that continued monitoring of the groundwater natural attenuation processes occurring at the East Landfill AOC would provide a similar environmental benefit as other potential remedies to address the groundwater beneath the East Landfill (i.e., the DCA environmental benefit scores for the three alternatives were not substantially different). Therefore, the monitored natural attenuation remedy was determined to provide the greatest environmental benefit in relation to the cost associated with additional remedial action. In addition, other alternatives with shorter projected restoration timeframes will not provide equivalent reductions in on-site risk. Figure 5-1 provides a graphic summary of the analysis. In accordance with WAC 173-340-370(7), natural attenuation of hazardous substances is appropriate at sites where:

- Source control has been conducted to the maximum extent practicable;
- On-site contaminants do not pose an unacceptable threat to human health or the environment during the restoration timeframe;
- There is evidence that natural biodegradation or chemical degradation is occurring and will continue to occur; and
- Appropriate monitoring is conducted to ensure that the natural attenuation process is taking place and that human health and the environment are protected.

Groundwater data collected before and after construction of the East Landfill engineered cap indicate that contaminants are naturally degrading. Observed reductions in the levels of TCE in groundwater are consistent with predicted values for natural degradation of TCE to vinyl chloride and ultimately to carbon dioxide and water. Accelerated degradation of TCE to vinyl chloride in the intermediate groundwater zone indicates that the cap is isolating the waste from surface water infiltration and limiting TCE and vinyl chloride exposure to groundwater.

Preliminary monitoring of TZW and surface water indicates that contaminants are not entering the Columbia River at levels that pose an unacceptable risk to human health or the environment. Compliance monitoring of groundwater and surface water in the vicinity of the East Landfill will ensure that the natural attenuation process continues and that human health and the environment are protected.

Ecology has determined that the selected final cleanup action for the East Landfill AOC meets the conditions of WAC 173-340-370(7) and -430, providing an alternative that is permanent to the maximum extent practicable and protective of human health and the environment.

Public participation and outreach is also an important part of the remedy selection process. Ecology considered public comments submitted during the 2003 Agreed Order, the Site-wide CAP, and CD processes in making its preliminary selection of a cleanup alternative for the Site. Ecology will continue to consider public concerns with notice of this SCAP.

**Table 5-1 Summary of East Landfill Disproportionate Cost Analysis Supporting WAC 173-340-430 Requirements**

| Remedial Alternative[1] | Protectiveness (30%)[2] | Permanence (25%) | Long-Term Effectiveness (20%) |
|---|---|---|---|
| | *Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.* | *The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.* | *Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or off-site disposal in an engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.* |
| Alternative 1 - Monitored Natural Attenuation | Institutional controls are easily implemented to prevent on-site risks during restoration. However, the potential for exposure is slightly higher than the other alternatives due to a relatively longer restoration timeframe. Therefore, this alternative is ranked slightly lower than the others. No off-site risk is expected<br>8 | With respect to groundwater, natural attenuation of TCE is a permanent and non-reversible process. No treatment residuals will be generated.<br>9 | Approximately 30 to 35 years will be required for groundwater contaminants below the East Landfill to naturally attenuate to below cleanup levels. During this time, institutional controls would be implemented to protect human health and the environment from exposures associated with drinking on-site groundwater.<br>8 |
| Alternative 2 - Pump and Ex Situ Treatment | With respect to on-site risk reduction, this alternative meets the criteria to a slightly higher degree than Alternative 1 as the restoration timeframe is expected to be shorter. However, implementation of the alternative will generate residual wastes annually and therefore ranks slightly below Alternative 3 on an overall environmental quality basis. Off-site risk associated with treatment residuals can be sufficiently managed with best management practices.<br>8 | This alternative provides an active solution to reduce contaminant mass within a shorter timeframe than Alternative 1; however, during construction and annually thereafter, treatment residuals would be generated and require off-site disposal. Therefore, the benefit scores of Alternatives 1 and 2 are relatively equal.<br>9 | While this alternative employs treatment in efforts to reduce restoration timeframe, the degree of certainty to which this technology is expected to achieve this goal is questionable due to the geologic and hydrologic conditions at the Site. Therefore, the benefit scores of Alternatives 1 and 2 are relatively equal.<br>8 |
| Alternative 3 - In Situ Treatment | With respect to on-site risk, this alternative removes the most contaminant mass from the Site within a shorter timeframe. Off-site risk associated with treatment residuals can be sufficiently managed with best management practices.<br>9 | With respect to on-site risk, this alternative provides the greatest on-site contaminant mass reduction within the shortest timeframe in comparison to the other alternatives. However, during construction, treatment residuals would be generated and require off-site disposal. Therefore, the benefit scores of Alternatives 1 and 3 are relatively equal.<br>9 | This alternative includes more of the higher ranking cleanup action components as listed in the column heading above in comparison to the other alternatives. Therefore, this alternative ranks most preferred for this category.<br>9 |

**Notes:**

1. Consideration of public concerns is not addressed in this table since the public has not yet had an opportunity to provide comments.
2. Each of the DCA criteria listed were weighted such that the overall DCA score would be influenced by criteria directly relating to protectiveness and effectiveness. A score of 10 represents an alternative that satisfies the criteria to the highest degree.
3. Although allowed, costs were not considered in the environmental benefit scoring.

**Table 5-1 Summary of East Landfill Disproportionate Cost Analysis Supporting WAC 173-340-430 Requirements**

| Remedial Alternative[1] | Short-Term Risk Management (10%) | Technical and Administrative Implementability (15%) | Environmental Benefit Score[3] | Probable Cost |
|---|---|---|---|---|
| | *The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.* | *Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions.* | | |
| Alternative 1 - Monitored Natural Attenuation | This alternative results in the least disturbance of contaminants and accordingly poses the least short-term risk; therefore, the alternative meets the criteria to the highest degree.<br>10 | This alternative is the most technically and administratively implementable alternative and consists of remedial action components that are regularly implemented at cleanup sites.<br>10 | 8.8 | $1M |
| Alternative 2 - Pump and Ex Situ Treatment | During well installation and development, impacted soil and water will be generated requiring off-site disposal. The annual volumes would be relatively small and can be reasonably managed using best management practices.<br>8 | This alternative relies on a relatively well proven groundwater technology; however, success is variable from site to site. At this Site, challenges are present with respect to the discharge of treated groundwater. This FS assumes that permitting an outfall to the Columbia River for clean water would be successful and that technologies would be able to achieve the required surface water criteria. Some portion of the water would also require discharge to the City of Vancouver Publicly Owned Treatment Works. An alternate scenario may be to pump all water to the Publicly Owned Treatment Works, but this is highly dependent on the capacity of the system. In additional to these administrative challenges, the system may require regular pump rate adjustments to ensure the wells effectively extract water from the contaminated zone and not continually from the adjacent surface water. Because physical barriers are not technically feasible at the Site, the effect of surface water infiltration would not be fully understood until operation commenced. This may also require periods when pumps are halted so that steady state monitoring is permitted. These cycles could also extend the restoration timeframes used in this analysis.<br>6 | 8.0 | $24M |
| Alternative 3 - In Situ Treatment | During treatment injection, impacted soil will be generated requiring off-site disposal. The annual volumes would be relatively small and can be reasonably managed using best management practices. Because treatment residuals will be generated at a lower frequency than Alternative 2, this alternative ranks slightly higher.<br>9 | This alternative relies upon groundwater technologies that are applicable to Site contaminants and have shown effective results at nearby sites, but have not yet been demonstrated on this Site. A pilot study would be required to verify the full-scale viability of this alternative. Success of the technology would be limited by the geologic conditions beneath the East Landfill. In addition, because the Site is tidally influenced, the potential for infiltration of elevated dissolved oxygen bearing surface water to interfere with the anaerobic process exists. Because this technology can be implemented through a greater density of injection points (increasing accuracy of coverage) rather than horizontal wells, it is more implementable and ranks slightly higher than Alternative 2.<br>8 | 8.9 | $22M |

**Notes:**

1. Consideration of public concerns is not addressed in this table since the public has not yet had an opportunity to provide comments.
2. Each of the DCA criteria listed were weighted such that the overall DCA score would be influenced by criteria directly relating to protectiveness and effectiveness. A score of 10 represents an alternative that satisfies the criteria to the highest degree.
3. Although allowed, costs were not considered in the environmental benefit scoring.

May 07, 2010 4:59pm rdesrosiers K:\Jobs\070002-ALCOA\07000214 - ALCOA Vancouver GW07000214-041.dwg Anc-A-Land

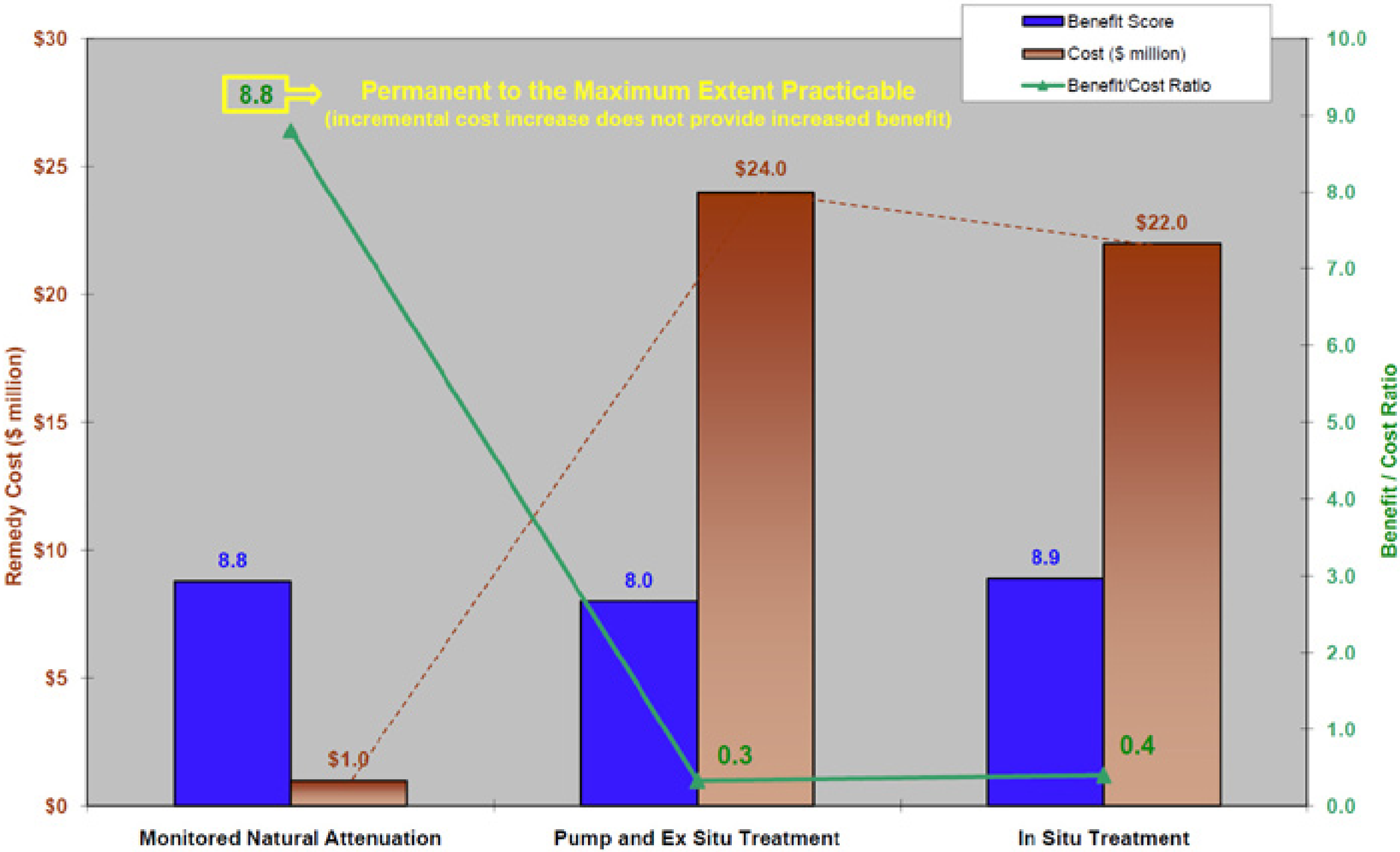


**Figure 5-1**
East Landfill Disproportionate Cost Analysis Summary
East Landfill AOC SCAP
Vancouver, Washington

# 6 SCHEDULE

An outline of the schedule for implementing the remedial action activities for the East Landfill AOC is shown below in Table 6-1.

**Table 6-1**
**Schedule for Implementation of Cleanup Actions**

| Action | Timeframe |
|---|---|
| Source Control Remedial Action | Completed 2004 |
| Upland Groundwater Monitoring and East Landfill Engineered Cap Maintenance | Ongoing per Plans |
| Restrictive Covenants | Completed March 2009 |
| TZW Investigation Summary Report East Landfill AOC (Data collected 12/2008 – 1/2009) | Completed February 2010 |
| Draft East Landfill AOC SCAP and Amended CD out for Public Comment | October 2010 |
| Extension of Public Notice Period | November - December 2010 |
| Response to Public Comments | June 2011 |
| Final East Landfill AOC SCAP and Amended CD | June 2011 |
| Develop TZW CMP | Summer 2011 |
| First TZW Sampling Event | Fall 2011 |
| Five-year Review (per 2009 CD and CAP) | January 2014 |

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# APPENDIX A

## East Landfill Groundwater Monitoring Summary Tables (November 2003 through December 2010)

**Appendix A - Table 1**

Monitoring Well Cluster 35

| Date | MW-35-S | | | | | MW-35-I | | | | | MW-35-D | | | | | MW-35-A | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride |
| November 2003 | DRY | DRY | DRY | DRY | DRY | **20** | 0.5 U | **14** | 0.5 U | 0.5 U | **0.7** | **0.72** | **17** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2004 | **16** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **13** | 0.5 U | **11** | 0.5 U | 0.5 U | **0.795** | **0.72** | **17** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2004 | **41** | 0.5 U | **0.51** | 0.5 U | 0.5 U | **16** | 0.5 U | **13** | 0.5 U | 0.5 U | **1.1** | **0.7** | **18** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| September 2004 | DRY | DRY | DRY | DRY | DRY | **13** | 0.5 U | **10** | 0.5 U | 0.5 U | **0.88** | **0.68** | **18** | 0.5 U | 0.5 UJ | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 UJ |
| December 2004 | DRY | DRY | DRY | DRY | DRY | **13** | 0.5 U | **10** | 0.5 U | 0.5 U | 0.5 U | **0.7** | **16** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2005 | DRY | DRY | DRY | DRY | DRY | **15** | 0.5 U | **11** | 0.5 U | 0.5 U | 0.5 U | **0.59** | **17** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2005 | **14** | 0.5 U | **2.5** | 0.5 U | 0.5 U | **13.5** | 0.5 U | **10.5** | 0.5 U | 0.5 U | 0.5 U | **0.64** | **18** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2005 | DRY | DRY | DRY | DRY | DRY | **14** | 0.5 U | **11** | 0.5 U | 0.5 U | 0.5 U | **0.57** | **15** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2005 | DRY | DRY | DRY | DRY | DRY | **14** | 0.5 U | **10** | 0.5 U | 0.5 U | 0.5 U | **0.51** | **13** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2006 | **12** | 0.5 U | **4.5** | 0.5 U | 0.5 U | **10** | 0.5 U | **9.1** | 0.5 U | 0.5 U | 0.5 U | **0.52** | **13** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2006 | **11** | 0.5 U | **5.9** | 0.5 U | 0.5 U | **9.3** | 0.5 U | **7.6** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **13** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2006 | DRY | DRY | DRY | DRY | DRY | **12** | 0.5 U | **9** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **11** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2006 | **11** | 0.5 U | **0.62** | 0.5 U | 0.5 U | **12** | 0.5 U | **9.3** | 0.5 U | 0.5 U | 0.5 U | 0.5 | **14** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2007 | **11** | 0.5 U | **28** | 0.5 U | 0.5 U | **12** | 0.5 U | **9.3** | 0.5 U | 0.5 U | 0.5 U | 0.51 | **13** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2007 | **10** | 0.5 U | **20** | 0.5 U | 0.5 U | **8.8** | 0.5 U | **7** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **10** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| September 2007 | DRY | DRY | DRY | DRY | DRY | **9.9** | **0.25** J | **8.3** | **0.43** J | **0.13** J | 0.5 U | **0.45** J | **11** | **0.19** J | **0.09** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.04 U |
| December 2007 | DRY | DRY | DRY | DRY | DRY | **8.9** | **0.15** J | **7.2** | **0.25** J | **0.07** J | 0.5 U | **0.49** J | **14** | **0.2** J | **0.12** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2008 | **6** | 0.5 U | **12** | 0.5 U | 0.5 U | **7.25** | **0.16** J | **6.5** | **0.26** J | **0.08** J | 0.5 U | **0.43** J | **11** | **0.19** J | **0.1** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2008 | DRY | DRY | DRY | DRY | DRY | **10** | **0.23** J | **7.9** | **0.41** J | **0.11** J | 0.5 U | **0.48** J | **13** | **0.22** J | **0.11** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2008 | DRY | DRY | DRY | DRY | DRY | **36** | 0.5 U | **1.2** | **0.12** J | 0.5 U | 8.6 | **0.23** J | **6.5** | **0.37** J | **0.08** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2008 | DRY | DRY | DRY | DRY | DRY | **9.4** | **0.18** J | **6.8** | **0.22** J | 0.5 U | **0.08** J | **0.41** J | **11** | **0.19** J | **0.1** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2009 | DRY | DRY | DRY | DRY | DRY | **8** | **0.19** J | **5.8** | **0.27** J | **0.09** J | 0.5 U | **0.32** J | **10** | **0.15** J | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2009 | DRY | DRY | DRY | DRY | DRY | **6.9** | 1.0 U | **5.4** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **14** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| August 2009 | DRY | DRY | DRY | DRY | DRY | **6.6** | 1.0 U | **6** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **13** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2009 | DRY | DRY | DRY | DRY | DRY | **NS** | NS | NS | NS | NS | 1.0 U | 1.0 U | **12** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| February 2010 | DRY | DRY | DRY | DRY | DRY | **7.2** | 1.0 U | **7.1** | **2.4** | 0.2 U | 1.0 U | **2.9** | **10.3** | **2.3** | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| June 2010 | DRY | DRY | DRY | DRY | DRY | **6.3** | 1.0 U | **5.8** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **9.4** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| September 2010 | DRY | DRY | DRY | DRY | DRY | **6.8** | 1.0 U | **6.6** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **9.5** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2010 | DRY | DRY | DRY | DRY | DRY | **5.6** | 1.0 U | **5.4** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **9.1** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |

Notes:

Gray highlight - Result shown is the average of the primary and field duplicate sample.

Bold values - detected

**Appendix A - Table 2**

Monitoring Well Cluster 41

| | MW-41-S | | | | | MW-41-I | | | | | MW-41-D | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride |
| November 2003 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2004 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2004 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| September 2004 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| December 2004 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2005 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2005 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2005 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2005 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2006 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2006 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2006 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2006 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2007 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2007 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| September 2007 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.042 U |
| December 2007 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2008 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2008 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2008 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2008 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2009 | DRY | DRY | DRY | DRY | DRY | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2009 | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| August 2009 | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2009 | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| February 2010 | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| June 2010 | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| September 2010 | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2010 | DRY | DRY | DRY | DRY | DRY | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |

Notes:

Gray highlight - Result shown is the average of the primary and field duplicate sample.

## Appendix A - Table 3
Monitoring Well Cluster 46

| Date | MW-46-I | | | | | MW-46-D | | | | | MW-46-A | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride |
| November 2003 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.2** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2004 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.9** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.5** | 0.5 U | 0.5 U |
| May 2004 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **1.3** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| September 2004 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.74** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| December 2004 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.1** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2005 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.7** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2005 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.93** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2005 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **1.5** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2005 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.1** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| March 2006 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.4** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| May 2006 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **1.8** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| August 2006 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **1** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| November 2006 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **1.5** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| February 2007 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **3.1** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.63** | 0.5 U | 0.5 U |
| May 2007 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.4** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U |
| September 2007 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.04 U | 0.5 U | 0.5 U | **0.97** | 0.5 U | 0.04 U | 0.5 U | 0.5 U | **0.87** | 0.5 U | **0.17** J |
| December 2007 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.05** J | 0.5 U | 0.5 U | **0.96** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.31** J | 0.5 U | **0.18** J |
| March 2008 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.5** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.93** | 0.5 U | **0.16** J |
| May 2008 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **2.1** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.28** J | 0.5 U | **0.34** J |
| August 2008 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.09** J | 0.5 U | 0.5 U | **1.3** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.45** J | 0.5 U | 0.5 U |
| November 2008 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.18** J | 0.5 U | **2.9** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.5** J | 0.5 U | **0.17** J |
| February 2009 | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.16** J | 0.5 U | 0.5 U | **2** | 0.5 U | 0.5 U | 0.5 U | 0.5 U | **0.3** J | 0.5 U | **0.14** J |
| May 2009 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **1.4** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| August 2009 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2009 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **1.1** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | **0.2** |
| February 2010 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **3.7** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| June 2010 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **1.5** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| September 2010 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **1.6** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2010 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U | 1.0 U | 1.0 U | **1.4** | 1.0 U | 0.2 U | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |

Notes:
Gray highlight - Result shown is the average of the primary and field duplicate sample.
Bold values - detected

## Appendix A - Table 4

Monitoring Well Cluster 94-1

| Date | MW-94-1-I | | | | | MW-94-1-D | | | | | MW-94-1-A | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride |
| November 2003 | 1200 | 27 | 4600 | 12 | 660 | 24 | 15 | 1100 | 5.1 | 150 | 1.2 | 0.5 U | 4.0 | 0.5 U | 0.5 U |
| February 2004 | 730 | 19 | 4700 | 13 U | 440 | 35 | 14 | 1200 | 3.5 | 120 | 1.0 | 0.5 U | 3.3 | 0.5 U | 0.5 U |
| May 2004 | 765 | 20 | 5650 | 13 U | 510 | 40 | 22 | 1600 | 5 U | 170 | 1.2 | 0.5 U | 3.0 | 0.5 U | 0.5 U |
| September 2004 | 590 | 12 | 4800 | 23 | 270 | NS[1] | NS[1] | NS[1] | NS[1] | NS[1] | 1.0 | 0.5 U | 2.1 | 0.5 U | 0.5 U |
| December 2004 | 490 | 10 U | 4400 | 10 U | 130 | 8.7 | 4.4 | 540 | 2.6 | 21 | 0.9 | 0.5 U | 2.5 | 0.5 U | 0.5 U |
| March 2005 | 660 | 10 | 5000 | 14 | 330 | 8 | 11 | 1000 | 3.75 | 110 | 0.9 | 0.5 U | 1.9 | 0.5 U | 0.5 U |
| May 2005 | 1100 | 30 | 5100 | 14 | 660 | 12 | 21 | 1700 | 6.6 | 220 | 0.9 | 0.5 U | 3.3 | 0.5 U | 0.5 U |
| August 2005 | 720 | 13.5 | 6150 | 14 | 450 | 1 | 2.6 | 530 | 8.9 | 14 | 1.0 | 0.5 U | 2.5 | 0.5 U | 0.5 U |
| November 2005 | 640 | 10 U | 5200 | 14 | 250 | 1.3 | 2.2 | 310 | 1.9 | 16 | 0.7 | 0.5 U | 1.8 | 0.5 U | 0.5 U |
| March 2006 | 510 D | 5 U | 4600 D | 8.2 D | 52 D | 0.53 | 3 | 500 D | 2.7 | 21 | 1.1 | 0.5 U | 2.6 | 0.5 U | 0.5 U |
| May 2006 | 580 D | 10 U | 4800 D | 11 D | 150 D | 1.1 | 1.7 | 325 D | 2.35 | 6.5 | 0.8 | 0.5 U | 2.8 | 0.5 U | 0.5 U |
| August 2006 | 525 D | 10 U | 4100 D | 11.5 D | 14.5 D | 5.1 | 0.71 | 22 | 1.1 | 0.5 U | 0.7 | 0.5 U | 2.1 | 0.5 U | 0.5 U |
| November 2006 | 600 D | 10 U | 4900 D | 10 D | 130 D | 0.72 | 1.8 | 280 D | 1.9 | 11 | 0.8 | 0.5 U | 2.3 | 0.5 U | 0.5 U |
| February 2007 | 630 D | 10 U | 4800 D | 15 D | 130 D | 2.3 D | 3.3 D | 680 D | 3.0 D | 22 D | 0.7 | 0.5 U | 2.1 | 0.5 U | 0.5 U |
| May 2007 | 420 D | 10 U | 3700 D | 10 U | 25 D | 1.0 U | 2.0 D | 440 D | 2.5 D | 5.7 D | 0.6 | 0.5 U | 1.8 | 0.5 U | 0.5 U |
| September 2007 | 620 | 13 | 4700 | 11 | 280 | 7.2 | 4.4 | 580 | 2.6 | 39 | 0.5 | 0.5 U | 1.4 | 0.5 U | 0.042 U |
| December 2007 | 750 | 13 | 5500 | 10 | 280 | 11 | 37 | 4000 | 8.0 J | 460 | 0.7 | 0.5 U | 1.7 | 0.5 U | 0.07 J |
| March 2008 | 410 | 3.8 | 3300 | 8 | 37 | 8.7 | 6.0 | 760 | 3.3 | 49 | 0.4 J | 0.5 U | 1.0 | 0.5 U | 0.5 U |
| May 2008 | 960 | 24 | 5300 | 17 | 510 | 2.9 | 17 | 2100 | 6.0 | 170 | 0.8 | 0.5 U | 2.1 | 0.09 J | 0.1 J |
| August 2008 | 610 | 10 J | 4700 | 9.3 J | 94 | 7.1 | 6.7 | 1000 | 6.5 | 74.5 | 0.6 | 0.5 U | 1.8 | 0.06 J | 0.5 U |
| November 2008 | 690 | 9.8 J | 4500 | 8.4 J | 210 | 5.9 | 11 | 1300 | 4.1 | 100 | 0.7 | 0.5 U | 2.0 | 0.06 J | 0.5 U |
| February 2009 | 590 | 8.8 | 3900 | 7.7 | 190 | 2.65 | 1.75 | 415 | 1.6 | 6.25 | 0.6 | 0.5 U | 1.9 | 0.5 U | 0.5 U |
| May 2009 | 435 | 8.4 | 3700 | 7.7 | 90 | 5.0 | 1.1 | 534 | 1.7 | 0.2 U | 1.0 U | 1.0 U | 3.4 | 1.0 U | 0.2 U |
| August 2009 | 377 | 1.0 U | 3390 | 5.9 | 7.5 | 7.2 | 6.5 | 1180 | 3.3 | 62 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2009 | 486 | 5.6 | 3920 | 7 | 63 | 2.3 | 6.3 | 955 | 3.2 | 55 | 1.0 U | 1.0 U | 1.6 | 1.0 U | 0.2 U |
| February 2010 | 474 | 5.9 | 3770 | 7.1 | 21 | 1.1 | 3.9 | 765 | 4.1 | 9.2 | 1.0 U | 1.0 U | 1.9 | 1.0 U | 0.2 U |
| June 2010 | 438 | 4.9 | 3350 | 6.1 | 1.7 | 1.2 | 6.9 | 1530 | 3.5 | 80.1 | 1.0 U | 1.0 U | 2.5 | 1.0 U | 0.2 U |
| September 2010 | 512 | 8.0 | 3550 | 6.7 | 9.2 | 2.0 U | 3.2 | 753 | 3.3 | 13.7 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2010 | 336 | 6.1 | 2520 | 5.7 | 5.1 | 1.6 | 6.0 | 649 | 3.4 | 60.3 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |

Notes:
Gray highlight - Result shown is the average of the primary and field duplicate sample.
Bold values - detected
[1] Well could not be sampled due to access issues related to landfill construction activity.
NS = no sample

**Appendix A - Table 5**

Monitoring Well Cluster 94-2

| Date | MW-94-2-I | | | | | MW-94-2-D | | | | | MW-94-2-A | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride | Trichloroethene | 1,1-Dichloroethene | cis-1,2-Dichloroethene | trans-1,2-Dichloroethene | Vinyl chloride |
| November 2003 | 17 | 4.7 | 1300 | 7.8 | 9.2 | 2.5 U | 10 | 1400 | 6.6 | 30 | 0.5 U | 0.5 U | 2.1 | 0.5 U | 0.5 U |
| February 2004 | 19 | 4.0 | 1200 | 7.7 | 9.7 | 5 U | 10 | 1300 | 6.5 | 32 | 0.5 U | 0.5 U | 1.4 | 0.5 U | 0.5 U |
| May 2004 | 12 | 4.4 | 1500 | 11 | 10 | 2.5 U | 11 | 1700 | 8.7 | 34 | 0.5 U | 0.5 U | 1.6 | 0.5 U | 0.5 U |
| September 2004 | 5.4 | 3.4 | 1200 | 13 | 6 | 2.5 U | 9 | 1400 | 8.5 | 26 | 0.5 U | 0.5 U | 1.7 | 0.5 U | 0.5 U |
| December 2004 | 5.3 | 3.2 | 1300 | 7.3 | 4.7 | 5 U | 12 | 1600 | 6.5 | 30 | 0.5 U | 0.5 U | 1.1 | 0.5 U | 0.5 U |
| March 2005 | 9.7 | 3.2 | 1200 | 9 | 4.9 | 2.5 U | 11 | 1700 | 7.6 | 31 | 0.5 U | 0.5 U | 1.2 | 0.5 U | 0.5 U |
| May 2005 | 4.5 | 3.8 | 1300 | 11 | 4.5 | 2.5 U | 10 | 1700 | 8.9 | 34 | 0.5 U | 0.5 U | 2.4 | 0.5 U | 0.5 U |
| August 2005 | 7.2 | 2.5 U | 950 | 8.8 | 2.5 U | 2.5 U | 11 J | 2000 | 13 | 36 | 0.5 U | 0.5 U | 1.2 | 0.5 U | 0.5 U |
| November 2005 | 8.7 | 3.1 | 1300 | 7.8 | 3.2 | 2.5 U | 12 J | 1900 | 8.5 | 36 | 0.5 U | 0.5 U | 1.2 | 0.5 U | 0.5 U |
| March 2006 | 24 D | 3.6 D | 1300 D | 15 D | 4.0 D | 2.5 U | 12 D | 2000 D | 9.4 D | 52 D | 0.5 U | 0.5 U | 1.3 | 0.5 U | 0.5 U |
| May 2006 | 12 D | 2.9 D | 1100 D | 9.7 D | 2.6 D | 5 U | 16 D | 2100 D | 10 D | 49 D | 0.5 U | 0.5 U | 1.5 | 0.5 U | 0.5 U |
| August 2006 | 4.8 D | 2.5 U | 700 D | 10 D | 2.5 U | 5 U | 12 D | 1800 D | 9.7 D | 35 D | 0.5 U | 0.5 U | 0.81 | 0.5 U | 0.5 U |
| November 2006 | 8 D | 3.0 D | 1200 D | 9 D | 2.5 D | 5 U | 13 D | 2100 D | 10 D | 36 D | 0.5 U | 0.5 U | 1.6 | 0.5 U | 0.5 U |
| February 2007 | 9.6 D | 3.1 D | 1400 D | 10 D | 2.5 U | 5 U | 15 D | 3200 D | 12 D | 51 D | 0.5 U | 0.5 U | 0.99 | 0.5 U | 0.5 U |
| May 2007 | 8.2 D | 2.5 U | 1100 D | 8.2 D | 2.5 U | 5 U | 14 D | 2400 D | 9.6 D | 45 D | 0.5 U | 0.5 U | 1.2 | 0.5 U | 0.5 U |
| September 2007 | 4.9 | 0.92 J | 610 | 6.9 | 1.8 | 5 U | 15 | 2000 | 9.6 | 38 | 0.5 U | 0.5 U | 0.62 | 0.5 U | 0.0 U |
| December 2007 | 5.6 | 2.8 | 1300 | 8.9 | 3.3 | 5 U | 17 | 2900 | 12 | 55 | 0.16 J | 0.5 U | 1.6 | 0.5 U | 0.1 J |
| March 2008 | 17 | 2.6 J | 1100 | 6.8 | 2.4 J | 5 U | 15 | 2200 | 10 | 48 | 0.5 U | 0.5 U | 0.87 | 0.5 U | 0.5 U |
| May 2008 | 7.2 | 2.9 | 1300 | 15 | 2.5 J | 5 U | 18 | 3000 | 14 | 62 | 0.17 J | 0.5 U | 1.1 | 0.5 U | 0.08 J |
| August 2008 | 7.1 | 2.2 J | 850 | 8.6 | 1.8 J | 10 U | 16 | 2800 | 13 | 58 | 0.13 J | 0.5 U | 0.99 | 0.5 U | 0.5 U |
| November 2008 | 5.3 | 1.6 | 840 | 6.2 | 1.5 | 5 U | 17 | 2800 | 12 | 54 | 0.12 J | 0.5 U | 0.83 | 0.5 U | 0.5 U |
| February 2009 | 6.6 | 1.5 | 850 | 6.3 | 1.4 | 0.8 J | 14 | 2600 | 11 | 46 | 0.12 J | 0.5 U | 1.2 | 0.5 U | 0.5 U |
| May 2009 | 3.3 | 2.2 | 887 | 9.3 | 1.5 | 1.0 U | 20 | 2780 | 15 | 46 | 1.0 U | 1.0 U | 2.1 | 1.0 U | 0.2 U |
| August 2009 | 3.4 | 1.0 U | 1220 | 7.9 | 0.2 U | 1.0 U | 19 | 3140 | 15 | 88 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2009 | 8.3 | 1.9 | 997 | 8 | 2.4 | 1.0 U | 17 | 3420 | 15 | 72 | 1.0 U | 1.0 U | 1.3 | 1.0 U | 0.2 U |
| February 2010 | 10.9 | 4.4 | 1400 | 9.2 | 1.9 | 1.0 U | 15 | 3820 | 13.1 | 77.5 | 1.0 U | 1.0 U | 2.6 | 1.0 U | 0.2 U |
| June 2010 | 5.3 | 2.3 | 1460 | 7.6 | 2.4 | 1.0 U | 15.7 | 3305 | 13.9 | 85.4 | 1.0 U | 1.0 U | 1.7 | 1.0 U | 0.2 U |
| September 2010 | 6.1 | 2.3 | 1360 | 10.4 | 1.7 | 1.0 U | 18.1 | 3625 | 19.6 | 60 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |
| November 2010 | 3.5 | 2.1 | 993 | 9.3 | 2.2 | 1.0 U | 19.9 | 3245 | 17.8 | 87.9 | 1.0 U | 1.0 U | 1.0 U | 1.0 U | 0.2 U |

Notes:
Gray highlight - Result shown is the average of the primary and field duplicate sample.
Bold values - detected