Report
Remedial Investigation/Feasibility Study/and Cleanup Action Plan
35th Street Landfill
Tacoma, Washington

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Prepared for

City of Tacoma

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1.0 INTRODUCTION

This document presents the results of a remedial investigation/feasibility study (RI/FS) and presents a cleanup action plan (CAP) for soil remediation at the City of Tacoma's (City's) 35th Street Landfill site (site). The site is located just east of the intersection of South 35th Street and Pacific Avenue in Tacoma, Washington and is included on the Washington State Department of Ecology (Ecology) Confirmed and Suspected Contaminated Sites List (CSCSL). The site was listed on the CSCSL after an initial investigation by the Tacoma-Pierce County Health Department (TPCHD) in August 2005. On behalf of the City of Tacoma (City), Landau Associates submitted a Voluntary Cleanup Program (VCP) application to Ecology on February 27, 2008 to conduct independent remedial actions under Ecology supervision. Landau Associates subsequently submitted an independent remedial action report on March 11, 2008 (Landau Associates 2008a) and requested a no further action (NFA) determination for the site based on previously collected data. After reviewing the data, Ecology issued a further action determination on April 19, 2008 (Ecology 2008a) requiring additional remedial actions to characterize the site. In response to this further action determination, the RI/FS and cleanup action plan presented in this report were prepared in accordance with the Model Toxics Control Act (MTCA) [WAC 173-340] under the VCP. The location of the site is shown on the vicinity map on Figure 1.

The City plans to transfer the site property to a private developer as part of a partnership to develop apartment housing. Currently there are no specific development plans; however, it is likely the project will support multiple buildings, parking areas, and associated infrastructure. The RI/FS/CAP is being conducted to document current site soil, groundwater, surface water, and air conditions and to identify a final cleanup action that is protective of human health and the environment and consistent with future development plans. It is the intent of the City to request an NFA determination from Ecology after implementation of the CAP.

1.1 SITE DESCRIPTION

The site as documented in the TPCHD initial investigation (TPCHD 2005) is an approximately 5-acres consisting of six tax parcels[1] along Pacific Avenue in Tacoma, Washington. The site is bordered to the west by Pacific Avenue between East Harrison Street and East 34th Street, and to the east by 'A' Street. A vacant parcel borders the site to the south. The site is shown on Figure 2.

The site is located in an area that was occupied by a natural ravine. The ravine was one of a number of north-south trending glacial channels in the Tacoma area. These channels represent glacial

[1] Tax parcels 2084140040, 2084140050, 2085130060, 2085130070, 2085140040, 2085140070

melt water features that in recent times did not contain an active surface water channel (i.e., they were dry ravines). The ravine at the site extended roughly a half mile or more from approximately East 37th Street to north of East 34th Street directly east and parallel to Pacific Avenue. The area between the East 34th Street Bridge and East 37th Street was filled beginning in the early 1960s. The bulk of the fill material was placed during construction of the I-5/I-705 extension between 1960 and 1965; a large part of this early material was fill dirt. Between 1985 and 1990, the site was used to dispose of vactor waste from catch basin cleanings and street sweeping material. This more recent material was reportedly disposed of primarily in the northern portion of the site. In 1991, the City re-graded the site to improve slope stability (City of Tacoma 1992).

The site is undeveloped and currently slopes gently downward to the west and north, with a steeper north-facing slope that terminates in the bottom of a ravine. Surface cover consists of grass, brambles, scattered patches of soil and gravel, and piles of construction debris composed of concrete, reinforcing steel, and wood. Currently, the surrounding area land use (including filled portions of the area to the south of the site) is mixed, consisting of residential, commercial, and light industrial land uses.

Subsurface conditions at the site consist of up to 80 ft or more of fill overlain by glacially derived sand and silty sand. A groundwater seep emanates from the toe of the north-facing fill slope in the area of a buried concrete pipe[2]. Groundwater beneath the site is anticipated to be greater than 100 ft below ground surface (below the bottom of the fill in this area). Therefore, the seeps at the base of the slope likely represent water that has percolated through the fill and collected on the original ground surface soil horizon or relatively lower permeability layers below this surface to form isolated areas of perched groundwater.

1.2 SITE BACKGROUND

Based on previous investigations and site history, Ecology (2008a) defined the primary contaminants of concern at the site as total petroleum hydrocarbons (TPH) and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) in soil. These constituents are consistent with the type of constituents related to vactor waste (i.e., material from street catch basins) and street sweeping material. Methane was also detected in soil gas and is likely generated from organic debris (leaves, branches, yard waste etc.) disposed along with soil and inert material.

[2] The concrete pipe is located near sampling location SW-LAI-01 on Figure 2.

1.2.1 PREVIOUS INVESTIGATIONS

Previous investigations of the site were conducted by the City of Tacoma and TPCHD from approximately 1990 to 2006. These investigations included soil, groundwater seep and air sampling. They confirmed that much of the near-surface fill consists of soil mixed with inert material such as waste concrete, asphalt, and brick. Data results also identified minor arsenic and TPH impacts to soil and the presence of low levels of methane.

1.2.1.1 Soil

Soil sampling was conducted during an environmental site assessment by the City in 1991 (City of Tacoma 1992). During the investigation, nine test pits were dug and five soil samples were collected and analyzed for TPH; priority pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc); and VOCs. The samples were collected from test pits between 12 and 15 ft below ground surface (BGS). Additionally, two samples were analyzed for TCLP[3] arsenic, chromium, and lead. All samples had detectable levels of TPH, with the highest result at 1,330 mg/kg. No results for TPH exceeded the current MTCA Method A cleanup standard of 2,000 mg/kg. Of the 13 metals that were sampled, only arsenic had concentrations that exceeded MTCA cleanup standards (arsenic MTCA Method A standard is 20 mg/kg), with two of the five arsenic samples (TP-3 and TP-9) having concentrations of 21.7 mg/kg and 228 mg/kg, respectively. No metals were detected in the TCLP sample results. No VOC compounds were detected in any of the samples. Previous investigation test pit locations are shown on Figure 2.

Additional soil sampling for TPH (including diesel-range, heavy oil-range, and gasoline-range petroleum hydrocarbons) was conducted annually from 1999 through 2001 and from 2003 through 2004 (City of Tacoma 1999b, 2000, 2001a, 2003, 2004b). One grab sample was collected during each event; however, the exact sampling locations were not documented in subsequent monitoring reports. Gasoline-range and diesel-range petroleum hydrocarbons were not detected in any of these grab samples. Heavy oil-range petroleum hydrocarbons were detected three times with the highest result, 230 mg/kg, occurring in 2004. None of the sample results exceeded the MTCA cleanup standard of 2,000 mg/kg.

1.2.1.2 Groundwater Seeps

Sampling of the spring or groundwater seep at the base of the north-facing slope was first conducted in 1990. Three samples were collected and analyzed; TPH was not detected, and pH was in the

[3] TCLP is the toxicity characteristic leachate procedure used as an identifier of the presence of hazardous waste.

normal range for groundwater (6 to 9) (City of Tacoma 1990). Groundwater seep sampling was also conducted in 1991. Two samples (one sample from the seep and one sample from runoff from the east hillside of the ravine) were collected and analyzed for TPH, VOCs, and priority pollutant metals (City of Tacoma 1992). The results indicated the presence of TPH, although the results are suspect because of the laboratory methodology[4] and the lack of reproducibility (i.e., this was the only TPH detection at the seep). Arsenic was detected in one of the seep sample at 13 µg/L, above the MTCA Method A cleanup standard of 5 ug/L. 1,1,1-Trichloroethane (TCA) was the only VOC compound detected at 8.5 µg/L, which is less than the MTCA Method A cleanup standard of 200 µg/L. The seep sampling location is approximately coincident with the location of SW-LAI-01 shown on Figure 2.

Groundwater seep sampling was conducted annually between 1999 and 2004 (City of Tacoma 1999b, 2000, 2001a, 2001b, 2002, 2003, 2004b). Samples were analyzed for TPH during all sampling events. TPH was not detected in any groundwater seep samples during this time period. In addition to TPH, samples collected in 2001 and 2002 were analyzed for nitrogen; total metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury); SVOCs, VOCs; and chlorinated pesticides. With the exception of several metals, none of the above-mentioned analytes were detected. In 2001, mercury was detected at 0.012 µg/L, barium was detected at 11.0 µg/L, and lead was detected at 1.1 µg/L. In 2002, arsenic was detected at 2.6 µg/L, barium was detected at 11.4 µg/L, chromium was detected at 1.24 µg/L, and lead was detected at 2.4 µg/L. All of these results are below MTCA cleanup standards for their associated compounds.

1.2.1.3 Methane

The TPCHD first conducted sampling for methane on two occasions in December 1990 using a bar hole sampling technique and hand-held portable gas meter (TPCHD 1990a, 1990b). Bar holes ranged from 6 inches to 36 inches in depth. The highest methane levels were detected on the north side of the landfill at the top of the fill slope. Results ranged from non-detect to 40 percent methane, well above the lower explosive limit (LEL) of 5 percent methane[5].

Sampling for methane gas was conducted during the environmental site assessment performed by the City in 1991 (City of Tacoma 1992). A gas probe consisting of 4-inch and ½ inch PVC pipe was

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[4] The analytical method used to analyze TPH for the 1991 sampling event was EPA Method 418.1, which does not use a silica and acid wash to extract organics from the sample prior to analysis. Organic compounds, if not removed, can cause matrix interference and can show up as detections of TPH in a sample result that would otherwise be non-detect.

[5] The LEL is a typical standard used by the Tacoma Pierce County Health Department to evaluate methane at the property boundary of a landfill [WAC 173-304-460(2)(b)]. Since this site will be converted to residential use, the LEL is assumed to be the compliance standard throughout the property for the purposes of this evaluation.

installed in test pit TP-2. Results from this probe indicated the presence of 52 percent methane (over 10 times the LEL). The location of TP-2 is shown on Figure 2.

In 1992, the TPCHD conducted methane sampling events on two city-owned properties within two blocks of the landfill site (Tacoma-Pierce County Health Department 1992a, 1992b). Neither site had detectable levels of methane in the bar holes. These results suggest that methane migration is not a significant problem.

Methane sampling was conducted by the TPCHD annually or semi-annually from 1997 through 2006 (Tacoma-Pierce County Health Department 1997, 1998a,1998b,1998c, 2000, 2001, 2002a, 2002b, 2003a, 2003b, 2004; City of Tacoma 1999a, 1999b, 2004a, 2004c, 2005a, 2005b, 2006). Samples were collected from various locations at the landfill using a bar hole sampling technique and a hand-held portable gas meter though the exact locations were not recorded. Results ranged from non-detect to 87 percent LEL (i.e., 4.3 percent methane). Between 2004 and 2006, six separate sampling events were conducted with the highest sampling result being 3.1 percent of the LEL (i.e., 0.15 percent methane). This most recent data indicates that methane concentrations in shallow soil are currently very low.

1.3 SITE DEVELOPMENT CONCEPT

Current plans call for development of the site as a multi-family or mixed use complex. The upper portion of the site would be developed with buildings, paved parking areas, paved roads, and landscaped areas. It is anticipated that this development will be completed within the next couple of years; however a development schedule has not been finalized. The site development concept is consistent with the site's residential and commercial site zoning. The site consists of six separate tax parcels zoned as follows:

- 2084140040: R4L (Low-density multiple family dwelling district)
- 2048140050: R4L (Low-density multiple family dwelling district)
- 2085130060: R2 (One family dwelling district)
- 2085130070: R2 (One family dwelling district)
- 2085140070: R2 and C1 (One family dwelling district) (General neighborhood commercial)
- 2085140070: R2-SRD (Residential special review district)

2.0 REMEDIAL INVESTIGATION

In response to Ecology's further action determination (Ecology 2008a), the City conducted a remedial investigation (RI) in May 2008 to further define the nature and extent of contamination at the site. The RI included a field investigative approach using a combination of test pits, direct push borings, a single hollow stem auger (HSA) boring, and groundwater seep sampling[6]. Prior to initiating field activities, a work plan was prepared and submitted to Ecology for review. Unless otherwise noted, the RI field activities were conducted in accordance with the RI Work Plan (Landau Associates 2008b).

The overall objectives of the RI were to characterize soil, water, and air quality at the site to:

- Evaluate the nature and extent of soil and groundwater contamination if any
- Evaluate the potential for site soil contamination to impact groundwater
- Characterize the nature and extent of methane at the site
- Collect sufficient data to support decisions regarding an appropriate cleanup action.

2.1 FIELD INVESTIGATION

Field investigation activities consisted of test pits, direct push borings, gas monitoring well installation, HSA boring, groundwater seep sampling, and methane sampling. Landau Associates contracted with MRC Construction for excavation of the test pits using a rubber-tired backhoe, ESN Northwest for the direct push probes and gas monitoring well installation, and Holocene Drilling for the HSA boring. Landau Associates field personnel documented soil and fill conditions, collected and evaluated soil samples and the groundwater seep sample, and directed the installation of the gas monitoring probes at the direct push probe locations. Methane sampling was conducted by the City and TPCHD. Boring logs for the test pits, direct push borings, and the HSA boring are included in Appendix A. The test pit, direct push (geoprobe), HSA boring, and groundwater seep sampling locations are shown on Figure 2.

During site exploration, Landau Associates performed field screening[7] of samples and soil conditions at all exploration locations (Landau Associates 2008b). Samples were selected for laboratory analysis based on where field screening indicated TPH contamination was most likely to occur. The intent in using this procedure was to document the highest concentrations of constituents in soil at the

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[6] In the RI Work Plan (Landau Associates 2008) groundwater seep sampling is referred to as surface water sampling.

7 Field screening consisted of visual observation, odor observations and photoionization detector (PID) screening of soil conditions (test pits) or samples (probes and boring). Field screening data is summarized on logs in Appendix A.

site. Explosimeter readings were also collected as part of the health and safety plan. Soil and water samples were analyzed at the City laboratory at the Tacoma Landfill (metals only) and at Analytical Resources Incorporated (ARI) in Tukwila, WA

2.1.1 TEST PITS

Ten test pits (TP-LAI-01 through -10) were excavated to observe shallow soil conditions and to collect soil samples. The depth of the test pits ranged from 12 to 14.5 ft BGS. Two soil samples were collected from each location for laboratory analysis. Each sample was tested for select metals and diesel-range hydrocarbons (NWTPH-Dx). Based on field observations, six samples that were most likely to contain TPH contamination were selected for additional analyses for benzene, toluene, ethylbenzene, and xylenes (BTEX), extractable petroleum hydrocarbon fraction (EPH) and carcinogenic polyaromatic hydrocarbons (cPAHs)[8]. After sampling was completed, the excavated soil was returned to the test pit and graded to its original profile.

2.1.2 HOLLOW STEM AUGER BORING

One HSA boring (B-LAI-01) was drilled in the center of the landfill site to a depth of 81 ft BGS with a truck-mounted hollow-stem auger drill rig. Soil samples were collected at 5-ft intervals using a split spoon sampler driven 18-inches with a 140-lb automatic hammer with a 30-inch fall. Three of the samples (collected at 15-16.5 ft, 35-36.5 ft, and 75-76.5 ft BGS) were retained for laboratory analysis based on field observations. Each sample was tested for metals and NWTPH-Dx. One sample from the 35-36.5 depth was also tested for cPAHs and BTEX.

After the drilling was completed, the boring was backfilled in accordance with applicable well regulations (WAC 173-160) and capped with quick-setting concrete. Soil and decontamination water from drilling activities were spread out onsite adjacent to the boring location.

2.1.3 DIRECT PUSH BORINGS

Six direct push (geoprobe) borings (GP-LAI-01 through -06) were installed using a direct push probe rig . Boring depths ranged from 25 to 30 ft BGS. After the borings were completed, gas monitoring wells were installed in all six borings.

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[8] In accordance with WAC 173-340-708 (8)(e), cPAH concentrations were adjusted using toxicity equivalency factors and summed to determine a total toxicity equivalent (TEQ) value. All summary tables present individual cPAH values and the corresponding TEQ value.

The direct push probe is designed to collect a continuous sample in 4-ft increments. As is often the case, sample recovery may be less than 4 ft. Actual sample collection intervals ranged from about 1-ft to 4 ft. Three soil samples were collected for laboratory analysis from each boring based on field observations. Each sample was tested for metals and NWTPH-Dx. Based on field observations, a total of four samples were also analyzed for cPAHs and BTEX. Soil from boring activities was spread out onsite adjacent to each boring location.

2.1.4 INSTALLATION OF GAS PROBE WELLS

Gas probe wells were installed at the six direct push probe locations (GP-LAI-01 through -06). The wells were constructed and sealed with bentonite material in accordance with Washington well construction standards for resource protection wells (WAC 173-160). The wells were installed between 25 ft and 30 ft BGS in fill soil and debris. Well installation included 3/4-inch diameter ID schedule 80 PVC pipe. The wells were installed with a 20 ft, 0.010-inch slot size screen, and backfilled with 10 to 20-filter sand pack. The top of screen was set 5 to 10 ft BGS. Each well was completed with a flush mount monument. Well construction details are presented on the well logs in Appendix A.

The gas probe wells were used to monitor methane concentrations during three events on May 15, May 22, and May 29, 2008. Barometric pressure, LEL, oxygen, and hydrogen sulfide levels were also measured. Methane samples were collected in the field using either a GasTech Innova LS or GasTech GT201 & Landtec GEM 500 instruments. During the first sampling event, methane was measured by Mike Gore from the City and John Wright from the TPCHD. During the subsequent sampling events, methane was measured by the City. During the first sampling event, no significant purging was done from the probes other than to let them vent for a minute or two. Subsequent sampling followed standard City procedures that included evacuating the probes prior to sampling.

2.1.5 GROUNDWATER SEEP SAMPLING

A groundwater seep sample (SW-LAI-01) was collected from the north-facing edge of the landfill. The groundwater seep surfaces on the north side of the East 34th Street bridge through a concrete pipe that collects water from the base of the fill[9]. The water flows from the vicinity of the pipe across the ground surface and disappears into vegetation; there is no defined surface water channel. The water sampling was performed by Landau Associates using a peristaltic pump and 1/4-inch tubing with a

[9] The City does not have a record of the concrete pipe being connected to the City sewer system; therefore, it is assumed that this pipe represents groundwater seepage from water infiltrating through the fill.

filtered end, placed into the center of the discharge stream. The water sample was analyzed for dissolved metals, NWTPH-Dx, BETX, cPAHs and naphthalenes.

2.2 PROPOSED SITE CLEANUP STANDARDS

Cleanup standards were developed in accordance with MTCA requirements to be protective of human health, terrestrial ecological receptors, and groundwater. Exposure pathways and receptors based on current and likely future uses of the site were identified as part of cleanup standard development.

2.2.1 CURRENT AND LIKELY FUTURE LAND USE

The site is zoned as residential and commercial, and is currently undeveloped. The City anticipates development of the site after approval and implementation of the CAP. Based on zoning and development, plans summarized in Section 1.3, future land use is assumed to be residential and commercial. Based on current and likely future land use, cleanup levels should be protective of unrestricted land use.

2.2.2 EXPOSURE PATHWAYS

Potential exposure pathways were identified for human and environmental impacts based on the planned land use and by media. The potential exposure pathways for site soil are:

- Human contact through dermal, incidental ingestion, or inhalation with contaminants in soil at the site
- Human ingestion of constituents in groundwater affected by contaminants leached from site soil.

Uptake of contaminants in site soil by terrestrial biota is not considered a potential exposure pathway because the site qualifies for an exclusion for a terrestrial ecological evaluation (Section 2.2.4).

Exposures to methane in air is not addressed by MTCA. Therefore, the Minimum Functional Standards for Solid Waste Handling regulations (MFS Regulations) (WAC 173-350-400) were used to assess acceptable levels for human exposure.

2.2.3 PROPOSED SITE CLEANUP LEVELS

Soil cleanup levels for unrestricted land use were developed in accordance with WAC-173-340-740, using the exposure pathways identified above. Based on the known contaminants at the site, MTCA Method A residential soil cleanup levels and MTCA Method A groundwater as drinking water levels (WAC 173-340-740) have been established as conservative cleanup levels for the site because the site has

relatively few hazardous substances, and is expected to undergo a routine cleanup action. The MTCA Method A levels are presented on Tables 1, 2, and 3 for soil and Table 4 for groundwater.

As a conservative measure to evaluate whether the residual total petroleum hydrocarbon (TPH) concentrations would be protective of groundwater, EPH concentrations were used to develop total TPH cleanup levels for six of the test pit samples. The worksheets for these calculations are included in Appendix B.

For assessing exposures to methane in air, the LEL for methane of 5 percent was used. This is the allowable level for protection of human health at the property boundary, as specified in the MFS Regulations.

2.2.4 ASSESSMENT OF ECOLOGICAL RISKS

MTCA requires that ecological receptors be evaluated in conjunction with assessing potential human health impacts. Components of an ecological risk evaluation are terrestrial, aquatic, and benthic. The site is a mixed use area with limited habitat for wildlife. Final build out plans will result in the majority of the 5 acre site being covered with impervious services or fenced areas, with the remainder landscaped and managed vegetation.

Ecology provides exclusions from a terrestrial ecological evaluation if the site meets certain criteria identified in WAC 173-340-7491. Based on the development concept for the site, Landau Associates determined that all soil contaminated with hazardous substances will be covered by buildings, pavement, or other maintained physical barriers/caps. Consequently, the site qualifies for an exclusion from a terrestrial ecological evaluation under WAC 173-340-7491(1)(b). This exclusion requires the implementation of engineered and institutional controls through an environmental covenant.

2.2.5 POINTS OF COMPLIANCE

Under MTCA, the point of compliance is the location on a site where the cleanup levels must be attained. The point of compliance for soil will be assumed to be throughout the site to a depth of 15 ft for human exposure due to direct contact, in accordance with WAC 173-340-740. The point of compliance for protection of groundwater is soil throughout the site. The point of compliance for groundwater is throughout the site in accordance with WAC 173-340-720. The point of compliance for methane in air is assumed to be throughout the site to a depth of 15 ft.

Not for protection of gw

3.0 RI RESULTS SUMMARY

RI field observations and laboratory sampling results indicate that soil contamination is limited to minor cPAH impacts. Groundwater quality is not affected by releases at the site, however there is buried organic matter producing a limited amount of methane. The results of the RI field investigations are generally consistent with historical site investigations described in Section 1.2.1. RI soil data is summarized in Tables 1 through 3 and is displayed graphically on Figures 3 through 9. RI groundwater seep data is summarized in Table 4 and displayed graphically on Figure 10. RI methane sampling data is summarized in Table 5.

3.1.1 SOIL

Field observations during test pit and drilling activities conducted for the RI indicate that mixed fill material and soil exists to the full depths of the test pits and direct push borings (maximum depth of 30 ft BGS). It is also likely that fill exists to the full depth of the HSA boring (81 ft BGS) based on the presence of wood debris and gravel observed near the base of the boring. This interpretation is consistent with aerial photographic analysis of the ravine prior to and during filling[10] and a deep (over 90 ft) boring drilled near South 37th Street (AGI 1990). Analytical results indicate that none of the soil concentrations from the RI or the historical results exceed MTCA Method A cleanup levels (see Tables 1 through 3 and Figures 3 through 9), except for the following:

- ***Motor Oil Range Petroleum Hydrocarbons:*** TPH was analyzed in 41 RI samples. Only one soil sample exceeded the MTCA Method A cleanup level of 2,000 mg/kg (at B-LAI-01 at 35-36.5 ft BGS) for motor-oil range hydrocarbons with a level of 4,000 mg/kg. While a single sample exceeded the MTCA Method A cleanup level, the TPH data set is in compliance with TPH cleanup levels, as follows:

  - the upper 95th percent confidence level of the mean of the data is 1,132 mg/kg, which is below the MTCA Method A cleanup level [WAC 173-340-740(d)(i)] (MTCA Stat statistical work sheets are included in Appendix C)

  - less than 10 percent of the samples concentrations exceed the MTCA Method A soil cleanup level [WAC 173-340-740(7)(e)]

  - no single sample is greater than two times the MTCA Method A cleanup level [WAC 173-340-740(7)(e)]

  - the single exceedence of the cleanup standard was from a sample below the point of compliance (i.e., 15 ft depth) for direct contact

[10] A summary of aerial photographs is presented in the *Environmental Site Assessment* prepared by the City of Tacoma (1992).

- there are no TPH impacts to groundwater.

- ***Arsenic:*** Arsenic was analyzed in 41 RI samples. A single soil concentration of arsenic of 21.5 mg/kg was observed at direct push boring GP-LAI-04 at 16-20 ft BGS, exceeding the MTCA Method A cleanup level of 20 mg/kg. This boring was located about 40 ft north of the southern boundary of the site. Previous investigations detected arsenic concentrations that were twice the MTCA Method A cleanup level. While a single RI sample exceeded the MTCA Method A cleanup level, the RI arsenic data set is in compliance with arsenic cleanup levels, as follows:

  - the upper 95th percent confidence level of the mean of the RI data is, 9.9 mg/kg, below the MTCA Method A cleanup level [WAC 173-340-740(d)(i)] (MTCA STAT statistical work sheets are included in Appendix C)

  - less than 10 percent of the samples concentrations exceed the MTCA Method A soil cleanup level [WAC 173-340-740(7)(e)]

  - no single sample is greater than two times the MTCA Method A cleanup level [WAC 173-340-740(7)(e)].

- ***cPAHs:*** CPAHs were analyzed at 11 locations where soil was estimated to have the highest potential for a cPAH impact based on field observations. Concentrations (adjusted to TEQ) exceeding the MTCA Method A cleanup level of 0.1 mg/kg (100 µg/kg) were observed at eight locations with total cPAH concentrations ranging from 102.7 to 614.2 µg/kg at depths ranging from 4 to 20 ft BGS.

EPH analyses were conducted on six test pit samples where soil was estimated to have the highest potential for a TPH impact based on field observations. EPH analyses consist of aromatic and aliphatic hydrocarbons in a specific carbon range (i.e., C8 to C34). Screening criteria were evaluated for each sample using equation 740-3, the four-phase partitioning model [WAC 173-340-747(6)], and Ecology's MTCA petroleum hydrocarbons workbook (Ecology 2006). Data included in the workbook evaluations include BTEX and cPAHs. The results of the workbook evaluations are presented in Appendix B. Workbook evaluations indicate that four of the six samples exceed cleanup criteria for direct contact based on cPAH concentrations. The workbook evaluations indicate that soil concentrations are protective of groundwater.

3.1.2 GROUNDWATER SEEP

The groundwater seep sample consists of groundwater that infiltrates through the fill and discharges along the base of the old ravine. Groundwater seep samples did not detect any constituents above cleanup levels.

As described in Section 1.2.1.2, multiple groundwater seep samples were collected by the City or its contractors between 1999 and 2004. None of the concentrations in these samples exceeded MTCA Method A values for drinking water.

3.1.3 METHANE

Methane measurements were collected from the six gas probe wells during three events in May 2008. Methane exceeded the LEL at LAI-05 and LAI-06 during the first sampling event, but not in the two subsequent sampling events. Methane exceeded the LEL at LAI-02 only in the two latter sampling events. The discrepancy in sampling results may have to do with sampling technique. The wells were purged prior to sampling in the second and third sampling events, but not in the first. The highest methane concentration was 27 percent at LAI-05 (May 15, 2008 sampling event), though the concentration declined to 1.7 percent by the May 29, 2008 sampling event. The gas probe measurements are presented on Table 5.

As discussed in Section 1.2.1.3, multiple methane measurements have been conducted historically by the City or TPCHD between 1990 and 2006. These measurements indicated that relatively high methane concentrations were detected initially, but concentrations decreased over time to well below cleanup levels. During the six sampling events conducted between 2004 and 2006, overall methane levels were very low, with the highest sampling result being 3.1 percent LEL (i.e., 0.15 percent methane).

3.1.4 SUMMARY

Based on the RI sampling data set, the only constituent that exceeds cleanup levels is cPAH in soil. CPAHs were detected above the cleanup level from 4 to 20 ft BGS in 8 of 11 samples. Three of the eight exceedences were from samples below the point of compliance (i.e., below 15 ft). Overall, cPAH impacts to the site, while above the cleanup standard, are considered low to moderate. Sample results were collected at what was considered the most impacted soil horizons; this methodology produces sample results that are biased toward higher concentrations. If random samples were collected within the upper 15 ft of the soil column, concentrations would very likely be lower than cleanup standards based on MTCA statistical procedures. CPAHs are relatively common constituents in urban environments and would be expected in vactor waste and street sweepings. The occurrence of cPAHs at the site is consistent with the historical use of this site as an area where these materials were placed.

Based on the historical data set, some arsenic concentrations were detected above the MTCA soil cleanup level. However, the RI data set did not indicate an exceedance of arsenic in soil. For the

purposes of site characterization, the RI data set is considered higher quality and therefore more representative.

Impacts to groundwater are not a concern at the site. Groundwater was not encountered in fill soil. The groundwater seep at the toe of the fill slope did not detect constituents above cleanup levels. Evaluation of TPH related constituents and arsenic indicate soil concentrations are below levels that would impact groundwater through the soil to groundwater pathway.

Methane being generated at the site is likely from decaying organic matter within the fill. The source of the organic matter was not identified in site explorations and is assumed to be distributed throughout the fill. Methane concentrations in RI wells is generally low but variable. Concentrations were detected above the LEL during at least one sampling event in three locations. These data indicate the potential for methane to accumulate in onsite structures without appropriate mitigation. Previous investigations suggest that methane concentrations are declining over time and are not present offsite.

4.0 FEASIBILITY STUDY

This cleanup action was developed to address cPAHs in soil and methane in soil gas. Development of a cleanup action is a multi-step process that includes identifying cleanup action objectives (CAO) and cleanup action alternatives that achieve CAOs.

This alternative development, evaluation, and selection process is accomplished by conducting a feasibility study [FS; WAC 173-340-350(8)]. The FS develops alternatives that achieve the CAOs, compares the alternatives against criteria established under MTCA (WAC 173-340-360), and selects the alternative that is permanent to the maximum extent practicable. A consideration in evaluating technologies and alternatives is the need to integrate cleanup with redevelopment for the site (Section 1.3).

4.1 CLEANUP ACTION OBJECTIVES

CAOs for site remediation are:

- Prevent human contact (dermal, incidental ingestion, or inhalation) with site soil containing cPAHs above the proposed soil cleanup level
- Prevent terrestrial ecological exposure above acceptable levels
- Provide measures to monitor and control methane gas at the site
- Return the site to productive use.

MTCA Method A soil cleanup levels for cPAHs have been established as cleanup levels for site soil to allow for unrestricted site use. The point of compliance for human/ecological receptors is defined in MTCA as throughout the site from the surface to a depth of 15 ft. If site development requires excavation of soil below 15 ft, the point of compliance will extend to the maximum depth of site excavation.

4.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Cleanup actions conducted under MTCA must comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate. Collectively, these requirements are referred to as ARARs. This section provides a brief overview of potential ARARs for the site cleanup. The primary ARAR is the MTCA cleanup regulation (WAC 173-340) especially with respect to the development of cleanup levels and procedures for development and implementation of a cleanup under MTCA. Other primary ARARs that may be applicable to the cleanup action include the following:

- **Washington Solid Waste Management Act (Chapter 70.95 RCW) and the following implementing regulations: Solid Waste Handling Standards (WAC 173-350) and Criteria for Municipal Solid Waste Landfills (WAC 173-351).** These regulations establish a comprehensive statewide program for solid waste management, including proper handling and disposal. Although not planned, the management of excavated contaminated soil from the site will be conducted in accordance with these regulations.

- **Washington Hazardous Waste Management Act (Chapter 70.105 RCW) and the following implementing regulation: Dangerous Waste Regulations (WAC 173-303).** These regulations establish a comprehensive statewide framework for the planning, regulation, control, and management of dangerous waste. The regulation designates those solid wastes that are dangerous or extremely hazardous to the public health and environment. Although not planned, the management of excavated contaminated soil from the site would be conducted in accordance with these regulations to the extent that any dangerous wastes are discovered or generated during the cleanup action.

- **Hazardous Waste Operations (WAC 296-843).** This regulation establishes safety requirements for workers providing investigation and cleanup operations at sites containing hazardous materials. These requirements would be applicable to onsite cleanup activities and would be addressed in a site health and safety plan prepared specifically for these activities.

4.3 DEVELOPMENT OF CLEANUP ACTION ALTERNATIVES

MTCA allows for complying with the cleanup standards at a site by various methods. Some methods involve physical removal or destruction of the hazardous substances to achieve concentrations in media that are below the cleanup levels. Other methods consist of stabilizing or containing the hazardous substances onsite and preventing human contact with concentrations above the cleanup levels. MTCA provides a hierarchy for selecting cleanup technologies [WAC 173-340-360(4)] with more permanent technologies (such as destruction) preferred over less permanent technologies (such as containment). However, either approach (or a combination) results in an acceptable cleanup action, provided the risk posed by the site is reduced to an acceptable level as a result of the cleanup action and it can be shown, through a disproportionate cost analysis [WAC 173-340-360(3)(e)], that the cleanup action uses permanent solutions to the maximum extent practicable.

Cleanup actions have been divided into active and passive cleanup actions. Potentially viable active cleanup actions identified for the site are:

- Excavation and offsite disposal
- Soil stabilization or encapsulation
- Containment.

Potentially viable passive cleanup actions identified for the site are:

- Soil gas venting and monitoring

- Institutional controls
- Education
- Fencing or other access constraints.

Actions are evaluated based on effectiveness, implementability, and cost. Applicable actions are combined into proposed cleanup action alternatives.

4.3.1 EVALUATION OF ACTIVE CLEANUP ACTIONS

This section provides a description and evaluation of the active cleanup actions for the site. Containment is the active cleanup action that was identified as most appropriate and applicable to meet cleanup action objectives for the site. Containment is the preferred option because it is effective at isolating underlying contamination from direct contact, thereby providing reasonable protection, given the relatively low concentration of cPAH in soil and absence of groundwater contamination. Excavation and offsite disposal and soil stabilization were not considered appropriate due to the minimal additional effectiveness in providing protection to human health and the environment combined with higher implementation difficulty and cost.

4.3.1.1 Containment

Under the containment option, soil and debris is contained and isolated from direct human contact by placing a cap or barrier layer over contaminated soil prior to site development. Containment would be feasible and appropriate across the site. Because the majority of the site is planned for development, and select fill will be required to support planned development, some soil and debris will need to be removed and either screened and consolidated under structures and infrastructure as fill at the developed site, or be managed offsite.

Containment at the site could include a clean fill cap overlying impacted soil and debris and covered by a vegetative layer with or without an intervening crushed rock subgrade and/or geotextile fabric (the geotextile fabric would provide a long-term physical marker separating the underlying contaminated material from the overlying clean fill cap). In areas covered by impervious surfaces, such as asphalt, roads, paved parking surfaces, and buildings, containment could be appropriately designed to incorporate these structures as containment cap components. Under all design scenarios, the goal of containment would be to reduce direct exposure to contaminated soil. Best management practices (BMPs) such as erosion control, grading, and seeding would be employed to preserve the integrity of the cap.

The *in-situ* containment action is consistent with the site development goals, since it would be effective in protecting human health and the environment as long as it is combined with institutional controls, and can be conducted for relatively low cost.

Advantages associated with the containment option are:

- Containment would be relatively easy to implement. The containment cap could be constructed primarily from inert fill material (i.e. concrete, asphalt, or clean soil). This option could be incorporated into the future development design where fill material will be needed for construction.

- A containment cap would be effective in preventing dermal contact with contaminated fill or soil. The long-term integrity of containment could be preserved through institutional controls.

- The cost of containment (assuming a 1½ ft thick soil and crushed rock cap with underlying geotextile fabric and planted vegetative surface over 5 acres) would be moderate[11] .

4.3.1.2 Excavation and Offsite Disposal

This option would include the removal of the upper 10 to 15 ft of soil and fill across the site, requiring about 80,000 to 120,000 yards (120,000 to 200,000 tons) of material to be managed. Contaminated soil and fill would be placed in dump trucks (after segregation from clean material) and disposed at a regional RCRA Subtitle D landfill (assuming the soil passes TCLP tests for characteristic hazardous waste). Assuming 50 percent of the excavated material was contaminated, 40,000 to 60,000 yards (60,000 to 100,000 tons) of material would need to be transported and disposed of offsite. The nearest landfill that may accept the soil is the Olympic View Landfill on the Kitsap Peninsula, but others are also available in western Washington.

The excavation and offsite disposal option was not considered applicable at this site for the following reasons:

- The cost of this option would be high compared to containment. A total of 60,000 to 100,000 tons of contaminated material would need to be transported and disposed of at a cost of $45/ton (assuming a cost of $40/ton for excavation, transport, and disposal, and $5/ton for segregation) for a total excavation and disposal cost of $2.7 to $4.5 million. Backfilling the excavation with clean fill would cost an additional $2.4 to $3.6 million for a total project cost of $5.1 to $8.1 million. This cost is estimated to be over 10 times greater than the containment option and achieves a similar level of protection.

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[11] The incremental cost of containment depends on areas that require capping (i.e., where cPAHs exceed cleanup levels) and proposed development plans (i.e., percentage of site that would be capped anyway with roads and buildings), the need for a geotextile and the thickness of fill. The costs would likely be more than $100,000 but less than $500,000.

- This option creates many adverse off-site impacts. Transporting contaminated materials would require 3,300 to 5,500 dump truck trips (assuming 12 yards per load), creating substantial truck traffic at and near the site and along urban and rural roads in Pierce and other counties (depending on the disposal site selected). This option also creates attendant noise, fuel consumption, emission, and other impacts.

4.3.1.3 Soil Stabilization/Encapsulation

Soil stabilization/encapsulation both entail mixing contaminated soil and construction debris with cement to reduce contaminant solubility, mobility, leachability, and toxicity. Stabilization or encapsulation would be used in combination with the onsite containment option (i.e., the stabilized/encapsulated soil would be contained on site). The stabilization and encapsulation option was not considered applicable for the following reasons:

- The process would not be significantly more effective in protecting human health and the environment than the containment option alone.

- The mixed nature of the fill material (i.e. construction debris with soil) would make it very difficult to stabilize or encapsulate.

- The potentially large volume of soil and fill would require significant infrastructure, potentially causing a significant modification to the development plan.

- The cost of this option would potentially be very high relative to other options. Segregation of soil from construction debris, replacement of segregated materials, and soil stabilization would cost approximately $100 per yard, or $70 per ton for 60,000 to 100,000 tons of managed material, at a cost of $4.2 million to $7 million. The cost of this option is within the same range as the excavation and disposal option.

4.3.2 Evaluation of Passive Cleanup Actions

This section provides an evaluation of passive cleanup actions. These actions would be applied to the site to reduce potential exposure to contaminated fill/soil and methane in air and to maintain active remedies. Soil gas monitoring, institutional controls, education and access constraints are the four passive actions that are most applicable for future development of the site.

4.3.2.1 Soil Gas Venting and Monitoring

Soil gas venting and monitoring provides a way of addressing the potential for methane to accumulate beneath impervious or low permeability surfaces at the site. This technology would be flexible and allow for the inclusion of active pumping if deemed necessary based on monitoring. A soil gas venting system is considered more applicable than a larger more costly extraction system because of the relatively low levels of methane at the site, the lack of offsite methane and the relatively similar effectiveness of the two approaches. Methane venting and extraction should be accompanied by a

monitoring plan that records the concentration of methane being extracted from the system as well as the concentration of methane in high occupancy areas within each building.

4.3.2.2 Institutional Controls

Institutional controls consist of environmental covenants placed on the property deed notifying the property owner of requirements for specific operations and management procedures for a site where waste is left in place. The primary purpose of the environmental covenant would be to notify a potential property purchaser of the presence of site soil and methane impacts. It would also require certain actions of future owners such as protection of site workers that may become exposed to the waste and proper disposal of the waste if it is removed in the future. Restrictive covenants are required by MTCA if contaminants are left onsite above cleanup levels. Restrictive covenants should be relatively low cost and easy to implement.

4.3.2.3 Education

Education would consist of outreach and communication to inform workers and future residents of soil and methane impacts. Signage or provisions in the O&M manual would be one example of educational communication. Site signage is not considered effective due to the low concentrations of cPAHs, and the difficulty in communicating the low level risk on a public sign; the likelihood that the sign would be misinterpreted would be high. An operations and maintenance manual is considered an effective way of documenting site conditions and site procedures. The site owner should maintain an operation and maintenance (O&M) manual and log that documents the specific cleanup actions that were carried out at the site and implement specific procedures for maintaining containment areas, worker health and safety procedures, preventing runoff and erosion, and conducting long-term monitoring, as necessary. The development and implementation of O&M procedures would be relatively low-cost, easy to implement, and effective at reducing exposure to soil and methane impacts.

4.3.2.4 Fencing or other Access Constraints

Access constraints consist of fencing and gates. Deed restrictions that limit use of portions of the site may also be considered an access constraint. Though access constraints would be relatively low-cost, they would be difficult to enforce and could limit the use and atheistic value of the property. Consequently, access constraints are not considered applicable or appropriate to development of this site.

4.4 REQUIREMENT FOR A PERMANENT SOLUTION TO THE MAXIMUM EXTENT PRACTICABLE

WAC 173-340-200 defines a permanent solution as one in which cleanup standards can be met without further action being required at the site, other than the approved disposal of any residue from the treatment of hazardous substances. Ecology recognizes that permanent solutions may not be practicable for all sites and provides a procedure referred to as a disproportionate cost analysis [WAC 173-340-360(3)(e)] to determine whether a cleanup action is permanent to the maximum extent practicable.

The purpose of the disproportionate cost analysis is to determine if the incremental increase in costs of a cleanup alternative over that of a lower cost alternative is justified by providing a corresponding incremental increase in human health and environmental benefits. If the incremental increase in costs is determined to be disproportionate to the benefits, the more expensive alternative is considered impracticable and the lower cost alternative is determined to be permanent to the maximum extent practicable. This process provides a mechanism for balancing the permanence of the cleanup action with its costs, while ensuring that human health and the environment are adequately protected.

All of the active cleanup technologies described in Section 4.3.1 are considered to be permanent cleanup solutions. While the excavation and disposal option permanently removes contaminated material from the site (for disposal in a certified Class D landfill), it is very expensive to implement given the low impacts and risks posed by onsite contamination and it imposes significant off-site impacts. The stabilization and encapsulation option does not remove contaminated material from the site (except for material that removed during excavation as part of site development), but it does provide a permanent and appropriate protection from direct contact through stabilization and isolation of contaminated soil and construction debris. The cost of this option is prohibitively expensive because of the substantial costs and impractability associated with excavating the material temporarily to segregate soil from debris before returning it to the excavation and stabilizing the soil before encapsulation. This option also provides little additional protection to human health and the environment when compared with the containment option. The containment option is considered permanent in that it provides permanent protection as long as institutional and other controls are maintained, and it is highly cost-effective relative to the most permanent option (i.e., the excavation and disposal option), rendering it permanent to the maximum extent practicable.

4.5 REQUIREMENT FOR A REASONABLE RESTORATION TIMEFRAME

WAC 173-340-360(6)(a) specifies that eight factors be considered when determining whether a cleanup action provides for a reasonable restoration timeframe. These factors are:

- ***Potential risks to human health and the environment***: All proposed soil cleanup options will eliminate the exposure pathway for human contact with affected soil. The soil gas venting and monitoring option will be necessary to prevent potential human exposure to methane via the soil gas to indoor air pathway.

- ***Practicability of achieving shorter restoration time frame***: While all active cleanup action options will achieve cleanup within a reasonable restoration timeframe, the containment option will require the least time to complete. This cleanup action is expected to be completed within a couple of years of completing site development plans; the other two options are likely to take longer.

- ***Current use of the site, surrounding areas, and associated resources that are, or may be, affected by releases from the site***: Parcels composing the current site are zoned as residential and residential/commercial, and the site is expected to be developed in zoning-compatible residential uses. Contamination will be contained and offsite migration of contaminants is not expected to occur with any of the active cleanup options considered.

- ***Availability of alternate water supplies***: Groundwater is not impacted by site conditions.

- ***Likely effectiveness and reliability of institutional controls***: Environmental covenants would be required under both the stabilization/encapsulation and containment cleanup options. A covenant filed with the deed is an effective and relatively standard approach to address low levels of contamination left in place.

- ***Ability to control and monitor migration of hazardous substances from the site***: Monitoring data indicate that significant migration of hazardous substances from the site is not occurring at levels of concern. Specific monitoring requirements for soil gas will be implemented as part of the recommended cleanup action.

- ***Toxicity of hazardous substances at the site***: The main constituents of concern at the site are cPAHs in soil and methane in soil gas. The toxicity of these constituents and the risk to human receptors at the site is low because the concentrations are low

- ***Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions***: Natural processes are not anticipated to reduce the concentrations of cPAHs in soil, but historical trends in methane gas levels indicate that methane levels have decreased under natural conditions.

4.6 REQUIREMENT FOR CONSIDERATION OF PUBLIC CONCERNS

Consideration of public concerns is part of the site cleanup process under MTCA (WAC 173-340-600). Public concerns will be addressed if they are raised through the permitting process or as they are brought to the attention of Ecology or the City.

5.0 RECOMMENDED CLEANUP ACTION ALTERNATIVE

The recommended cleanup action alternative consists of the following combination of active and passive cleanup actions:

- *In-situ* containment of impacted soil left in place
- Venting and monitoring of soil gas for methane
- Deed restrictions in the form of an environmental covenant
- Preparation of an O&M manual for the site for compliance monitoring
- Preparation of a health and safety plan.

This alternative meets the CAOs of protecting human health and the environment from the low levels of cPAHs at the site and provides for assessment and control of methane gas. These actions are also consistent with and can be incorporated into site development plans. They also can be implemented at a relatively reasonable cost.

5.1 *IN-SITU* CONTAINMENT

Recommended *in-situ* containment activities consist of placing and maintaining a soil and vegetative soil cover over areas across the site where cPAHs exceed MTCA cleanup standards in the upper 15 ft. Currently it appears that cPAHs may be present throughout the site. However, additional sampling should be conducted to refine the understanding of the cPAH distribution and delineate areas where capping is necessary. This cleanup action does not include the geotechnical considerations that will be required to address structural integrity of construction of buildings on fill material; these will be included within the development design.

The selected *in-situ* containment option for the site includes:

- Development and implementation of a final sampling plan to refine the characterization cPAHs and determine where containment is necessary. Sampling would be completed on a regular grid pattern with samples collected from two depths between 0 and 15 ft BGS in each grid

- Removal of any vegetation and composting in areas where containment is necessary

- Placement of a 1½ ft thick soil layer consisting of clean soil or structural fill and placement of a vegetative surface layer over the fill. This cap would be placed in areas where cPAHs exceed cleanup levels but not in areas occupied by buildings or paved surfaces or in areas where cPAHs are not present above cleanup levels.

5.2 SOIL GAS VENTING AND MONITORING

The final design of the gas venting system would be developed as part of the building design with the primary objective of preventing the occurrence of methane gas within the building. It is anticipated that the gas vents will consist of installation of a minimum of three soil vapor extraction wells per residential development area (major constructed building). Wells will be installed within structural backfill and will extend beneath the buildings. The backfill should facilitate the development of positive pressure gradients towards the wells underneath the building, thereby passively intercepting methane gas before it migrates into the structure. In the event that passive venting is not effective in preventing methane gas from entering the structure, a manifold and blower system will be installed for each residential development area.

Within the first month after the containment cap is installed, indoor air monitoring should be conducted at a minimum of three locations in high occupancy living spaces (e.g. work space, living space). The indoor air quality monitoring should be conducted over 8-hour periods using Summa canisters and continue on a quarterly basis. Indoor methane monitoring should continue until a full year of results are non-detect for methane. Methane monitoring should also be conducted in each of the passive/active vents on a quarterly basis for the first year. Afterwards, monitoring should continue on an annual basis until concentrations are below the LEL for two consecutive years. Methane monitoring procedures will be defined in a site operation and maintenance manual.

5.3 DEED RESTRICTIONS

The site deed will be amended with an environmental covenant. The covenant will be consistent with the Uniform Environmental Covenants Act (RCW 64.70.040) and be signed by the property owner and Ecology. The covenant will document the occurrence of elevated cPAHs in soil and methane in soil gas, the location of *in-situ* containment areas, require the maintenance of the *in-situ* containment areas, and require protection of workers exposed to contained materials and the proper disposal of contained materials if generated during future construction work. The requirement for an operations and maintenance manual will also be included in the environmental covenant.

5.4 OPERATIONS AND MAINTENANCE MANUAL

An O&M manual will be prepared for the site. The purpose of the manual will be to document current contamination conditions at the site and identify appropriate health and safety procedures and requirements for construction activities. The O&M manual will document the location and as-built specification of the containment cell and define specific procedures for maintaining the *in-situ*

containment areas, define specific procedures for methane monitoring, and define worker health and safety procedures The manual will also include procedures for documenting and maintaining site monitoring data. The site owner will maintain and implement the manual. The manual will be developed as part of development activities and updated as appropriate during following construction phases.

5.5 HEALTH AND SAFETY PLAN

A health and safety plan (HSP) that will be consistent with MTCA requirements in WAC 173-340-810 will be developed for construction activities at the site once the CAP is approved by Ecology. Appropriate health and safety protocols in the HSP will be implemented by the contractors and consultants working onsite during remedial actions. The health and safety plan will address physical and chemical hazards.

The purpose of the plan will be to limit construction worker and site visitor exposure to environmental hazards while employed at the site. Elements of the HSP will include:

- Development of an air monitoring plan to monitor air emissions (e.g. methane) during construction activities. The plan will also include development of compliance criteria for methane in air based on potential worker exposure. The air monitoring plan will be consistent with the Puget Sound Clean Air Agency (PSCAA) regulations for controlling air emissions for workers during construction activities.

- Requirements for worker education and certification.

- Procedures for maintaining personal hygiene and associated facility requirements (i.e. hand and boot wash stations).

- Identification of applicable construction areas where the plan applies.

The HSP will be developed and approved prior to the beginning of construction activities. The plan will be incorporated into the site O&M Manual.

6.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of City of Tacoma for specific application to the 35th Street Landfill site project. No other party is entitled to reply on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

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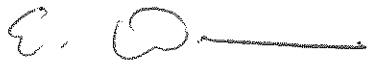

Eric F. Weber, L.G.
Principal

EFW/RB/jas

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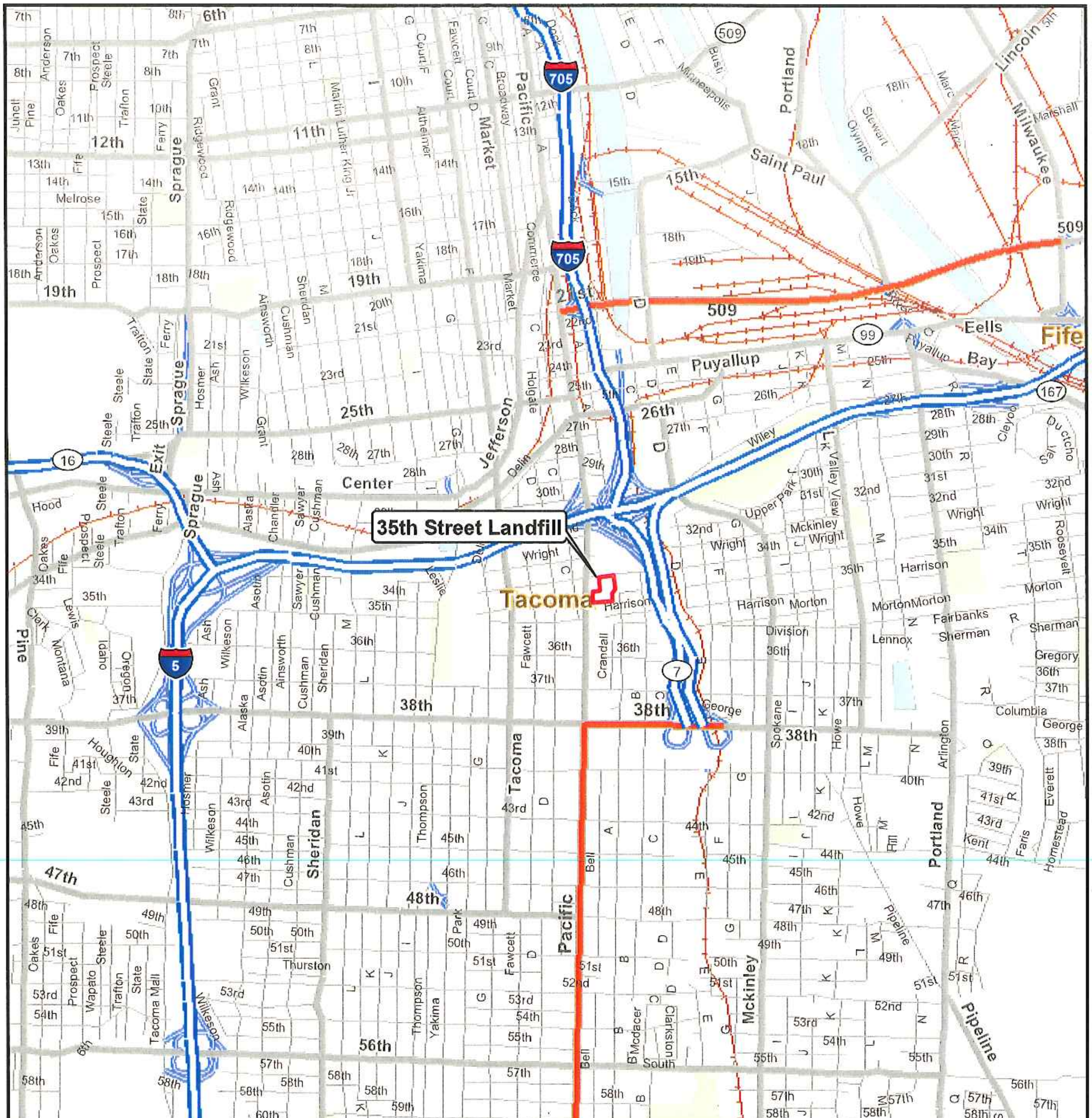

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Data Source: ESRI 2006

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35th Street Landfill Tacoma, Washington	**Vicinity Map**	Figure 1

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Data Source: Google Earth

0 125 250

Scale in Feet

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35th Street Landfill Site
Tacoma, Washington

Current and Historical Sampling Locations

Figure 2

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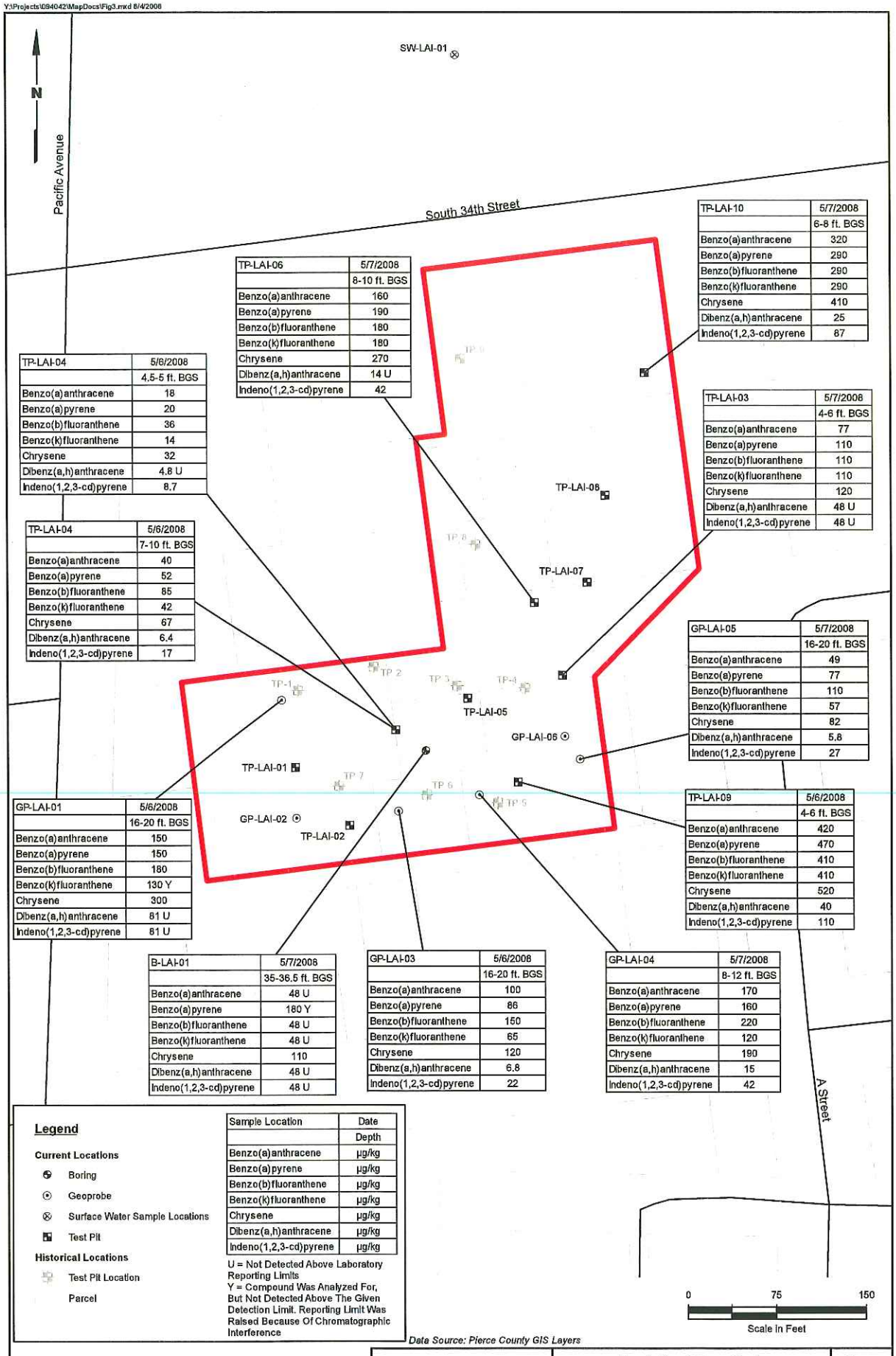

TP-LAI-10	5/7/2008
	6-8 ft. BGS
Benzo(a)anthracene	320
Benzo(a)pyrene	290
Benzo(b)fluoranthene	290
Benzo(k)fluoranthene	290
Chrysene	410
Dibenz(a,h)anthracene	25
Indeno(1,2,3-cd)pyrene	87

TP-LAI-06	5/7/2008
	8-10 ft. BGS
Benzo(a)anthracene	160
Benzo(a)pyrene	190
Benzo(b)fluoranthene	180
Benzo(k)fluoranthene	180
Chrysene	270
Dibenz(a,h)anthracene	14 U
Indeno(1,2,3-cd)pyrene	42

TP-LAI-04	5/6/2008
	4.5-5 ft. BGS
Benzo(a)anthracene	18
Benzo(a)pyrene	20
Benzo(b)fluoranthene	36
Benzo(k)fluoranthene	14
Chrysene	32
Dibenz(a,h)anthracene	4.8 U
Indeno(1,2,3-cd)pyrene	8.7

TP-LAI-03	5/7/2008
	4-6 ft. BGS
Benzo(a)anthracene	77
Benzo(a)pyrene	110
Benzo(b)fluoranthene	110
Benzo(k)fluoranthene	110
Chrysene	120
Dibenz(a,h)anthracene	48 U
Indeno(1,2,3-cd)pyrene	48 U

TP-LAI-04	5/6/2008
	7-10 ft. BGS
Benzo(a)anthracene	40
Benzo(a)pyrene	52
Benzo(b)fluoranthene	85
Benzo(k)fluoranthene	42
Chrysene	67
Dibenz(a,h)anthracene	6.4
Indeno(1,2,3-cd)pyrene	17

GP-LAI-05	5/7/2008
	16-20 ft. BGS
Benzo(a)anthracene	49
Benzo(a)pyrene	77
Benzo(b)fluoranthene	110
Benzo(k)fluoranthene	57
Chrysene	82
Dibenz(a,h)anthracene	5.8
Indeno(1,2,3-cd)pyrene	27

GP-LAI-01	5/6/2008
	16-20 ft. BGS
Benzo(a)anthracene	150
Benzo(a)pyrene	150
Benzo(b)fluoranthene	180
Benzo(k)fluoranthene	130 Y
Chrysene	300
Dibenz(a,h)anthracene	81 U
Indeno(1,2,3-cd)pyrene	81 U

TP-LAI-09	5/6/2008
	4-6 ft. BGS
Benzo(a)anthracene	420
Benzo(a)pyrene	470
Benzo(b)fluoranthene	410
Benzo(k)fluoranthene	410
Chrysene	520
Dibenz(a,h)anthracene	40
Indeno(1,2,3-cd)pyrene	110

B-LAI-01	5/7/2008
	35-36.5 ft. BGS
Benzo(a)anthracene	48 U
Benzo(a)pyrene	180 Y
Benzo(b)fluoranthene	48 U
Benzo(k)fluoranthene	48 U
Chrysene	110
Dibenz(a,h)anthracene	48 U
Indeno(1,2,3-cd)pyrene	48 U

GP-LAI-03	5/6/2008
	16-20 ft. BGS
Benzo(a)anthracene	100
Benzo(a)pyrene	86
Benzo(b)fluoranthene	150
Benzo(k)fluoranthene	65
Chrysene	120
Dibenz(a,h)anthracene	6.8
Indeno(1,2,3-cd)pyrene	22

GP-LAI-04	5/7/2008
	8-12 ft. BGS
Benzo(a)anthracene	170
Benzo(a)pyrene	160
Benzo(b)fluoranthene	220
Benzo(k)fluoranthene	120
Chrysene	190
Dibenz(a,h)anthracene	15
Indeno(1,2,3-cd)pyrene	42

Legend

Current Locations

- Boring
- Geoprobe
- Surface Water Sample Locations
- Test Pit

Historical Locations

- Test Pit Location
- Parcel

Sample Location	Date
	Depth
Benzo(a)anthracene	µg/kg
Benzo(a)pyrene	µg/kg
Benzo(b)fluoranthene	µg/kg
Benzo(k)fluoranthene	µg/kg
Chrysene	µg/kg
Dibenz(a,h)anthracene	µg/kg
Indeno(1,2,3-cd)pyrene	µg/kg

U = Not Detected Above Laboratory Reporting Limits
Y = Compound Was Analyzed For, But Not Detected Above The Given Detection Limit. Reporting Limit Was Raised Because Of Chromatographic Interference

Data Source: Pierce County GIS Layers

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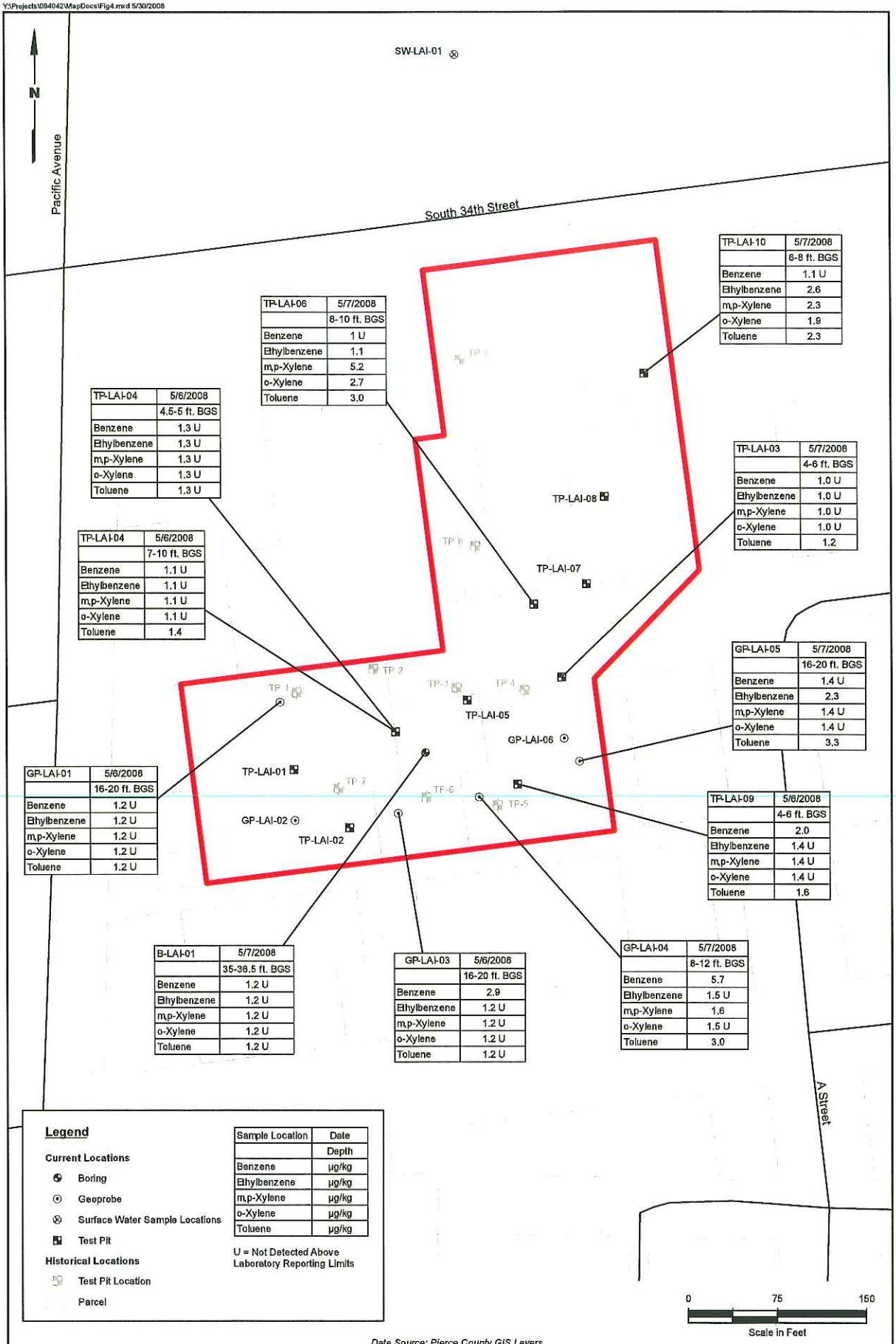
35th Street Landfill Site
Tacoma, Washington

Analytical Results for Carcinogenic Polycyclic Aromatic Hydrocarbons in Soil

Figure 3

Y:\Projects\094042\MapDocs\Fig4.mxd 5/30/2008



Data Source: Pierce County GIS Layers

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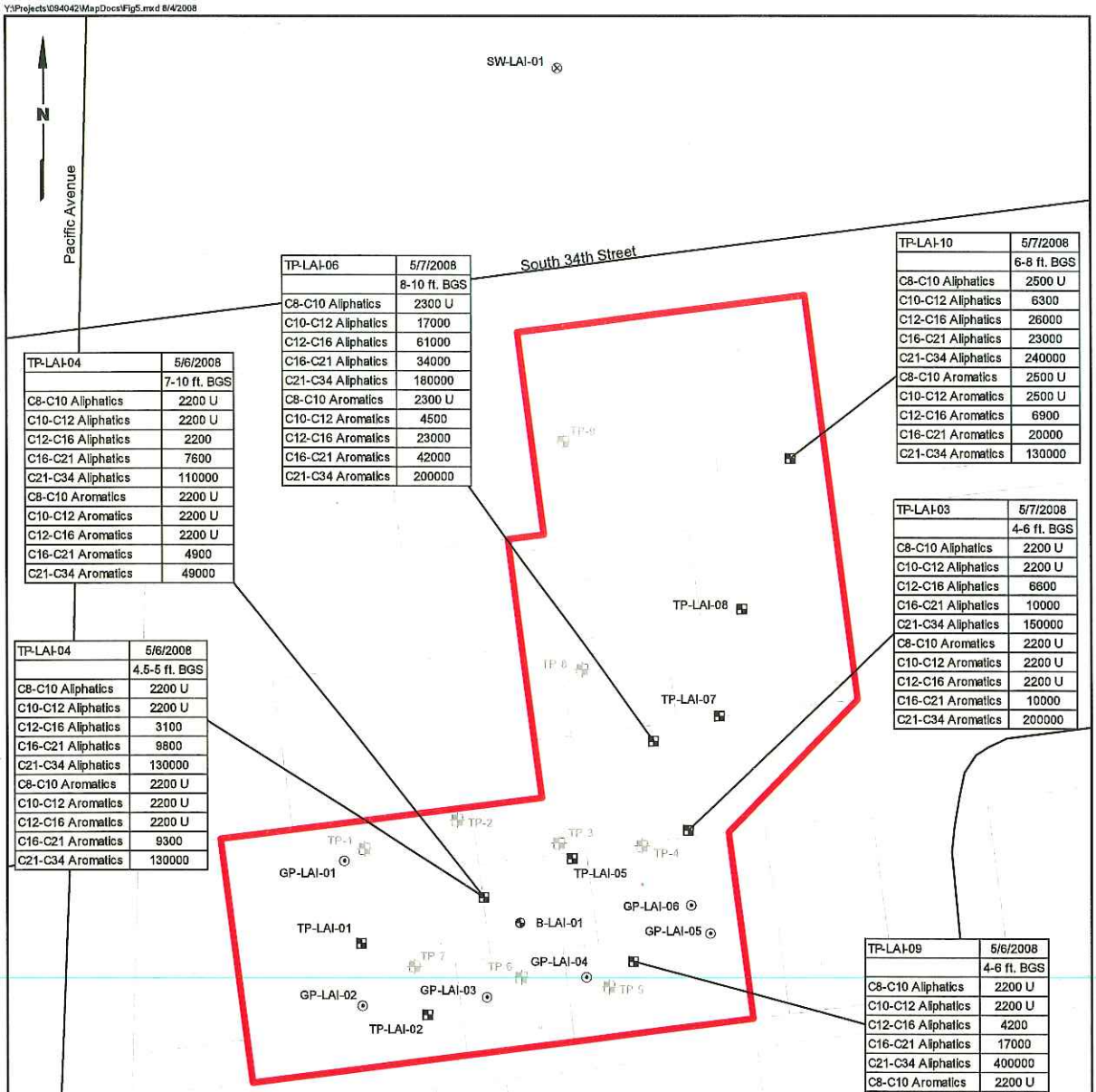
35th Street Landfill Site Tacoma, Washington	**Analytical Results for Benzene, Toluene, Ethylbenzene, and Xylenes in Soil**	Figure 4

Y:\Projects\094042\MapDocs\Fig5.mxd 8/4/2008



TP-LAI-06	5/7/2008
	8-10 ft. BGS
C8-C10 Aliphatics	2300 U
C10-C12 Aliphatics	17000
C12-C16 Aliphatics	61000
C16-C21 Aliphatics	34000
C21-C34 Aliphatics	180000
C8-C10 Aromatics	2300 U
C10-C12 Aromatics	4500
C12-C16 Aromatics	23000
C16-C21 Aromatics	42000
C21-C34 Aromatics	200000

TP-LAI-10	5/7/2008
	6-8 ft. BGS
C8-C10 Aliphatics	2500 U
C10-C12 Aliphatics	6300
C12-C16 Aliphatics	26000
C16-C21 Aliphatics	23000
C21-C34 Aliphatics	240000
C8-C10 Aromatics	2500 U
C10-C12 Aromatics	2500 U
C12-C16 Aromatics	6900
C16-C21 Aromatics	20000
C21-C34 Aromatics	130000

TP-LAI-04	5/6/2008
	7-10 ft. BGS
C8-C10 Aliphatics	2200 U
C10-C12 Aliphatics	2200 U
C12-C16 Aliphatics	2200
C16-C21 Aliphatics	7600
C21-C34 Aliphatics	110000
C8-C10 Aromatics	2200 U
C10-C12 Aromatics	2200 U
C12-C16 Aromatics	2200 U
C16-C21 Aromatics	4900
C21-C34 Aromatics	49000

TP-LAI-03	5/7/2008
	4-6 ft. BGS
C8-C10 Aliphatics	2200 U
C10-C12 Aliphatics	2200 U
C12-C16 Aliphatics	6600
C16-C21 Aliphatics	10000
C21-C34 Aliphatics	150000
C8-C10 Aromatics	2200 U
C10-C12 Aromatics	2200 U
C12-C16 Aromatics	2200 U
C16-C21 Aromatics	10000
C21-C34 Aromatics	200000

TP-LAI-04	5/6/2008
	4.5-5 ft. BGS
C8-C10 Aliphatics	2200 U
C10-C12 Aliphatics	2200 U
C12-C16 Aliphatics	3100
C16-C21 Aliphatics	9800
C21-C34 Aliphatics	130000
C8-C10 Aromatics	2200 U
C10-C12 Aromatics	2200 U
C12-C16 Aromatics	2200 U
C16-C21 Aromatics	9300
C21-C34 Aromatics	130000

TP-LAI-09	5/6/2008
	4-6 ft. BGS
C8-C10 Aliphatics	2200 U
C10-C12 Aliphatics	2200 U
C12-C16 Aliphatics	4200
C16-C21 Aliphatics	17000
C21-C34 Aliphatics	400000
C8-C10 Aromatics	2200 U
C10-C12 Aromatics	2200 U
C12-C16 Aromatics	2600
C16-C21 Aromatics	25000
C21-C34 Aromatics	400000

Legend

Current Locations

- Boring
- Geoprobe
- Surface Water Sample Locations
- Test Pit

Historical Locations

- Test Pit Location
- Parcel

Sample Location	Date
	Depth
C8-C10 Aliphatics	µg/kg
C10-C12 Aliphatics	µg/kg
C12-C16 Aliphatics	µg/kg
C16-C21 Aliphatics	µg/kg
C21-C34 Aliphatics	µg/kg
C8-C10 Aromatics	µg/kg
C10-C12 Aromatics	µg/kg
C12-C16 Aromatics	µg/kg
C16-C21 Aromatics	µg/kg
C21-C34 Aromatics	µg/kg

U = Not Detected Above Laboratory Reporting Limits

0 75 150

Scale in Feet

Data Source: Pierce County GIS Layers

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35th Street Landfill Site
Tacoma, Washington

Analytical Results for Extractable Petroleum Hydrocarbons in Soil

Figure 5

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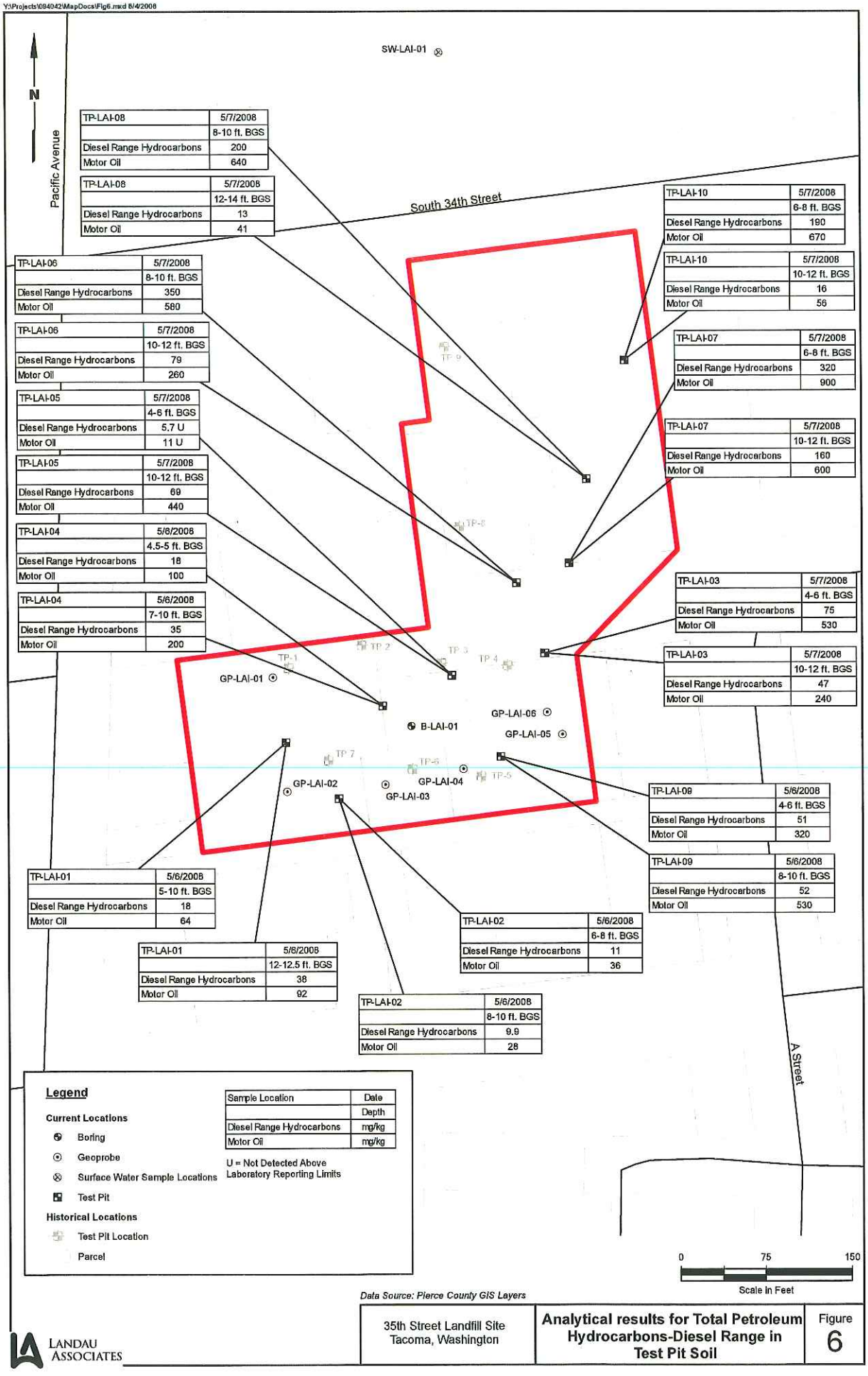

Data Source: Pierce County GIS Layers

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35th Street Landfill Site
Tacoma, Washington

Analytical results for Total Petroleum Hydrocarbons-Diesel Range in Test Pit Soil

Figure 6

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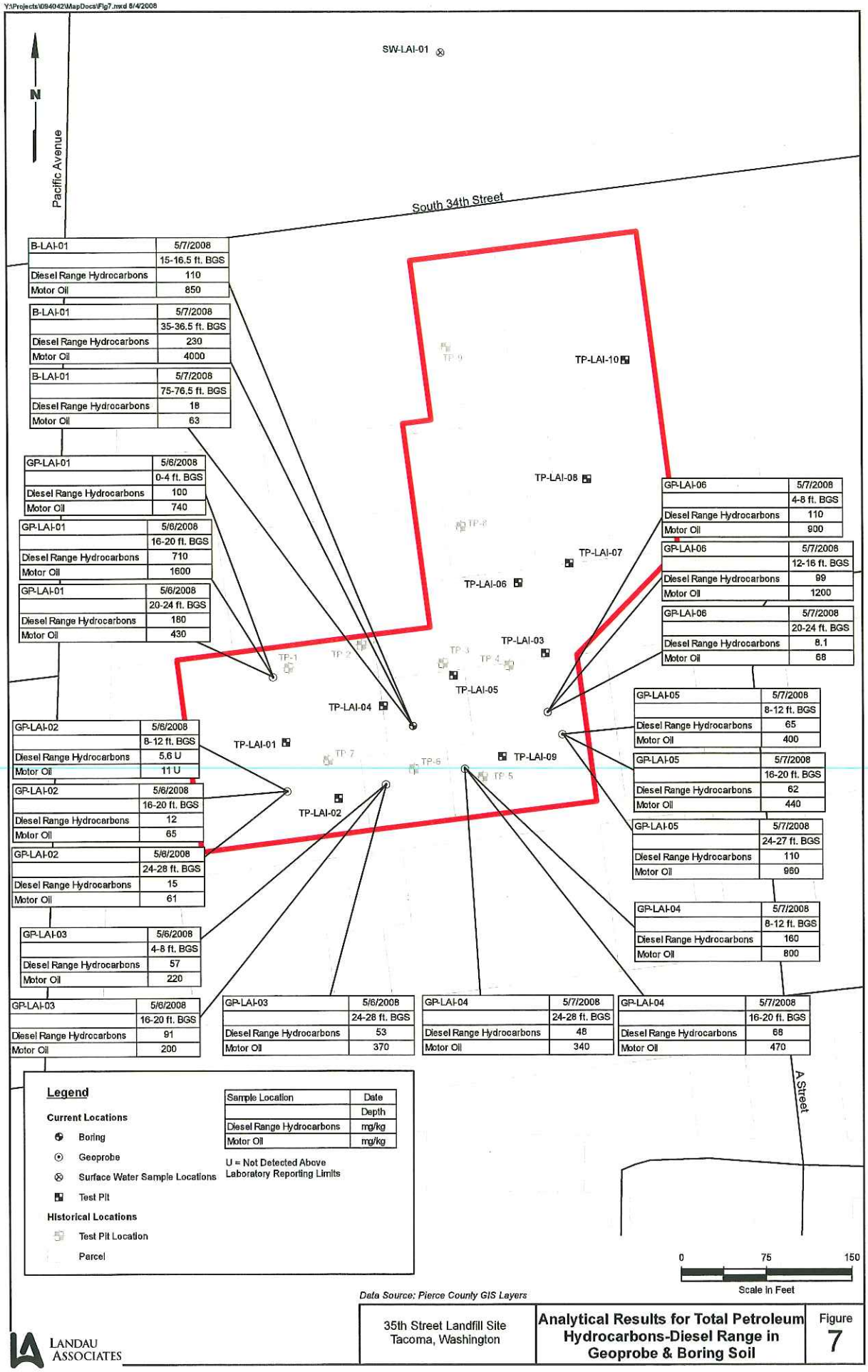

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35th Street Landfill Site
Tacoma, Washington

Analytical Results for Total Petroleum Hydrocarbons-Diesel Range in Geoprobe & Boring Soil

Figure 7

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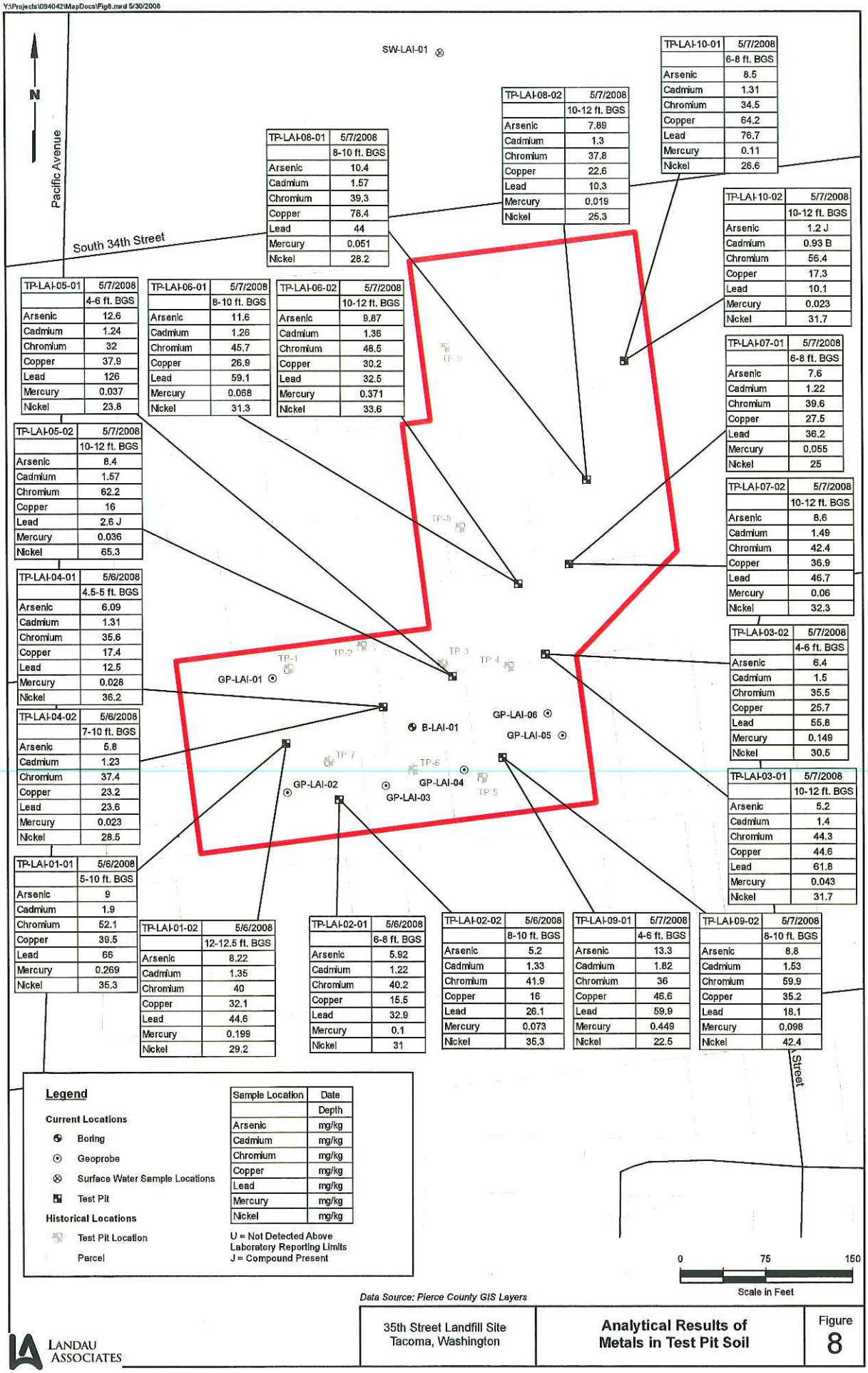

TP-LAI-10-01	5/7/2008
	6-8 ft. BGS
Arsenic	8.5
Cadmium	1.31
Chromium	34.5
Copper	64.2
Lead	76.7
Mercury	0.11
Nickel	26.6

TP-LAI-08-02	5/7/2008
	10-12 ft. BGS
Arsenic	7.89
Cadmium	1.3
Chromium	37.8
Copper	22.6
Lead	10.3
Mercury	0.019
Nickel	25.3

TP-LAI-08-01	5/7/2008
	8-10 ft. BGS
Arsenic	10.4
Cadmium	1.57
Chromium	39.3
Copper	78.4
Lead	44
Mercury	0.051
Nickel	28.2

TP-LAI-10-02	5/7/2008
	10-12 ft. BGS
Arsenic	1.2 J
Cadmium	0.93 B
Chromium	56.4
Copper	17.3
Lead	10.1
Mercury	0.023
Nickel	31.7

TP-LAI-05-01	5/7/2008
	4-6 ft. BGS
Arsenic	12.6
Cadmium	1.24
Chromium	32
Copper	37.9
Lead	126
Mercury	0.037
Nickel	23.8

TP-LAI-06-01	5/7/2008
	8-10 ft. BGS
Arsenic	11.6
Cadmium	1.26
Chromium	45.7
Copper	26.9
Lead	59.1
Mercury	0.068
Nickel	31.3

TP-LAI-06-02	5/7/2008
	10-12 ft. BGS
Arsenic	9.87
Cadmium	1.36
Chromium	48.5
Copper	30.2
Lead	32.5
Mercury	0.371
Nickel	33.6

TP-LAI-07-01	5/7/2008
	6-8 ft. BGS
Arsenic	7.6
Cadmium	1.22
Chromium	39.6
Copper	27.5
Lead	36.2
Mercury	0.055
Nickel	25

TP-LAI-05-02	5/7/2008
	10-12 ft. BGS
Arsenic	8.4
Cadmium	1.57
Chromium	62.2
Copper	16
Lead	2.6 J
Mercury	0.036
Nickel	65.3

TP-LAI-07-02	5/7/2008
	10-12 ft. BGS
Arsenic	8.6
Cadmium	1.49
Chromium	42.4
Copper	36.9
Lead	46.7
Mercury	0.06
Nickel	32.3

TP-LAI-04-01	5/6/2008
	4.5-5 ft. BGS
Arsenic	6.09
Cadmium	1.31
Chromium	35.6
Copper	17.4
Lead	12.5
Mercury	0.028
Nickel	36.2

TP-LAI-03-02	5/7/2008
	4-6 ft. BGS
Arsenic	6.4
Cadmium	1.5
Chromium	35.5
Copper	25.7
Lead	55.8
Mercury	0.149
Nickel	30.5

TP-LAI-04-02	5/6/2008
	7-10 ft. BGS
Arsenic	5.8
Cadmium	1.23
Chromium	37.4
Copper	23.2
Lead	23.6
Mercury	0.023
Nickel	28.5

TP-LAI-03-01	5/7/2008
	10-12 ft. BGS
Arsenic	5.2
Cadmium	1.4
Chromium	44.3
Copper	44.6
Lead	61.8
Mercury	0.043
Nickel	31.7

TP-LAI-01-01	5/6/2008
	5-10 ft. BGS
Arsenic	9
Cadmium	1.9
Chromium	52.1
Copper	39.5
Lead	66
Mercury	0.269
Nickel	35.3

TP-LAI-01-02	5/6/2008
	12-12.5 ft. BGS
Arsenic	8.22
Cadmium	1.35
Chromium	40
Copper	32.1
Lead	44.6
Mercury	0.199
Nickel	29.2

TP-LAI-02-01	5/6/2008
	6-8 ft. BGS
Arsenic	5.92
Cadmium	1.22
Chromium	40.2
Copper	15.5
Lead	32.9
Mercury	0.1
Nickel	31

TP-LAI-02-02	5/6/2008
	8-10 ft. BGS
Arsenic	5.2
Cadmium	1.33
Chromium	41.9
Copper	16
Lead	26.1
Mercury	0.073
Nickel	35.3

TP-LAI-09-01	5/7/2008
	4-6 ft. BGS
Arsenic	13.3
Cadmium	1.82
Chromium	36
Copper	46.6
Lead	59.9
Mercury	0.449
Nickel	22.5

TP-LAI-09-02	5/7/2008
	8-10 ft. BGS
Arsenic	8.8
Cadmium	1.53
Chromium	59.9
Copper	35.2
Lead	18.1
Mercury	0.098
Nickel	42.4

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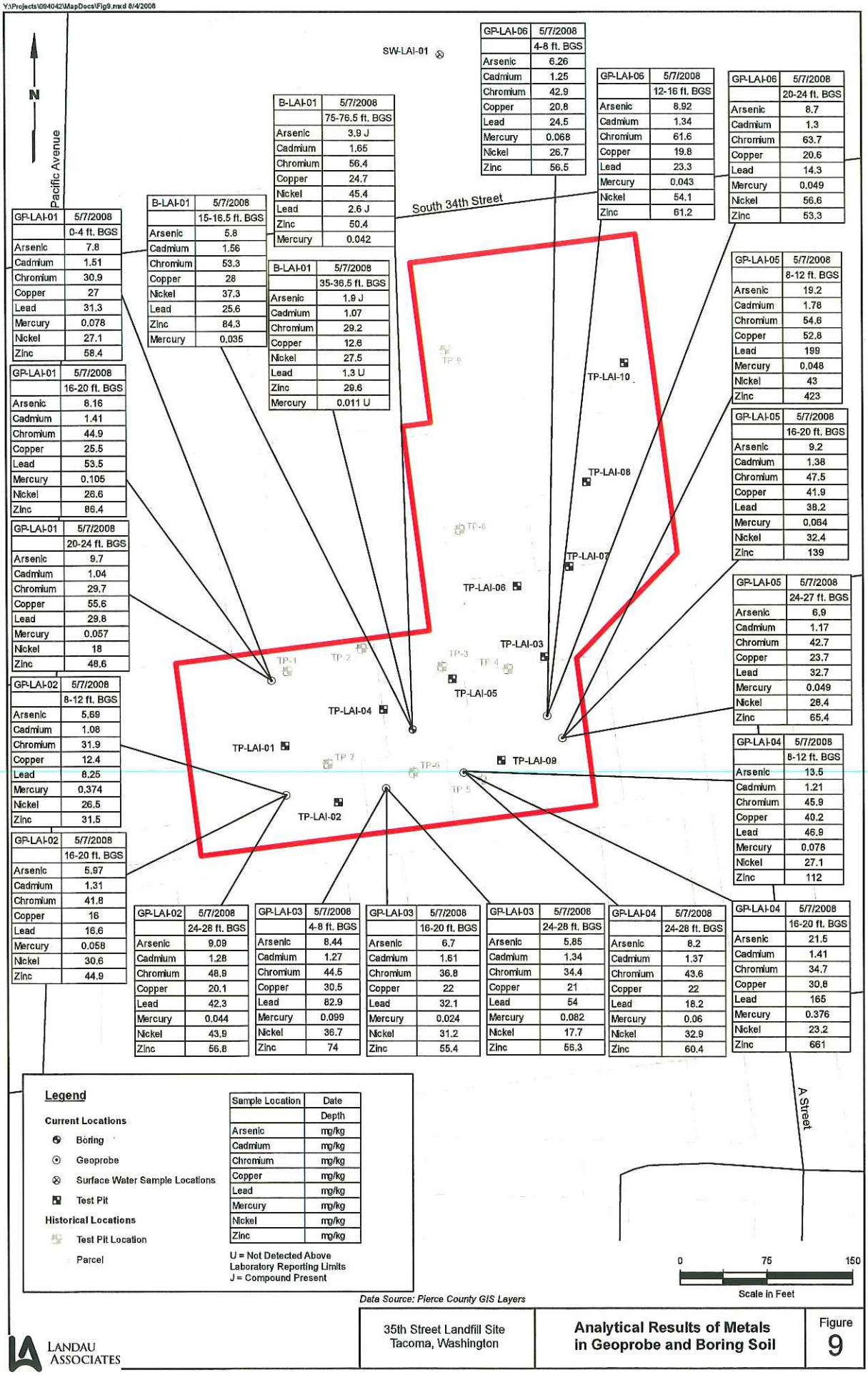
35th Street Landfill Site Tacoma, Washington	**Analytical Results of Metals in Test Pit Soil**	Figure 8

Y:\Projects\084042\MapDocs\Fig9.mxd 8/4/2008



GP-LAI-01	5/7/2008
	0-4 ft. BGS
Arsenic	7.8
Cadmium	1.51
Chromium	30.9
Copper	27
Lead	31.3
Mercury	0.078
Nickel	27.1
Zinc	58.4

GP-LAI-01	5/7/2008
	16-20 ft. BGS
Arsenic	8.16
Cadmium	1.41
Chromium	44.9
Copper	25.5
Lead	53.5
Mercury	0.105
Nickel	26.6
Zinc	86.4

GP-LAI-01	5/7/2008
	20-24 ft. BGS
Arsenic	9.7
Cadmium	1.04
Chromium	29.7
Copper	55.6
Lead	29.8
Mercury	0.057
Nickel	18
Zinc	48.6

GP-LAI-02	5/7/2008
	8-12 ft. BGS
Arsenic	5.69
Cadmium	1.08
Chromium	31.9
Copper	12.4
Lead	8.25
Mercury	0.374
Nickel	26.5
Zinc	31.5

GP-LAI-02	5/7/2008
	16-20 ft. BGS
Arsenic	5.97
Cadmium	1.31
Chromium	41.8
Copper	16
Lead	16.6
Mercury	0.058
Nickel	30.6
Zinc	44.9

GP-LAI-02	5/7/2008
	24-28 ft. BGS
Arsenic	9.09
Cadmium	1.28
Chromium	48.9
Copper	20.1
Lead	42.3
Mercury	0.044
Nickel	43.9
Zinc	56.8

GP-LAI-03	5/7/2008
	4-8 ft. BGS
Arsenic	8.44
Cadmium	1.27
Chromium	44.5
Copper	30.5
Lead	82.9
Mercury	0.099
Nickel	36.7
Zinc	74

GP-LAI-03	5/7/2008
	16-20 ft. BGS
Arsenic	6.7
Cadmium	1.61
Chromium	36.8
Copper	22
Lead	32.1
Mercury	0.024
Nickel	31.2
Zinc	55.4

GP-LAI-03	5/7/2008
	24-28 ft. BGS
Arsenic	5.85
Cadmium	1.34
Chromium	34.4
Copper	21
Lead	54
Mercury	0.082
Nickel	17.7
Zinc	56.3

GP-LAI-04	5/7/2008
	24-28 ft. BGS
Arsenic	8.2
Cadmium	1.37
Chromium	43.6
Copper	22
Lead	18.2
Mercury	0.06
Nickel	32.9
Zinc	60.4

GP-LAI-04	5/7/2008
	16-20 ft. BGS
Arsenic	21.5
Cadmium	1.41
Chromium	34.7
Copper	30.8
Lead	165
Mercury	0.376
Nickel	23.2
Zinc	661

GP-LAI-04	5/7/2008
	8-12 ft. BGS
Arsenic	13.5
Cadmium	1.21
Chromium	45.9
Copper	40.2
Lead	46.9
Mercury	0.078
Nickel	27.1
Zinc	112

GP-LAI-05	5/7/2008
	24-27 ft. BGS
Arsenic	6.9
Cadmium	1.17
Chromium	42.7
Copper	23.7
Lead	32.7
Mercury	0.049
Nickel	28.4
Zinc	65.4

GP-LAI-05	5/7/2008
	16-20 ft. BGS
Arsenic	9.2
Cadmium	1.38
Chromium	47.5
Copper	41.9
Lead	38.2
Mercury	0.064
Nickel	32.4
Zinc	139

GP-LAI-05	5/7/2008
	8-12 ft. BGS
Arsenic	19.2
Cadmium	1.78
Chromium	54.6
Copper	52.8
Lead	199
Mercury	0.048
Nickel	43
Zinc	423

GP-LAI-06	5/7/2008
	20-24 ft. BGS
Arsenic	8.7
Cadmium	1.3
Chromium	63.7
Copper	20.6
Lead	14.3
Mercury	0.049
Nickel	56.6
Zinc	53.3

GP-LAI-06	5/7/2008
	12-16 ft. BGS
Arsenic	8.92
Cadmium	1.34
Chromium	61.6
Copper	19.8
Lead	23.3
Mercury	0.043
Nickel	54.1
Zinc	61.2

GP-LAI-06	5/7/2008
	4-8 ft. BGS
Arsenic	6.26
Cadmium	1.25
Chromium	42.9
Copper	20.8
Lead	24.5
Mercury	0.068
Nickel	26.7
Zinc	56.5

B-LAI-01	5/7/2008
	15-16.5 ft. BGS
Arsenic	5.8
Cadmium	1.56
Chromium	53.3
Copper	28
Nickel	37.3
Lead	25.6
Zinc	84.3
Mercury	0.035

B-LAI-01	5/7/2008
	75-76.5 ft. BGS
Arsenic	3.9 J
Cadmium	1.65
Chromium	56.4
Copper	24.7
Nickel	45.4
Lead	2.6 J
Zinc	50.4
Mercury	0.042

B-LAI-01	5/7/2008
	35-36.5 ft. BGS
Arsenic	1.9 J
Cadmium	1.07
Chromium	29.2
Copper	12.6
Nickel	27.5
Lead	1.3 U
Zinc	29.6
Mercury	0.011 U

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35th Street Landfill Site Tacoma, Washington	**Analytical Results of Metals in Geoprobe and Boring Soil**	Figure 9

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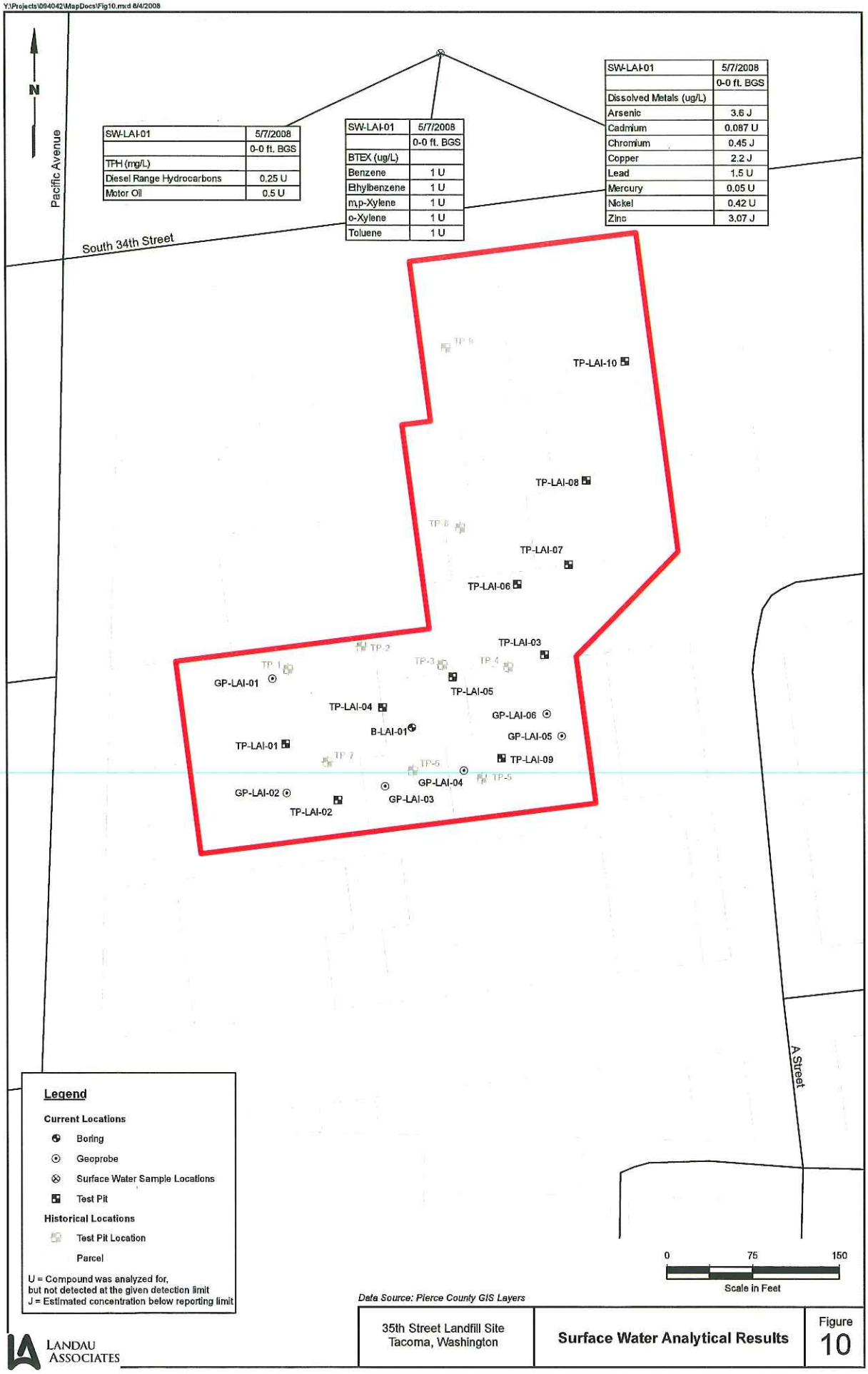

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35th Street Landfill Site
Tacoma, Washington

Surface Water Analytical Results

Figure 10

TABLE 1
TEST PITS SOIL DATA
35TH STREET LANDFILL
MAY 2008

Parameter	MTCA A Soil Unrestricted Land Uses	TP-LAI-01 5-10 ft BGS 5/6/2008	TP-LAI-01 12-12.5 ft BGS 5/6/2008	TP-LAI-02 6-8 ft BGS 5/6/2008	TP-LAI-02 8-10 ft BGS 5/6/2008	TP-LAI-03 4-6 ft BGS 5/7/2008	TP-LAI-03 10-12 ft BGS 5/7/2008	TP-LAI-04 4.5-5 ft BGS 5/6/2008	TP-LAI-04 7-10 ft BGS 5/6/2008	TP-LAI-05 4-6 ft BGS 5/7/2008	TP-LAI-05 10-12 ft BGS 5/7/2008	TP-LAI-06 8-10 ft BGS 5/7/2008	TP-LAI-06 10-12 ft BGS 5/7/2008	TP-LAI-07 6-8 ft BGS 5/7/2008
TPH mg/kg														
Diesel Range Hydrocarbons	2000	18	38	11	9.9	75	47	18	35	5.7 U	69	350	79	320
Motor Oil		64	92	36	28	530	240	100	200	11 U	440	580	260	900
BTEX ug/kg														
Benzene	30	NA	NA	NA	NA	1 U	NA	1.3 U	1.1 U	NA	NA	1 U	NA	NA
Ethylbenzene	600	NA	NA	NA	NA	1 U	NA	1.3 U	1.1 U	NA	NA	1.1	NA	NA
m,p-Xylene	900(a)	NA	NA	NA	NA	1 U	NA	1.3 U	1.1 U	NA	NA	5.2	NA	NA
o-Xylene	900(a)	NA	NA	NA	NA	1 U	NA	1.3 U	1.1 U	NA	NA	2.7	NA	NA
Toluene	700	NA	NA	NA	NA	1.2	NA	1.3 U	1.4	NA	NA	3.0	NA	NA
EPH ug/kg														
C8-C10 Aliphatics		NA	NA	NA	NA	2200 U	NA	2200 U	2200 U	NA	NA	2300 U	NA	NA
C10-C12 Aliphatics		NA	NA	NA	NA	2200 U	NA	2200 U	2200 U	NA	NA	17,000	NA	NA
C12-C16 Aliphatics		NA	NA	NA	NA	6600	NA	3100	2200	NA	NA	61,000	NA	NA
C16-C21 Aliphatics		NA	NA	NA	NA	10,000	NA	9800	7600	NA	NA	34,000	NA	NA
C21-C34 Aliphatics		NA	NA	NA	NA	150,000	NA	130,000	110,000	NA	NA	180,000	NA	NA
C8-C10 Aromatics		NA	NA	NA	NA	2200 U	NA	2200 U	2200 U	NA	NA	2300 U	NA	NA
C10-C12 Aromatics		NA	NA	NA	NA	2200 U	NA	2200 U	2200 U	NA	NA	4500	NA	NA
C12-C16 Aromatics		NA	NA	NA	NA	2200 U	NA	2200 U	2200 U	NA	NA	23,000	NA	NA
C16-C21 Aromatics		NA	NA	NA	NA	10,000	NA	9300	4900	NA	NA	42,000	NA	NA
C21-C34 Aromatics		NA	NA	NA	NA	200,000	NA	130,000	49,000	NA	NA	200,000	NA	NA
Sum of Total Petroleum Hydrocarbons mg/kg		NA	NA	NA	NA	376.7	NA	282.2	173.7	NA	NA	561.5	NA	NA
cPAH ug/kg														
Calculated for TEF														
Benzo(a)anthracene		NA	NA	NA	NA	7.7	NA	1.8	4	NA	NA	16	NA	NA
Benzo(a)pyrene		NA	NA	NA	NA	110	NA	20	52	NA	NA	190	NA	NA
Benzo(b)fluoranthene		NA	NA	NA	NA	11	NA	3.6	8.5	NA	NA	18	NA	NA
Benzo(k)fluoranthene		NA	NA	NA	NA	11	NA	1.4	4.2	NA	NA	18	NA	NA
Chrysene		NA	NA	NA	NA	1.2	NA	0.32	0.67	NA	NA	2.7	NA	NA
Dibenz(a,h)anthracene		NA	NA	NA	NA	48 U	NA	4.8 U	0.64	NA	NA	14 U	NA	NA
Indeno(1,2,3-cd)pyrene		NA	NA	NA	NA	48 U	NA	0.87	1.7	NA	NA	4.2	NA	NA
Total cPAH calculated for TEF	100 (b)	NA	NA	NA	NA	140.9	NA	27.99	71.71	NA	NA	248.9	NA	NA
Metals (mg/kg)														
Arsenic	20	9	8.22	5.92	5.2	5.2	6.4	6.09	5.8	12.6	8.4	11.6	9.87	7.6
Cadmium	2	1.9	1.35	1.22	1.33	1.4	1.5	1.31	1.23	1.24	1.57	1.26	1.36	1.22
Chromium	2000 (c)	52.1	40	40.2	41.9	44.3	35.5	35.8	37.4	32	62.2	45.7	48.5	39.6
Copper		39.5	32.1	15.5	16	44.6	25.7	17.4	23.2	37.9	16	26.9	30.2	27.5
Lead	250	66	44.6	32.9	26.1	61.8	55.8	12.5	23.6	126	2.6 J	59.1	32.5	36.2
Mercury	2	0.269	0.199	0.1	0.073	0.043	0.149	0.028	0.023	0.037	0.036	0.068	0.371	0.055
Nickel		35.3	29.2	31	35.3	31.7	30.5	36.2	28.5	23.8	65.3	31.3	33.6	25
Zinc		110	136	55.9	47.1	84.8	73.3	39.5	55.3	76	37	59.9	62.2	61.6

Notes:

MTCA A = Model Toxics Control Act Method A

mg/kg = milligrams per kilogram

U = Compound was analyzed for, but not detected at the given detection limit

ug/kg = micrograms per kilogram

NA = Not applicable

(a) = value for total of all Xylenes

(b) = value used for the total concentration of all carcinogenic PAHs

TEF = Toxicity Equivalency Factors

Boxed values indicate constituent concentrations reported in excess of the published risk-based target cleanup concentration

J = Estimated concentration below reporting limit

B = Reported value is less than the CDRL, but greater than the reporting limit

(c) = value for Chromium III

TABLE 1
TEST PITS SOIL DATA
35TH STREET LANDFILL
MAY 2008

Parameter	TP-LAI-07 10-12 ft BGS 5/7/2008	TP-LAI-08 8-10 ft BGS 5/7/2008	TP-LAI-08 12-14 ft BGS 5/7/2008	TP-LAI-09 4-6 ft BGS 5/6/2008	TP-LAI-09 8-10 ft BGS 5/6/2008	TP-LAI-10 6-8 ft BGS 5/7/2008	TP-LAI-10 10-12 ft BGS 5/7/2008
TPH mg/kg							
Diesel Range Hydrocarbons	160	200	13	51	52	190	16
Motor Oil	600	640	41	320	530	670	56
BTEX ug/kg							
Benzene	NA	NA	NA	2.0	NA	1.1 U	NA
Ethylbenzene	NA	NA	NA	1.4 U	NA	2.6	NA
m,p-Xylene	NA	NA	NA	1.4 U	NA	2.3	NA
o-Xylene	NA	NA	NA	1.4 U	NA	1.9	NA
Toluene	NA	NA	NA	1.6	NA	2.3	NA
EPH ug/kg							
C8-C10 Aliphatics	NA	NA	NA	2200 U	NA	2500 U	NA
C10-C12 Aliphatics	NA	NA	NA	2200 U	NA	6300	NA
C12-C16 Aliphatics	NA	NA	NA	4200	NA	26,000	NA
C16-C21 Aliphatics	NA	NA	NA	17,000	NA	23,000	NA
C21-C34 Aliphatics	NA	NA	NA	400,000	NA	240,000	NA
C8-C10 Aromatics	NA	NA	NA	2200 U	NA	2500 U	NA
C10-C12 Aromatics	NA	NA	NA	2200 U	NA	2500 U	NA
C12-C16 Aromatics	NA	NA	NA	2600	NA	6900	NA
C16-C21 Aromatics	NA	NA	NA	25,000	NA	20,000	NA
C21-C34 Aromatics	NA	NA	NA	400,000	NA	130,000	NA
Sum of Total Petroleum Hydrocarbons mg/kg	NA	NA	NA	848.8	NA	452.2	NA
cPAH ug/kg							
Calculated for TEF							
Benzo(a)anthracene	NA	NA	NA	42	NA	32	NA
Benzo(a)pyrene	NA	NA	NA	470	NA	290	NA
Benzo(b)fluoranthene	NA	NA	NA	41	NA	29	NA
Benzo(k)fluoranthene	NA	NA	NA	41	NA	29	NA
Chrysene	NA	NA	NA	5.2	NA	4.1	NA
Dibenz(a,h)anthracene	NA	NA	NA	4	NA	2.5	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	11	NA	8.7	NA
Total cPAH calculated for TEF	NA	NA	NA	614.2	NA	395.3	NA
Metals (mg/kg)							
Arsenic	8.6	10.4	7.89	13.3	8.8	8.5	1.2 J
Cadmium	1.49	1.57	1.3	1.82	1.53	1.31	0.93 B
Chromium	42.4	39.3	37.8	36	59.9	34.5	58.4
Copper	36.9	76.4	22.6	46.6	35.2	64.2	17.3
Lead	46.7	44	10.3	59.9	18.1	76.7	10.1
Mercury	0.06	0.051	0.019	0.449	0.098	0.11	0.023
Nickel	32.3	28.2	25.3	22.5	42.4	26.6	31.7
Zinc	71.5	61.3	37.4	75	57.8	174	44.6

Notes:

MTCA A = Model Toxics Control Act Method A
mg/kg = milligrams per kilogram
U = Compound was analyzed for, but not detected at the
ug/kg = micrograms per kilogram
NA = Not applicable
(a) = value for total of all Xylenes
(b) = value used for the total concentration of all carcino
TEF = Toxicity Equivalency Factors
Boxed values indicate constituent concentrations reporte
J = Estimated concentration below reporting limit
B = Reported value is less than the CDRL, but greater th
(c) = value for Chromium III

TABLE 2
GEOPROBE SOIL DATA
35TH STREET LANDFILL
MAY 2008

Parameter	MTCA A Soil Unrestricted Land Uses	GP-LAI-01 0-4 ft BGS 5/6/2008	GP-LAI-01 16-20 ft BGS 5/6/2008	GP-LAI-01 20-24 ft BGS 5/6/2008	GP-LAI-02 8-12 ft BGS 5/6/2008	GP-LAI-02 16-20 ft BGS 5/6/2008	GP-LAI-02 24-28 ft BGS 5/6/2008	GP-LAI-03 4-8 ft BGS 5/6/2008	GP-LAI-03 16-20 ft BGS 5/6/2008	GP-LAI-03 24-28 ft BGS 5/6/2008	GP-LAI-04 8-12 ft BGS 5/7/2008
TPH mg/kg											
Diesel Range Hydrocarbons	2000	100	710	180	5.6 U	12	15	57	91	53	160
Motor Oil		740	1600	430	11 U	65	61	220	200	370	800
BTEX ug/kg											
Benzene	30	NA	1.2 U	NA	NA	NA	NA	NA	2.9	NA	5.7
Ethylbenzene	600	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	1.5 U
m,p-Xylene	900 (a)	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	1.6
o-Xylene	900 (a)	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	1.5 U
Toluene	700	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	3.0
cPAH ug/kg											
Calculated for TEF											
Benzo(a)anthracene		NA	15	NA	NA	NA	NA	NA	10	NA	17
Benzo(a)pyrene		NA	150	NA	NA	NA	NA	NA	86	NA	160
Benzo(b)fluoranthene		NA	18	NA	NA	NA	NA	NA	15	NA	22
Benzo(k)fluoranthene		NA	130 Y	NA	NA	NA	NA	NA	6.5	NA	12
Chrysene		NA	3	NA	NA	NA	NA	NA	1.2	NA	1.9
Dibenz(a,h)anthracene		NA	81 U	NA	NA	NA	NA	NA	0.68	NA	1.5
Indeno(1,2,3-cd)pyrene		NA	81 U	NA	NA	NA	NA	NA	2.2	NA	4.2
Total cPAH calculated for TEF	100 (b)	NA	186	NA	NA	NA	NA	NA	121.58	NA	218.6
Metals (mg/kg)											
Arsenic	20	7.8	8.16	9.7	5.69	5.97	9.09	8.44	6.7	5.85	13.5
Cadmium	2	1.51	1.41	1.04	1.08	1.31	1.28	1.27	1.61	1.34	1.21
Chromium	2000 (c)	30.9	44.9	29.7	31.9	41.8	48.9	44.5	36.8	34.4	45.9
Copper		27	25.5	55.6	12.4	16	20.1	30.5	22	21	40.2
Lead	250	31.3	53.5	29.8	8.25	16.6	42.3	82.9	32.1	54	46.9
Mercury	2	0.078	0.105	0.057	0.374	0.058	0.044	0.099	0.024	0.082	0.078
Nickel		27.1	26.6	18	26.5	30.6	43.9	36.7	31.2	17.7	27.1
Zinc		58.4	86.4	48.6	31.5	44.9	56.8	74	55.4	56.3	112

Notes:

MTCA A = Model Toxics Control Act Method A

mg/kg = milligrams per kilogram

U = Compound was analyzed for, but not detected at the given detection limit

ug/kg = micrograms per kilogram

NA = Not applicable

(a) = value for total of all Xylenes

(b) = value used for the total concentration of all carcinogenic PAHs

TEF = Toxicity Equivalency Factors

Boxed values indicate constituent concentrations reported in excess of the published risk-based target cleanup concentration

Y = Compound was analyzed for, but not detected at the given detection limit. Reporting limit was raised because of chromatographic interference

(c) = value for Chromium III

TABLE 2
GEOPROBE SOIL DATA
35TH STREET LANDFILL
MAY 2008

Parameter	GP-LAI-04 16-20 ft BGS 5/7/2008	GP-LAI-04 24-28 ft BGS 5/7/2008	GP-LAI-05 8-12 ft BGS 5/7/2008	GP-LAI-05 16-20 ft BGS 5/7/2008	GP-LAI-05 24-27 ft BGS 5/7/2008	GP-LAI-06 4-8 ft BGS 5/7/2008	GP-LAI-06 12-16 ft BGS 5/7/2008	GP-LAI-06 20-24 ft BGS 5/7/2008
TPH mg/kg								
Diesel Range Hydrocarbons	68	48	65	62	110	110	99	8.1
Motor Oil	470	340	400	440	960	900	1200	68
BTEX ug/kg								
Benzene	NA	NA	NA	1.4 U	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	2.3	NA	NA	NA	NA
m,p-Xylene	NA	NA	NA	1.4 U	NA	NA	NA	NA
o-Xylene	NA	NA	NA	1.4 U	NA	NA	NA	NA
Toluene	NA	NA	NA	3.3	NA	NA	NA	NA
cPAH ug/kg								
Calculated for TEF								
Benzo(a)anthracene	NA	NA	NA	4.9	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	77	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	11	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	5.7	NA	NA	NA	NA
Chrysene	NA	NA	NA	0.82	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	0.58	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	2.7	NA	NA	NA	NA
Total cPAH calculated for TEF	NA	NA	NA	102.7	NA	NA	NA	NA
Metals (mg/kg)								
Arsenic	21.5	8.2	19.2	9.2	6.9	6.26	8.92	8.7
Cadmium	1.41	1.37	1.78	1.38	1.17	1.25	1.34	1.3
Chromium	34.7	43.6	54.6	47.5	42.7	42.9	61.6	63.7
Copper	30.8	22	52.8	41.9	23.7	20.8	19.8	20.6
Lead	165	18.2	199	38.2	32.7	24.5	23.3	14.3
Mercury	0.376	0.06	0.048	0.064	0.049	0.068	0.043	0.049
Nickel	23.2	32.9	43	32.4	28.4	26.7	54.1	56.6
Zinc	661	60.4	423	139	65.4	56.5	61.2	53.3

Notes:

MTCA A = Model Toxics Control Act Meth
mg/kg = milligrams per kilogram
U = Compound was analyzed for, but not
ug/kg = micrograms per kilogram
NA = Not applicable
(a) = value for total of all Xylenes
(b) = value used for the total concentratio
TEF = Toxicity Equivalency Factors
Boxed values indicate constituent concen
Y = Compound was analyzed for, but not was raised because of chromatographic i
(c) = value for Chromium III

TABLE 3
BORING SOIL DATA
35TH STREET LANDFILL
MAY 2008

Parameter	MTCA A Soil Unrestricted Land Uses	B-LAI-01 15-16.5 ft BGS 5/7/2008	B-LAI-01 35-36.5 ft BGS 5/7/2008	B-LAI-01 75-76.5 ft BGS 5/7/2008
TPH mg/kg				
Diesel Range Hydrocarbons	2000	**110**	**230**	**18**
Motor Oil		**850**	**4000**	**63**
BTEX ug/kg				
Benzene	30	NA	1.2 U	NA
Ethylbenzene	600	NA	1.2 U	NA
m,p-Xylene	900 (a)	NA	1.2 U	NA
o-Xylene	900 (a)	NA	1.2 U	NA
Toluene	700	NA	1.2 U	NA
cPAH ug/kg				
Calculated for TEF				
Benzo(a)anthracene		NA	48 U	NA
Benzo(a)pyrene		NA	180 Y	NA
Benzo(b)fluoranthene		NA	48 U	NA
Benzo(k)fluoranthene		NA	48 U	NA
Chrysene		NA	**1.1**	NA
Dibenz(a,h)anthracene		NA	48 U	NA
Indeno(1,2,3-cd)pyrene		NA	48 U	NA
Total cPAH calculated for TEF	100 (b)	NA	**1.1**	NA
Metals (mg/kg)				
Arsenic	20	**5.8**	**1.9 J**	**3.9 J**
Cadmium	2	**1.56**	**1.07**	**1.65**
Chromium	2000 (c)	**53.3**	**29.2**	**56.4**
Copper		**28**	**12.6**	**24.7**
Lead	250	**25.6**	1.3 U	**2.6 J**
Mercury	2	**0.035**	0.011 U	**0.042**
Nickel		**37.3**	**27.5**	**45.4**
Zinc		**84.3**	**29.6**	**50.4**

Notes:

MTCA A = Model Toxics Control Act Method A
mg/kg = milligrams per kilogram
U = Compound was analyzed for, but not detected at the given detection limit
ug/kg = micrograms per kilogram
NA = Not applicable
(a) = value for total of all Xylenes
(b) = value used for the total concentration of all carcinogenic PAHs
TEF = Toxicity Equivalency Factors
Y = Compound was analyzed for, but not detected at the given detection limit. Reporting limit was raised because of chromatographic interference
(c) = value for Chromium III

TABLE 4
SURFACE WATER DATA
35TH STREET LANDFILL
MAY 2008

Parameter	MTCA A Soil Ground Water	SW-LAI-01 0-0 ft BGS 5/7/2008
TPH (mg/L)		
Diesel Range Hydrocarbons		0.25 U
Motor Oil		0.5 U
BTEX (ug/L)		
Benzene	5	1 U
Ethylbenzene	700	1 U
m,p-Xylene	1000 (a)	1 U
o-Xylene	1000 (a)	1 U
Toluene	1000	1 U
Dissolved Metals (ug/L)		
Arsenic	5	**3.6 J**
Cadmium	5	0.087 U
Chromium	50	**0.45 J**
Copper		**2.2 J**
Lead	15	1.5 U
Mercury	2	0.05 U
Nickel		0.42 U
Zinc		**3.07 J**

Notes:
MTCA A = Model Toxics Control Act Method A
mg/L = milligrams per liter
U = Compound was analyzed for, but not detected at the given detection limit
ug/L = micrograms per liter
(a) = value for total of all Xylenes
J = Estimated concentration below reporting limit

TABLE 5
METHANE SAMPLE DATA
35TH STREET LANDFILL
MAY 2008

	LAI 01 5/15/2008	LAI 01 5/15/2008	LAI 01 5/22/2008	LAI 01 5/29/2008	LAI 02 5/15/2008	LAI 02 5/15/2008	LAI 02 5/22/2008	LAI 02 5/29/2008
Technician	Wright	Gore	Gore	Gore	Wright	Gore	Gore	Gore
Instrument	GT Innova LS	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 501	GT Innova LS	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 501
Barometric Pressure	30.09	30.34	29.96	30.08	30.09	30.34	29.96	30.08
Methane (percent)	NA	3.9	1.7	3.3	NA	5.1	5.9	5
Methane (percent of LEL)	67	62	11	NA	68	26	over	over
Methane (PPM)	NA	NA	5640	2980	NA	NA	NA	NA
Oxygen (percent)	4.1	NA	NA	NA	5.8	NA	NA	NA
Hydrogen Sulfide (ppm)	0	NA	NA	NA	0	NA	NA	NA

Notes:
GT = GasTech
NA = Not analyzed
LEL = Lower explosion limit
PPM = parts per million
over = exceeds LEL

TABLE 5
METHANE SAMPLE DATA
35TH STREET LANDFILL
MAY 2008

	LAI 03 5/15/2008	LAI 03 5/15/2008	LAI 03 5/22/2008	LAI 03 5/29/2008	LAI 04 5/15/2008	LAI 04 5/15/2008	LAI 04 5/22/2008	LAI 04 5/29/2008	LAI 05 5/15/2008
Technician	Wright	Gore	Gore	Gore	Wright	Gore	Gore	Gore	Wright
Instrument	GT Innova LS	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 501	GT Innova LS	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 501	GT Innova LS
Barometric Pressure	30.09	30.34	29.96	30.08	30.09	30.34	29.96	30.08	30.09
Methane (percent)	NA	0.2	0	0	NA	0.2	0	0	15
Methane (percent of LEL)	NA	4	2	3	NA	2	2	3	over
Methane (PPM)	1480	1480	1200	1920	860	860	1100	1600	NA
Oxygen (percent)	6.5	NA	NA	NA	19.6	NA	NA	NA	2.8
Hydrogen Sulfide (ppm)	NA	NA	NA	NA	NA	NA	NA	NA	0

Notes:
GT = GasTech
NA = Not analyzed
LEL = Lower explosion limit
PPM = parts per million
over = exceeds LEL

TABLE 5
METHANE SAMPLE DATA
35TH STREET LANDFILL
MAY 2008

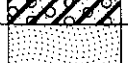
	LAI 05 5/15/2008	LAI 05 5/22/2008	LAI 05 5/29/2008	LAI 06 5/15/2008	LAI 06 5/15/2008	LAI 06 5/22/2008	LAI 06 5/29/2008
Technician	Gore	Gore	Gore	Wright	Gore	Gore	Gore
Instrument	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 501	GT Innova LS	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 500	GT GT201 & Landtec GEM 501
Barometric Pressure	**30.34**	**29.96**	**30.08**	**30.09**	**30.34**	**29.96**	**30.08**
Methane (percent)	**27**	**5.4**	**1.7**	**8**	**17**	4.7	0.1
Methane (percent of LEL)	over	**56**	4	**over**	over	66	1
Methane (PPM)	NA	over	2180	NA	NA	over	480
Oxygen (percent)	NA	NA	NA	**6.7**	NA	NA	NA
Hydrogen Sulfide (ppm)	NA	NA	NA	**0**	NA	NA	NA

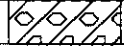
Notes:
GT = GasTech
NA = Not analyzed
LEL = Lower explosion limit
PPM = parts per million
over = exceeds LEL

APPENDIX A

Field Explorations

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS [2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

NOTES:

1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent:	> 50%	- "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents:	> 30% and ≤ 50%	- "very gravelly," "very sandy," "very silty," etc.
	> 15% and ≤ 30%	- "gravelly," "sandy," "silty," etc.
Additional Constituents:	> 5% and ≤ 15%	- "with gravel," "with sand," "with silt," etc.
	≤ 5%	- "trace gravel," "trace sand," "trace silt," etc., or not noted.

8/4/08 Y:\0941042.010\T\094042 010.GPJ SCS WSDOT 1OF2

LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Soil Classification System and Key

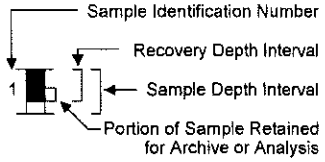
Figure A-1 (1 of 2)

Drilling and Sampling Key

SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Single-Tube Core Barrel
f	Double-Tube Core Barrel
g	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Rotosonic
5	Air Rotary (Rock)
6	Wash Rotary (Rock)
7	Other - See text if applicable

SAMPLE NUMBER & INTERVAL



Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
VST	Vane Shear Test
GT	Other Geotechnical Testing
CA	Chemical Analysis

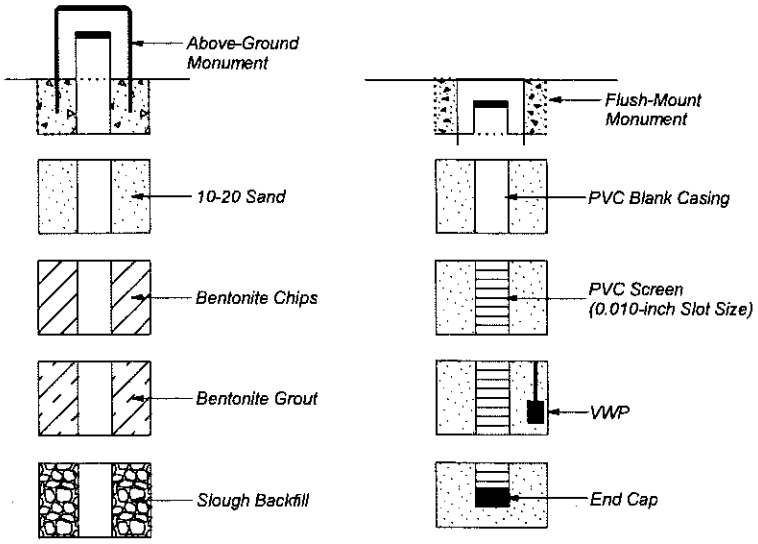
Groundwater

▽ Approximate water elevation at time of drilling (ATD).

▼ Approximate water elevation at other time(s). When multiple water levels are obtained other than ATD, only a representative range is shown. See text for additional information.

Note: Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Well Log Graphics

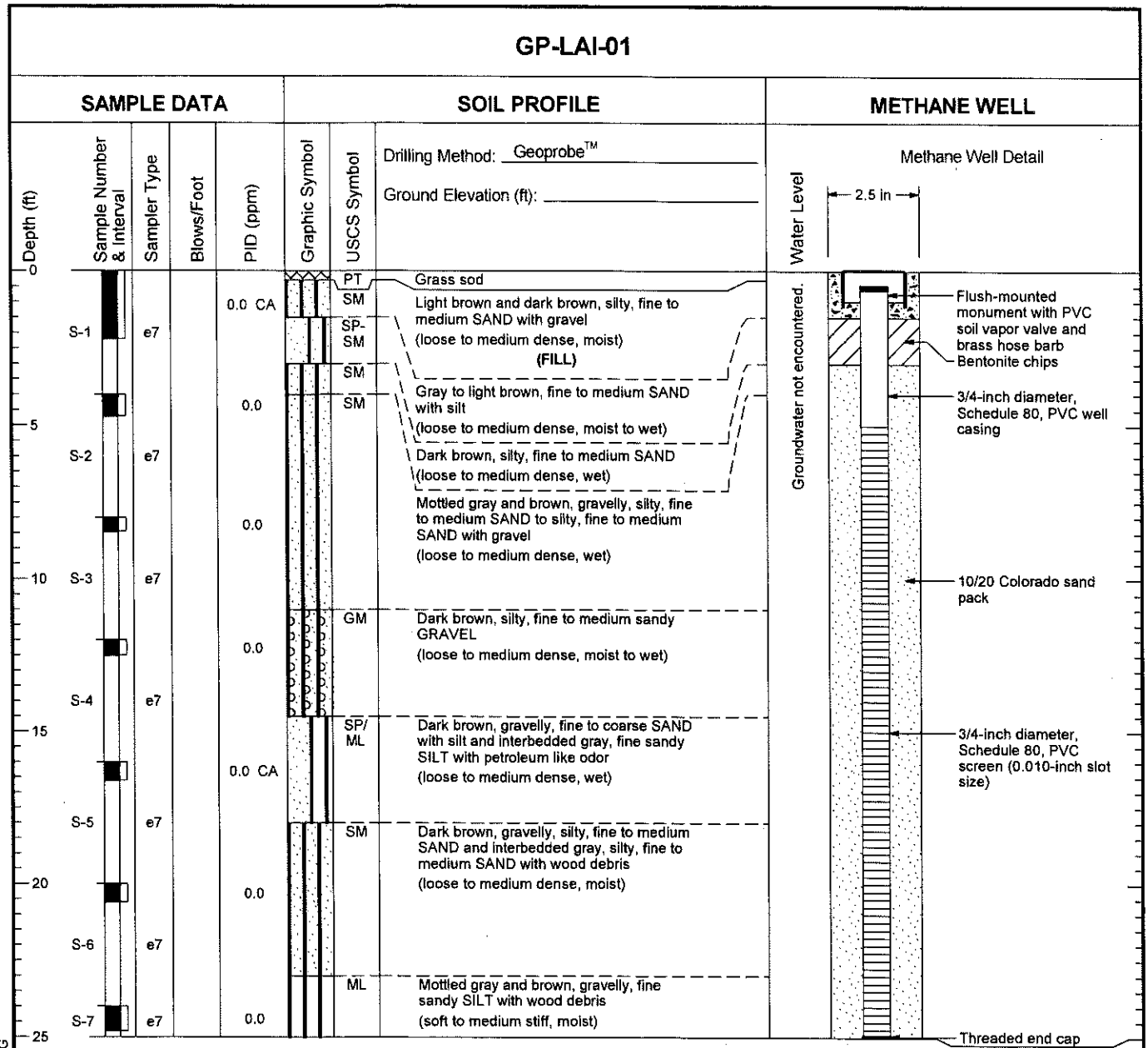


8/4/08 Y:\094\042.010\T\094042 010.GPJ SCS WSDOT 2OF2

LANDAU ASSOCIATES

35th Street Landfill Tacoma, Washington	Soil Classification System and Key	Figure A-1 (2 of 2)

GP-LAI-01



Boring Completed 05/06/08
Total Depth of Boring = 25.0 ft.

Methane Well Completed 05/06/08

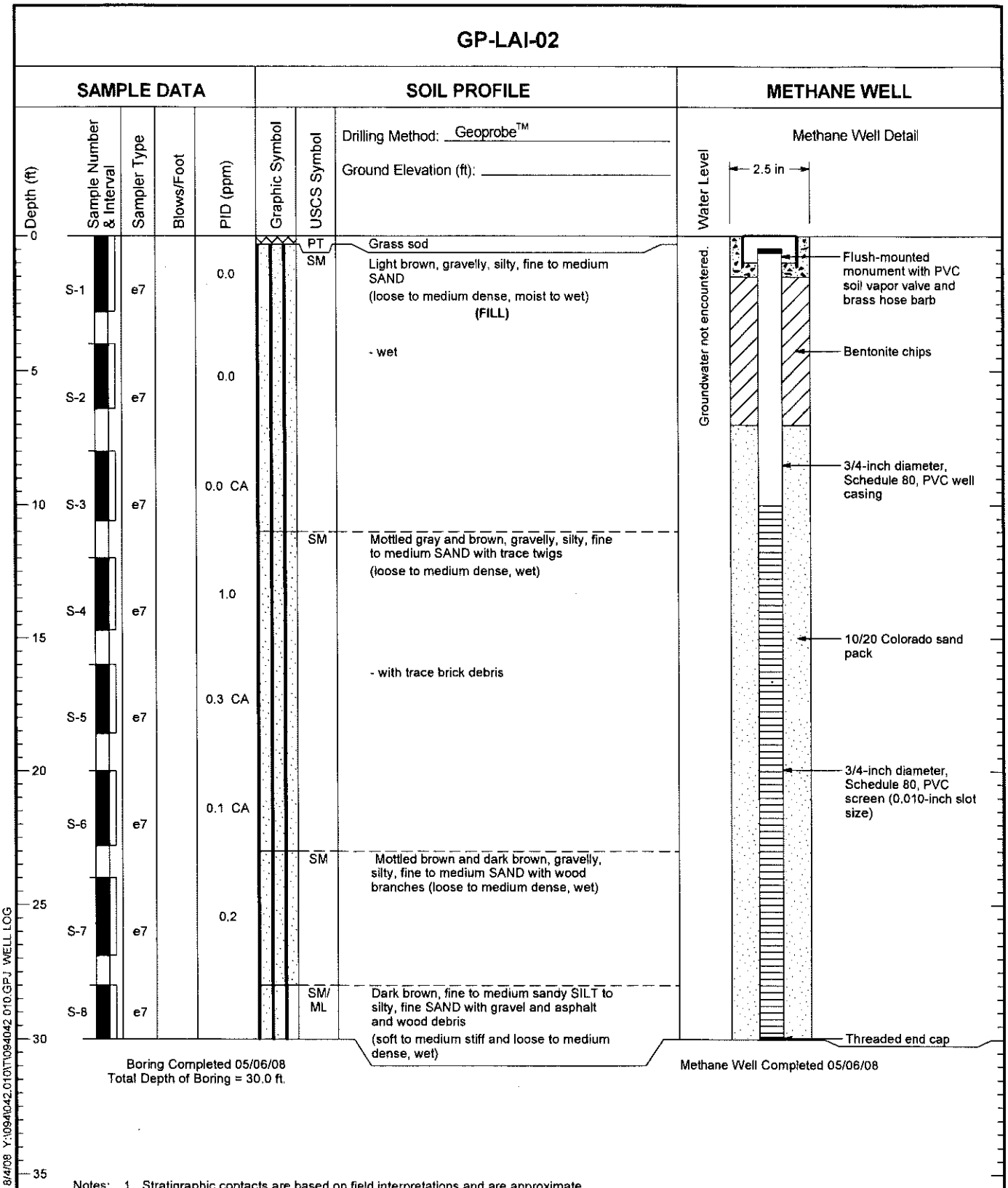
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ WELL LOG

LANDAU ASSOCIATES

35th Street Landfill Tacoma, Washington	Log of Methane Well GP-LAI-01	Figure A-2

GP-LAI-02



Boring Completed 05/06/08
Total Depth of Boring = 30.0 ft.

Methane Well Completed 05/06/08

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\1994\042.01\T\094042 010.GPJ WELL LOG

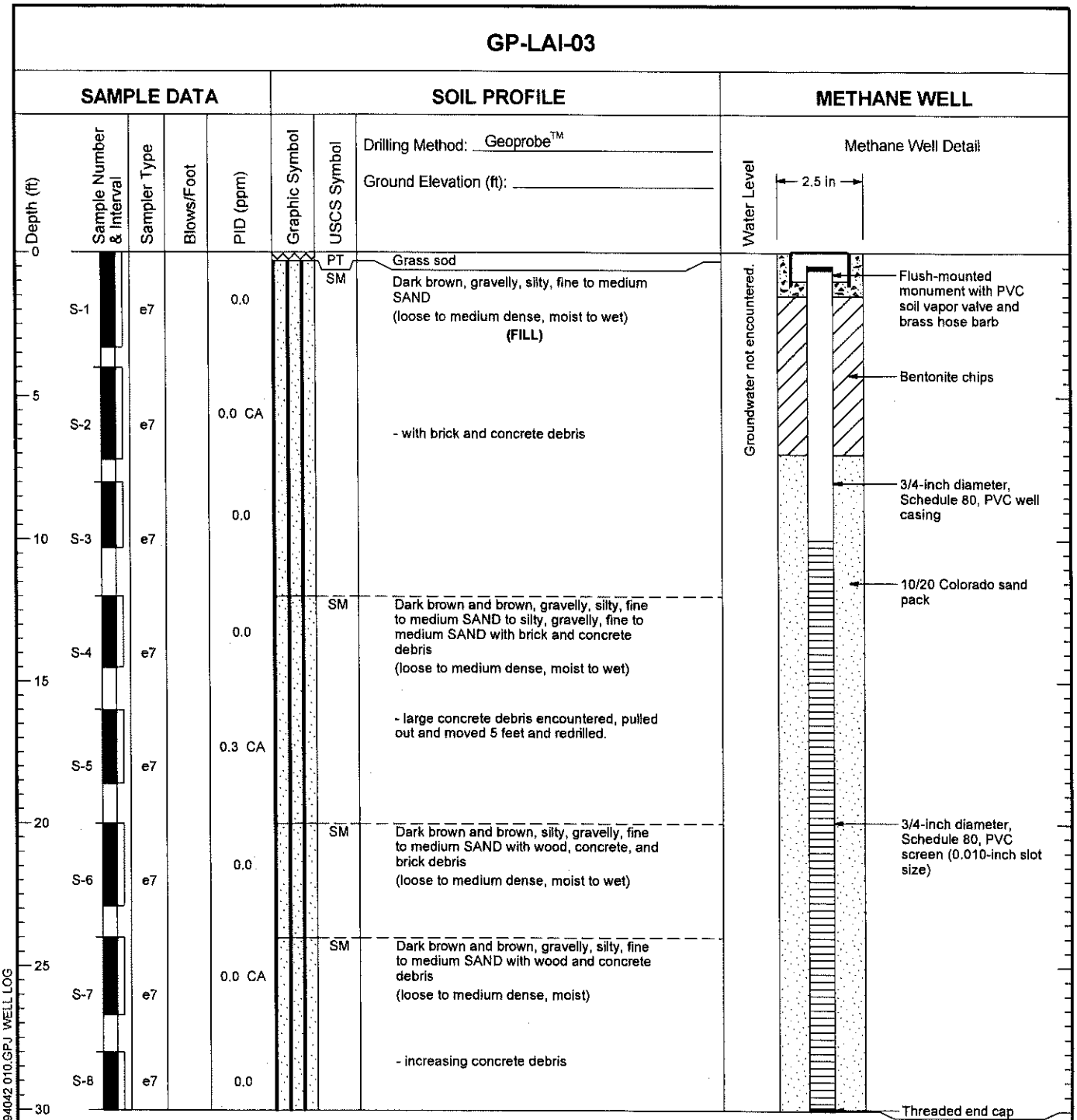
LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Methane Well GP-LAI-02

Figure
A-3

GP-LAI-03



Boring Completed 05/06/08
Total Depth of Boring = 30.0 ft.

Methane Well Completed 05/06/08

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\1094\042.01\T\1094042 010.GPJ WELL LOG

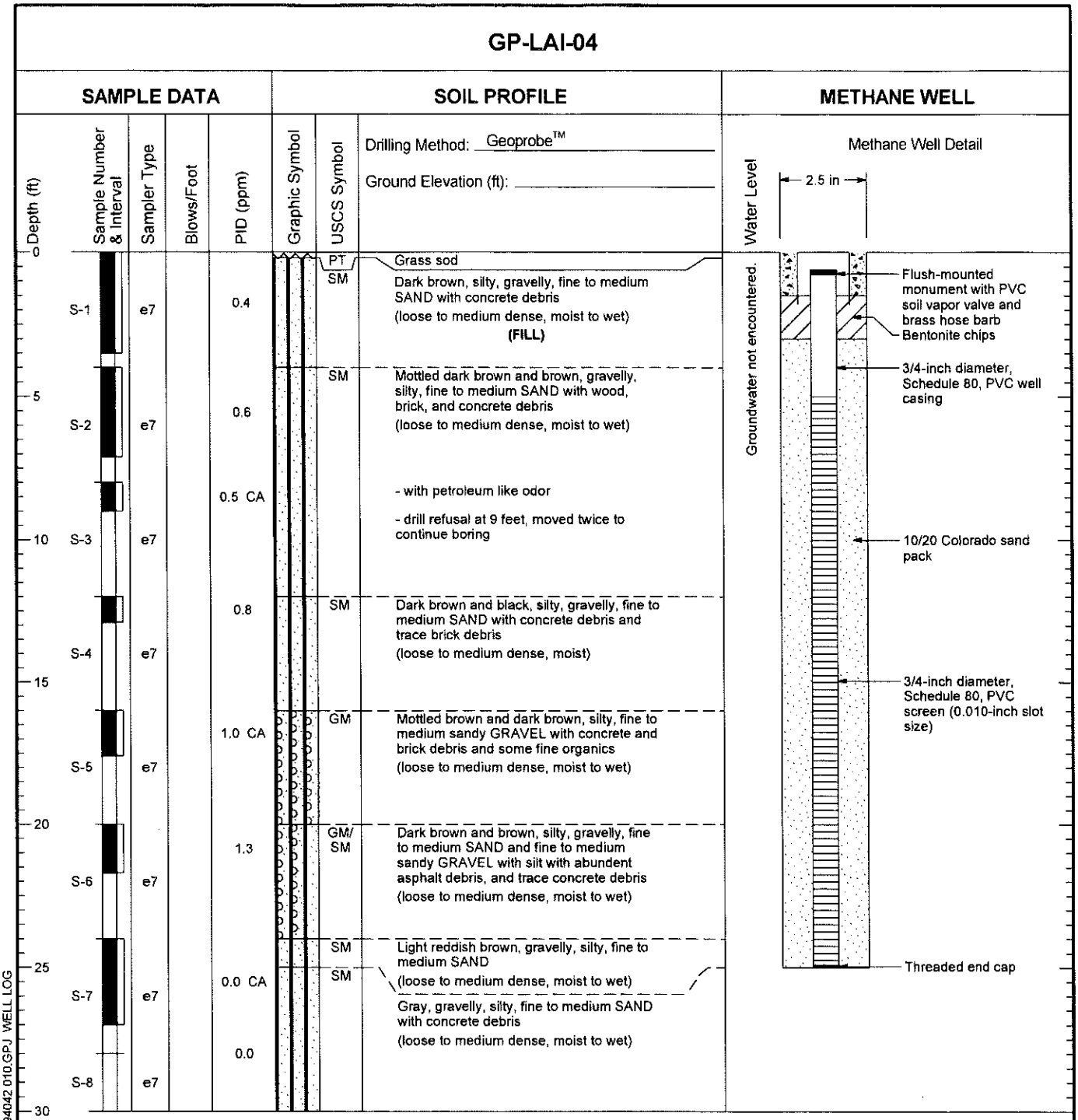
LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Methane Well GP-LAI-03

Figure
A-4

GP-LAI-04



Boring Completed 05/07/08
Total Depth of Boring = 30.0 ft.

Methane Well Completed 05/07/08

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ WELL LOG

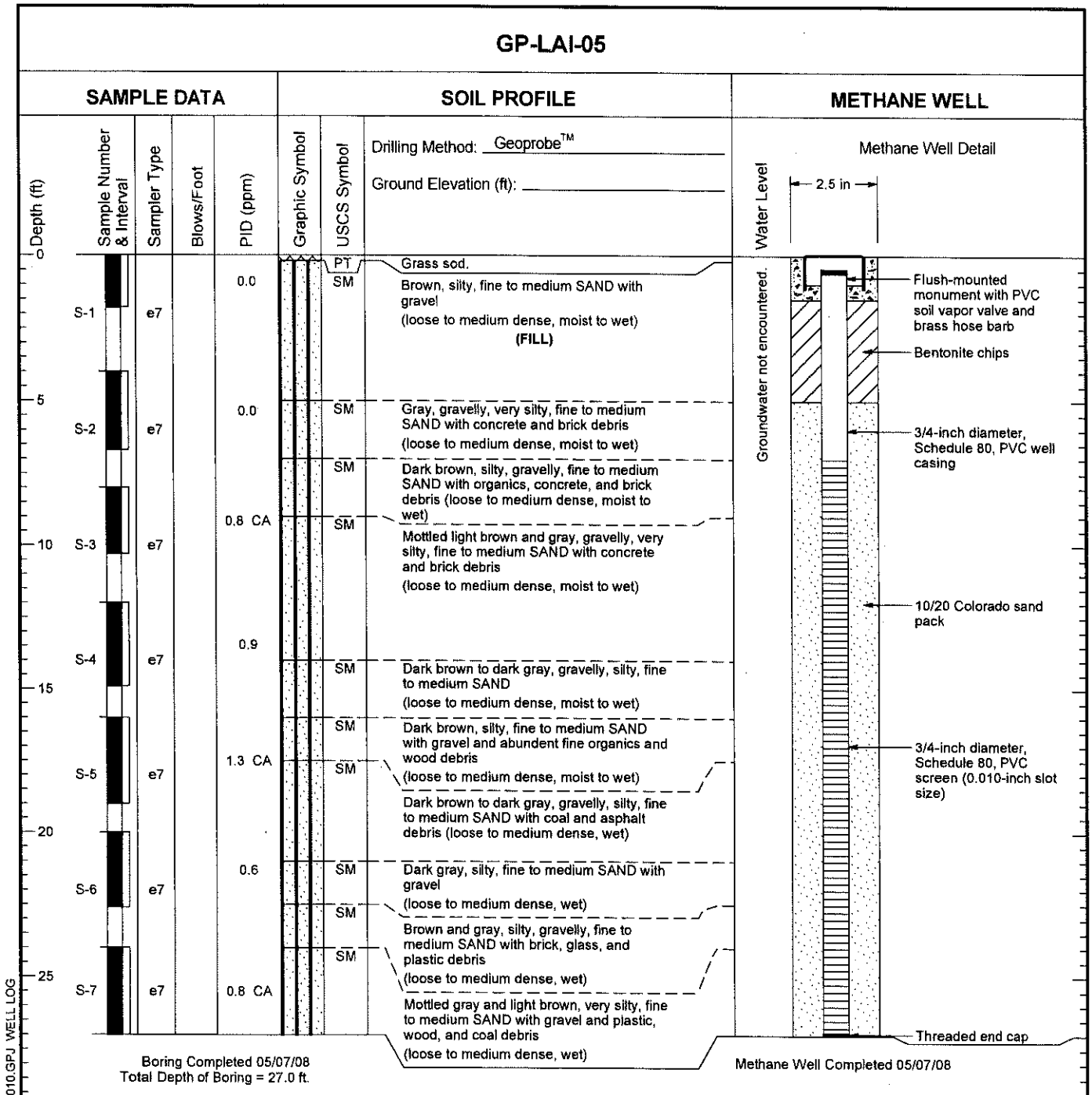
LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Methane Well GP-LAI-04

Figure
A-5

GP-LAI-05



Boring Completed 05/07/08
Total Depth of Boring = 27.0 ft.

Methane Well Completed 05/07/08

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\1094\042.010\T\094042 010.GPJ WELL LOG

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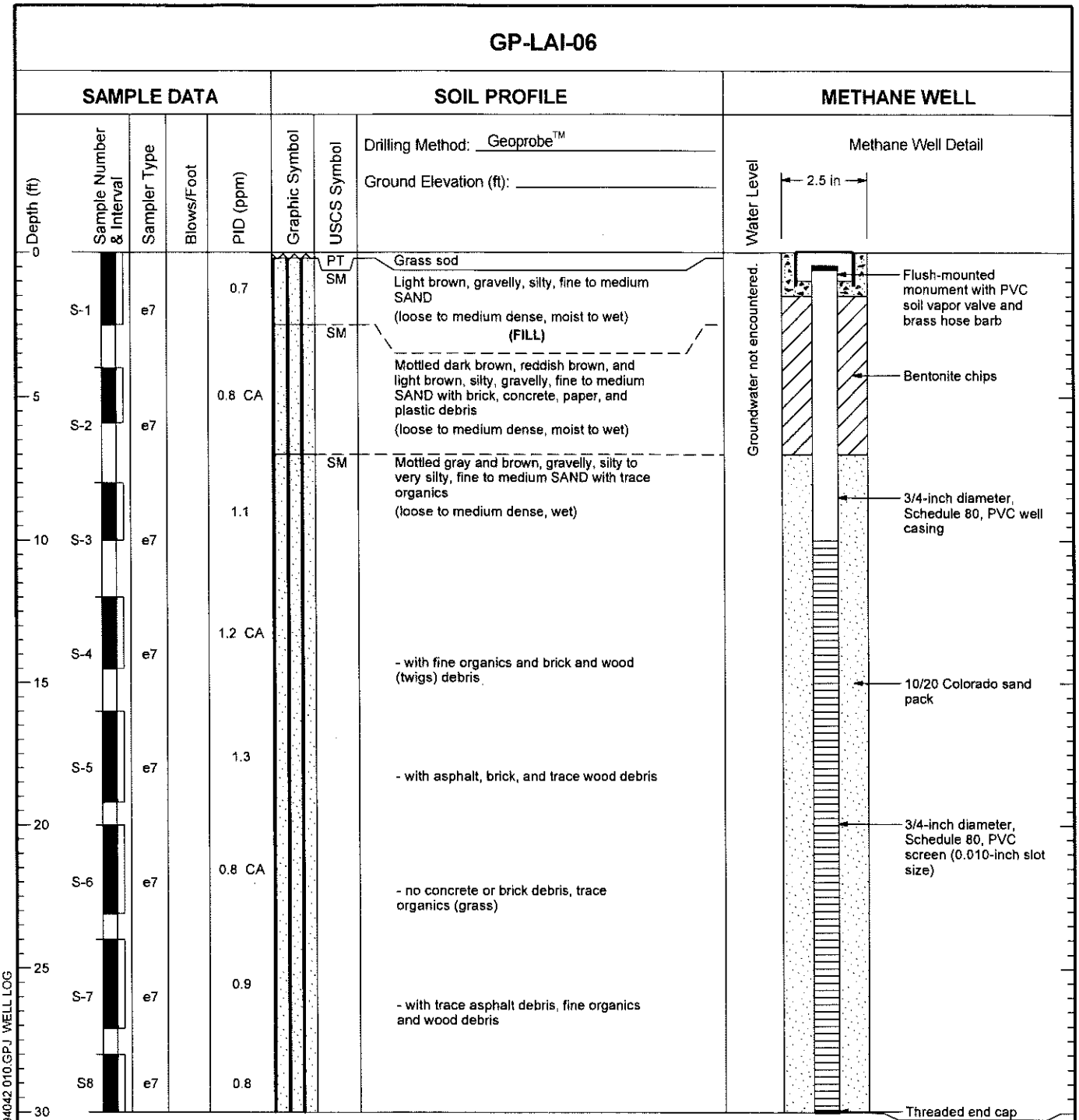
35th Street Landfill
Tacoma, Washington

Log of Methane Well GP-LAI-05

Figure
A-6

GP-LAI-06



Boring Completed 05/07/08
Total Depth of Boring = 30.0 ft.

Methane Well Completed 05/07/08

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\094t042.010\T\094042 010.GPJ WELL LOG

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35th Street Landfill
Tacoma, Washington

Log of Methane Well GP-LAI-06

Figure
A-7

B-LAI-01

SAMPLE DATA				SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Drilling Method: Hollow-Stem Auger Ground Elevation (ft):
0						SM	Black-brown silty, fine SAND (loose dense, damp)
5	S-1	b2	5	0.0			- drill refusal moved once and continued drilling
10	S-2	b2	50	0.0		GW	Black, sandy GRAVEL (very dense, damp)
15	S-3	b2	20	0.0 CA		ML	Gray, sandy SILT (very stiff, moist)
20	S-4	b2	11	0.0		SP	Black, medium to coarse SAND with gravel and asphalt (medium dense, damp)
25	S-5	b2	9	0.0		SM	Gray, silty, medium SAND with trace gravel (loose, moist)
30	S-6	b2	6	0.0		SP	Black, medium to coarse SAND with gravel and trace silt and wood debris (loose, damp)
35							

Groundwater not encountered.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ SOIL BORING LOG

LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Boring B-LAI-01

Figure
A-8
(1 of 3)

B-LAI-01

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	SOIL PROFILE	GROUNDWATER
							Drilling Method: Hollow-Stem Auger Ground Elevation (ft):	
35	S-7	b2	42	1.4 CA		SP	Black, medium to coarse SAND with gravel (loose, damp)	Groundwater not encountered.
40	S-8	b2	50	0.0		SP	Black, fine to coarse SAND with gravel (medium dense, damp) - dense material lodged in tip, blow count may not be representative	
45	S-9	b2	50	0.0		SW	Brown-black medium SAND with gravel and concrete debris (very dense, damp) - dense material lodged in tip, blow count may not be representative	
50	S-10	b2	3	0.0		SM	Gray, silty, fine SAND with trace gravel (very loose dense, moist)	
55	S-11	b2	25	0.0		SM	Gray, silty, fine SAND with trace gravel and trace wood debris (medium dense, damp)	
60	S-12	b2	68	0.0		SP	Light brown-gray, fine to coarse SAND with gravel (very dense, damp) - dense material lodged in tip, blow count may not be representative	
65	S-13	b2	50	0.0		SP	Gray, medium to coarse SAND w/ gravel (very dense, damp)	
70								

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\094\042.010\T\094042 010.GPJ SOIL BORING LOG

LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Boring B-LAI-01

Figure
A-8
(2 of 3)

B-LAI-01

SAMPLE DATA					SOIL PROFILE			GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Drilling Method: Hollow-Stem Auger Ground Elevation (ft):	
70	S-14	b2	50	0.0		SM	Gray, silty, medium SAND with gravel (very dense, damp)	Groundwater not encountered.
75	S-15	b2	29	0.0 CA		SM	Gray, very silty, fine to medium SAND with gravel and trace wood debris (medium dense, damp)	
80	S-16	b2	50	0.0		SP-SM	Gray, gravelly, fine SAND with silt (very dense, moist)	
							Boring Completed 05/07/08 Total Depth of Boring = 81.0 ft.	
							- large rock lodged in tip, blow count may not be representative	
85								
90								
95								
100								
105								

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\094\042.010\T\094042.010.GPJ SOIL BORING LOG

LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Boring B-LAI-01

Figure
A-8
(3 of 3)

TP-LAI-01

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SM	Brown silty medium SAND with gravel and construction debris (moist)	Groundwater not encountered.
5	S-1	d	0.0 CA				
10					SC	Gray fine to medium silty SAND with gravel (moist)	
	S-2	d	0.0 CA				
15							

Test Pit Completed 05/06/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-01

Figure
A-9

TP-LAI-02

SAMPLE DATA				SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					DB	Concrete, rebar, and brick construction debris with light brown, fine to medium SAND with gravel (dry, very dense)	Groundwater not encountered.
5					SP	Light brown to light gray, fine to medium SAND with gravel and construction debris (dry, dense)	
	S-1	d	0.0 CA				
	S-2	d	0.0 CA				
10							
15							

Test Pit Completed 05/06/08
Total Depth of Test Pit = 13.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\094042.010\T\094042.010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-02

Figure
A-10

TP-LAI-03

SAMPLE DATA				SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SP	Brown, fine to medium SAND with trace silt (dry, medium dense) and concrete and construction debris	Groundwater not encountered.
5	S-01	d	0.0 CA				
10	S-02	d	0.0 CA				
15							

Test Pit Completed 05/07/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-03

Figure
A-11

TP-LAI-04

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SP	Gray fine to medium SAND with trace silt and debris (dry)	Groundwater not encountered.
5	S-01	d	0.2 CA		SC DB	Gray CLAY with fine to medium SAND and gravel with trace debris (moist, very dense) - distinct odor, PID reading 0.2 PPM Concrete, rebar and construction debris	
10	S-02	d	0.0 CA		SM/CL	Gray, gravelly, fine to medium SAND with clay and trace debris (moist, very dense)	
15							

Test Pit Completed 05/06/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-04

Figure
A-12

TP-LAI-05

SAMPLE DATA				SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SP	Light brown, fine to medium SAND with trace gravel, clay and debris (dry, medium dense)	Groundwater not encountered.
5	S-01	d	0.0 CA				
10	S-02	d	0.0 CA				
15							

Test Pit Completed 05/07/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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LANDAU ASSOCIATES

35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-05

Figure
A-13

TP-LAI-06

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					DB	Concrete and asphalt with light gray, fine to medium SAND and gravel with clay (moist, dense) - slight sheen	Groundwater not encountered.
5							
	S-01	d	0.0 CA				
10					SP	Light brown, fine to medium SAND with trace gravel and debris (most, dense) - slight sheen	
	S-02	d	0.0 CA				
15							

Test Pit Completed 05/07/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T094042 010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-06

Figure
A-14

TP-LAI-07

SAMPLE DATA				SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SP	Brown, fine to medium SAND with trace silt and gravel (dry, medium dense)	Groundwater not encountered.
5	S-01	d	0.0 CA				
					DB	Concrete, brick and construction debris	
10	S-02	d	0.0 CA		SP	Brown, fine to medium SAND with trace silt and gravel (dry, medium dense) - slight sheen	
15							

Test Pit Completed 05/07/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-07

Figure
A-15

TP-LAI-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SP	Brown, fine to medium SAND with gravel, concrete and brick debris (moist, dense)	Groundwater not encountered.
						- encountered saturated soil	
5							
	S-01	d	0.0 CA				
10							
	S-02	d	0.0 CA				
15							

Test Pit Completed 05/07/08
Total Depth of Test Pit = 14.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\0941042.010\T\094042 010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-08

Figure
A-16

TP-LAI-09

SAMPLE DATA				SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					DB	Large slabs of concrete, rebar, and wood debris with black and grey stratified SAND and gravel (dry, very dense)	Groundwater not encountered.
5	S-01	d	0.0 CA		DB	Rebar and concrete debris with light brown, fine to medium SAND with gravel	
	S-02	d	0.0 CA				
10							
15							

Test Pit Completed 05/06/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

94042.01 8/4/08 Y:\094\042.01\T\094042 010.GPJ SINGLE TEST PIT LOG

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-09

Figure
A-17

TP-LAI-10

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	PID (ppm)	Graphic Symbol	USCS Symbol	Excavation Method: Rubber-tired Backhoe Ground Elevation (ft):	
0					SP	Gray medium to course gravelly SAND with trace organic debris (moist, dense)	Groundwater not encountered.
5	S-01	d	0.0 CA				
10	S-02	d	0.0 CA				
15							

Test Pit Completed 05/07/08
Total Depth of Test Pit = 12.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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35th Street Landfill
Tacoma, Washington

Log of Test Pit TP-LAI-10

Figure
A-18

APPENDIX B

Soil Cleanup Level Worksheets

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LAI-10 (6-8 ft)

2. Enter Soil Concentration Measured

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12	6.3	1.39%
AL_EC >12-16	26	5.75%
AL_EC >16-21	23	5.09%
AL_EC >21-34	240	53.07%
AR_EC >8-10		0.00%
AR_EC >10-12		0.00%
AR_EC >12-16	6.9	1.53%
AR_EC >16-21	20	4.42%
AR_EC >21-34	128.288	28.37%
Benzene		0.00%
Toluene	0.0023	0.00%
Ethylbenzene	0.0026	0.00%
Total Xylenes	0.0042	0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.32	0.07%
Benzo(b)fluoranthene	0.29	0.06%
Benzo(k)fluoranthene	0.29	0.06%
Benzo(a)pyrene	0.29	0.06%
Chrysene	0.41	0.09%
Dibenz(a,h)anthracene	0.025	0.01%
Indeno(1,2,3-cd)pyrene	0.087	0.02%
Sum	452.2091	100.00%

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here:	355	ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LAI-10 (6-8 ft)
Measured Soil TPH Concentration, mg/kg: 452.209

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	119	3.81E-06	9.30E-02	Fail
	Method C	4,776	9.47E-07	7.66E-03	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	9.50E-09	1.21E-02	Pass
	Target TPH GW Conc. @ 355 ug/L	100% NAPL	NA	NA	Pass

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through -7494).

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	118.60	4,776.36
Most Stringent Criterion	Risk of cPAHs mixture= 1E-6	Total Risk=1E-5

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI =1	*NO*	4.86E+03	4.10E-05	1.00E+00	*NO*	5.90E+04	1.24E-04	1.00E+00
Total Risk=1E-5	*NO*	1.19E+03	1.00E-05	2.44E-01	YES	4.78E+03	1.00E-05	8.09E-02
Risk of Benzene= 1E-6	NA	NA	NA	NA	NA			
Risk of cPAHs mixture= 1E-6	YES	1.19E+02	1.00E-06	2.44E-02				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	Soil-to-Ground Water is not a critical pathway!

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Total Risk = 1E-5	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Total Risk = 1E-6	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Benzene MCL = 5 ug/L	NA	NA	NA	NA	NA
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 78000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	1.13E+01	9.42E-09	1.57E-02	100% NAPL

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LAI-03 (4-6 ft)

2. Enter Soil Concentration Measured

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12		0.00%
AL_EC >12-16	6.6	1.75%
AL_EC >16-21	10	2.65%
AL_EC >21-34	150	39.82%
AR_EC >8-10		0.00%
AR_EC >10-12		0.00%
AR_EC >12-16		0.00%
AR_EC >16-21	10	2.65%
AR_EC >21-34	199.583	52.98%
Benzene		0.00%
Toluene	0.012	0.00%
Ethylbenzene		0.00%
Total Xylenes		0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.077	0.02%
Benzo(b)fluoranthene	0.11	0.03%
Benzo(k)fluoranthene	0.11	0.03%
Benzo(a)pyrene	0.11	0.03%
Chrysene	0.12	0.03%
Dibenz(a,h)anthracene		0.00%
Indeno(1,2,3-cd)pyrene		0.00%
Sum	376.722	100.00%

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here:	355	ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LAI-03 (4-6 ft)
Measured Soil TPH Concentration, mg/kg: 376.722

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	277	1.36E-06	1.01E-01	Fail
	Method C	11,163	3.37E-07	8.43E-03	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	3.52E-09	3.34E-03	Pass
	Target TPH GW Conc. @ 355 ug/L	100% NAPL	NA	NA	Pass

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through -7494)

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	277.19	11,163.34
Most Stringent Criterion	Risk of cPAHs mixture= 1E-6	Total Risk=1E-5

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI=1	*NO*	3.72E+03	1.34E-05	1.00E+00	*NO*	4.47E+04	4.00E-05	1.00E+00
Total Risk=1E-5	*NO*	2.77E+03	1.00E-05	7.45E-01	YES	1.12E+04	1.00E-05	2.50E-01
Risk of Benzene= 1E-6	NA	NA	NA	NA	NA			
Risk of cPAHs mixture= 1E-6	YES	2.77E+02	1.00E-06	7.45E-02				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	Soil-to-Ground Water is not a critical pathway!

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	3.76E+00	3.55E-09	6.40E-03	100% NAPL
Total Risk = 1E-5	YES	3.76E+00	3.55E-09	6.40E-03	100% NAPL
Total Risk = 1E-6	YES	3.76E+00	3.55E-09	6.40E-03	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	3.76E+00	3.55E-09	6.40E-03	100% NAPL
Benzene MCL = 5 ug/L	NA	NA	NA	NA	NA
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 87000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	3.76E+00	3.55E-09	6.40E-03	100% NAPL

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LA1-4 (4.5-5 ft)

2. Enter Soil Concentration Measured

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12		0.00%
AL_EC >12-16	3.1	1.10%
AL_EC >16-21	9.8	3.47%
AL_EC >21-34	130	46.07%
AR_EC >8-10		0.00%
AR_EC >10-12		0.00%
AR_EC >12-16		0.00%
AR_EC >16-21	9.3	3.30%
AR_EC >21-34	129.8713	46.02%
Benzene		0.00%
Toluene		0.00%
Ethylbenzene		0.00%
Total Xylenes		0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.018	0.01%
Benzo(b)fluoranthene	0.036	0.01%
Benzo(k)fluoranthene	0.014	0.00%
Benzo(a)pyrene	0.02	0.01%
Chrysene	0.032	0.01%
Dibenz(a,h)anthracene		0.00%
Indeno(1,2,3-cd)pyrene	0.0087	0.00%
Sum	282.2	100.00%

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here:	355	ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LAI-4 (4.5-5 ft)
Measured Soil TPH Concentration, mg/kg: 282.200

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	1,045	2.70E-07	6.71E-02	Pass
	Method C	42,096	6.70E-08	5.60E-03	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	9.85E-10	2.70E-03	Pass
	Target TPH GW Conc, @ 355 ug/L	100% NAPL	NA	NA	Pass

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through -7494).

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	1,045.23	42,095.76
Most Stringent Criterion	Risk of cPAHs mixture= 1E-6	Total Risk=1E-5

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI =1	*NO*	4.20E+03	4.02E-06	1.00E+00	*NO*	5.04E+04	1.20E-05	1.00E+00
Total Risk=1E-5	*NO*	1.05E+04	1.00E-05	2.49E+00	YES	4.21E+04	1.00E-05	8.35E-01
Risk of Benzene= 1E-6	NA	NA	NA	NA	NA			
Risk of cPAHs mixture= 1E-6	YES	1.05E+03	1.00E-06	2.49E-01				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	Soil-to-Ground Water is not a critical pathway!

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	1.48E+00	9.95E-10	2.98E-03	100% NAPL
Total Risk = 1E-5	YES	1.48E+00	9.95E-10	2.98E-03	100% NAPL
Total Risk = 1E-6	YES	1.48E+00	9.95E-10	2.98E-03	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	1.48E+00	9.95E-10	2.98E-03	100% NAPL
Benzene MCL = 5 ug/L	NA	NA	NA	NA	NA
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 84000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	1.48E+00	9.95E-10	2.98E-03	100% NAPL

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LAI-4 (7-10 ft)

2. Enter Soil Concentration Measured

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12		0.00%
AL_EC >12-16	2.2	1.27%
AL_EC >16-21	7.6	4.38%
AL_EC >21-34	110	63.32%
AR_EC >8-10		0.00%
AR_EC >10-12		0.00%
AR_EC >12-16		0.00%
AR_EC >16-21	4.9	2.82%
AR_EC >21-34	48.6906	28.03%
Benzene		0.00%
Toluene	0.014	0.01%
Ethylbenzene		0.00%
Total Xylenes		0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.04	0.02%
Benzo(b)fluoranthene	0.085	0.05%
Benzo(k)fluoranthene	0.042	0.02%
Benzo(a)pyrene	0.052	0.03%
Chrysene	0.067	0.04%
Dibenz(a,h)anthracene	0.0064	0.00%
Indeno(1,2,3-cd)pyrene	0.017	0.01%
Sum	173.714	100.00%

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here:	355	ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LAI-4 (7-10 ft)
Measured Soil TPH Concentration, mg/kg: 173.714

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	251	6.92E-07	2.72E-02	Pass
	Method C	10,114	1.72E-07	2.27E-03	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	4.31E-09	3.77E-03	Pass
	Target TPH GW Conc. @ 355 ug/L	100% NAPL	NA	NA	Pass

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	251.14	10,114.38
Most Stringent Criterion	Risk of cPAHs mixture= 1E-6	Total Risk=1E-5

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI=1	*NO*	6.38E+03	2.54E-05	1.00E+00	*NO*	7.66E+04	7.57E-05	1.00E+00
Total Risk=1E-5	*NO*	2.51E+03	1.00E-05	3.94E-01	YES	1.01E+04	1.00E-05	1.32E-01
Risk of Benzene= 1E-6	NA	NA	NA	NA	NA			
Risk of cPAHs mixture= 1E-6	YES	2.51E+02	1.00E-06	3.94E-02				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	Soil-to-Ground Water is not a critical pathway!

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	8.58E+00	4.39E-09	1.40E-02	100% NAPL
Total Risk = 1E-5	YES	8.58E+00	4.39E-09	1.40E-02	100% NAPL
Total Risk = 1E-6	YES	8.58E+00	4.39E-09	1.40E-02	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	8.58E+00	4.39E-09	1.40E-02	100% NAPL
Benzene MCL = 5 ug/L	NA	NA	NA	NA	NA
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 77000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	8.58E+00	4.39E-09	1.40E-02	100% NAPL

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LAI-06 (8-10 ft)

2. Enter Soil Concentration Measured

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12	17	3.03%
AL_EC >12-16	61	10.86%
AL_EC >16-21	34	6.06%
AL_EC >21-34	180	32.06%
AR_EC >8-10		0.00%
AR_EC >10-12	4.5	0.80%
AR_EC >12-16	23	4.10%
AR_EC >16-21	42	7.48%
AR_EC >21-34	198.978	35.44%
Benzene		0.00%
Toluene	0.003	0.00%
Ethylbenzene	0.0011	0.00%
Total Xylenes	0.0079	0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.16	0.03%
Benzo(b)fluoranthene	0.18	0.03%
Benzo(k)fluoranthene	0.18	0.03%
Benzo(a)pyrene	0.19	0.03%
Chrysene	0.27	0.05%
Dibenz(a,h)anthracene		0.00%
Indeno(1,2,3-cd)pyrene	0.042	0.01%
Sum	561.512	100.00%

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here: 355 ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LA1-06 (8-10 ft)
Measured Soil TPH Concentration, mg/kg: **561.512**

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	234	2.40E-06	1.72E-01	Fail
	Method C	9,419	5.96E-07	1.40E-02	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	3.97E-09	1.01E-01	Pass
	Target TPH GW Conc. @ 355 ug/L	100% NAPL	NA	NA	Pass

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through -7494).

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	233.88	9,419.30
Most Stringent Criterion	Risk of cPAHs mixture= 1E-6	Total Risk=1E-5

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI = 1	*NO*	3.26E+03	1.39E-05	1.00E+00	*NO*	4.01E+04	4.26E-05	1.00E+00
Total Risk=1E-5	*NO*	2.34E+03	1.00E-05	7.17E-01	YES	9.42E+03	1.00E-05	2.35E-01
Risk of Benzene= 1E-6	NA	NA	NA	NA	NA			
Risk of cPAHs mixture= 1E-6	YES	2.34E+02	1.00E-06	7.17E-02	NA			
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	Soil-to-Ground Water is not a critical pathway!

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	4.27E+01	3.86E-09	1.52E-01	100% NAPL
Total Risk = 1E-5	YES	4.27E+01	3.86E-09	1.52E-01	100% NAPL
Total Risk = 1E-6	YES	4.27E+01	3.86E-09	1.52E-01	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	4.27E+01	3.86E-09	1.52E-01	100% NAPL
Benzene MCL = 5 ug/L	NA	NA	NA	NA	NA
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 82000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	4.27E+01	3.86E-09	1.52E-01	100% NAPL

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LAI-09 (4-6 ft)

2. Enter Soil Concentration Measured

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12		0.00%
AL_EC >12-16	4.2	0.49%
AL_EC >16-21	17	2.00%
AL_EC >21-34	400	47.13%
AR_EC >8-10		0.00%
AR_EC >10-12		0.00%
AR_EC >12-16	2.6	0.31%
AR_EC >16-21	25	2.95%
AR_EC >21-34	397.62	46.85%
Benzene	0.002	0.00%
Toluene	0.0016	0.00%
Ethylbenzene		0.00%
Total Xylenes		0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.41	0.05%
Benzo(b)fluoranthene	0.41	0.05%
Benzo(k)fluoranthene	0.41	0.05%
Benzo(a)pyrene	0.47	0.06%
Chrysene	0.52	0.06%
Dibenz(a,h)anthracene	0.04	0.00%
Indeno(1,2,3-cd)pyrene	0.11	0.01%
Sum	848.7936	100.00%

Notes for Data Entry | Set Default Hydrogeology

Clear All Soil Concentration Data Entry Cells

Restore All Soil Concentration Data cleared previously

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here: 355 ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LA1-09 (4-6 ft)
Measured Soil TPH Concentration, mg/kg: **848.794**

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	144	5.91E-06	2.01E-01	Fail
	Method C	5,779	1.47E-06	1.68E-02	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	2.43E-07	1.04E-02	Pass
	Target TPH GW Conc. @ 355 ug/L	100% NAPL	NA	NA	Pass

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through -7494).

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	**143.50**	**5,779.36**
Most Stringent Criterion	**Risk of cPAHs mixture= 1E-6**	**Total Risk=1E-5**

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI =1	*NO*	4.22E+03	2.94E-05	1.00E+00	*NO*	5.06E+04	8.76E-05	1.00E+00
Total Risk=1E-5	*NO*	1.43E+03	1.00E-05	3.40E-01	YES	5.78E+03	1.00E-05	1.14E-01
Risk of Benzene= 1E-6	*NO*	7.71E+06	5.37E-02	1.83E+03	NA			
Risk of cPAHs mixture= 1E-6	YES	1.44E+02	1.00E-06	3.40E-02				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	**Soil-to-Ground Water is not a critical pathway!**

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	3.98E+00	9.51E-07	2.86E-02	100% NAPL
Total Risk = 1E-5	YES	3.98E+00	9.51E-07	2.86E-02	100% NAPL
Total Risk = 1E-6	YES	3.98E+00	9.51E-07	2.86E-02	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	3.98E+00	9.51E-07	2.86E-02	100% NAPL
Benzene MCL = 5 ug/L	YES	3.98E+00	9.51E-07	2.86E-02	100% NAPL
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 85000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	3.98E+00	9.51E-07	2.86E-02	**100% NAPL**

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/07/08
Site Name: 35th Street Landfill
Sample Name: TP-LAI-10 (6-8 ft)

2. Enter Soil Concentration Measured

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	0	0.00%
AL_EC >6-8	0	0.00%
AL_EC >8-10		0.00%
AL_EC >10-12	6.3	1.39%
AL_EC >12-16	26	5.75%
AL_EC >16-21	23	5.09%
AL_EC >21-34	240	53.07%
AR_EC >8-10		0.00%
AR_EC >10-12		0.00%
AR_EC >12-16	6.9	1.53%
AR_EC >16-21	20	4.42%
AR_EC >21-34	128.288	28.37%
Benzene		0.00%
Toluene	0.0023	0.00%
Ethylbenzene	0.0026	0.00%
Total Xylenes	0.0042	0.00%
Naphthalene		0.00%
1-Methyl Naphthalene		0.00%
2-Methyl Naphthalene		0.00%
n-Hexane		0.00%
MTBE		0.00%
Ethylene Dibromide (EDB)		0.00%
1,2 Dichloroethane (EDC)		0.00%
Benzo(a)anthracene	0.32	0.07%
Benzo(b)fluoranthene	0.29	0.06%
Benzo(k)fluoranthene	0.29	0.06%
Benzo(a)pyrene	0.29	0.06%
Chrysene	0.41	0.09%
Dibenz(a,h)anthracene	0.025	0.01%
Indeno(1,2,3-cd)pyrene	0.087	0.02%
Sum	452.2091	100.00%

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

REMARK:
Enter site-specific information here.....

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.003	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here:	355	ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/7/2008
Site Name: 35th Street Landfill
Sample Name: TP-LAI-10 (6-8 ft)
Measured Soil TPH Concentration, mg/kg: 452.209

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	119	3.81E-06	9.30E-02	Fail
	Method C	4,776	9.47E-07	7.66E-03	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	100% NAPL	9.50E-09	1.21E-02	Pass
	Target TPH GW Conc. @ 355 ug/L	100% NAPL	NA	NA	Pass

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through -7494).

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	118.60	4,776.36
Most Stringent Criterion	Risk of cPAHs mixture= 1E-6	Total Risk=1E-5

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI =1	*NO*	4.86E+03	4.10E-05	1.00E+00	*NO*	5.90E+04	1.24E-04	1.00E+00
Total Risk=1E-5	*NO*	1.19E+03	1.00E-05	2.44E-01	YES	4.78E+03	1.00E-05	8.09E-02
Risk of Benzene= 1E-6	NA	NA	NA	NA	NA			
Risk of cPAHs mixture= 1E-6	YES	1.19E+02	1.00E-06	2.44E-02				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	NA
Protective Ground Water Concentration, ug/L	NA
Protective Soil Concentration, mg/kg	Soil-to-Ground Water is not a critical pathway!

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Total Risk = 1E-5	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Total Risk = 1E-6	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Risk of cPAHs mixture= 1E-5	YES	1.13E+01	9.42E-09	1.57E-02	100% NAPL
Benzene MCL = 5 ug/L	NA	NA	NA	NA	NA
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 78000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 355 ug/L	1.13E+01	9.42E-09	1.57E-02	100% NAPL

APPENDIX C

MTCA Statistical Worksheet

Compliance calculations

Data	Count	
64	1	TPH
92	2	
36	3	
28	4	
530	5	
240	6	
100	7	
200	8	
11	9	
440	10	
580	11	
260	12	
900	13	
600	14	
640	15	
41	16	
320	17	
530	18	
670	19	
56	20	
740	21	
1600	22	
430	23	
11	24	
65	25	
61	26	
220	27	
200	28	
370	29	
800	30	
470	31	
340	32	
400	33	
440	34	
960	35	
900	36	
1200	37	
68	38	
850	39	
4000	40	
63	41	

Number of samples		Uncensored values	
Uncensored	41	Mean	500.63
Censored		Lognormal mean	620.94
Detection limit or PQL		Std. devn.	668.956679
Method detection limit		Median	370
TOTAL	41	Min.	11
		Max.	4000

Lognormal distribution?		Normal distribution?	
r-squared is:	0.950	r-squared is:	0.597

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 1132.38833964294

data check

9	1	Arsenic
8.2	2	
5.92	3	
5.2	4	
5.2	5	
6.4	6	
6.1	7	
5.8	8	
12.6	9	
8.4	10	
11.6	11	
9.9	12	
7.6	13	
8.6	14	
10.4	15	
7.9	16	
13.3	17	
8.8	18	
8.5	19	
1.2	20	
7.8	21	
8.2	22	
9.7	23	
5.7	24	
6	25	
9.1	26	
8.44	27	
6.7	28	
5.9	29	
13.5	30	
21.5	31	
8.2	32	
19.2	33	
9.2	34	
6.9	35	
6.3	36	
8.9	37	
8.7	38	
5.8	39	
1.9	40	
3.9	41	

Number of samples		Uncensored values	
Uncensored	41	Mean	8.35
Censored		Lognormal mean	8.52
Detection limit or PQL		Std. devn.	3.77494907
Method detection limit		Median	8.2
TOTAL	41	Min.	1.2
		Max.	21.5

Lognormal distribution?		Normal distribution?	
r-squared is:	0.853	r-squared is:	0.858

Recommendations:

Reject BOTH lognormal and normal distributions. See Statistics Guidance.

UCL (Land's method) is 9.91435861719817

TRANSMITTAL

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

To: City of Tacoma
Environmental Services Division

Date: August 5, 2008

Attn: Mr. John O'Loughlin

Project No.: 094042.010.011

RE: 35th Street Landfill Investigation

Copies	Description
3	Report-Remedial Investigation/Feasibility Study 35th Street Landfill, Tacoma, Washington; June 30, 2008
1	CD

Dear Mr. O'Loughlin:

Enclosed you will find the above-mentioned report for your information and files.

LANDAU ASSOCIATES, INC.

Jacqueline Slakey

Jacqueline A. Slakey
Project Coordinator
8/5/08 Y:\094\042.010\R\RI-CAP\35th Street RI-FS CAP_ rpt_trn.doc
JAS

RECEIVED
AUG 07 2008
Washington State
Department of Ecology

Cc: Mr. Chuck Cline, Washington State Dept. of Ecology/2 copies ✓