FLOYD | SNIDER
strategy • science • engineering
Two Union Square • 601 Union Street • Suite 600
Seattle, Washington 98101 • tel: 206.292.2078 • fax: 206.682.7867

# Memorandum

**To:** Pete Rude, City of Seattle

**From:** Jessi Massingale

**Date:** May 5, 2008

**Re:** **NE Corner Investigation Chemical Analysis Results—Gas Works Park**

This memorandum presents the results of chemical testing conducted by the City of Seattle law department on selected environmental samples collected during the September 2007 NE Corner soil investigation at Gas Works Park in Seattle, Washington.

## INTRODUCTION

The NE Corner investigation at Gas Works Park consisted of two coordinated field events implemented by the City of Seattle (City) and Puget Sound Energy (PSE) to identify and characterize the presence of subsurface dense non-aqueous phase liquid (DNAPL) and tar in the northeastern portion of the park and shoreline. Information generated by these investigations is useful for evaluation of sediment remedial actions in the Eastern Study Area of the Gas Works Sediment Area (GWSA) and to the City Department of Parks and Recreation for their continued maintenance and management of tar exposures in the park.

The scope of the investigative work at the park is documented in separate sampling and analysis plans (SAPs) prepared by the City, which focused on the meadow area of the northeast corner of the park, and PSE, which focused on the park's eastern shoreline. The SAPs were developed in accordance with the MTCA Agreed Order for the GWSA.

The investigation lead by the City team included a soil boring investigation in the meadow area to visually identify the presence of tar and/or DNAPL, evaluate the potential mobility of the tar and/or DNAPL impacted media, and evaluate the geologic conditions and physical properties of the soil. The investigation lead by the PSE team included a soil boring investigation along the eastern shoreline/bank and a soil hand auger investigation at the adjacent lake's edge with similar objectives to the City's investigation in the meadow.

## SAMPLING METHODS

Separate tar and/or NAPL impacted media samples from both investigations were collected by the City team and submitted to Analytical Resources, Inc. (ARI) in Tukwila, WA for holding. A subset of the held samples was selected for chemical analysis under the direction of the City's

Gas Works legal team. The City's SAP provides that: "In any boring location, if a significant tar and/or NAPL-impacted zone is present and collection of a second sample is possible, a sample may be collected and archived at the PTS Laboratories for potential future analysis" (SAP § 2.3.2).

When impacted media (i.e., heavy sheen, NAPL, tar) was encountered during the advancement of soil borings in the meadow by the City, a ring sample was collected for petrophysical testing. If additional impacted media was available it was placed in a labeled 8 ounce glass jar, placed in a chilled cooler, and transported to the analytical laboratory under chain-of-custody for potential chemical analysis. A Floyd|Snider geologist observed the advancement of Geoprobes along the shoreline by PSE's consultant (ENSR) and co-logged the borings. ENSR collected continuous soil/media samples from each Geoprobe. When highly impacted media was encountered during the PSE investigation and enough sample volume was available, in addition to what ENSR collected, a sample was collected by the Floyd|Snider field staff in a glass jar, but not initially stored on ice in the field. Storing these samples at room temperature for a period of approximately 24 hours could result in an underestimation of the detected SVOCs and VOCs concentrations due to potential microbial degradation and/or volatilization.

## CHEMICAL ANALYSIS RESULTS

A total of 11 samples selected from the impacted media samples described above were submitted for chemical analysis. Figure 1 shows the locations of the samples submitted for chemical analysis. All samples submitted for chemical analysis were from the subsurface and the depth intervals below ground surface analyzed ranged from 1-2.0 ft at SB-6 to 23-24 ft at GP-12. Table 1 provides the coordinates for each boring location. The samples were submitted for various combinations of the following analysis based on available sample volumes. Not all samples were analyzed for all chemical groups due to limitations on sample volumes and other factors.

- Semi-volatile Organic Compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAH)s, Method USEPA 8270
- Volatile Organic Compounds (VOCs) including BTEX, Method USEPA 8260
- Diesel and Motor Oil, NWTPH-Dx
- Synthetic Precipitation Leaching Procedure (SPLP) Analysis and SVOCs with Method USEPA 8270.

All chemical analyses were performed by ARI. The results of the chemical analysis for SVOCs, VOCs, and Diesel and Motor Oil are presented in Table 2. PAHs were detected in all samples analyzed for SVOCs. The detected concentrations of naphthalene ranged from 630 µg/kg to 2,700,000 µg/kg. The concentrations of total PAH ranged from 3,803 µg/kg to16,219,000 µg/kg (1.6 percent PAHs).

Two solid media samples (from borings SB-6 and SB-13) were selected for the Synthetic Precipitation Leaching Procedure (SPLP). Results of the SPLP can be used to evaluate the potential for leaching of metals or SVOCs into ground and surface waters. The analysis was intended to provide information regarding which PAHs could potentially leach or be mobilized

from site tars and anthropogenic solids and what the PAH concentration in the leachate might be. The sample from SB-6 was described during sample collection as globs of tar with the possible formation of naphthalene crystals in the sample jar overnight. The sample from SB-13 was described as a solid soot-like black material. Table 3 presents the results of the SPLP for both the solid material that was subjected to the SPLP procedure and the leachate generated. Only five PAHs were detected in the leachate from the SB-13 sample and at relatively low concentrations. However, all six low molecular weight PAHs (LPAHs) and two high molecular weight PAHs (HPAHs) were detected in the leachate from the SB-6 sample, which was collected in the vicinity of the recent May 2007 tar seep and from a depth of 1.0 to 2.0 feet bgs. The leachate concentration of naphthalene from the SB-6 sample was 15,000 µg/L..

**FIGURES**

Figure 1—Sample Locations Selected for Chemical Analysis

**TABLES**

Table 1—Northeast Corner Investigation Boring Location Coordinates

Table 2—Northeast Corner Investigation Chemical Analysis Results

Table 3—Results of the Synthetic Precipitation Leaching Procedure (SPLP) Analysis

**ATTACHMENTS**

Attachment 1—Electronic Data Deliverable (EDD) of Chemical Analysis

Attachment 2—Laboratory Reports (PDFs) – Including Chain-of-Custodies

## Table 1
## Northeast Corner Investigation Boring Location Coordinates

| Boring ID | Sample Coordinates[1,2] | |
|---|---|---|
| | Northing | Easting |
| **GP1** | 239485.5 | 1270791.2 |
| GP2 | 239464.7 | 1270793.6 |
| GP3 | 239449.6 | 1270801.7 |
| GP4 | 239433.8 | 1270811.4 |
| GP5 | 239422.2 | 1270813.6 |
| GP6 | 239402.3 | 1270815.2 |
| GP7 | 239367.6 | 1270815.8 |
| GP8 | 239310.2 | 1270825.3 |
| **GP9** | 239228.8 | 1270815.1 |
| GP10 | 239171.1 | 1270806.5 |
| **GP11** | 239086.4 | 1270780.4 |
| **GP12** | 239133.7 | 1270796.2 |
| GP13 | 239207.3 | 1270820.5 |
| GP14 | 239380.2 | 1270788.7 |
| HA1 | 239085.5 | 1270799.6 |
| HA2 | 239123.6 | 1270808.7 |
| HA3 | 239187.4 | 1270825.2 |
| HA4 | 239218.9 | 1270831.7 |
| HA5 | 239438.6 | 1270827.2 |
| HA6 | 239423.7 | 1270829.1 |
| HA7 | 239409.0 | 1270830.1 |
| HA8 | 239448.5 | 1270815.2 |
| HA9 | 239460.7 | 1270804.5 |
| SB 1 | 239409.0 | 1270640.1 |
| **SB 2** | 239455.1 | 1270637.7 |
| SB 2A | 239452.9 | 1270638.7 |
| **SB 3** | 239466.1 | 1270701.3 |
| SB 3A | 239463.8 | 1270703.6 |
| SB 4 | 239386.1 | 1270727.4 |
| SB 5 | 239436.4 | 1270742.5 |
| **SB 6** | 239414.0 | 1270790.9 |
| SB 7 | 239462.1 | 1270789.3 |
| **SB 8** | 239440.3 | 1270678.7 |
| SB 9 | 239448.0 | 1270718.4 |
| **SB 10** | 239385.8 | 1270766.3 |
| SB 11 | 239432.7 | 1270641.8 |
| SB 12 | 239471.5 | 1270642.9 |
| SB 12A | 239488.1 | 1270657.3 |
| **SB 13** | 239395.5 | 1270649.1 |

Notes:

**Bolded** Boring IDs denote those locations where samples were collected for chemical analysis.

GP - Geoprobe Borings advanced by ENSR.

HA - Hand Auger Borings advanced by ENSR.

SB - Soil Borings (Hollow Stem Auger) advanced by Floyd|Snider.

1. Location coordinates are presented in NAD 83 Datum, Washington State Plane Coordinate System, North Zone, FIPS, Units of Feet.
2. Locations surveyed by True North, Inc.

# Table 2
## Northeast Corner Investigation Chemical Analysis Results

| Location | Northern Meadow | | | | | | NE Shoreline | SE Shoreline | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | SB-2 S5 8-9.5 | SB-3 S5 10-11.5 | SB-6 S2 1-2.0 | SB-8 S5 9-10.5 | SB-10 S7 15-16.5 | SB-13 2.5-4.0 | GP-1 12.5-13 | GP-9 7-8 | GP-12 S1 8-12 | GP-12 S2 23-24 | GP-11 14-14.5 |
| Depth Interval (ft) | 8-9.5 | 10-11.5 | 1-2.0 | 9-10.5 | 15-16.5 | 2.5-4.0 | 12.5-13 | 7-8 | 8-12 | 23-24 | 14-14.5 |
| **NWTPH-Dx (mg/kg)** | | | | | | | | | | | |
| Diesel | **9,000** | NA | NA | **3,000** | NA | NA | NA | **24,000** | NA | NA | NA |
| Motor oil | **2,100** | NA | NA | **400** | NA | NA | NA | **26,000** | NA | NA | NA |
| **SVOCs (µg/kg)** | | | | | | | | | | | |
| 1-Methylnaphthalene | NA | **320** | **1,500,000** | NA | **360** | **10,000** | **210** | NA | NA | **33,000** | **280,000** |
| 2-Methylnaphthalene | NA | **300** | **2,700,000** | NA | **520** | **16,000** | **230** | NA | NA | **56,000** | **520,000** |
| 2-Chloronaphthalene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Acenaphthene | NA | **6,500** | **93,000** | NA | 220 U | **3,600** | **280** | NA | NA | **2,800** | **24,000** |
| Acenaphthylene | NA | **1,600** | **1,200,000** | NA | **270** | **35,000** | **300** | NA | NA | **18,000** | **75,000** |
| Anthracene | NA | **2,000** | **730,000** | NA | **580** | **120,000** | **220** | NA | NA | **15,000** | **50,000** |
| Fluorene | NA | **1,800** | **680,000** | NA | **280** | **42,000** | **250** | NA | NA | **18,000** | **51,000** |
| Naphthalene | NA | **630** | **13,000,000** | NA | **3,300** | **71,000** | **1,200** | NA | NA | **230,000** | **2,700,000** |
| Phenanthrene | NA | **4,200** | **3,800,000** | NA | **2,200** | **830,000** | **650** | NA | NA | **62,000** | **220,000** |
| **Total LPAH** | NA | **16,730** | **19,503,000** | | **6,630** | **1,101,600** | **2,900** | NA | NA | **345,800** | **3,120,000** |
| Benzo(a)anthracene | NA | **1,600** | **620,000** | NA | **1,200** | **370,000** | **110** | NA | NA | **12,000** | **57,000** |
| Benzo(a)pyrene | NA | **1,500** | **810,000** | NA | **1,000** | **510,000** | **73** | NA | NA | **11,000** | **73,000** |
| Benzo(b)fluoranthene | NA | **820** | **480,000** | NA | **510** | **350,000** | **60** | NA | NA | **8,600** | **54,000** |
| Benzo(k)fluoranthene | NA | **950** | **380,000** | NA | **750** | **350,000** | 52 U | NA | NA | **7,200** | **47,000** |
| Benzofluoranthenes (total) | NA | **1,770** | **860,000** | NA | **1,260** | **700,000** | **60** | NA | NA | **15,800** | **101,000** |
| Benzo(g,h,i)perylene | NA | **750** | **700,000** | NA | **480** | **420,000** | 52 U | NA | NA | 180 U | **39,000** |
| Chrysene | NA | **1,800** | **760,000** | NA | **1,100** | **460,000** | **110** | NA | NA | **11,000** | **57,000** |
| Dibenzo(a,h)anthracene | NA | 200 U | **80,000** | NA | 220 U | **44,000** | 52 U | NA | NA | 180 U | **6,400** |
| Fluoranthene | NA | **2,600** | **1,700,000** | NA | **2,100** | **1,200,000** | **270** | NA | NA | **36,000** | **170,000** |
| Indeno(1,2,3-cd)pyrene | NA | **730** | **490,000** | NA | **440** | **350,000** | 52 U | NA | NA | 180 U | **37,000** |
| Pyrene | NA | **3,400** | **2,500,000** | NA | **2,300** | **1,400,000** | **280** | NA | NA | **28,000** | **160,000** |
| **Total HPAH** | NA | **14,150** | **8,520,000** | NA | **9,880** | **5,454,000** | **903** | NA | NA | **113,800** | **700,400** |
| **Total PAH** | NA | **30,880** | **28,023,000** | NA | **16,510** | **6,555,600** | **3,803** | NA | NA | **459,600** | **3,820,400** |
| Carbazole | NA | **250** | **180,000** | NA | 220 U | **13,000** | 52 U | NA | NA | **9,900** | **17,000** |
| Dimethyl phthalate | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Diethylphthalate | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Di-n-butyl phthalate | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Butyl benzyl phthalate | NA | 200 U | 14,000 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| bis(2-ethylhexyl)phthalate | NA | **360 B** | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Di-n-octyl phthalate | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Phenol | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 2-Methylphenol | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 4-Methylphenol | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 2,4-Dimethylphenol | NA | 200 U | **2,900** | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Pentachlorophenol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| Benzyl alcohol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| Benzoic acid | NA | 2000 U | 27,000 U | NA | 2,200 U | 9,700 U | 520 U | NA | NA | 1,800 U | 3,800 U |
| 1,2-Dichlorobenzene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 1,3-Dichlorobenzene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 1,4-Dichlorobenzene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 1,2,4-Trichlorobenzene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Hexachloroethane | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Hexachlorobenzene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Dibenzofuran | NA | **250** | **110,000** | NA | 220 U | **6,900** | **53** | NA | NA | **11,000** | **32,000** |
| Hexachlorobutadiene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| N-Nitrosodinpropylamine | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| N-Nitrosophenylamine | NA | 680 | 27,000 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | **4,200** |
| Bis(2-Chloroethyl) Ether | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 2-Chlorophenol | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |

| Location | Northern Meadow | | | | | | NE Shoreline | SE Shoreline | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample ID** | **SB-2 S5 8-9.5** | **SB-3 S5 10-11.5** | **SB-6 S2 1-2.0** | **SB-8 S5 9-10.5** | **SB-10 S7 15-16.5** | **SB-13 2.5-4.0** | **GP-1 12.5-13** | **GP-9 7-8** | **GP-12 S1 8-12** | **GP-12 S2 23-24** | **GP-11 14-14.5** |
| **Depth Interval (ft)** | **8-9.5** | **10-11.5** | **1-2.0** | **9-10.5** | **15-16.5** | **2.5-4.0** | **12.5-13** | **7-8** | **8-12** | **23-24** | **14-14.5** |
| 2,2' Oxybis (1-Chloropropane) | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Nitrobenzene | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| Isophorone | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 2-Nitrophenol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 3,800 U |
| Bis (2-Chloroethoxy) Methane | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 2,4-Dichlorophenol | NA | 1000 U | 14,000 U | NA | 220 U | 4,800 U | 260 U | NA | NA | 890 U | 3,800 U |
| 4-Chloroaniline | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 4-Chloro-3-methylphenol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| Hexachlorocyclopentadiene | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 2,4,6-Trichlorophenol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 2,4,5-Trichlorophenol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 2-Nitroaniline | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 3-Nitroaniline | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 2,4-Dinitrophenol | NA | 2000 U | 27,000 U | NA | 2,000 U | 9,700 U | 520 U | NA | NA | 1,800 U | 38,000 U |
| 4-Nitrophenol | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 52 U | NA | NA | 890 U | 19,000 U |
| 2,6-Dinitotoluene | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 2,4-Dinitrotoluene | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 4-Nitroaniline | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 890 U | 19,000 U |
| 4,6-Dinitro-2-Methylphenol | NA | 2000 U | 27,000 U | NA | 2,200 U | 9,700 U | 520 U | NA | NA | 1,800 U | 38,000 U |
| 4-Bromophenyl-phenylether | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 4-Chloropheny-phenylether | NA | 200 U | 2,700 U | NA | 220 U | 970 U | 52 U | NA | NA | 180 U | 3,800 U |
| 3,3'-Dichlorobenzidine | NA | 1000 U | 14,000 U | NA | 1,100 U | 4,800 U | 260 U | NA | NA | 180 U | 19,000 U |
| **VOCs (µg/kg)** | | | | | | | | | | | |
| Chloromethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Bromomethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Vinyl Chloride | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Chloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Methylene Chloride | 690 U | NA | NA | 580 U | NA | NA | NA | 1,300 U | 1,100 U | 160 U | 1,200 U |
| Acetone | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| Carbon Disulfide | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,1-Dichloroethene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,1-Dichloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| trans-1,2-Dichloroethene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| cis-1,2-Dichloroethene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Chloroform | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,2-Dichloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 2-Butanone | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| 1,1,1-Trichloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Carbon Tetrachloride | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Vinyl Acetate | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| Bromodichloromethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,2-Dichloropropane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| cis-1,3-Dichloropropene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Trichloroethene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Dibromochloromethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,1,2-Trichloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Benzene | **1,700** | NA | NA | 290 U | NA | NA | NA | 670 U | **1,100** | **84** | **4,300** |
| trans-1,3-Dichloropropene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 2-Chloroethylvinylether | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| Bromoform | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 4-Methyl-2-Pentanone (MIBK) | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| 2-Hexanone | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| Tetrachloroethene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,1,2,2-Tetrachloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Toluene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | **2,100** | **540** | **41,000** |
| Chlorobenzene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | <82 U | 570 U |
| Ethylbenzene | **28,000** | NA | NA | **5,600** | NA | NA | NA | 670 U | **21,000** | **270** | **54,000** |

| Location | Northern Meadow | | | | | | NE Shoreline | SE Shoreline | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample ID** | **SB-2 S5 8-9.5** | **SB-3 S5 10-11.5** | **SB-6 S2 1-2.0** | **SB-8 S5 9-10.5** | **SB-10 S7 15-16.5** | **SB-13 2.5-4.0** | **GP-1 12.5-13** | **GP-9 7-8** | **GP-12 S1 8-12** | **GP-12 S2 23-24** | **GP-11 14-14.5** |
| **Depth Interval (ft)** | **8-9.5** | **10-11.5** | **1-2.0** | **9-10.5** | **15-16.5** | **2.5-4.0** | **12.5-13** | **7-8** | **8-12** | **23-24** | **14-14.5** |
| Styrene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | **5,900** | 82 U | 570 U |
| Trichlorofluoromethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,1,2-Trichloro-1,2,2-trifluor | 690 U | NA | NA | 580 U | NA | NA | NA | 1,300 U | 1,100 U | 160 U | 1,200 U |
| m,p-Xylene | **1,100** | NA | NA | 290 U | NA | NA | NA | 670 U | **35,000** | **1,000** | **300,000** |
| o-Xylene | **2,200** | NA | NA | **750** | NA | NA | NA | 670 U | **17,000** | **390** | **100,000** |
| 1,2-Dichlorobenzene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,3-Dichlorobenzene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,4-Dichlorobenzene | 17,000 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Acrolein | 340 U | NA | NA | 15,000 U | NA | NA | NA | 33,000 U | 28,000 U | 4,100 U | 29,000 U |
| Methyl Iodide | 690 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Bromoethane | 1,700 U | NA | NA | 580 U | NA | NA | NA | 1,300 U | 1,100 U | 160 U | 1,200 U |
| Acrylonitrile | 340 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| 1,1-Dichloropropene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Dibromomethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,1,1,2-Tetrachloroethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,2-Dibromo-3chloropropane | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| 1,2,3-Trichloropropane | 690 U | NA | NA | 580 U | NA | NA | NA | 1,300 U | 1,100 U | 160 U | 1,200 U |
| trans-1,4-Dichloro-2-butene | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| 1,3,5-Trimethylbenzene | **2,100** | NA | NA | **340** | NA | NA | NA | 670 U | **21,000** | **500** | **30,000** |
| 1,2,4-Trimethylbenzene | **20,000** | NA | NA | **3,200** | NA | NA | NA | **1,500** | **54,000** | **870** | **65,000** |
| Hexachlorobutadiene | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| Ethylene Dibromide | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Bromochloromethane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 2,2-Dichloropropane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 1,3-Dichloropropane | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| Isopropylbenzene | **35,000** | NA | NA | **6,100** | NA | NA | NA | 670 U | **4,800** | 82 U | **5,000** |
| n-Propylbenzene | **1,800** | NA | NA | **1,600** | NA | NA | NA | 670 U | **1,200** | 82 U | 570 U |
| Bromobenzene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 2-Chlorotoluene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 4-Chlorotoluene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| tert-Butylbenzene | 340 U | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| sec-Butylbenzene | **820** | NA | NA | 290 U | NA | NA | NA | 670 U | 570 U | 82 U | 570 U |
| 4-Isopropyltoluene | **19,000** | NA | NA | **4,100** | NA | NA | NA | 670 U | **8,400** | 82 U | **6,200** |
| n-Butylbenzene | **10,000** | NA | NA | **2,300** | NA | NA | NA | 670 U | **7,200** | 82 U | **4,200** |
| 1,2,4-Trichlorobenzene | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |
| Naphthalene | **1,200,000** | NA | NA | **280,000** | NA | NA | NA | **37,000** | **440,000** | **32,000** | **2,000,000** |
| 1,2,3-Trichlorobenzene | 1,700 U | NA | NA | 1,500 U | NA | NA | NA | 3,300 U | 2,800 U | 410 U | 2,900 U |

**Notes:**

Detected Concentrations are in Bold.

Methylnaphthalenes and Chloronaphthalenes not included in calculated Total LPAH.

NA: Not Analyzed

**Qualifiers:**

U - Undetected

B - The analyte was detected in the associated method blank.

# Table 3
## Results of the Synthetic Precipitation Leaching Procedure (SPLP) Analysis

| Location | SW Section of Meadow | SW Section of Meadow | E Section of Meadow | E Section of Meadow |
|---|---|---|---|---|
| Sample ID | SB-13 2.5-4.0 | SB-13 2.5-4.0 | SB-6 S2 1-2.0 | SB-6 S2 1-2.0 |
| Depth Interval (ft) | 2.5-4.0 | 2.5-4.0 | 1-2.0 | 1-2.0 |
| | Solid (ug/kg) | Leachate (ug/L) | Solid (ug/kg) | Leachate (ug/L) |
| **SVOCs** | | | | |
| 1-Methylnaphthalene | **10,000** | 10 U | **1,500,000** | **440** |
| 2-Methylnaphthalene | **16,000** | 10 U | **2,700,000** | **690** |
| 2-Chloronapthalene | 970 U | 10 U | 2,700 U U | 10 U |
| Acenaphthene | **3,600** | 10 U | **93,000** | **10** |
| Acenaphthylene | **35,000** | 10 U | **1,200,000** | **310** |
| Anthracene | **120,000** | 10 U | **730,000** | **20** |
| Fluorene | **42,000** | **12** | **680,000** | **54** |
| Naphthalene | **71,000** | 10 U | **13,000,000** | **15,000** |
| Pheneanthrene | **830,000** | **98** | **3,800,000** | **120** |
| **Total LPAH** | **1,101,600** | **110** | **19,503,000** | **15,514** |
| Benzo (a) anthracene | **370,000** | 10 U | **620,000** | 10 U |
| Benzo (a) pyrene | **510,000** | 10 U | **810,000** | 10 U |
| Benzo (b) fluoranthene | **350,000** | 10 U | **480,000** | 10 U |
| Benzo (k) fluoranthene | **350,000** | 10 U | **380,000** | 10 U |
| Benzofluoranthenes (total) | **700,000** | 10 U | **860,000** | 10 U |
| Benzo (g,h,i) perylene | **420,000** | 10 U | **700,000** | 10 U |
| Chrysene | **460,000** | 10 U | **760,000** | 10 U |
| Dibenz (a,h) anthracene | **44,000** | 10 U | **80,000** | 10 U |
| Fluoranthene | **1,200,000** | **21** | **1,700,000** | **12** |
| Indeno (1,2,3-cd) pyrene | **350,000** | 10 U | **490,000** | 10 U |
| Pyrene | **1,400,000** | **30** | **2,500,000** | **19** |
| **Total HPAH** | **5,454,000** | **51** | **8,520,000** | **31** |
| **Total PAH** | **6,555,600** | **161** | **28,023,000** | **15,545** |
| Carbazole | **13,000** | 10 U | **180,000** | **140** |
| Dimethylphthalate | 970 U | 10 U | 2,700 U | 10 U |
| Diethylphthalate | 970 U | 10 U | 2,700 U | 10 U |
| Di-n-Butylphthalate | 970 U | 10 U | 2,700 U | 10 U |
| Butylbenzylphthalate | 970 U | 10 U | 14,000 U | 10 U |
| bis (2-Ethylhexyl) phthalate | 970 U | 10 U | 2,700 U | 10 U |
| Di-n-Octyl phthalate | 970 U | 10 U | 2,700 U | 10 U |
| Phenol | 970 U | 10 U | 2,700 U | 10 U |
| 2-Methylphenol | 970 U | 10 U | 2,700 U | 10 U |
| 4-Methylphenol | 970 U | 10 U | 2,700 U | **18** |
| 2,4-Dimethylphenol | 970 U | 10 U | **2,900** | 10 U |
| Pentachlorophenol | 4,800 U | 50 U | 14,000 U | 50 U |
| Benzyl Alcohol | 4,800 U | 50 U | 14,000 U | 50 U |
| Benzoic Acid | 9,700 U | 100 U | 27,000 U | 100 U |
| 1,2-Dichlorobenzene | 970 U | 10 U | 2,700 U | 10 U |
| 1,3-Dichlorobenzene | 970 U | 10 U | 2,700 U | 10 U |
| 1,4-Dichlorobenzene | 970 U | 10 U | 2,700 U | 10 U |
| 1,2,4-Trichlorobenzene | 970 U | 10 U | 2,700 U | 10 U |
| Hexachloroethane | 970 U | 10 U | 2,700 U | 10 U |
| Hexachlorobenzene | 970 U | 10 U | 2,700 U | 10 U |
| Dibenzofuran | **6,900** | 10 U | **110,000** | **12** |
| Hexachlorobutadiene | 970 U | 10 U | 2,700 U | 10 U |

| Location | SW Section of Meadow | SW Section of Meadow | E Section of Meadow | E Section of Meadow |
|---|---|---|---|---|
| **Sample ID** | **SB-13 2.5-4.0** | **SB-13 2.5-4.0** | **SB-6 S2 1-2.0** | **SB-6 S2 1-2.0** |
| **Depth Interval (ft)** | **2.5-4.0** | **2.5-4.0** | **1-2.0** | **1-2.0** |
| | **Solid (ug/kg)** | **Leachate (ug/L)** | **Solid (ug/kg)** | **Leachate (ug/L)** |
| N-Nitroso-Di-N-Propylamine | 4,800 U | 50 U | 14,000 U | 50 U |
| N-Nitrosodiphenylamine | 970 U | 10 U | 27,000 U | 10 U |
| Bis-(2-Choroethyl) Ether | 970 U | 10 U | 2,700 U | 10 U |
| 2-Chlorophenol | 970 U | 10 U | 2,700 U | 10 U |
| 2,2'-Oxybis (1-Chloropropane | 970 U | 10 U | 2,700 U | 10 U |
| Nitrobenzene | 970 U | 10 U | 2,700 U | 10 U |
| Isophorone | 970 U | 10 U | 2,700 U | 10 U |
| 2-Nitrophenol | 4,800 U | 50 U | 14,000 U | 50 U |
| bis (2-Choroethoxy) Methane | 970 U | 10 U | 2,700 U | 10 U |
| 2,4-Dichlorophenol | 4,800 U | 50 U | 14,000 U | 50 U |
| 4-Chloroaniline | 4,800 U | 50 U | 14,000 U | 50 U |
| 4-Chloro-3-methylphenol | 4,800 U | 50 U | 14,000 U | 50 U |
| Hexachlorocyclopentadiene | 4,800 U | 50 U | 14,000 U | 50 U |
| 2,4,6-Trichlorophenol | 4,800 U | 50 U | 14,000 U | 50 U |
| 2,4,5-Trichlorophenol | 4,800 U | 50 U | 14,000 U | 50 U |
| 2-Nitroaniline | 4,800 U | 50 U | 14,000 U | 50 U |
| 3-Nitroaniline | 4,800 U | 50 U | 14,000 U | 50 U |
| 2,4-Dinitrophenol | 9,700 U | 100 U | 27,000 U | 100 U |
| 4-Nitrophenol | 4,800 U | 50 U | 14,000 U | 50 U |
| 2,6-Dinitrotoluene | 4,800 U | 50 U | 14,000 U | 50 U |
| 2,4-Dinitrotoluene | 4,800 U | 50 U | 14,000 U | 50 U |
| 4-Nitroaniline | 4,800 U | 50 U | 14,000 U | 50 U |
| 4,6-Dinitro-2-Methylphenol | 9,700 U | 100 U | 27,000 U | 100 U |
| 4-Bromophenyl-phenylether | 970 U | 10 U | 2,700 U | 10 U |
| 4-Chorophenyl phenylether | 970 U | 10 U | 2,700 U | 10 U |
| 3,3'-Dichlorobenzidine | 4,800 U | 50 U | 14,000 U | 50 U |

**Notes:**

Detected Concentrations are in Bold.

Methylnaphthalenes and Chloronaphthalenes not included in calculated Total LPAH.

**Qualifiers:**

U - Undetected


FLOYD | SNIDER
strategy ▪ science ▪ engineering

**Gas Works Park**
**NE Corner Investigation**
**Seattle, Washington**

Figure 1
Sample Locations Selected for Chemical Analysis

File: F:\projects\COS-GWSA\GIS\Task 03061\MXD\Figure 1 (Sample Locations Selected for Chemical Analysis).mxd
Date: 05/05/2008