APPENDIX A

Summary Pages from Historical Investigation were noted entering this feature from under S March Point Road. Wetland vegetation was observed in various locations within this stream; most notably red alder, willow, creeping buttercup and skunk cabbage. A portion of the stream between the site and S March Point Road is tidally influenced and could be considered estuarine habitat. The stream enters the tideland south of the side, turns north and flows along the eastern edge of the landfill into Padilla Bay Lagoon (Figure 4, Photographs 3 and 4). Several unidentified species of juvenile fish were noted within the stream channel on the eastern edge of the landfill, which separates the landfill from the Swinomish Indian Reservation.

On-site upland habitat is minimal because of the active sawmill operations. The extreme edges of the landfill as well as a relatively undisturbed 2 to 3 acre area along the southeast portion of the site contain the only notable upland habitat. Invasive blackberry and scotch broom were the most dominant upland species of vegetation noted on-site. Other upland species observed mostly within the southern portion included red alder, big-leaf maple, bitter cherry and possibly black hawthorn. The vegetation within this area (to the south) was not completely inventoried during the field reconnaissance.

3.0 PREVIOUS INVESTIGATIONS – UPLAND

This section discusses previous investigations where leachate and surface water sampling and testing were conducted at the landfill. Note that some of these studies also included sediment and/or biota sampling and testing but no soil or groundwater sampling has been completed at the site. These results are summarized in the Sediment Data Gaps report (SAIC, 2007). According to Ecology, the Swinomish Tribe collected a water (surface water or leachate) sample in 1997 (Ecology, 1999). The analytical results for this sample were not provided to us and have not been reviewed.

The approximate location of previous leachate/surface water samples are shown on Figure 5. The analytical data associated with these samples are included in this work plan as Tables 2 through 5. Note that the surface water criteria have changed (in general, some criteria have become more stringent) since the studies outlined below have been completed. In Sections 3.1 through 3.6, we have reiterated the conclusions of six environmental studies (primarily related to leachate sampling and testing) that have been completed at the site. We have also compared the detected leachate concentrations to current surface water criteria to evaluate whether chemicals of concern are present and are of regulatory concern based on current criteria. The surface water criteria are being used in this report for screening purposes, and are not intended to represent proposed or final cleanup levels.

3.1 PRELIMINARY ASSESSMENT (ECOLOGY, 1985)

Ecology and EPA conducted a Preliminary Assessment (PA) of the landfill in November 1984 and identified the site as a medium priority. The PA identified potentially contaminated groundwater, tidal incursion into the landfill, and leachate surfacing on the eastern landfill boundary as potential hazards to human health or the environment. The PA identified concerns regarding industries (i.e., Shell and Texaco refineries, Allied Chemical Sulfuric Acid Plant, and the Northwest Petrochemical Company) that were present in the local area at the time of unregulated dumping. Texaco, in a 103(c) notification, called March Point Landfill their "off-site No. 2," which has been interpreted as an offsite disposal facility for Texaco. The PA recommended analyzing leachate for priority pollutants and, if necessary, follow-up sampling including the installation and sampling of groundwater monitoring wells. The PA also recommended that historical data on industrial activities and waste dumping practices should be obtained from industries operating on March Point. However, we do not know if the historical data were obtained.

3.2 SITE INSPECTION (ECOLOGY, 1986)

Based on the results of the 1984 PA, Ecology conducted a site inspection (SI) at the March Point Landfill in December 1985. Ecology collected three surface water samples (NCT091, NCT092, and NCT094), one leachate sample (NCT095), and two sediment samples (surface water and leachate sample locations are shown on Figure 5). The surface water samples were collected at the following locations: 1) borrow pit upgradient of the landfill (NCT091), 2) estuarial stream southeast of landfill (NCT092), and 3) Padilla Bay lagoon surface water at the northeast side of landfill (NCT094). The location where sample NCT092 was collected is not clear. The SI report states that "sample NCT092 was taken from an estuarial stream on the southeast edge of the landfill." However, the sample location figure in the SI report (Figure 1) shows the NCT092 sample location approximately 2,500 feet southeast of the landfill (Ecology, 1986). Figure 5 shows both potential NCT092 sample locations. The leachate sample was collected at the northeast side of landfill. The surface water and leachate samples were analyzed for EPA priority pollutant metals and volatile organic compounds (VOCs). At the time that the report was produced, Ecology concluded that "sampling data do not show a significant problem at this landfill to warrant further sampling or remedial actions."

Based on a review of the 1985 sample results compared to current surface water criteria: arsenic, copper, mercury, and nickel were detected in at least two water samples at concentrations greater than their respective aquatic life or human health surface water criteria (Table 2).

3.3 ANALYSIS OF LEACHATE FROM WHITMARSH LANDFILL (ECOLOGY, 1989)

Ecology collected a grab sample of leachate (sample 88-257426) from the northeast corner of the landfill in June 1988 (Figure 5). The sample was analyzed for priority pollutant metals. The letter concluded that the results were "an indication of a heavy metals problem at Whitmarsh which will require further study."

Based on our review of the 1989 sample results as compared to current surface water criteria: arsenic, cadmium, chromium, copper, lead, nickel, thallium, and zinc were detected at concentrations greater than their respective surface water criteria (Table 3).

3.4 SKAGIT COUNTY DEPARTMENT OF HEALTH SAMPLING (SKAGIT COUNTY, 1996)

Based on Swinomish Indian Tribal Community concerns regarding potential contaminant releases from the March Point Landfill (referred to as the Whitmarsh Landfill in this 1996 letter) into Padilla Bay, the Skagit County Department of Health collected surface water and sediment samples near the landfill in October 1996. Two water sample locations were identified based on the presence of discolored water emanating from the concrete rip-rap wall along the northeast side of the landfill (Figure 5). A leachate and sediment sample were collected at each location (leachate sample numbers WMW-1 and WMW-2; see the Sediment Data Gaps report [SAIC, 2007] for sediment sample information). Samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and metals. No analytes were detected at concentrations greater than their respective surface water criteria (Table 4). The report concluded that "further investigation using county resources is not warranted at this time."

Based on a review of the 1996 sample results as compared to current surface water criteria, although there were detected concentrations of VOCs and SVOCs and phenols, none of the chemicals exceeded their respective surface water criteria.

TABLE 2

1986 ECOLOGY SITE INSPECTION REPORT - WATER SAMPLES[1]

MARCH POINT LANDFILL
ANACORTES, WASHINGTON

Analytes	Sample ID				Surface Water Criteria[2]		
	NCT091 (Surface Water) Figure 9 - Location 1A	NCT092 (Surface Water) Figure 9 - Location 1B	NCT094 (Surface Water) Figure 9 - Location 1C	NCT095 (Leachate) Figure 9 - Location 1D	Aquatic Life Marine/Chronic[3]	Human Health Marine[4]	MTCA Method B[5]
Dissolved Metals - EPA Method Not Known (µg/L)							
Antimony	<1	<1	<1	<1	--	640	1000
Arsenic	**5**	<1	**74**	**2**	36	0.14	0.098
Beryllium	<0.1	<0.1	**14.2**	<0.1	--	--	270
Cadmium	<0.2	<0.2	<0.2	<0.2	8.8	--	20
Chromium	<1	<1	<1	<1	50	--	490
Copper	**7**	**11**	**2**	**1**	2.4	--	2700
Lead	<1	<1	<1	<1	8.1	--	--
Mercury	**0.06**	**0.06**	<0.06	<0.06	0.025	0.15	--
Nickel	**5**	**100**	**40**	**6**	8.2	4600	1100
Selenium	**2**	<1	**62**	**5**	71	4200	2700
Silver	<0.1	<0.1	<0.1	<0.1	--	--	26000
Telurium	**1**	<1	**24**	**3**	--	--	--
Zinc	<1	**32**	**3**	**22**	81	26000	17000
Phenolics - EPA Method Not Known (mg/L)							
Phenolics	0.030	0.005	0.010	0.020	--	--	--
Volatile Organic Compounds - EPA Method Not Known (µg/L)							
Benzene	<1	<1	<1	13	--	51	23

Notes:

[1]Ecology, 1986

[2]Surface water criteria identified in WAC 173-340-730(3)(b)(i). The surface water criteria are being used in this report for screening purposes, and are not intended to represent proposed or final cleanup levels.

[3]Lowest available aquatic life marine chronic criteria from Chapter 173-201A, Clean Water Act Section 304, and National Toxics Rule (40 CFR 131)

[4]Lowest available human health marine criteria from Clean Water Act Section 304 and National Toxics Rule (40 CFR 131)

[5]MTCA Method B surface water cleanup level [WAC 173-340-730(3)(b)(iii)]

-- = not available

nd = not detected

n/a = not analyzed or not applicable

bold indicates a detected concentration

underline indicates that detection limit is greater than at least one surface water criteria

shading indicates that detected concentration is greater than at least one surface water criteria

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TABLE 3
1989 ECOLOGY LETTER - LEACHATE SAMPLES[1]
MARCH POINT LANDFILL
ANACORTES, WASHINGTON

Analytes	Sample ID 88-257426 Figure 9 - Location 2	Surface Water Criteria[2] Aquatic Life Marine/Chronic[3]	Human Health Marine[4]	MTCA Method B[5]
Metals - EPA Method Unknown (µg/L)				
Antimony[6]	1U	--	640	1,000
Arsenic[6]	**91**	36	0.14	0.098
Beryllium[7]	**8.5**	--	--	270
Cadmium[7]	**9.9**	8.8	--	20
Chromium[7]	**324**	50	--	490
Copper[7]	**357**	2.4	--	2,700
Lead[6]	**126**	8.1	--	--
Mercury[6]	--	0.025	0.15	--
Nickel[7]	**959**	8.2	4,600	1,100
Selenium[6]	1U	71	4,200	2,700
Silver[6]	**2.2**	--	--	26,000
Thallium[6]	**1.8**	--	0.47	--
Zinc[7]	**779**	81	26,000	17,000

Notes:
[1]Ecology, 1989
[2]Surface water criteria identified in WAC 173-340-730(3)(b)(i). The surface water criteria are being used in this report for screening purposes, and are not intended to represent proposed or final cleanup levels.
[3]Lowest available aquatic life marine chronic criteria from Chapter 173-201A, Clean Water Act Section 304, and National Toxics Rule (40 CFR 131)
[4]Lowest available human health marine criteria from Clean Water Act Section 304 and National Toxics Rule (40 CFR 131)
[5]MTCA Method B surface water cleanup level [WAC 173-340-730(3)(b)(iii)]
-- = not available
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bold indicates a detected concentration
shading indicates that detected concentration is greater than at least one surface water criteria

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SKAGIT COUNTY
DEPARTMENT OF HEALTH

HOWARD L. LEIBRAND, M.D. HEALTH OFFICER
PATRICIA A. PEARCE, DIRECTOR

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PHONE: (360) 336-9380
FAX: (360) 336-9401
ANACORTES TOLL-FREE: (360) 293-9508

December 6, 1996

Lauren Rich
Swinomish Indian Tribal Community
P.O. Box 817
La Conner, WA 98257

Re: Whitmarsh Landfill Sample Data Results

Dear Lauren:

The Skagit County Health Department received a complaint from you regarding potential contaminant releases from the Whitmarsh Landfill into Padilla Bay. In response to that complaint, Gary Sorensen of the Skagit County Public Works conducted a site visit with you and Kenneth Edwards to survey the site. Based on that visit it was agreed that Skagit County would conduct some surface water and sediment sampling from sites of suspected contamination.

On October 24, 1996 Britt Pfaff, Gary Sorensen, and I met you at the site to determine sample locations and conduct sampling of surface water and marine sediment. Sample locations were selected based largely on discolored surface water emanating from the concrete rip-rap wall at points where it discharged to the adjacent mudflats. Two such discharge points were identified (see attached map). At each discharge point a surface water sample and a sediment sample were collected. A full priority pollutant analysis was conducted on each of the two surface water and sediment samples.

A summary sheet of the data results is enclosed along with a copy of the full laboratory report. Generally, only a few organic compounds and metals were detected within the surface water sample. Those that were detected were at very low levels. Several organic compounds and metal species were detected within the sediment samples. However, these too were detected at extremely low concentration levels, and many parameters were flagged as estimated values detected below the laboratory reporting limits.

The Washington State Department of Ecology conducted a site inspection (Site Inspection Report March Point Landfill, Anacortes, Washington, March 1986). A copy of that report is enclosed for your information. Two of their samples (leachate sample NCT095 and sediment sample NCT096) appear to be similar to the water and sediment samples collected as part of this investigation and from a similar area.

Observed concentration levels from Ecology's sediment sample NCT096 does show some correlation with the two sediment samples we collected. For example, acetone and methylene chloride were detected in NCT096 and both sediment samples we collected. However, they concluded both compounds were laboratory contaminants and not within the sediments because both compounds were detected in the transport blank. Neither compound was detected in the transport blank submitted with our samples. This would indicate that both compounds were in the sediment samples and not due to laboratory contamination. Additionally, toluene and fluoranthene were detected in NCT096 and one (WM-1) of the two sediment samples we collected. Observed concentration levels for all four compounds in NCT096 ranged from slightly above to significantly above the respective levels observed in the sediment samples we collected.

Ecology concluded from their sampling that it could not be determined whether the slight contamination detected resulted directly from the landfill contents or from other non-point sources in the area (such as fuel spills).

Ecology also concluded that the presence of flouranthene and toluene are not unexpected in the offshore marine sediment samples for such a highly industrialized area. They further concluded that their sampling data did not show a significant problem with the landfill to warrant further sampling or remedial actions, and there was no conclusive indication that hazardous materials were leaching from the landfill into Padilla Bay or its surrounding estuarial area.

Based on the sample results from our investigation and Ecology's investigation, we agree with Ecology's findings and conclude that further investigation using county resources is not warranted at this time. However, we would be pleased to cooperate with any further investigation the Swinomish Tribe may pursue regarding this site.

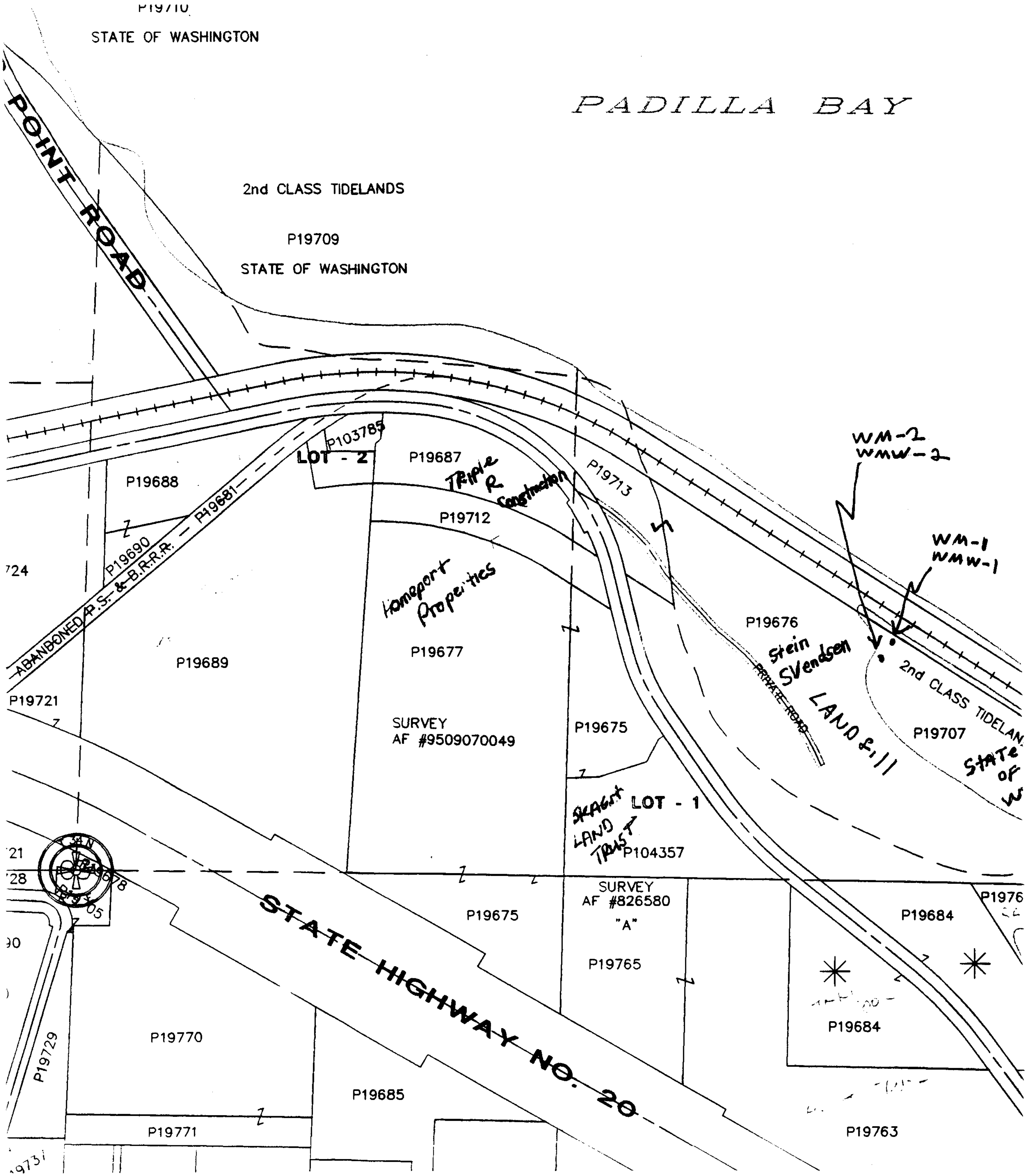
After your review of the data, we would be happy to meet with you and your representatives to discuss the data results and our findings. If you would like to meet, please contact either Britt Pfaff or me to arrange such a meeting.

Sincerely,

Ken Willis
Environmental Health Specialist

Attachments

cc: Gary Sorensen, Public Works
Britt Pfaff, Heath Department
Paul Reilley, Civil Litigator
Dave Fleming, Risk Manager


P19710
STATE OF WASHINGTON
PADILLA BAY
POINT ROAD
2nd CLASS TIDELANDS
P19709
STATE OF WASHINGTON
P103785
LOT - 2
P19687
Triple R Construction
P19688
P19713
WM-2
WMW-2
P19681
P19712
P19690
ABANDONED P.S. & B.R.R.R.
Homeport Properties
WM-1
WMW-1
P19676
Stein Svendsen
PRIVATE ROAD
LANDfill
P19689
P19677
2nd CLASS TIDELAN
P19707
State of W
P19721
SURVEY
AF #9509070049
P19675
Skagit LAND TRUST
LOT - 1
P104357
SURVEY
AF #826580
"A"
P19675
P19684
P19765
STATE HIGHWAY NO. 20
P19684
P19770
P19729
P19685
P19771
P19763

Whitmarsh Landfill

Samples Collected: October 24, 1996

PARAMETER	Water WMW-1	Water WMW-2	Sediment WM-1	Sediment WM-2
8260 Method	ug/L	ug/L	mg/kg	mg/kg
Benzene	6			
Chlorobenzene	15	1J		
m,p-Xylenes	3	1J	0.005J	0.008J
o-Xylene	3			
Acetone			0.52	0.7
Carbon Disulfide			0.03	0.05
Methylene Chloride			0.014J	0.016J
2-Butanone			0.17	0.19
4-Methyl-2-pentanone			0.1	
Toluene			0.008J	0.011J
2-Hexanone			0.038J	0.036J
8270 Method	ug/L	ug/L	mg/kg	mg/kg
2,4-Dimethylphenol	3			
Naphthalene	2			
2-Methylnaphthalene	1			
N-Nitrosodiphenylamine		1		
Bis(2-ethylhexyl)phthalate		1	0.1	0.44
Fluoranthene			0.046J	
Pyrene			0.084	
Benzo(a)anthracene			0.074	
Chrysene			0.064	
Benzo(b)fluoranthene			0.048J	
Benzo(k)fluoranthene			0.03J	
8080 Method	ND	ND	ND	ND
Metals	ug/L	ug/L	mg/kg	mg/kg
Antimony	6U	3U	1U	2U
Arsenic	5U	5U	12	11
Beryllium	10U	10U	0.46U	0.64U
Cadmium	10U	10U	1.3	1.8
Chromium	10U	10U	44	49
Copper	10U	10U	47	39
Cyanide	5U	5U	0.23U	0.56U
Lead	50U	50U	26	27
Mercury	0.2U	0.2U	0.1U	0.3
Nickel	20U	20U	50	51
Selenium	5U	5U	0.8	0.2U
Silver	10U	10U	0.91U	1.3U
Thallium	1U	1U	0.2U	0.4
Total Phenol	10	5U	2.2	1.7U
Total Solids	NT	NT	55.7	33.1
Zinc	26	31	85	110

Note:

1) "J" indicates the analyte of interest was detected below the routine reporting limit.
This value should be regarded as an estimate.

2) "U" indicates the analyte of interest was not detected, to the limit of detection indicated.

3) "ND" indicates the analytes of interest were not detected, to the limit of the detection indicated.

4) "NT" indicates the analyte was not tested.

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Investigation of Chemical Contamination at Whitmarsh Landfill and Padilla Bay Lagoon

February 1999
Publication No. 99-306

Summary

In response to concerns of the Swinomish Tribal Community, the Washington State Department of Ecology conducted an investigation to determine the extent to which Padilla Bay Lagoon has been degraded by discharges from the Whitmarsh Landfill. The abandoned fill is located at the head of Padilla Bay on tidelands at the west end of the lagoon. It was used as an unregulated public dump from the 1950s until 1973. Previous investigations had concluded the level of chemical contamination in the lagoon was low and not readily traceable to the fill. Results of toxicity tests on the sediments seemed to contradict these findings.

An extensive chemical screening was first conducted on two samples each of seepage and intertidal sediments collected at the base of the landfill on June 11, 1998. The analyses included a wider range of compounds and lower detection limits than had been done previously.

The contaminants detected in Whitmarsh seepage and their concentration ranges (parts per billion) are listed below. A number of additional benzenes, phenols, and polyaromatic hydrocarbons (PAH) were also tentatively identified

Chemical Contaminant (number of compounds)	Whitmarsh Seepage (ug/L)
iron	5,600 - 16,600
diesel	470 - 850
benzenes (5)	0.1 - 2.5
chlorinated benzenes (4)	0.01 - 0.92
xylenes (3)	0.14 - 1.3
toluene	0.15 - 0.86
ethylether	0.51
polyaromatic hydrocarbons (14)	0.02 - 0.84
phenol and methylphenols (4)	0.08 - 0.52
chloromethylphenol	0.52
diethylphthalate	0.14 - 0.19
nitrosodiphenylamine	0.41 - 1.5
dibenzofuran	0.08 - 0.16
carbazole	0.05
PCB-1242	0.011 - 0.028
carbaryl	0.012 - 5.8

The concentrations in seepage were generally low and, in most cases, beneath thresholds of toxicity. Iron and the higher concentrations of the insecticide carbaryl (Sevin) were potentially toxic until further diluted. PCB-1242 approached the chronic water quality criterion of 0.03 ug/L for marine waters.

Chemicals analyzed but not detected in the seepage were priority pollutants metals, cyanide, organophosphorus pesticides, organochlorine pesticides, and herbicides. Previous investigations by Skagit County and others have also shown that metals, cyanide, and pesticides are not important contaminants in the seepage.

Results from screening the Whitmarsh sediment samples showed elevations in a range of chemicals including, but not limited to, iron, PAH, phenols, phthalates, and 2,3,7,8-TCDD (dioxin). Methylphenols exceeded Ecology's Sediment Management Standards (SMS) Chemicals analyzed but not detected in the sediments were PCBs, organophosphorus pesticides, organochlorine pesticides, and herbicides Organotins were at background levels.

The screening results were consistent with past studies indicating there was a low potential for the landfill to cause toxicity in the lagoon water column. Sediment contamination, however, appeared to be a greater concern than had previously been appreciated. A wider sediment quality survey was therefore conducted in the lagoon.

The objectives of the sediment survey were to:

- Determine the occurrence of chemicals of potential concern
- Determine the extent of contamination
- Assess compliance with SMS chemical and biological criteria
- Evaluate the significance of contamination by non-SMS chemicals
- Draw conclusions about probable sources of contamination

Samples for the expanded sediment survey were collected August 7, 1998 and included three sites farther out in the lagoon (#3, #4, and #5), one site outside the lagoon (#6), and an established reference area nine miles to the north in Samish Bay Sediments in the reference area are known to have a low level of chemical contamination and no significant toxicity. The samples were analyzed for a subset of the screening survey chemicals and tested for acute toxicity to amphipod crustaceans (*Ampelisca abdita*), sea urchins (*Stongylocentrotus purpuratus*), and chronic toxicity to juvenile polychaete worms (*Neanthes arenaceodentata*).

The major findings from Ecology's 1998 investigation on sediment quality in Padilla Bay Lagoon can be summarized as follows:

2-Methylphenol, 4-methylphenol, and 2,4-dimethylphenol in the inner lagoon exceed SMS Cleanup Screening Levels (CSL). A station cluster of potential concern (sites #1, #2, and #3) exists for these compounds, making it a priority for evaluation as a cleanup site

Site	2-Methylphenol	4-Methylphenol	2,4-Dimethylphenol
#1	180	545	288
#2	121	238	118
#3	1740	7950	5580
CSL =	63	670	29

ug/Kg, dry; parts per billion

Except for phenol at inner lagoon site #3, all other SMS chemicals were within Sediment Quality Standards (SQS). Chemicals meeting the SQS are not expected to cause adverse effects on biological resources.

Chemicals, in addition to phenols, that are substantially elevated in the lagoon and appear to be associated with Whitmarsh Landfill include iron, low molecular weight PAH, high molecular weight PAH, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, coprostanol (an indicator of fecal matter), dibenzofuran, retene, and 2,3,7,8-TCDD Sources other than Whitmarsh Landfill are indicated for higher weight PAH in the outer lagoon and outside the lagoon

In terms of equivalent concentrations of 2,3,7,8-TCDD, the levels of polychlorinated dioxin and -furan compounds in the lagoon (up to 5 7 ng/Kg; parts per trillion) are comparable to some industrialized embayments in Puget Sound. EPA has concluded that this level of sediment contamination poses a low risk to fish and wildlife.

Among the chemicals analyzed in the sediments, but either not detected or not substantially elevated, were total petroleum hydrocarbons (except site #3), priority pollutant metals, volatile organic compounds (except #3), and PCBs.

Site #3 is located on the north side of the inner lagoon, approximately 200 yards east of the landfill. It has extremely high levels of petroleum (5,300 mg/Kg diesel; 4,000 mg/Kg lube oil; parts per million) and, as noted above, phenols. The sediments are black, viscous, and have a strong petroleum odor The hydrocarbons were extremely weathered and do not match any pattern of common petroleum products All bioassay test organisms died on exposure to this sample. Given its distance from the landfill, the source of this material may be a spill from the adjacent railroad tracks. Alternately, it could be that historical discharge of a dense product from the landfill followed the lagoon drainage channel that passes through this site

The percentage of abnormal larvae in the sea urchin bioassay exceeded CSLs both inside and outside the lagoon. A station cluster of potential concern (sites #3, #4, #5, and #6) exists for this bioassay, making it a priority for cleanup evaluation. The chemical data furnish no clues to the reason for the toxicity seen at sites #4, #5, and #6

Site	Amphipod % Survival	Sea Urchin % Normal	Polychaete % Survival	Polychaete Biomass (g)
Lab Control	90	82	100	11.3
Reference Area	95	77	100	10.9
#6	91	32*	100	9.3*
#5	95	35*	88	9.6*
#4	83	36*	96	11.5
#3	0*	0*	0*	- -

*significantly less (p < 05) than reference sediments

The amphipod and polychaete bioassays showed no acute toxicity at any location other than site #3. There was slightly less growth of polychaetes for outer lagoon site #5 and outside the lagoon at site #6, suggesting a low level of chronic toxicity to this species. The two bioassay "hits" at sites #5 and #6 are considered an exceedance of CSLs

Bioassays were not conducted at sites #1 and #2 adjacent to Whitmarsh, but historical data show toxicity to the amphipod *Rhepoxynius abronius* The historical data also indicate there is some toxicity in sediments outside the lagoon

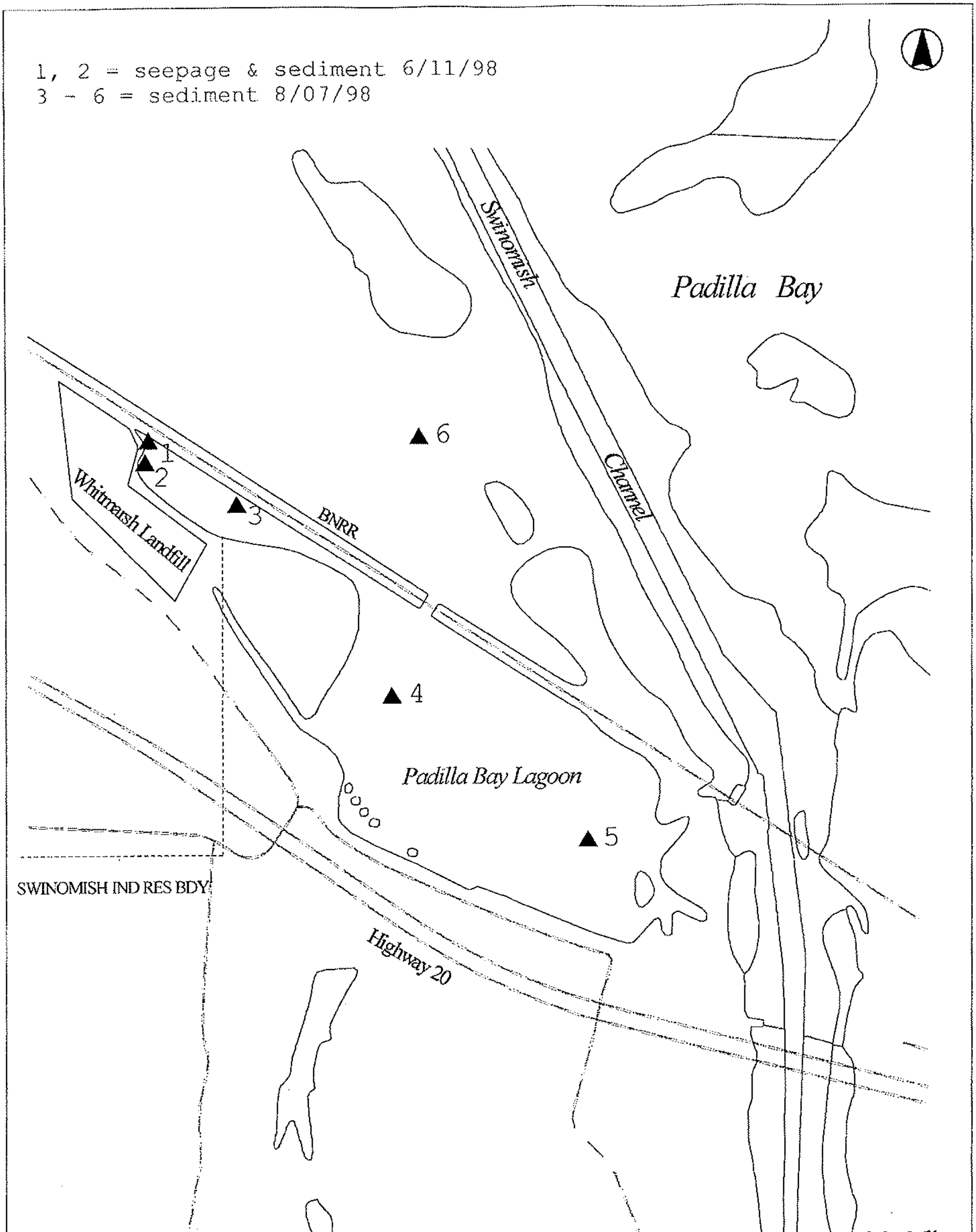


Figure 4. Location of Department of Ecology Samples Collected in 1998

Table 5. Water Quality of Whitmarsh Intertidal Seepage Collected June 11, 1998

Site Number:	1	2
Date:	11-Jun	11-Jun
Sample Number:	248005	248006
Salinity (ppt)	0.0	0.0
Conductivity (umhos/cm)	**1240**	**1020**
pH (lab)	**8.0**	**8.0**
Total Suspended Solids (mg/L)	**25**	**30**
Turbidity (NTU)	**26**	**190**
Ammonia (mg/L)	**3.2**	**6.8**
Nitrite-Nitrate (mg/L)	0.01 U	0.01 U
Phosphorus (mg/L)	**0.17**	**0.25**
Total Organic Carbon (mg/L)	**12**	**9.3**

U = Not detected at or above reported value (i.e., less than)

Table 6. Chemicals Detected in Whitmarsh Intertidal Samples Collected June 11, 1998
[Volatiles, semivolatiles, and pesticides show detected compounds only.]

Sample Type:	Seepage		Sediment	
Site Number:	1	2	1	2
Sample Number:	248005	248006	248007	248008
Priority Pollutant Metals (ug/L or mg/Kg, dry)				
Antimony	30 UJ	30 U	3 UJ	3 UJ
Arsenic	30 U	30 U	**11**	**12**
Beryllium	1 U	1 U	**0.39**	**0.40** U
Cadmium	4 U	4 U	0.5 U	0.5 U
Chromium	5 U	5 U	**65**	**59**
Copper	5 U	5 U	**44**	**39**
Lead	20 U	20 U	**13**	**13**
Mercury	0.05 U	0.05 U	**0.082**	**0.076**
Nickel	15 U	15 U	**51**	**42**
Selenium	40 U	40 U	**0.50**	**0.42**
Silver	4 U	4 U	0.4 U	0.4 U
Thallium	50 U	50 U	0.3 U	0.3 U
Zinc	5 U	5 U	**98**	**93**
Misc. Trace Elements (ug/L or mg/Kg, dry)				
Aluminum	**106**	**39**	**19900**	**19200**
Barium	**103**	**162**	**50**	**50**
Calcium	**43400**	**54500**	**6680**	**7240**
Cobalt	5 U	5 U	**8.8**	**9.1**
Iron	**5660**	**16200**	**47000**	**47500**
Magnesium	**37300**	**31400**	**13900**	**14000**
Manganese	**127**	**234**	**311**	**296**
Molybdenum	**7.4**	5 U	**3.1**	**3.1**
Potassium	**17400**	**15500**	**3380**	**3400**
Sodium	**137000**	**86200**	**20800**	**21300**
Strontium	**402**	**369**	**79** J	**94** J
Titanium	5 U	5 U	**1120**	**1170**
Vanadium	5 U	5 U	**68**	**66**
Cyanide (ug/L)	5 U	5 U	--	--

Note: Detections indicated in **bold**.
U = Not detected at or above reported value (i.e., less than)
J = The analyte was positively identified; associated numerical value is an estimated.
-- = Not analyzed.

Table 6. Whitmarsh June 1998 Chemicals (continued)

Sample Type:	Seepage		Sediment	
Site Number:	1	2	1	2
Sample Number:	248005	248006	248007	248008
Total Petroleum Hydrocarbons (ug/L or mg/Kg, dry)				
#2 Diesel	**850**	**470**	70 U	44 U
Lube Oil	80 U	80 U	180 U	**190***
Gasoline	120 U	120 U	34 U	38 U
Volatile Organic Compounds (ug/L)				
Benzene	**2.5**	**1.6**	- -	- -
Ethylbenzene	**0.10** J	1.0 U	- -	- -
Isopropylbenzene	**0.15** J	**0.29** J	- -	- -
Chlorobenzene	**0.55**	**0.92** J	- -	- -
1,2-Dichlorobenzene	**0.33** J	**0.28** J	- -	- -
1,4-Dichlorobenzene	**0.52** J	**0.42** J	- -	- -
1,2,4-Trimethylbenzene	**0.79** J	1 U	- -	- -
1,3,5-Trimethylbenzene	**0.14** J	1 U	- -	- -
Toluene	**0.86** J	**0.15** J	- -	- -
m & p-Xylene	**1.2** J	**0.41** J	- -	- -
o-Xylene	**1.3** J	**0.14** J	- -	- -
Naphthalene	**2.1**	1 U	- -	- -
Ethylether	1 U	**0.51** J	- -	- -
Low Molecular Weight Polyaromatic Hydrocarbons (ug/L or ug/Kg, dry)				
Naphthalene	**0.84**	**0.09** J	**66** J	**44** J
1-Methylnaphthalene	**0.49**	**0.52**	**50** J	**32** J
2-Methylnaphthalene	**0.39**	**0.28**	**87** J	**60** J
2,6-Dimethylnaphthalene	**0.10** J	**0.15**	**352**	**219**
1,6,7-Trimethylnaphthalene	0.12 U	**0.02** J	179 U	**37** J
Acenaphthene	**0.42**	**0.24**	**35** J	115 U
Flourene	**0.26**	**0.16**	**52** J	**29** J
Phenanthrene	**0.24**	**0.06** J	**198**	**112** J
1-Methylphenanthrene	0.12 U	**0.02** J	**287**	**234**
2-Methylphenanthrene	**0.04** J	**0.02** J	**61** J	**26** J
Anthracene	**0.04** J	**0.03** J	**64** J	**27** J

*Concentration was below quantitation limit (160 mg/Kg) in a duplicate analysis of this sample.

Table 6. Whitmarsh June 1998 Chemicals (continued)

Sample Type:	Seepage		Sediment	
Site Number:	1	2	1	2
Sample Number:	248005	248006	248007	248008
High Molecular Weight Polyaromatic Hydrocarbons (ug/L or ug/Kg, dry)				
Fluoranthene	**0.07** J	**0.02** J	**332**	**161**
Pyrene	**0.04** J	**0.04** J	**311**	**146**
Benzo(a)anthracene	**0.03** J	0.12 U	**123** J	**66** J
Chrysene	0 12 U	0.12 U	**240**	**112** J
Benzo(b)fluoranthene	0.12 U	0.12 U	**283**	**138**
Benzo(k)fluoranthene	0.25 U	0.25 U	**79** J	**40** J
Benzo(e)pyrene	0 12 U	0 12 U	**127** J	**72** J
Benzo(a)pyrene	0 25 U	0.25 U	**103** J	**35** J
Perylene	0.12 U	0 12 U	**263**	**123**
Indeno(1,2,3-cd)pyrene	0.62 U	0.62 U	**229** J	576 U
Benzo(g,h,i)perylene	0.12 U	0.12 U	**192**	**116**
Phenols (ug/L or ug/Kg, dry)				
Phenol	**0.08** J	0.12 U	**178** J	**271**
2-Methylphenol	**0.16**	0.25 U	**180**	**121**
4-Methylphenol	**0.30**	**0.10** J	**545**	**238**
2,4-Dimethylphenol	0.12 U	0 12 U	**288**	**118**
4-Chloro-3-methylphenol	**0.52**	0.12 U	179 U	115 U
Chlorinated Benzenes (ug/L or ug/Kg, dry)				
1,2-Dichlorobenzene	**0.18**	**0.13**	179 U	115 U
1,3-Dichlorobenzene	**0.01** J	0.25 U	359 U	231 U
1,4-Dichlorobenzene	**0.34**	**0.24**	179 U	115 U
Phthalate Esters (ug/L or ug/Kg, dry)				
Diethylphthalate	**0.19** J	**0.14** J	**25** J	576 U
Di-n-butylphthalate	0.12 U	0.12 U	**1380**	**698**
Bis(2-ethylhexyl)phthalate	0.12 U	0 25 U	**1630**	**421** J
Miscellaneous Semivolatiles (ug/L or ug/Kg, dry)				
N-Nitrosodiphenylamine	**0.41**	**1.5**	179 U	115 U
Dibenzofuran	**0.16**	**0.08** J	**53** J	**30** J
Carbazole	**0.18**	**0.18**	179 U	115 U
Dibenzothiophene	0 12 U	**0.05** J	179 U	115 U
3B-Coprostanol	0 62 U	0 62 U	**3370**	**2530**
Retene	0.25 U	0.25 U	**184**	**75** J

Table 6. Whitmarsh June 1998 Chemicals (continued)

Sample Type:	Seepage		Sediment	
Site Number:	1	2	1	2
Sample Number:	248005	248006	248007	248008
Polychlorinated Biphenyls (ug/L or ug/Kg, dry)				
PCB-1016	0.033 UJ	0.034 UJ	59 U	12 U
PCB-1221	0.033 UJ	0.034 UJ	59 U	12 U
PCB-1232	0.033 UJ	0.034 UJ	59 U	12 U
PCB-1242	**0.028** J	**0.011** J	59 U	12 U
PCB-1248	0.033 UJ	0.034 UJ	59 U	12 U
PCB-1254	0.033 UJ	0.034 UJ	59 U	12 U
PCB-1260	0.033 UJ	0.034 UJ	59 U	12 U
Organotins (ug/Kg, dry)				
Tributyltin chloride	- -	- -	**3.8** J	**3.6** J
Dibutyltin chloride	- -	- -	**3.9** J	**3.9** J
Monobutyltin chloride	- -	- -	**55** J	**44** J
Nitrogen-Containing Pesticides (ug/L or ug/Kg, dry)			nd	nd
Carbaryl	**4.5** J	**0.13** J	- -	- -
Organophosphorous Pesticides	nd	nd	nd	nd
Organochlorine Pesticides	nd	nd	nd	nd
Carbamate Pesticides				
Carbaryl	**5.8** J	**0.12** J	- -	- -
Herbicides	nd	nd	nd	nd

nd = None detected

Table 6. Whitmarsh June 1998 Chemicals (continued)

Sample Type:	Seepage		Sediment	
Site Number:	1	2	1	2
Sample Number:	248005	248006	248007	248008
Polychlorinated Dioxins (ng/Kg, dry)				
2,3,7,8-TCDD	--	--	**0.23** NJ	**0.22** J
1,2,3,7,8-PeCDD	--	--	**1.2** J	**0.83** J
1,2,3,4,7,8-HxCDD	--	--	**2.0** J	**1.4** J
1,2,3,6,7,8-HxCDD	--	--	**6.0**	**4.9** J
1,2,3,7,8,9-HxCDD	--	--	**5.8**	**4.5** J
1,2,3,4,6,7,8-HpCDD	--	--	**75**	**68**
OCDD	--	--	**579**	**490**
Polychlorinated Furans (ng/Kg, dry)				
2,3,7,8-TCDF	--	--	**1.8**	**1.9**
1,2,3,7,8-PeCDF	--	--	**0.79** J	**0.52** J
2,3,4,7,8-PeCDF	--	--	**1.3** J	**0.78** J
1,2,3,4,7,8-HxCDF	--	--	**2.1** J	**1.5** J
1,2,3,6,7,8-HxCDF	--	--	**1.1** J	**0.73** J
2,3,4,6,7,8-HxCDF	--	--	**1.6** J	**1.2** J
1,2,3,7,8,9-HxCDF	--	--	0.2 U	0.2 U
1,2,3,4,6,7,8-HpCDF	--	--	**14**	**12**
1,2,3,4,7,8,9-HpCDF	--	--	**1.0** J	**0.89** J
OCDF	--	--	**35**	**30**

NJ = There is evidence that analyte may be present; associated numerical value is an estimate.

Table 7. Chemicals Detected in Padilla Bay Lagoon Sediment Samples in 1998
[Volatiles and semivolatiles show detected compounds only. Metals concentrations are in mg/Kg; organics are in ug/Kg, except ng/Kg for dioxins & furans; all on a dry weight basis.]

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay
Site Number:	1	2	3	4	5	6	Ref. Area
Date:	11-Jun	11-Jun	7-Aug	7-Aug	7-Aug	7-Aug	7-Aug
Sample Number:	248007	248008	328004	328003	328002	328001	328000
Ancillary Parameters (%)							
Gravel	--	--	**6**	**4**	**0**	**1**	**0**
Sand	--	--	**21**	**6**	**78**	**24**	**64**
Silt	--	--	**50**	**59**	**15**	**53**	**22**
Clay	--	--	**23**	**31**	**7**	**22**	**13**
Total Organic Carbon	**3.8**	**3.6**	**9.8**	**3.7**	**1.3**	**2.7**	**0.9**
Priority Pollutant Metals							
Zinc	**98**	**93**	**111**	**80**	**48**	**68**	**42**
Chromium	**65**	**59**	**44**	**54**	**35**	**46**	**22**
Nickel	**51**	**42**	**40**	**46**	**31**	**41**	**26**
Copper	**44**	**39**	**35**	**38**	**21**	**33**	**12**
Lead	**13**	**13**	**34**	**12**	**6.6**	**50**	**5.8**
Arsenic	**11**	**12**	**9.8**	**11**	**6.7**	**8.9**	**4.8**
Beryllium	**0.39**	**0.40**	**0.30**	**0.38**	**0.23**	**3.0**	**0.25**
Silver	0.4 U	0.4 U	**0.70** J	**0.54** J	**0.47** J	**0.56** J	0.4 U
Selenium	**0.50**	**0.42**	**0.40**	**0.35**	**0.33**	0.3 U	0.3 U
Cadmium	0.5 U	0.5 U	**0.48**	0.4 U	0.4 U	0.4 U	0.4 U
Mercury	**0.082**	**0.076**	**0.095** J	**0.081** J	**0.047** J	**0.078** J	**0.048** J
Antimony	3 UJ	3 UJ	3 UJ	3 UJ	3 UJ	3 UJ	3 UJ
Thallium	0.3 U	0.3 U	0.3 UJ	0.3 UJ	0.3 UJ	0.3 UJ	0.3 UJ
Other Metals							
Iron	**47000**	**47500**	**28300**	**26400**	**19500**	**25200**	**15100**
Aluminum	**19900**	**19200**	**14200**	**17600**	**10800**	**14100**	**8930**

Note: Detections indicated in **bold**.
-- = Not analyzed.
U = Not detected at or above reported value (i.e., less than)
J = The analyte was positively identified; associated numerical value is an estimated.
UJ = The analyte was not detected at or above the reported estimated result

Table 7. Chemicals in Lagoon Sediments (continued)

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay
Site Number:	1	2	3	4	5	6	Ref. Area
Date:	11-Jun	11-Jun	7-Aug	7-Aug	7-Aug	7-Aug	7-Aug
Sample Number:	248007	248008	328004	328003	328002	328001	328000
Total Petroleum Hydrocarbons (mg/L or mg/Kg, dry)							
#2 Diesel	70 U	44 U	**5300** J	56 U	25 U	73 U	31 U
Lube Oil	180 U	**190**	**4000** J	140 U	63 U	180 U	77 U
Volatile Organic Compounds							
Carbon disulfide	--	--	**16** J	**5.6** J	**2.4** J	**7.8** J	5 U
2-Butanone	--	--	**31**	7.7 U	6 U	**28** U	5 U
Benzene	--	--	**10**	3.8 U	3 U	3.3 U	2.5 U
Toluene	--	--	**160**	**61**	**0.61** J	3.3 U	**1.1** J
Ethylbenzene	--	--	**260** J	3.8 U	3 U	3.3 U	2.5 U
m & p-Xylene	--	--	**2070**	7.7 U	6 U	6.7 U	5 U
o-Xylene	--	--	**350** J	3.8 U	3 U	3.3 U	2.5 U
Isopropylbenzene	--	--	**34**	3.8 U	3 U	3.3 U	2.5 U
n-Propylbenzene	--	--	**223** J	3.8 U	3 U	3.3	2.5 U
1,3,5-Trimethylbenzene	--	--	**130** J	3.8 U	3 U	3.3	2.5 U
1,2,4-Trimethylbenzene	--	--	**506**	3.8 U	3 U	3.3	2.5 U
Sec-Butylbenzene	--	--	**46**	3.8 U	3 U	3.3	2.5 U
p-Isopropyltoluene	--	--	**78**	3.8 U	3 U	3.3	2.5 U
n-Butylbenzene	--	--	**123**	3.8 U	3 U	3.3	2.5 U
Naphthalene	--	--	**131**	3.8 U	3 U	3.3 U	2.5 U
Low Molecular Weight Polyaromatic Hydrocarbons							
Naphthalene	**66** J	**44** J	**386**	**8.7** J	**11** J	**7.4** J	**8.4** J
1-Methylnaphthalene	**50** J	**32** J	**986**	**6.6** J	78 U	**4.6** J	**7.1** J
2-Methylnaphthalene	**87** J	**60** J	**1330**	**11** J	**9.5** J	**6.7** J	**8.6** J
2,6-Dimethylnaphthalene	**352**	**219**	**1120**	**14** J	**4.5** J	**29** J	**6.1** J
1,6,7-Trimethylnaphthalene	179 U	**37** J	**515**	61 U	78 U	52 U	**5.7** J
Acenaphthene	**35** J	115 U	**144** J	**4.2** J	**4.0** J	**3.1** J	**4.4** J
Fluorene	**52** J	**29** J	**140** J	**7.7** J	**5.8** J	**7.1** J	**14** J
Acenaphthylene	179 U	115 U	254 U	**6.4** J	**2.8** J	**3.9** J	**7.1** J
Phenanthrene	**198**	**112** J	**390**	**30** J	**18** J	**40** J	**101**
1-Methylphenanthrene	**287**	**234**	254 U	61 U	78 U	52 U	**65**
2-Methylphenanthrene	**61** J	**26** J	254 U	61 U	78 U	52 U	**53**
Anthracene	**64** J	**27** J	254 U	**9.1** J	**6.1** J	**11** J	**25** J
Total LPAH	**1252**	**820**	**5011**	**98**	**62**	**113**	**305**

Table 7. Chemicals in Lagoon Sediments (continued)

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay
Site Number:	1	2	3	4	5	6	Ref Area
Date:	11-Jun	11-Jun	7-Aug	7-Aug	7-Aug	7-Aug	7-Aug
Sample Number:	248007	248008	328004	328003	328002	328001	328000
High Molecular Weight Polyaromatic Hydrocarbons							
Fluoranthene	**332**	**161**	254 U	**53** J	**38** J	**119**	**125**
Pyrene	**311**	**146**	254 U	**51** J	**33**	**94**	**110**
Benzo(a)anthracene	**123** J	**66** J	254 U	61 U	78 U	**32** J	**45**
Chrysene	**240**	**112** J	**151** J	121 U	**22** J	**49** J	**40**
Benzo(b)fluoranthene	**283**	**138**	1270 U	**45** J	**40** J	**52** J	**54** J
Benzo(k)fluoranthene	**79** J	**40** J	254 U	**14** J	**8.3** J	**14** J	**17** J
Benzo(e)pyrene	**127** J	**72** J	254 U	**16** J	**13** J	**20** J	**20** J
Benzo(a)pyrene	**103** J	**35** J	254 U	**17** J	**13** J	**18** J	**43**
Perylene	**263**	**123**	254 U	**46** J	**38** J	**42** J	**32** J
Indeno(1,2,3-cd)pyrene	**229** J	576 U	1270 U	**17** J	**9.7** J	**11** J	**27** J
Dibenzo(a,h,)anthracene	359 U	231 U	254 U	61 U	78 U	**28** J	**22** J
Benzo(g,h,i)perylene	**192**	**116**	1270 U	**12** J	392 U	**6.9** J	**25** J
Total HPAH	**2282**	**1009**	**151**	**271**	**215**	**486**	**560**
Phenols							
Phenol	**178** J	**271**	**820**	61 U	78 U	52 U	35 U
2-Methylphenol	**180**	**121**	**1740**	61 U	78 U	52 U	35 U
4-Methylphenol	**545**	**238**	**7950**	**16** J	**44** J	**17** J	**5.9** J
2,4-Dimethylphenol	**288**	**118**	**5580**	161 U	78 U	52 U	35 U
4-Nitrophenol	897 U	576 U	**570** J	605 U	784 U	516 U	349 U
Phthalate Esters							
Bis(2-ethylhexyl)phthalate	**1630**	**421** J	771 U	**119** J	157 U	**63** J	70 U
Di-n-butylphthalate	**1380**	**698**	254 U	61 U	83 U	52 U	71 U
Butylbenzylphthalate	897 U	576 U	**2970** J	303 U	392 U	258 U	174 U
Diethylphthalate	**25** J	576 U	1270 U	303 U	392 U	258 U	174 U

Table 7. Chemicals in Lagoon Sediments (continued)

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay
Site Number:	1	2	3	4	5	6	Ref. Area
Date:	11-Jun	11-Jun	7-Aug	7-Aug	7-Aug	7-Aug	7-Aug
Sample Number:	248007	248008	328004	328003	328002	328001	328000
Miscellaneous Semivolatiles							
3B-Coprostanol	**3370**	**2530**	5090 U	**731** J	**432** J	**297** J	**188** J
Dibenzofuran	**53** J	**30** J	**81** J	**8.1** J	**5.9** J	**6.2** J	**6.4** J
Retene	**184**	**75** J	254 U	**22** J	**16** J	**18** J	**13** J
Dibenzothiophene	179 U	115 U	**145** J	61 U	78 U	52 U	35 U
Carbazole	179 U	115 U	254 U	61 U	78 U	52 U	**9.8** J
1,1'-Biphenyl	179 U	115 U	254 U	61 U	78 U	52 U	**6.5** J
Bis(2-chloroethyl)ether	359 U	231 U	254 U	61 U	78 U	**2.5** J	35 U
Polychlorinated Biphenyls							
PCB-1016	59 U	12 U	1.6 UJ	1.3 U	1.3 U	1.6 U	1.1 U
PCB-1221	59 U	12 U	1.6 UJ	1.3 U	1.3 U	1.6 U	1.1 U
PCB-1232	59 U	12 U	22 UJ	1.3 U	1.3 U	1.6 U	1.1 U
PCB-1242	59 U	12 U	2100 UJ	1.3 U	1.3 U	1.6 U	1.1 U
PCB-1248	59 U	12 U	63 UJ	1.3 U	1.3 U	1.6 U	1.1 U
PCB-1254	59 U	12 U	490 UJ	1.3 U	1.3 U	1.6 U	1.1 U
PCB-1260	59 U	12 U	7.9 UJ	1.3 U	1.3 U	1.6 U	1.1 U
Polychlorinated Dioxins							
2,3,7,8-TCDD	**0.23** NJ	**0.22** J	0.29 U	1.4 U	0.12 U	0.13 U	0.2 U
1,2,3,7,8-PeCDD	**1.2** J	**0.83** J	**0.46** J	**2.0** J	0.97 U	0.25 U	0.19 U
1,2,3,4,7,8-HxCDD	**2.0** J	**1.4** J	**0.91** J	**2.6** J	**0.26** J	0.22 U	0.47 U
1,2,3,6,7,8-HxCDD	**6.0**	**4.9** J	**2.2** J	**8.1**	**0.38** J	0.38 U	0.36 U
1,2,3,7,8,9-HxCDD	**5.8**	**4.5** J	**1.2** J	**4.0** J	0.29 U	0.32 U	0.2 U
1,2,3,4,6,7,8-HpCDD	**75**	**68**	**36**	**120**	**7.6**	1.4 U	**2.8** J
OCDD	**579**	**490**	**270**	**670**	**77**	**12**	**18** J
Polychlorinated Furans							
2,3,7,8-TCDF	**1.8**	**1.9**	**0.86** J	**0.83** J	0.25 U	0.2 U	0.3 U
1,2,3,7,8-PeCDF	**0.79** J	**0.52** J	1.4 U	**1.1** J	0.49 U	0.1 U	0.15 U
2,3,4,7,8-PeCDF	**1.3** J	**0.78** J	**0.36** J	2.3 U	0.15 U	0.14 U	0.22 U
1,2,3,4,7,8-HxCDF	**2.1** J	**1.5** J	0.43 U	**3.6** J	0.62 U	0.17 U	**0.36** J*
1,2,3,6,7,8-HxCDF	**1.1** J	**0.73** J	**0.61** J	**2.3** J	0.24 U	0.1 U	**0.22** J

NJ = There is evidence that analyte may be present; associated numerical value is an estimate.

*Not detected in a duplicate analysis of this sample

Table 7. Chemicals in Lagoon Sediments (continued)

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay
Site Number:	1	2	3	4	5	6	Ref Area
Date:	11-Jun	11-Jun	7-Aug	7-Aug	7-Aug	7-Aug	7-Aug
Sample Number:	248007	248008	328004	328003	328002	328001	328000
Polychlorinated Furans (continued)							
2,3,4,6,7,8-HxCDF	**1.6** J	**1.2** J	**0.89** J	**3.7** J	0.43 U	0.3 U	**0.40** J*
1,2,3,7,8,9-HxCDF	0.2 U	0.2 U	0.21 U	0.93 U	0.42 U	0.2 U	0.18 U
1,2,3,4,6,7,8-HpCDF	**14.0**	**11.9**	20 U	**24**	7.3 U	1 U	**0.55** J
1,2,3,4,7,8,9-HpCDF	**1.0** J	**0.89** J	0.71 U	**2.0** J	0.78 U	0.29 U	0.24 U
OCDF	**35**	**30**	**12**	**38**	**4.5** J	0.7 U	**0.91** J*
TEQ**	**5.1**	**4.0**	**1.7**	**5.7**	**0.22**	**0.012**	**0.15**

*Not detected in a duplicate analysis of this sample.
**2,3,7,8-TCDD Equivalence (summed for all dioxin and furan congeners)

Table 8. Results of Bioassays on Sediments Collected from Padilla Bay Lagoon and Vicinity on August 7, 1998
[Mean of 5 replicates each; +/- 1 standard deviation]

Location	Site No.	Sample No.	Amphipod - 10 day		Polychaete - 20 day		Sea Urchin - 4 day
			% Survival	% Emergence	% Survival	Biomass (mg)	% Normal
Laboratory Control	- -	- -	90 +/- 4	10 +/- 5	100 +/- 0	11.3 +/- 1.3	82 +/- 7
Samish Bay	Ref. Area	32800	95 +/- 6	12 +/- 9	100 +/- 0	10.9 +/- 1.0	77 +/- 13
Outside Lagoon Entrance	6	328001	91 +/- 10	12 +/- 5	100 +/- 0	**9.3 +/- 1.3***	**32 +/- 15***
Outer Lagoon, E. End	5	328002	95 +/- 6	12 +/- 5	88 +/- 27	**9.6 +/- 0.7***	**35 +/- 18***
Outer Lagoon, W. End	4	328003	83 +/- 20	5 +/- 4	96 +/- 9	11.5 +/- 1.1	**36 +/- 19***
Inner Lagoon, N. Side	3	328004	**0 +/- 0***	**73 +/- 5***	**0 +/- 0***	NA	**0 +/- 0***

*Significantly less than reference area (t test, $p<.05$)
NA = Not applicable due to zero percent survival

Table 9. Padilla Bay Lagoon Sediment Chemistry Compared to Ecology Marine Sediment Management Standards

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay	Sediment Quality	Cleanup Screening
Site Number:	1	2	3	4	5	6	Ref. Area	Standard	Level
Metals (mg/Kg, dry weight)									
Arsenic	**11**	**12**	**9.8**	**11**	**6.7**	**8.9**	**4.8**	57	93
Cadmium	0.5 U	0.5 U	**0.48**	0.4 U	0.4 U	0.4 U	0.4 U	5.1	6.7
Chromium	**65**	**59**	**44**	**54**	**35**	**46**	**22**	260	270
Copper	**44**	**39**	**35**	**38**	**21**	**33**	**12**	390	390
Lead	**13**	**13**	**34**	**12**	**6.6**	**50**	**5.8**	450	530
Mercury	**0.082**	**0.076**	**0.95**	**0.081**	**0.047**	**0.078**	**0.048**	0.41	0.59
Silver	0.4 U	0.4 U	**0.70**	**0.54**	**0.47**	**0.56**	0.4 U	6.1	6.1
Zinc	**98**	**93**	**111**	**80**	**48**	**68**	**42**	410	960
Nonionizable Organic Compounds (mg/Kg TOC)									
Polyaromatic Hydrocarbons									
Total LPAH[a]	**11**	**5.9**	**11**	**1.8**	**3.7**	**2.7**	**18**	370	780
Naphthalene	**1.7**	**1.2**	**3.9**	**0.2**	**0.8**	**0.3**	**0.9**	99	170
Acenaphthylene	4.7 U	3.2 U	2.6 U	**0.2**	**0.2**	**0.1**	**0.8**	66	66
Acenaphthene	**0.9**	3.2 U	**1.5**	**0.1**	**0.3**	**0.1**	**0.5**	16	57
Fluorene	**1.4**	**0.8**	**1.4**	**0.2**	**0.4**	**0.3**	**1.6**	23	79
Phenanthrene	**5.2**	**3.1**	**4.0**	**0.8**	**1.4**	**1.5**	**11**	100	480
Anthracene	**1.7**	**0.8**	2.6 U	**0.2**	**0.5**	**0.4**	**2.8**	220	1200
2-Methylnaphthalene	**2.3**	**1.7**	**14**	**0.3**	**0.7**	**0.2**	**1.0**	38	64

Note: Detections indicated in **bold**

U = Not detected at or above reported value (i.e. less than)

[a]naphthalene+acenaphthylene+acenaphthene+fluorene+phenanthrene+anthracene

Table 9. Comparison to Sediment Management Standards (continued)

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay	Sediment Quality Standard	Cleanup Screening Level
Site Number:	1	2	3	4	5	6	Ref. Area		
Nonionizable Organic Compounds (mg/Kg TOC)									
Polyaromatic Hydrocarbons									
Total HPAH[b]	**53**	**25**	**1.5**	**6.1**	**14**	**16**	**56**	960	5300
Fluoranthene	**8.7**	**4.5**	2.6 U	**1.4**	**2.9**	**4.4**	**14**	160	1200
Pyrene	**8.2**	**4.1**	2.6 U	**1.4**	**2.5**	**3.5**	**12**	1000	1400
Benzo[a]anthracene	**3.2**	**1.8**	2.6 U	1.6 U	6.0 U	**1.2**	**5.0**	110	270
Chrysene	**6.3**	**3.1**	**1.5**	3.3 U	**1.7**	**1.8**	**4.4**	110	460
Tot. Benzofluoranthenes	**9.5**	**4.9**	16 U	**1.6**	**3.7**	**2.4**	**7.9**	230	450
Benzo[a]pyrene	**2.7**	**1.0**	2.6 U	**0.5**	**1.0**	**0.7**	**4.8**	99	210
Indeno[1,2,3-c,d]pyrene	**6.0**	16 U	13 U	**0.5**	**0.7**	**0.4**	**3.0**	34	88
Dibenzo[a,h]anthracene	9.4 U	6.4 U	2.6 U	1.6 U	6.0 U	**1.0**	**2.4**	12	33
Benzo[g,h,i]perylene	**5.1**	**3.2**	13 U	**0.3**	30 U	**0.3**	**2.8**	31	78
Chlorinated Benzenes									
1,2-Dichlorobenzene	4.7 U	3.2 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	2.3	2.3
1,4-Dichlorobenzene	9.4 U	6.4 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	3.1	9
1,2,4-Trichlorobenzene	4.7 U	3.2 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	0.81	1.8
Hexachlorobenzene	4.7 U	3.2 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	0.38	2.3

[b]fluoranthene+pyrene+benzo[a]anthracene+chrysene+total benzofluoranthenes+benzo[a]pyrene indeno[1,2,3-c,d]pyrene+dibenzo[a,h]anthracene+benzo[g,h,i]perylene

Table 9. Comparison to Sediment Management Standards (continued)

Location:	Inner Lagoon			Outer Lagoon		Outside Lagoon	Samish Bay	Sediment Quality Standard	Cleanup Screening Level
Site Number:	1	2	3	4	5	6	Ref. Area		
Nonionizable Organic Compounds (mg/Kg TOC)									
Phthalate Esters									
Dimethyl phthalate	4.7 U	3.2 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	53	53
Diethyl phthalate	**0.7**	16 U	13 U	8.2 U	30 U	9.6 U	19 U	61	110
Di-N-butyl phthalate	**36**	**19**	2.6 U	1.6 U	6.4 U	1.9 U	7.9 U	220	1700
Butylbenzyl phthalate	24 U	16 U	**30**	8.2 U	30 U	9.6 U	19 U	4.9	64
Bis(2-ethylhexyl)phthalate	**43**	**12**	7.9 U	**3.2**	12 U	**2.3**	7.8 U	47	78
Di-N-Octyl phthalate	9.4 U	6.4 U	13 U	8.2 U	30 U	9.6 U	19 U	58	4500
Miscellaneous									
Dibenzofuran	**1.4**	**0.8**	**0.8**	**0.2**	**0.5**	**0.2**	**0.7**	15	58
Hexachlorobutadiene	4.7 U	3.2 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	3.9	6.2
N-Nitrosodiphenylamine	4.7 U	3.2 U	2.6 U	1.6 U	6.0 U	1.9 U	3.9 U	11	11
Poychlorinated Biphenyls									
Total PCBs	11 U	2.3 U	27 U	0.2 U	0.7 U	0.4 U	0.9 U	12	65
Ionizable Organic Compounds (ug/Kg, dry weight)									
Phenol	**178**	**271**	**820**	61 U	78 U	52 U	35 U	420	1200
2-Methylphenol	**180**	**121**	**1740**	61 U	78 U	52 U	35 U	63	63
4-Methylphenol	**545**	**238**	**7950**	**16**	**44**	**17**	**5.9**	670	670
2,4-Dimethylphenol	**288**	**118**	**5580**	161 U	78 U	52 U	35 U	29	29
Pentachlorophenol	897 U	576 U	1270 U	303 U	392 U	258 U	174 U	360	690
Benzyl alcohol	179 U	115 U	254 U	61 U	78 U	52 U	35 U	57	73
Benzoic acid	REJ	REJ	REJ	REJ	REJ	REJ	REJ	650	650

REJ = Data rejected [ ] = Exceeds SQS [shaded] = Exceeds CSL

Table 10. Chemicals Exceeding or Approaching Sediment Standards in Padilla Bay Lagoon
[Concentrations in ug/Kg, dry; except BEHP in mg/Kg TOC]

Chemical Parameter	Site	Concentration	Standard Exceeded / Factor
Phenol	#3	820	MC / 2.0
2-Methylphenol	#1	180	CSL / 2.8
"	#2	121	CSL / 1.9
"	#3	1740	CSL / 28
4-Methylphenol	#3	7950	CSL / 12
2,4-Dimethylphenol	#1	288	CSL / 10
"	#2	118	CSL / 4.1
"	#3	5580	CSL / 192
Bis(2-ethylhexyl)phthalate	#1	43	MC / 0.9

MC = Marine Criteria
CSL = Cleanup Screening Level

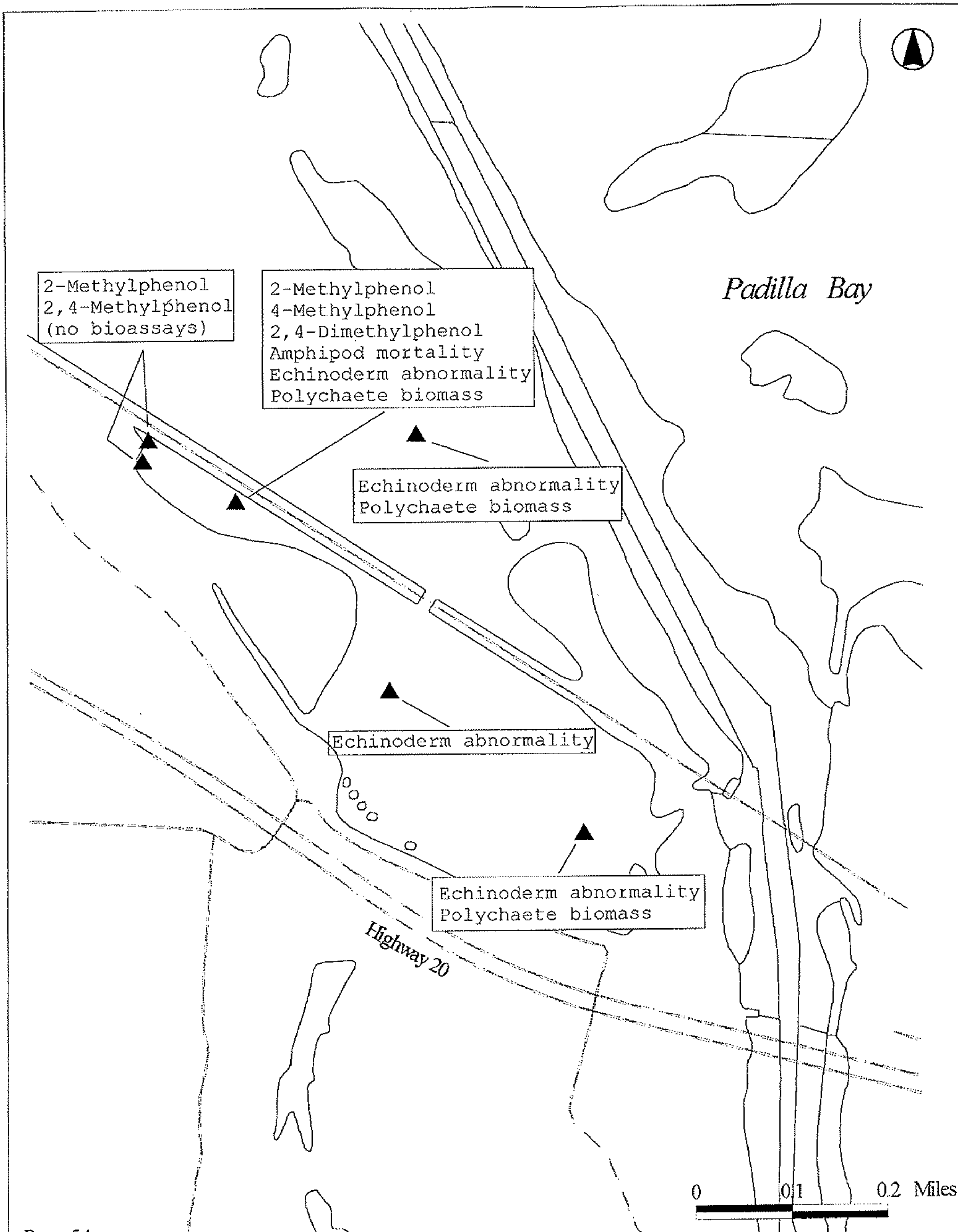


Figure 7. Sites Exceeding Cleanup Screening Levels in Padilla Bay Lagoon, 1998

Table 11. AETs for Non-SMS Chemicals Detected in Padilla Bay Lagoon and Reference Area

	Concentration Range (ug/Kg, dry)	Location of Maximum	Lowest AET	Highest AET
Metals (mg/Kg, dry)				
Antimony	3 UJ - 15 UJ	nd	200	- -
Beryllium	0.5 U - 3.0	#6	0.36	- -
Nickel	26 - 51	#1	>140	>140
Selenium	0.3 U - 0.40	#3	1.0	- -
Thallium	0.3 UJ - 25 U	nd	0.24	0.40
Organics (ug/Kg, dry)				
Ethylbenzene	2.5 U - 260 J	#3	10	37
Total Xylene	2.5 U - 2420 J	#3	40	120
Isopropyltoluene	2.5 U - 34	#3	600	2800
1-Methylphenanthene	52 U - 287 J	#1	370	1300
2-Methylphenanthrene	52 U - 61 J	#1	470	1500
Dibenzothiophene	35 U - 145 J	#3	240	950
Carbazole	52 U - 9.8 J	ref. area	970	3600
Coprostanol	188 - 3370	#1/#2	140	160
Biphenyl	52 U - 6.5 J	ref. area	260	310
Retene	13 J - 184	#1	1700	2000

Sources: PTI (1989) except antimony and nickel from PTI (1988b)
AET = Apparent Effects Threshold
U = Not detected at or above reported value (i.e., less than)
J = The analyte was positively identified; associated numerical value is an estimated.

Table 12 . Dioxin TEQs in Northern Puget Sound Sediments
[ng/Kg, dry]

Location	TEQ* median	TEQ* range	N =	Reference
Reference Areas				
Dungeness Bay	0.02	0 - 0 12	3	Ecology & Environment (1998)
Samish Bay	0.04	0.034 - 0.044	2	CH2M Hill (1992a,b)
" "	0.15	- -	1	present study
Urban/Industrial Areas				
Padilla Bay, outside lagoon	0.012	- -	1	present study
Outer Port Angeles Harbor	0.23	0.13 - 2.91	4	Ecology & Environment (1998)
March Point, Shell outfall	0.34	0.29 - 0.39	2	CH2M Hill (1992a)
March Point, Texaco outfall	0.32	0.28 - 0.36	2	CH2M Hill (1992b)
Inner Port Angeles Harbor	3.3	0.63 - 4.67	6	Ecology & Environment (1998)
Duwamish Waterway	3.6	1.22 - 4.39	3	Ecology (unpublished)**
Padilla Bay Lagoon	4.0	0.22 - 5.7	5	present study
Bellingham Bay, near pulp mill outfall	83	- -	1	Golding (1994)
Everett Harbor, near pulp mill outfall	110	- -	1	Anderson & Jones (1997)

*2,3,7,8-TCDD Equivalence
**Data provided by Bill Yake

APPENDIX B

Sediment RI Investigation

REMEDIAL INVESTIGATION / FEASIBILITY STUDY SEDIMENT INVESTIGATION

March Point (Whitmarsh) Landfill

Skagit County, Washington

Prepared for:

Whitmarsh Landfill PLP Group
Mount Vernon, Washington

Prepared by:

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November 2015

Project No. 0141590000

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March Point (Whitmarsh) Landfill
Skagit County, Washington

1.0 INTRODUCTION

On behalf of the participating March Point (Whitmarsh) Landfill Potentially Liable Parties (PLPs) and in accordance with Agreed Order DE-08TCPHQ (the Agreed Order), AMEC Environment & Infrastructure, Inc. (AMEC) has prepared this Sediment Remedial Investigation Report (Report) for the former March Point (Whitmarsh) Landfill (the Site) located on the west side of March Point at 9663 South March Point Road in Anacortes, Washington. The Site is listed on the Washington State Department of Ecology (Ecology) Hazardous Sites List as Facility Site ID 2662.

The Site is located north of South March Point Road at the base of a bluff in the tidelands area of Padilla Bay (Figure 1). It is bounded by South March Point Road to the south, the Burlington Northern Santa Fe (BNSF) Railroad and Padilla Bay to the north and northeast, and the Swinomish Channel to the east and southeast. State Highway 20 runs about 800 feet southeast of the Site beyond South March Point Road.

The elevation of the Site ranges from 6 to 25 feet above mean lower low water (MLLW). It is relatively flat across the top with higher elevations on the north end. The Site slopes down to tidelands on the northeast and east sides and to drainage swales along the north and south sides.

Padilla Bay is part of an ancient delta of the Skagit River that was abandoned by the river and currently has no significant freshwater stream input. Water depths in Padilla Bay are shallow, with the bottom at an elevation higher than -12 feet below MLLW. Tidal fluctuation within Padilla Bay can vary from about -3.5 feet to +10 feet MLLW.

The tideflats adjacent to the Site include the Inner Lagoon bounded by the BNSF Railroad spur to the north and the surrounding uplands to the east, south, and west. The area north of the BNSF Railroad spur is considered to be Padilla Bay.

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2.0 OBJECTIVES AND DESIGN OF INVESTIGATION

The objectives of this investigation were to:

- determine if sediments within and adjacent to the Inner Lagoon adjacent to the Site meet the Sediment Management Standards' (SMS; WAC 173-204) biological criteria;
- determine if sediments in the drainage swale south of the Site have concentrations of SMS chemicals of concern (COCs) above the SMS cleanup criteria;
- determine if dioxins/furans and polychlorinated biphenyls (PCBs) in sediments that otherwise meet SMS biological criteria pose an unacceptable risk to human health; and
- determine if any of the above impacts are attributable to the landfill

The data from this investigation are being used to determine if sediments adjacent to the Site pose an adverse risk to human health and the environment.

The sampling design for this project used a tiered testing approach:

- Tier 1 – Conducting biological testing (i.e., SMS bioassay tests; amphipod, sediment larval, and Microtox®) at selected sample locations,
- Tier 2 – Conducting chemical analysis for SMS COCs at selected sample locations or conducting chemical analyses at stations that failed Tier 1 biological tests (SMS Sediment Quality Standards [SQS; WAC 173-204-320]), and
- Tier 3 – Sediment samples (or composites of samples) that met the SQS biological criteria would be evaluated for potential unacceptable human health risk from bioaccumulative chemicals (dioxins/furans and PCBs) using an exposure scenario that would be developed by Ecology.

The biological and chemical testing and human health risk assessment would be used to identify areas that may require additional investigation or to identify areas that may have to be considered for remedial action.

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3.0 METHODOLOGY

3.1 SEDIMENT SAMPLING

Four rounds of sediment samples were collected as described below.

3.1.1 Round 1

The initial round of sediment samples were collected by AMEC staff from August 26 to 28, 2008. Thirteen samples (MP-1 through MP-13) were collected from the Inner Lagoon area adjacent to the Site, and three samples (MPS-1 through MPS-3) were collected in the drainage swale running south of the Site (Table 1 and Figure 2). Sediment sampling and analysis were performed as proposed in the Sediment Work Plan (AMEC, 2008) with minor differences, which were noted in the *Draft Phase I Remedial Investigation Report* (AMEC, 2009).

3.1.2 Round 2

A second round of sediment sampling was conducted from September 1 to 3, 2009. These samples were collected from seven locations in the Inner Lagoon (MP-4, MP-5, MP-8, MP-9, MP-10, MP-11, and MP-13; Table 1 and Figure 2) that failed to meet the SQS Microtox® bioassay criteria during the initial round of sediment sampling (see Section 3.3 below). Sediment sampling and analysis was performed as proposed in the *Draft Addendum to the Sediment Investigation Work Plan* (AMEC, 2010). The objective of the additional sediment sampling was to collect additional sediments for bioassays. These bioassays were conducted to investigate the possible causes of the Sediment Quality Standards (SQS) failures in Microtox® bioassays from samples collected at seven of the Inner Lagoon locations. Additional sediment was also collected at these same seven locations for juvenile polychaete bioassay. The approach in conducting these additional bioassays was developed in collaboration with Ecology.

Sampling in this second round included the collection and archival of additional sample volume from the 13 original locations for subsequent use in Tier 3 testing of the potential effects of dioxins/furans and PCBs in sediments.

3.1.3 Round 3

A third round of sediment sampling was conducted from September 8 to 9, 2010 (Table 1) to provide better spatial coverage in the Inner Lagoon. Twenty samples were collected from locations within the Inner Lagoon (including locations adjacent to potential point sources not associated with the Site) and two areas north of the BNSF Railroad spur (in Padilla Bay; Figure 2). Sediment sampling and analysis were performed as proposed in the *Draft Addendum to the Sediment Investigation Work Plan* (AMEC, 2010). Sediments from a single location or composites of sediments from three or five sample locations (Figure 2) were homogenized and composited, and analyzed for PCBs and dioxins/furans.

In addition, archived sediments (collected in September 2009 adjacent to the 13 Inner Lagoon sample location) were composited (from three (MPC-3), four (MPC-2), and six (MPC-1) locations) and analyzed for PCBs and dioxins/furans (Figure 2).

3.1.4 Round 4

A fourth round of sediment sampling was conducted on May 17, 2011 (Table 1). Sediments were collected from a tidal drainage channel running along the east side of the Site to investigate the spatial pattern of dioxin concentrations within the tidal channel, in the proximity of Location MP-25. Sediment sampling and analysis were performed as proposed in the *Addendum to the Sediment Investigation Work Plan (Additional Dioxin and Furan Investigation)* (AMEC, 2011). Samples were collected from six locations within the tidal drainage channel (Figure 2), and were analyzed for dioxins and furans.

Samples for chemical analysis and the initial round of Tier 1 bioassay testing were submitted to Columbia Analytical Services (conventionals); Analytical Resources, Inc. (ARI; SMS list of COCs and conventionals); NewFields (amphipod and sediment larval bioassay); and Nautilus Environmental (Microtox® pore water bioassay) using chain-of-custody procedures. Samples for bioassay testing collected during the second round of sampling were transferred to NewFields for the juvenile polychaete bioassay. Microtox® pore water bioassays were performed by ARI on sediment transferred to NewFields. Sediment samples for compositing and dioxins/furans and PCB analysis were transferred to ARI for analysis.

Samples for bioassay testing and conventional parameters were chilled with “Blue Ice” refrigeration packs and held in the dark until transferred to the respective laboratories. Archived sample material was frozen at -18 degrees Celsius (°C) and stored by the analytical laboratory until analyzed. Bioassay sediments were held at 4°C and stored in the dark at the bioassay laboratory until used.

3.2 Conventionals and SMS Chemical Analysis

Samples for mercury analysis from the Inner Lagoon and swale locations were frozen until digested and analyzed within the 28-day holding time. Sediments for conventional analyses (grain size, total organic carbon [TOC], total volatile solids, total solids, and bulk ammonia) were refrigerated before being analyzed within the specified holding times.

Mr. Peter Adolphson, Ecology manager of the sediment investigation, requested that frozen archived sediment samples be analyzed for bulk sulfides after the recommended holding times had been exceeded. The analyses were conducted, but the data were flagged for exceeding the recommended holding times.

The sediments from the swale samples were analyzed for the SMS list of COCs and TOC within the recommended holding times.

Pore water samples were collected from the sediments or saturated soils at each of the sample locations in the drainage swale on the south side of the Site (MPS-1, MPS-2 and MPS-3). Salinity of the extracted pore water was measured using a pocket refractometer.

Archived sediments were thawed and analyzed (Round 2) or composited and analyzed (Round 3) for PCBs (by Aroclor) and for dioxins and furans. Sediments were also analyzed for total solids, TOC, and grain size. Samples from the Inner Lagoon that were collected in September 2009 (Round 2) and were composited for analysis (MPC-1, MPC-2, and MPC-3) were not analyzed within the recommended holding time and were frozen prior to analysis. The remaining samples (Round 3) were analyzed within the recommended holding times.

Sediment samples collected during the fourth round of sampling (MP-34 through MP-39) within a tidal drainage channel connecting location MP-25 in the upper tidal elevations and the lower tidal elevations portions of the Inner Lagoon were analyzed for dioxins and furans, total solids, TOC, and percent fines by ARI. All samples were analyzed within the recommended holding times.

3.3 BIOASSAY TESTING

There were two rounds of bioassay testing conducted as described below.

3.3.1 Round 1

The initial round of Tier 1 bioassay testing was conducted in August 2008 within the recommended holding time. Reference sediments were collected by NewFields personnel from Sequim Bay and Carr Inlet. Reference sediments were matched to the test sediments on the basis of the percent fines (particle size less than 63 micrometers [µm]). The amphipod bioassay was conducted using *Ampelisca abdita* after consultation with Ecology. The sediment larval test was conducted using the sand dollar *Dendraster excentricus*. Test sediments were exposed to full spectrum lighting. The Microtox® pore water, the amphipod, and the sediment larval tests were conducted using the test guidelines and protocols presented in the Puget Sound Estuarine Program (PSEP, 1995), Sampling and Analysis Plan Appendix (Ecology, 2008), and various updates and revisions presented during Sediment Management Annual Review Meetings (SMARM). The bioassay results were compared to the SMS criteria.

3.3.2 Round 2

Based on discussions with Ecology, it was determined that there may have been factors other than SMS COC chemistry that contributed to the SQS exceedances for the Microtox® bioassay in the first round of sampling. Factors that may have contributed to the negative response of the organisms include (1) holding times, (2) elevated total sulfides/dissolved sulfides, and (3) elevated ammonia. Consequently, a second round of bioassay testing was conducted on seven sediment samples collected at stations MP-4, MP-5, MP-8, MP-9, MP-10, MP-11, and MP-13 (Figure 3) that exceeded the SQS in the initial Tier 1 testing. In addition, a standard 20-day *Neanthes arenaceodentata* growth and survival test was also run to provide additional information.

Samples for the second round of bioassays were collected in September 2009. Sediment for bioassay testing and the chemical analyses were transferred to NewFields and ARI using chain-of-custody procedures. Additional sediments were collected and archived from the remaining sample locations within the Inner Lagoon for later Tier 3 analysis. NewFields coordinated the bioassay testing and chemical analyses. NewFields also conducted the juvenile polychaete bioassay. ARI conducted the Microtox® bioassays at the NewFields facility and the requested chemical analyses at their facility.

The second round of bioassay tests were conducted within the recommended holding time. Reference sediments were collected by NewFields personnel from Sequim Bay. Reference sediments were matched to the test sediments on the basis of the percent fines (particle size less than 63 µm). Reference sediment with a suitable percentage of fines was obtained by compositing sediments from multiple locations in Sequim Bay.

Test organisms for the juvenile polychaete bioassay were obtained from Dr. Don Reish of Long Beach, California. Test sediments for the polychaete growth and survival bioassay were exposed to full spectrum lighting. Survival, dry weight, and ash-free dry weight were measured for the polychaete endpoints. The polychaete growth and survival bioassay was started on Day 10 following sample collection.

Successive rounds of the Microtox® bioassay were run on sediments held for an increasing length of time. The archived sediments were held under refrigeration in the dark at 4°C until used. The first round of Microtox® testing was conducted between 2 to 3 days after sample collection. The second round of testing was conducted after 20 to 21 days of holding time and the third round was conducted after 37 to 38 days of holding time. Pore water was extracted from the sediments by centrifugation. During each test run 1/2 of the collected pore water was tested immediately after extraction. The remaining pore water was aerated for 24 hours before testing on the second day of the test run.

3.4 BIOACCUMULATIVE CHEMICALS OF CONCERN

Archived sediments collected in September 2009 within the Inner Lagoon adjacent to the Site and additional sediments collected from the Inner Lagoon and Padilla Bay during the third round of sediment sampling in September 2010 were analyzed for Tier 3 bioaccumulative chemicals of concern (PCBs by Aroclor and dioxins and furans). Sediments from three to six locations were composited together to represent eight areas within the Inner Lagoon and in Padilla Bay north of the BNSF Railroad spur. In addition, discrete samples were analyzed at three potential point sources within the Inner Lagoon (MP-25, MP-26, and MP-27). Sediments and sediment composite samples were also analyzed for total solids, TOC, and grain size. Composite samples from the Inner Lagoon collected in September 2009 (MPC-1, MPC-2, and MPC-3) were not analyzed within the recommended holding time and were frozen prior to analysis. The remaining samples (composites and discrete samples) were analyzed within the recommended holding times.

During a fourth round of sampling, sediments were collected within a tidal drainage channel between the discrete sample location MP-25 (near a potential point source in the upper tidal elevations) and the lower tidal elevations within the Inner Lagoon. The discrete samples (MP-34 through MP-39) were analyzed for dioxins and furans, total solids, TOC, and percent fines by ARI. All samples were analyzed within the recommended holding times.

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4.0 SEDIMENT RESULTS

Analytical data validation reports for the data presented below are provided in Appendix C.

4.1 SWALE CHEMISTRY RESULTS

A single sediment sample was collected at each of three sample locations in the drainage swale on the south side of the Site (MPS-1, MPS-2, and MPS-3, Figure 2). Pore water extracted from the sediments or from saturated soils along the swale showed a salinity gradient with salinity of 17 parts per thousand (ppt) near the mouth of the swale (MPS-3), where it discharges into the Inner Lagoon, to 0 ppt at the upper station (MPS-1) (Table 2). Chemistry results indicate that TOC levels ranged from 11.8 to 16.6 percent (Table 2). The total organic carbon results were above the value for which carbon normalization is considered appropriate. Consequently, the SMS list of COCs was compared to the SMS dry-weight equivalents (Table 2). The comparison of results indicates that a single analyte (phenol at 1,900 parts per billion [ppb]) exceeded the cleanup screening level (CSL) value. No other analytes exceeded the SQS or the CSL dry-weight equivalents in the swale samples.

4.2 INNER LAGOON CONVENTIONAL RESULTS

Sediment samples from the initial round of sampling in the Inner Lagoon (MP-1 through MP-13) were analyzed for TOC, total solids, bulk ammonia, total volatile solids, and grain size (Table 3). Analysis of bulk sulfides was conducted on archived sediments that had been frozen. The bulk sulfides results are also presented in Table 3. The conventional analyses were used in the selection of suitable bioassay reference sediments. Clean reference sediments were matched to the test sediments on the basis of grain size and TOC.

4.3 BIOASSAY TESTING RESULTS

4.3.1 Round 1

Sediments collected within the Inner Lagoon adjacent to the Site during the initial round of sampling were screened for toxicity using a suite of three bioassays: an acute 10-day amphipod bioassay using *Ampelisca abdita* (Table 4), a chronic 48- to 96-hour sediment larval test using *Dendraster excentricus* (Table 5), and a chronic saline pore water Microtox® bioassay (Table 5). A complete bioassay report is provided in Appendix A. None of the amphipod or sediment larval tests exceeded the SQS criteria; however, the Microtox® pore water bioassay exceeded the SQS at seven locations within the Inner Lagoon (MP-4, MP-5, MP-8, MP-9, MP-10, MP-11, and MP-13; Table 6 and Figure 3).

4.3.2 Round 2

Based on discussions with Ecology and the conclusion that there may have been factors other than SMS COC chemistry that contributed to the Microtox® bioassay SQS exceedances, additional sediments were collected during the second round of sediment sampling at the locations with Microtox® pore water bioassay SQS exceedances (Figure 3). The additional sediments were screened for toxicity using the standard chronic 20-day *Neanthes arenaceodentata* (juvenile polychaete) growth and survival test (Table 7). The endpoints were determined using the standard endpoint and using the ash-free dry weight endpoint. In addition, additional runs of the saline pore water Microtox® bioassay were conducted to determine if the initial test results could be replicated or if other factors such as holding time might have had an adverse effect on the results (Table 8). The complete bioassay report is provided in Appendix B. One of the 20-day juvenile polychaete tests exceeded the SQS criteria (Table 7). All of the test sediments tested with the Microtox® pore water bioassay within 2 to 3 days of sample collection passed the SQS criteria (Table 8). Samples held for longer holding times showed an increasing number of failures with increased holding times (Table 8 and Appendix B). Based on the results of the bioassay testing conducted on the Round 2 sediments, the Microtox® bioassay SQS exceedances during the Round 1 testing appear to be the result of increased toxicity associated with holding time and not chemistry.

4.4 BIOACCUMULATIVE COC RESULTS

PCBs were not detected in any of the composite samples from the Inner Lagoon or Padilla Bay north of the BNSF Railroad spur; however, one composite sample (MPC-2) did have elevated reporting limits due to matrix interference (Table 9 and Figure 1). PCBs were not detected in the discrete samples collected adjacent to three potential point sources within the Inner Lagoon (MP-25, MP-26, or MP-27, Table 9) or in the samples collected from the drainage swale on the south side of the Site (Table 2).

The composite samples and the discrete samples from the Inner Lagoon were analyzed for dioxins and furans (Table 10). A toxic equivalency quotient (TEQ) was calculated for selected congeners using the World Health Organization 2005 toxicity equivalency factors (TEFs [Van den Berg et al., 2006]). TEQs for the samples ranged from 0.36 parts per trillion (pptr) to 47.82 pptr (at MP-25) (Table 10 and Figure 5).

The sediment sample collected near the location of a stormwater culvert southeast of the Site ((MP-25) Figure 5) had dioxin/furan concentrations substantially higher than any other sample. Excluding MP-25, the next highest TEQ was 4.17 pptr. This anomalous result prompted further investigation of the distribution of dioxins and furans in all of the sediment samples collected during this remedial investigation. This further investigation included the collection of samples from the tidal drainage channel downgradient of sample MP-25 (MP-34 through MP-39; Figure 5). The TEQs for these samples ranged from 0.69 pptr to 13.62 pptr (Table 10 and Figure 5). The TEQ values did not show a consistent trend in decreasing concentration with distance from the suspected upgradient source near MP-25. Sediments collected in the ditch had TOC values that ranged from 1.01 percent to 5.23

percent and total percent fines (grain size < 63 µm) ranged from 1.5 percent to 61.6 percent. Dioxins and furans are associated with the finer organic fractions and samples with a higher percentage of TOC and fines had higher concentrations. The concentration of dioxins and furans in samples within the ditch with TOC values and percent fines similar to the values seen at MP-25 (4.64 percent TOC and 44 percent fines) had substantially lower TEQs (Table 10). Samples collected within the Inner Lagoon with similar TOC values and a higher percentage of fines had lower TEQs. [This seems to contradict bullet points four and five below, or at the least is ambiguous]

An evaluation of the potential sources of dioxins and furans was also conducted for the Site sediment samples as well as additional data from literature (for potential dioxin sources) and samples collected from Fidalgo Bay, Padilla Bay, and Samish Bay (Appendix D). The evaluation concluded that:

- The signatures of dioxins and furans in all samples collected in this study are clearly distinguished from those associated with dioxins/furans from wood burning, trash burning, and municipal solid waste incineration, as derived from the literature cited dioxin/furan signatures (Appendix D).
- The signatures of dioxins and furans in collected samples from this study can be accounted for by a mixture of signatures for typical marine sediments near stormwater outfalls and regional background samples from nearby Padilla Bay and Fidalgo Bay, as derived from the cited literature (Appendix D).
- Samples collected from locations closer to the stormwater culvert adjacent to the southeast portion of the Site (SE Culvert Figure 5) are more similar to the dioxin/furan signature of stormwater runoff (Figure 6). Samples in the lagoon have a dioxin/furan signature more closely resembling Puget Sound regional background data. This gradient of signature, from stormwater outfall to background, reflects the spatial arrangement of the samples moving away from the SE Culvert (MP-25).
- In general, total dioxin/furan concentrations in the samples collected display a decreasing concentration gradient from the SE Culvert (MP-25) to the receiving tidal drainage channel, to the Inner Lagoon and, finally, to Padilla Bay, north of the BNSF railroad spur (Figure 7).
- This gradient is also reflected in the proportional contribution of octa-chlorinated dibenzo dioxin (OCDD), which accounts for the majority of the dioxins and furans in collected samples and Puget Sound regional background samples (Figure 8).
- A watershed assessment which included an outfall survey conducted as part of the Whitmarsh Landfill remedial investigation indicates that the SE Culvert (where MP-25 was obtained) drains surface water runoff from areas upgradient of the Site (Figure 9).

Groundwater wells within the Site were sampled during the “wet season” (March 2013) and the ‘dry season” (August 2013) as part of the upland investigation. Groundwater was tested for dioxins and furans. Concentrations of dioxins and furans were undetected in the groundwater. Soil samples collected during the installation of test pits G-41 and G-43 had calculated 2,3,7,8-TCDD TEQs that ranged from 0.13 to 2.58 picograms/gram (pg/g) compared to the MTCA Method B cleanup level of 11 pg/g.

Groundwater samples collected in March 2013 did not have detected concentrations of dioxins. Groundwater does not appear to contribute to the dioxin concentration in the sediment adjacent to the Site. The upland soils have low but detected concentrations of dioxins and furans; however, the calculated TEQs are lower than the TEQs found in the adjacent drainage ditch and the Inner Lagoon adjacent to site. The banks surrounding the former landfill are vegetated and do not appear to be contributing significant amounts of material to the marsh.

These findings provide multiple lines of evidence that:

1. Sources unrelated to the Site contribute dioxins and furans in the samples associated with the tidal drainage channel draining away from the SE Culvert; and
2. Dioxins/furans in the Inner Lagoon adjacent to the Site, farther from the SE Culvert, are more similar in signature and concentration to data from nearby regional background bays than MP-25 and its associated source(s).

5.0 SUMMARY OF FINDINGS

Based on the data presented above and meetings held with Ecology, the following are the conclusions of the sediment remedial investigation:

- There are no impacts to sediments in the Inner Lagoon or Padilla Bay from the landfill.
- The initial failures of the Microtox® test conducted on sediments from the Inner and the Outer Lagoon (Decision Unit A) are attributable to longer holding times for initial bioassays and not attributable to ecological effects of the Site in adjacent sediments.
- Watershed studies conducted as part of the site investigation show that the SE Culvert (adjacent to station MP-25) discharges stormwater runoff draining from areas upgradient of the Site. These results provide multiple lines of evidence that a source unrelated to the Whitmarsh Landfill is contributing to dioxins and furans in the drainage channel (Decision Unit B) and the lagoon adjacent to the Site, and that its influence decreases moving away from MP-25.
- The elevated concentrations of dioxins and furans detected near the SE Culvert adjacent to the Site are not from a Site source. Ecology has determined that the identification of the source(s) of dioxins and furans in the drainage channel adjacent to the Site is not associated with the Whitmarsh / March Point Landfill. In addition, Ecology is in the process of compiling information on the stormwater system in the vicinity of the Site to potentially identify the source of the dioxins and furans.

Based on these findings, no additional sediment work is warranted and the sediments adjacent to the Site will not be considered as part of the future Feasibility Study.

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6.0 REFERENCES

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TABLES

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TABLE 1

SAMPLE LOCATIONS

March Point (Whitmarsh) Landfill
Skagit County, Washington

Station[1]	Date	Actual Sample Location (SPCS WA N [4601] NAD83 Survey Feet) Northing	Easting	Sample ID	Composite ID
Round 1					
MP-1	8/28/2008	537993	1229337	MP-1	
MP-2	8/26/2008	538148	1229111	MP-2	
MP-3	8/26/2008	538328	1228894	MP-3	
MP-4	8/27/2008	538518	1228857	MP-4	
MP-5	8/27/2008	538415	1229185	MP-5	
MP-6	8/28/2008	538196	1229438	MP-6	
MP-7	8/27/2008	538004	1229643	MP-7	
MP-8	8/27/2008	537905	1229900	MP-8	
MP-9	8/27/2008	537728	1229997	MP-9	
MP-10	8/27/2008	537525	1230055	MP-10	
MP-11	8/27/2008	537293	1229979	MP-11	
MP-12	8/27/2008	538441	1229010	MP-12	
MP-13	8/27/2008	538248	1229261	MP-13	
Swale Samples					
MPS-1	8/28/2008	538006	1228723	MPS-1	
MPS-2	8/28/2008	537849	1228833	MPS-2	
MPS-3	8/28/2008	537533	1229226	MPS-3	
Round 2 Resample					
MP-2	9/3/2009	538148	1229111		MPC-1
MP-3	9/1/2009	538327	1228893		
MP-4R	9/1/2009	538518	1228858	MP-4R	
MP-5R	9/1/2009	538414	1229185	MP-5R	
MP-12	9/1/2009	538440	1229010		
MP-13R	9/1/2009	538245	1229263	MP-13R	
MP-1	9/3/2009	537993	1229337		MPC-2
MP-6	9/1/2009	538196	1229438		
MP-7	9/1/2009	538003	1229647		
MP-8R	9/1/2009	537908	1229903	MP-8R	
MP-9R	9/1/2009	537728	1229995	MP-9R	MPC-3
MP-10R	9/1/2009	537524	1230056	MP-10R	
MP-11R	9/1/2009	537292	1229978	MP-11R	

TABLE 1

SAMPLE LOCATIONS
March Point (Whitmarsh) Landfill
Skagit County, Washington

Station[1]	Date	Actual Sample Location (SPCS WA N [4601] NAD83 Survey Feet) Northing	Easting	Sample ID	Composite ID
Round 3 Samples					
MP-14	9/8/2010	537436	1230278		MPC-4
MP-15	9/8/2010	537325	1230475		
MP-16	9/8/2010	537227	1230658		
MP-17	9/8/2010	537024	1229979		MPC-5
MP-18	9/8/2010	536957	1230201		
MP-19	9/8/2010	536879	1230468		
MP-20	9/8/2010	536662	1230181		
MP-21	9/8/2010	536618	1230452		
MP-22	9/8/2010	536999	1230798		MPC-6
MP-23	9/8/2010	536794	1230756		
MP-24	9/8/2010	536578	1230701		
MP-25	9/9/2010	537386	1229404		MP-25
MP-26	9/9/2010	536485	1230002		MP-26
MP-27	9/8/2010	536356	1230530		MP-27
MP-28	9/8/2010	537893	1230272		MPC-7
MP-29	9/8/2010	537845	1230428		
MP-30	9/8/2010	537672	1230617		
MP-31	9/9/2010	539003	1228640		MPC-8
MP-32	9/9/2010	538798	1229037		
MP-33	9/9/2010	538540	1229465		
Round 4 Samples					
MP-34	5/17/2011	537468	1229346	MP-34	
MP-35	5/17/2011	537550	1229355	MP-35	
MP-36	5/17/2011	537651	1229327	MP-36	
MP-37	5/17/2011	537744	1229345	MP-37	
MP-38	5/17/2011	537836	1229368	MP-38	
MP-39	5/17/2011	537914	1229395	MP-39	

Note(s)
1. R indicates reoccupied location.

Abbreviation(s)
NAD83 = North American Datum of 1983
SPCS = State Plane Coordinate System

TABLE 2

RESULTS OF SWALE SAMPLES

March Point (Whitmarsh) Landfill
Skagit County, Washington

Parameter	SMS Dry Weight Equivalents		MPS-1			MPS-2			MPS-3		
	SQS	CSL	Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²
Conventionals											
Pore water Salinity (ppt)	—	—	0			7			17		
Total Organic Carbon (%)	—	—	16.6			13.9			11.8		
Metals	**ppm**	**ppm**	**ppm**			**ppm**			**ppm**		
Arsenic	57	93	30			20	U		20	U	
Cadmium	5.1	6.7	0.9			0.9			0.9		
Chromium	260	270	63			52			58		
Copper	390	390	67.2			51.1			54.3		
Lead	450	530	37			19			21		
Mercury	0.41	0.59	0.2	U		0.2	U		0.1	U	
Silver	6.1	6.1	1	U		1	U		1	U	
Zinc	410	960	199			131			194		
Organics											
LPAHs	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Naphthalene	2100	2100	20	U		20	U		20	U	
Acenaphthylene	1300	1300	20	U		20	U		20	U	
Acenaphthene	500	500	20	U		20	U		20	U	
Fluorene	540	540	20	U		20	U		20	U	
Phenanthrene	1500	1500	20	U		20	U		20	U	
Anthracene	960	960	20	U		20	U		20	U	
2-Methylnaphthalene	670	670	20	U		20	U		20	U	
Total LPAH	5200	5200	20	U		20	U		20	U	

TABLE 2

RESULTS OF SWALE SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Parameter	SMS Dry Weight Equivalents		MPS-1			MPS-2			MPS-3		
	SQS	CSL	Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²
Organics (continued)											
HPAHs	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Fluoranthene	1700	2500	20	U		20	U		20	U	
Pyrene	2600	3300	20	U		20	U		20	U	
Benzo(a)anthracene	1300	1600	20	U		20	U		20	U	
Chrysene	1400	2800	20	U		20	U		20	U	
Total Benzofluoranthenes	3200	3600	20	U		20	U		20	U	
Benzo(b)fluoranthene			20	U		20	U		20	U	
Benzo(k)fluoranthene			20	U		20	U		20	U	
Benzo(a)pyrene	1600	1600	20	U		20	U		20	U	
Indeno(1,2,3-cd)pyrene	600	690	20	U		20	U		20	U	
Dibenz(a,h)anthracene	230	230	20	U		20	U		20	U	
Benzo(g,h,i)perylene	670	720	20	U		20	U		20	U	
Total HPAH	12000	17000	20	U		20	U		20	U	
Chlorinated Benzenes	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
1,4-Dichlorobenzene	110	110	20	U		20	U		20	U	
1,2-Dichlorobenzene	35	50	20	U		20	U		20	U	
1,2,4-Trichlorobenzene	31	51	20	U		20	U		20	U	
Hexachlorobenzene	22	70	0.99	U		1.8			1	U	
Phthalates	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Dimethylphthalate	71	160	20	U		20	U		20	U	
Diethylphthalate	200	1200	20	U		20	U		20	U	
Di-n-Butylphthalate	1400	5100	20	U		20	U		20	U	
Butylbenzylphthalate	63	900	20	U		31	Y	UY	26	?Y	UY
bis(2-Ethylhexyl)phthalate	1300	3100	20	U		20	U		33		
Di-n-Octyl phthalate	6200	6200	20	U		20	U		20	U	

TABLE 2

RESULTS OF SWALE SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Parameter	SMS Dry Weight Equivalents		MPS-1			MPS-2			MPS-3		
	SQS	CSL	Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²
Miscellaneous Extractables	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Hexachlorobutadiene	11	120	0.99	U		1	U		1	U	
N-Nitrosodiphenylamine	28	40	20	U	UJ	20	U	UJ	20	U	UJ
Dibenzofuran	540	540	20	U		20	U		20	U	
PCBs	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Aroclor 1016	--	--	20	U		20	U		20	U	
Aroclor 1221	--	--	20	U		20	U		20	U	
Aroclor 1232	--	--	20	U		20	U		20	U	
Aroclor 1242	--	--	20	U		20	U		20	U	
Aroclor 1248	--	--	20	U		20	U		20	U	
Aroclor 1254	--	--	20	U		20	U		20	U	
Aroclor 1260	--	--	20	U		20	U		20	U	
Total PCB	130	1000	20	U		20	U		20	U	
Phenols	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Phenol	420	1200	23			46			1900		
2-Methylphenol	63	63	20	U		20	U		20	U	
4-Methylphenol	670	670	20	U		20	U		20	U	
2,4-Dimethylphenol	29	29	20	U		20	U		20	U	
Pentachlorophenol	360	690	99	U		100	U		100	U	
Miscellaneous Extractables	**ppb**	**ppb**	**ppb**			**ppb**			**ppb**		
Benzyl Alcohol	57	73	20	U		20	U		20	U	
Benzoic Acid	650	650	200	U		200	U		200	U	

TABLE 2

RESULTS OF SWALE SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Parameter	SMS Dry Weight Equivalents		MPS-1			MPS-2			MPS-3		
	SQS	CSL	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]

Note(s)

Data qualifiers are as follows:

- U = Undetected at the reporting limit.
- Y = Analyte is not detected at the raised reporting limit.
- UJ = Undetected at the reporting limit. Associated value is an estimate.
- UY = Analyte is undetected at the raised reporting limit.

Sample results highlighted in red are above the SMS CSL.

TOC values in the swale samples were well above the range of values where is it considered appropriate to compare the nonionizable organic compounds against the carbon-normalized SMS criteria.

Nonionizable organic compounds were compared against the SMS dry weight equivalents.

Abbreviation(s)

CSL = cleanup screening levels
Dry Weight "SMS" = lowest-apparent-effects threshold, dry weight equivalent of the SMS "SQS"
Dry Weight "CSL" = second lowest-apparent-effects threshold (2LAET), dry weight equivalent of the SMS "CSL"-- some exceptions
HPAHs = high-molecular-weight polycyclic aromatic hydrocarbons
LPAHs = low-molecular-weight polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
ppb = parts per billion
ppt = parts per thousand
Q[1] = Laboratory assigned data qualifier
Q[2] = Data validation assigned data qualifier
SMS = Sediment Management Standards
SQS = Sediment Quality Standards
TOC = total organic carbon

TABLE 3

RESULTS FOR CONVENTIONAL ANALYSIS ROUND 1 SEDIMENT SAMPLES
March Point (Whitmarsh) Landfill
Skagit County, Washington

Station	Date	TVS %	TS %	Ammonia mg/kg	Sulfides mg/kg	TOC %	Fines (<63 µm) %
MP-1	8/28/2008	6.2	44.4	55.1	309	2.05	83%
MP-2	8/26/2008	6.18	47.2	12.7	513	2.02	81%
MP-3	8/26/2008	9.61	35.2	19.8	8180	3.26	67%
MP-4	8/27/2008	10.6	33.7	18.5	4160	3.06	77%
MP-5	8/27/2008	8.49	40.8	9.3	370	2.85	66%
MP-6	8/28/2008	9.21	49.7	1.5	916	2.93	61%
MP-7	8/27/2008	7.81	38.5	14.6	239	2.44	70%
MP-8	8/27/2008	8.24	46.5	4.6	31.6	4.61	60%
MP-9	8/27/2008	7.68	46.1	5	52.7	2.82	78%
MP-10	8/27/2008	6.58	42.3	5.4	157	2.03	74%
MP-11	8/27/2008	7.46	40.3	5.1	102	2.39	84%
MP-12	8/27/2008	6.4	41.8	13.1	210	1.94	80%
MP-13	8/27/2008	7.58	43.3	14	276	2.29	76%

Abbreviation(s)
mg/kg = milligrams per kilogram
µm = micrometer
TS = total solids
TOC = total organic carbon
TVS = total volatile solids

TABLE 4

RESULTS FOR AMPHIPOD (*AMPELISCA ABDITA*) BIOASSAY FOR ROUND 1 SEDIMENT SAMPLES

March Point (Whitmarsh) Landill
Skagit County, Washington

Treatment	Mean Mortality (%)	Estimated Percent Fines[1]	Reference Comparison[2]	Statistically More than Reference?	MT-MR	Fails SQS?	Fails CSL?
Control	9						
CR-1[3]	15	60%	---				
SBREF-80[3]	19	80%	---				
MP-1	18	83%	SBREF-80	No	-1	No	No
MP-2	10	81%	SBREF-80	No	-9	No	No
MP-3	24	67%	CR-1	No	9	No	No
MP-4	27	77%	SBREF-80	No	8	No	No
MP-5	29	66%	CR-1	Yes	14	No	No
MP-6	12	61%	CR-1	No	-3	No	No
MP-7	26	70%	SBREF-80	No	7	No	No
MP-8	12	60%	CR-1	No	-3	No	No
MP-9	25	78%	SBREF-80	No	6	No	No
MP-10	16	74%	SBREF-80	No	-3	No	No
MP-11	17	84%	SBREF-80	No	-2	No	No
MP-12	23	80%	SBREF-80	No	4	No	No
MP-13	28	76%	SBREF-80	No	9	No	No
Biological Criteria: SQS: Statistical Significance and MT-MR >25% CSL: Statistical Significance and MT-MR >30%							

Note(s)
1. Percent fines for reference samples determined in the field by NewFields. Percent fines for test treatments supplied by Columbia Analytical.
2. Reference sediment pairings with test sediment based on similarity of percent fines and were approved by Pete Adolphson of the Washington State Department of Ecology.
3. Reference sediments.

Abbreviation(s)
CSL = chemical screening levels
SQS = Sediment Quality Standards

TABLE 5

RESULTS FOR SEDIMENT LARVAL (*DENDRASTER EXCENTRICUS*) BIOASSAY FOR ROUND 1 SEDIMENT SAMPLES

March Point (Whitmarsh) Landfill
Skagit County, Washington

Treatment	Mean Normal Survival (%)	Estimated Percent Fines[1]	Reference Comparison[2]	Statistically Less than Associated Reference?	Normal Survival Comparison to Reference (NT/NC)/(NR/NC)	Fails SQS?	Fails CSL?
Control	89.0						
CR-1[3]	87.3	60%	---				
SBREF80[3]	93.9	80%	---				
MP-1	97.9	83%	SBREF-80	No	1.04	No	No
MP-2	96.4	81%	SBREF-80	No	1.03	No	No
MP-3	93.0	67%	CR-1	No	1.06	No	No
MP-4	91.5	77%	SBREF-80	No	0.97	No	No
MP-5	87.3	66%	CR-1	No	1.00	No	No
MP-6	99.4	61%	CR-1	No	1.14	No	No
MP-7	97.9	70%	SBREF-80	No	1.04	No	No
MP-8	94.2	60%	CR-1	No	1.08	No	No
MP-9	96.3	78%	SBREF-80	No	1.03	No	No
MP-10	95.3	74%	SBREF-80	No	1.01	No	No
MP-11	98.1	84%	SBREF-80	No	1.04	No	No
MP-12	95.7	80%	SBREF-80	No	1.02	No	No
MP-13	95.5	76%	SBREF-80	No	1.02	No	No
Biological Criteria: SQS: Statistical Significance and MT/MR <0.85 CSL: Statistical Significance and MT/MR <0.70							

Note(s)

1. Percent fines for reference samples determined in the field by NewFields. Percent fines for test treatments supplied by Columbia Analytical.
2. Reference sediment pairings with test sediment based on similarity of percent fines and were approved by Pete Adolphson of the Washington State Department of Ecology.
3. Reference sediments.

Abbreviation(s)

CSL = chemical screening levels
SQS = Sediment Quality Standards

amec

TABLE 6

RESULTS FOR MICROTOX® PORE WATER BIOASSAY FOR ROUND 1 SEDIMENT SAMPLES

March Point (Whitmarsh) Landfill
Skagit County, Washington

Treatment	5-Minute Reading		15-Minute Reading		Fails SQS?
	Mean % output	Statistically Less than Reference and >20% Difference?	Mean % output	Statistically Less than Reference and >20% Difference?	
Test 1[1]					
Control	96 ± 2	---	83 ± 2	---	
SBREF-80	76 ± 3	---	67 ± 2	---	
MP-1	76 ± 5	No	70 ± 3	No	No
MP-2	102 ± 3	No	98 ± 3	No	No
MP-4	67 ± 3	Yes	62 ± 2	Yes	Yes
MP-7	93 ± 3	No	70 ± 5	No	No
Test 2[1]					
Control	98 ± 2	---	93 ± 4	---	
SBREF-80	66 ± 1	---	68 ± 4	---	
MP-9	71 ± 4	Yes	71 ± 8	Yes	Yes
MP-10	74 ± 3	Yes	72 ± 2	Yes	Yes
MP-11	66 ± 3	Yes	63 ± 4	Yes	Yes
MP-12	112 ± 3	No	121 ± 5	No	No
Test 3[1]					
Control	96 ± 3	---	99 ± 5	---	
SBREF-80	72 ± 5	---	76 ± 4	---	
MP-13	43 ± 2	Yes	46 ± 2	Yes	Yes
Test 4					
Control	92 ± 2	---	81 ± 5	---	
CR-1	102 ± 2	---	91 ± 3	---	
MP-3	104 ± 2	No	94 ± 3	No	No
MP-5	73 ± 6	Yes	72 ± 4	Yes	Yes
MP-6	97 ± 1	No	90 ± 5	No	No
MP-8	74 ± 11	Yes	67 ± 7	Yes	Yes

Biological Criteria:
SQS: >20% difference and statistically significant difference ($p<0.05$) relative to the reference.
CSL: No failure criteria for Microtox under SMS rule.

Note(s)

1. Reference sample was significantly less than Control; test treatments compared to the Control.

Abbreviation(s)

CSL = chemical screening levels
SMS = Sediment Management Standards
SQS = Sediment Quality Standards

TABLE 7

RESULTS FOR JUVENILE POLYCHAETE (*NEANTHES ARENACEODENTATA*) BIOASSAY FOR ROUND 2 SEDIMENT SAMPLES

March Point (Whitmarsh) Landfill
Skagit County, Washington

Endpoint: Non-Ashed / Ashed	Sample[1]	Test Sample Mean	Reference Mean	Mean Treatment/ Mean	Statistically Significant ($p \leq 0.05$)	Fails SQS?	Fails CSL?
Non-Ashed	MP-4R	0.273	0.416	65.5	No	No	No
	MP-5R	0.465	0.416	111.7	No	No	No
	MP-8R	0.230	0.416	55.2	Yes	Yes	No
	MP-9R	0.381	0.416	91.6	No	No	No
	MP-10R	0.339	0.416	81.5	No	No	No
	MP-11R	0.285	0.416	68.5	No	No	No
	MP-13R	0.420	0.416	100.8	No	No	No
Ashed	MP-4R	0.211	0.318	66.5	No	No	No
	MP-5R	0.353	0.318	111.2	No	No	No
	MP-8R	0.176	0.318	55.5	Yes	Yes	No
	MP-9R	0.296	0.318	93.1	No	No	No
	MP-10R	0.243	0.318	76.4	No	No	No
	MP-11R	0.206	0.318	64.7	No	No	No
	MP-13R	0.312	0.318	98.3	No	No	No

Note(s)
1. R indicates reoccupied location.

Abbreviation(s)
CSL = cleanup screening levels
SQS = Sediment Quality Standards

TABLE 8

RESULTS FOR MICROTOX® PORE WATER BIOASSAY FOR ROUND 2 SEDIMENT SAMPLES

March Point (Whitmarsh) Landfill

Skagit County, Washington

Aeration	Sample [2]	5-Minute Comparisons (T/R[1])						15 Minute-Comparisons (T/R[1])					
		Day 2 & 3		Day 20 & 21		Day 37 & 38		Day 2 & 3		Day 20 & 21		Day 37 & 38	
Non-aerated	MP-4R	1.02		0.99		**0.62**	*	1.02		0.97		**0.61**	*
	MP-5R	0.95		**0.61**	*	**0.57**	*	0.80		**0.54**	*	**0.55**	*
	MP-8R	0.96		0.97		**0.66**	*	0.88		0.83		**0.57**	*
	MP-9R	0.98		0.93		**0.14**	*	0.88		**0.78**	*	**0.15**	*
	MP-10R	0.99		**0.61**	*	**0.25**	*	0.93		**0.57**	*	**0.22**	*
	MP-11R	0.98		**0.32**	*	**0.42**	*	1.00		**0.24**	*	**0.36**	*
	MP-13R	0.93		**0.34**	*	**0.73**	*	0.87		**0.27**	*	**0.74**	*
Aerated	MP-4R	0.96		**0.69**	*	0.89		0.95		**0.66**	*	**0.76**	*
	MP-5R	0.94		0.99		0.92		0.90		0.98		0.86	
	MP-8R	0.94		0.95		**0.73**	*	0.91		0.91		**0.70**	*
	MP-9R	0.94		**0.40**	*	0.93		0.91		**0.37**	*	0.89	
	MP-10R	0.98		1.00		**0.60**	*	0.90		0.99		**0.56**	*
	MP-11R	0.99		**0.69**	*	**0.53**	*	0.96		**0.65**	*	**0.45**	*
	MP-13R	1.00		**0.65**	*	0.96		0.98		**0.65**	*	0.97	

Note(s)

* Statistically lower than Reference, shaded cells indicate SQS failure (T/R <0.8 and statistically significant).

1. Compared to Control when Reference did not meet acceptability criteria (see text). Control and reference results are shown by batch in Tables 12, 16, and 20 of Appendix B.
2. R indicates reoccupied location.

TABLE 9

RESULTS FOR PCB ANALYSIS (BY AROCLOR)
March Point (Whitmarsh) Landfill
Skagit County, Washington

	Sept 2009 Samples									Sept 2010 Samples																							
	MPC-1			MPC-2			MPC-3			MPC-4			MPC-5			MPC-6			MPC-7			MPC-8			MP-25			MP-26			MP-27		
Analyte	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2	Value	Q^1	Q^2
Conventional																																	
TOC (%)	3.19			2.08			1.54			2.89			2.12			3.14			2.57			1.89			4.64			2.17			0.327		
Percent fines	80.23			77.9			75.5			73.3			63.5			77.3			79			77.5			44			47.1			2.4		
PCBs	**ppb**			**ppb**			**ppb**			**ppb**			**ppb**			**ppb**			**ppb**			**ppb**			**ppb**			**ppb**			**ppb**		
Aroclor 1016	4.0	U		3.9	U		4.0	U		4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Aroclor 1242	4.0	U		3.9	U		4.0	U		4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Aroclor 1248	9.9	Y	U	160.0	Y	U	4.0	U		4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Aroclor 1254	9.9	Y	U	79.0	Y	U	4.0	U		4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Aroclor 1260	4.0	U		3.9	U		4.0	U		4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Aroclor 1221	4.0	U		3.9	U		4.0	U		4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Aroclor 1232	4.0	U		3.9	U		6.0	Y	U	4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	
Total PCBs	19.8	Y	U	160.0	Y	U	6.0	Y	U	4.0	U		3.9	U		4.0	U		3.9	U		4.0	U		4.0	U		4.0	U		3.9	U	

Note(s)
Data qualifiers are as follows:
U = Undetected at the reporting limit.
Y = Analyte is not detected at the raised reporting limit.

Abbreviation(s)
PCBs = polychlorinated biphenyls
ppb = parts per billion
Q^1 = Laboratory assigned data qualifier
Q^2 = Data validation assigned data qualifier

TABLE 10

RESULTS FOR DIOXIN/FURAN ANLYSIS (TEQ)
March Point (Whitmarsh) Landfill
Skagit County, Washington

		September 2009									September 2010																							
		MPC-1			MPC-2			MPC-3			MPC-4			MPC-5			MPC-6			MPC-7			MPC-8			MP-25			MP-26			MP-27		
Analyte		Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]	Value	Q[1]	Q[2]
Conventional																																		
TOC (%)		3.19			2.08			1.54			2.89			2.12			3.14			2.57			1.89			4.64			2.17			0.327		
Percent fines		80.2			77.9			75.5			73.3			63.5			77.3			79			77.5			44			47.1			2.4		
Dioxins (pptr)	**TEF**																									pg/g								
2,3,7,8-TCDD	1	0.277	JY	U	0.22	JY	U	0.269	JY	U	0.147	JY	U	0.164	JY	U	0.171	JY	U	0.197	JY	U	0.159	JY	U	2.29			0.134	JY	U	0.034	U	
1,2,3,7,8-PeCDD	1	1.26	JY	U	1.12	J		1.36	J		0.756	J	J	0.865	J	J	0.996	J	J	0.832	J	J	0.769	J	J	9.65		J	0.556	J	J	0.0938	JY	U
1,2,3,4,7,8-HxCDD	0.1	1.58	J		1.44	J		2.62	J		0.71	JY	U	0.978	J	J	1.09	J	J	0.838	J	J	0.753	J	J	17.7		J	0.634	J	J	0.248	J	J
1,2,3,6,7,8-HxCDD	0.1	4.95			5.9			3.9	J		2.59	J	J	2.87	J	J	3.18	J	J	2.63	J	J	2.42	J	J	64.5		J	1.75	J	J	0.454	J	J
1,2,3,7,8,9-HxCDD	0.1	3.7	J		3.23	J		2.98	J		1.78	J		2.33	J		2.62	J		1.83	J		1.64	J		46.2			1.45	J		0.516	J	
1,2,3,4,6,7,8-HpCDD	0.01	92.1			102			56.6			41	B	J	50.1	B	J	50.2	B	J	50.2	B	J	38.1	B	J	1,390	B	J	37.6	B	J	11.7	B	J
OCDD	0.0003	930	B		827	B		374	B		302	B		359	B		337	B		369	B		260	B		15,000	B		363	B		76	B	
Furans (pptr)																																		
2,3,7,8-TCDF	0.1	1.36			1.07			1.23			0.989	BJ		0.871	BJ		0.94	BJ		0.983	BJ		1.14	B		0.970	BJ		0.411	BJ		0.0446	BJY	U
1,2,3,7,8-PeCDF	0.03	0.548	J		0.543	J		0.473	JY	U	0.261	JY	U	0.337	J		0.231	JY	U	0.299	J		0.284	J		1.39	J		0.214	J		0.0306	U	
2,3,4,7,8-PeCDF	0.3	0.653	J		0.521	JY	U	0.665	J		0.332	BJ		0.298	BJY	U	0.337	BJ		0.343	BJY	U	0.375	BJY	U	1.64	BJ		0.265	BJ		0.0313	U	
1,2,3,4,7,8-HxCDF	0.1	0.969	J		0.968	JY	U	0.838	J		0.533	BJ		0.609	BJ		0.576	BJ		0.581	BJ		0.521	BJ		5.85	B		0.431	BJ		0.0633	BJY	U
1,2,3,6,7,8-HxCDF	0.1	0.764	J		0.82	J		0.722	J		0.43	BJ	U	0.477	BJY	U	0.438	BJY	U	0.353	BJY	U	0.421	BJ	U	5.28	B		0.298	BJY	U	0.0885	JY	U
2,3,4,6,7,8-HxCDF	0.1	1.12	J		1.13	J		0.989	J		0.537	BJ	U	0.684	BJ	U	0.625	BJ	U	0.552	BJ	U	0.581	BJ	U	9.91	B	J	0.512	BJ	U	0.0275	U	
1,2,3,7,8,9-HxCDF	0.1	0.312	J		0.451	J		0.299	J		0.159	J		0.124	JY	U	0.151	JY	U	0.106	JY	U	0.054	U		2.64	J		0.233	JY	U	0.0291	U	
1,2,3,4,6,7,8-HpCDF	0.01	12			11.4			9.36			6.39	B	J	8.75	B	J	7.74	B	J	6.9	B	J	6.38	B	J	143	B	J	6.54	B	J	1.99	BJ	U
1,2,3,4,7,8,9-HpCDF	0.01	0.775	J		0.756	J		0.61	J		0.41	JY	U	0.571	J		0.444	JY	U	0.471	J		0.157	U		7.71			0.644	J		0.104	U	
TEQ (ND=1/2RL) (pptr)		3.79			4.17			3.84			2.19			2.54			2.78			2.42			2.14			47.82			1.80			0.36		
TEQ (ND=0) (pptr)		3.03			3.94			3.70			2.03			2.35			2.62			2.22			1.95			47.82			1.68			0.26		
Homolog Totals (pptr)																																		
Total TCDD		9.78	Y		8.26	Y		13.8	Y		11.8	BY		11.3	BY		5.68	BY		19.3	BY		13.6	BY		10.9	BY		2.61	BY		0.188	BY	
Total PeCDD		14.2	Y		10.4	Y		17.6	Y		7.56	Y		7.97	Y		9.56	Y		10.4	Y		8.33	Y		36.3	Y		4.06	Y		0.212	Y	
Total HpCDD		229			229			135			125	B		29.4	B		138	B		179	B		113	B		2,440	B		90.7	B		20.1	B	
Total HxCDD		50.2	Y		43.6	Y		49.7			28.1	Y		119	Y		36.2			33.3			28.7			325			16.2	Y		3.06	Y	
OCDD		930	B		827	B		374	B		302	B		359	B		337	B		369	B		260	B		15,000	B	DNR	363	B		76	B	
Total TCDF		14.5	Y		10.2	Y		14.6	Y		8.43	BXY	J	8.1	BXY	J	7.68	BXY	J	8.52	BXY	J	8.89	BXY	J	15.7	BXY	J	4.54	BY		0.142	BY	
Total PeCDF		12	Y		10.6	Y		13.1	Y		5.23	BY		5.96	BY		5.52	BY		5.11	BXY	J	5.77	BY		49.1	BY		4.29	BY		0.423	BY	
Total HxCDF		18			20.8	Y		14.7			9.3	BY		10.8	BY		10.8	BY		9.46	BY		9.31	B		240	BY		8.13	BY		2.04	BY	
Total HpCDF		32.6	Y		30.4			22.9			16.7	BY		22	B		19.7	BY		18.3	BY		15.8	BY		475	BY		27.2	B		4.82	B	
OCDF		32.8			26.3			20.2			17	B		23.7	B		20.6	B		19.2	B		16	B		432	B		49.3	B		6.57	BJ	

TABLE 10

RESULTS FOR DIOXIN/FURAN ANLYSIS (TEQ)
March Point (Whitmarsh) Landfill
Skagit County, Washington

		May 2011																	
		MP-34			MP-35			MP-36			MP-37			MP-38			MP-39		
Analyte		Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²	Value	Q¹	Q²
Conventional																			
TOC (%)		2.49			3.66			1.07			1.01			5.23			3.27		
Percent fines		19.1			48.5			3.5			1.5			61.6			23.4		
Dioxins (pptr)	**TEF**	pg/g			pg/g			pg/g			pg/g			pg/g			pg/g		
2,3,7,8-TCDD	1	0.396	JEMPC	U	0.762	J		0.0983	JEMPC	U	0.0471	JEMPC	U	0.665	J		0.313	JEMPC	U
1,2,3,7,8-PeCDD	1	1.37	J		3.38	J		0.368	BJ		0.312	BJ		2.72	J		1.83	J	
1,2,3,4,7,8-HxCDD	0.1	2.04	J		4.96			0.319	JEMPC	U	0.186	J		3.76	J		2.28	J	
1,2,3,6,7,8-HxCDD	0.1	7.63			15.6			1.2	J		0.41	JEMPC	U	12.6			5.9		
1,2,3,7,8,9-HxCDD	0.1	4.42	J		12.3			0.824	BJ		0.416	BJ	U	8.96			4.33	J	
1,2,3,4,6,7,8-HpCDD	0.01	144			329			20.7			6.26			271			113		
OCDD	0.0003	1600			3510			203			54.8			2760			1260		
Furans (pptr)																			
2,3,7,8-TCDF	0.1	0.891	J		1.61			0.49	BJX	J	0.5	BJ		1.96			1.04		
1,2,3,7,8-PeCDF	0.03	1.14	BJ		1.98	J		0.551	BJ	U	0.516	BJEMPC	U	1.79	J		1.15	BJ	
2,3,4,7,8-PeCDF	0.3	0.638	BJ		1.19	J		0.281	BJ		0.261	BJEMPC	U	1.16	J		0.918	J	
1,2,3,4,7,8-HxCDF	0.1	1.91	J		3.34	J		0.816	BJ		0.761	BJ		2.88	J		1.92	J	
1,2,3,6,7,8-HxCDF	0.1	1.07	J		2.04	J		0.35	BJ		0.288	BJ		1.75	J		1.25	J	
2,3,4,6,7,8-HxCDF	0.1	1.38	J		2.6	J		0.289	J		0.141	JEMPC	U	2.38	J		1.48	J	
1,2,3,7,8,9-HxCDF	0.1	0.449	J		0.807	J		0.0428	U		0.0373	U		0.612	J		0.346	J	
1,2,3,4,6,7,8-HpCDF	0.01	16.9			34.8			3.21	J		1.47	BJ	U	32.2			14.7		
1,2,3,4,7,8,9-HpCDF	0.01	0.942	J		1.99	J		0.191	J		0.0666	U		2.13	J		0.822	J	
TEQ (ND=1/2RL) (pptr)		5.88			13.62			1.23			0.69			11.19			5.83		
TEQ (ND=0) (pptr)		5.69			13.62			1.15			0.57			11.19			5.67		
Homolog Totals (pptr)																			
Total TCDD		3.42			8.98			1.01			0.825			8.1			12		
Total PeCDD		7.27			15.9			0.657			0.773			15.7			21.8		
Total HpCDD		252			597			35.2			10.8			492			215		
Total HxCDD		39.3			93.9			5.97			2.11			75.8			44.2		
OCDD		1600			3510			203			54.8			2760			1260		
Total TCDF		8.17			17			3.14			2.41			16.1			11.3		
Total PeCDF		14.4			25.6			3.06			2.19			24			14.7		
Total HxCDF		33.3			62.5			5.75			2.9			53.2			26.9		
Total HpCDF		48.5			98.5			7.91			2.74			96.2			38.2		
OCDF		42.2			97.7			7.72	J		2.16	J		103			38.2		

Note(s)

Data qualifiers are as follows:
- B = Detected at a concentration greater than one-half of ARI's reporting limit or 5% o the analyte concentration in the sample.
- EMPC = Estimated Maximum Possible Concentration.
- D = Spiked compound was not detected due to sample extract dilution.
- J = Estimated concentration when the value is less that ARI's established reporting limits.
- NR = Recovery is not reported due to chromatographic interference.
- U = Undetected at the reporting limit.
- X = Includes interference from the sample matrix or perfluorokerosense ions.
- Y = Analyte is not detected at the raised reporting limit.

Dioxin results qualified as EMPC treated as an undetected value with a raised reporting limit in calculation of TEQ using the World Health Organization (WHO) 2005 TEFs (Van den Berg et all, 2006).

TEQs calculated from Q² if present.

Abbreviation(s)
- pptr = parts per trillion
- Q¹ = Laboratory assigned data qualifier
- Q² = Data validation assigned data qualifier
- TEF = toxicity equivalency factors
- TEQ = toxic equivalency quotient

FIGURES

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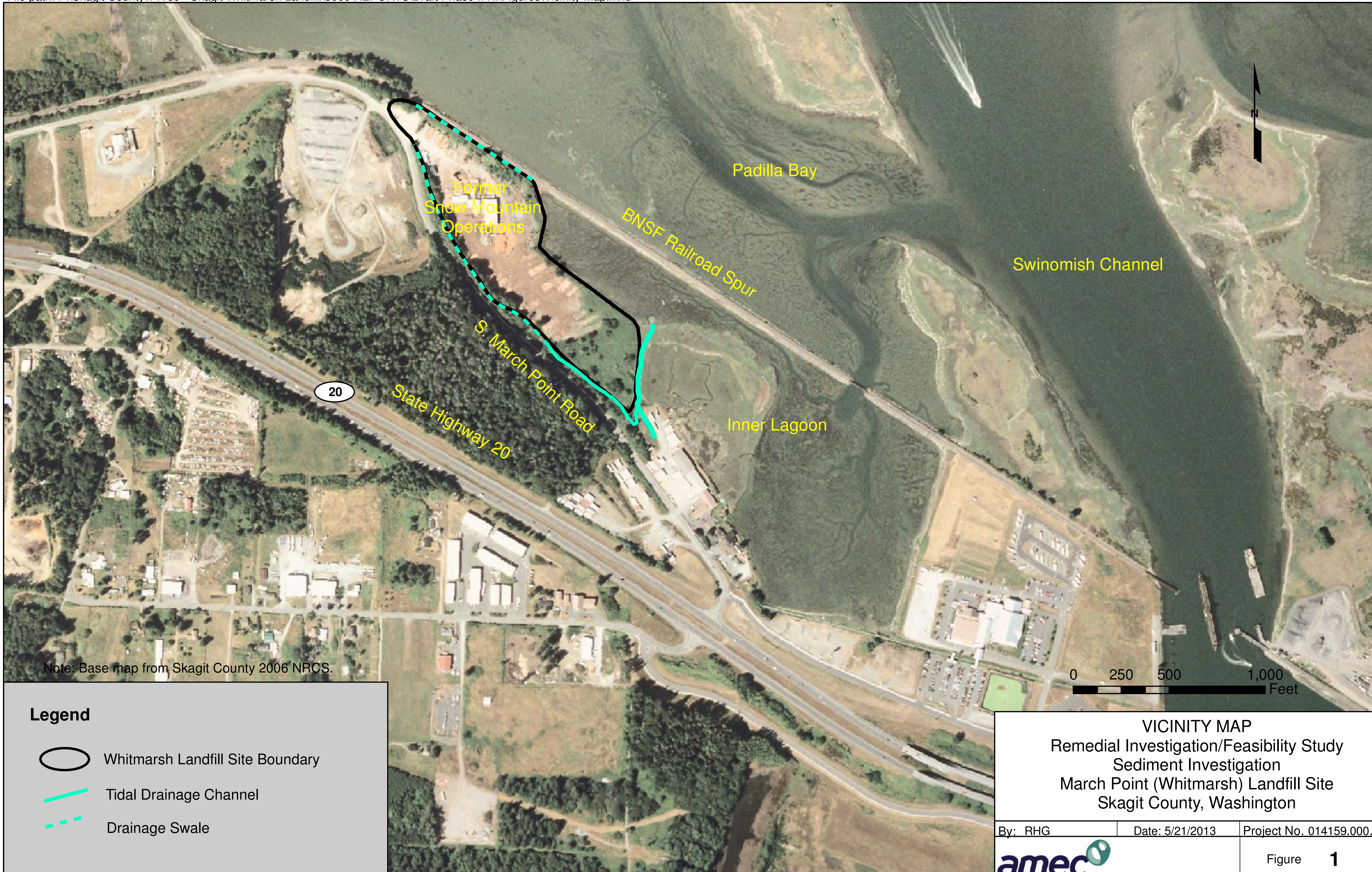
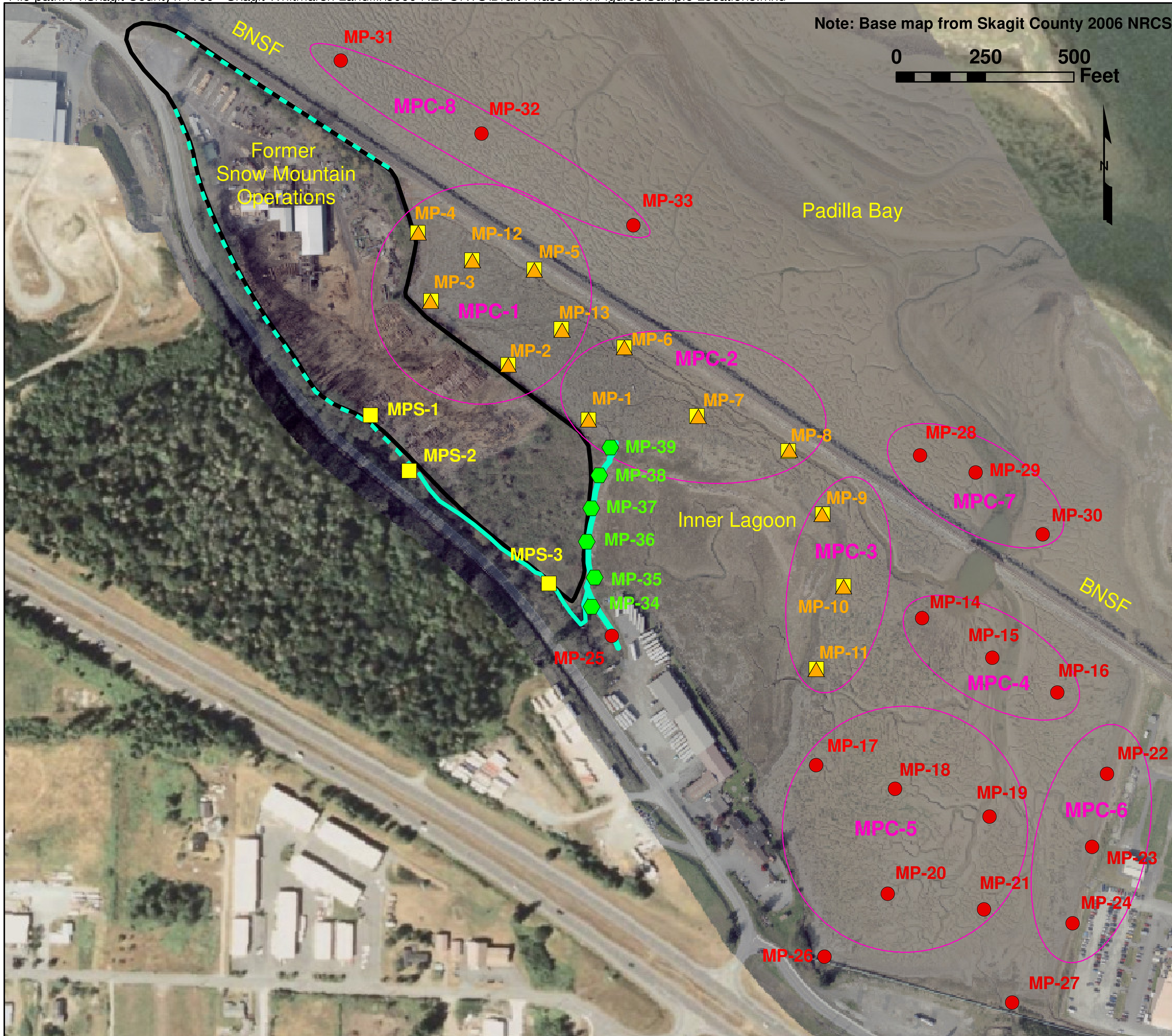


VICINITY MAP
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 5/21/2013	Project No. 014159.000.0
amec		Figure 1

File path: P:\Skagit County\14159 - Skagit Whitmarsh Landfill\3000 REPORTS\Draft Phase II RI\Figures\Sample Locations.mxd



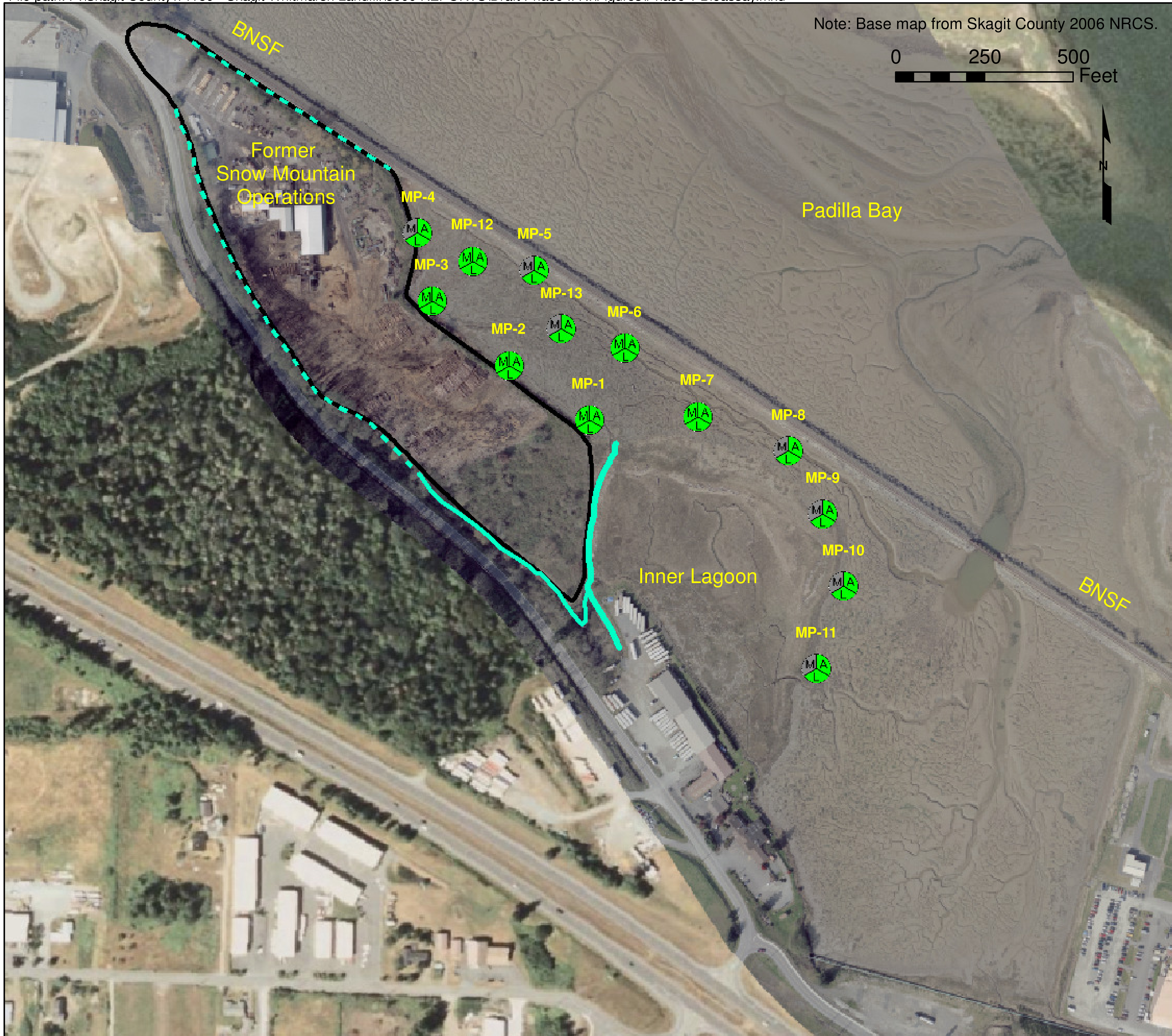
Legend

- MP-3 — August 2008
- MP-3R — September 2009
- MP-14 — September 2010
- MP-34 — May 2011
- MPC-3 — Composite Sample
- Whitmarsh Landfill Site Boundary
- Tidal Drainage Channel
- Drainage Swale

SEDIMENT SAMPLING LOCATIONS
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 5/21/2013	Project No. 014159.000.0
amec		Figure 2

File path: P:\Skagit County\14159 - Skagit Whitmarsh Landfill\3000 REPORTS\Draft Phase II RI\Figures\Phase 1 Bioassay.mxd



Legend

EXPLANATION

M = Microtox Bioassay

A = Amphipod Bioassay

L = Sediment Larval Bioassay

Green Indicates Bioassay Meets SQS

Gray Indicates Bioassay Exceeds SQS

Whitmarsh Landfill Site Boundary

Tidal Drainage Channel

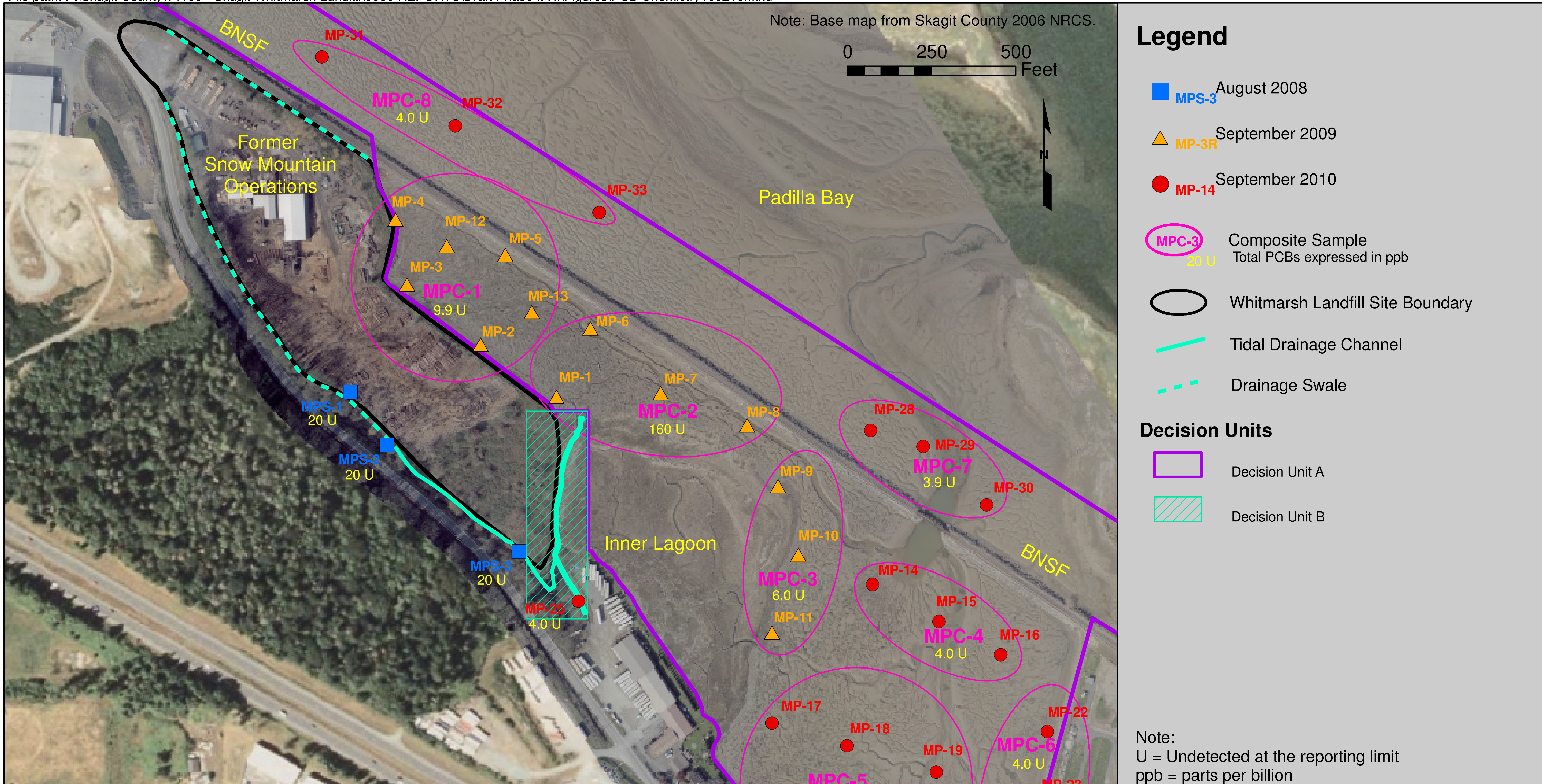
Drainage Swale

Note:
Sediments for bioassay testing were collected between August 26 and August 28, 2008
SQS = Sediment Quality Standard

PHASE 1 BIOASSAY STATIONS AND RESULTS
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 5/20/2013	Project No. 014159.000.0
amec		Figure 3

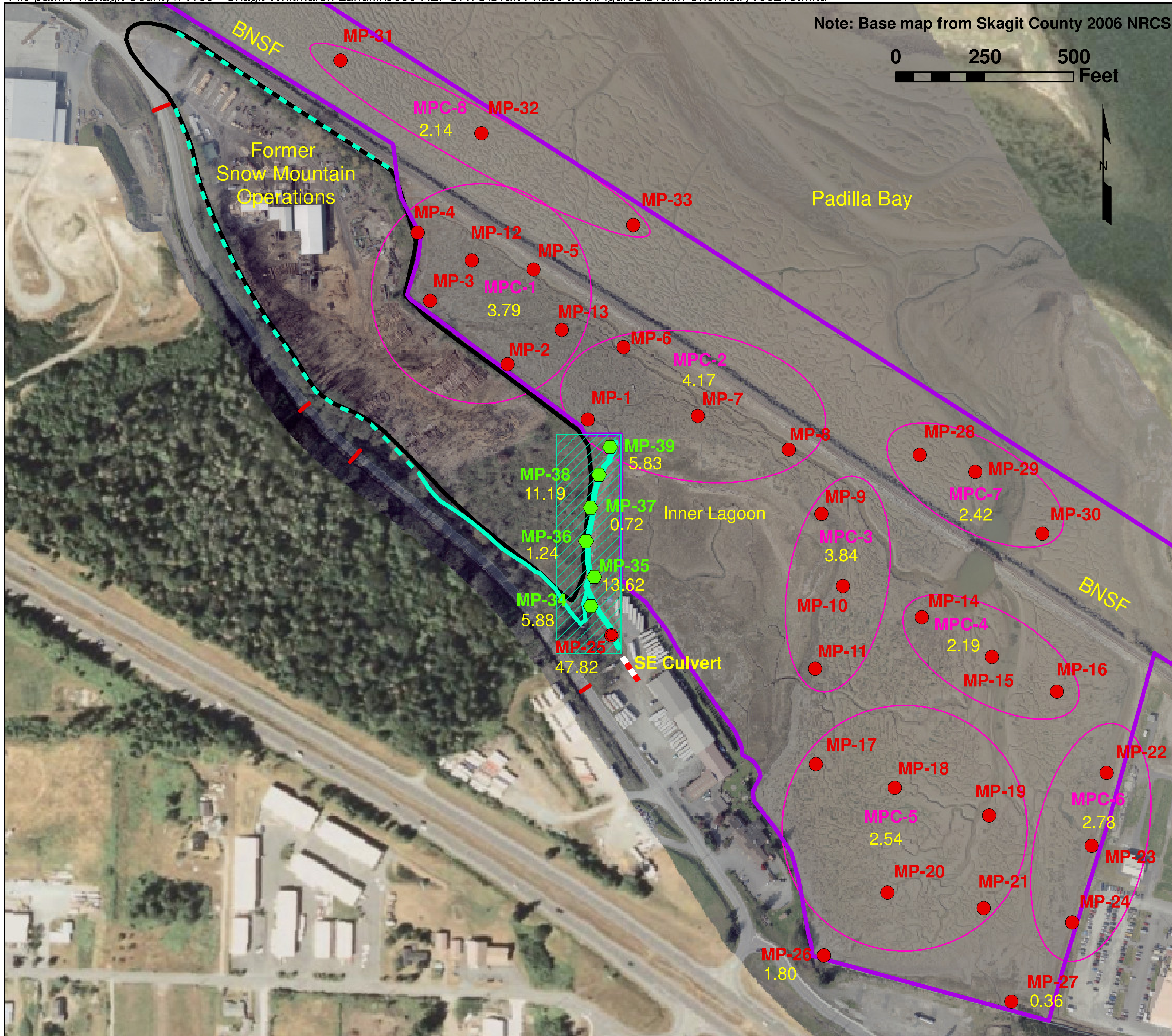
File path: P:\Skagit County\14159 - Skagit Whitmarsh Landfill\3000 REPORTS\Draft Phase II RI\Figures\PCB Chemistry100215.mxd



TOTAL PCBs (PPB)
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date:10/2/2015	Project No. 014159.000.0
amec		Figure 4

File path: P:\Skagit County\14159 - Skagit Whitmarsh Landfill\3000 REPORTS\Draft Phase II RI\Figures\DIoxin Chemistry100215.mxd



Sediment Sampling

- MP-39 5.83 — Samples associated with drainage from culvert upgradient of MP-25. Dioxin/furans expressed in pptr TEQ
- MP-27 0.42 — Sediment sampling locations. Dioxin/furans expressed in pptr TEQ
- MPC-3 2.36 — Composite samples. Dioxin/furans expressed in pptr TEQ
- Whitmarsh Landfill Site Boundary
- Tidal Drainage Channel
- Drainage Swale
- 18 Inch Culvert
- 36 Inch Culvert

Decision Units

- Decision Unit A
- Decision Unit B

Note:
Dioxin/furan concentrations expressed in parts per trillion Toxicity Equivalency Quotient using WHO 2005 TEFs

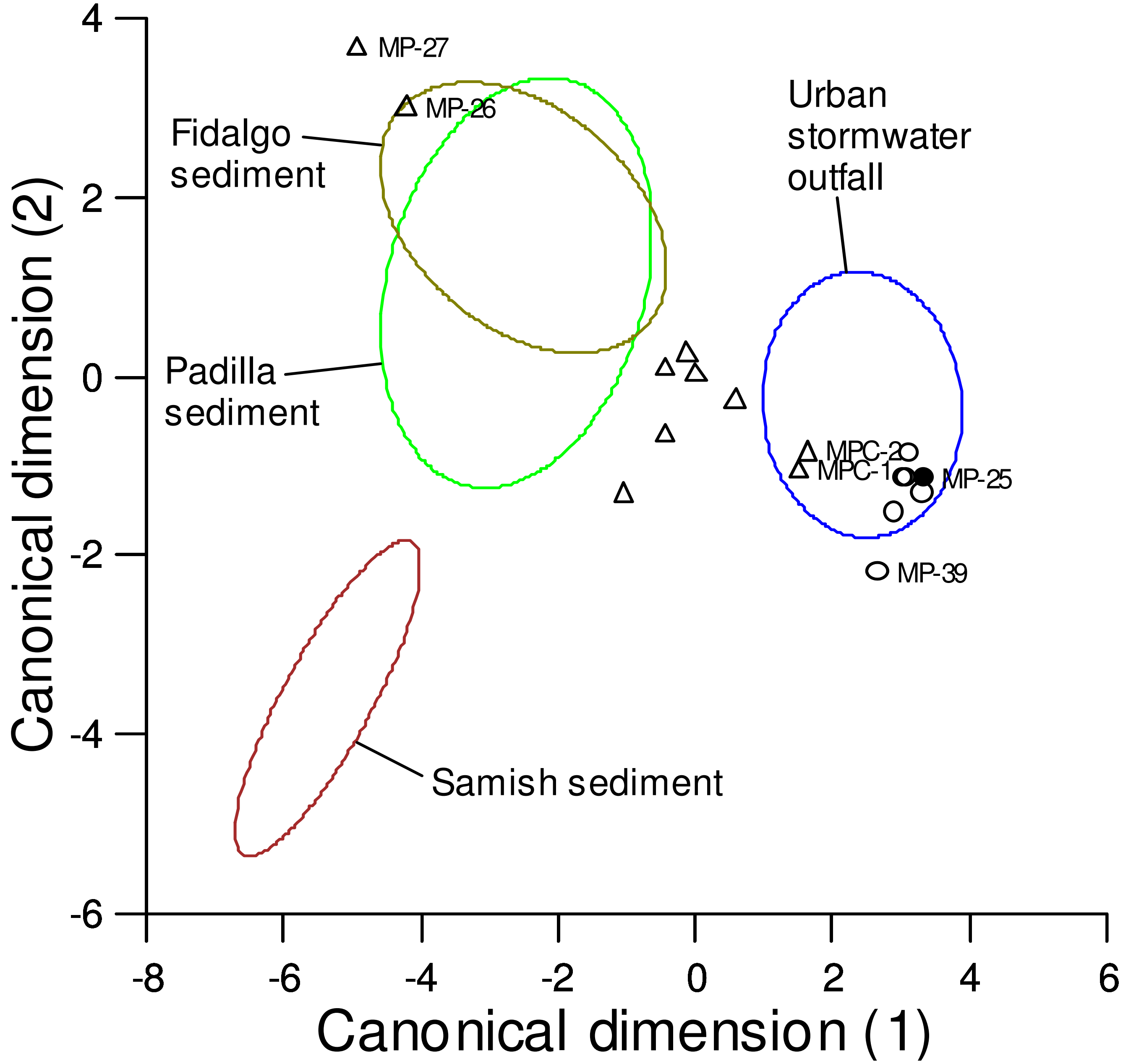
Some locations in tidal drainagechannel along east margin of the landfill were moved to match the aerial photograph. Locations were moved within ± 1m which is the accuracy of the GPS.

DIOXINS/FURANS (PPTR TEQ)
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date:10/2/2015	Project No. 014159.000.0

amec

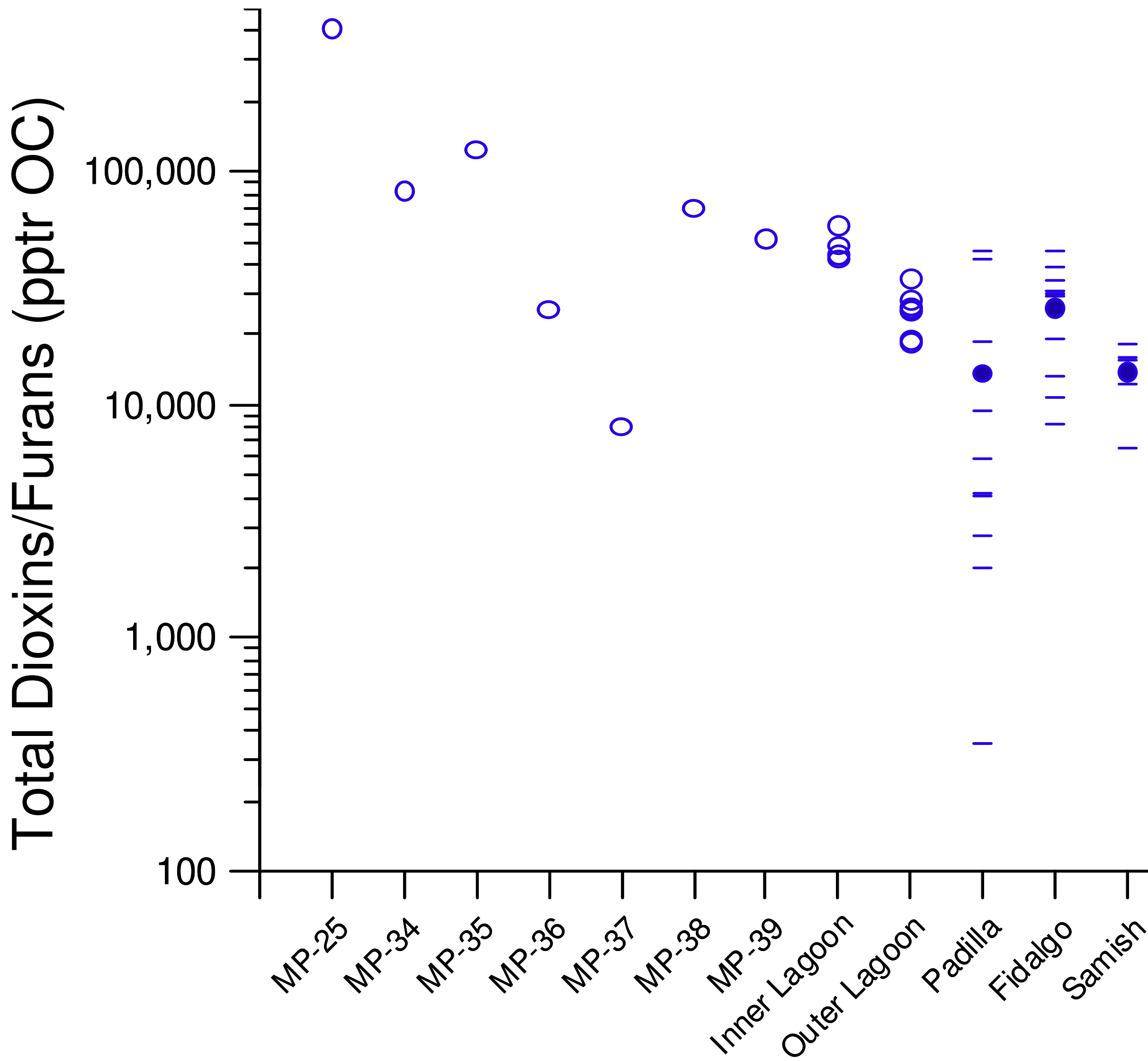
Figure 5



Source: Figure 1 of Arcadis Memo July, 2012 (see Appendix D)

Note:
Ellipses are from the training data set (see explanation on page 8 of Arcadis memo) , by identified type. Triangles are Whitmarsh lagoon and nearshore samples, open circles are Whitmarsh ditch samples MP-34 through MP39; filled circle is Whitmarsh culvert sample MP-25 (see Figure 5).

LINEAR DISCRIMINANT RESULTS BASED ON REDUCED DATA SET, WITH WHITMARSH DATA Remedial Investigation/Feasibility Study Sediment Investigation March Point (Whitmarsh) Landfill Site Skagit County, Washington		
By: RHG	Date: 4/15/2013	Project No. 014159.000.0
amec		**Figure 6**

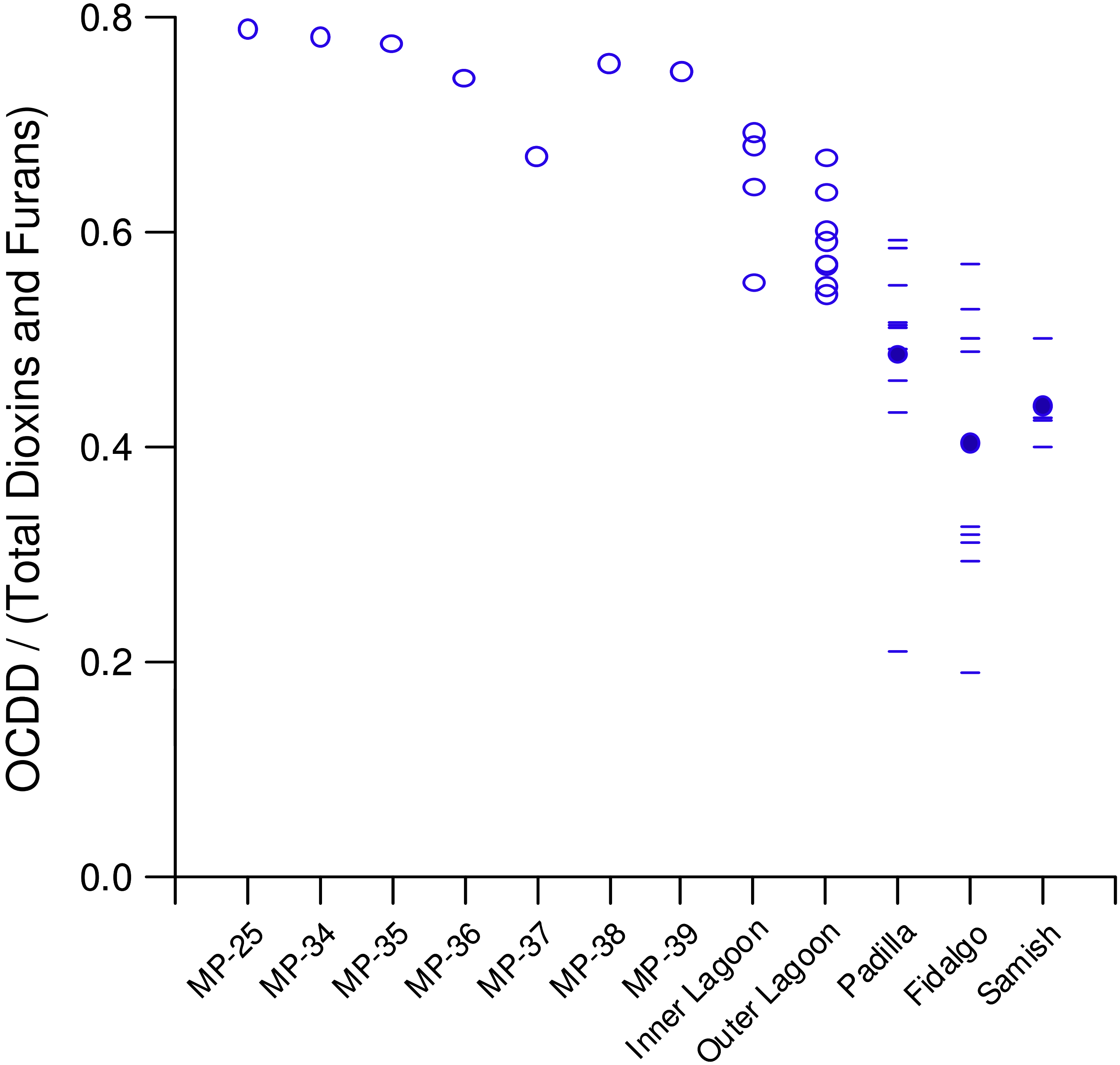


Source: Figure 2 of Arcadis Memo July, 2012 (see Appendix D)

Note:
Open circles are Whitmarsh samples (see Figure 5); dashes are Puget Sound regional background samples; filled circles are mean concentrations for each regional background data set. Concentrations are normalized to total organic carbon content of sample.
pptr = parts per trillion
OC = Organic Carbon

TOTAL DIOXINS/FURANS IN WHITMARSH AND PUGET SOUND REGIONAL BACKGROUND DATA
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 5/20/2013	Project No. 014159.000.0
amec		Figure 7



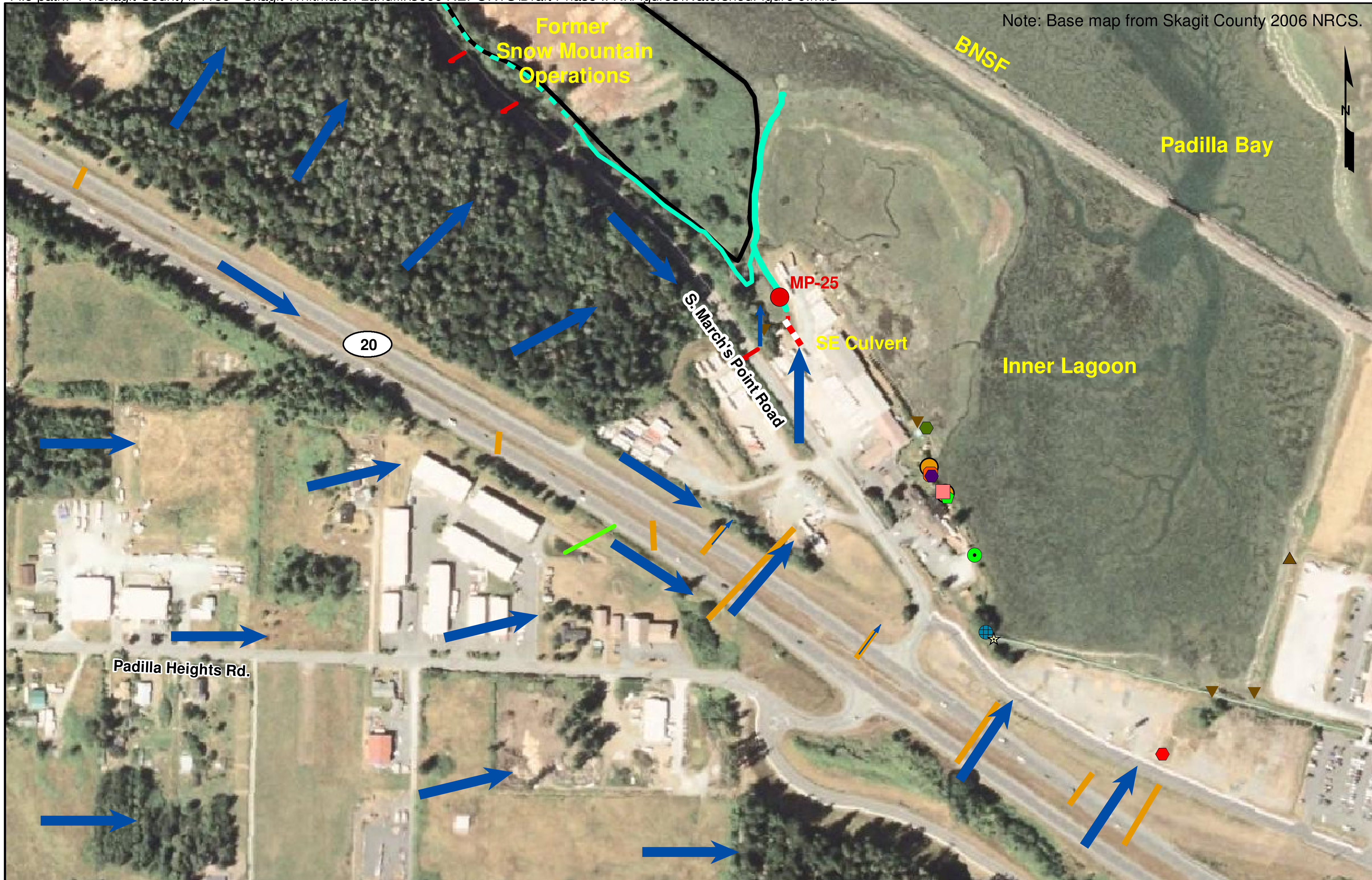
Source: Figure 3 of Arcadis Memo July, 2012 (see Appendix D)

Note:
Open circles are Whitmarsh samples (see Figure 5); dashes are Puget Sound regional background samples; filled circles are mean proportions for each regional background data set.
OCDD = Octa-Chlorinated Dibenzo Dioxins

PROPORTION OCDD IN WHITMARSH AND PUGET SOUND REGIONAL BACKGROUND DATA
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 5/20/2013	Project No. 014159.000.0
amec		**Figure 8**

File path: "P:\Skagit County\14159 - Skagit Whitmarsh Landfill\3000 REPORTS\Draft Phase II RI\Figures\WatershedFigure 9.mxd"



Potential surface water point sources to Inner Lagoon

- 36" Corrugated Steel
- 36" Steel
- 18" Corrugated Plastic
- 6" PVC
- 6" Iron w/Flapper
- 4" PVC
- 4" ABS
- 4" Corrugated Plastic
- 2" PVC+2" ABS
- 2" ABS
- Ditch
- Seep
- Swale

AMEC January 2010 Outfall Survey

MP-25 Dioxin Sediment Sampling Location (AMEC September 2010)

0 250 500 Feet

Legend

- Whitmarsh Landfill Site Boundary
- Tidal Drainage Channel
- Drainage Swale
- Generalized Surface Water Flow

Drain Pipes and Culverts Within Watershed

- Drain pipe (AMEC Field Survey 12/19/11)
- Roadway Culvert(s) Along Route 20 (provided by WSDOT 12/8/11)
- 18" Culvert(s) Under South March's Point Road (provided by City of Anacortes 11/28/11)

GENERALIZED SURFACE WATER FLOW
Remedial Investigation/Feasibility Study
Sediment Investigation
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 5/21/2013	Project No. 014159.000.0
amec		Figure 9

APPENDIX A

Bioassay Report Round 1

BIOLOGICAL TESTING OF SEDIMENT FOR MARCH POINT (WHITMARSH) LANDFILL ANACORTES, WASHINGTON

NOVEMBER 2008

PREPARED FOR:
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PREPARED BY:
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NEWFIELDS

1.0 INTRODUCTION

NewFields conducted toxicity tests with sediment samples collected by AMEC Geomatrix at the March Point Landfill in Padilla Bay. Biological effects were evaluated relative to the biological criteria defined in the Sediment Management Standards (SMS). This report presents the results for the toxicity testing portion of the March Point Landfill sediment investigation.

2.0 METHODS

This section summarizes the test methods that were followed for this biological characterization. Test methods followed guidance provided by the Puget Sound Estuary Program (PSEP 1995), the WDOE Sampling and Analysis Plan Appendix (SAPA; Ecology 2008), the various updates presented during the Annual Sediment Management Review meetings (SMARM), and the Sediment Investigation Work Plan March Point (Whitmarsh) Landfill Skagit County, Washington prepared by AMEC Geomatrix (AMEC 2008). Sediment toxicity was evaluated using three standard PSEP bioassays, the 10-day amphipod test, the 48 to 96-hour benthic larval test, and the Microtox® porewater test. NewFields performed the amphipod and benthic larval tests, the Microtox® test was performed by Nautilus Environmental LLC. The amphipod test species, *Ampelisca abdita*, was selected by the Ecology based on the predominant grain size distribution of the test sediments.

2.1 SAMPLE AND ANIMAL RECEIPT

Thirteen test sediments were received by NewFields on August 29, 2008. Reference sediment was collected from Carr Inlet on September 12, 2008 and from Sequim Bay on September 16, 2008 by NewFields. Sediment samples were stored in a walk-in cold room at 4 ± 2ºC in the dark. Test sediment was not sieved prior to testing. All tests were conducted within the eight week holding time.

Amphipods (*Ampelisca abdita*) were supplied by Brezina and Associates in Dillon Beach, California. Animals were held in native sediment at 20°C prior to test initiation. *Dendraster excentricus* (sand dollar) broodstock was collected by NewFields staff from Hood Canal, Washington. Broodstock were held in unfiltered seawater from Hood Canal prior to spawning.

Native *Ampelisca* sediment from Dillon Beach, California was also provided by Brezina and Associates for use as control sediment for the amphipod test.

2.2 ULTRA-VIOLET LIGHT EXPOSURE

Test sediment samples were exposed to ultra-violet (UV) light during the entire test exposure. The UV light regime followed guidance provided by Sub-Appendix D (Ecology 2008) and in consultation with Ecology. UV light was provided by fluorescent light ballast containing one Duro-Test Vita-Lite® (40W, 5500°K, 91 CRI) fluorescent bulb and one standard fluorescent bulb (Phillips F40CW). The UV bulbs were placed within 12" above the sediment surface. All test chambers in the UV exposures were left uncovered to prevent any UV loss. Tests were conducted on water-tables to ensure that the additional lighting did not alter water temperatures in the test chambers. In all other respects, the methods followed the standard testing protocols are summarized below.

2.3 10-DAY AMPHIPOD BIOASSAY

The 10-day acute toxicity test with *A. abdita* was initiated on September 23, 2008. To prepare the test exposures, approximately 175 mL of sediment was placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled with 775 mL of 0.45-µm filtered seawater at 28 ppt. Seven replicate chambers were prepared for each test treatment, the two reference sediments, and the native control sediment. The control and reference sediments were tested with the test treatments. Five replicates were used to evaluate sediment toxicity while the remaining two replicates were designated as sacrificial surrogate chambers. One surrogate chamber was sacrificed at test initiation to measure porewater and overlying ammonia and sulfides. The remaining surrogate chamber was used for measuring daily water quality throughout the test, as well as porewater and overlying ammonia and sulfides at test termination. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{2-} were monitored using a HACH DR/4000V Spectrophotometer.

Test chambers were placed in randomly assigned positions in a 20°C water bath and allowed to equilibrate overnight. Trickle-flow aeration was provided to prevent dissolved oxygen concentrations from dropping below acceptable levels.

Immediately prior to test initiation, water quality parameters were measured in the surrogate chamber for each treatment. Dissolved oxygen (DO), temperature, pH, and salinity were then monitored in the surrogate chambers daily until test termination. Target test parameters were:

Dissolved Oxygen:	≥4.6 mg/L
pH:	7.8 ± 0.5 units
Temperature:	20 ± 1°C
Salinity:	28 ± 1‰

The tests were initiated by randomly allocating 20 *A. abdita* into each test chamber, ensuring that each of the amphipods successfully buried into the sediment. Amphipods that did not bury within approximately one hour were replaced with healthy amphipods. The 10-day amphipod bioassay was conducted as a static test with no feeding during the exposure period. At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered amphipods transferred into a Petri dish. The number of surviving and dead amphipods was recorded. A water-only, 4-day reference-toxicant test was conducted concurrently with the sediment tests, using cadmium chloride. The cadmium reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests.

2.4 Larval Developmental Bioassay

Test sediment was evaluated using the larval benthic toxicity test with the sand dollar, *D. excentricus*. The sand dollar larval test was initiated on September 24, 2008. A sea water control and the two reference sediments were tested with the test treatments. To prepare the test exposures, 18 g (±1 g) of test sediment was placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled to 900 mL with 0.45-µm of filtered seawater. Six replicate chambers were prepared for each test treatment, reference sediment, and the native sediment control treatment. Five of the replicates were used to evaluate the test; the sixth replicate was used as a water quality surrogate. Each chamber was shaken for 10 seconds and then placed in predetermined randomly-assigned positions in a water bath at 15°C.

To collect gametes for each test, spawning was induced by injecting 0.5 mL of 0.5M KCl into the coelomic cavity of the sand dollar. Spawning males and females were placed aboral surface down into a beaker with clean seawater. Gametes from at least two males and two females were used to initiate the test. Once sufficient eggs and sperm had been collected, the eggs were rinsed to remove any detritus or feces and a homogenized sperm solution was added to the egg solutions. Egg-sperm solutions were periodically homogenized with a perforated plunger during the fertilization process. Approximately 60 minutes after fertilization, embryo solutions were checked for fertilization rate. Only those embryo stocks with >90% fertilization were used to initiate the tests. Embryo solutions were rinsed free of excess sperm and then combined to create one embryo stock solution. Density of the embryo stock solution was determined by counting the number of embryos in a sub sample of stock solution. This was used to determine the volume of embryo stock solution to deliver approximately 27,000 embryos to each test chamber. The tests were initiated by randomly allocating an aliquot of the embryo stock solution into each test chamber four hours after sediments were shaken and within two hours of egg fertilization. Embryos were held in suspension during initiation using a perforated plunger.

Dissolved oxygen, temperature, pH, and salinity were monitored in water quality surrogates to prevent loss or transfer of larvae by adhesion to water-quality probes. Overlying water ammonia and sulfides were measured on Day 0 and Day 3. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{2-} were monitored using a HACH DR/4000V Spectrophotometer. Target test parameters were as follows:

Dissolved Oxygen:	≥4.8 mg/L
pH:	7.8 ± 0.5 units
Temperature:	15 ± 1°C
Salinity:	28 ± 1‰

The larval developmental tests were terminated approximately 71 hours after initiation when approximately 90% of the control larvae had achieved the pluteus stage. To terminate the test, the overlying seawater was decanted into a clean 1-L jar and mixed with a perforated plunger. From this container, a 10 mL sub sample was transferred to a scintillation vial and preserved in 5% buffered formalin. The number of normal and abnormal larvae was enumerated on an inverted microscope. Normal larvae included all pluteus stage larvae. Abnormal larvae included abnormally shaped pluteus larvae and all early stage larvae. A 72-h water-only reference-toxicant test with copper sulfate was conducted concurrently with each test.

2.5 MICROTOX® TEST

The Microtox® test was performed by Nautilus Environmental LLC. A complete report on the test is included as Appendix A.

2.6 DATA ANALYSIS AND QA/QC

All water quality and endpoint data were entered into Excel spreadsheets. Water quality parameters were summarized by calculating the mean, minimum, and maximum values for each test treatment. Endpoint data were calculated for each replicate and mean values and standard deviations were determined for each test treatment.

All hand-entered data was reviewed for data entry errors, which were corrected prior to summary calculations. A minimum of 10% of all calculations and data sorting were reviewed for errors. Review counts were conducted on any apparent outliers.

For the larval test, the normalized combined mortality and abnormality endpoint was used to evaluate the test sediment. This was based on the number of normal larvae in the treatment and reference divided by the number of normal larvae in the control, as defined in Ecology (2005).

For SMS suitability determinations, comparisons were made according to SAPA and Fox et al. (1998). Data reported as percent mortality or survival was transformed using an arcsine square root transformation prior to statistical analysis. All data were tested for normality using the Wilk-

Shapiro test and equality of variance using Levene's test. Determinations of statistical significance were based on one-tailed Student's t-tests with an alpha of 0.05. A comparison of the larval endpoint, relative to the reference was made using an alpha level of 0.10. For samples failing to meet assumptions of normality, a Mann-Whitney test was conducted to determine significance. For those samples failing to meet the assumptions of normality and equality of variance, a t-test on rankits was used.

3.0 RESULTS

The results of the sediment testing, including a summary of test results and water quality observations are presented in this section. Data for each of the replicates, as well as laboratory bench sheets are provided Appendix B and statistical analyses are provided in Appendix C.

3.1 10-DAY AMPHIPOD BIOASSAY

A summary of test conditions is shown in Table 1, *A. abdita* survival is presented in Table 2, and a summary of water quality observations is presented in Table 3. Mean percent survival in the control was 91%, above the 90% acceptance criterion. This indicates that the test conditions were suitable for adequate amphipod survival.

Initial observations on the SBREF-80 samples showed high numbers of amphipods emerging from the sediment and mortalities. Initial sulfide measurements on the interstitial water for this sample were 13.1 mg/L S^{2-} and likely contributed to the amphipod response. To determine if the sulfides were responsible for the mortality, a second set of samples was set up and allowed to acclimate for three days while measuring ammonia and sulfides before initiating the test with amphipods. The acclimated sediment showed an acceptable reference sediment response and the results from this test were used for comparisons. This deviation was discussed with the AMEC project manager prior to initiating the test. A general discussion regarding acclimation of test sediments prior to testing was discussed with Department of Ecology.

The LC_{50} for the cadmium reference-toxicant test was 0.58 mg Cd/L, which is within the control chart limits (0.12 to 1.14 mg Cd/L), indicating that the test organisms used in this study were of similar sensitivity of those previously tested at NewFields. Temperature and dissolved oxygen measurements were within acceptable limits throughout the test. Salinity was recorded above the recommended limit in the control sample and the Carr Inlet reference (CR-1), likely due to higher interstitial salinities in the sediments. The salinities in these two samples were constant throughout the tests and do not appear to have impaired survival which was acceptable at 90% for the Control and 85% for the CR-1 reference sample. The measurements of pH was just above the recommended range at the end of the test for several samples, but all measurements were 8.6 or below. This was within the tolerance range for this species and would not be expected to affect the test results. Initial and final interstitial ammonia concentrations were all below the threshold concentration of 30 mg/L total ammonia (Barton 2002). Initial and final interstitial sulfide concentrations were below 5 mg/L with the exception of the initial reading of 13.1 mg/L for sample SBREF-80 as discussed previously.

Mean mortality in the reference treatments were 15% (CR-1) and 19% (SBREF-80) which met the SMS (<25% mortality) performance criteria and indicated that the reference sediment was acceptable for suitability determination. Mean percentage mortality in the test treatments ranged between 71% and 90% (Table 2).

Table 1. Test Condition Summary for *Ampelisca abdita*.

Test Conditions: PSEP *A. abdita* (SMS)		
Sample Identification	MP-1 to MP-13, Reference CR-1, SBREF-80	
Date sampled	8/26 – 8/28/2008 test samples; 9/12/2008 CR-1; 9/16/2008 SBREF-80	
Date received at NewFields Northwest	8/29/2008; 9/12/2008; 9/17/2008	
Sample storage conditions	4°C, dark	
Weeks of holding	4 weeks	
Source of control sediment	Brezina and Associates (Dillon Beach)	
Test Species	***A. abdita***	
Supplier	Brezina and Associates	
Date acquired	9/17/2008	
Acclimation/holding time	6 days	
Age class	Adult	
Test Procedures	PSEP 1995 with SMARM revisions	
Regulatory Program	SMS	
Test location	NewFields Northwest Laboratory	
Test type/duration	10-Day static	
Test dates	9/23/08 – 10/3/08 ; 10/1/08-10/10/08 acclimated SBREF-80	
Control water	North Hood Canal, sand filtered	
Test temperature	Recommended: 20 ± 1 °C	Achieved: 19.6 – 20.8 °C
Test Salinity	Recommended: 28 ± 2 ppt	Achieved: 28-29 ppt test sediments, 29-31 Control and Reference sediments
Test dissolved oxygen	Recommended: > 4.6 mg/L	Achieved: 5.6-8.9 mg/L
Test pH	Recommended: 7.8 ± 0.5	Achieved: 7.4-8.6
SMS control performance standard	Recommended: Control ≤ 10% mortality	Achieved: 9%
SMS reference performance standard	Recommended: Reference mortality < 25%	Achieved: 15% CR-1; 19% SBREF-80
SMS pass/fail SQS	Treatment – Reference < 25% mortality = **PASS**	All Pass
SMS pass/fail CSL	Treatment – Reference < 30% mortality = **PASS**	All Pass
Reference Toxicant LC50	0.59 mg/L cadmium	
Acceptable Range	0.12 to 1.14 mg/L cadmium	
Test Lighting	Continuous UV exposure	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 2 surrogates (one that is used for WQ measurements throughout the test)	
Organisms/replicate	20	
Exposure volume	175 mL sediment/ 950 mL water	
Feeding	None	
Water renewal	None	
Deviations from Test Protocol	High salinities in Control and Reference samples pH above 8.3 on last days of test in several samples	

Table 2. Test Results for *Ampelisca abdita*.

Sample ID	Mean survival (%)	Standard Deviation
Control	91	5.5
CR-1	85	9.4
SBREF-80	81	17.8
MP-1	82	8.4
MP-2	90	5.0
MP-3	76	8.2
MP-4	73	2.7
MP-5	71	2.2
MP-6	88	9.1
MP-7	74	14.7
MP-8	88	2.7
MP-9	75	22.9
MP-10	84	9.6
MP-11	83	17.2
MP-12	77	13.5
MP-13	72	16.8

Table 3. Water Quality Summary for *Ampelisca abdita*.

Treatment	Dissolved Oxygen (mg/L)			Temperature (°C)			pH (units)			Salinity (ppt)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	7.4	6.8	7.7	20.4	20.0	20.7	8.0	7.8	8.3	30.3	30.0	31.0
CR-1	7.4	6.8	7.7	20.3	20.0	20.6	8.0	7.7	8.3	30.1	29.0	31.0
SBREF-80	7.6	6.9	8.9	20.0	19.4	20.3	8.0	7.3	8.2	28.5	27.0	30.0
MP-1	7.3	6.6	7.7	20.3	20.0	20.7	7.9	7.7	8.2	26.9	26.0	28.0
MP-2	7.3	6.8	7.7	20.4	20.0	20.8	8.2	7.7	8.6	28.1	27.0	29.0
MP-3	7.0	6.0	7.6	20.0	19.6	20.5	8.1	7.5	8.5	27.9	27.0	29.0
MP-4	7.4	6.9	7.7	20.3	19.8	20.7	8.0	7.7	8.3	27.3	26.0	28.0
MP-5	7.4	6.8	7.7	20.3	20.0	20.7	8.1	7.7	8.3	28.1	27.0	29.0
MP-6	7.4	6.7	7.6	20.4	20.1	20.7	7.8	7.4	8.3	28.0	27.0	29.0
MP-7	7.4	7.0	7.6	20.4	20.0	20.7	8.2	7.9	8.6	28.3	28.0	29.0
MP-8	7.0	5.6	7.6	20.2	19.9	20.6	7.8	7.5	8.1	28.2	28.0	29.0
MP-9	7.3	6.8	7.6	20.1	19.8	20.6	7.9	7.6	8.2	28.1	27.0	29.0
MP-10	7.2	6.7	7.6	20.3	19.9	20.7	8.0	7.6	8.3	28.2	28.0	29.0
MP-11	7.5	7.0	7.8	20.3	19.8	20.6	8.1	7.7	8.4	28.5	28.0	30.0
MP-12	7.5	6.9	7.7	20.3	19.9	20.7	8.1	7.8	8.4	28.2	27.0	29.0
MP-13	7.5	7.0	7.8	20.4	20.0	20.7	8.3	7.8	8.6	28.4	28.0	29.0

3.2 Larval Development Bioassay

Test conditions for the larval development bioassay are shown in Table 4, a summary of the test results from the *D. excentricus* test is presented in Table 5 and a summary of water quality observations is shown in Table 6. The larval test was validated by 11% mean combined mortality in the control treatment, within the acceptability criteria of <30%. Water quality parameters pH and salinity remained within the target limits throughout the 70-hour test. Dissolved oxygen below the recommended range was observed in one test chamber on Day 1 of the test, aeration was applied to the sample to increase the dissolved oxygen. Temperature observations were slightly above the recommended range on the last day of the test in several chambers. The deviations did not exceed 0.5 °C. Neither of these deviations were large enough to invalidate the test and did not appear to affect larval development.

Ammonia values detected in the test chambers were below the NOEC values for *D. excentricus*. The EC_{50} for the copper reference-toxicant test for proportion normal was 12.5 µg Cu/L, within the control chart limits (5.4 to 16.7 µg Cu/L). The results of the reference-toxicant test indicate that the test organisms used in this study were similar in sensitivity to those previously tested at NewFields. Mean control-normalized normal survival in the reference sediments were 87.3% (CR-1) and 93.9% (SB Ref-80); mean normal survival in the test treatments ranged from 87.3% to 99.4%.

Table 4. Test Condition Summary for *Dendraster excentricus*.

Test Conditions: PSEP *D. excentricus* (SMS)		
Sample Identification	MP-1 to MP-13, Reference CR-1, SBREF-80	
Date sampled	8/26 – 8/28/2008 test samples; 9/12/2008 CR-1; 9/16/2008 SBREF-80	
Date received at NewFields Northwest	8/29/2008; 9/12/2008; 9/17/2008	
Sample storage conditions	4°C, dark	
Weeks of holding	4 weeks	
Test Species	***D. excentricus***	
Supplier	Field collected (north Hood Canal)	
Date acquired	9/23/2008	
Acclimation/holding time	1 day	
Age class	<2-h old embryos	
Test Procedures	PSEP 1995 with SMARM revisions	
Regulatory Program	SMS	
Test location	NewFields Northwest Laboratory	
Test type/duration	48-96 Hour static test	
Test dates	9/24/08-9/27/08 – 70 hours	
Control water	Sand-filtered North Hood Canal sea water	
Test temperature	Recommended: 15 ± 1 °C	Achieved: 14.3-16.5 °C
Test Salinity	Recommended: 28 ± 2 ppt	Achieved: 28-30 ppt
Test dissolved oxygen	Recommended: > 4.8 mg/L	Achieved: 4.2-8.4 mg/L
Test pH	Recommended: 7.8 ± 0.5	Achieved: 7.3-7.9
Stocking Density	Recommended: 20 – 30 embryos/mL	Achieved: 24 embryos/mL
SMS control performance standard	Recommended: Control normal survival ≥ 70%	Achieved: 89%
SMS reference performance standard	Recommended: Reference survival/Control survival ≥ 65%	Achieved: CR-1 87% SB Ref-80 94%
SMS pass/fail SQS	(Treatment normal/Control Normal)/ (Reference normal/ Control Normal) > 0.85 = **PASS**	All pass
SMS pass/fail CSL	(Treatment normal/Control Normal)/ (Reference normal/ Control Normal) > 0.70 = **PASS**	All pass
Reference Toxicant LC50	12.5 mg/L copper	
Acceptable Range	5.4 to 16.7 mg/L copper	
Test Lighting	Continuous UV Exposure	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 1 surrogate (used for WQ measurements throughout the test)	
Exposure volume	18 g sediment/ 900 mL water	
Feeding	none	
Water renewal	none	
Deviations from Test Protocol	Low DO in one sample, aeration applied. Temperature above recommended range on last day of test in several samples.	

Table 5. Test Results for *Dendraster excentricus*.

Treatment	Mean Normal Survival (%)[1]	Standard Deviation
Control	89.0	6.4
CR-1	87.3	13.2
SBREF-80	93.9	7.0
MP-1	97.9	3.1
MP-2	96.4	4.7
MP-3	93.0	6.9
MP-4	91.5	7.3
MP-5	87.3	10.6
MP-6	99.4	1.2
MP-7	97.9	2.2
MP-8	94.2	5.6
MP-9	96.3	6.5
MP-10	95.3	4.4
MP-11	98.1	4.3
MP-12	95.7	5.8
MP-13	95.5	4.4

[1] Reference and treatment normal survivals are normalized to Control normal survival.

Table 6. Water Quality Summary for *Dendraster excentricus*.

Treatment	Dissolved Oxygen (mg/L)			Temperature (°C)			pH (units)			Salinity (ppt)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	7.6	7.2	7.9	15.7	15.3	16.0	7.7	7.4	7.8	29.0	29.0	29.0
CR-1	6.9	6.0	7.7	15.8	15.1	16.1	7.7	7.6	7.8	29.0	29.0	29.0
SBREF-80	6.8	4.2	8.6	15.4	14.4	16.2	7.8	7.7	7.8	28.8	28.0	29.0
MP-1	5.8	5.2	6.6	15.5	14.7	16.0	7.5	7.3	7.8	28.8	28.0	29.0
MP-2	6.1	5.5	6.6	15.6	15.1	15.9	7.7	7.5	7.8	28.8	28.0	29.0
MP-3	8.2	8.0	8.4	14.9	14.3	15.4	7.8	7.7	7.9	28.8	28.0	29.0
MP-4	8.0	7.5	8.2	14.9	14.3	15.6	7.6	7.4	7.7	28.8	28.0	29.0
MP-5	6.1	5.2	7.0	15.6	15.0	16.5	7.6	7.4	7.7	29.0	29.0	29.0
MP-6	6.3	5.6	7.2	16.0	15.2	16.4	7.6	7.4	7.8	29.3	29.0	30.0
MP-7	5.9	5.4	6.6	15.5	15.0	15.8	7.6	7.5	7.8	29.0	29.0	29.0
MP-8	6.2	5.5	6.8	15.5	15.2	16.2	7.5	7.3	7.7	29.0	29.0	29.0
MP-9	6.1	5.5	7.0	15.7	14.9	16.2	7.6	7.4	7.8	29.3	29.0	30.0
MP-10	5.8	5.2	6.9	15.6	14.8	16.3	7.6	7.4	7.8	29.3	29.0	30.0
MP-11	6.5	5.7	7.3	15.8	15.5	16.2	7.7	7.4	7.8	29.0	29.0	29.0
MP-12	6.8	6.5	7.0	15.6	15.0	16.1	7.7	7.6	7.8	28.8	28.0	29.0
MP-13	6.0	5.6	6.5	15.6	15.1	16.0	7.7	7.5	7.8	29.0	29.0	29.0

4.0 DISCUSSION

Sediments were evaluated based on Sediment Management Standards (SMS) criteria. The biological criteria are based on both statistical significance (a statistical comparison) and the degree of biological response (a numerical comparison). The SMS criteria are derived from the Washington Department of Ecology Sampling and Analysis Plan Appendix (WDOE 2008). Comparisons were made for each treatment against each of the reference sample. Two numerical comparisons were made under SMS, the Sediment Quality Standards (SQS) and the Cleanup Standards Limit (CSL).

4.1 AMPHIPOD TEST SUITABILITY DETERMINATION

Under the SMS program, a test treatment will fail SQS if mean mortality in the test is >25% more than the mean mortality in the appropriate reference sediment and the difference is statistically significant ($p \leq 0.05$). Treatments fail the CSL if mean mortality in the test treatment >30%, relative to the reference sediment and the difference is statistically significant.

Test treatment MP-5 showed significantly higher mortality than the CR-1 reference sediment, but the mortality relative to the reference did not exceed the numerical criteria, therefore all test treatments meet the SQS and CSL for *A. abdita* (Table 7).

Table 7. SMS Comparison for *Ampelisca abdita*.

Treatment	Mean Mortality (%)	Estimated Percent Fines*	Reference Comparison**	Statistically More than Reference?	M_T-M_R	Fails SQS?	Fails CSL?
Control	9						
CR-1	15	60%					
SBREF-80	19	80%					
MP-1	18	83%	SBREF-80	No	-1	No	No
MP-2	10	81%	SBREF-80	No	-9	No	No
MP-3	24	67%	CR-1	No	9	No	No
MP-4	27	77%	SBREF-80	No	8	No	No
MP-5	29	66%	CR-1	Yes	14	No	No
MP-6	12	61%	CR-1	No	-3	No	No
MP-7	26	70%	SBREF-80	No	7	No	No
MP-8	12	60%	CR-1	No	-3	No	No
MP-9	25	78%	SBREF-80	No	6	No	No
MP-10	16	74%	SBREF-80	No	-3	No	No
MP-11	17	84%	SBREF-80	No	-2	No	No
MP-12	23	80%	SBREF-80	No	4	No	No
MP-13	28	76%	SBREF-80	No	9	No	No

SQS: Statistical Significance and M_T-M_R >25%
CSL: Statistical Significance and MT-MR >30%
* Percent fines for reference samples determined in the field. Percent fines for test treatments supplied by client (AMEC)
** Reference sediment pairings with test sediment based on similarity of percent fines and were approved by Pete Adolphson of Ecology.

4.2 LARVAL TEST SUITABILITY DETERMINATION

Larval test treatments fail SQS criteria if the percentage of normal larvae in the test treatment is significantly lower than that of the reference and if the normal larval development in the test treatment is less than 85% of the normal development in the reference. Treatments fail CSL criteria if the normal development is less than 70% of the response observed in the reference.

All test treatments met the SQS and CSL criteria (Table 8).

Table 8. SMS Comparison for *Dendraster excentricus*.

Treatment	Mean Normal Survival (%)	Estimated Percent Fines*	Reference Comparison**	Statistically Less than Associated Reference?	Normal Survival Comparison to Reference $(N_T/N_C)/(N_R/N_C)$	Fails SQS?	Fails CSL?
Control	89.0						
CR-1	87.3	60%					
SBREF80	93.9	80%					
MP-1	97.9	83%	SBREF-80	No	1.04	No	No
MP-2	96.4	81%	SBREF-80	No	1.03	No	No
MP-3	93.0	67%	CR-1	No	1.06	No	No
MP-4	91.5	77%	SBREF-80	No	0.97	No	No
MP-5	87.3	66%	CR-1	No	1.00	No	No
MP-6	99.4	61%	CR-1	No	1.14	No	No
MP-7	97.9	70%	SBREF-80	No	1.04	No	No
MP-8	94.2	60%	CR-1	No	1.08	No	No
MP-9	96.3	78%	SBREF-80	No	1.03	No	No
MP-10	95.3	74%	SBREF-80	No	1.01	No	No
MP-11	98.1	84%	SBREF-80	No	1.04	No	No
MP-12	95.7	80%	SBREF-80	No	1.02	No	No
MP-13	95.5	76%	SBREF-80	No	1.02	No	No

SQS: Statistical Significance and $M_T/M_R < 0.85$
CSL: Statistical Significance and $M_T/M_R < 0.70$
* Percent fines for reference samples supplied by NewFields. Percent fines for test treatments supplied by client (AMEC)
** Reference sediment pairings with test sediment based on similarity of percent fines were approved by Pete Adolphson of Ecology

4.3 Microtox Test Suitability Determination

The SMS program criteria state that a test sediment fails the SQS criteria when the mean light output of the highest concentration of the test sediment is less than 80% of the mean light output of the reference sediment and the two means are statistically different ($p \leq 0.05$). No criteria exist for the Microtox test for CSL.

The SBREF-80 reference sample performed poorly in the Microtox test; therefore in the test batches using this reference sample, the test treatments were compared to the Control sample (deviation approved by Pete Adolphson of Ecology via email to Nautilus). Treatments MP-4, MP-9, MP-10, MP-11, and MP-13 fail SQS criteria compared to the Control; treatments MP-5 and MP-8 fail SQS compared to reference CR-1 (Table 9).

Table 9. SMS Comparison for Microtox®.

Treatment	5-minute reading		15 minute reading		Fails SQS?
	Mean % output	Statistically Less than Reference and > 20% Difference?	Mean % output	Statistically Less than Reference and > 20% Difference?	
Test 1[1]					
Control	96 ± 2	---	83 ± 2	---	
SBREF-80	76 ± 3	---	67 ± 2	---	
MP-1	76 ± 5	---	70 ± 3	---	
MP-2	102 ± 3	---	98 ± 3	---	
MP-4	67 ± 3	Yes	62 ± 2	Yes	Yes
MP-7	93 ± 3	---	70 ± 5	---	
Test 2[1]					
Control	98 ± 2	---	93 ± 4	---	
SBREF-80	66 ± 1	---	68 ± 4	---	
MP-9	71 ± 4	Yes	71 ± 8	Yes	Yes
MP-10	74 ± 3	Yes	72 ± 2	Yes	Yes
MP-11	66 ± 3	Yes	63 ± 4	Yes	Yes
MP-12	112 ± 3	---	121 ± 5	---	
Test 3[1]					
Control	96 ± 3	---	99 ± 5	---	
SBREF-80	72 ± 5	---	76 ± 4	---	
MP-13	43 ± 2	Yes	46 ± 2	Yes	Yes
Test 4					
Control	92 ± 2	---	81 ± 5	---	
CR-1	102 ± 2	---	91 ± 3	---	
MP-3	104 ± 2	---	94 ± 3	---	
MP-5	73 ± 6	Yes	72 ± 4	Yes	Yes
MP-6	97 ± 1	---	90 ± 5	---	
MP-8	74 ± 11	Yes	67 ± 7	Yes	Yes

[1] Reference sample was significantly less than Control; test treatments compared to the Control.
SQS: > 20% difference and statistically significant difference (p<0.05) relative to the reference.
CSL: No failure criteria for Microtox under SMS rule.

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APPENDIX A

MICROTOX REPORT

Nautilus Environmental

Toxicological Evaluation of Sediment
March Point Landfill

Microtox

Report date: November 7, 2008

Submitted to:

NEWFIELDS NORTHWEST
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This report has been prepared based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party.

1.0 INTRODUCTION

Sediment samples were collected and evaluated for toxicity as part of a project being conducted by NewFields Northwest. Sediment samples were tested for toxicity using Microtox tests.

2.0 METHODS

2.1 Samples

Thirteen sediment and two reference site subsamples were collected by NewFields personnel on August 26, 27, 28, 2008 and September 17, 2008 and were delivered on September 3 and September 18 to the Nautilus Environmental laboratory in Tacoma, WA. The condition of the sample containers were inspected upon receipt and the identities compared with the information provided on the chain-of-custody forms. The samples were stored at 4±2°C in the dark prior to test initiation.

2.2 Test Procedures

The luminescent marine bacterium *Vibrio fischeri* was used as the test organism for the Microtox test. The bacteria were exposed to porewater extracted from sediment samples and light readings were measured after 5 minutes and 15 minutes of exposure. Test equipment included the Microtox Model 500 Analyzer, which measures light output and is equipped with a 15°C chamber to maintain test temperature in the samples and a 4°C chamber to keep the rehydrated bacteria chilled.

Vials of freeze-dried bacteria (Microtox® Acute Reagent Lot # 8E1080, Expiration date 8/2010) were obtained from Strategic Diagnostics, Inc. and stored at -20°C until use. On the day of the test, a vial was rehydrated with 1.0 ml of Microtox Reconstitution Solution, mixed thoroughly, and allowed to equilibrate for 30 minutes at 4°C. The bacteria were used within 2 hours of rehydration.

The tests were conducted in accordance with WDOE (2008) test protocol. These methods are summarized in Table 1. Approximately 50 ml of porewater was extracted from each sample by centrifuging for 30 minutes at 4500 G. The DO in each sample was between 50 and 100 percent saturation and, as a result, the samples did not require aeration. The pH was adjusted to 7.8 to 8.2 using NaOH or HCl, if necessary. The control was deionized water adjusted to 20 ppt with artificial seasalt. Each porewater was tested within 3 hours of extraction.

Tests were conducted using five replicates. Disposable glass cuvettes were placed in the Microtox test wells and 1 ml of salinity adjusted porewater was added. The rehydrated bacteria (reagent) were thoroughly mixed and 10 µl was added to each test cuvette. After an initial incubation period of 5 minutes, the control cuvette was placed in the read chamber of the Microtox Analyzer to set the instrument. Initial light readings (I_0) were then taken by placing each cuvette in the read chamber of the Microtox Analyzer and measurements were recorded on a data sheet. Light output was measured in each cuvette after an additional 5 minutes (I_5) and 15 minutes (I_{15}) of exposure.

Test acceptability criterion was final mean control light output greater than or equal to 80 percent of initial control mean output. The reference sample acceptability criterion was a final mean output greater than or equal to 80 percent of control final mean output. The data were evaluated statistically by conducting one-tailed t-tests (or Man-Whitney U tests for non-normal distributed data) on the change in output over time for porewater extracts compared to the reference. Where the reference did not meet acceptability criteria, comparisons were made against the control.

A reference toxicant test using phenol was conducted in conjunction with the soil tests to ensure that the sensitivity of the test was within the acceptable range of historical values determined in this laboratory.

Table 1. Summary of methods for the Microtox test.

Test date	September 22, 25, October 2, 2008
Test organism source	Strategic Diagnostics
Batch number and expiration date	Lot#8E1080, Expiry 8/2010
Control	Saltwater (20 ppt) prepared with Crystal Sea artificial seasalt
Sample preparation	Centrifugation at 4500 G for 30 minutes; salinity adjustment to 20 ppt using Crystal Sea salt; pH adjustment to 7.8-8.2 ppt
Test chamber	Glass cuvette
Test volume	1 mL
Volume of inoculum/replicate	10 μL
Number of replicates/sample	5
Test temperature	15 ± 1°C
Aeration	None
Reference toxicant	Phenol

3.0 RESULTS

The results of toxicity tests conducted using Microtox are provided in Tables 2 and 3.

Table 2. Results of Microtox tests showing change in light output of samples as a percentage of change in light output of control after 5 and 15 minute of exposure.

Sample	Change in light output as a % of Control (5 minutes)	Change in light output as a % of Control (15 minutes)
Test #1		
SBREF80	79	81
MP-1	80	85
MP-2	107	118
MP-4	70	74
MP-7	98	84
Test #2		
SBREF80	67	73
MP-9	72	77
MP-10	75	78
MP-11	67	68
MP-12	113	131
Test #3		
SBREF80	74	77
MP-13	45	47
Test #4		
CR-1	110	114
MP-3	113	117
MP-5	79	90
MP-6	105	111
MP-8	80	83

Table 3. Statistical analyses of Microtox results. Shaded data indicates > 20% difference and statistically significant difference ($p<0.05$) relative to the control or reference

Sample	5-minute reading		15 minute reading	
	Mean % change in light output	Statistical Comparison To	Mean % change in light output	Statistical Comparison To
Test 1				
Control	96 ± 2	---	83 ± 2	---
SBRef80	76 ± 3	---	67 ± 2	---
MP-1	76 ± 5	Control	70 ± 3	Reference
MP-2	102 ± 3	Control	98 ± 3	Reference
MP-4	67 ± 3	Control	62 ± 2	Reference
MP-7	93 ± 3	Control	70 ± 5	Reference
Test 2				
Control	98 ± 2	---	93 ± 4	---
SBRef80	66 ± 1	---	68 ± 4	---
MP-9	71 ± 4	Control	71 ± 8	Control
MP-10	74 ± 3	Control	72 ± 2	Control
MP-11	66 ± 3	Control	63 ± 4	Control
MP-12	112 ± 4	Control	121 ± 5	Control
Test 3				
Control	96 ± 3	---	99 ± 5	---
SBREF80	72 ± 5	---	76 ± 4	---
MP-13	43 ± 2	Control	46 ± 2	Control
Test 4				
Control	92 ± 2	---	81 ± 5	---
CR-1	102 ± 2	---	91 ± 3	---
MP-3	104 ± 2	Reference	94 ± 3	Reference
MP-5	73 ± 6	Reference	72 ± 4	Reference
MP-6	97 ± 1	Reference	90 ± 5	Reference
MP-8	74 ± 11	Reference	67 ± 7	Reference

3.1 QA/QC

The Microtox tests met control acceptance criteria and there were no deviations from protocol. There was no correlation between turbidity and initial light output ($R^2 \geq 0.01$) therefore it is unlikely there was interference with the reading.

Results of reference toxicant tests conducted in conjunction with this testing program are provided in Table 4. The results of these test fell within the range of mean ± two standard deviations of historical results for *Vibrio fischeri*, indicating that the sensitivity of the test organisms was appropriate.

Table 4. Reference toxicant test results.

Exposure Duration	Test date	Toxicant	EC50	Acceptable Range	CV (%)
5 Minutes	September 22, 2008	Phenol	35.8 mg/L	18.8-49.8	22.6
15 Minutes			49.5 mg/L	27.8-50.9	14.6
5 Minutes	September 25, 2008	Phenol	28.3 mg/L	18.9-49.8	22.5
15 Minutes			33.7 mg/L	27.8-50.9	14.7
5 Minutes	October 2, 2008	Phenol	33.6 mg/L	19.2-49.9	22.2
15 Minutes			42.1 mg/L	30.3-50.0	12.2

4.0 DISCUSSION

Samples MP-4, MP-5, MP-8, MP-9, MP-10, MP-11, and MP-13 exceeded sediment quality standards for microtox analysis per WDOE 2008 guidelines.

5.0 REFERENCES

American Society of Testing and Materials (ASTM). 2000. Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates. ASTM Designation E 1706-00.

U.S. Environmental Protection Agency (USEPA). 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. EPA/600/R-99/064.

Washington Department of Ecology (WDOE). 2008. Sediment Sampling and Analysis Plan Appendix: Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards Publication No. 03-09-043. Revised February 2008.

APPENDIX A – Results Summaries

Appendix Table A. Microtox 100 Percent Sediment Porewater Test
Sites SBREF80,MP-1,MP-2,MP-4,MP-7
NewFields Northwest
Test Date: October 2, 2008

Site	Light Reading									Quality Control Steps	
		Replicate								Change in control light readings compared to initial control	Evaluation of initial light output in site sediments
	Reading	1	2	3	4	5	Mean	St.Dev.	$T_{(mean)}/C_{(mean)}$	$F_{c(mean)}/I_{c(mean)}$	$I_{(0)T(mean)}/I_{(0)C(mean)}$
CON	$I_{(0)}$	95	97	99	105	106	100				
	$I_{(5)}$	92	91	92	104	101	96			0.96	
	$I_{(15)}$	78	79	82	87	91	83			0.83	
	$C_{(5)}$	0.97	0.94	0.93	0.99	0.95	0.96	0.02			
	$C_{(15)}$	0.82	0.81	0.83	0.83	0.86	0.83	0.02			
SBREF80	$I_{(0)}$	85	76	78	76	76	78				0.78
	$I_{(5)}$	79	71	78	75	78	76				
	$I_{(15)}$	68	65	68	68	69	68				
	$T_{(5)}$	0.79	0.71	0.78	0.75	0.78	0.76	0.03	0.79		
	$T_{(15)}$	0.68	0.65	0.68	0.68	0.69	0.67	0.02	0.81		
MP-1	$I_{(0)}$	77	80	77	77	76	77				0.77
	$I_{(5)}$	70	81	80	74	78	77				
	$I_{(15)}$	65	70	72	72	74	71				
	$T_{(5)}$	0.70	0.81	0.80	0.74	0.78	0.76	0.05	0.80		
	$T_{(15)}$	0.65	0.70	0.72	0.72	0.74	0.70	0.03	0.85		
MP-2	$I_{(0)}$	80	85	78	77	83	81				0.80
	$I_{(5)}$	81	92	78	78	84	83				
	$I_{(15)}$	76	88	76	76	80	79				
	$T_{(5)}$	1.01	1.08	1.00	1.01	1.01	1.02	0.03	1.07		
	$T_{(15)}$	0.95	1.04	0.97	0.99	0.96	0.98	0.03	1.18		
MP-4	$I_{(0)}$	73	67	66	70	63	68				0.68
	$I_{(5)}$	70	66	66	71	65	68				
	$I_{(15)}$	65	61	60	62	61	62				
	$T_{(5)}$	0.70	0.66	0.66	0.71	0.65	0.67	0.03	0.70		
	$T_{(15)}$	0.65	0.61	0.60	0.62	0.61	0.62	0.02	0.74		
MP-7	$I_{(0)}$	83	87	86	86	88	86				0.86
	$I_{(5)}$	74	82	82	83	81	80				
	$I_{(15)}$	52	64	62	64	58	60				
	$T_{(5)}$	0.89	0.94	0.95	0.97	0.92	0.93	0.03	0.98		
	$T_{(15)}$	0.63	0.74	0.72	0.74	0.66	0.70	0.05	0.84		

$I_{(0)}$ is the light reading after the initial five minute incubation period

$I_{(5)}$ is the light reading five minutes after $I_{(0)}$

$I_{(15)}$ is the light reading fifteen minutes after $I_{(0)}$

$C_{(t)}$, $R_{(t)}$, and $T_{(t)}$ are the changes in light readings from the intial reading in each sample container for the control, reference sediment

Quality Control Steps:

1. Is control final mean output greater than or equal to 80% control initial mean output?

$I_{(5)}$:$F_{c(mean)}/I_{c(mean)}$: **96%** **YES**

$I_{(15)}$:$F_{c(mean)}/I_{c(mean)}$: **83%** **YES**

YES: Control results are acceptable and can be used for statistical analyses.

NO: Control results are unacceptable (retest required).

2. Are test initial mean values greater than or equal to 80% of control initial mean values?

S1 $I_{T(mean)}/I_{C(mean)}$: **78%** **NO**

S2 $I_{T(mean)}/I_{C(mean)}$: **77%** **NO**

S3 $I_{T(mean)}/I_{C(mean)}$: **80%** **YES**

S4 $I_{T(mean)}/I_{C(mean)}$: **68%** **NO**

S5 $I_{T(mean)}/I_{C(mean)}$: **86%** **YES**

YES: Use initial site values to calculate change in final light readings

NO: Use control initial mean value to calculate change in final light readings for each site.

Appendix Table A. Microtox 100 Percent Sediment Porewater Test
Sites SBREF80, MP-9, MP-10, MP-11, MP-12
NewFields Northwest
Test Date: September 22, 2008

Site	Reading	Light Reading – Replicate 1	2	3	4	5	Mean	St.Dev.	$T_{(mean)}/C_{(mean)}$	Quality Control Steps: Change in control light readings compared to initial control $F_{c(mean)}/I_{c(mean)}$	Quality Control Steps: Evaluation of initial light output in site sediments $I_{(0)T(mean)}/I_{(0)C(mean)}$
CON	$I_{(0)}$	96	88	91	91	91	91				
	$I_{(5)}$	92	86	91	89	92	90			0.98	
	$I_{(15)}$	83	83	87	84	87	85			0.93	
	$C_{(5)}$	0.96	0.98	1.00	0.98	1.01	0.98	0.02			
	$C_{(15)}$	0.86	0.94	0.96	0.92	0.96	0.93	0.04			
SBREF80	$I_{(0)}$	62	59	61	61	60	61				0.66
	$I_{(5)}$	61	59	61	62	60	61				
	$I_{(15)}$	61	57	67	64	60	62				
	$T_{(5)}$	0.67	0.65	0.67	0.68	0.66	0.66	0.01	0.67		
	$T_{(15)}$	0.67	0.62	0.73	0.70	0.66	0.68	0.04	0.73		
MP-9	$I_{(0)}$	70	62	65	59	63	64				0.70
	$I_{(5)}$	69	64	68	59	66	65				
	$I_{(15)}$	77	62	63	57	67	65				
	$T_{(5)}$	0.75	0.70	0.74	0.65	0.72	0.71	0.04	0.72		
	$T_{(15)}$	0.84	0.68	0.69	0.62	0.73	0.71	0.08	0.77		
MP-10	$I_{(0)}$	68	70	67	66	62	67				0.73
	$I_{(5)}$	70	71	65	66	64	67				
	$I_{(15)}$	67	67	67	65	63	66				
	$T_{(5)}$	0.77	0.78	0.71	0.72	0.70	0.74	0.03	0.75		
	$T_{(15)}$	0.73	0.73	0.73	0.71	0.69	0.72	0.02	0.78		
MP-11	$I_{(0)}$	56	58	63	54	61	58				0.64
	$I_{(5)}$	61	61	62	55	61	60				
	$I_{(15)}$	58	61	60	52	59	58				
	$T_{(5)}$	0.67	0.67	0.68	0.60	0.67	0.66	0.03	0.67		
	$T_{(15)}$	0.63	0.67	0.66	0.57	0.65	0.63	0.04	0.68		
MP-12	$I_{(0)}$	72	74	72	79	80	75				0.82
	$I_{(5)}$	81	79	78	91	92	84				
	$I_{(15)}$	83	89	85	101	100	92				
	$T_{(5)}$	1.13	1.07	1.08	1.15	1.15	1.12	0.04	1.13		
	$T_{(15)}$	1.15	1.20	1.18	1.28	1.25	1.21	0.05	1.31		

$I_{(0)}$ is the light reading after the initial five minute incubation period

$I_{(5)}$ is the light reading five minutes after $I_{(0)}$

$I_{(15)}$ is the light reading fifteen minutes after $I_{(0)}$

$C_{(t)}$, $R_{(t)}$, and $T_{(t)}$ are the changes in light readings from the intial reading in each sample container for the control, reference sediment

Quality Control Steps:

1. Is control final mean output greater than or equal to 80% control initial mean output?

$I_{(5)}$:$F_{c(mean)}/I_{c(mean)}$:	**98%**	**YES**
$I_{(15)}$:$F_{c(mean)}/I_{c(mean)}$:	**93%**	**YES**

YES: Control results are acceptable and can be used for statistical analyses.

NO: Control results are unacceptable (retest required).

2. Are test initial mean values greater than or equal to 80% of control initial mean values?

S1	$I_{T(mean)}/I_{C(mean)}$:	**66%**	**NO**
S2	$I_{T(mean)}/I_{C(mean)}$:	**70%**	**NO**
S3	$I_{T(mean)}/I_{C(mean)}$:	**73%**	**NO**
S4	$I_{T(mean)}/I_{C(mean)}$:	**64%**	**NO**
S5	$I_{T(mean)}/I_{C(mean)}$:	**82%**	**YES**

YES: Use initial site values to calculate change in final light readings

NO: Use control initial mean value to calculate change in final light readings for each site.

Appendix Table A. Microtox 100 Percent Sediment Porewater Test
Sites SBREF80, MP-13
NewFields Northwest
Test Date: September 22, 2008

Site	Reading	Light Reading – Replicate 1	2	3	4	5	Mean	St.Dev.	$T_{(mean)}/C_{(mean)}$	Quality Control Steps: Change in control light readings compared to initial control $F_{c(mean)}/I_{c(mean)}$	Evaluation of initial light output in site sediments $I_{(0)T(mean)}/I_{(0)C(mean)}$
CON	$I_{(0)}$	92	95	95	94	95	94				
	$I_{(5)}$	92	92	94	86	90	91			0.96	
	$I_{(15)}$	91	88	100	96	89	93			0.99	
	$C_{(5)}$	1.00	0.97	0.99	0.91	0.95	0.96	0.03			
	$C_{(15)}$	0.99	0.93	1.05	1.02	0.94	0.99	0.05			
SBREF80	$I_{(0)}$	74	69	64	63	61	66				0.70
	$I_{(5)}$	74	72	64	64	64	68				
	$I_{(15)}$	76	76	67	71	69	72				
	$T_{(5)}$	0.79	0.76	0.68	0.68	0.68	0.72	0.05	0.74		
	$T_{(15)}$	0.81	0.81	0.71	0.75	0.73	0.76	0.04	0.77		
MP-13	$I_{(0)}$	38	41	39	41	40	40				0.42
	$I_{(5)}$	38	42	40	42	41	41				
	$I_{(15)}$	42	44	43	46	44	44				
	$T_{(5)}$	0.40	0.45	0.42	0.45	0.44	0.43	0.02	0.45		
	$T_{(15)}$	0.45	0.47	0.46	0.49	0.47	0.46	0.02	0.47		

$I_{(0)}$ is the light reading after the initial five minute incubation period

$I_{(5)}$ is the light reading five minutes after $I_{(0)}$

$I_{(15)}$ is the light reading fifteen minutes after $I_{(0)}$

$C_{(t)}$, $R_{(t)}$, and $T_{(t)}$ are the changes in light readings from the intial reading in each sample container for the control, reference sediment

Quality Control Steps:

1. Is control final mean output greater than or equal to 80% control initial mean output?

$I_{(5)}$:$F_{c(mean)}/I_{c(mean)}$:	**96%**	**YES**
$I_{(15)}$:$F_{c(mean)}/I_{c(mean)}$:	**99%**	**YES**

YES: Control results are acceptable and can be used for statistical analyses.
NO: Control results are unacceptable (retest required).

2. Are test initial mean values greater than or equal to 80% of control initial mean values?

S1	$I_{T(mean)}/I_{C(mean)}$:	**70%**	**NO**
S2	$I_{T(mean)}/I_{C(mean)}$:	**42%**	**NO**

YES: Use initial site values to calculate change in final light readings
NO: Use control initial mean value to calculate change in final light readings for each site.

Appendix Table A. Microtox 100 Percent Sediment Porewater Test
Sites CR-1, MP-3, MP-5, MP-6, MP-8
NewFields Northwest
Test Date: September 25, 2008

Site	Reading	Light Reading: Replicate 1	2	3	4	5	Mean	St.Dev.	$T_{(mean)}/C_{(mean)}$	Quality Control Steps: Change in control light readings compared to initial control $F_{c(mean)}/I_{c(mean)}$	Evaluation of initial light output in site sediments $I_{(0)T(mean)}/I_{(0)C(mean)}$
CON	$I_{(0)}$	90	95	93	92	99	94				
	$I_{(5)}$	84	86	85	87	91	87			0.92	
	$I_{(15)}$	77	78	77	73	72	75			0.80	
	$C_{(5)}$	0.93	0.91	0.91	0.95	0.92	0.92	0.02			
	$C_{(15)}$	0.86	0.82	0.83	0.79	0.73	0.81	0.05			
CR-1	$I_{(0)}$	87	77	78	74	73	78				0.83
	$I_{(5)}$	88	79	80	73	76	79				
	$I_{(15)}$	82	72	68	66	68	71				
	$T_{(5)}$	1.01	1.03	1.03	0.99	1.04	1.02	0.02	1.10		
	$T_{(15)}$	0.94	0.94	0.87	0.89	0.93	0.91	0.03	1.14		
MP-3	$I_{(0)}$	76	79	74	73	75	75				0.80
	$I_{(5)}$	81	81	76	76	79	79				
	$I_{(15)}$	74	75	70	66	71	71				
	$T_{(5)}$	1.07	1.03	1.03	1.04	1.05	1.04	0.02	1.13		
	$T_{(15)}$	0.97	0.95	0.95	0.90	0.95	0.94	0.03	1.17		
MP-5	$I_{(0)}$	78	73	74	67	69	72				0.77
	$I_{(5)}$	74	67	74	62	66	69				
	$I_{(15)}$	73	66	72	64	65	68				
	$T_{(5)}$	0.79	0.71	0.79	0.66	0.70	0.73	0.06	0.79		
	$T_{(15)}$	0.78	0.70	0.77	0.68	0.69	0.72	0.04	0.90		
MP-6	$I_{(0)}$	81	76	74	75	81	77				0.83
	$I_{(5)}$	80	73	71	74	78	75				
	$I_{(15)}$	72	69	65	73	68	69				
	$T_{(5)}$	0.99	0.96	0.96	0.99	0.96	0.97	0.01	1.05		
	$T_{(15)}$	0.89	0.91	0.88	0.97	0.84	0.90	0.05	1.11		
MP-8	$I_{(0)}$	87	81	67	64	71	74				0.79
	$I_{(5)}$	85	74	62	60	64	69				
	$I_{(15)}$	72	66	56	58	62	63				
	$T_{(5)}$	0.91	0.79	0.66	0.64	0.68	0.74	0.11	0.80		
	$T_{(15)}$	0.77	0.70	0.60	0.62	0.66	0.67	0.07	0.83		

$I_{(0)}$ is the light reading after the initial five minute incubation period

$I_{(5)}$ is the light reading five minutes after $I_{(0)}$

$I_{(15)}$ is the light reading fifteen minutes after $I_{(0)}$

$C_{(t)}$, $R_{(t)}$, and $T_{(t)}$ are the changes in light readings from the intial reading in each sample container for the control, reference sediment

Quality Control Steps:

1. Is control final mean output greater than or equal to 80% control initial mean output?

$I_{(5)}$:$F_{c(mean)}/I_{c(mean)}$:	**92%**	**YES**
$I_{(15)}$:$F_{c(mean)}/I_{c(mean)}$:	**80%**	**YES**

YES: Control results are acceptable and can be used for statistical analyses.
NO: Control results are unacceptable (retest required).

2. Are test initial mean values greater than or equal to 80% of control initial mean values?

S1	$I_{T(mean)}/I_{C(mean)}$:	**83%**	**YES**
S2	$I_{T(mean)}/I_{C(mean)}$:	**80%**	**YES**
S3	$I_{T(mean)}/I_{C(mean)}$:	**77%**	**NO**
S4	$I_{T(mean)}/I_{C(mean)}$:	**83%**	**YES**
S5	$I_{T(mean)}/I_{C(mean)}$:	**79%**	**NO**

YES: Use initial site values to calculate change in final light readings
NO: Use control initial mean value to calculate change in final light readings for each site.

Project Name: March Point

Sample:	x1
Samp ID:	MP-1
Alias:	5 minute reading
Replicates:	5
Mean:	0.766
SD:	0.046
Tr Mean:	5.019
Trans SD:	0.151

Ref Samp:	x2
Ref ID:	Control
Alias:	5 minute reading
Replicates:	5
Mean:	0.956
SD:	0.024
Tr Mean:	5.611
Trans SD:	0.071

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.077
SS:	0.111
K:	5
b:	0.325
Alpha Level:	0.05
Calculated Value:	0.9523
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.122
Test Residual SD:	0.065
Ref. Residual Mean:	0.056
Ref. Residual SD:	0.032
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	2.0036
Critical Value:	>= 1.860
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	6
Experimental Alpha Level:	0.05
Calculated Value:	7.9315
Critical Value:	>= 1.943
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.7	4.799	0.97	5.652	0.22	0.041			-0.22
2	0.81	5.164	0.94	5.564	0.144	0.047			-0.084
3	0.8	5.132	0.93	5.534	0.112	0.077			-0.077
4	0.74	4.935	0.99	5.71	0.084	0.1			-0.047
5	0.78	5.067	0.95	5.593	0.048	0.017			-0.017
6									0.041
7									0.048
8									0.1
9									0.112
10									0.144

Project Name: March Point

Sample:	x1
Samp ID:	MP-4
Alias:	5 minute reading
Replicates:	5
Mean:	0.676
SD:	0.027
Tr Mean:	4.715
Trans SD:	0.094

Ref Samp:	x2
Ref ID:	Control
Alias:	5 minute reading
Replicates:	5
Mean:	0.956
SD:	0.024
Tr Mean:	5.611
Trans SD:	0.071

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.054
SS:	0.055
K:	5
b:	0.221
Alpha Level:	0.05
Calculated Value:	0.8802
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.081
Test Residual SD:	0.026
Ref. Residual Mean:	0.056
Ref. Residual SD:	0.032
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	1.315
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	8
Experimental Alpha Level:	0.05
Calculated Value:	16.9985
Critical Value:	>= 1.860
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.7	4.799	0.97	5.652	0.084	0.041			-0.091
2	0.66	4.66	0.94	5.564	0.056	0.047			-0.077
3	0.66	4.66	0.93	5.534	0.056	0.077			-0.056
4	0.71	4.834	0.99	5.71	0.118	0.1			-0.056
5	0.65	4.624	0.95	5.593	0.091	0.017			-0.047
6									-0.017
7									0.041
8									0.084
9									0.1
10									0.118

Project Name: March Point

Sample:	x1
Samp ID:	MP-4
Alias:	15-minute reading
Replicates:	5
Mean:	0.618
SD:	0.019
Tr Mean:	4.508
Trans SD:	0.07

Ref Samp:	x2
Ref ID:	SPRef80
Alias:	15-minute reading
Replicates:	5
Mean:	0.676
SD:	0.015
Tr Mean:	4.716
Trans SD:	0.053

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.04
SS:	0.031
K:	5
b:	0.172
Alpha Level:	0.05
Calculated Value:	0.9535
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.049
Test Residual SD:	0.043
Ref. Residual Mean:	0.037
Ref. Residual SD:	0.034
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	0.5257
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	8
Experimental Alpha Level:	0.05
Calculated Value:	5.2795
Critical Value:	>= 1.860
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.65	4.624	0.68	4.73	0.116	0.014			-0.092
2	0.61	4.479	0.65	4.624	0.029	0.092			-0.066
3	0.6	4.443	0.68	4.73	0.066	0.014			-0.029
4	0.62	4.516	0.68	4.73	0.008	0.014			-0.029
5	0.61	4.479	0.69	4.765	0.029	0.049			0.008
6									0.014
7									0.014
8									0.014
9									0.049
10									0.116

Project Name: March Point

Sample:	x1
Samp ID:	MP-7
Alias:	5-minute reading
Replicates:	5
Mean:	0.934
SD:	0.03
Tr Mean:	5.545
Trans SD:	0.091

Ref Samp:	x2
Ref ID:	Control
Alias:	5-minute reading
Replicates:	5
Mean:	0.956
SD:	0.024
Tr Mean:	5.611
Trans SD:	0.071

Shapiro-Wilk Results:

Residual Mean: 0
Residual SD: 0.053
SS: 0.053
K: 5
b: 0.227

Alpha Level: 0.05
Calculated Value: 0.9681
Critical Value: <= 0.842

Normally Distributed: Yes

Override Option: N/A

Levene's Results:

Test Residual Mean: 0.069
Test Residual SD: 0.048
Ref. Residual Mean: 0.056
Ref. Residual SD: 0.032
Deg. of Freedom: 8

Alpha Level: 0.1
Calculated Value: 0.5009
Critical Value: >= 1.860

Variances Homogeneous: Yes

Test Results:

Statistic: Student's t
Balanced Design: Yes
Transformation: ArcSin

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom: 8
Experimental Alpha Level: 0.05
Calculated Value: 1.2676
Critical Value: >= 1.860
Accept Null Hypothesis: Yes

Power:
Min. Difference for Power:

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.89	5.413	0.97	5.652	0.132	0.041			-0.132
2	0.94	5.564	0.94	5.564	0.018	0.047			-0.077
3	0.95	5.593	0.93	5.534	0.048	0.077			-0.047
4	0.97	5.652	0.99	5.71	0.107	0.1			-0.041
5	0.92	5.504	0.95	5.593	0.041	0.017			-0.017
6									0.018
7									0.041
8									0.048
9									0.1
10									0.107

Project Name: March Point

Sample:	x1
Samp ID:	MP-9
Alias:	5 minute
Replicates:	5
Mean:	0.712
SD:	0.04
Tr Mean:	4.839
Trans SD:	0.136

Ref Samp:	x2
Ref ID:	Control
Alias:	5 minute
Replicates:	5
Mean:	0.986
SD:	0.019
Tr Mean:	5.698
Trans SD:	0.057

Shapiro-Wilk Results:

Residual Mean: 0
Residual SD: 0.068
SS: 0.087
K: 5
b: 0.286

Alpha Level: 0.05
Calculated Value: 0.9392
Critical Value: <= 0.842

Normally Distributed: Yes

Override Option: N/A

Levene's Results:

Test Residual Mean: 0.102
Test Residual SD: 0.075
Ref. Residual Mean: 0.044
Ref. Residual SD: 0.028
Deg. of Freedom: 8

Alpha Level: 0.1
Calculated Value: 1.6032
Critical Value: >= 1.860

Variances Homogeneous: Yes

Test Results:

Statistic: Student's t
Balanced Design: Yes
Transformation: ArcSin

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom: 8
Experimental Alpha Level: 0.05
Calculated Value: 13.0242
Critical Value: >= 1.860
Accept Null Hypothesis: No

Power:
Min. Difference for Power:

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.75	4.968	0.96	5.623	0.129	0.076			-0.215
2	0.7	4.799	0.98	5.681	0.04	0.017			-0.076
3	0.74	4.935	1	5.739	0.096	0.041			-0.04
4	0.65	4.624	0.98	5.681	0.215	0.017			-0.017
5	0.72	4.868	1.01	5.768	0.029	0.069			-0.017
6									0.029
7									0.041
8									0.069
9									0.096
10									0.129

Project Name: March Point

Sample:	x1
Samp ID:	MP-9
Alias:	15 minutes
Replicates:	5
Mean:	0.712
SD:	0.082
Tr Mean:	4.834
Trans SD:	0.275

Ref Samp:	x2
Ref ID:	Control
Alias:	15 minute
Replicates:	5
Mean:	0.928
SD:	0.041
Tr Mean:	5.527
Trans SD:	0.125

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.138
SS:	0.364
K:	5
b:	0.587
Alpha Level:	0.05
Calculated Value:	0.9474
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.197
Test Residual SD:	0.164
Ref. Residual Mean:	0.091
Ref. Residual SD:	0.072
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	1.3091
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom:	8
Experimental Alpha Level:	0.05
Calculated Value:	5.1339
Critical Value:	>= 1.860
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.84	5.259	0.86	5.321	0.424	0.206			-0.318
2	0.68	4.73	0.94	5.564	0.104	0.037			-0.206
3	0.69	4.765	0.96	5.623	0.069	0.096			-0.104
4	0.62	4.516	0.92	5.504	0.318	0.023			-0.069
5	0.73	4.901	0.96	5.623	0.067	0.096			-0.023
6									0.037
7									0.067
8									0.096
9									0.096
10									0.424

Project Name: March Point

Sample:	x1
Samp ID:	MP-10
Alias:	5 minute
Replicates:	5
Mean:	0.736
SD:	0.036
Tr Mean:	4.92
Trans SD:	0.122

Ref Samp:	x2
Ref ID:	Control
Alias:	5 minute
Replicates:	5
Mean:	0.986
SD:	0.019
Tr Mean:	5.698
Trans SD:	0.057

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.062
SS:	0.072
K:	5
b:	0.262
Alpha Level:	0.05
Calculated Value:	0.9515
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.104
Test Residual SD:	0.036
Ref. Residual Mean:	0.044
Ref. Residual SD:	0.028
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	2.967
Critical Value:	>= 1.860
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	6
Experimental Alpha Level:	0.05
Calculated Value:	12.9557
Critical Value:	>= 1.943
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.77	5.034	0.96	5.623	0.114	0.076			-0.121
2	0.78	5.067	0.98	5.681	0.147	0.017			-0.087
3	0.71	4.834	1	5.739	0.087	0.041			-0.076
4	0.72	4.868	0.98	5.681	0.053	0.017			-0.053
5	0.7	4.799	1.01	5.768	0.121	0.069			-0.017
6									-0.017
7									0.041
8									0.069
9									0.114
10									0.147

Project Name: March Point

Sample:	x1
Samp ID:	MP-10
Alias:	15 minute
Replicates:	5
Mean:	0.718
SD:	0.018
Tr Mean:	4.86
Trans SD:	0.061

Ref Samp:	x2
Ref ID:	Control
Alias:	15 minute
Replicates:	5
Mean:	0.928
SD:	0.041
Tr Mean:	5.527
Trans SD:	0.125

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.064
SS:	0.078
K:	5
b:	0.259
Alpha Level:	0.05
Calculated Value:	0.8631
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.049
Test Residual SD:	0.027
Ref. Residual Mean:	0.091
Ref. Residual SD:	0.072
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	1.2339
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	8
Experimental Alpha Level:	0.05
Calculated Value:	10.7027
Critical Value:	>= 1.860
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.73	4.901	0.86	5.321	0.041	0.206			-0.206
2	0.73	4.901	0.94	5.564	0.041	0.037			-0.096
3	0.73	4.901	0.96	5.623	0.041	0.096			-0.027
4	0.71	4.834	0.92	5.504	0.027	0.023			-0.023
5	0.69	4.765	0.96	5.623	0.096	0.096			0.037
6									0.041
7									0.041
8									0.041
9									0.096
10									0.096

Project Name: March Point

Sample:	x1
Samp ID:	MP-11
Alias:	5 minute
Replicates:	5
Mean:	0.658
SD:	0.033
Tr Mean:	N/A
Trans SD:	N/A

Ref Samp:	x2
Ref ID:	Control
Alias:	5 minute
Replicates:	5
Mean:	0.986
SD:	0.019
Tr Mean:	N/A
Trans SD:	N/A

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.06
SS:	0.068
K:	5
b:	0.233
Alpha Level:	0.05
Calculated Value:	0.7966
Critical Value:	<= 0.842
Normally Distributed:	No
Override Option:	Not Invoked

Levene's Results:

Test Residual Mean:	0.084
Test Residual SD:	0.072
Ref. Residual Mean:	0.044
Ref. Residual SD:	0.028
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	1.1507
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Mann-Whitney
Balanced Design:	Yes
Transformation:	rank-order

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Mann-Whitney N1:	5
Mann-Whitney N2:	5
Degrees of Freedom:	
Experimental Alpha Level:	0.05
Calculated Value:	25
Critical Value:	>= 21.000
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.67	3	0.96	6	0.044	0.076	1		-0.209
2	0.67	3	0.98	7.5	0.044	0.017	3		-0.076
3	0.68	5	1	9	0.079	0.041	3		-0.017
4	0.6	1	0.98	7.5	0.209	0.017	3		-0.017
5	0.67	3	1.01	10	0.044	0.069	5		0.041
6							6		0.044
7							7.5		0.044
8							7.5		0.044
9							9		0.069
10							10		0.079

Project Name: March Point

Sample:	x1
Samp ID:	MP-11
Alias:	15 minutes
Replicates:	5
Mean:	0.636
SD:	0.04
Tr Mean:	N/A
Trans SD:	N/A

Ref Samp:	x2
Ref ID:	Control
Alias:	15 minute
Replicates:	5
Mean:	0.928
SD:	0.041
Tr Mean:	N/A
Trans SD:	N/A

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.088
SS:	0.147
K:	5
b:	0.348
Alpha Level:	0.05
Calculated Value:	0.8227
Critical Value:	<= 0.842
Normally Distributed:	No
Override Option:	Not Invoked

Levene's Results:

Test Residual Mean:	0.105
Test Residual SD:	0.086
Ref. Residual Mean:	0.091
Ref. Residual SD:	0.072
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	0.2678
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Mann-Whitney
Balanced Design:	Yes
Transformation:	rank-order

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Mann-Whitney N1:	5
Mann-Whitney N2:	5
Degrees of Freedom:	
Experimental Alpha Level:	0.05
Calculated Value:	25
Critical Value:	>= 21.000
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.63	2	0.86	6	0.02	0.206	1		-0.242
2	0.67	5	0.94	8	0.123	0.037	2		-0.206
3	0.66	4	0.96	9.5	0.088	0.096	3		-0.023
4	0.57	1	0.92	7	0.242	0.023	4		-0.02
5	0.65	3	0.96	9.5	0.052	0.096	5		0.037
6							6		0.052
7							7		0.088
8							8		0.096
9							9.5		0.096
10							9.5		0.123

Project Name: March Point

Sample:	x1
Samp ID:	MP-13
Alias:	5 minute
Replicates:	5
Mean:	0.432
SD:	0.022
Tr Mean:	3.768
Trans SD:	0.095

Ref Samp:	x2
Ref ID:	Control
Alias:	5 minute
Replicates:	5
Mean:	0.964
SD:	0.036
Tr Mean:	5.634
Trans SD:	0.105

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.065
SS:	0.081
K:	5
b:	0.268
Alpha Level:	0.05
Calculated Value:	0.8859
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.077
Test Residual SD:	0.04
Ref. Residual Mean:	0.08
Ref. Residual SD:	0.056
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	0.0898
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	8
Experimental Alpha Level:	0.05
Calculated Value:	29.3488
Critical Value:	>= 1.860
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.4	3.626	1	5.739	0.141	0.105			-0.16
2	0.45	3.846	0.97	5.652	0.079	0.018			-0.141
3	0.42	3.716	0.99	5.71	0.052	0.077			-0.052
4	0.45	3.846	0.91	5.474	0.079	0.16			-0.04
5	0.44	3.803	0.95	5.593	0.036	0.04			0.018
6									0.036
7									0.077
8									0.079
9									0.079
10									0.105

Project Name: March Point

Sample:	x1
Samp ID:	MP-13
Alias:	15 minute
Replicates:	5
Mean:	0.468
SD:	0.015
Tr Mean:	3.922
Trans SD:	0.062

Ref Samp:	x2
Ref ID:	Control
Alias:	15minute
Replicates:	5
Mean:	0.986
SD:	0.051
Tr Mean:	5.697
Trans SD:	0.149

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.074
SS:	0.104
K:	5
b:	0.318
Alpha Level:	0.05
Calculated Value:	0.971
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.044
Test Residual SD:	0.038
Ref. Residual Mean:	0.119
Ref. Residual SD:	0.067
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	2.1682
Critical Value:	>= 1.860
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	5
Experimental Alpha Level:	0.05
Calculated Value:	24.6344
Critical Value:	>= 2.015
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.45	3.846	0.99	5.71	0.076	0.013			-0.163
2	0.47	3.931	0.93	5.534	0.009	0.163			-0.133
3	0.46	3.889	1.05	5.881	0.033	0.184			-0.076
4	0.49	4.014	1.02	5.796	0.092	0.099			-0.033
5	0.47	3.931	0.94	5.564	0.009	0.133			0.009
6									0.009
7									0.013
8									0.092
9									0.099
10									0.184

Project Name: March Point

Sample:	x1
Samp ID:	MP-5
Alias:	5 minute
Replicates:	5
Mean:	0.73
SD:	0.058
Tr Mean:	4.898
Trans SD:	0.195

Ref Samp:	x2
Ref ID:	CR-1
Alias:	5 minute
Replicates:	5
Mean:	1.02
SD:	0.02
Tr Mean:	5.796
Trans SD:	0.057

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.093
SS:	0.165
K:	5
b:	0.395
Alpha Level:	0.05
Calculated Value:	0.9483
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.161
Test Residual SD:	0.075
Ref. Residual Mean:	0.046
Ref. Residual SD:	0.026
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	3.2591
Critical Value:	>= 1.860
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	5
Experimental Alpha Level:	0.05
Calculated Value:	9.8951
Critical Value:	>= 2.015
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.79	5.099	1.01	5.768	0.201	0.028			-0.238
2	0.71	4.834	1.03	5.825	0.065	0.029			-0.099
3	0.79	5.099	1.03	5.825	0.201	0.029			-0.086
4	0.66	4.66	0.99	5.71	0.238	0.086			-0.065
5	0.7	4.799	1.04	5.853	0.099	0.057			-0.028
6									0.029
7									0.029
8									0.057
9									0.201
10									0.201

Project Name: March Point

Sample:	x1
Samp ID:	MP-5
Alias:	15 minute
Replicates:	5
Mean:	0.724
SD:	0.047
Tr Mean:	4.879
Trans SD:	0.159

Ref Samp:	x2
Ref ID:	CR-1
Alias:	15 minute
Replicates:	5
Mean:	0.914
SD:	0.032
Tr Mean:	5.485
Trans SD:	0.097

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.085
SS:	0.139
K:	5
b:	0.354
Alpha Level:	0.05
Calculated Value:	0.9025
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.137
Test Residual SD:	0.041
Ref. Residual Mean:	0.082
Ref. Residual SD:	0.031
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	2.3739
Critical Value:	>= 1.860
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	7
Experimental Alpha Level:	0.05
Calculated Value:	7.2847
Critical Value:	>= 1.895
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.78	5.067	0.94	5.564	0.188	0.078			-0.149
2	0.7	4.799	0.94	5.564	0.08	0.078			-0.133
3	0.77	5.034	0.87	5.352	0.155	0.133			-0.114
4	0.68	4.73	0.89	5.413	0.149	0.072			-0.08
5	0.69	4.765	0.93	5.534	0.114	0.049			-0.072
6									0.049
7									0.078
8									0.078
9									0.155
10									0.188

Project Name: March Point

Sample:	x1
Samp ID:	MP-6
Alias:	5 min
Replicates:	5
Mean:	0.972
SD:	0.016
Tr Mean:	5.658
Trans SD:	0.048

Ref Samp:	x2
Ref ID:	CR-1
Alias:	5 minute
Replicates:	5
Mean:	1.02
SD:	0.02
Tr Mean:	5.796
Trans SD:	0.057

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.034
SS:	0.022
K:	5
b:	0.14
Alpha Level:	0.05
Calculated Value:	0.8754
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.042
Test Residual SD:	0.01
Ref. Residual Mean:	0.046
Ref. Residual SD:	0.026
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	0.3053
Critical Value:	>= 1.860
Variances Homogeneous:	Yes

Test Results:

Statistic:	Student's t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	8
Experimental Alpha Level:	0.05
Calculated Value:	4.1492
Critical Value:	>= 1.860
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.99	5.71	1.01	5.768	0.052	0.028			-0.086
2	0.96	5.623	1.03	5.825	0.035	0.029			-0.035
3	0.96	5.623	1.03	5.825	0.035	0.029			-0.035
4	0.99	5.71	0.99	5.71	0.052	0.086			-0.035
5	0.96	5.623	1.04	5.853	0.035	0.057			-0.028
6									0.029
7									0.029
8									0.052
9									0.052
10									0.057

Project Name: March Point

Sample:	x1
Samp ID:	MP-6
Alias:	15 minute
Replicates:	5
Mean:	0.898
SD:	0.048
Tr Mean:	5.436
Trans SD:	0.144

Ref Samp:	x2
Ref ID:	CR-1
Alias:	15 minute
Replicates:	5
Mean:	0.914
SD:	0.032
Tr Mean:	5.485
Trans SD:	0.097

Shapiro-Wilk Results:

Residual Mean: 0
Residual SD: 0.08
SS: 0.121
K: 5
b: 0.343

Alpha Level: 0.05
Calculated Value: 0.9735
Critical Value: <= 0.842

Normally Distributed: Yes

Override Option: N/A

Levene's Results:

Test Residual Mean: 0.102
Test Residual SD: 0.089
Ref. Residual Mean: 0.082
Ref. Residual SD: 0.031
Deg. of Freedom: 8

Alpha Level: 0.1
Calculated Value: 0.4604
Critical Value: >= 1.860

Variances Homogeneous: Yes

Test Results:

Statistic: Student's t
Balanced Design: Yes
Transformation: ArcSin

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom: 8
Experimental Alpha Level: 0.05
Calculated Value: 0.6336
Critical Value: >= 1.860
Accept Null Hypothesis: Yes

Power:
Min. Difference for Power:

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.89	5.413	0.94	5.564	0.023	0.078			-0.178
2	0.91	5.474	0.94	5.564	0.038	0.078			-0.133
3	0.88	5.383	0.87	5.352	0.053	0.133			-0.072
4	0.97	5.652	0.89	5.413	0.216	0.072			-0.053
5	0.84	5.259	0.93	5.534	0.178	0.049			-0.023
6									0.038
7									0.049
8									0.078
9									0.078
10									0.216

Project Name: March Point

Sample:	x1
Samp ID:	MP-8
Alias:	5 minute
Replicates:	5
Mean:	0.736
SD:	0.113
Tr Mean:	4.91
Trans SD:	0.372

Ref Samp:	x2
Ref ID:	CR-1
Alias:	5 minute
Replicates:	5
Mean:	1.02
SD:	0.02
Tr Mean:	5.796
Trans SD:	0.057

Shapiro-Wilk Results:

Residual Mean:	0
Residual SD:	0.172
SS:	0.565
K:	5
b:	0.72
Alpha Level:	0.05
Calculated Value:	0.9168
Critical Value:	<= 0.842
Normally Distributed:	Yes
Override Option:	N/A

Levene's Results:

Test Residual Mean:	0.301
Test Residual SD:	0.157
Ref. Residual Mean:	0.046
Ref. Residual SD:	0.026
Deg. of Freedom:	8
Alpha Level:	0.1
Calculated Value:	3.5798
Critical Value:	>= 1.860
Variances Homogeneous:	No

Test Results:

Statistic:	Approximate t
Balanced Design:	Yes
Transformation:	ArcSin

Experimental Hypothesis

Null:	x1 >= x2
Alternate:	x1 < x2

Degrees of Freedom:	4
Experimental Alpha Level:	0.05
Calculated Value:	5.2696
Critical Value:	>= 2.132
Accept Null Hypothesis:	No
Power:	
Min. Difference for Power:	

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.91	5.474	1.01	5.768	0.564	0.028			-0.322
2	0.79	5.099	1.03	5.825	0.189	0.029			-0.25
3	0.66	4.66	1.03	5.825	0.25	0.029			-0.18
4	0.64	4.589	0.99	5.71	0.322	0.086			-0.086
5	0.68	4.73	1.04	5.853	0.18	0.057			-0.028
6									0.029
7									0.029
8									0.057
9									0.189
10									0.564

Project Name: March Point

Sample:	x1
Samp ID:	MP-8
Alias:	15 minute
Replicates:	5
Mean:	0.67
SD:	0.068
Tr Mean:	4.69
Trans SD:	0.236

Ref Samp:	x2
Ref ID:	CR-1
Alias:	15 minute
Replicates:	5
Mean:	0.914
SD:	0.032
Tr Mean:	5.485
Trans SD:	0.097

Shapiro-Wilk Results:

Residual Mean: 0
Residual SD: 0.117
SS: 0.26
K: 5
b: 0.5

Alpha Level: 0.05
Calculated Value: 0.9586
Critical Value: <= 0.842

Normally Distributed: Yes

Override Option: N/A

Levene's Results:

Test Residual Mean: 0.181
Test Residual SD: 0.121
Ref. Residual Mean: 0.082
Ref. Residual SD: 0.031
Deg. of Freedom: 8

Alpha Level: 0.1
Calculated Value: 1.7659
Critical Value: >= 1.860

Variances Homogeneous: Yes

Test Results:

Statistic: Student's t
Balanced Design: Yes
Transformation: ArcSin

Experimental Hypothesis
Null: x1 >= x2
Alternate: x1 < x2

Degrees of Freedom: 8
Experimental Alpha Level: 0.05
Calculated Value: 6.9669
Critical Value: >= 1.860
Accept Null Hypothesis: No

Power:
Min. Difference for Power:

Replicate Number	Test Data	Trans. Test Data	Reference Data	Trans. Reference Data	Levene's Test Residuals	Levene's Reference Residuals	Mann-Whitney Ranks	Rankits	Shipiro-Wilk Residuals
1	0.77	5.034	0.94	5.564	0.344	0.078			-0.248
2	0.7	4.799	0.94	5.564	0.109	0.078			-0.174
3	0.6	4.443	0.87	5.352	0.248	0.133			-0.133
4	0.62	4.516	0.89	5.413	0.174	0.072			-0.072
5	0.66	4.66	0.93	5.534	0.031	0.049			-0.031
6									0.049
7									0.078
8									0.078
9									0.109
10									0.344

APPENDIX B – Laboratory Bench Sheets

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Microtox
100% Sediment Porewater Toxicity

Client Name: Newfields
Test Date: 10/2/08
Sample ID: SBREF80, MP-1, MP-2, MP-4, MP-7
Test No.: 0809-T062-T068

Site	Light Reading	Time	Replicate 1	2	3	4	5
CON	$I_{(0)}$	5 min	95	97	99	105	106
	$I_{(5)}$	10min	92	91	92	104	101
	$I_{(15)}$	20 min	78	79	82	87	91
SBREF80	$I_{(0)}$	5 min	85	76	78	76	76
	$I_{(5)}$	10min	79	71	78	75	78
	$I_{(15)}$	20 min	68	65	68	68	69
MP-1	$I_{(0)}$	5 min	77	80	77	77	76
	$I_{(5)}$	10min	70	81	80	74	78
	$I_{(15)}$	20 min	65	70	72	72	74
MP-2	$I_{(0)}$	5 min	80	85	78	77	83
	$I_{(5)}$	10min	81	92	78	78	84
	$I_{(15)}$	20 min	76	88	76	76	80
MP-4	$I_{(0)}$	5 min	73	67	66	70	63
	$I_{(5)}$	10min	70	66	66	71	65
	$I_{(15)}$	20 min	65	61	60	62	61
MP-7	$I_{(0)}$	5 min	83	87	86	86	88
	$I_{(5)}$	10min	74	82	82	83	81
	$I_{(15)}$	20 min	52	64	62	64	58

Comments:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Microtox
100% Sediment Porewater Toxicity

Client Name: Newfields   Test Date: 9/22/08

Sample ID: March Point Landfill   Test No.: 0809-T067-T070

Site	Light Reading	Time	Replicate 1	2	3	4	5
CON	$I_{(0)}$	5 min	96	88	91	91	91
	$I_{(5)}$	10min	92	86	91	89	92
	$I_{(15)}$	20 min	83	83	87	84	87
S08-~~076~~ 091	$I_{(0)}$	5 min	62	59	61	61	60
	$I_{(5)}$	10min	61	59	61	62	60
SBREF80	$I_{(15)}$	20 min	61	57	67	64	60
S08-084	$I_{(0)}$	5 min	70	62	65	59	63
	$I_{(5)}$	10min	69	64	68	59	66
MP-9	$I_{(15)}$	20 min	77	62	63	57	67
S08-085	$I_{(0)}$	5 min	68	70	67	66	62
	$I_{(5)}$	10min	70	71	65	66	64
MP-10	$I_{(15)}$	20 min	67	67	67	65	63
S08-086	$I_{(0)}$	5 min	56	58	63	54	61
	$I_{(5)}$	10min	61	61	62	55	61
MP-11	$I_{(15)}$	20 min	58	61	60	52	59
S08-087	$I_{(0)}$	5 min	72	74	72	79	80
	$I_{(5)}$	10min	81	79	78	91	92
MP-12	$I_{(15)}$	20 min	83	89	85	101	100

Comments:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Microtox
100% Sediment Porewater Toxicity

Client Name: Newfields **Test Date:** 9/22/08

Sample ID: March Point Landfill **Test No.:** 0809-T071

Site	Light Reading	Time	Replicate 1	2	3	4	5
CON	$I_{(0)}$	5 min	92	95	95	94	95
	$I_{(5)}$	10min	92	92	94	86	90
	$I_{(15)}$	20 min	91	88	100	96	89
508-091	$I_{(0)}$	5 min	74	69	64	63	61
	$I_{(5)}$	10min	74	72	64	64	64
SBREF80	$I_{(15)}$	20 min	76	76	67	71	69
508-088	$I_{(0)}$	5 min	38	41	39	41	40
	$I_{(5)}$	10min	38	42	40	42	41
MP-13	$I_{(15)}$	20 min	42	44	43	46	44
	$I_{(0)}$	5 min					
	$I_{(5)}$	10min					
	$I_{(15)}$	20 min					
	$I_{(0)}$	5 min					
	$I_{(5)}$	10min					
	$I_{(15)}$	20 min					
	$I_{(0)}$	5 min					
	$I_{(5)}$	10min					
	$I_{(15)}$	20 min					

Comments:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Microtox
100% Sediment Porewater Toxicity

Client Name: Newfields

Test Date: 9/25/08

Sample ID: CR-1, MP-3, MP-5, MP-6, MP-8

Test No.: 0809-T072-T076

Site	Light Reading	Time	Replicate 1	2	3	4	5
CON	$I_{(0)}$	5 min	90	95	93	92	99
	$I_{(5)}$	10min	84	86	85	87	91
	$I_{(15)}$	20 min	77	78	77	73	72
508-090 CR-1	$I_{(0)}$	5 min	87	77	78	74	73
	$I_{(5)}$	10min	88	79	80	73	76
	$I_{(15)}$	20 min	82	72	68	66	68
508-078 MP-3	$I_{(0)}$	5 min	76	79	74	73	75
	$I_{(5)}$	10min	81	81	76	76	79
	$I_{(15)}$	20 min	74	75	70	66	71
508-080 MP-5	$I_{(0)}$	5 min	78	73	74	67	69
	$I_{(5)}$	10min	74	67	74	62	66
	$I_{(15)}$	20 min	73	66	72	64	65
508-081 MP-6	$I_{(0)}$	5 min	81	76	74	75	81
	$I_{(5)}$	10min	80	73	71	74	78
	$I_{(15)}$	20 min	72	69	65	73	68
508-083 MP-8	$I_{(0)}$	5 min	87	81	67	64	71
	$I_{(5)}$	10min	85	74	62	60	64
	$I_{(15)}$	20 min	72	66	56	58	62

Comments:

APPENDIX C – Water Quality Results

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Physical and Chemical Measurements of Porewaters Sediment Bioassays

Analyst: gt

Client : Newfields

Test Date: 9/22/08

Test Type: Microtox 100% Porewater Toxicity Test

Test No: 0809-T062-T068

Test Species: *Vibrio fischeri*

Site	Initial Salinity (ppt)	Final Salinity (ppt)	Initial D.O. (mg/L)	Final D.O (mg/L)	Initial pH	Adjusted pH	NaOH or HCl Vol. Used	Final Porewater Conc.	Ammonia
S08-091 SBREF80	32.4	32.4	5.8	5.8	7.49	7.92	30µL 0.1N NaOH	99.9	21.2
S08-076 MP-1	3.6	20.8	6.8	6.8	7.23	7.90	180µL 0.1N NaOH	99.3	43.7
S08-077 MP-2	25.7	25.7	6.9	6.9	7.27	7.91	225µL 0.1N NaOH	99.1	25.5
S08-079 MP4	17.7	19.4	6.1	6.1	7.42	7.97	150µL 0.1N NaOH	99.4	14.3
S08-082 MP-7	27.2	27.2	6.5	6.5	7.46	7.98	150µL 0.1N NaOH	99.4	11.3
S08-084 MP-9	26.7	26.7	6.7	6.7	7.12	7.95	300µL 0.1N NaOH	98.8	15.0
S08-085 MP-10	27.4	27.4	6.7	6.7	7.09	7.94	300µL 0.1N NaOH	98.8	13.6

Sample Description:

Comments:

QA Check: MR

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Physical and Chemical Measurements of Porewaters Sediment Bioassays

Analyst: ET

Client: Newfields

Test Date: 9/22/08

Test Type: Microtox 100% Porewater Toxicity Test

Test No: 0809-T069-T071

Test Species: *Vibrio fischeri*

Site	Initial Salinity (ppt)	Final Salinity (ppt)	Initial D.O. (mg/L)	Final D.O (mg/L)	Initial pH	Adjusted pH	NaOH or HCl Vol. Used	Final Porewater Conc.	Ammonia
508-086 MP-11	27.3	27.3	6.4	6.4	7.12	7.93	300 µL 0.1N NaOH	98.8	17.5
508-087 MP-12	28.7	28.7	6.7	6.7	7.60	7.92	75 µL 0.1N NaOH	99.7	22.7
508-088 MP-13	29.0	29.0	6.8	6.8	7.22	7.91	375 µL 0.1N NaOH	98.5	26.7
CON	20.1	20.1	7.0	7.0	8.95	8.16	90 µL 0.1N HCl	99.6	—

Sample Description:

Comments:

QA Check: [signature]

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Physical and Chemical Measurements of Porewaters Sediment Bioassays

Analyst: et

Client : Newfields

Test Date: 9/25/08

Test Type: Microtox 100% Porewater Toxicity Test

Test No: 0809-T072-T076

Test Species: *Vibrio fischeri*

Site	Initial Salinity (ppt)	Final Salinity (ppt)	Initial D.O. (mg/L)	Final D.O (mg/L)	Initial pH	Adjusted pH	NaOH or HCl Vol. Used	Final Porewater Conc.	Ammonia
508-090 CR-1	30.8	30.8	6.7	6.7	7.35	7.90	0.1N NaOH 100µL	99.6	27.2
508-079 MP-3	28.5	28.5	6.5	6.5	7.65	7.91	0.1N NaOH 100µL	99.6	37.8
508-080 MP-5	26.4	26.4	6.8	6.8	7.40	7.96	0.1N NaOH 100µL	99.6	22.5
508-081 MP-6	27.9	27.9	6.7	6.7	7.07	7.90	0.1N NaOH 200µL	99.2	8.5
508-083 MP-8	26.9	26.9	6.8	6.8	7.29	8.17	0.1N NaOH 200µL	99.2	8.9
CON	19.2	19.2	6.8	6.8	9.20	8.18	0.1N HCl 100µL	99.6	—

Sample Description: ____________________

Comments: ____________________

QA Check: mg

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Physical and Chemical Measurements of Porewaters Sediment Bioassays

Analyst: Et

Client : Newfields

Test Date: 10/2/08

Test Type: Microtox 100% Porewater Toxicity Test

Test No:

Test Species: *Vibrio fischeri*

Site	Initial Salinity (ppt)	Final Salinity (ppt)	Initial D.O. (mg/L)	Final D.O (mg/L)	Initial pH	Adjusted pH	NaOH or HCl Vol. Used	Final Porewater Conc.	Ammonia
CON	19.2	19.2	6.7	6.7	8.99	8.18	60µL 0.1N HCl	99.8	—
SBREF80	32.5	32.5	6.3	6.3	7.44	7.98	150µL 0.1N NaOH	99.4	22.9
MP-1	4.3	20.6	6.3	6.3	7.54	8.00	150µL 0.1N NaOH	99.4	45.2
MP-2	25.6	25.6	6.5	6.5	7.37	7.91	200µL 0.1N NaOH	99.2	26.2
MP-4	17.6	19.2	6.6	6.6	7.36	8.11	250µL 0.1N NaOH	99.0	17.4
MP-7	27.5	27.5	6.7	6.7	7.29	8.19	250µL 0.1N NaOH	99.0	16.3

Sample Description:

Comments:

QA Check:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy E., Suite 2
Tacoma, WA 98424

Turbidity Measurements

Client: Newfields
Date: 9/22/08
Analyst: Et

Sample ID	Measurement (NTU)
Standard 0-10	4.97
Standard 0-100	50.0
Standard 0-1000	481
DI	0.79
CON	4.43
S08-91 SBREF80	43.4
S08-76 MP-1	99.6
S08-77 MP-2	168
S08-79 MP-4	244
S08-82 MP-7	19.3
S08-84 MP-9	29.1
S08-85 MP-10	38.3
S08-86 MP-11	53.0
S08-87 MP-12	42.4
S08-88 MP-13	41.4
STANDARD 0-10	4.90
STANDARD 0-100	49.8
STANDARD 0-1000	479
DI	0.63
Standard 0-10	
Standard 0-100	
Standard 0-1000	
DI	

Measure standards and DI at beginning and end of analysis.

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy E., Suite 2
Tacoma, WA 98424

Turbidity Measurements

Client: Newfields
Date: 9/25/08
Analyst: gt

Sample ID	Measurement (NTU)
Standard 0-10	5.02
Standard 0-100	49.7
Standard 0-1000	493
DI	0.47
CON	0.62
508-090 CR-1	31.2
508-078 MP-3	67.9
508-080 MP-5	24.3
508-081 MP-6	38.4
508-083 MP-8	16.4
Standard 0-10	gt ~~49.~~ 4.94
Standard 0-100	49.6
Standard 0-1000	485
DI	0.55

Measure standards and DI at beginning and end of analysis.

Nautilus Environmental
Washington Laboratory
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Tacoma, WA 98424

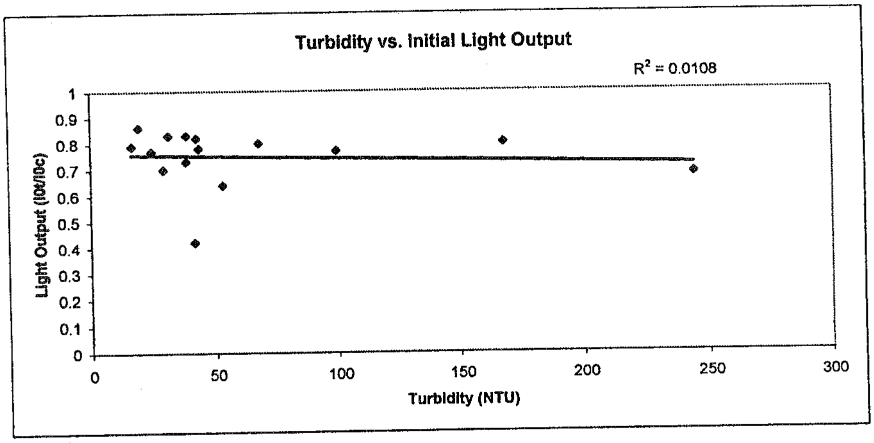
Turbidity Measurements

Client: Newfields
Date: 10/2/08
Analyst: [illegible]

Sample ID	Measurement (NTU)
Standard 0-10	4.92
Standard 0-100	49.8
Standard 0-1000	484
DI	0.40
REF-80	41.7
MP-1	60.8
MP-2	30.5
MP-4	248
MP-7	17.6
Standard 0-10	4.99
Standard 0-100	49.6
Standard 0-1000	484
DI	0.41

Measure standards and DI at beginning and end of analysis.

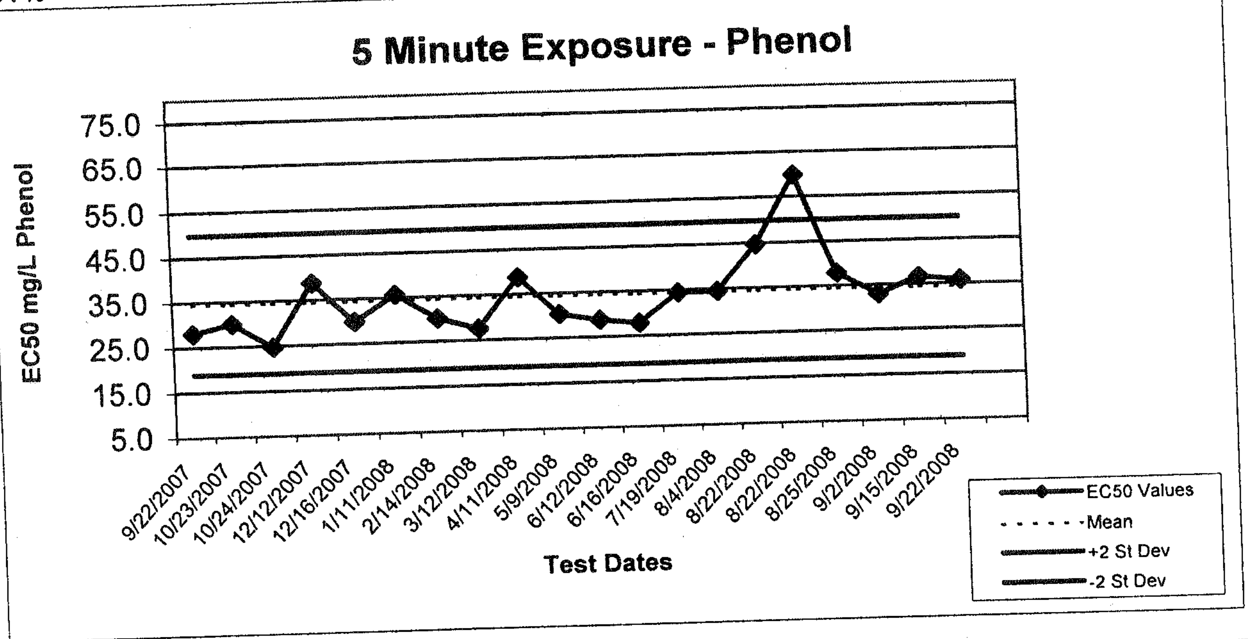
	I0t/I0c	turbidity
sbref80	0.78	43.4
mp-1	0.77	99.6
mp-2	0.8	168
mp-4	0.68	244
mp-7	0.86	19.3
mp-9	0.7	29.1
mp-10	0.73	38.3
mp-11	0.64	53
mp-12	0.82	42.4
mp-13	0.42	41.4
cr-1	0.83	31.2
mp-3	0.8	67.9
mp-5	0.77	24.3
mp-6	0.83	38.4
mp-8	0.79	16.4



APPENDIX D – Reference Toxicant Tests

Reference Toxicant Control Chart
Microtox 5-Minute Exposure

CV% = 22.6

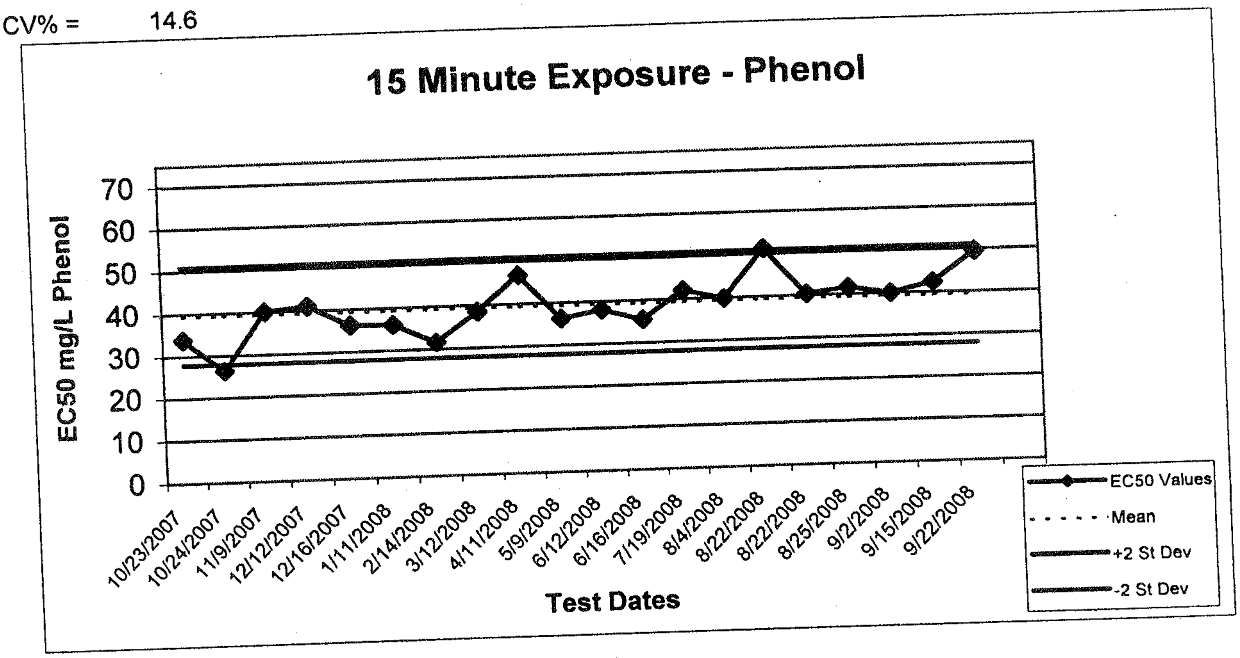


Date	Time	EC50 %	EC50 mg/L Phenol [a]	Mean	StDev	-2 SD	+2 SD
9/22/2007	1044	27.4	27.9	34.3	7.8	18.8	49.8
10/23/2007	830	29.4	30.0	34.3	7.8	18.8	49.8
10/24/2007	1114	24.2	24.7	34.3	7.8	18.8	49.8
12/12/2007	1316	38.0	38.8	34.3	7.8	18.8	49.8
12/16/2007	1140	29.3	29.9	34.3	7.8	18.8	49.8
1/11/2008	1015	34.9	35.6	34.3	7.8	18.8	49.8
2/14/2008	1239	29.5	30.1	34.3	7.8	18.8	49.8
3/12/2008	1245	27.0	27.6	34.3	7.8	18.8	49.8
4/11/2008	928	38.0	38.8	34.3	7.8	18.8	49.8
5/9/2008	1002	29.7	30.3	34.3	7.8	18.8	49.8
6/12/2008	1314	28.2	28.8	34.3	7.8	18.8	49.8
6/16/2008	1249	27.3	27.8	34.3	7.8	18.8	49.8
7/19/2008	1335	33.7	34.4	34.3	7.8	18.8	49.8
8/4/2008	1352	33.8	34.5	34.3	7.8	18.8	49.8
8/22/2008	856	43.8	44.7	34.3	7.8	18.8	49.8
8/22/2008	1108	58.6	59.8	34.3	7.8	18.8	49.8
8/25/2008	1343	37.1	37.8	34.3	7.8	18.8	49.8
9/2/2008	1327	32.3	32.9	34.3	7.8	18.8	49.8
9/15/2008	843	35.9	36.6	34.3	7.8	18.8	49.8
9/22/2008	1246	35.1	35.8	34.3	7.8	18.8	49.8

a - Highest concentration of Phenol is 102 mg/L

Reference Toxicant Control Chart
Microtox 15-Minute Exposure

CV% = 14.6



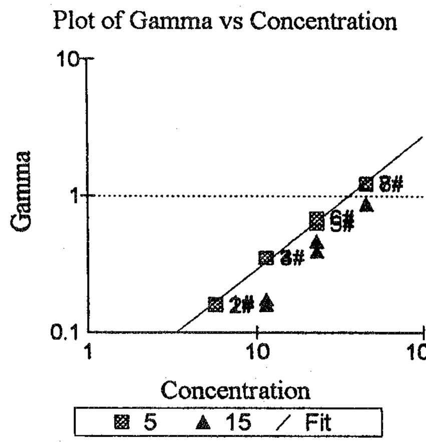
Date	Time	EC50 %	EC50 mg/L Phenol [a]	Mean	StDev	-2 SD	+2 SD
10/23/2007	830	33.2	33.9	39.4	5.8	27.8	50.9
10/24/2007	1114	25.8	26.3	39.4	5.8	27.8	50.9
11/9/2007	1337	39.3	40.1	39.4	5.8	27.8	50.9
12/12/2007	1316	40.2	41.0	39.4	5.8	27.8	50.9
12/16/2007	1140	35.6	36.3	39.4	5.8	27.8	50.9
1/11/2008	1015	35.4	36.1	39.4	5.8	27.8	50.9
2/14/2008	1239	31.0	31.6	39.4	5.8	27.8	50.9
3/12/2008	1245	37.7	38.5	39.4	5.8	27.8	50.9
4/11/2008	928	45.9	46.8	39.4	5.8	27.8	50.9
5/9/2008	1002	35.6	36.3	39.4	5.8	27.8	50.9
6/12/2008	1314	37.3	38.0	39.4	5.8	27.8	50.9
6/16/2008	1249	34.8	35.5	39.4	5.8	27.8	50.9
7/19/2008	1335	41.2	42.0	39.4	5.8	27.8	50.9
8/4/2008	1352	39.1	39.9	39.4	5.8	27.8	50.9
8/22/2008	856	50.2	51.2	39.4	5.8	27.8	50.9
8/22/2008	1108	39.6	40.4	39.4	5.8	27.8	50.9
8/25/2008	1343	40.8	41.6	39.4	5.8	27.8	50.9
9/2/2008	1327	39.3	40.1	39.4	5.8	27.8	50.9
9/15/2008	843	41.6	42.4	39.4	5.8	27.8	50.9
9/22/2008	1246	48.5	49.5	39.4	5.8	27.8	50.9

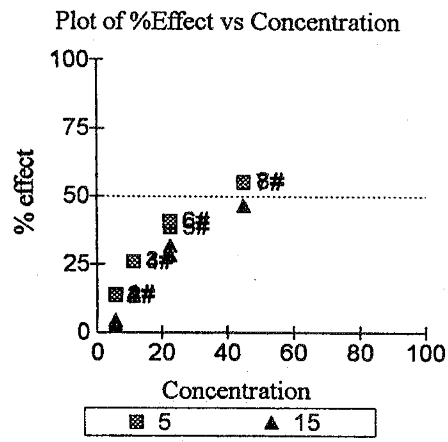
a - Highest concentration of Phenol is 102 mg/L

MicrotoxOmni Test Report

Date: 09/22/2008 12:46 PM

Test Protocol: Basic Test
Sample: 102mg/L Phenol
Toxicant: 102mg/L Phenol
Reagent Lot no.: 8E1080
Test description: Reference Toxicant
Test name: RT092208VF
Database file: \\Fif-ws3\alldata\Nautilus\former staff Folders\Karen\Microtox\MicrotoxOmni\Edge Analytical.mdb





			5 Mins Data:			15 Mins Data:		
Sample	Conc	Io	It	Gamma	% effect	It	Gamma	% effect
Control	0.000	101.43	94.59	0.9326 #		76.45	0.7537 #	
Control	0.000	107.59	102.50	0.9527 #		82.58	0.7675 #	
1	5.625	103.21	83.64	0.1632 #	14.03%	75.91	0.0341 *	3.305%
2	5.625	102.05	83.06	0.1581 #	13.65%	74.08	0.0478 *	4.564%
3	11.25	102.25	71.31	0.3516 #	26.01%	67.05	0.1600 #	13.79%
4	11.25	98.11	68.48	0.3505 #	25.95%	63.51	0.1750 #	14.90%
5	22.50	103.20	59.85	0.6254 #	38.48%	56.34	0.3933 #	28.23%
6	22.50	107.61	60.08	0.6884 #	40.77%	55.79	0.4671 #	31.84%
7	45.00	104.86	44.51	1.221 #	54.97%	42.53	0.8754 #	46.68%
8	45.00	109.25	45.96	1.241 #	55.37%	44.55	0.8653 #	46.39%

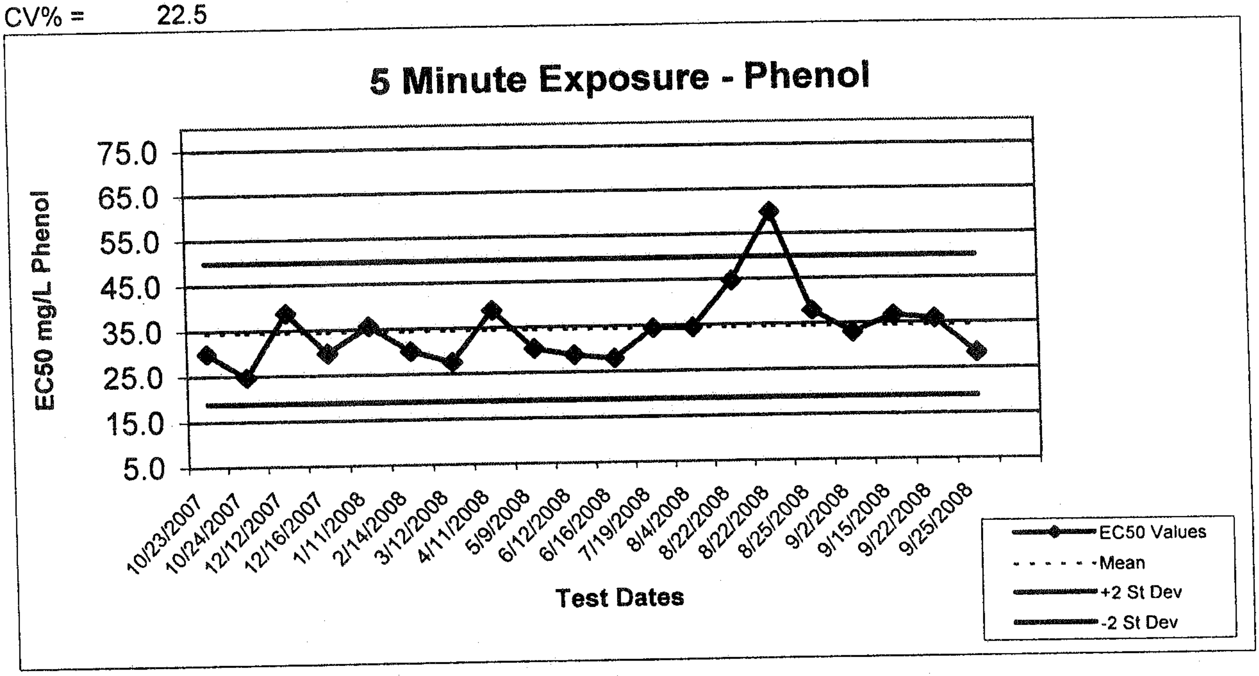
- used in calculation; * - invalid data; D - deleted from calcs.

Calculations on 5 Mins data:
EC50 Concentration:35.11% (95% confidence range: 32.66 to 37.75)
95% Confidence Factor: 1.075
Estimating Equation:LOG C =1.025 x LOG G +1.545
Coeff. of Determination (R^2):0.9957
Slope: 0.9715
Correction Factor: 0.9426

Calculations on 15 Mins data:
EC50 Concentration:48.45% (95% confidence range: 41.54 to 56.50)
95% Confidence Factor: 1.166
EC50 value was calculated from extrapolated data.
Estimating Equation:LOG C =0.8294 x LOG G +1.685
Coeff. of Determination (R^2):0.9866
Slope: 1.189
Correction Factor: 0.7606

Reference Toxicant Control Chart
Microtox 5-Minute Exposure

CV% = 22.5

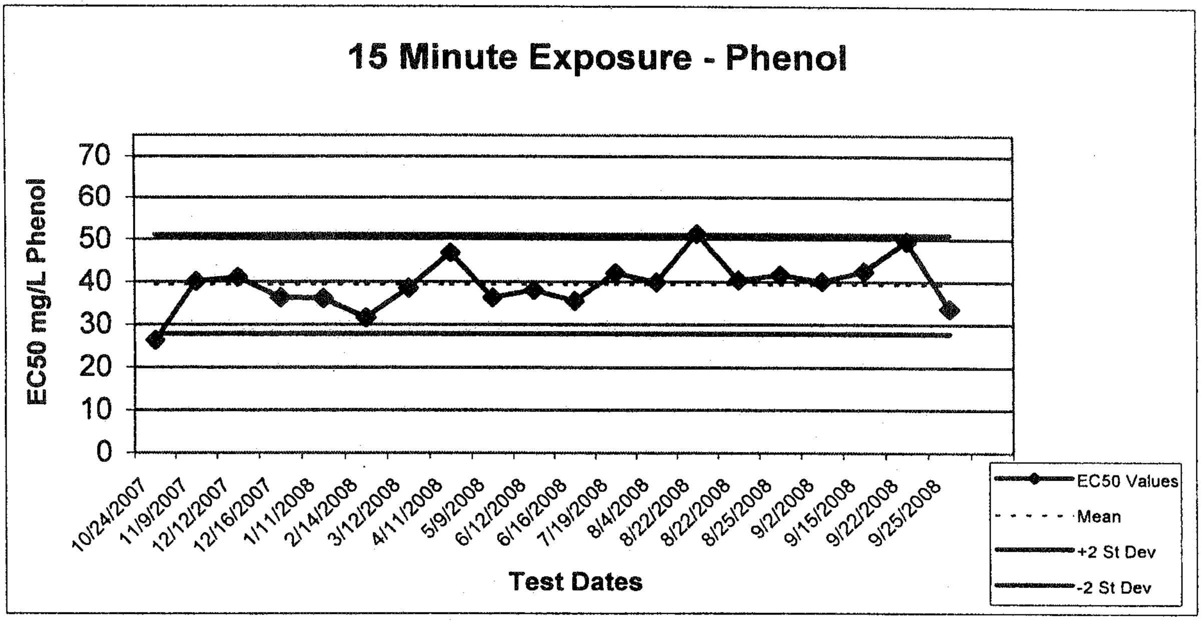


Date	Time	EC50 %	EC50 mg/L Phenol [a]	Mean	StDev	-2 SD	+2 SD
10/23/2007	830	29.4	30.0	34.3	7.7	18.9	49.8
10/24/2007	1114	24.2	24.7	34.3	7.7	18.9	49.8
12/12/2007	1316	38.0	38.8	34.3	7.7	18.9	49.8
12/16/2007	1140	29.3	29.9	34.3	7.7	18.9	49.8
1/11/2008	1015	34.9	35.6	34.3	7.7	18.9	49.8
2/14/2008	1239	29.5	30.1	34.3	7.7	18.9	49.8
3/12/2008	1245	27.0	27.6	34.3	7.7	18.9	49.8
4/11/2008	928	38.0	38.8	34.3	7.7	18.9	49.8
5/9/2008	1002	29.7	30.3	34.3	7.7	18.9	49.8
6/12/2008	1314	28.2	28.8	34.3	7.7	18.9	49.8
6/16/2008	1249	27.3	27.8	34.3	7.7	18.9	49.8
7/19/2008	1335	33.7	34.4	34.3	7.7	18.9	49.8
8/4/2008	1352	33.8	34.5	34.3	7.7	18.9	49.8
8/22/2008	856	43.8	44.7	34.3	7.7	18.9	49.8
8/22/2008	1108	58.6	59.8	34.3	7.7	18.9	49.8
8/25/2008	1343	37.1	37.8	34.3	7.7	18.9	49.8
9/2/2008	1327	32.3	32.9	34.3	7.7	18.9	49.8
9/15/2008	843	35.9	36.6	34.3	7.7	18.9	49.8
9/22/2008	1246	35.1	35.8	34.3	7.7	18.9	49.8
9/25/2008	1323	27.7	28.3	34.3	7.7	18.9	49.8

a - Highest concentration of Phenol is 102 mg/L

Reference Toxicant Control Chart
Microtox 15-Minute Exposure

CV% = 14.7



Date	Time	EC50 %	EC50 mg/L Phenol [a]	Mean	StDev	-2 SD	+2 SD
10/24/2007	1114	25.8	26.3	39.4	5.8	27.8	50.9
11/9/2007	1337	39.3	40.1	39.4	5.8	27.8	50.9
12/12/2007	1316	40.2	41.0	39.4	5.8	27.8	50.9
12/16/2007	1140	35.6	36.3	39.4	5.8	27.8	50.9
1/11/2008	1015	35.4	36.1	39.4	5.8	27.8	50.9
2/14/2008	1239	31.0	31.6	39.4	5.8	27.8	50.9
3/12/2008	1245	37.7	38.5	39.4	5.8	27.8	50.9
4/11/2008	928	45.9	46.8	39.4	5.8	27.8	50.9
5/9/2008	1002	35.6	36.3	39.4	5.8	27.8	50.9
6/12/2008	1314	37.3	38.0	39.4	5.8	27.8	50.9
6/16/2008	1249	34.8	35.5	39.4	5.8	27.8	50.9
7/19/2008	1335	41.2	42.0	39.4	5.8	27.8	50.9
8/4/2008	1352	39.1	39.9	39.4	5.8	27.8	50.9
8/22/2008	856	50.2	51.2	39.4	5.8	27.8	50.9
8/22/2008	1108	39.6	40.4	39.4	5.8	27.8	50.9
8/25/2008	1343	40.8	41.6	39.4	5.8	27.8	50.9
9/2/2008	1327	39.3	40.1	39.4	5.8	27.8	50.9
9/15/2008	843	41.6	42.4	39.4	5.8	27.8	50.9
9/22/2008	1246	48.5	49.5	39.4	5.8	27.8	50.9
9/25/2008	1323	33	33.7	39.4	5.8	27.8	50.9

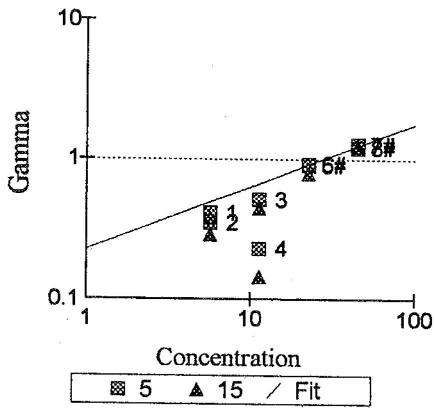
a - Highest concentration of Phenol is 102 mg/L

MicrotoxOmni Test Report

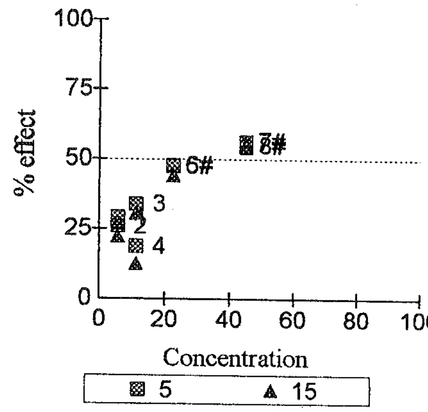
Date: 09/25/2008 01:23 PM

Test Protocol: Basic Test
Sample: 102mg/L Phenol
Toxicant: 102mg/L Phenol
Reagent Lot no.: 8E1080
Test description: Reference Toxicnat
Test name: RT092508VF#3
Database file: C:\Program Files\MicrotoxOmni\Edge Analytical.mdb

Plot of Gamma vs Concentration



Plot of %Effect vs Concentration



			5 Mins Data:			15 Mins Data:		
Sample	Conc	Io	It	Gamma	% effect	It	Gamma	% effect
Control	0.000	95.51	65.67	0.6876 #		60.83	0.6369 #	
Control	0.000	96.37	66.62	0.6913 #		62.72	0.6508 #	
1	5.625	103.19	50.39	0.4118	29.17%	48.17	0.3793	27.50%
2	5.625	111.04	56.59	0.3528	26.08%	55.50	0.2882	22.37%
3	11.25	104.69	47.73	0.5122	33.87%	46.64	0.4452	30.81%
4	11.25	108.42	60.72	0.2310	18.77%	60.99	0.1446	12.63%
5	22.50	110.34	39.93	0.9051 #	47.51%	39.72	0.7886 #	44.09%
6	22.50	108.84	39.08	0.9201 #	47.92%	39.18	0.7886 #	44.09%
7	45.00	119.30	36.10	1.278 #	56.11%	34.42	1.232 #	55.19%
8	45.00	112.23	35.04	1.208 #	54.71%	33.00	1.190 #	54.33%

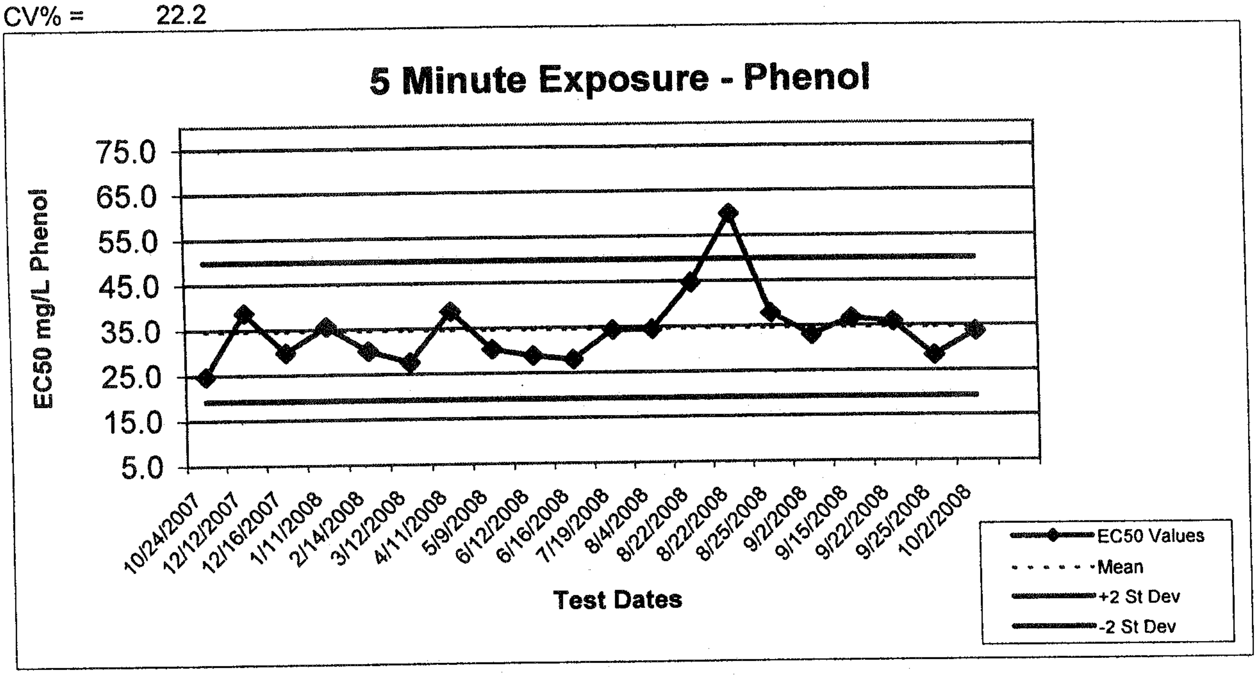
- used in calculation; * - invalid data; D - deleted from calcs.
Autocalc has been used.

Calculations on 5 Mins data:
EC50 Concentration:27.70% (95% confidence range: 23.80 to 32.24)
95% Confidence Factor: 1.164
Estimating Equation:LOG C =2.205 x LOG G +1.442
Coeff. of Determination (R^2):0.9822
Slope: 0.4455
Correction Factor: 0.6894

Calculations on 15 Mins data:
EC50 Concentration:33.03% (95% confidence range: 31.09 to 35.09)
95% Confidence Factor: 1.062
Estimating Equation:LOG C =1.612 x LOG G +1.519
Coeff. of Determination (R^2):0.9967
Slope: 0.6182
Correction Factor: 0.6439

Reference Toxicant Control Chart
Microtox 5-Minute Exposure

CV% = 22.2

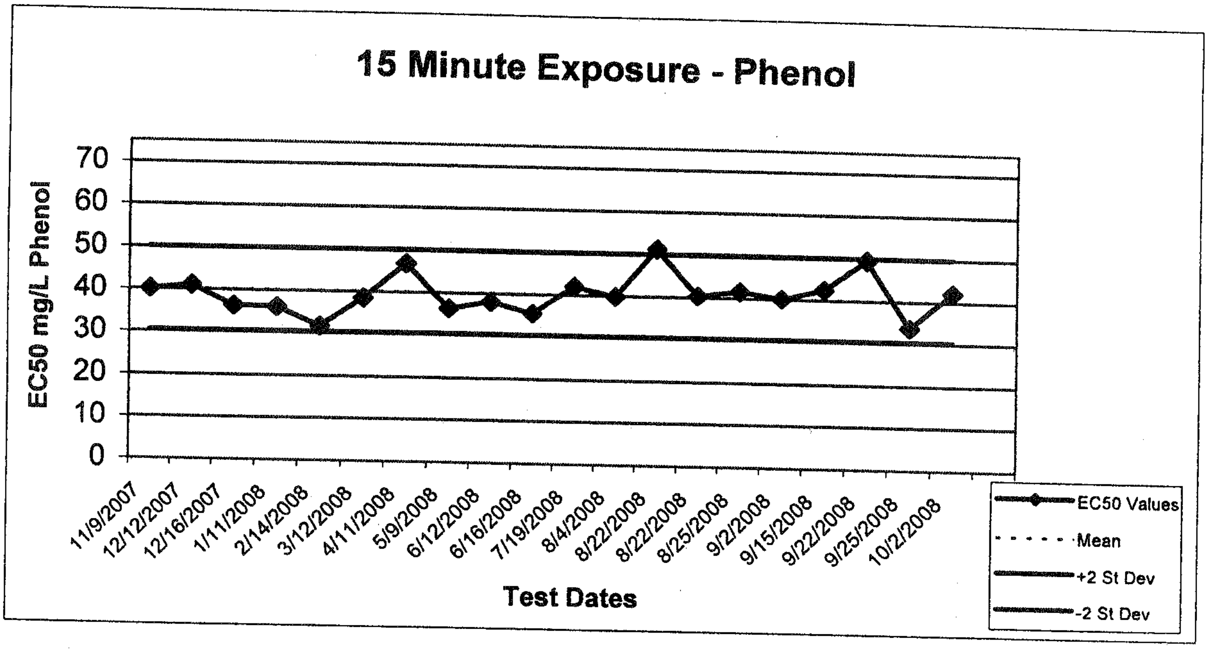


Date	Time	EC50 %	EC50 mg/L Phenol [a]	Mean	StDev	-2 SD	+2 SD
10/24/2007	1114	24.2	24.7	34.5	7.7	19.2	49.9
12/12/2007	1316	38.0	38.8	34.5	7.7	19.2	49.9
12/16/2007	1140	29.3	29.9	34.5	7.7	19.2	49.9
1/11/2008	1015	34.9	35.6	34.5	7.7	19.2	49.9
2/14/2008	1239	29.5	30.1	34.5	7.7	19.2	49.9
3/12/2008	1245	27.0	27.6	34.5	7.7	19.2	49.9
4/11/2008	928	38.0	38.8	34.5	7.7	19.2	49.9
5/9/2008	1002	29.7	30.3	34.5	7.7	19.2	49.9
6/12/2008	1314	28.2	28.8	34.5	7.7	19.2	49.9
6/16/2008	1249	27.3	27.8	34.5	7.7	19.2	49.9
7/19/2008	1335	33.7	34.4	34.5	7.7	19.2	49.9
8/4/2008	1352	33.8	34.5	34.5	7.7	19.2	49.9
8/22/2008	856	43.8	44.7	34.5	7.7	19.2	49.9
8/22/2008	1108	58.6	59.8	34.5	7.7	19.2	49.9
8/25/2008	1343	37.1	37.8	34.5	7.7	19.2	49.9
9/2/2008	1327	32.3	32.9	34.5	7.7	19.2	49.9
9/15/2008	843	35.9	36.6	34.5	7.7	19.2	49.9
9/22/2008	1246	35.1	35.8	34.5	7.7	19.2	49.9
9/25/2008	1323	27.7	28.3	34.5	7.7	19.2	49.9
10/2/2008	1237	19.8	33.6	34.5	7.7	19.2	49.9

a - Highest concentration of Phenol is 170 mg/L as of 10/1/08

Reference Toxicant Control Chart
Microtox 15-Minute Exposure

CV% = 12.2



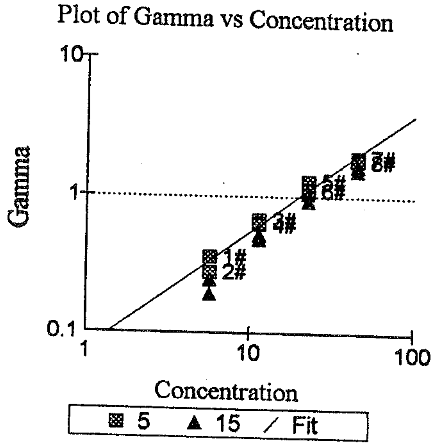
Date	Time	EC50 %	EC50 mg/L Phenol [a]	Mean	StDev	-2 SD	+2 SD
11/9/2007	1337	39.3	40.1	40.2	4.9	30.3	50.0
12/12/2007	1316	40.2	41.0	40.2	4.9	30.3	50.0
12/16/2007	1140	35.6	36.3	40.2	4.9	30.3	50.0
1/11/2008	1015	35.4	36.1	40.2	4.9	30.3	50.0
2/14/2008	1239	31.0	31.6	40.2	4.9	30.3	50.0
3/12/2008	1245	37.7	38.5	40.2	4.9	30.3	50.0
4/11/2008	928	45.9	46.8	40.2	4.9	30.3	50.0
5/9/2008	1002	35.6	36.3	40.2	4.9	30.3	50.0
6/12/2008	1314	37.3	38.0	40.2	4.9	30.3	50.0
6/16/2008	1249	34.8	35.5	40.2	4.9	30.3	50.0
7/19/2008	1335	41.2	42.0	40.2	4.9	30.3	50.0
8/4/2008	1352	39.1	39.9	40.2	4.9	30.3	50.0
8/22/2008	856	50.2	51.2	40.2	4.9	30.3	50.0
8/22/2008	1108	39.6	40.4	40.2	4.9	30.3	50.0
8/25/2008	1343	40.8	41.6	40.2	4.9	30.3	50.0
9/2/2008	1327	39.3	40.1	40.2	4.9	30.3	50.0
9/15/2008	843	41.6	42.4	40.2	4.9	30.3	50.0
9/22/2008	1246	48.5	49.5	40.2	4.9	30.3	50.0
9/25/2008	1323	33	33.7	40.2	4.9	30.3	50.0
10/2/2008	1237	24.79	42.1	40.2	4.9	30.3	50.0

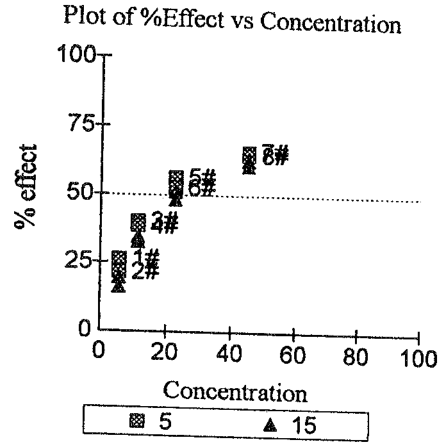
a - Highest concentration of Phenol is 170 mg/L as of 10/1/08

MicrotoxOmni Test Report

Date: 10/02/2008 12:37 PM

Test Protocol: Basic Test
Sample: Phenol
Toxicant: Phenol
Reagent Lot no.: 8E1080
Test description: Reference Toxicant
Test name: RT100208VF
Database file: \\Fif-ws3\alldata\Nautilus\former staff Folders\Karen\Microtox\MicrotoxOmni\Edge Analytical.mdb





Sample	Conc	Io	5 Mins Data: It	Gamma	% effect	15 Mins Data: It	Gamma	% effect
Control	0.000	99.31	95.92	0.9659 #		77.04	0.7758 #	
Control	0.000	104.17	101.57	0.9750 #		81.70	0.7843 #	
1	5.625	109.47	78.18	0.3589 #	26.41%	71.60	0.1926 #	16.15%
2	5.625	111.63	84.73	0.2786 #	21.79%	70.00	0.2439 #	19.61%
3	11.25	110.04	63.75	0.6751 #	40.30%	56.29	0.5249 #	34.42%
4	11.25	110.67	66.02	0.6268 #	38.53%	58.09	0.4861 #	32.71%
5	22.50	120.67	51.10	1.292 #	56.36%	45.94	1.049 #	51.19%
6	22.50	113.07	52.02	1.109 #	52.59%	45.78	0.9265 #	48.09%
7	45.00	109.98	36.35	1.936 #	65.94%	32.04	1.677 #	62.65%
8	45.00	113.14	38.75	1.833 #	64.71%	34.69	1.544 #	60.69%

- used in calculation; * - invalid data; D - deleted from calcs.

Calculations on 5 Mins data:
EC50 Concentration:19.79% (95% confidence range: 17.51 to 22.36)
95% Confidence Factor: 1.130
Estimating Equation:LOG C =1.135 x LOG G +1.296
Coeff. of Determination (R^2):0.9769
Slope: 0.8605
Correction Factor: 0.9705

Calculations on 15 Mins data:
EC50 Concentration:24.79% (95% confidence range: 21.64 to 28.39)
95% Confidence Factor: 1.145
Estimating Equation:LOG C =1.013 x LOG G +1.394
Coeff. of Determination (R^2):0.9770
Slope: 0.9642
Correction Factor: 0.7800

APPENDIX E – Chain-of Custody Forms

NEWFIELDS

NewFields Northwest, LLC.
Shipping: 4729 NE View Dr.
Mailing: P.O. Box 216
Port Gamble, WA. 98364
Tel: (360) 297-6040, Fax: (360)297-7268

CHAIN OF CUSTODY

13293

Destination Lab:	Nautilus
Destination Contact:	Eric Tollefson
Date:	9/3/08
Turn-Around-Time	Standard
Project Name	March Point Landfill
Contract/PO:	

Sample Originator:	Newfields
Contact Name:	Brian Hester
Address:	Same as above
Phone:	—
Fax:	—
E-mail	bhester@newfields.com

Report Results To:	NewFields
Contact Name:	Brian Hester
Address:	Same
Phone:	—
Fax:	—
Email:	—
Invoicing To:	NewFields
Comments or Special Instructions:	—

No.	Sample ID	Matrix	No. & Type of Container	Date & Time	Analysis: Microtox						Preservation	Sample Temp Upon Receipt	LAB ID
1	MP-1	SS	1-16oz	8/28/08 0809	X						4°C	3.2	S08-076
2	MP-2	SS	1-16oz	8/26/08 1145	X						↓	4.2	S08-077
3	MP-3	SS	1-16oz	8/26/08 1100	X						↓	2.6	S08-078
4	MP-4	SS	1-16oz	8/27/08 0800	X						↓	3.7	S08-079
5	MP-5	SS	1-16oz	8/27/08 0836	X						↓	2.5	S08-080
6	MP-6	SS	1-1LG (32oz)	8/28/08 0837	X						↓	3.8	S08-081
7	MP-7	SS	1-16oz	8/27/08 1311	X						↓	4.2	S08-082
8	MP-8	SS	1-16oz	8/27/08 1242	X						↓	5.8	S08-083
9	MP-9	SS	1-16oz	8/27/08 1048	X						↓	5.5	S08-084
10	MP-10	SS	1-16oz	8/27/08 1009	X						↓	5.2	S08-085
11	MP-11	SS	1-16oz	8/27/08 1128	X						↓	5.2	S08-086
12	MP-12	SS	1-16oz	8/27/08 0912	X						↓	5.3	S08-087
13	MP-13	SS	1-16oz	8/27/08 1348	X						↓	5.5	S08-088
14													
15													
16													
17													
18													
19													
20													

	Relinquished by:	Recieved by:	Relinquished by:	Recieved by:
Print Name:	Brian Hester	[illegible]		
Signature:	[signature]	Mary Ann Rempel-Hester		
Affiliation:	NewFields	Nautilus		
Date/Time:	9/3/08 0645	9/3/08 0645		

Matrix Codes
FW = Fresh Water
WW = Waste Water
SB = Salt & Brackish Water
SS = Soil & Sediment
TS = plant & Animal Tissue
OT = Other

WHITE – return to originator • YELLOW – lab • PINK – retained by originator

NEWFIELDS

NewFields Northwest, LLC.
Shipping: 4729 NE View Dr.
Mailing: P.O. Box 216
Port Gamble, WA. 98364
Tel: (360) 297-6040, Fax: (360)297-7268

CHAIN OF CUSTODY

13308

Destination Lab: Nautilus
Destination Contact:
Date: 9/18/08
Turn-Around-Time
Project Name: (1) March Point (2) Log Haul Out
Contract/PO:

Sample Originator: NewFields
Contact Name: Brian Hester
Address: see Above
Phone:
Fax:
E-mail: bhester@newfields.com

Report Results To: NewFields
Contact Name: Brian Hester
Address:
Phone:
Fax:
Email:

Invoicing To: NewFields
Comments or Special Instructions: will provide correlation between Ref stations and project seds

No.	Sample ID	Matrix	No. & Type of Container	Date & Time	Analysis: Microtox						Preservation	Sample Temp Upon Receipt	LAB ID
1	CR-1 (1)	SS	1 1L-G	9/17/08	X						4°C	6.6	S08-090
2	SBREF80 (1,2)	↓	2 1L-G	9/17/08	X						↓	6.9	S08-091
3													
4													
5													
6													
7													
8													
9													
10													
11	Please Archive any												
12	leftover Reference Sed.												
13													
14													
15													
16													
17													
18													
19													
20													

Relinquished by:	Recieved by:	Relinquished by:	Recieved by:
Print Name: BRIAN HESTER	Print Name: [illegible signature]	Print Name:	Print Name:
Signature: [signature]	Signature: [signature]	Signature:	Signature:
Affiliation: NewFields	Affiliation: Nautilus	Affiliation:	Affiliation:
Date/Time: 9/18/08 0800	Date/Time: 9/18/08 0800	Date/Time:	Date/Time:

Matrix Codes
FW = Fresh Water
WW = Waste Water
SB = Salt & Brackish Water
SS = Soil & Sediment
TS = plant & Animal Tissue
OT = Other

APPENDIX B

LABORATORY DOCUMENTS

CHAIN OF CUSTODY

AMEC Geomatrix, Inc
3500 – 188th Street SW, Suite 600
Lynnwood, WA 98037
(425) 921-4000

CHAIN OF CUSTODY

New Fields

Checked by: ____________

Place COC Form Number Label Here or write in seq. number below.

Sample	Date / Time	SMS List of COCs	Mercury (digest and ho		TOC/TVS/TS	Grainsize	NH4		Bioassay	Microtox			Archive	Number of containers
AMEC Geomatrix MP-12 COC Form Initials: RHG Date: 8/27/08 Time: 0912	Date: Time:								2	1				3
AMEC Geomatrix MP-13 COC Form Initials: RES Date: 8/27/08 Time: 1348	Date: Time:								2	1				3
AMEC Geomatrix MP-8 COC Form Initials: KAA Date: 8/27/08 Time: 12:42	Date: Time:								2	1				3
AMEC Geomatrix MP-9 COC Form Initials: KAA Date: 8/27/08 Time: 10:48	Date: Time:								2	1				3
AMEC Geomatrix MP-1 COC Form Initials: RHG Date: 8/28/08 Time: 0809	Date: Time:								2	1				3
AMEC Geomatrix MP-6 COC Form Initials: RHG Date: 8/28/08 Time: 8:37	Date: Time:								2	1				3
Place Sample ID Label Here or Write ID Number Here	Date: Time:													

Laboratory/Analysis Comments

AMEC Geomatrix Project 14159.000
Dave Haddock Project Manager 206-342-1787 Cell 425-246-7409
AMEC Geomatrix Contact Rob Gilmour 425-921-4003 Cell 206-940-7635 or
Cliff Whitmus 425-921-4023

Relinquished By	Transported By	Received By
Name: [signature] Date: 8/29/08 Time: 0825		Name: [signature] Date: 8/29/08 Time: 0825
Name: Date: Time:		Name: Date: Time:

AMEC Geomatrix, Inc
3500 – 188th Street SW, Suite 600
Lynnwood, WA 98037
(425) 921-4000

CHAIN OF CUSTODY

New Fields

Place COC Form Number Label Here or write in seq. number below.

Checked by: ______

Sample Label	Date/Time	SMS List of COCs	Mercury (digest and ho		TOC/TVS/TS	Grainsize	NH4		Bioassay	Microtox			Archive	Number of containers
AMEC Geomatrix MP-3 COC Form Initials: KW Date: 8/26/08 Time: 1100	Date: Time:								X X 2	X 1				3
AMEC Geomatrix MP-2 COC Form Initials: KW Date: 8/26/04 Time: 1145	Date: Time:								X X 2	X 1				3
AMEC Geomatrix MP-4 COC Form Initials: RHG Date: 8/27/08 Time: 0800	Date: Time:								2	1				3
AMEC Geomatrix MP-10 COC Form Initials: KAA Date: 8/27/08 Time: 10:09	Date: Time:								2	1				3
AMEC Geomatrix MP-5 COC Form Initials: RG Date: 08/27/08 Time: 0836	Date: Time:								2	1				3
AMEC Geomatrix MP-7 COC Form Initials: KAA Date: 8/27/08 Time: 13:11	Date: Time:								2	1				3
AMEC Geomatrix MP-11 COC Form Initials: RG Date: 8/27/08 Time: 1128	Date: Time:								2	1				3

Laboratory/Analysis Comments

AMEC Geomatrix Project 14159.000
Dave Haddock Project Manager 206-342-1787 Cell 425-246-7409
AMEC Geomatrix Contact Rob Gilmour 425-921-4003 Cell 206-940-7635 or
Cliff Whitmus 425-921-4023

Relinquished By	Transported By	Received By
Name: [signature] Date: 8/25/08 Time: 0820		Name: [signature] Date: 8/29/08 Time: 0825
Name: Date: Time:		Name: Date: Time:

NEWFIELDS

NewFields N[illegible]west, LLC.
Shipping: 4729 NE View Dr.
Mailing: P.O. Box 216
Port Gamble, WA. 98364
Tel: (360) 297-6040, Fax: (360)297-7268

CHAIN OF CUST[illegible]Y

13306

Destination Lab: New Fields	Sample Originator:	Report Results To:	Phone:
Destination Contact: Brian Hester	Contact Name:	Contact Name:	Fax:
Date: 9/12/08	Address:	Address:	Email:
Turn-Around-Time: NA			
Project Name	Phone:		Invoicing To:
	Fax:		Comments or Special Instructions:
Contract/PO:	E-mail		

No.	Sample ID	Matrix	No. & Type of Container	Date & Time	Analysis						Preservation	Sample Temp Upon Receipt	LAB ID
1	CR-7 (53% fines)	Sed	5gal/bag	9/12/08 1200									
2	CR-22 (15% fines)	↓	↓	↓ 1305									
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Relinquished by:	Recieved by:	Relinquished by:	Recieved by:	Matrix Codes
Print Name: Jay Word	Print Name: Brian Hester	Print Name:	Print Name:	FW = Fresh Water
Signature: [signature]	Signature: [signature]	Signature:	Signature:	WW = Waste Water
Affiliation: New Fields	Affiliation: NewFields	Affiliation:	Affiliation:	SB = Salt & Brackish Water
Date/Time: 9/12/08 1540	Date/Time: 9/12/08 1540	Date/Time:	Date/Time:	SS = Soil & Sediment
				TS = plant & Animal Tissue
				OT = Other

WHITE – return to originator • YELLOW – lab • PINK – retained by originator

NEWFIELDS

NewFields N[illegible]west, LLC.
Shipping: 4729 NE View Dr.
Mailing: P.O. Box 216
Port Gamble, WA. 98364
Tel: (360) 297-6040, Fax: (360)297-7268

CHAIN OF CUST[illegible]Y

13307

Destination Lab: NewFields
Destination Contact: Brian Hester
Date: 9/16/08
Turn-Around-Time:
Project Name: Reference Sediment Collection
Contract/PO:

Sample Originator: Meg Pinza
Contact Name:
Address: NewFields
Phone: 297-6066
Fax:
E-mail:

Report Results To:
Contact Name:
Address:
Phone:
Fax:
Email:

Invoicing To:
Comments or Special Instructions:

No.	Sample ID	Matrix	No. & Type of Container	Date & Time	Analysis: Bioassay						Preservation	Sample Temp Upon Receipt	LAB ID
1	SBREF 80	Sed	5gal/Bag	9/16/08 10:53	✓								
2	SBREF 35	Sed	5gal/Bag	9/16/08 10:53	✓								
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

	Relinquished by:	Recieved by:	Relinquished by:	Recieved by:
Print Name:	Meg Pinza	BRIAN HESTER		
Signature:	Meg Pinza	[signature]		
Affiliation:	NewFields	NewFields		
Date/Time:	9/15/08 (16) 10:53	9/16/08 1055		

Matrix Codes
FW = Fresh Water
WW = Waste Water
SB = Salt & Brackish Water
SS = Soil & Sediment
TS = plant & Animal Tissue
OT = Other

WHITE – return to originator • YELLOW – lab • PINK – retained by originator

ORGANISM RECIEPT LOGS

NEWFIELDS

ORGANISM RECEIPT LOG

Date: 9/17/08	Time: 1345	NewFields Batch No. JB 9173
Organism: Ampelisca	Source: Brezina & Assoc.	
Address: On File		Invoice Attached: Yes (No) — No circled
Phone: On File	Contact: On File	
No. Ordered:	No. Received:	Source Batch: Field collected
Condition of Organisms: Good	Approximate Size or Age:	
Shipper: FedEx	B of L (Tracking No.) 8662 6888 9173	
Condition of Container: Good	Received By: MMB	
Confirmation of ID of Organism: Yes (No) — No circled		Technician (Initials): MMB

Notes:

pH (Units)	Temp. (°C)	D.O. (mg/L)	Conductivity or Salinity (Include Units)	Technician (Initials)
6.6	17.5	> 20.0	29 ppt	MMB

Notes:

NEWFIELDS

ORGANISM RECEIPT LOG

Field	Value
Date:	9/23/08
Time:	0900
NewFields Batch No.	De 092308
Organism:	Dendraster excentricus
Source:	Field
Address:	NA
Invoice Attached	Yes (No) — No circled
Phone:	
Contact:	
No. Ordered:	200
No. Received:	~200
Source Batch:	
Condition of Organisms:	Good
Approximate Size or Age:	Adult
Shipper:	NF courier
B of L (Tracking No.)	NA
Condition of Container:	Good
Received By:	CR
Confirmation of ID of Organism:	Yes (No) — No circled
Technician (Initials):	

Notes:

pH (Units)	Temp. (°C)	D.O. (mg/L)	Conductivity or Salinity (Include Units)	Technician (Initials)
* Received dry →				CK

Notes:

AMPHIPOD TEST

NEWFIELDS

10-DAY SOLID PHASE TEST OBSERVATION DATA

CLIENT	PROJECT	NEWFIELDS JOB NO.	PROJECT MAN.	NEWFIELDS LABORATOR	PROTOCOL	SPECIES
AMEC - Geomatrix	March Point	1437-001-860-1	M. Pinza	Port Gamble Bath 4	PSEP 1995	*Ampelisca abdida*

#E= Emergence (Surface of sediment, swimming in water column, or floating on surface)
#M= Number of Mortality
D=No Air Flow (DO?)
N=Normal
G=Growth (Fungal, algal, or bacterial mats)

INITIAL # OF ORGANISMS

ENDPOINT DATA & OBSERVATIONS

CLIENT/NEWFIELDS ID	REP	JAR #	INITIAL #	DATE 9/24 TECHNICIAN CR OBSERVNS	DATE 9/25 TECHNICIAN [illegible] OBSERVNS	DATE 9/26 TECHNICIAN CR OBSERVNS	DATE 9/27 TECHNICIAN CR OBSERVNS	DATE 9/28 TECHNICIAN CR OBSERVNS	DATE 9/29 TECHNICIAN CR OBSERVNS	DATE 9/30 TECHNICIAN TS OBSERVNS	DATE 10/1 TECHNICIAN TS OBSERVNS	DATE 10/2 TECHNICIAN [illegible] OBSERVNS	DATE TECHNICIAN OBSERVNS	NUMBER ALIVE
Control /	1	38		N	N	N	N	N	G	G	G	N		18
	2	73							G					18
	3	48							G					17
	4	45							G					18
	5	66							G					20
CR-1 / .	1	59							N	N	N	N		17
	2	3												15
	3	8												20
	4	16												17
	5	85									G			16
SBREF-80 / .	1	62		11E	N		N	N			N	N		0
	2	10		10E	4E	12E	5E 7M	4E						0
	3	19		N	N	N	N	N						0
	4	15		3E	4E	6E	4M	N						1
	5	78		N	N	N	N	2E						0
MP-1 / .	1	30		N	N	N	G	G	G	G	G	G		18
	2	89			G	G								18
	3	21			N	G								14
	4	76			G	G								16
	5	47		1E	G	G								16

10-DAY SOLID PHASE TEST OBSERVATION DATA

NEWFIELDS

CLIENT	PROJECT	NEWFIELDS JOB NO.	PROJECT MAN.	NEWFIELDS LABORATOR	PROTOCOL	SPECIES
AMEC - Geomatrix	March Point	1437-001-860-1	M. Pinza	Port Gamble Bath 4	PSEP 1995	*Ampelisca abdida*

#E= Emergence (Surface of sediment, swimming in water column, or floating on surface)
#M= Number of Mortality
D=No Air Flow (DO?)
N=Normal
G=Growth (Fungal, algal, or bacterial mats)

INITIAL # OF ORGANISMS

ENDPOINT DATA & OBSERVATIONS

				DATE 9/24	DATE 9/25	DATE 9/26	DATE 9/27	DATE 9/28	DATE 9/29	DATE 9/30	DATE 10/1	DATE 10/2	DATE	
				TECHNICIAN CR	TECHNICIAN TS	TECHNICIAN CR	TECHNICIAN CR	TECHNICIAN CR	TECHNICIAN CR	TECHNICIAN TS	TECHNICIAN	TECHNICIAN ✓	TECHNICIAN	
CLIENT/ NEWFIELDS ID	REP	JAR #	INITIAL #	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	OBSERVNS	NUMBER ALIVE
MP-2 / .	1	37		N	G	G	G	G	G	G	G	G		17
	2	24		↓	G	G	↓	↓	↓	↓	↓	↓		19
	3	58		↓	G	G	↓	↓	↓	↓	↓	↓		19
	4	28		↓	G	G	↓	↓	↓	↓	↓	↓		17
	5	36		↓	N	G	↓	↓	↓	↓	↓	↓		18
MP-3 / .	1	91		↓	G	G	↓	↓	↓	↓	↓	↓		14
	2	95		G	G	G	↓	↓	↓	↓	↓	↓		14
	3	56		N	G	G	↓	↓	↓	↓	↓	↓		15
	4	70		↓	G	G	↓	↓	↓	↓	↓	↓		18
	5	33		↓	N	G	↓	↓	↓	↓	↓	↓		15
MP-4 / .	1	94		↓	↓	G	↓	↓	↓	↓	↓	↓		14
	2	11		↓	↓	G	↓	↓	↓	↓	↓	↓		15
	3	1		↓	↓	N	↓	↓	↓	↓	↓	↓		15
	4	84		↓	G	G	↓	↓	↓	↓	↓	↓		15
	5	60		↓	G	G	↓	↓	↓	↓	↓	↓		14
MP-5 / .	6	54		↓	N	G	↓	↓	↓	↓	↓	↓		14
	7	67		↓	↓	G	↓	↓	↓	↓	↓	↓		15
	8	44		↓	↓	G	↓	↓	↓	↓	↓	↓		14
	9	23		↓	↓	G	↓	↓	↓	↓	↓	↓		14
	10	9		↓	↓	N	↓	↓	↓	↓	↓	↓		14

NEWFIELDS

10-DAY SOLID PHASE TEST OBSERVATION DATA

CLIENT	PROJECT	NEWFIELDS JOB NO.	PROJECT MAN.	NEWFIELDS LABORATOR	PROTOCOL	SPECIES
AMEC - Geomatrix	March Point	1437-001-860-1	M. Pinza	Port Gamble Bath 4	PSEP 1995	*Ampelisca abdida*

#E= Emergence (Surface of sediment, swimming in water column, or floating on surface)
#M= Number of Mortality
D=No Air Flow (DO?)
N=Normal
G=Growth (Fungal, algal, or bacterial mats)

INITIAL # OF ORGANISMS:

ENDPOINT DATA & OBSERVATIONS

CLIENT/ NEWFIELDS ID	REP	JAR #	INITIAL #	DATE 9/24 TECHNICIAN CR OBSERVNS	DATE 9/25 TECHNICIAN TS OBSERVNS	DATE 9/26 TECHNICIAN CR OBSERVNS	DATE 9/27 TECHNICIAN CR OBSERVNS	DATE 9/28 TECHNICIAN CR OBSERVNS	DATE 9/29 TECHNICIAN CR OBSERVNS	DATE 9/30 TECHNICIAN TJ OBSERVNS	DATE 10/1 TECHNICIAN TS OBSERVNS	DATE 10/2 TECHNICIAN + OBSERVNS	DATE TECHNICIAN OBSERVNS	NUMBER ALIVE
MP-6 / .	1	34		N	N	N	G	G	G	G	G	G		17
	2	80		↓	G	G	↓	↓	↓	↓	↓	↓		20
	3	40		↓	N	N	↓	↓	↓	↓	↓	↓		18
	4	32		↓	G	G	↓	↓	↓	↓	↓	↓		18
	5	13		↓	G	N	↓	↓	↓	↓	↓	↓		15
MP-7 / .	1	83		↓	N	↓	N	N	N	N	G	G		15
	2	14		↓	↓	↓	↓	↓	↓	↓	G	↓		10
	3	93		↓	↓	↓	↓	↓	↓	↓	N	↓		15
	4	81		↓	↓	↓	↓	↓	↓	↓	G	↓		16
	5	26		↓	↓	↓	↓	↓	↓	↓	G	↓		18
MP-8 / .	1	87		↓	G	G	G	G	G	G	G	N		18
	2	92		↓	G	N	↓	↓	↓	↓	↓	↓		18
	3	53		↓	N	G	↓	↓	↓	↓	↓	↓		17
	4	79		↓	G	G	↓	↓	↓	↓	↓	↓		18
	5	41		1E	N	G	↓	↓	↓	↓	↓	↓		17
MP-9 / .	1	77		N	↓	G	G	G	G	G	↓	N		18
	2	57		↓	↓	N	N	N	N	↓	↓	↓		16
	3	49		↓	↓	↓	N	N	N	↓	↓	↓		18
	4	29		↓	↓	↓	G	G	G	↓	↓	↓		16
	5	61		1E	↓	↓	G	G	G	↓	↓	↓		7

10-DAY SOLID PHASE TEST OBSERVATION DATA

NEWFIELDS

CLIENT	PROJECT	NEWFIELDS JOB NO.	PROJECT MAN.	NEWFIELDS LABORATOR	PROTOCOL	SPECIES
AMEC - Geomatrix	March Point	1437-001-860-1	M. Pinza	Port Gamble Bath 4	PSEP 1995	*Ampelisca abdida*

#E= Emergence (Surface of sediment, swimming in water column, or floating on surface)
#M= Number of Mortality
D=No Air Flow (DO?)
N=Normal
G=Growth (Fungal, algal, or bacterial mats)

INITIAL # OF ORGANISMS

ENDPOINT DATA & OBSERVATIONS

CLIENT/ NEWFIELDS ID	REP	JAR #	INITIAL #	DATE 9/24 TECHNICIAN CR OBSERVNS	DATE 9/25 TECHNICIAN TS OBSERVNS	DATE 9/26 TECHNICIAN CR OBSERVNS	DATE 9/27 TECHNICIAN CR OBSERVNS	DATE 9/28 TECHNICIAN CR OBSERVNS	DATE 9/29 TECHNICIAN CR OBSERVNS	DATE 9/30 TECHNICIAN TS OBSERVNS	DATE 10/1 TECHNICIAN TS OBSERVNS	DATE 10/2 TECHNICIAN J OBSERVNS	DATE TECHNICIAN OBSERVNS	NUMBER ALIVE
MP-10 / .	1	35		N	G	G	G	G	G	G	G	G		20
	2	88		N	G	G	↓	↓	↓	↓	↓	↓		16
	3	82		N	G	G	↓	↓	↓	↓	↓	↓		15
	4	17		2E	G	G	↓	↓	↓	↓	↓	↓		16
	5	52		N	G	G	↓	↓	↓	↓	↓	↓		17
MP-11 / .	1	64		G	G	G	↓	↓	↓	↓	↓	↓		20
	2	74		G	G	G	↓	↓	↓	↓	↓	↓		18
	3	68		N	N	G	↓	↓	↓	↓	↓	↓		18
	4	90		G	G	G	↓	↓	↓	↓	↓	↓		16
	5	22		N	N	G	↓	↓	↓	↓	↓	↓		11
MP-12 / .	1	42		↓	↓	N	G	↓	↓	↓	↓	↓		18
	2	43		↓	↓	↓	G	↓	↓	↓	↓	↓		11
	3	72		↓	↓	↓	1M	↓	↓	↓	↓	↓		15
	4	31		↓	↓	↓	G	↓	↓	↓	↓	↓		17
	5	69		↓	↓	↓	G	↓	↓	↓	↓	↓		16
MP-13 / .	1	86		↓	G	G	G	↓	↓	↓	↓	↓		15
	2	65		↓	G	G	↓	↓	↓	↓	↓	↓		9
	3	96		↓	N	G	↓	↓	↓	↓	↓	↓		14
	4	39		↓	G	G	↓	↓	↓	↓	↓	↓		16
	5	25		↓	G	G		↓	↓	↓	↓	↓		18

NEWFIELDS

10-DAY SOLID PHASE TEST OBSERVATION DATA

CLIENT	PROJECT	NEWFIELDS JOB NO.	PROJECT MAN.	NEWFIELDS LABORATOR	PROTOCOL	SPECIES
AMEC - Geomatrix	March Point	1437-001-860-1	M. Pinza	Port Gamble Bath 4	PSEP 1995	*Ampelisca abdida*

#E= Emergence (Surface of sediment, swimming in water column, or floating on surface)
#M= Number of Mortality
D=No Air Flow (DO?)
N=Normal
G=Growth (Fungal, algal, or bacterial mats)

INITIAL # OF ORGANISMS: 20

ENDPOINT DATA & OBSERVATIONS

CLIENT/ NEWFIELDS ID	REP	JAR #	INITIAL #	DATE 10/1 TECHNICIAN TS OBSERVNS	DATE 10/2 TECHNICIAN [illegible] OBSERVNS	DATE 10/3 TECHNICIAN [illegible] OBSERVNS	DATE 10/4 TECHNICIAN MMB OBSERVNS	DATE 10/5 TECHNICIAN MMB OBSERVNS	DATE 10/6 TECHNICIAN MMB OBSERVNS	DATE 10/7 TECHNICIAN TS OBSERVNS	DATE 10/8 TECHNICIAN MMB OBSERVNS	DATE 10/9 TECHNICIAN TS OBSERVNS	DATE 10/10 TECHNICIAN CR OBSERVNS	NUMBER ALIVE
SBREF-80 /	1	38		N	N	H	N	N	N	N	N	N	N	12
	2	73		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	13
	3	48		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	19
	4	45		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	17
	5	66		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	20

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME /	DILUTION WATER BATCH FSW092208.01	TEST SPECIES *Ampelisca abdida*
				TEST START DATE 23-Sep-2008
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008

131.5

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp °C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
Control /	0	Surr	51	4	7.6	4	20.1	1	~~28~~ (1) 30	1	7.8	CR	9/23
Control /	1	Surr	51	4	7.5	4	20.5	1	30	1	8.0	CR	9/24
Control /	2	Surr	51	3	6.8	3	20.2	R	30	3	7.9	TS	9/25
Control /	3	Surr	51	3	7.0	3	20.3	R	30	3	7.8	TS	9/26
Control /	4	Surr	51	4	7.5	4	20.7	1	31	1	8.1	CR	9/27
Control /	5	Surr	51	4	7.7	4	20.0	1	31	1	8.1	CR	9/28
Control /	6	Surr	51	4	7.7	4	20.6	1	30	1	8.1	CR	9/29
Control /	7	Surr	51	4	7.7	4	20.6	1	30	1	8.1	TS	9/30
Control /	8	Surr	51	4	7.6	4	20.3	1	30	1	8.1	TS	10/1
Control /	9	Surr	51	3	7.1	3	20.3	R	31	3	8.1	[illegible]	10/2
Control /	10	Surr	51	4	7.6	4	20.3	1	30	1	8.3	MPP	10/3

(1) WP CR 9/23

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

(315

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
				TEST START DATE 23-Sep-2008
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	D.O.		TEMP		SALINITY		pH		TECH.	Date
				meter	mg/L	meter	°C	meter	ppt	meter	unit		
CR-1 / .	0	Surr	46	4	7.4	4	20.2	1	29	1	7.7	CR	9/23
CR-1 / .	1	Surr	46	4	7.6	4	20.4	1	30	1	8.0	CR	9/24
CR-1 / .	2	Surr	46	3	6.8	3	20.2	R	30	3	7.9	TS	9/25
CR-1 / .	3	Surr	46	3	7.2	3	20.3	R	30	3	7.9	TS	9/26
CR-1 / .	4	Surr	46	4	7.6	4	20.6	1	31	1	8.1	CR	9/27
CR-1 / .	5	Surr	46	4	7.7	4	20.0	1	31	1	8.0	CR	9/28
CR-1 / .	6	Surr	46	4	7.6	4	20.6	1	30	1	8.1	CR	9/29
CR-1 / .	7	Surr	46	4	7.6	4	20.6	1	30	1	8.1	TS	9/30
CR-1 / .	8	Surr	46	4	7.6	4	20.3	1	30	1	8.2	TS	10/1
CR-1 / .	9	Surr	46	3	7.1	3	20.3	R	30	3	8.2	[illegible]	10/2
CR-1 / .	10	Surr	46	4	7.6	4	20.3	1	30	1	8.3	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT: AMEC - Geomatrix	PROJECT: March Point	START TIME/ END TIME: /	DILUTION WATER BATCH: FSW092208.01	TEST SPECIES: *Ampelisca abdida*
NEWFIELDS JOB NUMBER: 1437-001-860-1	PROJECT MANAGER: M. Pinza	NEWFIELDS LABORATORY: Port Gamble/Bath 4	TEMP. RECDR./HOBO#:	TEST START DATE: 23-Sep-2008 1315
				TEST END DATE: 3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
SBREF-80 / .	0	Surr	50	4	7.5	4	20.2	1	28	1	7.8	CR	9/23
SBREF-80 / .	1	Surr	50	4	7.5	4	20.4	1	29	1	8.0	CR	9/24
SBREF-80 / .	2	Surr	50	3	6.8	3	20.2	R	29	3	7.9	TS	9/25
SBREF-80 / .	3	Surr	50	3	7.1	3	20.3	R	28	3	7.9	TS	9/26
SBREF-80 / .	4	Surr	50	4	7.5	4	20.7	1	30	1	8.2	CR	9/27
SBREF-80 / .	5	Surr	50	4	7.6	4	20.1	1	30	1	8.2	CR	9/28
SBREF-80 / .	6	Surr	50	4	7.6	4	20.6	1	29	1	8.3	CR	9/29
SBREF-80 / .	7	Surr	50	4	7.6	4	20.7	1	29	1	8.3	TS	9/30
SBREF-80 / .	8	Surr	50	4	7.5	4	20.3	1	29	1	8.3	TS	10/1
SBREF-80 / .	9	Surr	50	3	7.1	3	20.3	R	30	3	8.3	✓	10/2
SBREF-80 / .	10	Surr	50	4	7.5	4	20.3	1	29	1	8.4	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST START DATE 23-Sep-2008
				TEST END DATE 3-Oct-2008

1315

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	D.O.		TEMP		SALINITY		pH		TECH.	Date
				meter	mg/L	meter	°C	meter	ppt	meter	unit		
MP-1 / .	0	Surr	7	4	7.7	4	20.1	1	28	1	7.7	CR	9/23
MP-1 / .	1	Surr	7	4	7.4	4	20.4	1	28	1	8.0	CR	9/24
MP-1 / .	2	Surr	7	3	6.9	3	20.2	R	28	3	7.8	TS	9/25
MP-1 / .	3	Surr	7	3	6.6	3	20.2	R	26	3	7.8	TS	9/26
MP-1 / .	4	Surr	7	4	7.3	4	20.7	1	28	1	8.0	CR	9/27
MP-1 / .	5	Surr	7	4	7.5	4	20.0	1	28	1	8.0	CR	9/28
MP-1 / .	6	Surr	7	4	7.5	4	20.6	1	26	1	7.9	CR	9/29
MP-1 / .	7	Surr	7	4	7.7	4	20.5	1	① ~~28~~ 26	1	① ~~8.2~~ 7.9	TS	9/30
MP-1 / .	8	Surr	7	4	7.5	4	20.2	1	26	1	8.0	TS	10/1
MP-1 / .	9	Surr	7	3	7.0	3	20.1	R	26	3	7.9	J	10/2
MP-1 / .	10	Surr	7	4	7.6	4	20.2	1	26	1	8.2		10/3

① WE 9/30/08 TS

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME /	DILUTION WATER BATCH FSW092208.01	TEST SPECIES *Ampelisca abdida*
				TEST START DATE 23-Sep-2008 1315
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	TECH.	Date
MP-2 / .	0	Surr	71	4	7.6	4	20.2	1	28	1	7.7	CR	9/23
MP-2 / .	1	Surr	71	4	7.5	4	20.5	1	28	1	7.8	CR	9/24
MP-2 / .	2	Surr	71	3	6.9	3	20.3	R	28	3	7.8	TS	9/25
MP-2 / .	3	Surr	71	3	6.9	3	20.3	R	28	3	7.9	TS	9/26
MP-2 / .	4	Surr	71	4	6.8	4	20.8	1	29	1	8.1	CR	9/27
MP-2 / .	5	Surr	71	4	7.2	4	20.0	1	29	1	8.1	CR	9/28
MP-2 / .	6	Surr	71	4	7.5	4	20.7	1	27	1	8.4	CR	9/29
MP-2 / .	7	Surr	71	4	7.7	4	20.7	1	28	1	8.6	TS	9/30
MP-2 / .	8	Surr	71	4	7.7	4	20.3	1	28	1	8.5	TS	10/1
MP-2 / .	9	Surr	71	3	7.1	3	20.3	R	28	3	8.5	[illegible]	10/2
MP-2 / .	10	Surr	71	4	7.6	4	20.4	1	28	1	8.5	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
NEWFIELDS JOB NUMBER	PROJECT MANAGER	NEWFIELDS LABORATORY	TEMP. RECDR./HOBO#	TEST START DATE
1437-001-860-1	M. Pinza	Port Gamble/Bath 4		23-Sep-2008
				TEST END DATE
				3-Oct-2008

1315

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	D.O.		TEMP		SALINITY		pH		TECH.	Date
				meter	mg/L	meter	°C	meter	ppt	meter	unit		
MP-3 / .	0	Surr	2	4	7.5	4	19.6	1	28	1	7.6	CR	9/23
MP-3 / .	1	Surr	2	4	7.1	4	19.6	1	28	1	7.5	CR	9/24
MP-3 / .	2	Surr	2	3	6.4	3	19.9	R	28	3	8.0	TS	9/25
MP-3 / .	3	Surr	2	3	6.6	3	20.0	R	28	3	7.9	TS	9/26
MP-3 / .	4	Surr	2	4	7.2	4	20.5	1	29	1	8.1	CR	9/27
MP-3 / .	5	Surr	2	4	6.0	4	19.7	1	29	1	8.2	CR	9/28
MP-3 / .	6	Surr	2	4	7.3	4	20.3	1	27	1	8.4	CR	9/29
MP-3 / .	7	Surr	2	4	7.5	4	20.4	1	27	1	8.5	TS	9/30
MP-3 / .	8	Surr	2	4	① ~~8.8~~ 7.5	4	20.0	1	27	1	8.4	TS	10/1
MP-3 / .	9	Surr	2	3	6.4	3	19.9	R	28	3	8.4	J	10/2
MP-3 / .	10	Surr	2	4	7.6	4	19.6	1	28	1	8.3	MPP	10/3

① WE 10/1/08 TS

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
NEWFIELDS JOB NUMBER	PROJECT MANAGER	NEWFIELDS LABORATORY	TEMP. RECDR./HOBO#	TEST START DATE
1437-001-860-1	M. Pinza	Port Gamble/Bath 4		23-Sep-2008 1315
				TEST END DATE
				3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp °C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-4 / .	0	Surr	20	4	7.4	4	20.1	1	28	1	7.7	CR	9/23
MP-4 / .	1	Surr	20	4	7.5	4	20.4	1	28	1	8.0	CR	9/24
MP-4 / .	2	Surr	20	3	7.1	3	20.2	R	28	3	7.9	TS	9/25
MP-4 / .	3	Surr	20	3	6.9	3	20.2	R	27	3	7.9	TS	9/26
MP-4 / .	4	Surr	20	4	7.5	4	20.7	1	28	1	8.1	CR	9/27
MP-4 / .	5	Surr	20	4	7.7	4	19.8	1	28	1	8.0	CR	9/28
MP-4 / .	6	Surr	20	4	7.6	4	20.5	1	26	1	8.0	CR	9/29
MP-4 / .	7	Surr	20	4	7.7	4	20.6	1	26	1	8.1	TS	9/30
MP-4 / .	8	Surr	20	4	7.7	4	20.2	1	27	1	8.1	TS	10/1
MP-4 / .	9	Surr	20	3	7.2	3	20.2	R	27	3	8.1	✓	10/2
MP-4 / .	10	Surr	20	4	7.6	4	20.2	1	27	1	8.3	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
NEWFIELDS JOB NUMBER	PROJECT MANAGER	NEWFIELDS LABORATORY	TEMP. RECDR./HOBO#	TEST START DATE
1437-001-860-1	M. Pinza	Port Gamble/Bath 4		23-Sep-2008 1315
				TEST END DATE
				3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-5 / .	0	Surr	12	4	7.5	4	20.1	1	28	1	7.7	CR	9/23
MP-5 / .	1	Surr	12	4	7.5	4	20.4	1	28	1	8.0	CR	9/24
MP-5 / .	2	Surr	12	3	6.9	3	20.1	R	28	3	7.9	TS	9/25
MP-5 / .	3	Surr	12	3	6.8	3	20.2	R	27	3	7.9	TS	9/26
MP-5 / .	4	Surr	12	4	7.5	4	20.7	1	29	1	8.1	CR	9/27
MP-5 / .	5	Surr	12	4	7.7	4	20.0	1	29	1	8.1	CR	9/28
MP-5 / .	6	Surr	12	4	7.7	4	20.5	1	28	1	8.1	CR	9/29
MP-5 / .	7	Surr	12	4	7.6	4	20.4	1	28	1	8.2	TS	9/30
MP-5 / .	8	Surr	12	4	7.7	4	20.2	1	28	1	8.1	TS	10/1
MP-5 / .	9	Surr	12	3	7.1	3	20.1	R	28	3	8.2	[illegible]	10/2
MP-5 / .	10	Surr	12	4	7.6	4	20.2	1	28	1	8.3	MPP	10/3

10 DAY SOLID PHASE TEST WATER QUALITY DATA

NEWFIELDS

CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME /	DILUTION WATER BATCH FSW092208.01	TEST SPECIES *Ampelisca abdida*
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST START DATE 23-Sep-2008
				TEST END DATE 3-Oct-2008

1315

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-6 / .	0	Surr	63	4	7.4	4	20.1	1	28	1	7.6	CR	9/23
MP-6 / .	1	Surr	63	4	7.3	4	20.5	1	28	1	7.8	CR	9/24
MP-6 / .	2	Surr	63	3	6.7	3	20.3	R	28	3	7.5	TS	9/25
MP-6 / .	3	Surr	63	3	6.9	3	20.3	R	27	3	7.4	TS	9/26
MP-6 / .	4	Surr	63	4	7.4	4	20.7	1	29	1	7.9	CR	9/27
MP-6 / .	5	Surr	63	4	7.6	4	20.1	1	29	1	7.6	CR	9/28
MP-6 / .	6	Surr	63	4	7.6	4	20.6	1	27	1	8.0	CR	9/29
MP-6 / .	7	Surr	63	4	7.6	4	20.7	1	28	1	8.1	TS	9/30
MP-6 / .	8	Surr	63	4	7.6	4	20.4	1	28	1	8.0	TS	10/1
MP-6 / .	9	Surr	63	3	7.2	3	20.3	R	28	3	7.4	[illegible]	10/2
MP-6 / .	10	Surr	63	4	7.6	4	20.3	1	28	1	8.3	MRP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

				TEST SPECIES *Ampelisca abdida*
CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME /	DILUTION WATER BATCH FSW092208.01	TEST START DATE 23-Sep-2008
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008

1315

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp °C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-7 / .	0	Surr	55	4	7.6	4	20.1	1	28	1	7.9	CR	9/23
MP-7 / .	1	Surr	55	4	7.5	4	20.5	1	28	1	8.1	CR	9/24
MP-7 / .	2	Surr	55	3	7.1	3	20.2	R	28	3	7.9	TS	9/25
MP-7 / .	3	Surr	55	3	7.0	3	20.3	R	28	3	7.9	TS	9/26
MP-7 / .	4	Surr	55	4	7.5	4	20.7	1	29	1	8.2	CR	9/27
MP-7 / .	5	Surr	55	4	7.5	4	20.0	1	29	1	8.1	CR	9/28
MP-7 / .	6	Surr	55	4	7.4	4	20.6	1	28	1	8.2	CR	9/29
MP-7 / .	7	Surr	55	4	7.6	4	20.7	1	28	1	8.3	TS	9/30
MP-7 / .	8	Surr	55	4	7.6	4	20.3	1	28	1	8.3	TS	10/1
MP-7 / .	9	Surr	55	3	7.2	3	20.3	R	29	3	8.5	✓	10/2
MP-7 / .	10	Surr	55	4	7.4	4	20.3	1	28	1	8.6	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

1315

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
				TEST START DATE 23-Sep-2008
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-8 / .	0	Surr	5	4	7.3	4	20.0	1	28	1	7.5	CR	9/23
MP-8 / .	1	Surr	5	4	6.6	4	20.3	1	28	1	7.6	CR	9/24
MP-8 / .	2	Surr	5	3	5.6	3	20.2	R	28	3	7.5	TS	9/25
MP-8 / .	3	Surr	5	3	6.1	3	20.2	R	28	3	7.6	TS	9/26
MP-8 / .	4	Surr	5	4	7.3	4	20.6	1	29	1	7.9	CR	9/27
MP-8 / .	5	Surr	5	4	7.4	4	19.9	1	29	1	7.8	CR	9/28
MP-8 / .	6	Surr	5	4	7.5	4	20.5	1	28	1	7.9	CR	9/29
MP-8 / .	7	Surr	5	4	7.6	4	20.5	1	28	1	8.1	TS	9/30
MP-8 / .	8	Surr	5	4	7.5	4	20.1	1	28	1	8.0	TS	10/1
MP-8 / .	9	Surr	5	3	7.0	3	20.1	R	28	3	8.0	J	10/2
MP-8 / .	10	Surr	5	4	7.5	4	20.0	1	28	1	8.1	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST START DATE 23-Sep-2008
				TEST END DATE 3-Oct-2008

1315

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp °C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-9 / .	0	Surr	4	4	7.3	4	19.9	1	28	1	7.6	CR	9/23
MP-9 / .	1	Surr	4	4	7.5	4	20.1	1	28	1	7.7	CR	9/24
MP-9 / .	2	Surr	4	3	6.8	3	20.0	R	28	3	7.8	[illegible]	9/25
MP-9 / .	3	Surr	4	3	7.0	3	20.1	R	28	3	7.7	TS	9/26
MP-9 / .	4	Surr	4	4	7.3	4	20.6	1	29	1	8.0	CR	9/27
MP-9 / .	5	Surr	4	4	7.5	4	19.9	1	29	1	7.9	CR	9/28
MP-9 / .	6	Surr	4	4	7.5	4	20.4	1	27	1	8.2	CR	9/29
MP-9 / .	7	Surr	4	4	7.6	4	20.5	1	28	1	8.2	TJ	9/30
MP-9 / .	8	Surr	4	4	7.6	4	20.1	1	28	1	8.1	TS	10/1
MP-9 / .	9	Surr	4	3	7.0	3	20.0	R	28	3	7.9	[illegible]	10/2
MP-9 / .	10	Surr	4	4	7.6	4	19.8	1	28	1	8.2	MRP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

				TEST SPECIES *Ampelisca abdida*
CLIENT AMEC - Geomatrix	**PROJECT** March Point	**START TIME/ END TIME** /	**DILUTION WATER BATCH** FSW092208.01	**TEST START DATE** 23-Sep-2008
NEWFIELDS JOB NUMBER 1437-001-860-1	**PROJECT MANAGER** M. Pinza	**NEWFIELDS LABORATORY** Port Gamble/Bath 4	**TEMP. RECDR./HOBO#**	**TEST END DATE** 3-Oct-2008

1315

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp °C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	TECH.	Date
MP-10 / .	0	Surr	6	4	7.4	4	20.1	1	28	1	7.6	CR	9/23/08
MP-10 / .	1	Surr	6	4	7.1	4	20.4	1	28	1	7.7	CR	9/24
MP-10 / .	2	Surr	6	3	6.8	3	20.2	R	28	3	7.7	TS	9/25
MP-10 / .	3	Surr	6	3	6.7	3	20.2	R	28	3	7.8	TS	9/26
MP-10 / .	4	Surr	6	4	7.2	4	20.7	1	29	1	8.1	CR	9/27
MP-10 / .	5	Surr	6	4	7.3	4	19.9	1	29	1	8.1	CR	9/28
MP-10 / .	6	Surr	6	4	7.5	4	20.5	1	28	1	8.2	CR	9/29
MP-10 / .	7	Surr	6	4	7.6	4	20.6	1	28	1	8.2	TS	9/30
MP-10 / .	8	Surr	6	4	7.4	4	20.1	1	28	1	8.2	TS	10/1
MP-10 / .	9	Surr	6	3	7.1	3	20.1	R	28	3	8.2	[illegible]	10/2
MP-10 / .	10	Surr	6	4	7.6	4	20.2	1	28	1	8.3	MRP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

				TEST SPECIES *Ampelisca abdida*	
CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME /	DILUTION WATER BATCH FSW092208.01	TEST START DATE 23-Sep-2008	1315
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008	

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp °C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-11 / .	0	Surr	27	4	7.5	4	20.2	1	28	1	7.7	CR	9/23
MP-11 / .	1	Surr	27	4	7.6	4	20.4	1	28	1	8.0	CR	9/24
MP-11 / .	2	Surr	27	3	7.0	3	20.2	R	28	3	8.0	TJ	9/25
MP-11 / .	3	Surr	27	3	7.2	3	20.2	R	28	3	7.9	TJ	9/26
MP-11 / .	4	Surr	27	4	7.5	4	20.6	1	29	1	8.1	CR	9/27
MP-11 / .	5	Surr	27	4	7.8	4	19.8	1	29	1	8.0	CR	9/28
MP-11 / .	6	Surr	27	4	7.7	4	20.5	1	28	1	8.2	CR	9/29
MP-11 / .	7	Surr	27	4	7.7	4	20.6	1	28	1	8.2	TJ	9/30
MP-11 / .	8	Surr	27	4	7.7	4	20.1	1	29	1	8.2	TJ	10/1
MP-11 / .	9	Surr	27	3	7.3	3	20.2	R	30	3	8.3	[illegible]	10/2
MP-11 / .	10	Surr	27	4	7.6	4	20.3	1	29	1	8.4	MRP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME /	DILUTION WATER BATCH FSW092208.01	TEST SPECIES *Ampelisca abdida*	
				TEST START DATE 23-Sep-2008	1315
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 3-Oct-2008	

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-12 / .	0	Surr	18	4	7.6	4	20.1	1	28	1	7.8	CR	9/23
MP-12 / .	1	Surr	18	4	7.6	4	20.4	1	28	1	8.0	CR	9/24
MP-12 / .	2	Surr	18	3	6.9	3	20.2	R	28	3	7.9	TS	9/25
MP-12 / .	3	Surr	18	3	7.0	3	20.2	R	27	3	8.0	TS	9/26
MP-12 / .	4	Surr	18	4	7.6	4	20.7	1	29	1	8.1	CR	9/27
MP-12 / .	5	Surr	18	4	7.7	4	19.9	1	29	1	8.1	CR	9/28
MP-12 / .	6	Surr	18	4	7.7	4	20.6	1	28	1	8.2	CR	9/29
MP-12 / .	7	Surr	18	4	7.7	4	20.5	1	28	1	8.2	TS	9/30
MP-12 / .	8	Surr	18	4	7.7	4	20.2	1	28	1	8.3	TS	10/1
MP-12 / .	9	Surr	18	3	7.2	3	20.3	R	29	3	8.3	J	10/2
MP-12 / .	10	Surr	18	4	7.7	4	20.3	1	28	1	8.4	MRP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

CLIENT	PROJECT	START TIME/ END TIME	DILUTION WATER BATCH	TEST SPECIES
AMEC - Geomatrix	March Point	/	FSW092208.01	*Ampelisca abdida*
NEWFIELDS JOB NUMBER	PROJECT MANAGER	NEWFIELDS LABORATORY	TEMP. RECDR./HOBO#	TEST START DATE
1437-001-860-1	M. Pinza	Port Gamble/Bath 4		23-Sep-2008 1315
				TEST END DATE
				3-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
MP-13 / .	0	Surr	75	4	7.7	4	20.2	1	28	1	7.8	CR	9/23
MP-13 / .	1	Surr	75	4	7.6	4	20.5	1	28	1	8.1	CR	9/24
MP-13 / .	2	Surr	75	3	7.0	3	20.3	R	28	3	8.0	TS	9/25
MP-13 / .	3	Surr	75	3	7.3	3	20.3	R	29	3	8.0	TS	9/26
MP-13 / .	4	Surr	75	4	7.4	4	20.7	1	29	1	8.3	CR	9/27
MP-13 / .	5	Surr	75	4	7.6	4	20.0	1	29	1	8.2	CR	9/28
MP-13 / .	6	Surr	75	4	7.7	4	20.7	1	28	1	8.4	CR	9/29
MP-13 / .	7	Surr	75	4	7.7	4	20.6	1	28	1	8.5	TS	9/30
MP-13 / .	8	Surr	75	4	7.8	4	20.3	1	28	1	8.4	TS	10/1
MP-13 / .	9	Surr	75	3	7.2	3	20.3	R	29	3	8.5	[illegible]	10/2
MP-13 / .	10	Surr	75	4	7.6	4	20.4	1	28	1	8.6	MPP	10/3

NEWFIELDS

10 DAY SOLID PHASE TEST WATER QUALITY DATA

				TEST SPECIES *Ampelisca abdida*
CLIENT AMEC - Geomatrix	PROJECT March Point	START TIME/ END TIME 1700 /	DILUTION WATER BATCH FSW092908.01	TEST START DATE 30-Sep-2008
NEWFIELDS JOB NUMBER 1437-001-860-1	PROJECT MANAGER M. Pinza	NEWFIELDS LABORATORY Port Gamble/Bath 4	TEMP. RECDR./HOBO#	TEST END DATE 10-Oct-2008

WATER QUALITY DATA

Test Conditions				DO (mg/L) > 4.6		Temp ° C 20 ± 1		SALINITY (ppt) 28 ± 1		pH (pH units) 7.8 ± 0.5		Initials & Date	
				D.O.		TEMP		SALINITY		pH			
CLIENT/NEWFIELDS ID	DAY	REP	JAR #	meter	mg/L	meter	°C	meter	ppt	meter	unit	TECH.	Date
SBREF-80 /	0	Surr	51	4	8.9	4	20.1	1	28	1	7.6	TS	~~10/1~~ 9/30
SBREF-80 /	1	Surr	51	4	7.6	4	20.2	1	27	1	7.7	TS	10/1
SBREF-80 /	2	Surr	51	3	7.1	3	20.0	R	28	3	8.0	[illegible]	10/2
SBREF-80 /	3	Surr	51	4	7.6	4	20.1	1	28	1	8.3	MRP	10/3
SBREF-80 /	4	Surr	51	4	7.6	4	20.3	1	28	1	8.2	MMB	10/4
SBREF-80 /	5	Surr	51	4	7.7	4	20.2	1	28	1	8.2	MMB	10/5
SBREF-80 /	6	Surr	51	4	7.2	4	20.3	R	27	1	8.2	MMB	10/6
SBREF-80 /	7	Surr	51	4	7.8	4	19.4	1	29	1	8.1	TS	10/7
SBREF-80 /	8	Surr	51	3	7.2	3	19.9	R	30	3	8.1	MMB	10/8
SBREF-80 /	9	Surr	51	4	7.7	4	19.7	1	30	1	8.0	TS	10/9
SBREF-80 /	10	Surr	51	3	6.9	3	19.7	R	30	3	8.2	CR	10/10

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
March Point	Ampelisca		10

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY of TEST: 0
OVERLYING (OV) / POREWATER (PW) (circle one)

Calibration Standards Temperature		
Date:	Temperature:	Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
9/23/08	19.5°C	

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
Control	surr	9/23/08 CR	2.21	19.5	9/23/08 CR	N			0.012
CR-1	↓	↓	<0.5		↓	↓			0.017
SB Ref			0.845						0.653
MP-1			3.46						0.005
MP-2			1.67						0.004
MP-3			1.69						0.005
MP-4			1.11						0.008
MP-5			1.36						0.008
MP-6			1.23						~~0.037~~ 0.015 ①
MP-7			1.17						0.076
MP-8			2.49						0.004
MP-9			0.662						0.007
MP-10			1.40						0.037
MP-11			1.06						0.036
MP-12			1.24						0.060
MP-13	↓	↓	1.02		↓	↓			0.019

① WC CR 9/23

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
Geomatrix/ March Point	Amps		10

PRETEST / INITIAL / FINAL / ~~OTHER (circle~~ one) DAY of TEST: 0
OVERLYING (OV) / POREWATER (PW) (circle one)

(INITIAL and POREWATER circled)

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	Temperature:	
23 September 2008	19.5	

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
Control	Surr.	9/23/08 MMB	3.20	20.0	9/23/08 CR	N	7.5	30	0.060
CR-1	Surr.	↓	1.85		↓	N	7.4	29	0.088
SBREF-80	Surr.		4.03			N	7.3	30	13.1
MP-1	Surr.		5.39			N	7.2	27	0.059
MP-2	Surr.		3.02			N	7.2	28	0.047
MP-3	Surr.		4.55			N	7.4	28	0.041
MP-4	Surr.		2.62			N	7.2	26	0.032
MP-5	Surr.		2.17			N	7.2	28	0.116
MP-6	Surr.		1.47			N	7.0	28	0.026
MP-7	Surr.		2.30			N	7.2	28	0.034
MP-8	Surr.		3.18			N	7.1	28	0.059
MP-9	Surr.		1.33			N	7.1	28	0.086
MP-10	Surr.		3.02			N	7.1	28	4.06
MP-11	Surr.		2.11			N	7.2	28	1.96
MP-12	Surr.		2.46			N	7.2	28	0.023
MP-13	Surr.		2.90			N	7.3	29	0.035

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
Geomatrix Marchpoint	Amps		~~20~~ 10d

PRETEST / INITIAL / FINAL / OTHER (circle one) (FINAL circled) **DAY of TEST:** _____

OVERLYING (OV) / POREWATER (PW) (circle one) (OVERLYING (OV) circled)

Calibration Standards Temperature		Sample temperature should be within $\pm 1^{o}C$ of standards temperature at time and date of analysis.
Date:	Temperature:	
10/3/08	20.0	

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
Ø	Surr	TS 10/3/08	<0.5	19.0	TS 10/3/08	N	NA →		0.008
CR-1 Ref	↓	↓	<0.5	↓	↓	↓		↓	0.011
53 Ref 80	↓	↓	2.51	↓	↓	↓		↓	0.007
MP-1	↓	↓	<0.5	↓	↓	↓		↓	0.005
2	↓	↓	<0.5	↓	↓	↓		↓	0.007
3	↓	↓	2.02	↓	↓	↓		↓	0.010
4	↓	↓	<0.5	↓	↓	↓		↓	0.005
5	↓	↓	<0.5	↓	↓	↓		↓	0.005
6	↓	↓	<0.5	↓	↓	↓		↓	0.005
7	↓	↓	<0.5	↓	↓	↓		↓	0.007
8	↓	↓	<0.5	↓	↓	↓		↓	0.006
9	↓	↓	<0.5	↓	↓	↓		↓	0.010
10	↓	↓	<0.5	↓	↓	↓		↓	0.014
11	↓	↓	<0.5	↓	↓	↓		↓	0.012
12	↓	↓	<0.5	↓	↓	↓		↓	0.006
13	↓	↓	<0.5	↓	↓	↓		↓	0.004

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
Geomatrix Marchpoint	Amps		10d

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY of TEST: _____
OVERLYING (OV) / POREWATER (PW) (circle one)

(FINAL and POREWATER (PW) circled)

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	Temperature:	
10/3/08	20.0	
10/14/08 (Ammonia)	18	

Reading taken 10/14/08 MRP

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
Ø	Surr	TB 10/3/08	<0.5	20.3	TB 10/3/08	N	7.6	31	0.105
CP-1 Ref	↓	↓	<0.5	20.3	↓	↓	7.5	32	0.082
SB Ref 80			2.02	20.3			7.2	30	0.072
MP-1			0.97	20.4			7.2	26	0.053
2			0.52	20.3			7.2	27	0.030
3			3.41	20.3			7.4	27	0.070
4			0.69	20.3			7.0	26	0.034
5			0.96	20.4			7.0	26	0.053
6			<0.5	20.5			6.9	28	0.036
7			<0.5	20.5			7.0	28	0.033
8			Not Available - sample spilled before measurements taken.						
9			<0.5	20.3			7.1	28	0.070
10			0.65	20.4			7.1	28	0.042
11			<0.5	20.5			7.1	29	0.049
12			<0.5	20.5			7.4	28	0.037
13			<0.5	20.3			7.4	28	0.038

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
Marchpoint /SBRef80	Ampelisca		10d

PRETEST / INITIAL / FINAL / OTHER (circle one) DAY of TEST: 14
OVERLYING (OV) / POREWATER (PW) (circle one)

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	Temperature:	
10/14/08	18.0	

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
overlying SBRef 80	surr	TS 10/14/08	<0.5	18.0	TS 10/14/08	N	NA →		.015
porewater ↓	↓	↓	<0.5		↓	N	7.2	30	.075

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
Marchpoint	Ampelisca		20

PRETEST / ~~INITIAL / FINAL~~ / ~~OTHER~~ (circle one) DAY of TEST: _____
OVERLYING (OV) / POREWATER (PW) (circle one)

Calibration Standards Temperature	
Date:	Temperature:
~~NA~~ 9/30/08	20.0

Sample temperature should be within ±1°C of standards temperature at time and date of analysis.

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
SBRef 80-Acclimated		TJ 9/29/08	Overlying sample			N	NA →		0.027
"		↓	porewater sample			N	↓	30	0.202
SB Ref 80-Acc		TJ 9/30/08	<0.5 ~~Over~~ (1)	19.5	overlying	N	—	—	
"		↓	0.929	19.5	porewater	N	—	—	

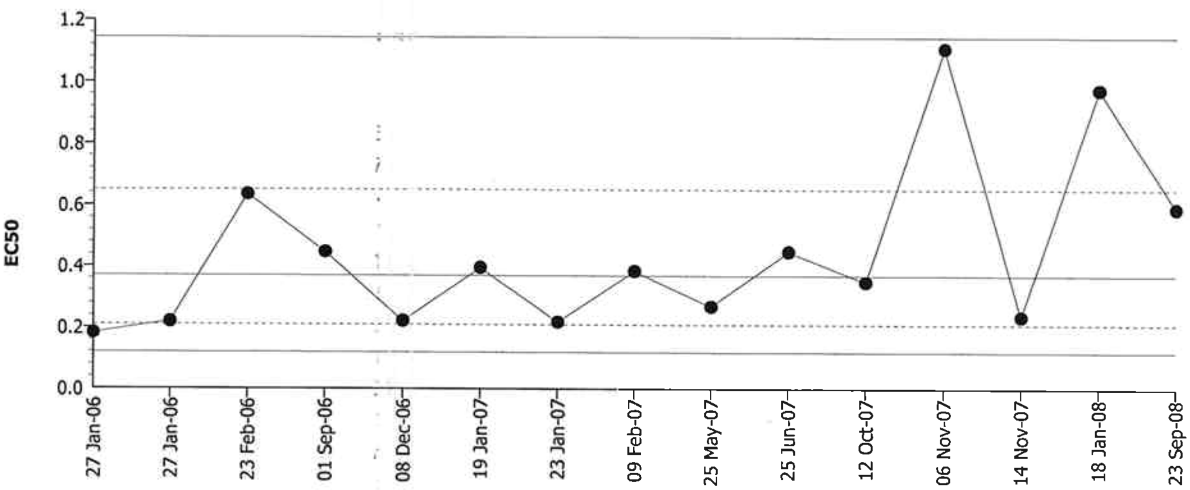
(1) WE 9/30/08 TJ

CETIS QC Chart

Report Date: 04 Nov-08 3:27 PM

Reference Toxicant 96-h Acute Survival Test | **NewFields**

Test Type: Survival
Protocol: PSEP (1995)
Organism: Ampelisca abdita (Amphipod)
Endpoint: Proportion Survived
Material: Cadmium chloride
Source: Reference Toxicant-REF



Mean: 0.36924 **Count:** 14 **-1s Warning Limit:** 0.20975 **-2s Action Limit:** 0.11915
Sigma: **CV:** 76.04% **+1s Warning Limit:** 0.65001 **+2s Action Limit:** 1.14427

Quality Control Data

Point	Year	Month	Day	Data	Delta	Sigma	Warning	Action	Test Link	Analysis
1	2006	Jan	27	0.18090	-0.18833	-1.26159	(-)		07-5435-8129	06-2014-1066
2			27	0.21846	-0.15077	-0.92798			02-3876-2955	12-1597-4541
3		Feb	23	0.63498	0.26574	0.95864			17-3687-3273	06-7672-2441
4		Sep	1	0.44694	0.07771	0.33772			11-8706-7493	01-2691-7469
5		Dec	8	0.22112	-0.14812	-0.90662			01-8163-5765	09-7294-9655
6	2007	Jan	19	0.39559	0.02635	0.12188			05-1919-0451	04-7876-6509
7			23	0.21727	-0.15196	-0.93766			13-4550-6899	02-3067-5161
8		Feb	9	0.38474	0.01550	0.07271			04-8872-6896	02-4257-0063
9		May	25	0.26923	-0.10001	-0.55854			16-5938-6055	08-1846-1770
10		Jun	25	0.44847	0.07923	0.34375			02-7818-3113	07-6434-4735
11		Oct	12	0.34850	-0.02073	-0.10218			07-2723-0368	03-4167-3848
12		Nov	6	1.10809	0.73886	1.94319	(+)		02-8822-1003	13-2266-5070
13			14	0.23515	-0.13409	-0.79788			10-0087-4493	11-2555-9069
14	2008	Jan	18	0.97369	0.60446	1.71456	(+)		16-7804-5373	13-2534-3341
15		Sep	23	0.58928	0.22005	0.82659			03-2847-7880	18-3138-3652

Analyst:________ Approval:________

CETIS Analysis Detail

Reference Toxicant 96-h Acute Survival Test | **NewFields**

Endpoint	Analysis Type	Sample Link	Control Link	Date Analyzed	Version
Proportion Survived	Comparison	03-2847-7880	03-2847-7880	04 Nov-08 1:38 PM	CETISv1.1.2

Method	Alt H	Data Transform	Zeta
Dunnett's Multiple Comparison	C > T	Angular (Corrected)	

NOEL	LOEL	Toxic Units	ChV	PMSD
0.25	0.5	400	0.35355	22.57%

Group Comparisons

Control vs	Conc-mg/L	Statistic	Critical	P-Value	MSD	Decision(0.05)
Dilution Water	0.125	1.70338	2.46559	0.1605	0.29419	Non-Significant Effect
	0.25	1.70338	2.46559	0.1605	0.29419	Non-Significant Effect
	0.5	4.39995	2.46559	0.0022	0.29419	Significant Effect
	1	6.87533	2.46559	0.0001	0.29419	Significant Effect

ANOVA Table

Source	Sum of Squares	Mean Square	DF	F Statistic	P-Value	Decision(0.05)
Between	1.252291	0.3130727	4	14.66	0.00035	Significant Effect
Error	0.2135537	0.0213554	10			
Total	1.46584442	0.3344281	14			

ANOVA Assumptions

Attribute	Test	Statistic	Critical	P-Value	Decision(0.01)
Variances	Modified Levene	6.01492	5.99434	0.00989	Unequal Variances
Distribution	Shapiro-Wilk W	0.88543		0.05723	Normal Distribution

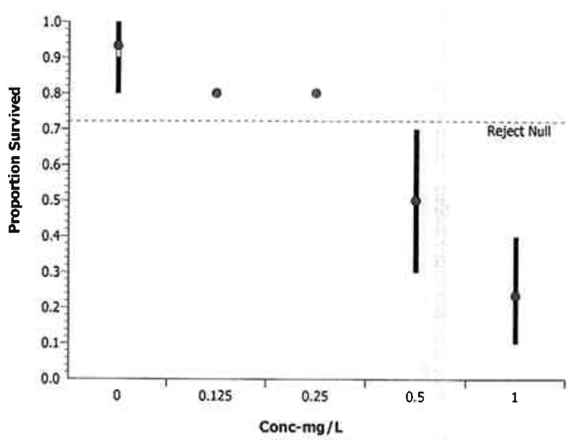
Data Summary

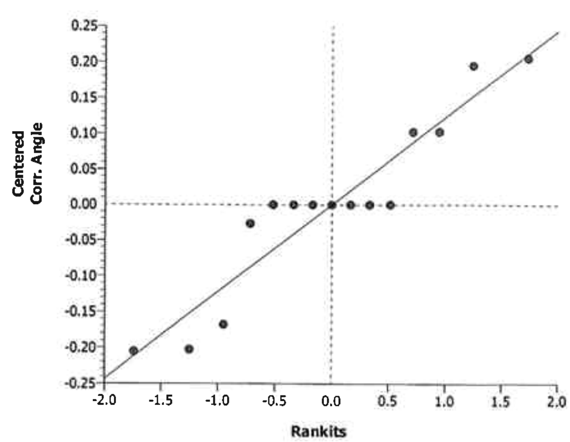
			Original Data				Transformed Data			
Conc-mg/L	Control Type	Count	Mean	Minimum	Maximum	SD	Mean	Minimum	Maximum	SD
0	Dilution Water	3	0.93333	0.80000	1.00000	0.11547	1.31039	1.10715	1.41202	0.17602
0.125		3	0.80000	0.80000	0.80000	0.00020	1.10715	1.10715	1.10715	0.00027
0.25		3	0.80000	0.80000	0.80000	0.00020	1.10715	1.10715	1.10715	0.00027
0.5		3	0.50000	0.30000	0.70000	0.20000	0.78540	0.57964	0.99116	0.20576
1		3	0.23333	0.10000	0.40000	0.15275	0.49004	0.32175	0.68472	0.18292

Data Detail

Conc-mg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Dilution Water	1.00000	1.00000	0.80000							
0.125		0.80000	0.80000	0.80000							
0.25		0.80000	0.80000	0.80000							
0.5		0.70000	0.30000	0.50000							
1		0.20000	0.40000	0.10000							

Graphics





CETIS Analysis Detail

Reference Toxicant 96-h Acute Survival Test — **NewFields**

Endpoint	Analysis Type	Sample Link	Control Link	Date Analyzed	Version
Proportion Survived	Linear Regression	03-2847-7880	03-2847-7880	04 Nov-08 1:40 PM	CETISv1.1.2

Linear Regression Options

Model Function	Threshold Option	Threshold	Threshold Opt	Reweighted	Pooled Groups	Het Corr
Log-Normal [NED=A+B*log(X)]	Control Threshold	0.06666667	Yes	Yes	No	No

Regression Summary

Iters	Log Likelihood	Mu	Sigma	G	Chi-Sq	Critical	P-Value	Decision(0.05)
19	-60.16584	1.60851	0.27577	0.16348	9.01521	22.36203	0.77179	Non-Significant Heterogeneity

Point Estimates

% Effect	Conc-mg/L	95% LCL	95% UCL
10	0.2611648	0.1168286	0.380091
15	0.3051479	0.1504196	0.428295
20	0.3453291	0.1835419	0.4717972
25	0.3839925	0.2173257	0.5135376
40	0.5017188	0.3288402	0.6432288
50	0.5892849	0.4163774	0.746276

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Statistic	P-Value	Decision(0.05)
Threshold	0.1276308	0.04465401	0.04010889	0.2151526	2.858	0.01344	Significant
Slope	3.626239	0.748043	2.160074	5.092403	4.848	0.00032	Significant
Intercept	5.832855	0.219061	5.403496	6.262215	26.627	0.00000	Significant

Residual Analysis

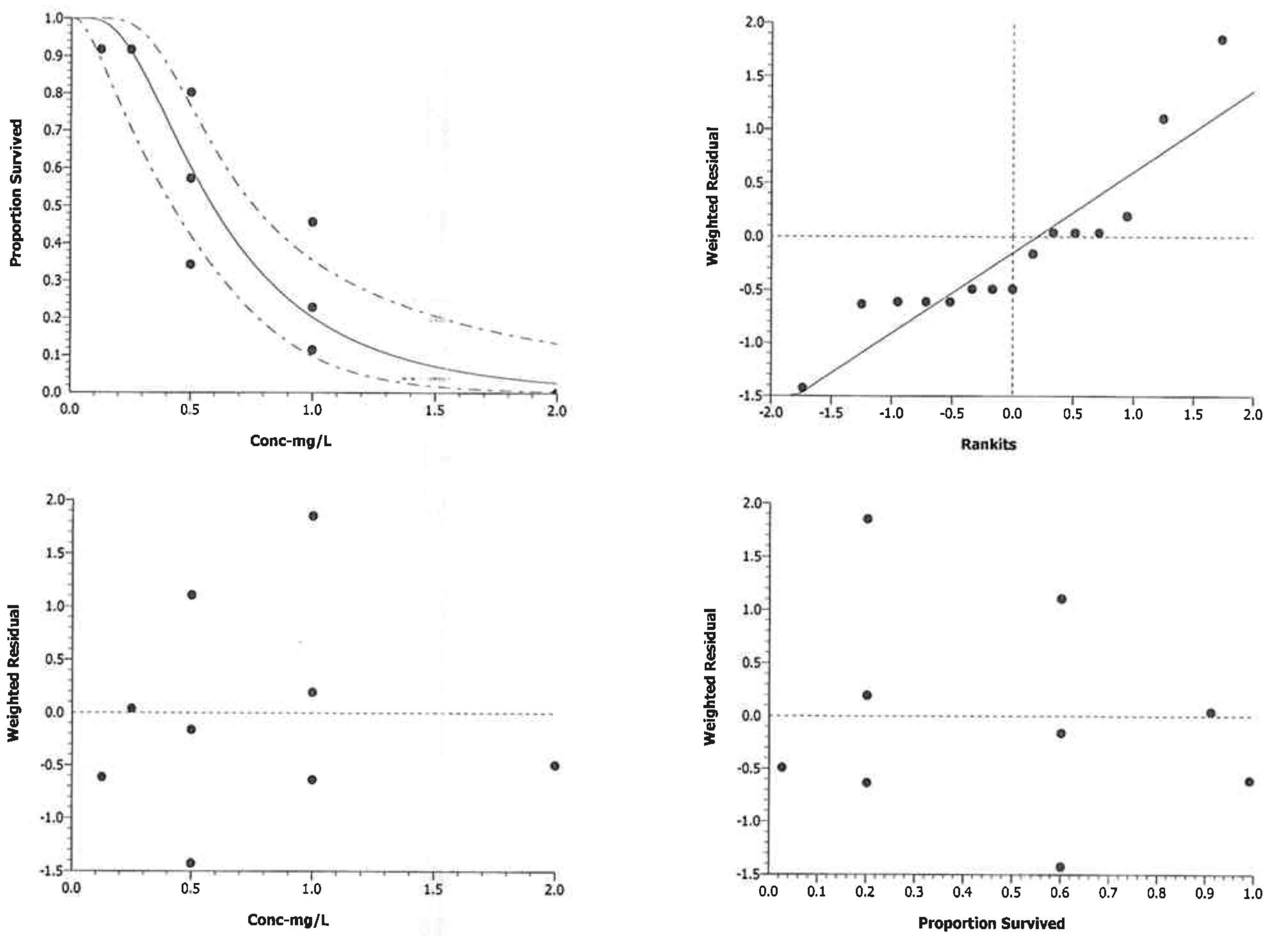
Attribute	Method	Statistic	Critical	P-Value	Decision(0.05)
Variances	Modified Levene	33.60804	3.47805	0.00001	Unequal Variances
Distribution	Shapiro-Wilk W	0.8640122		0.02759	Non-normal Distribution

Data Summary

			Calculated Variate(A/B)						
Conc-mg/	Control Type	Count	Mean	Minimum	Maximum	SE	SD	A	B
0	Dilution Water	3	0.93333	0.80000	1.00000	0.02357	0.11547	28	30
0.125		3	0.80000	0.80000	0.80000	0.00004	0.00020	24	30
0.25		3	0.80000	0.80000	0.80000	0.00004	0.00020	24	30
0.5		3	0.50000	0.30000	0.70000	0.04082	0.20000	15	30
1		3	0.23333	0.10000	0.40000	0.03118	0.15275	7	30
2		3	0.00000	0.00000	0.00000	0.00000	0.00000	0	30

CETIS Analysis Detail

Graphics



Cadmium Reference Toxicant Test Survival Data Sheet for Eohs

NEWFIELDS

CLIENT	PROJECT	NEWFIELDS JOB NO.	SPECIES		
			Ampelisca abdida		
			PROJECT MANAGER	NEWFIELDS LABORATORY	PROTOCOL
AMEC - Geomatrix	March Point	1437-001-860-1	M. Pinza	Port Gamble Bath 4	PSEP 1995

SURVIVAL & BEHAVIOR DATA

OBSERVATION KEY
N = Normal
LOE = Loss of equilibium
Q = Quiescent
DC = Discoloration
NB = No body
F = Floating on surface

INITIAL # OF ORGANISMS: 10

	DAY 1	DAY 2	DAY 3	DAY 4
DATE	9/24	9/25	9/26	9/27
TECHNICIAN	CR	TS	CR	CR

CLIENT/ NEWFIELDS ID	CONC. value	CONC. units	REP	INITIAL NUMBER	Day 1 #ALIVE	Day 1 #DEAD	Day 1 OBS	Day 2 #ALIVE	Day 2 #DEAD	Day 2 OBS	Day 3 #ALIVE	Day 3 #DEAD	Day 3 OBS	Day 4 #ALIVE	Day 4 #DEAD	Day 4 OBS
Ref.Tox.- cadmium	0	mg/L	1	10	10	0	N	10	Ø	1S	10	0	N	10	0	N
			2	↓	10	0	↓	10	Ø	N	10	0	N	10	0	N
			3		10	0		10	Ø	3S	9	1	1S	8	1	3S
Ref.Tox.- cadmium	0.125	mg/L	1		10	0		9	1	2S	9	0	1S	8	1	N
			2		10	0		10	Ø	1S	9	1	1S	8	1	1S
			3		10	0		9	1NB	N	9	1	N	8	1	N
Ref.Tox.- cadmium	0.25	mg/L	1		10	0		10	Ø	2S	10	0	2S	8	2	N
			2		8	1	1NB	9	1FB	N	9	0	1S	8	1	1S
			3		10	0	N	9	1	1S	8	1	1S	8	0	N
Ref.Tox.- cadmium	0.5	mg/L	1		10	0	① ~~DC~~	10	Ø	1S	8	2	1S	7	1	N
			2		10	0	① ~~Q~~	5	3, 2NB	3S	5	0	N	3	2	1S
			3		10	0	① ~~Q~~	10	Ø	1S	7	3	1S	5	2	N
Ref.Tox.- cadmium	1	mg/L	1		10	0	DC, Q	9	1	2S	8	1	1S	2	6	N
			2		10	0	Q	9	1	1S	6	3	1S	4	2	N
			3		10	0	Q	9	1	2S	6	3	2S	1	5	N
Ref.Tox.- cadmium	2	mg/L	1		10	0	4F	4	6	Q	1	3	2S	0	1	N
			2		10	0	2F	6	4	4S	3	3	2S	0	3	N
			3	↓	9	1	1F	8	1	2SQ	3	5	2S	0	3	N

① WC CR 9/24 Correct entry: N

NEWFIELDS

Cadmium Reference Toxicant Te Water Quality Data Sheet for Eohs

CLIENT	PROJECT	SPECIES		NEWFIELDS LABORATORY	PROTOCOL
AMEC - Geomatrix	March Point	Ampelisca abdida		Port Gamble Bath 4	PSEP 1995
NEWFIELDS JOB NUMBER: 1437-001-860-1	PROJECT MANAGER: M. Pinza	QUANTITY OF STOCK: ~~6.0mL~~ 0.3mL — ACTUAL: 0.306	QUANTITY OF DILUENT: 1500mL — ACTUAL: 1500.0	INIT ✓ — DATE PREP 9/23/08	
TEST ID: P080418.15	LOT #: 06 510TC	TEST START DATE: 9/23/08 ~~26Jul08~~	TIME: 1645 mP	TEST END DATE: 9/27/08 ~~30Jul08~~	TIME: ~~1745~~ 1600 ① BH

WATER QUALITY DATA

DILTIN.WAT.BATCH	TEMP REC#	REFERENCE TOX. MATERIAL	REFERENCE TOXXICANT		
FSW072608.01	NA	cadmium chloride	cadmium		

TEST CONDITIONS				DO (mg/L) ≥ 5.0		TEMP(C) 15 ± 1		SAL (ppt) 28 ± 1		pH 8.0 ± 0.5		TECHNICIAN	
CLIENT/ NEWFIELDS ID	CONCENTRATION value	units	DAY	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WQ TECH	Date
Ref.Tox.-cadmium	0	mg/L	0	Stock	4	7.5	4	20.0	1	28	1	7.6	✓	9/23/08
			1		4	7.6	4	19.8	1	29	1	7.5	CR	9/24
			2		3	6.8	3	20.1	R	29	3	7.6	TS	9/25
			3		3	7.0	3	20.1	R	29	3	7.8	TS	9/26
			4		4	7.3	4	20.7	1	29	1	7.7	CR	9/27
Ref.Tox.-cadmium	0.125	mg/L	0	Stock	4	7.7	4	20.2	1	28	1	7.7	✓	9/23/08
			1		4	7.5	4	20.4	1	29	1	7.7	CR	9/24
			2		3	6.5	3	20.2	R	29	3	7.6	TS	9/25
			3		3	7.0	3	20.2	R	29	3	7.8	TS	9/26
			4		4	7.4	4	20.7	1	29	1	7.7	CR	9/27
Ref.Tox.-cadmium	0.25	mg/L	0	Stock	4	7.7	4	20.1	1	28	1	7.7	✓	9/23/08
			1		4	7.5	4	20.4	1	29	1	7.8	CR	9/24
			2		3	6.5	3	20.3	R	29	3	7.7	TS	9/25
			3		3	7.0	3	20.2	R	29	3	7.8	TS	9/26
			4		4	7.5	4	20.7	1	29	1	7.8	CR	9/27

① WT 10/1/08 BH

NEWFIELDS

Cadmium Reference Toxicant Te Water Quality Data Sheet for Eohs

CLIENT	PROJECT	SPECIES		NEWFIELDS LABORATORY	PROTOCOL
AMEC - Geomatrix	March Point	*Ampelisca abdida*		Port Gamble Bath 4	PSEP 1995
NEWFIELDS JOB NUMBER	PROJECT MANAGER	QUANTITY OF STOCK : 0.3 mL	QUANTITY OF DILUENT: 1500mL	INIT ✓	
1437-001-860-1	M. Pinza	ACTUAL: 0.306	ACTUAL: 1500.0	DATE PREP 9/23/08	
TEST ID	LOT #:	TEST START DATE	TIME	TEST END DATE	TIME
7080418.15	06510TC	9/23/08 ~~26Jul08~~	1645 mf	9/27/08 ~~30Jul08~~	1600

WATER QUALITY DATA

DILTIN.WAT.BATCH	TEMP REC#	REFERENCE TOX. MATERIAL	REFERENCE TOXXICANT
FSW072608.01	NA	cadmium chloride	cadmium

TEST CONDITIONS	DO (mg/L)	TEMP(C)	SAL (ppt)	pH	TECHNICIAN
	≥ 5.0	15 ± 1	28 ± 1	8.0 ± 0.5	

CLIENT/ NEWFIELDS ID	CONCENTRATION value	CONCENTRATION units	DAY	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	SALINITY meter	SALINITY ppt	pH meter	pH unit	WQ TECH	Date
Ref.Tox.-cadmium	0.5	mg/L	0	Stock	4	7.7	4	20.2	1	28	1	7.8	✓	9/23/08
			1		4	7.5	4	20.5	1	29	1	7.8	CR	9/24
			2		3	6.6	3	20.3	R	29	3	7.7	TS	9/25
			3		3	7.0	3	20.3	R	29	3	7.8	TS	9/26
			4		4	7.5	4	20.7	1	29	1	7.8	CR	9/27
Ref.Tox.-cadmium	1	mg/L	0	Stock	4	7.7	4	20.3	1	28	1	7.8	✓	9/23/08
			1		4	7.5	4	20.5	1	29	1	7.9	CR	9/24
			2		3	6.6	3	20.3	R	29	3	7.8	TS	9/25
			3		3	6.7	3	20.3	R	29	3	7.8	TS	9/26
			4		4	7.3	4	20.7	1	29	1	7.9	CR	9/27
Ref.Tox.-cadmium	2	mg/L	0	Stock	4	7.7	4	20.2	1	28	1	7.8	✓	9/23/08
			1		4	7.6	4	20.5	1	29	1	7.9	CR	9/24
			2		3	6.5	3	20.3	R	29	3	7.7	TS	9/25
			3		3	6.7	3	20.3	R	29	3	7.8	TS	9/26
			4		4	7.4	4	20.7	1	29	1	7.9	CR	9/27

LARVAL TEST

QA/QC TS 10/27/08

BIVALVE LARVAE SUSPENDED PARTICULATE PHASE TEST

NEWFIELDS

SPECIES		
Dendraster excentricus		

CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	1437-001-860	M. Pinza	Port Gamble / Bath 7	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ NEWFIELDS ID	REP	NUMBER NORMAL	NUMBER ABNORMAL	DATE	TECHNICIAN	COMMENTS	
STOCKING DENSITY	1		218				
	2		213				
	3		255				
	4		280				
	5		247				
Control /	1	194	7				
	2	211	4				
	3	230	4				
	4	232	3				
	5	213	4				
Sediment Control /	1	233	2				
	2	213	4				
	3	237	1				
	4	216	4				
	5	197	0				
CR-1 /	1	191	7				
	2	204	5				
	3	191	5				
	4	237	5				
	5	141	4				
SBREF80 /	1	233	5	10/7/08	BWB		~~25~~ 26
	2	~~204~~ (202)	~~7~~ ① (1)	10/7/08	BWB		27
	3	~~178~~ (214)	~~11~~ ① (7)	10/7/08	BWB		28
	4	204	7				29
	5	178	11				30

① W.E. BWB 10/7/08

QA/QC JS 100%
11/5/08

BIVALVE LARVAE SUSPENDED PARTICULATE PHASE TEST

NEWFIELDS

CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	1437-001-860	M. Pinza	Port Gamble / Bath 7	PSEP (1995)

SPECIES: *Dendraster excentricus*

LARVAL OBSERVATION DATA

CLIENT/ NEWFIELDS ID	REP	NUMBER NORMAL	NUMBER ABNORMAL	DATE	TECHNICIAN	COMMENTS
MP-1 /	1	208	4	11/4	✓	
	2	201	7			
	3	233	7			
	4	227	5			
	5	221	5			
MP-2 /	1	236	6			
	2	198	Ø			
	3	215	5			
	4	196	5			
	5	233	7			
MP-3 /	1	207	6			
	2	175	2			
	3	205	3			
	4	204	3			
	5	213	13			
MP-4 /	1	225	3			
	2	208	2			
	3	199	3			
	4	189	9			
	5	176	12			
MP-5 /	1	197	5			
	2	219	1			
	3	153	6			
	4	190	10			
	5	187	10			

QA/QC 100%
TS 11/5/08

BIVALVE LARVAE SUSPENDED PARTICULATE PHASE TEST

NEWFIELDS

SPECIES					
			Dendraster excentricus		
CLIENT	**PROJECT**	**JOB NUMBER**	**PROJECT MANAGER**	**NEWFIELDS LAB / LOCATION**	**PROTOCOL**
AMEC Geomatrix	March Point	1437-001-860	M. Pinza	Port Gamble / Bath 7	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ NEWFIELDS ID	REP	NUMBER NORMAL	NUMBER ABNORMAL	DATE	TECHNICIAN	COMMENTS
MP-6 /	1	210	6	11/4	J	
	2	245	2	↓	↓	
	3	227	4			
	4	252	6			
	5	248	2			
MP-7 /	1	205	5			
	2	218	5			
	3	211	4			
	4	209	7			
	5	219	2			
MP-8 /	1	216	8			
	2	199	7			
	3	185	3			
	4	212	4			
	5	205	2			
MP-9 /	1	235	1			
	2	228	4			
	3	213	6			
	4	212	2			
	5	183	2			
MP-10 /	1	206	8			
	2	192	1			
	3	220	5			
	4	202	4			
	5	213	9			

QA/QC 100% TS 11/5/08

BIVALVE LARVAE SUSPENDED PARTICULATE PHASE TEST

NEWFIELDS

SPECIES					
			Dendraster excentricus		
CLIENT	**PROJECT**	**JOB NUMBER**	**PROJECT MANAGER**	**NEWFIELDS LAB / LOCATION**	**PROTOCOL**
AMEC Geomatrix	March Point	1437-001-860	M. Pinza	Port Gamble / Bath 7	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ NEWFIELDS ID	REP	NUMBER NORMAL	NUMBER ABNORMAL	DATE	TECHNICIAN	COMMENTS
MP-11 /	1	233	4	11/4	[illegible]	
	2	234	1			
	3	195	4			
	4	265	5			
	5	222	6			
MP-12 /	1	~~225~~ 194	3 ~~4~~ ①			
	2	220	6			
	3	220	5			
	4	192	5			
	5	217	5			
MP-13 /	1	230	4			
	2	221	5			
	3	204	2			
	4	200	7			
	5	195	4			

① IE 11/4/08 [illegible]

NEWFIELDS

LARVAL DEVELOPMENT TEST
WATER QUALITY DATA

CLIENT	PROJECT	SPECIES		NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	*Dendraster excentricus*		Port Gamble / Bath 7	PSEP (1995)
JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
1437-001-860	M. Pinza	24Sep08	2030	9/27/08	1830

* Day 3 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >4.8		Temp (°C) 15 ± 1		Sal (ppt) 28 ± 1		pH 7.8 ± 0.5		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
CLIENT/ NEWFIELDS ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	ug/L (Total)		
Control /	0	10	WQ Surr		7.9		16.0		29		7.8			BH	0.000	BH	9/24
Control /	1	10	WQ Surr	4	7.5	4	15.5	1	29	1	7.7					CR	9/25
Control /	2	10	WQ Surr	3	7.6	3	15.3	R	29	3	7.4					TS	9/26
Control /	3	10	WQ Surr	4	7.2	4	15.8	1	29	1	7.7			BH	0.000	CR	9/27
Control /	4	10	WQ Surr														
Sediment Control /	0	97	WQ Surr		8.0		16.0		29		~~8.~~ 7.8			BH	0.000	BH	9/24
Sediment Control /	1	97	WQ Surr	4	7.4	4	15.5	1	29	1	7.7					CR	9/25
Sediment Control /	2	97	WQ Surr	3	~~8~~ 8.5	3	15.5	R	29	3	7.7					TS	9/26
Sediment Control /	3	97	WQ Surr	4	~~6.1~~ 9.2 ①	4	~~16.2~~ 16.30	1	29	1	~~7.6~~ 7.8 ①			BH	0.000	CR	9/27
Sediment Control /	4	97	WQ Surr														
CR-1 /	0	84	WQ Surr		7.7		16.1		29		7.8			BH	0.038	BH	9/24
CR-1 /	1	84	WQ Surr	4	6.5	4	15.8	1	29	1	7.7					CR	9/25
CR-1 /	2	84	WQ Surr	3	6.0	3	15.1	R	29	3	7.6					TS	9/26
CR-1 /	3	84	WQ Surr	4	7.2	4	16.0	1	29	1	7.8			BH	0.014	CR	9/27
CR-1 /	4	84	WQ Surr														

① WP CR 9/27

NEWFIELDS

LARVAL DEVELOPMENT TEST
WATER QUALITY DATA

CLIENT	PROJECT	SPECIES		NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	*Dendraster excentricus*		Port Gamble / Bath 7	PSEP (1995)
JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
1437-001-860	M. Pinza	24Sep08			

* Day 3 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >4.8		Temp (°C) 15 ± 1		Sal (ppt) 28 ± 1		pH 7.8 ± 0.5		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
CLIENT/ NEWFIELDS ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	ug/L (Total)		
SBREF80 /	0	94	WQ Surr		5.8		15.9		29		7.8				0.101		
SBREF80 /	1	94	WQ Surr	4	4.2 ①	4	16.2	1	29	1	7.7			✓		CR	9/25
SBREF80 /	2	94	WQ Surr	3	8.6	3	14.4	R	28	3	7.7					TS	9/26
SBREF80 /	3	94	WQ Surr	4	8.4	4	15.0	1	29	1	7.8				0.011	CR	9/27
SBREF80 /	4	94	WQ Surr														
MP-1 /	0	45	WQ Surr		6.6		16.0		29		7.8				0.058		
MP-1 /	1	45	WQ Surr	4	5.6	4	15.2	1	29	1	7.5					CR	9/25
MP-1 /	2	45	WQ Surr	3	5.2	3	14.7	R	28	3	7.3					TS	9/26
MP-1 /	3	45	WQ Surr	4	5.7	4	16.0	1	29	1	7.5				0.002	CR	9/27
MP-1 /	4	45	WQ Surr														
MP-2 /	0	77	WQ Surr		6.6		15.9		29		7.8				0.051		
MP-2 /	1	77	WQ Surr	4	5.7	4	15.6	1	29	1	7.6					CR	9/25
MP-2 /	2	77	WQ Surr	3	5.5	3	15.1	R	28	3	7.5					TS	9/26
MP-2 /	3	77	WQ Surr	4	6.4	4	15.8	1	29	1	7.7				0.000	CR	9/27
MP-2 /	4	77	WQ Surr														

① Sample aerated 9/25 CR

NEWFIELDS

LARVAL DEVELOPMENT TEST
WATER QUALITY DATA

CLIENT	PROJECT	SPECIES		NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	*Dendraster excentricus*		Port Gamble / Bath 7	PSEP (1995)
JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
1437-001-860	M. Pinza	24Sep08			

* Day 3 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >4.8		Temp (°C) 15 ± 1		Sal (ppt) 28 ± 1		pH 7.8 ± 0.5		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
CLIENT/ NEWFIELDS ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	ug/L (Total)		
MP-3 /	0	95	WQ Surr		~~4.6~~ 8.0		15.4		29		7.9				0.022		
MP-3 /	1	95	WQ Surr	4	8.2	4	14.7	1	29	1	7.7					CR	9/25
MP-3 /	2	95	WQ Surr	3	8.2	3	14.3	R	28	3	7.7					TS	9/26
MP-3 /	3	95	WQ Surr	4	8.4	4	15.0	1	29	1	7.8				0.000	CK	9/27
MP-3 /	4	95	WQ Surr														
MP-4 /	0	48	WQ Surr		~~1.4~~ 8.2		15.6		29		7.4		•		0.024		
MP-4 /	1	48	WQ Surr	4	7.5	4	15.1	1	29	1	7.5					CR	9/25
MP-4 /	2	48	WQ Surr	3	8.2	3	14.3	R	28	3	7.6					TS	9/26
MP-4 /	3	48	WQ Surr	4	8.1	4	14.7	1	29	1	7.7				0.001	CK	9/27
MP-4 /	4	48	WQ Surr														
MP-5 /	0	34	WQ Surr		6.6		15.5		29		7.7				0.128		
MP-5 /	1	34	WQ Surr	4	5.7	4	15.5	1	29	1	7.7					CR	9/25
MP-5 /	2	34	WQ Surr	3	5.2	3	15.0	R	29	3	7.4					TS	9/26
MP-5 /	3	34	WQ Surr	4	7.0	4	16.5	1	29	1	7.7				0.008	CK	9/27
MP-5 /	4	34	WQ Surr														

NEWFIELDS

LARVAL DEVELOPMENT TEST
WATER QUALITY DATA

CLIENT	PROJECT	SPECIES		NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	*Dendraster excentricus*		Port Gamble / Bath 7	PSEP (1995)
JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
1437-001-860	M. Pinza	24Sep08			

* Day 3 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >4.8		Temp (°C) 15 ± 1		Sal (ppt) 28 ± 1		pH 7.8 ± 0.5		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
CLIENT/ NEWFIELDS ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	ug/L (Total)		
MP-6 /	0	92	WQ Surr		7.2		16.1		29		7.8				0.061		
MP-6 /	1	92	WQ Surr	4	6.0	4	16.2	1	29	1	7.6					CR	9/25
MP-6 /	2	92	WQ Surr	3	5.4	3	15.2	R	30	3	7.4					TS	9/26
MP-6 /	3	92	WQ Surr	4	6.2	4	16.4	1	29	1	7.7				0.010	CR	9/27
MP-6 /	4	92	WQ Surr														
MP-7 /	0	54	WQ Surr		6.6		15.9		29		7.8		7		0.058		
MP-7 /	1	54	WQ Surr	4	5.4	4	15.6	1	29	1	7.6					CR	9/25
MP-7 /	2	54	WQ Surr	3	5.4	3	15.0	R	29	3	7.5					TS	9/26
MP-7 /	3	54	WQ Surr	4	6.1	4	15.6	1	29	1	7.6				0.002	CR	9/27
MP-7 /	4	54	WQ Surr														
MP-8 /	0	35	WQ Surr		6.8		15.3		29		7.7				0.091		
MP-8 /	1	35	WQ Surr	4	5.9	4	15.2	1	29	1	7.5					CR	9/25
MP-8 /	2	35	WQ Surr	3	5.5	3	15.3	R	29	3	7.3					TS	9/26
MP-8 /	3	35	WQ Surr	4	6.5	4	16.2	1	29	1	7.6				0.007	CR	9/27
MP-8 /	4	35	WQ Surr														

NEWFIELDS

LARVAL DEVELOPMENT TEST
WATER QUALITY DATA

CLIENT	PROJECT	SPECIES		NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	*Dendraster excentricus*		Port Gamble / Bath 7	PSEP (1995)
JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
1437-001-860	M. Pinza	24Sep08			

* Day 3 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >4.8		Temp (°C) 15 ± 1		Sal (ppt) 28 ± 1		pH 7.8 ± 0.5		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
CLIENT/ NEWFIELDS ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	ug/L (Total)		
MP-9 /	0	89	WQ Surr		7.0		15.8		29		7.8				0.124		
MP-9 /	1	89	WQ Surr	4	5.7	4	15.8	1	29	1	7.7					CR	9/25
MP-9 /	2	89	WQ Surr	3	5.5	3	14.9	R	30	3	7.4					TS	9/26
MP-9 /	3	89	WQ Surr	4	6.1	4	16.2	1	29	1	7.6				0.016	CR	9/27
MP-9 /	4	89	WQ Surr														
MP-10 /	0	60	WQ Surr		5.9		15.7		29		7.8				0.155		
MP-10 /	1	60	WQ Surr	4	5.3	4	15.7	1	29	1	7.6					CR	9/25
MP-10 /	2	60	WQ Surr	3	5.2	3	14.8	R	30	3	7.4					TS	9/26
MP-10 /	3	60	WQ Surr	4	6.9	4	16.3	1	29	1	7.6				0.014	CR	9/27
MP-10 /	4	60	WQ Surr														
MP-11 /	0	12	WQ Surr		7.3		15.8		29		7.8				0.094		
MP-11 /	1	12	WQ Surr	4	6.2	4	15.6	1	29	1	7.7					CR	9/25
MP-11 /	2	12	WQ Surr	3	5.7	3	15.5	R	29	3	7.4					TS	9/26
MP-11 /	3	12	WQ Surr	4	6.6	4	16.2	1	29	1	7.7				0.010	CR	9/27
MP-11 /	4	12	WQ Surr														

NEWFIELDS

LARVAL DEVELOPMENT TEST
WATER QUALITY DATA

CLIENT	PROJECT	SPECIES		NEWFIELDS LAB / LOCATION	PROTOCOL
AMEC Geomatrix	March Point	*Dendraster excentricus*		Port Gamble / Bath 7	PSEP (1995)
JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
1437-001-860	M. Pinza	24Sep08			

* Day 3 observations needed only if development endpoint not met by day 2

WATER QUALITY DATA

TEST CONDITIONS				DO (mg/L) >4.8		Temp (°C) 15 ± 1		Sal (ppt) 28 ± 1		pH 7.8 ± 0.5		Ammonia NA		Sulfide NA		TECH	DATE
				D.O.		TEMP.		SALINITY		pH		AMMONIA		SULFIDE			
CLIENT/ NEWFIELDS ID	DAY	Random #	REP	meter	mg/L	meter	°C	meter	ppt	meter	unit	Techn.	mg/L (total)	Techn.	ug/L (Total)		
MP-12 /	0	2	WQ Surr		6.8		15.7		29		7.8		•		0.072		
MP-12 /	1	2	WQ Surr	4	7.0	4	15.4	1	29	1	7.6					CR	9/25
MP-12 /	2	2	WQ Surr	3	6.5	3	15.0	R	28	3	7.6					JB	9/26
MP-12 /	3	2	WQ Surr	4	6.7	4	16.1	1	29	1	7.6				0.006	CR	9/27
MP-12 /	4	2	WQ Surr														
MP-13 /	0	19	WQ Surr		6.2		16.0		29		7.8				0.058		
MP-13 /	1	19	WQ Surr	4	~~6~~ 5.6	4	15.3	1	29	1	7.7					CR	9/25
MP-13 /	2	19	WQ Surr	3	5.6	3	15.1	R	29	3	7.5					JB	9/26
MP-13 /	3	19	WQ Surr	4	6.5	4	15.9	1	29	1	7.7				0.007		
MP-13 /	4	19	WQ Surr														

OMC CR 9/25

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
March Point	Dendraster		

PRETEST / ~~INITIAL~~ / FINAL / OTHER (circle one) DAY of TEST: _____
OVERLYING (OV) / POREWATER (PW) (circle one)

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	Temperature:	
10/1/08	19.5	

Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
Ø			0.00	20	10/1/08 [initials]	Y	NA	NA	NA
Sed Ø			0.00	20	↓	↓	↓	↓	↓
SBREF80			0.0233	20					
MP-1			0.297	20					
MP-2			0.0449	20					
MP-3			0.217	20					
MP-4			0.00	20					
MP-5			0.00	20					
MP-6			0.00	20					
MP-7			0.00	20					
MP-8			0.0687	20					
MP-9			0.00	20					
MP-10			0.00	20					
MP-11			0.00	20					
MP-12			0.00	20					
MP-13			0.00	20	↓	↓	↓	↓	↓

NEWFIELDS

Ammonia Analysis
Total Ammonia (mg/L)

Client/Project:	Organism:	NewFields Test ID:	Test Duration (days):
March Point	Dendraster		

PRETEST / ~~INITIAL~~ / (FINAL) / OTHER (circle one) DAY of TEST: _____
(OVERLYING (OV)) / POREWATER (PW) (circle one)

Calibration Standards Temperature		Sample temperature should be within ±1°C of standards temperature at time and date of analysis.
Date:	Temperature:	
10/1/08	19.5	

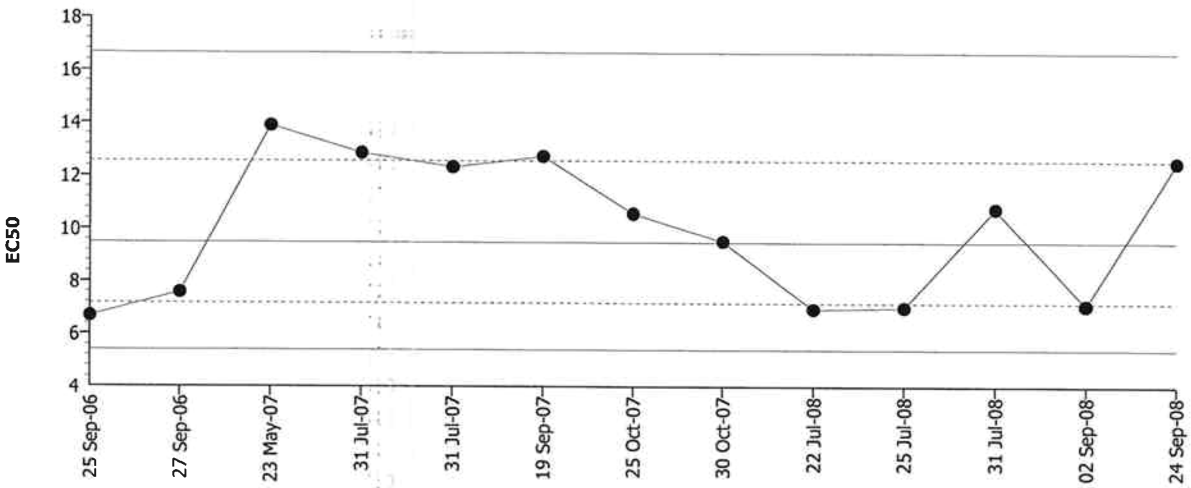
Sample ID or Description	Conc. or Rep	Date of Sampling and Initials	Ammonia Value (mg/L)	Temp °C	Date of Reading and Initials	Sample Preserved (Y/N)	pH	Sal (ppt)	Sulf. mg/L
Ø		9/27/08 BH	0.00	20	10/1/08 L	Y	NA	NA	NA
Sed Ø		↓	0.00	20	↓	↓	↓	↓	↓
SBREF80			0.00	20					
MP-1			0.178	20					
MP-2			0.00	20					
MP-3			0.0730	20					
MP-4			0.00	20					
MP-5			0.00	20					
MP-6			0.00	20					
MP-7			0.00	20					
MP-8			0.00	20					
MP-9			0.00	20					
MP-10			0.00	20					
MP-11			0.00	20					
MP-12			0.00	20					
MP-13			0.00	20					

CETIS QC Chart

Report Date: 04 Nov-08 4:22 PM

Echinoid Embryo-Larval Survival and Development Test **NewFields**

Test Type: Development-Survival
Protocol: PSEP (1995)
Organism: Dendraster excentricus (Sand Dollar)
Endpoint: Proportion Normal
Material: Copper sulfate
Source: Reference Toxicant-REF



Mean: 9.47709 **Count:** 12 **-1s Warning Limit:** 7.14851 **-2s Action Limit:** 5.39208
Sigma: **CV:** 32.57% **+1s Warning Limit:** 12.5642 **+2s Action Limit:** 16.6569

Quality Control Data

Point	Year	Month	Day	Data	Delta	Sigma	Warning	Action	Test Link	Analysis
1	2006	Sep	25	6.66180	-2.81529	-1.25008	(-)		15-9124-4449	12-6731-0558
2			27	7.56297	-1.91412	-0.80012			12-0508-6315	07-3739-8798
3	2007	May	23	13.89896	4.42187	1.35806	(+)		01-4296-4787	05-7613-5311
4		Jul	31	12.85222	3.37513	1.08039	(+)		13-9151-2777	12-8049-9522
5			31	12.33174	2.85465	0.93378			02-7352-2736	12-1169-5876
6		Sep	19	12.73121	3.25412	1.04684	(+)		09-8513-0350	13-2299-3806
7		Oct	25	10.57427	1.09718	0.38850			12-7566-1317	15-3106-2890
8			30	9.52576	0.04867	0.01817			12-1647-2406	05-3030-1731
9	2008	Jul	22	6.93340	-2.54369	-1.10836	(-)		20-1766-4632	11-5915-4021
10			25	6.99766	-2.47942	-1.07564	(-)		10-7779-9263	09-2506-4650
11			31	10.75282	1.27573	0.44789			21-0046-3420	08-3277-4745
12		Sep	2	7.06949	-2.40760	-1.03942	(-)		06-5417-1326	03-5415-0783
13			24	12.50536	3.02827	0.98336			09-4584-1077	10-5577-6876

 Analyst:________ Approval:________

CETIS Analysis Detail

Echinoid Embryo-Larval Survival and Development Test **NewFields**

Endpoint	Analysis Type	Sample Link	Control Link	Date Analyzed	Version
Proportion Normal	Linear Regression	09-4584-1077	09-4584-1077	04 Nov-08 4:21 PM	CETISv1.1.2

Linear Regression Options

Model Function	Threshold Option	Threshold	Threshold Opt	Reweighted	Pooled Groups	Het Corr
Log-Normal [NED=A+B*log(X)]	Control Threshold	0.0356564	Yes	Yes	No	No

Regression Summary

Iters	Log Likelihood	Mu	Sigma	G	Chi-Sq	Critical	P-Value	Decision(0.05)
7	-520.87280	-0.39152	0.14111	0.00835	19.71630	22.36203	0.10251	Non-Significant Heterogeneity

Point Estimates

% Effect	Conc-µg/L	95% LCL	95% UCL
10	8.246143	7.802433	8.649971
15	8.929775	8.502647	9.320782
20	9.513303	9.100245	9.894595
25	10.04421	9.642841	10.41868
40	11.51715	11.13445	11.89072
50	12.50536	12.11667	12.90023

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Statistic	P-Value	Decision(0.05)
Threshold	0.0319507	0.004092542	0.02392932	0.03997209	7.807	0.00000	Significant
Slope	7.086457	0.3303912	6.43889	7.734024	21.449	0.00000	Significant
Intercept	-2.774524	0.3641613	-3.48828	-2.060768	-7.619	0.00000	Significant

Residual Analysis

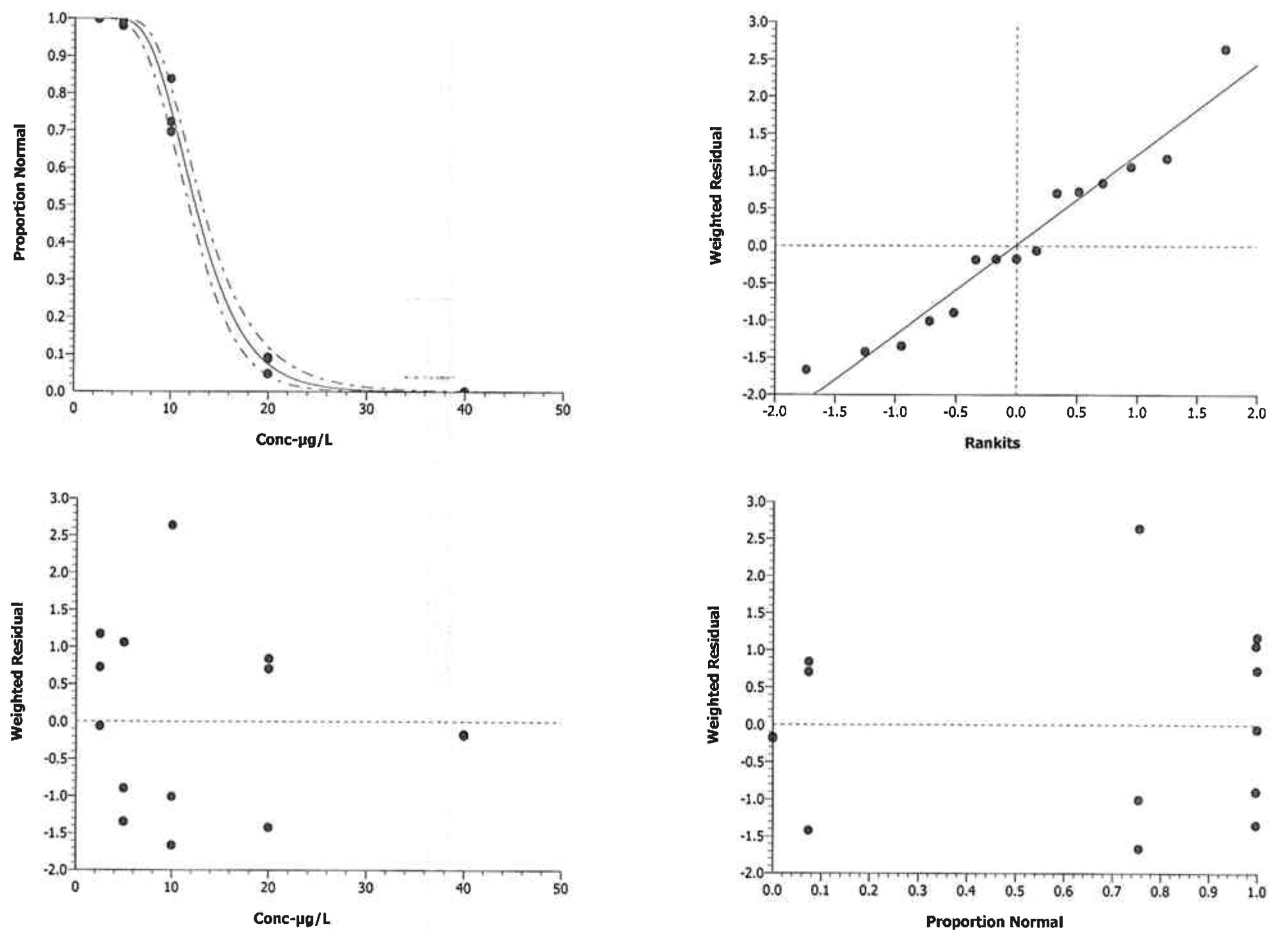
Attribute	Method	Statistic	Critical	P-Value	Decision(0.05)
Variances	Bartlett	18.79718	9.48773	0.00086	Unequal Variances
Distribution	Shapiro-Wilk W	0.9486683		0.50373	Normal Distribution

Data Summary

			Calculated Variate(A/B)						
Conc-µg/L	Control Type	Count	Mean	Minimum	Maximum	SE	SD	A	B
0	Dilution Water	3	0.96444	0.95122	0.98020	0.00299	0.01466	595	617
2.5		3	0.97531	0.96729	0.98190	0.00151	0.00741	634	650
5		3	0.96023	0.94907	0.97753	0.00310	0.01519	653	679
10		3	0.72847	0.67429	0.81159	0.01492	0.07309	435	595
20		3	0.07332	0.04569	0.08917	0.00490	0.02402	39	542
40		3	0.00000	0.00000	0.00000	0.00000	0.00000	0	570

CETIS Analysis Detail

Graphics



Report Date: 04 Nov-08 4:21 PM
Analysis: 10-6638-2953

CETIS Analysis Detail

Echinoid Embryo-Larval Survival and Development Test — **NewFields**

Endpoint	Analysis Type	Sample Link	Control Link	Date Analyzed	Version
Proportion Normal	Comparison	09-4584-1077	09-4584-1077	04 Nov-08 4:21 PM	CETISv1.1.2

Method	Alt H	Data Transform	Zeta
Dunnett's Multiple Comparison	C > T	Angular (Corrected)	

NOEL	LOEL	Toxic Units	ChV	PMSD
5	10	20	7.07107	4.89%

Group Comparisons

Control	vs	Conc-µg/L	Statistic	Critical	P-Value	MSD	Decision(0.05)
Dilution Water		2.5	-0.7086	2.46559	0.9485	0.10488	Non-Significant Effect
		5	0.26435	2.46559	0.7047	0.10488	Non-Significant Effect
		10	8.43347	2.46559	0.0000	0.10488	Significant Effect
		20	26.1531	2.46559	0.0000	0.10488	Significant Effect

ANOVA Table

Source	Sum of Squares	Mean Square	DF	F Statistic	P-Value	Decision(0.05)
Between	2.836377	0.7090942	4	261.27	0.00000	Significant Effect
Error	0.0271403	0.0027140	10			
Total	2.86351693	0.7118082	14			

ANOVA Assumptions

Attribute	Test	Statistic	Critical	P-Value	Decision(0.01)
Variances	Bartlett	2.73241	13.27670	0.60356	Equal Variances
Distribution	Shapiro-Wilk W	0.95546		0.61417	Normal Distribution

Data Summary

			Original Data				Transformed Data			
Conc-µg/L	Control Type	Count	Mean	Minimum	Maximum	SD	Mean	Minimum	Maximum	SD
0	Dilution Water	3	0.96444	0.95122	0.98020	0.01466	1.38402	1.34810	1.42961	0.04161
2.5		3	0.97531	0.96729	0.98190	0.00741	1.41416	1.38894	1.43585	0.02366
5		3	0.96023	0.94907	0.97753	0.01519	1.37278	1.34317	1.42032	0.04159
10		3	0.72847	0.67429	0.81159	0.07309	1.02529	0.96342	1.12180	0.08469
20		3	0.07332	0.04569	0.08917	0.02402	0.27156	0.21540	0.30324	0.04877

Data Detail

Conc-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Dilution Water	0.96190	0.95122	0.98020							
2.5		0.98190	0.97674	0.96729							
5		0.97753	0.94907	0.95408							
10		0.69953	0.81159	0.67429							
20		0.04569	0.08917	0.08511							

NEWFIELDS

LARVAL DEVELOPMENT TEST
COPPER REF TOX OBSERVATION SHEET

SPECIES					
			Dendraster excentricus		
CLIENT	PROJECT	JOB NUMBER	PROJECT MANAGER	NEWFIELDS LAB / LOCATION	PROTOCOL
Geoengineers ① AMEC-GEOMATRIX	① Port of Anacortes - Log Haul Out MARCH PT.	.	B. Hester	Port Gamble / Incubator	PSEP (1995)

LARVAL OBSERVATION DATA

CLIENT/ NEWFIELDS ID	CONC. value	CONC. units	VIAL NUMBER	REP	NUMBER NORMAL	NUMBER ABNORMAL	DATE	TECHNICIAN	COMMENTS
Ref.Tox. - Copper	0	µg/L		1	202	8	10/22/08	JW	
				2	195	10	↓	↓	
				3	198	4			
Ref.Tox. - Copper	2.5	µg/L		1	217	4			
				2	210	5			
				3	207	7			
Ref.Tox. - Copper	5	µg/L		1	261	6			
				2	205	11			
				3	187	9			
Ref.Tox. - Copper	10	µg/L		1	149	64			
				2	168	39			
				3	118	57			
Ref.Tox. - Copper	20	µg/L		1	14	143			
				2	16	172			
				3	9	188			
Ref.Tox. - Copper	40	µg/L		1	Ø	188			
				2	Ø	177			
				3	Ø	205	↓	↓	

STOCKING DENSITY		1		245	10/22/08	JW	
		2		266	↓	↓	
		3		236			

① Same batch of organisms used for both projects, one set of Ref tox tests SW

APPENDIX C

STATISTICAL COMPARISONS

Test	Endpoint	Treatment	Comparison	Probability Normal	Probability Homogeneous	Test Type	Test Probability	Significant?	One-Tail Comparison
10-day Ampelisca abdita	Percentage Survival	CR-1	Control	0.003	0.657	Mann-Whitney	0.098		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-1	CR-1	0.074	0.399	T-test Equal Var	0.251		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-11	CR-1	0.322	0.669	T-test Equal Var	0.469		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-12	CR-1	0.735	0.69	T-test Equal Var	0.144		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-13	CR-1	0.798	0.879	T-test Equal Var	0.085		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-2	CR-1	0.052	0.267	T-test Equal Var	0.66		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-7	CR-1	0.683	0.646	T-test Equal Var	0.099		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-9	CR-1	0.868	0.742	T-test Equal Var	0.175		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-10	CR-1	0.002	0.951	Mann-Whitney	0.417		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-3	CR-1	0.015	0.325	Mann-Whitney	0.085		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-6	CR-1	0.03	0.84	Mann-Whitney	0.731		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-8	CR-1	0.008	0.107	Mann-Whitney	0.848		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-4	CR-1	0.005	0.083	Rankit Equal Var	0.004	Yes	Treatment < Comparison
10-day Ampelisca abdita	Percentage Survival	MP-5	CR-1	0.004	0.067	Rankit Equal Var	0.001	Yes	Treatment < Comparison
10-day Ampelisca abdita	Percentage Survival	SBREF-80	Control	0.538	0.189	T-test Equal Var	0.225		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-1	SBREF-80	0.856	0.085	T-test Unequal Var	0.386		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-10	SBREF-80	0.258	0.43	T-test Equal Var	0.545		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-11	SBREF-80	0.622	0.728	T-test Equal Var	0.544		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-12	SBREF-80	0.614	0.198	T-test Equal Var	0.255		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-13	SBREF-80	0.607	0.313	T-test Equal Var	0.168		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-2	SBREF-80	0.835	0.053	T-test Unequal Var	0.699		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-3	SBREF-80	0.639	0.072	T-test Unequal Var	0.213		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-4	SBREF-80	0.281	0.017	T-test Unequal Var	0.142		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-5	SBREF-80	0.157	0.014	T-test Unequal Var	0.115		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-6	SBREF-80	0.482	0.309	T-test Equal Var	0.681		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-7	SBREF-80	0.54	0.205	T-test Equal Var	0.193		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-8	SBREF-80	0.397	0.021	T-test Unequal Var	0.604		Treatment >= Comparison
10-day Ampelisca abdita	Percentage Survival	MP-9	SBREF-80	0.599	0.648	T-test Equal Var	0.262		Treatment >= Comparison

------------------------------ Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=SBREF-80 ------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
result	Control	5	1.1046	1.2982	1.4918	0.0934	0.1559	0.448	0.0697	1.1731	1.5708
result	Reference	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
result	Diff (1-2)		-0.219	0.1156	0.4507	0.1552	0.2298	0.4402	0.1453		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
result	Pooled	Equal	8	0.80	0.4493
result	Satterthwaite	Unequal	6.2	0.80	0.4557

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
result	Folded F	4	4	3.34	0.2691

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=CR-1 --------------------------------

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable result
Classified by Variable group

group	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
Control	5	34.50	27.50	4.654747	6.90
Reference	5	20.50	27.50	4.654747	4.10

Average scores were used for ties.

Wilcoxon Two-Sample Test

Statistic	34.5000
Normal Approximation	
Z	1.3964
One-Sided Pr > Z	0.0813
Two-Sided Pr > |Z|	0.1626
t Approximation	
One-Sided Pr > Z	0.0980
Two-Sided Pr > |Z|	0.1961

Z includes a continuity correction of 0.5.

Kruskal-Wallis Test

Chi-Square	2.2615
DF	1
Pr > Chi-Square	0.1326

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-1 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	1.0046	1.1407	1.2769	0.0657	0.1096	0.3151	0.049	0.9912	1.249
Result	Diff (1-2)		-0.167	0.0736	0.3143	0.1115	0.1651	0.3162	0.1044		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.70	0.5011
Result	Satterthwaite	Unequal	6.1	0.70	0.5071

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	3.53	0.2491

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-11 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	0.8716	1.2023	1.533	0.1596	0.2663	0.7654	0.1191	0.8355	1.5708
Result	Diff (1-2)		-0.335	0.012	0.3593	0.1608	0.2381	0.4562	0.1506		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.08	0.9386
Result	Satterthwaite	Unequal	7.53	0.08	0.9388

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.67	0.6314

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-12 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	0.8872	1.0824	1.2776	0.0942	0.1572	0.4517	0.0703	0.8355	1.249
Result	Diff (1-2)		-0.135	0.1319	0.3992	0.1238	0.1833	0.3511	0.1159		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	1.14	0.2882
Result	Satterthwaite	Unequal	7.48	1.14	0.2904

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.72	0.6125

T-test Results, This is a 2-tailed result
See Summary Page for 1-tail Result

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-13 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	0.7916	1.026	1.2603	0.1131	0.1887	0.5424	0.0844	0.7353	1.249
Result	Diff (1-2)		-0.1	0.1883	0.4765	0.1335	0.1976	0.3786	0.125		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	1.51	0.1703
Result	Satterthwaite	Unequal	7.94	1.51	0.1706

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.19	0.8688

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-2 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	1.1501	1.2572	1.3642	0.0517	0.0862	0.2477	0.0386	1.1731	1.3453
Result	Diff (1-2)		-0.273	-0.043	0.1875	0.1067	0.158	0.3026	0.0999		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	-0.43	0.6790
Result	Satterthwaite	Unequal	5.36	-0.43	0.6844

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	5.71	0.1199

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-7 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	0.8386	1.0472	1.2558	0.1006	0.168	0.4827	0.0751	0.7854	1.249
Result	Diff (1-2)		-0.107	0.1671	0.4413	0.127	0.188	0.3602	0.1189		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	1.41	0.1976
Result	Satterthwaite	Unequal	7.69	1.41	0.1991

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.51	0.7017

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-9 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	CR-1	5	0.9584	1.2143	1.4702	0.1235	0.2061	0.5922	0.0922	1.0472	1.5708
Result	Test	5	0.7539	1.0691	1.3843	0.1521	0.2539	0.7295	0.1135	0.6331	1.249
Result	Diff (1-2)		-0.192	0.1452	0.4824	0.1562	0.2312	0.443	0.1462		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.99	0.3499
Result	Satterthwaite	Unequal	7.68	0.99	0.3511

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.52	0.6960

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-10 --------------------------------

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable Result
Classified by Variable group

group	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
CR-1	5	29.0	27.50	4.639804	5.80
Test	5	26.0	27.50	4.639804	5.20

Average scores were used for ties.

Wilcoxon Two-Sample Test

Statistic	29.0000
Normal Approximation	
Z	0.2155
One-Sided Pr > Z	0.4147
Two-Sided Pr > |Z|	0.8294
t Approximation	
One-Sided Pr > Z	0.4171
Two-Sided Pr > |Z|	0.8342

Z includes a continuity correction of 0.5.

Kruskal-Wallis Test

Chi-Square	0.1045
DF	1
Pr > Chi-Square	0.7465

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-3 --------------------------------

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable Result
Classified by Variable group

group	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
CR-1	5	35.0	27.50	4.699291	7.0
Test	5	20.0	27.50	4.699291	4.0

Average scores were used for ties.

Wilcoxon Two-Sample Test

Statistic	35.0000
Normal Approximation	
Z	1.4896
One-Sided Pr > Z	0.0682
Two-Sided Pr > |Z|	0.1363
t Approximation	
One-Sided Pr > Z	0.0853
Two-Sided Pr > |Z|	0.1705

Z includes a continuity correction of 0.5.

Kruskal-Wallis Test

Chi-Square	2.5472
DF	1
Pr > Chi-Square	0.1105

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-6 --------------------------------

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable Result
Classified by Variable group

group	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
CR-1	5	24.0	27.50	4.684490	4.80
Test	5	31.0	27.50	4.684490	6.20

Average scores were used for ties.

Wilcoxon Two-Sample Test

Statistic	24.0000
Normal Approximation	
Z	-0.6404
One-Sided Pr < Z	0.2610
Two-Sided Pr > |Z|	0.5219
t Approximation	
One-Sided Pr < Z	0.2689
Two-Sided Pr > |Z|	0.5379

Z includes a continuity correction of 0.5.

Kruskal-Wallis Test

Chi-Square	0.5582
DF	1
Pr > Chi-Square	0.4550

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-8 --------------------------------

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable Result
Classified by Variable group

group	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
CR-1	5	22.0	27.50	4.579544	4.40
Test	5	33.0	27.50	4.579544	6.60

Average scores were used for ties.

Wilcoxon Two-Sample Test

Statistic	22.0000
Normal Approximation	
Z	-1.0918
One-Sided Pr < Z	0.1375
Two-Sided Pr > |Z|	0.2749
t Approximation	
One-Sided Pr < Z	0.1516
Two-Sided Pr > |Z|	0.3033

Z includes a continuity correction of 0.5.

Kruskal-Wallis Test

Chi-Square	1.4424
DF	1
Pr > Chi-Square	0.2298

T-test Results on Rankits, This is a 2-tailed result
See Summary Page for 1-tail Result

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-4 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
rankit	CR-1	5	-0.161	0.6641	1.489	0.3981	0.6644	1.9091	0.2971	-0.258	1.5466
rankit	Test	5	-1.355	-0.664	0.0268	0.3334	0.5564	1.5988	0.2488	-1.274	-0.258
rankit	Diff (1-2)		0.4344	1.3281	2.2218	0.4139	0.6128	1.1739	0.3876		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
rankit	Pooled	Equal	8	3.43	0.0090
rankit	Satterthwaite	Unequal	7.76	3.43	0.0094

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
rankit	Folded F	4	4	1.43	0.7394

T-test Results on Rankits, This is a 2-tailed result
See Summary Page for 1-tail Result

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-5 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
rankit	CR-1	5	-0.004	0.7156	1.4352	0.3472	0.5796	1.6655	0.2592	73E-18	1.5466
rankit	Test	5	-1.212	-0.716	-0.219	0.2397	0.4	1.1495	0.1789	-0.895	73E-18
rankit	Diff (1-2)		0.7049	1.4312	2.1575	0.3364	0.498	0.954	0.3149		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
rankit	Pooled	Equal	8	4.54	0.0019
rankit	Satterthwaite	Unequal	7.11	4.54	0.0026

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
rankit	Folded F	4	4	2.10	0.4903

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-1 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	1.0046	1.1407	1.2769	0.0657	0.1096	0.3151	0.049	0.9912	1.249
Result	Diff (1-2)		-0.273	0.0419	0.3569	0.1459	0.216	0.4138	0.1366		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.31	0.7669
Result	Satterthwaite	Unequal	5.16	0.31	0.7711

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	6.76	0.0911

T-test Results, This is a 2-tailed result
See Summary Page for 1-tail Result

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-10 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.9386	1.2011	1.4636	0.1267	0.2114	0.6075	0.0946	1.0472	1.5708
Result	Diff (1-2)		-0.385	-0.018	0.3476	0.1695	0.251	0.4808	0.1587		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	-0.12	0.9102
Result	Satterthwaite	Unequal	7.38	-0.12	0.9104

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.82	0.5767

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-11 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.8716	1.2023	1.533	0.1596	0.2663	0.7654	0.1191	0.8355	1.5708
Result	Diff (1-2)		-0.422	-0.02	0.3827	0.1863	0.2759	0.5285	0.1745		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	-0.11	0.9129
Result	Satterthwaite	Unequal	7.96	-0.11	0.9129

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.15	0.8983

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-12 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.8872	1.0824	1.2776	0.0942	0.1572	0.4517	0.0703	0.8355	1.249
Result	Diff (1-2)		-0.236	0.1002	0.4359	0.1555	0.2302	0.441	0.1456		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.69	0.5108
Result	Satterthwaite	Unequal	6.23	0.69	0.5161

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	3.29	0.2753

------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-13 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.7916	1.026	1.2603	0.1131	0.1887	0.5424	0.0844	0.7353	1.249
Result	Diff (1-2)		-0.196	0.1566	0.5092	0.1633	0.2418	0.4632	0.1529		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	1.02	0.3357
Result	Satterthwaite	Unequal	6.94	1.02	0.3401

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	2.28	0.4439

T-test Results, This is a 2-tailed result
See Summary Page for 1-tail Result

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-2 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	1.1501	1.2572	1.3642	0.0517	0.0862	0.2477	0.0386	1.1731	1.3453
Result	Diff (1-2)		-0.382	-0.075	0.2326	0.1423	0.2106	0.4035	0.1332		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	-0.56	0.5910
Result	Satterthwaite	Unequal	4.73	-0.56	0.6011

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	10.94	0.0398

------------------------------ Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-3 ------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.9329	1.0652	1.1975	0.0638	0.1066	0.3062	0.0477	0.9912	1.249
Result	Diff (1-2)		-0.196	0.1174	0.4313	0.1454	0.2152	0.4123	0.1361		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.86	0.4133
Result	Satterthwaite	Unequal	5.1	0.86	0.4269

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	7.16	0.0828

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-4 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.9867	1.0248	1.0629	0.0184	0.0307	0.0882	0.0137	0.9912	1.0472
Result	Diff (1-2)		-0.138	0.1578	0.4535	0.137	0.2028	0.3884	0.1282		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	1.23	0.2534
Result	Satterthwaite	Unequal	4.09	1.23	0.2845

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	86.27	0.0008

T-test Results, This is a 2-tailed result
See Summary Page for 1-tail Result

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-5 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.9712	1.0024	1.0335	0.015	0.0251	0.072	0.0112	0.9912	1.0472
Result	Diff (1-2)		-0.115	0.1802	0.4754	0.1367	0.2024	0.3877	0.128		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	1.41	0.1967
Result	Satterthwaite	Unequal	4.06	1.41	0.2308

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	129.41	0.0004

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-6 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	1.0177	1.2578	1.498	0.1159	0.1934	0.5558	0.0865	1.0472	1.5708
Result	Diff (1-2)		-0.431	-0.075	0.2801	0.1646	0.2436	0.4667	0.1541		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	-0.49	0.6384
Result	Satterthwaite	Unequal	7.04	-0.49	0.6402

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	2.17	0.4708

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-7 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.8386	1.0472	1.2558	0.1006	0.168	0.4827	0.0751	0.7854	1.249
Result	Diff (1-2)		-0.206	0.1354	0.4767	0.158	0.234	0.4483	0.148		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.91	0.3870
Result	Satterthwaite	Unequal	6.48	0.91	0.3930

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	2.88	0.3300

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-8 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	1.167	1.2187	1.2703	0.0249	0.0416	0.1195	0.0186	1.1731	1.249
Result	Diff (1-2)		-0.333	-0.036	0.2611	0.1376	0.2037	0.3903	0.1289		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	-0.28	0.7866
Result	Satterthwaite	Unequal	4.17	-0.28	0.7929

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	46.97	0.0026

-------------------------------- Test=10-day Ampelisca abdita Endpoint=Percentage Survival Treatment=MP-9 --------------------------------

The TTEST Procedure

Statistics

Variable	group	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
Result	SBREF-80	5	0.8286	1.1826	1.5366	0.1708	0.2851	0.8193	0.1275	0.8861	1.5708
Result	Test	5	0.7539	1.0691	1.3843	0.1521	0.2539	0.7295	0.1135	0.6331	1.249
Result	Diff (1-2)		-0.28	0.1135	0.5072	0.1823	0.2699	0.5171	0.1707		

T-Tests

Variable	Method	Variances	DF	t Value	Pr > |t|
Result	Pooled	Equal	8	0.66	0.5248
Result	Satterthwaite	Unequal	7.89	0.66	0.5251

Equality of Variances

Variable	Method	Num DF	Den DF	F Value	Pr > F
Result	Folded F	4	4	1.26	0.8275

Test	Endpoint	Treatment	Comparison	Probability Normal	Probability Homogeneous	Test Type	Test Probability	Significant?	One-Tail Comparison
Larval	Percent Combined Mortality	CR-1	Control	0.672	0.339	T-test Equal Var	0.547		Treatment <= Comparison
Larval	Percent Combined Mortality	SBREF80	Control	0.724	0.387	T-test Equal Var	0.898		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-1	CR-1	0.742	0.532	T-test Equal Var	0.952		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-10	CR-1	0.906	0.484	T-test Equal Var	0.843		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-11	CR-1	0.131	0.503	T-test Equal Var	0.964		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-12	CR-1	0.679	0.946	T-test Equal Var	0.897		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-13	CR-1	0.947	0.757	T-test Equal Var	0.866		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-2	CR-1	0.938	0.765	T-test Equal Var	0.908		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-3	CR-1	0.703	0.358	T-test Equal Var	0.704		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-4	CR-1	0.834	0.74	T-test Equal Var	0.663		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-5	CR-1	0.288	0.839	T-test Equal Var	0.478		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-6	CR-1	0.201	0.18	T-test Equal Var	0.984		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-7	CR-1	0.698	0.364	T-test Equal Var	0.944		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-8	CR-1	0.939	0.577	T-test Equal Var	0.794		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-9	CR-1	0.547	0.601	T-test Equal Var	0.907		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-1	SBREF-80	0.514	0.735	T-test Equal Var	0.868		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-10	SBREF-80	0.764	0.645	T-test Equal Var	0.575		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-11	SBREF-80	0.156	0.674	T-test Equal Var	0.908		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-12	SBREF-80	0.092	0.447	T-test Equal Var	0.734		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-13	SBREF-80	0.382	0.867	T-test Equal Var	0.644		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-2	SBREF-80	0.412	0.855	T-test Equal Var	0.748		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-3	SBREF-80	0.682	0.436	T-test Equal Var	0.326		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-4	SBREF-80	0.836	0.965	T-test Equal Var	0.319		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-5	SBREF-80	0.603	0.892	T-test Equal Var	0.179		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-6	SBREF-80	0.706	0.143	T-test Equal Var	0.966		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-7	SBREF-80	0.612	0.423	T-test Equal Var	0.839		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-8	SBREF-80	0.660	0.798	T-test Equal Var	0.490		Treatment <= Comparison
Larval	Percent Combined Mortality	MP-9	SBREF-80	0.400	0.814	T-test Equal Var	0.750		Treatment <= Comparison

T-test Results, This is a 2-tailed result
See Summary Page for 1-tail Result
10:48 Wednesday, November 5, 2008

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=CR-1 ----------------

The TTEST Procedure

Variable: result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
Control	5	0.3261	0.1054	0.0471	0.2106	0.4641
Reference	5	0.3125	0.2272	0.1016	0	0.6301
Diff (1-2)		0.0137	0.1771	0.1120		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Control		0.3261	0.1953	0.4570	0.1054	0.0631	0.3029
Reference		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Diff (1-2)	Pooled	0.0137	-0.2446	0.2720	0.1771	0.1196	0.3393
Diff (1-2)	Satterthwaite	0.0137	-0.2647	0.2920			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.12	0.9060
Satterthwaite	Unequal	5.6452	0.12	0.9072

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	4.65	0.1659

-------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=SBREF80 ---------------

The TTEST Procedure

Variable: result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
Control	5	0.3261	0.1054	0.0471	0.2106	0.4641
Reference	5	0.2049	0.1655	0.0740	0	0.4328
Diff (1-2)		0.1212	0.1387	0.0877		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Control		0.3261	0.1953	0.4570	0.1054	0.0631	0.3029
Reference		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Diff (1-2)	Pooled	0.1212	-0.0811	0.3236	0.1387	0.0937	0.2658
Diff (1-2)	Satterthwaite	0.1212	-0.0876	0.3300			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.38	0.2045
Satterthwaite	Unequal	6.7862	1.38	0.2109

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	2.47	0.4034

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-1 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.0921	0.1287	0.0575	0	0.2667
Diff (1-2)		0.2204	0.1846	0.1168		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.0921	-0.0677	0.2518	0.1287	0.0771	0.3698
Diff (1-2)	Pooled	0.2204	-0.0489	0.4897	0.1846	0.1247	0.3537
Diff (1-2)	Satterthwaite	0.2204	-0.0618	0.5026			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.89	0.0958
Satterthwaite	Unequal	6.3266	1.89	0.1055

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	3.12	0.2966

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-10 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.1864	0.1313	0.0587	0	0.3398
Diff (1-2)		0.1260	0.1855	0.1174		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.1864	0.0235	0.3494	0.1313	0.0786	0.3772
Diff (1-2)	Pooled	0.1260	-0.1446	0.3966	0.1855	0.1253	0.3555
Diff (1-2)	Satterthwaite	0.1260	-0.1568	0.4089			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.07	0.3142
Satterthwaite	Unequal	6.4024	1.07	0.3217

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	3.00	0.3130

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-11 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.0634	0.1418	0.0634	0	0.3171
Diff (1-2)		0.2491	0.1894	0.1198		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.0634	-0.1127	0.2395	0.1418	0.0850	0.4075
Diff (1-2)	Pooled	0.2491	-0.0272	0.5253	0.1894	0.1279	0.3628
Diff (1-2)	Satterthwaite	0.2491	-0.0367	0.5348			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	2.08	0.0712
Satterthwaite	Unequal	6.7056	2.08	0.0779

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	2.57	0.3834

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-12 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.1329	0.1821	0.0814	0	0.3398
Diff (1-2)		0.1795	0.2059	0.1302		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.1329	-0.0932	0.3590	0.1821	0.1091	0.5233
Diff (1-2)	Pooled	0.1795	-0.1208	0.4798	0.2059	0.1391	0.3945
Diff (1-2)	Satterthwaite	0.1795	-0.1233	0.4823			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.38	0.2053
Satterthwaite	Unequal	7.6377	1.38	0.2070

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.56	0.6785

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-13 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.1661	0.1542	0.0690	0	0.3171
Diff (1-2)		0.1463	0.1942	0.1228		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.1661	-0.0254	0.3576	0.1542	0.0924	0.4432
Diff (1-2)	Pooled	0.1463	-0.1369	0.4295	0.1942	0.1312	0.3720
Diff (1-2)	Satterthwaite	0.1463	-0.1437	0.4364			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.19	0.2676
Satterthwaite	Unequal	7.0403	1.19	0.2720

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	2.17	0.4714

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-2 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.1340	0.1551	0.0693	0	0.3092
Diff (1-2)		0.1784	0.1945	0.1230		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.1340	-0.0585	0.3266	0.1551	0.0929	0.4456
Diff (1-2)	Pooled	0.1784	-0.1052	0.4621	0.1945	0.1314	0.3726
Diff (1-2)	Satterthwaite	0.1784	-0.1119	0.4688			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.45	0.1850
Satterthwaite	Unequal	7.0618	1.45	0.1898

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	2.15	0.4775

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-3 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.2480	0.1228	0.0549	0.1181	0.4508
Diff (1-2)		0.0645	0.1826	0.1155		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.2480	0.0955	0.4005	0.1228	0.0736	0.3528
Diff (1-2)	Pooled	0.0645	-0.2019	0.3308	0.1826	0.1234	0.3499
Diff (1-2)	Satterthwaite	0.0645	-0.2165	0.3454			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.56	0.5921
Satterthwaite	Unequal	6.1527	0.56	0.5965

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	3.42	0.2603

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-4 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.2568	0.1710	0.0765	0	0.4449
Diff (1-2)		0.0556	0.2011	0.1272		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.2568	0.0445	0.4692	0.1710	0.1025	0.4914
Diff (1-2)	Pooled	0.0556	-0.2377	0.3489	0.2011	0.1358	0.3852
Diff (1-2)	Satterthwaite	0.0556	-0.2416	0.3529			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.44	0.6734
Satterthwaite	Unequal	7.431	0.44	0.6743

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.77	0.5955

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-5 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.3202	0.2060	0.0921	0	0.5705
Diff (1-2)		-0.00775	0.2169	0.1372		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.3202	0.0644	0.5760	0.2060	0.1234	0.5919
Diff (1-2)	Pooled	-0.00775	-0.3240	0.3085	0.2169	0.1465	0.4155
Diff (1-2)	Satterthwaite	-0.00775	-0.3246	0.3091			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	-0.06	0.9563
Satterthwaite	Unequal	7.9243	-0.06	0.9564

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.22	0.8538

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-6 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.0335	0.0749	0.0335	0	0.1674
Diff (1-2)		0.2790	0.1692	0.1070		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.0335	-0.0595	0.1265	0.0749	0.0449	0.2152
Diff (1-2)	Pooled	0.2790	0.0323	0.5257	0.1692	0.1143	0.3241
Diff (1-2)	Satterthwaite	0.2790	0.00153	0.5564			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	2.61	0.0313
Satterthwaite	Unequal	4.8588	2.61	0.0492

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	9.21	0.0538

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-7 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.1123	0.1059	0.0474	0	0.2276
Diff (1-2)		0.2002	0.1773	0.1121		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.1123	-0.0192	0.2438	0.1059	0.0635	0.3044
Diff (1-2)	Pooled	0.2002	-0.0583	0.4587	0.1773	0.1197	0.3396
Diff (1-2)	Satterthwaite	0.2002	-0.0782	0.4786			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.79	0.1120
Satterthwaite	Unequal	5.6602	1.79	0.1274

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	4.60	0.1685

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-8 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.2074	0.1476	0.0660	0	0.3885
Diff (1-2)		0.1051	0.1916	0.1212		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.2074	0.0241	0.3907	0.1476	0.0885	0.4242
Diff (1-2)	Pooled	0.1051	-0.1744	0.3845	0.1916	0.1294	0.3671
Diff (1-2)	Satterthwaite	0.1051	-0.1826	0.3927			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.87	0.4112
Satterthwaite	Unequal	6.8665	0.87	0.4152

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	2.37	0.4241

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-9 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
CR-1	5	0.3125	0.2272	0.1016	0	0.6301
Test	5	0.1312	0.1641	0.0734	0	0.4016
Diff (1-2)		0.1812	0.1982	0.1253		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
CR-1		0.3125	0.0303	0.5946	0.2272	0.1361	0.6529
Test		0.1312	-0.0725	0.3350	0.1641	0.0983	0.4716
Diff (1-2)	Pooled	0.1812	-0.1078	0.4703	0.1982	0.1339	0.3797
Diff (1-2)	Satterthwaite	0.1812	-0.1129	0.4753			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.45	0.1862
Satterthwaite	Unequal	7.2806	1.45	0.1899

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.92	0.5440

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-1 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.0921	0.1287	0.0575	0	0.2667
Diff (1-2)		0.1128	0.1482	0.0938		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.0921	-0.0677	0.2518	0.1287	0.0771	0.3698
Diff (1-2)	Pooled	0.1128	-0.1034	0.3290	0.1482	0.1001	0.2840
Diff (1-2)	Satterthwaite	0.1128	-0.1057	0.3314			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.20	0.2631
Satterthwaite	Unequal	7.5419	1.20	0.2651

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.65	0.6378

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-10 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.1864	0.1313	0.0587	0	0.3398
Diff (1-2)		0.0185	0.1494	0.0945		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.1864	0.0235	0.3494	0.1313	0.0786	0.3772
Diff (1-2)	Pooled	0.0185	-0.1994	0.2363	0.1494	0.1009	0.2862
Diff (1-2)	Satterthwaite	0.0185	-0.2014	0.2383			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.20	0.8499
Satterthwaite	Unequal	7.6057	0.20	0.8502

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.59	0.6644

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-11 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.0634	0.1418	0.0634	0	0.3171
Diff (1-2)		0.1415	0.1541	0.0975		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.0634	-0.1127	0.2395	0.1418	0.0850	0.4075
Diff (1-2)	Pooled	0.1415	-0.0833	0.3663	0.1541	0.1041	0.2952
Diff (1-2)	Satterthwaite	0.1415	-0.0842	0.3672			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.45	0.1846
Satterthwaite	Unequal	7.8164	1.45	0.1855

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.36	0.7719

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-12 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.1329	0.1821	0.0814	0	0.3398
Diff (1-2)		0.0720	0.1740	0.1100		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.1329	-0.0932	0.3590	0.1821	0.1091	0.5233
Diff (1-2)	Pooled	0.0720	-0.1818	0.3257	0.1740	0.1175	0.3333
Diff (1-2)	Satterthwaite	0.0720	-0.1822	0.3261			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.65	0.5314
Satterthwaite	Unequal	7.928	0.65	0.5316

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.21	0.8575

--------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-13 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.1661	0.1542	0.0690	0	0.3171
Diff (1-2)		0.0388	0.1600	0.1012		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.1661	-0.0254	0.3576	0.1542	0.0924	0.4432
Diff (1-2)	Pooled	0.0388	-0.1945	0.2721	0.1600	0.1080	0.3064
Diff (1-2)	Satterthwaite	0.0388	-0.1947	0.2723			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.38	0.7115
Satterthwaite	Unequal	7.9605	0.38	0.7115

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.15	0.8945

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-2 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.1340	0.1551	0.0693	0	0.3092
Diff (1-2)		0.0709	0.1604	0.1014		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.1340	-0.0585	0.3266	0.1551	0.0929	0.4456
Diff (1-2)	Pooled	0.0709	-0.1630	0.3048	0.1604	0.1083	0.3072
Diff (1-2)	Satterthwaite	0.0709	-0.1632	0.3049			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.70	0.5044
Satterthwaite	Unequal	7.9663	0.70	0.5045

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.14	0.9026

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-3 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.2480	0.1228	0.0549	0.1181	0.4508
Diff (1-2)		-0.0431	0.1457	0.0922		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.2480	0.0955	0.4005	0.1228	0.0736	0.3528
Diff (1-2)	Pooled	-0.0431	-0.2556	0.1694	0.1457	0.0984	0.2792
Diff (1-2)	Satterthwaite	-0.0431	-0.2588	0.1726			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	-0.47	0.6525
Satterthwaite	Unequal	7.3796	-0.47	0.6535

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.82	0.5773

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-4 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.2568	0.1710	0.0765	0	0.4449
Diff (1-2)		-0.0519	0.1683	0.1064		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.2568	0.0445	0.4692	0.1710	0.1025	0.4914
Diff (1-2)	Pooled	-0.0519	-0.2974	0.1935	0.1683	0.1137	0.3224
Diff (1-2)	Satterthwaite	-0.0519	-0.2974	0.1935			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	-0.49	0.6387
Satterthwaite	Unequal	7.9914	-0.49	0.6387

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.07	0.9508

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-5 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.3202	0.2060	0.0921	0	0.5705
Diff (1-2)		-0.1153	0.1868	0.1182		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.3202	0.0644	0.5760	0.2060	0.1234	0.5919
Diff (1-2)	Pooled	-0.1153	-0.3878	0.1572	0.1868	0.1262	0.3580
Diff (1-2)	Satterthwaite	-0.1153	-0.3900	0.1594			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	-0.98	0.3578
Satterthwaite	Unequal	7.6452	-0.98	0.3590

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.55	0.6818

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-6 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.0335	0.0749	0.0335	0	0.1674
Diff (1-2)		0.1714	0.1284	0.0812		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.0335	-0.0595	0.1265	0.0749	0.0449	0.2152
Diff (1-2)	Pooled	0.1714	-0.0159	0.3588	0.1284	0.0868	0.2461
Diff (1-2)	Satterthwaite	0.1714	-0.0311	0.3740			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	2.11	0.0679
Satterthwaite	Unequal	5.572	2.11	0.0829

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	4.88	0.1537

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-7 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.1123	0.1059	0.0474	0	0.2276
Diff (1-2)		0.0926	0.1389	0.0879		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.1123	-0.0192	0.2438	0.1059	0.0635	0.3044
Diff (1-2)	Pooled	0.0926	-0.1100	0.2953	0.1389	0.0938	0.2662
Diff (1-2)	Satterthwaite	0.0926	-0.1164	0.3016			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	1.05	0.3226
Satterthwaite	Unequal	6.8062	1.05	0.3278

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	2.44	0.4085

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-8 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.2074	0.1476	0.0660	0	0.3885
Diff (1-2)		-0.00249	0.1568	0.0992		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.2074	0.0241	0.3907	0.1476	0.0885	0.4242
Diff (1-2)	Pooled	-0.00249	-0.2312	0.2262	0.1568	0.1059	0.3004
Diff (1-2)	Satterthwaite	-0.00249	-0.2317	0.2267			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	-0.03	0.9805
Satterthwaite	Unequal	7.8978	-0.03	0.9806

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.26	0.8301

---------------- Test=Larval Endpoint=Percent Combined Mortality Treatment=MP-9 ----------------

The TTEST Procedure

Variable: Result

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
SBREF-80	5	0.2049	0.1655	0.0740	0	0.4328
Test	5	0.1312	0.1641	0.0734	0	0.4016
Diff (1-2)		0.0737	0.1648	0.1042		

group	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
SBREF-80		0.2049	-0.00058	0.4104	0.1655	0.0992	0.4756
Test		0.1312	-0.0725	0.3350	0.1641	0.0983	0.4716
Diff (1-2)	Pooled	0.0737	-0.1667	0.3140	0.1648	0.1113	0.3157
Diff (1-2)	Satterthwaite	0.0737	-0.1667	0.3140			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	8	0.71	0.4998
Satterthwaite	Unequal	7.9994	0.71	0.4998

Equality of Variances

Method	Num DF	Den DF	F Value	Pr > F
Folded F	4	4	1.02	0.9873

APPENDIX B

Bioassay Report Round 2

Tier 2 Biological Testing of Sediment for March Point (Whitmarsh) Landfill Anacortes, Washington

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NEWFIELDS

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EXECUTIVE SUMMARY

Tier 2 biological testing of sediments from the March Point Landfill in Padilla Bay was performed to determine whether inconsistent results from one of three standard tests performed in 2008 were potentially due to factors not related to site contaminants, and consequently whether these results are suitable for use in evaluating potential impacts to sediments form contaminants of concern. Sediment toxicity was evaluated in 2008 using three standard PSEP bioassays, the 10-day amphipod test, the acute larval development test, and the Microtox® Porewater test. Biological effects were evaluated using the biological criteria defined in the Sediment Management Standards. All stations passed the criteria for the amphipod and larval tests, but seven of the thirteen stations failed to meet SQS criteria in the Microtox® test. Because of these potentially conflicting results, it is postulated that these failures may have been the result of factors other than contaminants of concern.

Although the failures did not indicate a CSL level of concern overall, there are no CSL criteria for the Microtox® Porewater test. Washington Department of Ecology expressed concern over the SQS failures and agreed to evaluate additional testing for the seven stations that showed negative results in the Microtox® portion of the Tier 1 evaluation. The 2009 evaluation used Microtox® and also the juvenile polychaete test to help verify or refute initial results.

The goal of this study was to examine the Microtox® test performance, determine if effects found in the Tier 1 study were repeatable, and to determine if previous responses were related to non-anthropogenic contributing factors (e.g., holding times, elevated total and dissolved sulfide levels in sediment, and elevated ammonia and H_2S levels).

Sediments were held for 35 days prior to testing during the Tier 1 evaluation; therefore, to assess the effect of holding time, Tier 2 testing was designed to run the standard Microtox® porewater test at three time points within the same time frame. To address the question regarding the effect of ammonia and sulfides on test performance, these parameters were measured before and after aeration. All samples were tested according to standard protocol and also tested after aeration for 24 hours.

The results of the Tier 2 testing were evaluated using the Sediment Management Standards criteria. One sample failed to meet the SQS criteria for the polychaete test. The results of the Microtox® porewater test varied at the three time points. The first run conducted on Days 2 and 3 after collection had no SQS failures. However, as the sediments were stored and retested at 20 (Run 2) and 37 days (Run 3) after collection, the number of stations with SQS failures increased. At Day 20, post field collection, about half the stations failed the SQS criteria. At 37 days post collection, all of the stations failed the SQS criteria while several stations passed after aeration on Day 38.

The repeatability of the Microtox® test was evaluated by a comparison of the Tier 1 results conducted by Nautilus Environmental with the Tier 2 results from 37 days post collection. For standard methodology, all seven test samples failed the SQS criteria for the Microtox® test in both tests.

The results of this investigative Tier 2 evaluation of March Point sediments led to a series of conclusions.

- First, the responses of the previous Tier 1 evaluation of sediment using the Microtox® test were related to contributing factors. The responses observed in this study confirm this finding.
- Second, the length of time sediment samples are held in storage negatively impact the outcome of the Microtox® test. The differences in responses observed between Runs 1, 2, and 3 confirm this finding. No samples failed on Run 1, five of seven samples failed on Run 2, and all seven samples failed on Run 3 (15 minute endpoint). Consequently, it seems prudent to run the Microtox® test relatively soon after field collection of sediments from a marshy, estuarine environment to avoid any interference related to holding times.
- Third, ammonia and sulfide concentrations fluctuate with the length of time sediment samples are stored. Sulfide concentrations tend to increase with holding time and can therefore negatively impact biological test responses. Aeration reduces sulfide levels but may increase unionized ammonia levels, another negative impact on biological tests. It is likely the sulfide or unionized ammonia concentrations influenced the adverse responses observed in the Microtox® during the previous Tier 1 evaluation. The sediments from the Tier 1 evaluation were held approximately 35 days prior to testing providing ample time for the accumulation of sulfides in the samples. Run 3 of this study was conducted 37 days after collection to compare results with the previous evaluation.

The results of this Tier 2 investigation indicate contributing factors related to holding times and ammonia and sulfide concentrations were likely responsible for the adverse impacts associated with the Tier 1 Microtox® test results. The Tier 2 results for samples run the day after field collection provides an evaluation that minimizes these contributing factors and that coincides with the results of the amphipod, larval, and polychaete biological tests.

INTRODUCTION

Standardized toxicity testing following guidance provided in documents such as the Puget Sound Estuary Protocols-PSEP (1986, 1995, and 1997) and the Sediment Sampling and Analysis Plan Appendix - SAPA (Ecology 2008) provides useful information for regulatory agencies regarding site conditions. However, as the field of toxicology continues to advance, specific methodologies will be modified or clarified accordingly. One standardized test under consideration by NewFields, AMEC Geomatrix, and the Department of Ecology for further evaluation is the Marine Microtox® Sediment Porewater test (guidance provided in Appendix B of the SAPA).

PROBLEM STATEMENT

NewFields conducted an initial series of toxicity tests on sediment samples collected by AMEC Geomatrix at the March Point Landfill in Padilla Bay in 2008. Sediment toxicity was evaluated using three standard PSEP bioassays, the 10-day amphipod test, the acute larval development test, and the Microtox® Porewater test. Biological effects were evaluated using the biological criteria defined in the Sediment Management Standards (Chapter 173 – 204 of the Washington Administrative Code). All stations passed the criteria for the amphipod and larval tests, but seven of the thirteen stations failed to meet SQS criteria in the Microtox® test (Table 1).

Table 1 SMS Comparison for each of the PSEP Tests Performed in 2008

Sample	Amphipod		Larval		Microtox®
	Pass/Fail SQS	Pass/Fail CSL	Pass/Fail SQS	Pass/Fail CSL	Pass/Fail SQS[1]
MP-1	Pass	Pass	Pass	Pass	Pass
MP-2	Pass	Pass	Pass	Pass	Pass
MP-3	Pass	Pass	Pass	Pass	Pass
MP-4	Pass	Pass	Pass	Pass	Fail
MP-5	Pass	Pass	Pass	Pass	Fail
MP-6	Pass	Pass	Pass	Pass	Pass
MP-7	Pass	Pass	Pass	Pass	Pass
MP-8	Pass	Pass	Pass	Pass	Fail
MP-9	Pass	Pass	Pass	Pass	Fail
MP-10	Pass	Pass	Pass	Pass	Fail
MP-11	Pass	Pass	Pass	Pass	Fail
MP-12	Pass	Pass	Pass	Pass	Pass
MP-13	Pass	Pass	Pass	Pass	Fail

[1]CSL: No failure criteria for Microtox® under SMS rule.

These failures may have been the result of factors other than contaminants of concern. For example, two factors which may influence the outcome of the Microtox® tests include the amount of time the sediments are held in storage prior to testing and the changes in ammonia and sulfide levels that occur during this extended holding time. Other researchers have reported on the interference of sulfur or sulfides or other parameters such as particle size distribution on the outcome of the Microtox®tests (Brouwer and Murphy 1994; Benton et al. 1995; Pardos et al 1999; Bennet and Cubbage 1992). Brouwer and Murphy showed uncontaminated sediment spiked with hydrogen sulfide was highly toxic using the Microtox® solid phase test.

The failures did not definitively indicate an SMS level of concern, however, the Washington Department of Ecology (Ecology) still expressed some concern over the negative results and agreed to allow further evaluation using additional testing of the seven stations that failed the Microtox® portion of the Tier 1 evaluation. NewFields conducted a second round of bioassays for sediment samples collected from the inner lagoon at March Point in September 2009. The 2009 evaluation using Microtox® and the juvenile polychaete (Tier 2) was performed as a follow-up analysis to the Tier 1 assessment.

BACKGROUND ON THE SITE

The former landfill site at March Point is situated beneath a bluff and is located within the tidelands area of Padilla Bay. Several stakeholders are associated with this property. The elevation of the site ranges from approximately 6 to 25 ft MLLW, with the higher elevations on the north end nearest the Burlington Northern Santa Fe railroad. The topography slopes down to the tidelands on the northeast and east sides and to the drainage channels along the north and south sides. Figure 1 provides a map of the site with the corresponding locations of the field samples. A portion of the upland area of this site was used as a landfill that has been closed since 1973.

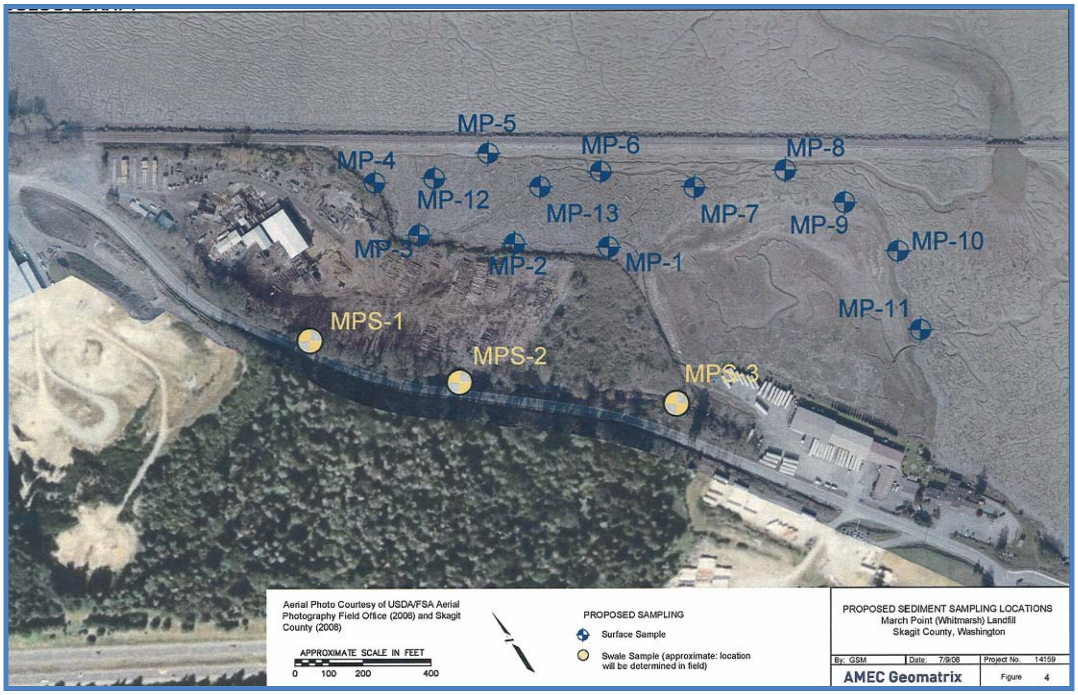

Figure 1 Map Showing Study Area for March Point

APPROACH

The goal of this study was to examine the Microtox® test performance and to determine if effects found in the Tier 1 study were repeatable and to determine if previous responses were related to non-anthropogenic contributing factors (e.g., holding times, elevated total and dissolved sulfide levels in sediment, and elevated ammonia and H_2S levels). Under PSEP Guidelines there are two acceptable tests to demonstrate chronic effects, the Microtox® porewater test and the 20-day Juvenile Polychaete Growth test. After discussion with Ecology and AMEC Geomatrix it was determined that both tests would be run side-by-side to compare results.

The main objective of the Tier 2 evaluation was to determine why seven of the March Point sediment samples failed SQS criteria in the Microtox® test while none of the samples failed criteria in the other PSEP tests during Tier 1 testing. To achieve this objective, the following questions were asked and steps were taken to address these questions:

- Were toxic effects noted in the previous Microtox® Porewater Tests based on actual contamination or other contributing factors?
    - Conduct parallel studies using standardized and modified protocols
- Do varying lengths of holding times affect Microtox® test results?
    - Test samples at three different time points and compare results

- Are ammonia and sulfide levels changing during holding and ultimately affecting the Microtox® test results?
  - Test samples with and without aeration
  - Monitor ammonia and sulfides throughout testing
- Is the Microtox® porewater test reliable to indicate toxicity in an estuarine, intertidal environment?
  - Compare results to the other accepted chronic PSEP bioassay (20-day Juvenile Polychaete test)
  - Compare results to Tier 1 Microtox® data for reproducibility

Sediments were held for 35 days prior to testing during the Tier 1 evaluation, and it was collectively decided Tier 2 testing would include running the standard Microtox® porewater test at three time points to bracket this 35 day period. Time intervals were selected in relation to sample collection, and target times were 1 - 2 days, 17 - 18 days, and 35 - 36 days post field collection to investigate the effects of holding time on test performance.

The other contributing factor in question was the effect of ammonia and sulfides on test performance. Aeration is often used to mitigate the influence of these materials based on the assumption that aeration removes or reduces sulfide and ammonia concentrations. At each of the three selected time points, all samples were tested in parallel without aeration and with aeration (24 h aeration period). Chemical analysis for these attributes was performed at each of the three testing events using standard laboratory testing and NewFields also measured H_2S and total ammonia levels in the porewater samples used in the Microtox® tests. Unionized ammonia was calculated based on observed total ammonia, salinity, pH, and temperature. Unionized ammonia is often the most toxic form of ammonia (Word et al. 2005).

To further evaluate the Microtox® porewater test performance the PSEP 20-day Juvenile Polychaete Growth test was performed during this 35 day period beginning on day 10 after collection. No adaptations to the standard polychaete test were anticipated. It should be noted that PSEP procedure calls for aeration of all test chambers throughout the 20-day period as well as water renewals every third day. Aeration tends to drive sulfide levels down, while water exchanges effectively reduce ammonia levels. Results from both standard PSEP tests would be compared to better understand the relationship between aeration and ammonia and sulfide levels.

METHODS

This section summarizes the test methods that were followed for this biological and conventional chemical assessment. Test methods followed guidance provided by the Puget Sound Estuary

Program (PSEP 1995), the WDOE Sampling and Analysis Plan Appendix (SAPA; Ecology 2008), the various updates presented during the Annual Sediment Management Review meetings (SMARM), the Sediment Investigation Work Plan March Point (Whitmarsh) Landfill Skagit County, Washington prepared by AMEC Geomatrix (AMEC 2008), and the Addendum to the original work plan (AMEC 2009). NewFields performed the 20-day Juvenile Polychaete Growth test and the test specific water quality measurements, including ammonia and sulfide analyses; Analytical Resources Inc. (ARI) performed the Microtox® testing at NewFields laboratory and the conventional chemistry analyses at their facility.

Conventional Chemical Analyses

Analytical Resources Incorporated (ARI) in Seattle, Washington performed the conventional chemical analyses to accompany the biological testing. Total organic carbon (TOC), grain size, total solids, and total volatile solids were measured once upon sample receipt. Preserved total solids and total and porewater sulfides were measured at each of the three Microtox® testing events. NewFields also made test specific determinations of porewater sulfides, ammonia, pH, salinity, temperature and dissolved oxygen at the time the Microtox® analyses were performed. The NewFields methods are presented in the biological testing section for each species.

Analysis	Method
Total Organic Carbon	Plumb1981
Grain size	PSEP Methods
Total Solids	EPA 160.3
Total Volatile Solids	EPA 160.4
Total and Dissolved Sulfides	EPA 376.2

Sample and Animal Receipt

Reference sediment was collected by NewFields from Sequim Bay on August 26, 2009. Three reference locations were sampled within Sequim Bay in an attempt to collect sediment with approximately 75% fines. Sediment from all three stations was composited to achieve this goal, and the percent fines in the composite was roughly 71% (SB REF COMP). Seven test sediments were collected by AMEC Geomatrix and delivered to NewFields on September 1, 2009. The sediment sampling methods presented in the Work Plan (AMEC Geomatrix 2008) were followed during this round of additional sampling. The sample locations MP-4, MP-5, MP-8, MP-9, MP-10, MP-11, and MP-13 were reoccupied and a minimum of two hand cores were collected at each location.

Sediment samples and references were stored in a walk-in cold room at 4 ± 2°C in the dark. Test sediment was not sieved prior to testing. All tests were conducted within the eight week holding time.

Polychaetes (*Neanthes arenaceodentata*) were supplied by Don Reish, Ph.D. of Long Beach, California. Animals were held in unfiltered seawater at 20°C prior to test initiation.

Microtox bacteria were obtained from Strategic Diagnostics, Inc. Two different lots of bacteria were used for these experiments.

- SDI Microtox® Acute Reagent Lot No.: 8L1002 Exp: 11/2010
- SDI Microtox® Acute Reagent Lot No.: 09C1049A Exp: 03/2011

20-DAY JUVENILE POLYCHAETE GROWTH BIOASSAY

The 20-day acute toxicity test with *N. arenaceodentata* was started on September 11, 2009 when the animals were placed into the test chambers. The test exposures were prepared with approximately 175 mL of sediment placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled with 775 mL of 0.45-µm filtered seawater at 28 ppt. Seven replicate chambers were prepared for each test treatment, the reference sediment, and the control sediment. The control and reference sediments were tested with the test treatments. Five replicates were used to evaluate sediment toxicity while the remaining two replicates were designated as sacrificial surrogate chambers. One surrogate chamber was sacrificed at test initiation to measure porewater and overlying ammonia and sulfides. The remaining surrogate chamber was used for daily water quality measurements as well as for porewater and overlying ammonia and sulfide determinations at test termination. Total ammonia as nitrogen was monitored using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{2-} were monitored using a HACH DR/4000V Spectrophotometer.

Test chambers were placed in randomly assigned positions in a 20°C water bath and allowed to equilibrate overnight. Trickle-flow aeration was provided to prevent dissolved oxygen concentrations from dropping below acceptable levels.

Test sediment samples were exposed to ultra-violet (UV) light during the entire test exposure. The UV light regime followed guidance provided by Sub-Appendix D (Ecology 2008) and in consultation with Ecology. UV light was provided by fluorescent light ballast containing one Duro-Test Vita-Lite® (40W, 5500°K, 91 CRI) UV bulb and one standard fluorescent bulb (Phillips F40CW). The bulbs were placed approximately 12” above the sediment surface, and test chambers were left uncovered to ensure UV transmittance.

Immediately prior to test initiation, water quality was measured in the surrogate chamber for each treatment. Dissolved oxygen (DO), temperature, pH, and salinity were then monitored in the surrogate chambers daily until test termination. Target test parameters were:

Dissolved Oxygen:	≥ 6.0 mg/L
Temperature:	20 ± 1°C
Salinity:	28 ± 1‰
pH:	8.0 ± 1.0 units

The test was initiated by randomly allocating five *N. arenaceodentata* into each test chamber, ensuring that each of the polychaetes successfully buried into the sediment. The 20-day test was conducted as a static-renewal test, with exchanges of 300 mL of water occurring every third day. *N. arenaceodentata* were fed every other day with 40 mg of TetraMarin® (approximately 8 mg dry weight per worm). Daily observations were made to note abnormalities on the sediment surface and animal behavior.

At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered polychaetes were transferred into a plastic cup. Survival was recorded and worms were placed in pre-weighed foil boats and dried in a drying oven at 60°C for at least 24 hours. Each weigh-boat was removed from the oven, cooled in a desiccator for approximately 30 minutes, and then weighed on a microbalance to 0.01 mg. Individual worm weight and growth rates were calculated.

The contents of the weigh-boats were subsequently ashed in a Thermolyne oven at 550°C degrees for 2 hours to obtain an ash free dry weight (AFDW) for each sample. Each weigh-boat was then weighed again in the same manner as described above, and AFDW and growth rates for each worm were calculated. This adaptation to the standard method was thought to reflect more accurate growth measurements. The organic material is removed during ashing providing a measurement of the sediment present in the gut of the worms at test termination. The residue was weighed and subtracted from the individual animal weight. This process gives a precise weight measurement of the organisms and removes any potential grain size related effects from test results.

A water-only, 4-day reference-toxicant test was conducted with cadmium chloride concurrently with the sediment test. The cadmium reference-toxicant test was used to ensure animals used in the test were healthy and of similar sensitivity to prior tests.

MICROTOX® POREWATER TESTS

ARI performed the series of Microtox® tests at the NewFields Laboratory. Testing was conducted at three time periods relative to sediment collection and each time interval consisted of two consecutive days of testing (Days 2 & 3, Days 20 & 21, and Day 37 & 38 post collection). On the first test day, samples were tested immediately after porewater collection. Samples were then gently aerated for 24 hours and tested again on the second day.

Sediments were centrifuged twice to collect porewater for use in the tests. The first centrifugation utilized a BEP High Performance Centrifuge. Sediment was placed in Teflon-coated cylinders using stainless steel spoons and centrifuged for 30 minutes at approximately 1000 G to collect sufficient porewater volume for use in the tests. Porewater was subsequently centrifuged for 30 minutes at approximately 4500 G in a Hettich Rotofix 32A centrifuge, and the remaining liquid was poured into 400 mL glass beakers. Half of the porewater from each station was used the same day; the other half was covered with parafilm and gently aerated for 24 hours.

Water quality was measured prior to testing. Total ammonia as nitrogen was measured using an Orion meter fitted with an ammonia ion-specific probe. Total sulfides as S^{2-} were monitored using a HACH DR/4000V Spectrophotometer. Temperature was recorded. Dissolved oxygen, salinity, and pH were measured and adjusted if necessary to within the following parameters.

Dissolved Oxygen:	≥ 50%
Salinity:	if > 20 ppt, no adjustment needed and control is adjusted to match test salinities ± 2 ppt
	If < 20 ppt, adjust sample to 20 ± 2 ppt
pH:	7.9 – 8.2 units

Microtox® procedures outlined in SAPA Appendix B were adhered to with some minor changes suggested by Mr. Peter Adolphson of Ecology as follows. A revised version of SAPA Appendix B is included in Appendix C of this report.

- Control water was prepared in a 600 mL beaker for Runs 2 and 3. Salinity adjustments were made in the beaker and water quality was measured before control water was used in the tests.
- 0.1 M NaOH was used to increase pH when needed.
- Reconstituted bacteria were allowed to equilibrate for a minimum of 20 minutes.
- A 15 minute wait period was established after loading test chambers to allow the samples to cool down to 15°C.
- Samples were mixed after addition of bacteria with a 10 µL pipette by drawing in liquid near the bottom of the vial and releasing sample liquid near the surface of the remaining liquid three times in each test chamber.

Light output was recorded immediately after mixing and at 5 minutes and 15 minutes post-mixing (I_0, I_5, and I_{15} respectively).

Quality Assurance/Quality Control

Chemical Analyses

A method blank, a sample duplicate or a matrix spike and matrix spike duplicate were included with each analytical batch to assess the quality of the analyses. The QA objective with respect to accuracy, precision, and sensitivity of laboratory data is to achieve the QC acceptance criteria of the testing protocols. In general, the accuracy and precision criteria are those stipulated by the most recent versions or modifications of the methods cited for each analyses.

To assess the quality of data resulting from the analytical chemistry program, the following QA/QC measures were included:

- Procedural blanks were analyzed to check for artifacts associated with sample extraction and analysis. Procedural blanks were performed at a rate of one per 20 samples or each analytical batch.

- Sufficient sample volume was supplied to the laboratory in order to perform matrix spike/matrix spike duplicate (MS/MSD). MS/MSD samples evaluated the analytical accuracy and precision. MS/MSD samples were performed at a frequency of one per 20 (5%) investigative samples or each analytical batch.

- Laboratory duplicate samples were performed to check precision of the analytical process. Lab duplicate samples were conducted at a frequency of one per 20 (5%) investigative samples or one per analytical batch.

Biological Analyses

The quality assurance objectives for toxicity testing are provided in the methods cited for each test. Overall the objectives for accuracy and precision involved aspects of the testing process, and included the following:

- Source and condition of test organisms
- Condition of equipment
- Test conditions
- Instrument calibration
- Use of reference toxicants
- Record keeping
- Data evaluation

The sensitivity of the test organisms relative to established laboratory control charts was evaluated using reference toxicant tests. The reference toxicant LC_{50} or EC_{50} should fall within two standard deviations of the historical laboratory mean. Water quality measurements were monitored to ensure that they fall within prescribed limits and corrective actions were taken if necessary. All limits established for this program met or exceeded those recommended by testing protocols.

Finally, all data collected and produced were recorded on approved data sheets, which became part of the permanent data record of the program. If any aspect of a test deviated from protocol, the test was evaluated to determine whether it was valid according to the regulatory agencies responsible for approval of the proposed permitting action.

Toxicity tests incorporate standard QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of negative and positive controls, the use of testing replicates and the measurement of water quality parameters daily during testing.

20-Day Juvenile Polychaete Test Data

There is no established accuracy or precision requirement for toxicity tests. Acceptable accuracy levels are generally assessed by the calibration of water quality instruments, the use of certified standards, and the establishment of acceptable water quality testing parameters. For example, water quality is monitored and adjusted if necessary throughout testing in at least one test replicate. Parameters that fall outside of acceptable test ranges may require corrective action. Deviations from water quality testing ranges do not necessarily fail the test; however, the potential impact on test exposures is evaluated.

Test organism behavior is visually monitored for each test chamber. The system is evaluated by conducting concurrent tests with negative control sediment. Adequate organism survival in the negative control as specified in the test methods indicates a healthy testing population. Control survival is species and method specific; survival below recommended limits does not necessarily fail the test, however, it is an indication that the test system and test organisms should be further evaluated.

Random allocation of test organisms and testing chambers was conducted to remove any bias associated selectively picking the strongest organisms first or any bias associated with location of test chambers.

Representativeness was maintained for toxicity testing by ensuring that sediment was held in the dark at 4°C until needed for testing. Test sediment was homogenized prior to placement in test chambers. All test chambers and utensils were washed in warm soapy water, rinsed in deionized water, acid-rinsed, and solvent rinsed. Water quality parameters were measured daily in at least one replicate per treatment. A calibration check was performed daily on all water quality instruments.

All water quality and endpoint data were entered into Excel spreadsheets. Water quality parameters were summarized by calculating the mean, minimum, and maximum values for each test treatment. Endpoint data were calculated for each replicate and mean value and standard deviations were determined for each test treatment.

MICROTOX® POREWATER TEST DATA

Details regarding QA/QC for the Microtox® test are provided in the SAPA Appendix B (Ecology 2008). A brief description of these procedures follows:

- QC1: Control Final mean light output should be greater than or equal to 80% of Control Initial mean light output. $F_{c(mean)}/I_{c(mean)} \geq 0.80$
- QC: 2 Reference Final mean light output should be greater than or equal to 80% of Control Final mean light output. $F_{r(mean)}/F_{c(mean)} \geq 0.80$
    - Note: If reference criteria are not met, Control output may be used for comparison with sediment site output.
- QC: 3 Reference Initial mean light output ($I_{r(mean)}$) must be greater than or equal to 80% of Control Initial mean light output ($I_{c(mean)}$).
    - Note: If Reference Initial mean light output is less than 80% of Control Initial mean output, then the Control Initial mean light output should be used in place of each of the individual Reference Initial values. (When $I_{r(mean)} < 0.80$ of $I_{c(mean)}$, $I_{c(mean)}$ is used in place of each $I_{r.}$) This may be necessary when the light reduction response occurs so rapidly that the initial test response falls below 80% before the initial measurement is taken.
- QC:4 Test Initial mean light output ($I_{t(mean)}$) must be greater than or equal to 80% of Control Initial mean light output ($I_{c(mean)}$).
    - Note: If Test Initial mean light output is less than 80% of Control Initial mean light output, then the Control Initial mean light output should be used in place of each of the individual Test Initial values. (When $I_{t(mean)} < 0.80$ of $I_{c(mean)}$, n $I_{c(mean)}$ is used in place of each $I_{t.}$) This may be necessary when the light reduction response occurs so rapidly that the initial test response falls below 80% before the initial measurement is taken.

Water quality and light output data were entered into Excel spreadsheets. Mean light output was calculated for the three time intervals I_0, I_5, and I_{15}.

All hand-entered data was reviewed for data entry errors, which were corrected prior to summary calculations. A minimum of 10% of all calculations and data sorting were reviewed for errors. Review counts were conducted on any apparent outliers.

Statistical Analyses

For SMS suitability determinations, comparisons were made according to SAPA and Fox et al. (1998). Data reported as percent mortality or survival was transformed using an arcsine square root transformation prior to statistical analysis. All data were tested for normality using the Wilk-Shapiro test and equality of variance using Levene's test. Determinations of statistical significance were based on one-tailed Student's t-tests with an alpha of 0.05. For samples failing to meet assumptions of normality, a Mann-Whitney test was conducted to determine significance. For those samples failing to meet the assumptions of normality and equality of variance, a t-test on rankits was used.

Results

The results of the testing, including a summary of test results and water quality observations are presented in this section. Data for each of the replicates, as well as laboratory bench sheets and statistical analyses are provided in the appendices.

Chemical Analyses

Total solids, total volatile solids, TOC, and grain size were measured at the beginning of the Tier 2 evaluation (Table 2). The QA/QC data represented by the method blanks, matrix spikes, and sample duplicates and the analytical laboratory reported no anomalies for the conventional analyses. Appendix A contains the complete data records for the chemical analyses. The measured parameters were undetected in the method blanks at the detection limit for each of the conventional analysis. The matrix spike recovery for total organic carbon was 112.4% of the spiked concentration indicating accuracy of the method. The relative percent difference for replicate analysis for total solids, TVS, and TOC were ranged from 0.2% to 2.6% indicating acceptable precision of the method.

The total solids ranged from 30.9% to 47.8% in the test treatments which are typical for most estuarine sediments. The total volatile solids ranged from 6.83 to 10.6% and total organic carbon ranged from 2.13% to 5.41%. The TVS and TOC values are indicative of a fairly organically enriched environment typical of tidally influenced estuaries. The grain size distribution for the test treatments was predominantly silts and clays.

Total preserved solids and total and dissolved sulfides were analyzed at all three time points (Day 2, Day 20, and Day 37) corresponding to the days of the Microtox® porewater tests (Table 3).

Table 2 Initial Chemistry Results

Sample	Total Solids (%)	Total Volatile Solids (%)	TOC (%)	Grain Size (%)			
				Gravel	Sand	Silt	Clay
MP-4R	30.90	10.60	5.14	0.3	17.5	61.3	20.9
MP-5R	41.70	8.02	3.40	0.1	7.0	59.7	33.2
MP-8R	46.70	7.53	2.71	0.1	10.9	58.6	30.4
MP-9R	47.80	8.54	2.98	0.3	12.6	59.3	27.7
MP-10R	41.40	6.83	2.27	1.7	14.9	56.3	26.9
MP-11R	42.10	7.02	2.13	0.0	5.7	62.4	32.0
MP-13R	40.10	7.54	2.77	0.0	7.2	61.1	31.6

Table 3 Chemistry Results (ARI) at Three Different Time Points

Sample	Preserved Total Solids (%)			Sulfides (mg/kg)			Dissolved Sulfides (mg/L)		
	Day 2	Day 20	Day 37	Day 2	Day 20	Day 37	Day 2	Day 20	Day 37
Sequim Bay REF 1	31.8	32.3	32.3	312	413	915	NM	NM	NM
Sequim Bay REF 2	38.2	37.3	35.3	416	419	600	NM	NM	NM
Sequim Bay REF 3	26.0	26.1	25.5	996	807	1130	NM	NM	NM
MP-4R	31.0	29.6	30.0	12600	12900	9450	0.050 U	0.050 U	0.050 U
MP-5R	40.4	39.9	40.9	192	56	303	0.050 U	0.050 U	0.050 U
MP-8R	45.6	42.9	45.3	94.4	1650	685	0.050 U	0.050 U	0.077 U
MP-9R	45.1	43.4	43.2	139	248	64.6	0.050 U	27.4	66.4
MP-10R	36.8	37.3	38.5	234	528	684	0.050 U	0.050 U	14.1
MP-11R	36.4	36.8	38.2	275	575	839	0.050 U	9.06	61.0
MP-13R	40.6	40.0	40.3	404	560	827	0.050 U	19.5	67.4

NM – not measured, there was insufficient sample to perform the analysis.
Grey shading indicates an overall increase in sulfide concentration with time.

There were seven different analytical batches (PP16, PP27, PR85, PS06, PL99, PQ43, and PM99) associated with the total solids, total sulfides, and dissolved sulfides analysis measured over time. The QA/QC data were represented by the method blanks, matrix spikes, and sample duplicates; the analytical laboratory reported two anomalies for these analyses. The method blanks were undetected at the detection limit for each of the conventional analyses. The matrix spike recoveries were all within control limits with the exception of the MS/MSD for station MP-4R which had a recovery of 70.4% (the control limit for sulfides is 75 – 150%). The replicate analyses for total solids, total sulfides, and dissolved sulfides were within control limits with the exception of total sulfides for samples SB REF1 Day17 and MP-5R DAY 20 which had RPDs of greater than the control limit of 20%. The laboratory re-analyzed the samples to confirm the results. The outliers were attributed to sample heterogeneity. The overall quality of the data is considered acceptable for interpretation.

Total solids did not change significantly over the three different time periods. The relative concentration of total sulfides as measured in the sediment increased for five of the seven test treatments and for all three Sequim Bay reference stations as shown in Table 3. Grey shading indicates on overall increase in sulfide concentration from Day 2 to Day 37. A similar trend of increasing concentration over time was observed for dissolved sulfides. Four of seven stations increased from undetected on Day 2 to concentrations ranging from 14.1 to 67.4 mg/L on day 37. The increase in sulfide concentration with storage will be explored in the discussion section of this report.

20-DAY JUVENILE POLYCHAETE GROWTH BIOASSAY

A summary of test conditions for the bioassay is shown in Table 4, summaries of water quality conditions including ammonia and sulfides as measured by the biological laboratory are presented in Tables 5 and 6, and *N. arenaceodentata* growth is presented in Table 7. Survival in the control sample was 100%. Appendix B contains all of the data records associated with the *N. arenaceodentata* test. The tissue samples were weighed once using the standard procedures for drying and weighing and again after obtaining an AFDW of the samples as described previously. Mean individual growth (MIG) in the control was 0.86 mg/ind/day before the sediment in the organisms gut contents was accounted for and 0.49 mg/ind/day AFDW. Both growth rates met the performance criteria of >0.38 mg/ind/day. This indicates that the test conditions were suitable for adequate polychaete survival and growth.

The LC_{50} for the cadmium reference-toxicant test was 9.2 mg Cd/L, which is within the control chart limits (1.2 to 28.9 mg Cd/L), indicating that the test organisms used in this study were of similar sensitivity of those previously tested at NewFields. Water quality measurements were within target parameters throughout the test with a few minor exceptions. These deviations were within tolerance ranges for the species and therefore not expected to affect the test results. Initial and final interstitial ammonia concentrations (Table 6) were all below the threshold concentration of 30 mg/L total ammonia (Barton 2002). Initial and final interstitial sulfide concentrations (Table 6) were below 5 mg/L.

Table 4 Test Condition Summary for *Neanthes arenaceodentata*

Test Conditions: PSEP		
Sample Identification	MP-4R, MP-5R, MP-8R, MP-9R, MP-10R, MP-11R, MP-13R, SB REF COMP	
Date sampled	9/1/09 (Test sediments); 8/26/09 (Reference)	
Date received at NewFields Northwest	9/1/09 (Test sediments); 8/26/09 (Reference)	
Sample storage conditions	4°C, dark	
Holding Time	10 days	
Source of control sediment	Northwest Aquatic Sciences (*Eohaustorius* control)	
Test Species	*N. arenaceodentata*	
Supplier	California State University at Long Beach	
Date acquired	9/10/09	
Acclimation/holding time	1 day	
Age class	Juvenile (minimum 0.5 mg dry wt.)	
Test Procedures	PSEP 1995 with SMARM revisions	
Regulatory Program	SMS	
Test location	NewFields Northwest Laboratory	
Test type/duration	20-Day static renewal	
Test dates	9/11/09 – 10/1/09	
Control water	North Hood Canal, 0.45µm filtered	
Test temperature	Recommended: 20 ± 1 °C	Achieved: 19.3 – 21.9
Test salinity	Recommended: 28 ± 1 ppt	Achieved: 27.0 – 31.0
Test dissolved oxygen	Recommended: > 6.0 mg/L	Achieved: 5.9 – 8.8 mg/L
Test pH	Recommended: 8.0 ± 1	Achieved: 7.3 – 9.0
SMS control performance standard	Recommended: Control < 10% mortality; Control MIG ≥ 0.38 mg/ind/day	Achieved: 0% mortality; MIG = 0.86 mg/ind/day (non-ashed), MIG = 0.49 mg/ind/day (ashed)
SMS reference performance standard	Recommended: Reference mortality R < 20%; MIG R/C ≥ 80%	Achieved: 0% mortality; MIG = 0.42 mg/ind/day (non-ashed), 0.32 mg/ind/day (ashed)
Reference Toxicant LC50	9.2 mg/L	
Acceptable Range	1.2 – 28.9 mg/L	
Test Lighting	16-h light; 8-hr-dark; UV/fluorescent lighting used	
Test chamber	1-Liter Glass Chamber	
Replicates/treatment	5 + 2 surrogates (one used for WQ measurements throughout the test)	
Organisms/replicate	5	
Exposure volume	175 mL sediment/ 950 mL water	
Feeding	8 mg/worm TetraMarin every other day	
Water renewal	250 mL every third day	

Table 5 Water Quality Summary for *Neanthes arenaceodentata*

Sample	Dissolved Oxygen (mg/L)			Temperature (°C)			pH (units)			Salinity (ppt)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	7.4	7.1	7.7	20.4	20.0	20.7	7.9	7.8	8.1	29.3	28.0	31.0
SB Ref Comp	7.6	7.1	8.7	20.4	19.9	21.7	8.1	7.8	8.7	29.3	28.0	30.0
MP-4R	7.8	6.5	8.8	20.5	20.1	21.8	8.0	7.3	9.0	28.5	27.0	29.0
MP-5R	7.5	5.9	8.6	20.1	19.3	21.4	7.9	7.3	8.3	29.3	28.0	30.0
MP-8R	7.6	7.3	8.3	20.5	20.1	21.9	7.9	7.6	8.2	29.7	28.0	31.0
MP-9R	7.4	6.4	7.8	20.4	19.9	21.6	8.0	7.8	8.2	29.3	28.0	30.0
MP-10R	7.6	6.5	8.2	20.5	20.1	21.8	8.1	7.6	8.5	29.2	28.0	30.0
MP-11R	7.5	6.5	7.7	20.5	20.1	21.9	8.0	7.7	8.4	29.1	28.0	30.0
MP-13R	7.6	7.2	8.0	20.5	20.1	21.9	8.1	7.7	8.5	29.3	28.0	31.0

Table 6 Ammonia and Sulfide Measurements for *Neanthes arenaceodentata*

Sample	Overlying Ammonia (mg/L Total)		Interstitial Ammonia (mg/L Total)		Overlying Sulfides (mg/L)		Interstitial Sulfides (mg/L)	
	Day 0	Day 20	Day 0	Day 20	Day 0	Day20	Day 0	Day20
Control	< 0.5	1.64	< 0.5	3.00	0.005	<0.002	0.060	<0.002
SB Ref Comp	0.68	< 0.5	3.43	< 0.5	0.152	<0.002	0.073	0.082
MP-4R	1.95	< 0.5	7.12	1.12	0.003	<0.002	0.034	0.106
MP-5R	1.11	0.87	2.30	1.55	0.002	<0.002	0.059	<0.002
MP-8R	1.26	< 0.5	3.34	1.05	0.004	<0.002	0.024	<0.002
MP-9R	0.56	< 0.5	2.24	< 0.5	0.005	<0.002	0.129	0.047
MP-10R	1.15	< 0.5	4.44	< 0.5	0.015	<0.002	0.254	0.007
MP-11R	< 0.5	0.69	2.17	1.14	0.035	<0.002	0.272	<0.002
MP-13R	0.84	0.63	2.99	1.30	0.021	<0.002	0.140	<0.002

Mean survival in the reference was 100%. To pass SMS suitability criteria for reference performance MIG in the reference should be ≥ 80% of MIG in the control. The MIG in the control sediment treatment was relatively high averaging near 1 mg/ind/day, well above the criteria of 0.38 mg/ind/day. MIG for the reference prior to AFDW was 0.42 mg/ind/day which also meets the control criteria and 0.32 mg/ind/day after being ashed. Although the MIG for the reference would be an acceptable control response, neither of these reference growth rates met the performance criteria of 80% of the control sediment MIG. However, the animal is cultured in water (no sediment) in glass containers and provided with high quality food; its original habitat more than 50 years ago was as an inhabitant of the mussel fouling community on pilings within a marina, also rich in organic foods. The control sediments used in the polychaete test are not representative of either of these conditions, although they have been used routinely for this test. The control sediment contains a high percentage of coarse grained sandy material supplemented with high quality food. Ashing of the control treatments showed approximately 40% of the gut content was coarse grained sediment; therefore the MIG is an overrepresentation of the actual growth of the organism when the substrate in the gut is treated as organism growth.

Table 7 Test Results for *Neanthes arenaceodentata*

Sample	Mean survival		MIG Non-ashed		MIG AFDW	
	(%)	SD	(mg/ind/day)	SD	(mg/ind/day)	SD
Control	100	0.0	0.86	0.26	0.49	0.13
SB REF COMP	100	0.0	0.42	0.17	0.32	0.13
MP-4R	100	0.0	0.27	0.07	0.21	0.05
MP-5R	100	0.0	0.47	0.10	0.35	0.08
MP-8R	100	0.0	0.23	0.04	0.18	0.03
MP-9R	100	0.0	0.38	0.14	0.30	0.11
MP-10R	100	0.0	0.34	0.11	0.24	0.07
MP-11R	100	0.0	0.29	0.12	0.21	0.09
MP-13R	100	0.0	0.42	0.13	0.31	0.10

A discussion between NewFields, AMEC Geomatrix, and Ecology concluded that this test is considered acceptable for interpretation even though the reference MIG was not within 80% of the control MIG because of these issues of sediment differences in gut content. This decision was based in part on the similar responses observed between the reference sample and the test samples. As shown in Figure 2, the confidence limits of the reference sample overlap with all of the test sample confidence limits. In the future, control sediment with a higher percentage of fine-grained sediment will be used.

The test samples were compared to the reference. Mean percentage survival in the all of the test samples was 100%. MIG in the treatments ranged from 0.23 – 0.47 mg/ind/day before ashing and from 0.18 – 0.35 mg/ind/day after the ashing the samples to an AFDW.

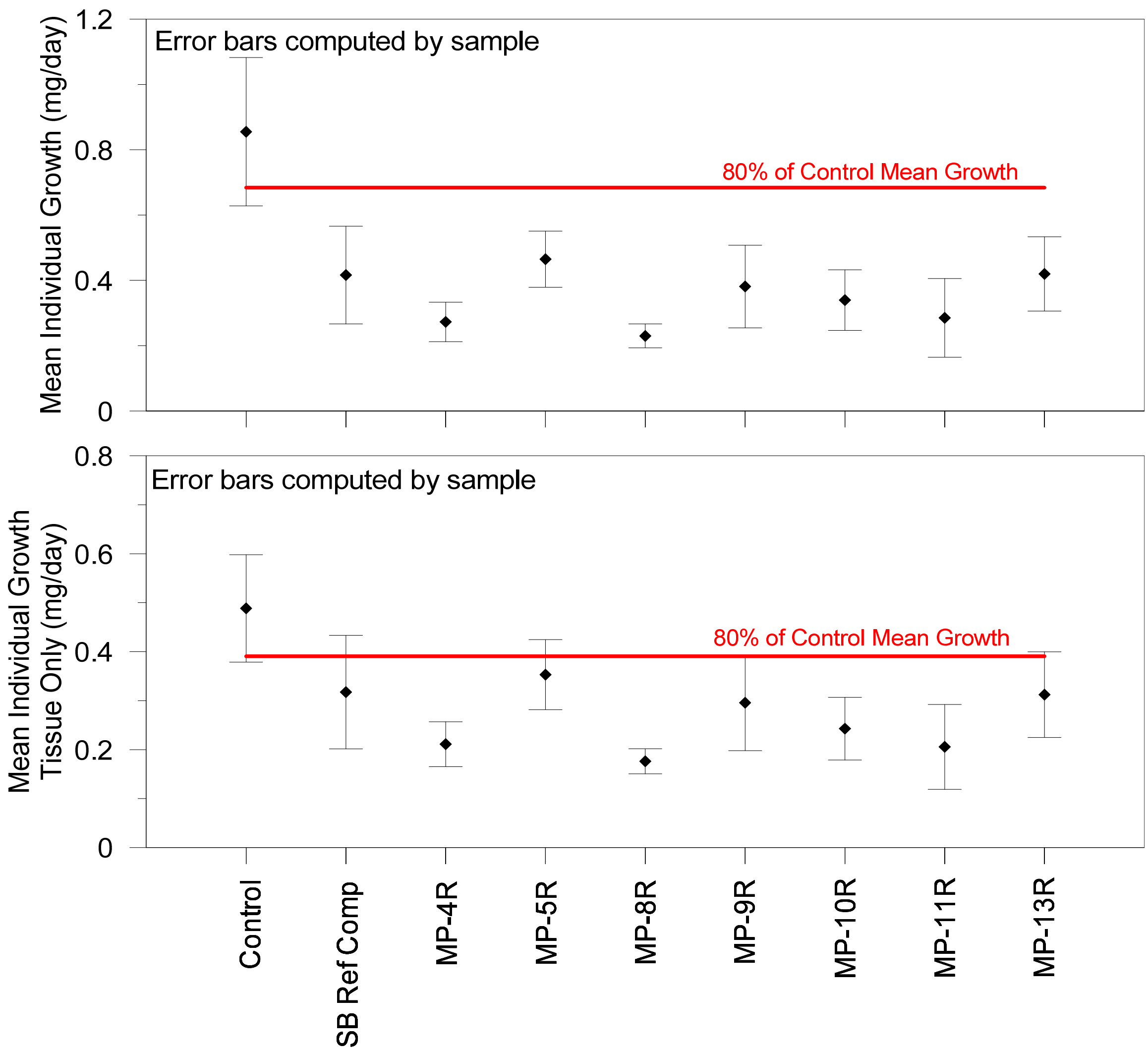

Figure 2 Graph showing Mean Growth Before and After Samples were Ashed.

Microtox® Porewater Tests

The Microtox® test was conducted on six different days to represent short, medium and longer term storage after field collection, with and without aeration for each time period. A summary of test conditions for each of the experimental runs is shown in Table 8.

A reference toxicant test with zinc acetate was conducted with each lot of *Vibrio fischeri* used as source organisms. Zinc acetate is routinely used by the testing laboratory to verify the batch of *Vibrio fischeri* are sufficiently sensitive and provide responses that fall within the laboratory control chart (mean± two standard deviations). Two different lots were used for this program, SDI Microtox® Acute Reagent Lot No.: 8L1002 Exp: 11/2010 and SDI Microtox® Acute Reagent Lot No.: 09C1049A Exp: 03/2011. The effective concentration (EC_{50}) demonstrated to produce an effect in

50% of the test population was calculated for each reference toxicant test. The EC_{50} for the first for Microtox® test (Lot No.: 8L1002) conducted on 9/4/09 was above the control chart limits provided by the laboratory. A second reference toxicant test was conducted (Lot No.: 09C1049A) on 9/4/09. The EC_{50} from this reference toxicant test was within the control chart limits established by this laboratory. This lot was used for all subsequent testing.

The data generated for each of the three test runs are reported separately and contain the water quality summaries, ammonia and sulfide data collected by the biological laboratory, the quality control results, and 5 and 15 minute endpoints for each Microtox batch. Two Microtox® batches, each with a separate control and reference were conducted on each test day to accommodate the number of samples requiring analysis.

Table 8 Test Conditions Summary for the Microtox® Tests

Test Conditions: SAPA Appendix B	
Test Dates	Run 1: 9/3, 9/4, Run 2: 9/21, 9/22, Run 3:10/8 and 10/9
Test Organism Source	Strategic Diagnostics
Batch Number and Expiration Date	SDI Microtox® Acute Reagent Lot No.: 8L1002 Exp: 11/2010 SDI Microtox® Acute Reagent Lot No.: 09C1049A Exp: 03/2011
Control	Run 1: Microtox Solid Phase Test Diluent Runs 2 & 3: Artificial Seawater prepared with deionized water and Forty Fathoms Reef® Seasalts
Sample Preparation	Centrifugation at 1000 G for 30 minutes, Centrifugation at 4500 G for 30 minutes
Test Chamber	Glass Cuvette
Test Volume	1mL
Volume of Inoculum/replicate	10µL
Number of Replicates/station	5
Aeration	Only on samples 9/4, 9/22, and 10/9
Reference Toxicant	Zinc Acetate

RUN 1 - DAYS 2 & 3

Water quality measurements are presented in Table 9, ammonia and sulfide are shown in Table 10 and the Microtox® quality control results are summarized in Table 11. Test results at both the 5-minute and 15-minute endpoints are provided in Table 12. The water quality conditions of salinity, dissolved oxygen and pH were adjusted whenever necessary to adhere to the methods in the SAPA Appendix B.

Table 9 Water Quality Summary for Microtox® Run 1

Test Day	Sample	Salinity (ppt)	DO (%)	pH	Temp (ºC)
Day 2 Batch 1 Non-Aerated	Control	30	NA	NA	NA
	SB Ref Comp	33	52.0	8.0	19.3
	MP-4R	31	91.7	8.0	19.3
	MP-5R	30	93.4	8.2	19.3
	MP-8R	28	96.3	7.9	19.3
	MP-9R	30	89.4	7.9	19.3
Day 2 Batch 1 Non-Aerated	Control	31	NA	NA	NA
	SB Ref Comp	33	57.9	7.9	21.0
	MP-10R	31	83.6	8.0	21.0
	MP-11R	31	85.9	7.9	21.0
	MP-13R	31	83.1	7.9	21.0
Day 3 Batch 1 Aerated	Control	31	NA	NA	NA
	SB Ref Comp	33	94	8.2	15.7
	MP-4R	31	108.1	8.2	15.6
	MP-5R	31	102.9	8	15.7
	MP-8R	30	102.4	8	15.6
	MP-9R	30	102.4	7.9	15.6
Day 3 Batch 2 Aerated	Control	31	NA	NA	NA
	SB Ref Comp	33	94.6	8.2	15.6
	MP-10R	30	102.4	8.2	15.6
	MP-11R	30	101.7	8.2	15.7
	MP-13R	30	102.4	7.9	15.7

Aeration had little effect on total ammonia while consistently increasing unionized ammonia in the Run 1 analyses. Higher initial concentrations of sulfides in the SB Ref Comp sample decreased with aeration as shown in Table 10.

Table 10 Ammonia and Sulfide Data for Microtox® Run 1

Sample	Day 2 Ammonia (mg/L)	Day 3 Ammonia (mg/L)	Day 2 Unionized Ammonia (mg/L)	Day 3 Unionized Ammonia (mg/L)	Day 2 Sulfides (mg/L)	Day 3 Sulfides (mg/L)
Control	NA	NA	NA	NA	NA	NA
SB Ref Comp	10.5	8.87	0.15	0.88	0.952	0.027
MP-4R	2.80	2.12	0.11	0.35	0.008	0.009
MP-5R	1.18	1.18	0.02	0.08	0.018	0.016
MP-8R	4.41	2.97	0.04	0.10	0.014	0.017
MP-9R	0.615	0.334	0.01	0.02	0.028	0.019
MP-10R	2.57	3.75	0.02	0.31	0.010	0.030
MP-11R	0.285	0.185	0.00	0.01	0.013	0.018
MP-13R	1.95	2.04	0.01	0.14	0.005	0.023

Quality control criteria for the Microtox® test are referred to in the header of Table 11 and are discussed in detail in the QA/QC methods section. The control percentage light output for some of the 5 and 15 minutes readings did not meet the criteria that the light output of the control at 5 and 15 minutes must be 80% of the initial light output. However, since the light output of the reference and test treatments were higher in most cases than the control, the data were considered acceptable for interpretation.

Mean light output readings and comparisons of the readings at 5 and 15 minutes are shown in Table 12. The original readings for individual replicates are provided in Appendix C to this report. As stated earlier, several control samples failed to meet the QC criteria, however, since the light output of the reference and test treatments were higher in most cases than the control, the data were considered acceptable for interpretation.

Table 11 Quality Control Results Summary for Microtox® Run 1

QC Pass Criterion > 0.80		5 Minutes		15 Minutes		Initial Readings
		QC 1	QC 2	QC 1	QC 2	QC 3 & QC 4
Test Day	Sample	Fc(mean)/ Ic(mean)	Fr(mean)/ Ir(mean)	Fc(mean)/ Ic(mean)	Fr(mean)/ Ir(mean)	Ir(mean) or It(mean)/ Ic(mean)
Day 2 Batch 1 Non-Aerated	Control	0.81		0.69		
	SB Ref Comp		1.37		1.44	1.22
	MP-4R					1.22
	MP-5R					1.15
	MP-8R					1.46
	MP-9R					1.34
Day 2 Batch 2 Non-Aerated	Control	0.87		0.79		
	SB Ref Comp		1.44		1.48	1.29
	MP-10R					1.09
	MP-11R					1.05
	MP-13R					1.01
Day 3 Batch 1 Aerated	Control	0.79		0.67		
	SB Ref Comp		1.59		1.68	1.33
	MP-4R					1.22
	MP-5R					1.39
	MP-8R					1.40
	MP-9R					1.40
Day 3 Batch 2 Aerated	Control	0.92		0.86		
	SB Ref Comp		1.28		1.34	1.18
	MP-10R					1.17
	MP-11R					1.20
	MP-13R					1.25

Ic = Initial Control, Fc = Final Control, Ir = Initial Reference, Fr = Final Reference, It = Initial Test, Ft = Final Test
Shaded cells indicate deviations from QC criteria.

Table 12 Test Results for Microtox Run 1

Test Day	Sample	Initial Mean	5 Minutes		15 Minutes	
			Final Mean	Final mean/ Initial mean	Final Mean	Final mean/ Initial mean
Day 2 Batch 1 Non-Aerated	Control	94.6	76.6	0.81	65.6	0.69
	SB Ref Comp	115.8	105.2	0.91	94.6	0.82
	MP-4R	115.6	106.8	0.92	96.6	0.83
	MP-5R	109.2	94.6	0.87	71.4	0.65
	MP-8R	137.8	120.4	0.87	99.4	0.72
	MP-9R	127.2	112.8	0.89	91.6	0.72
Day 2 Batch 2 Non-Aerated	Control	97.2	84.2	0.87	76.6	0.79
	SB Ref Comp	125.4	121.0	0.97	113.4	0.91
	MP-10R	105.6	100.8	0.95	88.6	0.84
	MP-11R	101.6	95.6	0.94	91.8	0.90
	MP-13R	98.4	88.6	0.90	77.4	0.79
Day 3 Batch 1 Aerated	Control	101.8	80.6	0.79	68.4	0.67
	SB Ref Comp	135.4	128.0	0.95	115.0	0.85
	MP-4R	124.4	113.0	0.91	100.6	0.81
	MP-5R	141.0	125.0	0.89	107.8	0.77
	MP-8R	142.2	126.8	0.89	109.8	0.77
	MP-9R	142.8	127.2	0.89	109.8	0.77
Day 3 Batch 2 Aerated	Control	82.6	76.2	0.92	70.8	0.86
	SB Ref Comp	97.6	97.2	1.00	94.8	0.97
	MP-10R	96.8	94.8	0.98	85.2	0.88
	MP-11R	99.0	98.0	0.99	92.4	0.93
	MP-13R	103.6	103.8	1.00	99.0	0.96

Shaded cells indicate deviations from QC criteria.

Run 2 - Days 20 & 21

Final water quality measurements are presented in Table 13, ammonia and sulfide results are summarized in Table 14, and the Microtox® quality control results are summarized in Table 15. Test results at both the 5-minute and 15-minute endpoints are provided in Table 16. The water quality conditions were adjusted whenever necessary to follow the methods in the SAPA Appendix B.

Table 13 Water Quality Summary for Microtox® Run 2

Test Day	Sample	Salinity (ppt)	DO (%)	pH	Temp (°C)
Day 20 Batch 1 Non-Aerated	Control	31	73.8	8.1	18.8
	SB Ref Comp	34	58.1	7.9	18.1
	MP-4R	22	84.9	8.0	18.1
	MP-5R	31	90.8	7.9	18.1
	MP-8R	31	92.3	8.0	18.6
	MP-9R	31	55.3	7.9	18.4
Day 20 Batch 2 Non-Aerated	Control	31	73.8	8.1	18.8
	SB Ref Comp	34	58.1	7.9	18.1
	MP-10R	31	77.0	7.9	18.0
	MP-11R	31	99.9	8.0	18.1
	MP-13R	31	68.8	7.9	18.0
Day 21 Batch 1 Aerated	Control	31	99.5	7.9	17.7
	SB Ref Comp	34	97.4	8.0	17.8
	MP-4R	20	100.4	8.1	17.9
	MP-5R	31	100.9	7.9	17.9
	MP-8R	31	100.5	7.9	17.9
	MP-9R	31	100.4	8.1	17.9
Day 21 Batch 2 Aerated	Control	31	99.5	7.9	17.7
	SB Ref Comp	31	97.4	8.0	17.8
	MP-10R	31	100.4	8.2	17.9
	MP-11R	31	100.3	8.1	17.9
	MP-13R	31	100.4	8.2	18.0

Total ammonia concentrations were essentially the same with and without aeration while all of the samples showed consistent increases in unionized ammonia concentrations with aeration. Samples with concentrations of total sulfides above 0.1 mg/L decreased in concentration with aeration (Table 14).

Table 14 Ammonia and Sulfide Data for Microtox® Run 2

Sample	Day 20 Ammonia (mg/L)	Day 21 Ammonia (mg/L)	Day 20 Un-ionized Ammonia (mg/L	Day 21 Un-ionized Ammonia (mg/L)	Day 20 Sulfides (mg/L)	Day 21 Sulfides (mg/L)
Control	NA	NA	NA	NA	0.006	0.004
SB Ref Comp	11.9	12.1	0.16	1.08	0.476	0.023
MP-4R	24.6	24.9	0.89	5.27	0.007	0.004
MP-5R	10.7	8.26	0.19	0.75	0.005	0.009
MP-8R	6.64	5.22	0.01	0.13	<0.002	0.014
MP-9R	6.50	5.70	0.09	0.64	7.42	0.017
MP-10R	18.4	17.4	0.20	2.38	0.005	0.009
MP-11R	4.75	5.89	0.16	0.66	6.10	0.035
MP-13R	6.97	5.82	0.08	0.53	0.468	0.026

The numbered quality control criteria for the Microtox® test shown in the header of Table 15 are discussed in detail in the QA/QC methods section. The control and reference results acceptance criteria were met for Run 2. Some of the initial light output for the test samples were not within 80% of the control, therefore per QC3 or QC4 of the method, the initial mean control value was used for subsequent calculations of light output for these samples. The data from Run 2 were considered acceptable for interpretation.

Table 15 Test Results Summary for Microtox® Run 2

QC Pass Criterion > 0.80		5 Minutes		15 Minutes		Initial Readings
		QC 1	QC 2	QC 1	QC 2	QC 3 & QC 4
Test Day	Sample	Fc(mean)/ Ic(mean)	Fr(mean)/ Ir(mean)	Fc(mean)/ Ic(mean)	Fr(mean)/ Ir(mean)	Ir(mean) or It(mean)/ Ic(mean
Day 20 Batch 1 Non-aerated	Control	0.99		0.99		
	SB Ref Comp		0.94		1.01	0.92
	MP-4R					0.82
	MP-5R					0.70
	MP-8R					1.12
	MP-9R					0.86
Day 20 Batch 2 Non-aerated	Control	1.01		1.02		
	SB Ref Comp		1.10		1.20	1.00
	MP-10R					0.67
	MP-11R					0.47
	MP-13R					0.51
Day 21 Batch 1 Aerated	Control	0.99		0.99		
	SB Ref Comp		1.31		1.23	1.22
	MP-4R					0.70
	MP-5R					1.00
	MP-8R					0.95
	MP-9R					0.52
Day 21 Batch 2 Aerated	Control	1.01		0.98		
	SB Ref Comp		1.10		1.21	1.04
	MP-10R					1.05
	MP-11R					0.75
	MP-13R					0.70

Ic = Initial Control, Fc = Final Control, Ir = Initial Reference, Fr = Final Reference, It = Initial Test, Ft = Final Test
Shaded cells indicate deviations from QC criteria.

Mean light output readings and comparisons of the readings at 5 and 15 minutes are shown in Table 16. Readings for individual replicates are provided in Appendix C to this report. As stated earlier, several sample readings failed to meet the QC criteria, these are shown in the shaded cells. Calculations of light output relative to the initial readings were made using the control initial mean for these samples.

Table 16 Test Results for Microtox Run 2.

Test Day	Sample	Initial Mean	5 Minutes		15 Minutes	
			Final Mean	Final mean/ Initial mean	Final Mean	Final mean/ Initial mean
Day 20 Batch 1 Non-Aerated	Control	101.6	101.0	0.99	100.8	0.99
	SB Ref Comp	93.6	95.4	1.02	101.8	1.09
	MP-4R	83.4	83.8	1.01	88.0	1.06
	MP-5R	71.0	63.0	0.62	59.8	0.59
	MP-8R	113.8	112.4	0.99	102.6	0.90
	MP-9R	87.6	83.2	0.95	74.4	0.85
Day 20 Batch 2 Non-Aerated	Control	95.6	96.8	1.01	97.2	1.02
	SB Ref Comp	95.8	106.4	1.11	116.4	1.22
	MP-10R	64.2	64.2	0.67	65.6	0.69
	MP-11R	44.6	34.4	0.36	27.4	0.29
	MP-13R	48.4	36.0	0.38	31.6	0.33
Day 21 Batch 1 Aerated	Control	97.6	96.2	0.99	96.4	0.99
	SB Ref Comp	119.4	125.8	1.06	118.8	1.17
	MP-4R	68.8	70.6	0.72	74.0	0.76
	MP-5R	97.2	101.4	1.04	111.6	1.15
	MP-8R	93.0	93.0	1.00	98.4	1.06
	MP-9R	50.6	41.0	0.42	41.0	0.42
Day 21 Batch 2 Aerated	Control	97.4	98.2	1.01	95.2	0.98
	SB Ref Comp	101.4	108.2	1.07	114.8	1.13
	MP-10R	102.2	108.8	1.06	115.0	1.13
	MP-11R	73.0	71.2	0.73	71.6	0.74
	MP-13R	68.2	67.6	0.69	71.6	0.74

Shaded cells indicate initial readings that fail QC4; initial means for Batch Control were used in computations.

Run 3 - Days 37 & 38

Final water quality measurements are presented in Table 17, ammonia and sulfide data are shown in Table 18 and the Microtox® quality control results are summarized in Table 19. Test results at both the 5-minute and 15-minute endpoints are provided in Table 20. The water quality conditions were adjusted whenever necessary to follow the methods in the SAPA Appendix B.

Table 17 Water Quality Summary for Microtox® Run 3

Test Day	Sample	Salinity (ppt)	DO (%)	pH	Temp (°C)
Day 37 Batch 1 Non-Aerated	Control	31	57	8.2	18.3
	SB Ref Comp	33	54	7.9	20.8
	MP-4R	19	59	8.0	19.7
	MP-5R	31	55	7.9	19.7
	MP-8R	31	52	7.9	19.7
	MP-9R	31	51	7.9	19.8
Day 37 Batch 2 Non-Aerated	Control	31	57	8.2	18.3
	SB Ref Comp	33	54	7.9	20.8
	MP-10R	31	54	8.2	19.8
	MP-11R	31	55	8.1	19.9
	MP-13R	32	50	8.0	19.8
Day 38 Batch 1 Aerated	Control	31	104.3	7.9	18.1
	SB Ref Comp	34	104.4	8.2	18.2
	MP-4R	19	104.9	8.2	18.3
	MP-5R	32	104.5	8.2	18.4
	MP-8R	31	104.8	8.2	18.4
	MP-9R	31	104.6	8.2	18.4
Day 38 Batch 2 Aerated	Control	31	104.3	7.9	18.1
	SB Ref Comp	34	104.4	8.2	18.2
	MP-10R	32	104.5	8.2	18.4
	MP-11R	32	104.1	8.2	18.4
	MP-13R	33	104.8	8.2	18.4

As in the previous two runs, aerated samples had little effect on total ammonia concentration while unionized ammonia consistently increased with aeration. Total sulfides did not show a consistent pattern with aeration in Run 3.

The quality control criteria for the Microtox® test shown in the header of Table 19 are discussed in detail in the QA/QC methods section. The reference sample for Day 37 Batch 1 non-aerated did not meet the performance criteria of >80% of the control light output. Therefore the samples for this batch were compared to the control for SMS comparison. The control and reference samples passed the performance criteria for the remaining batches associated with this run. Some of the samples did not meet the performance criteria of initial light output within 80% of the control. Therefore, the control initial mean value was used to calculate the change in percentage of light output for these samples. The data for Run 3 were considered acceptable for interpretation.

Table 18 Ammonia and Sulfide Data for Microtox® Run 3

Sample	Day 37 Ammonia (mg/L)	Day 38 Ammonia (mg/L)	Day 37 Un-ionized Ammonia (mg/L)	Day 38 Un-ionized Ammonia (mg/L)	Day 37 Sulfides (mg/L)	Day 38 Sulfides (mg/L)
Control	NA	NA	NA	NA	0.004	<0.002
SB Ref Comp	13.9	14.3	0.18	1.99	0.271	0.016
MP-4R	21.1	18.5	0.46	4.05	0.002	0.003
MP-5R	19.1	19.4	0.39	2.72	0.198	0.184
MP-8R	18.4	18.2	0.05	1.71	<0.002	0.012
MP-9R	11.6	10.7	0.24	1.24	0.186	0.325
MP-10R	16.9	11.4	0.84	1.60	0.033	0.089
MP-11R	24.3	14.4	0.96	1.65	0.055	0.008
MP-13R	21.2	17.3	0.66	2.42	0.136	0.224

Table 19 Test Results Summary for Microtox® Run 3

QC Pass Criterion > 0.80		5 Minutes		15 Minutes		Initial Readings
		QC 1	QC 2	QC 1	QC 2	QC 3 & QC 4
Test Day	Sample	Fc(mean)/ Ic(mean)	Fr(mean)/ Ir(mean)	Fc(mean)/ Ic(mean)	Fr(mean)/ Ir(mean)	Ir(mean) or It(mean)/ Ic(mean)
Day 37 Batch 1 Non-aerated	Control	0.99		1.03		
	SB Ref Comp		0.74		0.70	0.77
	MP-4R					0.65
	MP-5R					0.78
	MP-8R					0.69
	MP-9R					0.22
Day 37 Batch 2 Aerated	Control	0.99		1.00		
	SB Ref Comp		0.86		0.84	0.86
	MP-10R					0.34
	MP-11R					0.51
	MP-13R					0.77
Day 378 Batch 1 Aerated	Control	1.03		1.07		
	SB Ref Comp		0.96		1.01	0.90
	MP-4R					0.82
	MP-5R					0.82
	MP-8R					0.77
	MP-9R					0.92
Day 378 Batch 2 Aerated	Control	1.04		1.11		
	SB Ref Comp		1.00		0.99	0.96
	MP-10R					0.69
	MP-11R					0.64
	MP-13R					0.90

Ic = Initial Control, Fc = Final Control, Ir = Initial Reference, Fr = Final Reference, It = Initial Test, Ft = Final Test
Shaded cells indicate deviations from QC criteria.

Mean light output readings and comparisons of the readings at 5 and 15 minutes are shown in Table 20. Readings for individual replicates are provided in Appendix C to this report. As stated earlier, several sample readings failed to meet the QC criteria, these are shown in the shaded cells. Calculations of light output relative to the initial readings were made using the control initial mean for these samples.

Table 20 Test Results for Microtox Run 3.

Test Day	Sample	Initial Mean	5 Minutes		15 Minutes	
			Final Mean	Final mean/ Initial mean	Final Mean	Final mean/ Initial mean
Day 37 Batch 1 Non-Aerated	Control	93.6	93.0	0.99	96.0	1.03
	SB Ref Comp	72.2	68.6	0.73	67.2	0.72
	MP-4R	61.2	58.0	0.62	58.2	0.62
	MP-5R	73.0	66.5	0.57	65.8	0.56
	MP-8R	64.6	61.6	0.66	54.8	0.59
	MP-9R	21.0	13.2	0.14	14.4	0.15
Day 37 Batch 2 Non-Aerated	Control	93.6	93.0	0.99	93.8	1.00
	SB Ref Comp	80.8	80.0	0.99	79.0	0.98
	MP-10R	31.6	22.8	0.24	19.8	0.21
	MP-11R	47.4	39.0	0.42	33.2	0.35
	MP-13R	72.4	68.0	0.73	67.8	0.72
Day 38 Batch 1 Aerated	Control	94.2	96.6	1.03	100.4	1.07
	SB Ref Comp	85.2	92.8	1.09	101.8	1.20
	MP-4R	77.2	74.8	0.97	70.0	0.91
	MP-5R	77.4	77.4	1.00	79.2	1.02
	MP-8R	73.0	75.4	0.80	79.4	0.84
	MP-9R	87.0	88.6	1.02	92.6	1.06
Day 38 Batch 2 Aerated	Control	95.6	99.8	1.04	106	1.11
	SB Ref Comp	91.4	99.4	1.09	105.2	1.15
	MP-10R	66.4	62.8	0.66	61.8	0.65
	MP-11R	60.8	55.6	0.58	49.8	0.52
	MP-13R	86.2	90.2	1.05	96.6	1.12

Shaded cells indicate initial readings that fail QC4; initial means for Batch Control were used in computations.

DISCUSSION

Sediments were evaluated based on Sediment Management Standards (SMS) criteria. The biological criteria are based on both statistical significance (a statistical comparison) and the degree of biological response (a numerical comparison). The SMS criteria are derived from the Washington Department of Ecology Sampling and Analysis Plan Appendix (WDOE 2008). Comparisons were made for each test sample with the reference sample unless otherwise noted. Two numerical comparisons were made under SMS, the Sediment Quality Standards (SQS) and the Cleanup Standards Limit (CSL) for the polychaete test. Currently, no CSL criteria have been established for the Microtox test, and therefore treatment suitability was based solely upon SMS criteria.

JUVENILE POLYCHAETE TEST

Under the SMS program, a test sample will fail SQS if MIG in the sample is <70% of the MIG in the reference sediment and the difference is statistically significant ($p \leq 0.05$). Treatments fail CSL if MIG in the test sample is <50% relative to the reference sediment and the difference is statistically significant. MP-8R failed SQS criteria but passed CSL. All of the other stations passed both criteria (Table 21).

The failure of station MP-8R needs to be considered within the context of all of the biological and chemical data collected for the March Point site. Station MP-8R had no biological failures for either the amphipod or larval test conducted during the Tier 1 testing. The physical (grain size and TOC) and analytical data (ammonia, sulfides, total volatile sulfides) for this site are similar to measurements at the other sites that pass the *Neanthes* test and the first and second runs of the Microtox® test. In terms of responses relative to the 95% confidence interval for the reference treatments), there are no data that extend beyond the range of the reference response. Two of the sediment treatments MP-4R and MP-8R had similar individual growth rates during the test period but the variation at MP-8R was very small. As a result, while the growth rates were statistically significantly different at MP-8R from the Sequim Bay reference they were still within the reference 95% confidence interval for growth. Variation in growth of individual polychaetes is consistently large (>30% CV) for all of the sediment treatments (control, reference and test materials) except MP-8R. In the absence of other signs of biological response, the lack of variation in this sample, while resulting in a statistical significant difference, does not appear to be biologically meaningful.

Table 21 SMS Comparison for the Polychaete Test

Non-ashed/ Ashed	Sample	Test Sample Mean	Reference Mean	$Mean_{Treatment}/Mean_{Reference}$	Statistically Significant ($p \leq 0.05$)	Pass/Fail SQS	Pass/Fail CSL
Non-ashed	MP-4R	0.273	0.416	65.5	No	Pass	Pass
	MP-5R	0.465	0.416	111.7	No	Pass	Pass
	MP-8R	0.230	0.416	55.2	Yes	**Fail**	Pass
	MP-9R	0.381	0.416	91.6	No	Pass	Pass
	MP-10R	0.339	0.416	81.5	No	Pass	Pass
	MP-11R	0.285	0.416	68.5	No	Pass	Pass
	MP-13R	0.420	0.416	100.8	No	Pass	Pass
Ashed	MP-4R	0.211	0.318	66.5	No	Pass	Pass
	MP-5R	0.353	0.318	111.2	No	Pass	Pass
	MP-8R	0.176	0.318	55.5	Yes	**Fail**	Pass
	MP-9R	0.296	0.318	93.1	No	Pass	Pass
	MP-10R	0.243	0.318	76.4	No	Pass	Pass
	MP-11R	0.206	0.318	64.7	No	Pass	Pass
	MP-13R	0.312	0.318	98.3	No	Pass	Pass

MICROTOX® TEST

SMS control performance criteria requires light output of the control at 5 and 15 minutes to be 80% of the initial control light output. Controls failed to meet the criteria in Run 1. Controls for this run were prepared in test vials, and water quality parameters measured and adjusted within these vials. This preparation method was thought to be at least partially responsible for the control failures. Control water for Runs 2 and 3 were prepared in larger volumes (600 mL beakers), and water quality was measured and adjusted before control water was poured into test vials. Controls for both Runs 2 and 3 passed the SMS control performance criteria.

The SMS program criteria state that a test sediment fails the SQS criteria when the mean light output of the highest concentration of the test sediment is less than 80% of the mean light output of the reference sediment and the two means are statistically different ($p \leq 0.05$). No CSL criteria exist for the Microtox® test. Table 22 shows a summary of SQS comparisons for non-aerated and aerated samples from all three runs. The results of the first run conducted on 9/3 and 9/4/2009 (Days 2 and 3) show no SQS failures for either the 5 or 15 minute comparison. However, as the sediments were stored and tested at 20 and 37 days after collection the number of stations showing SQS failure increased. At Day 20 post field collection, half the stations fail for the 5 and 15 minute comparison to the reference. At 37 days post collection all of the stations fail the SQS criteria at the 5 and 15 minute comparison while several pass after aeration on Day 38. These findings are further discussed in the context of the objectives put forth for this study.

Some of the samples (MP-4, MP-9, and MP-13) showed an improvement in light output under aeration between the second (Day 20 & 21) and third testing periods (Day 37 & 38). This improvement may be related to a combination of factors including non-homogeneity of the samples, fluctuating sulfide and ammonia concentrations and their combined interactions, or some other water quality parameter not measured during this study.

Table 22 SMS Comparison for Microtox® Tests

Aeration	Sample	5 Minute Comparisons (T/R[1])						15 Minute Comparisons (T/R[1])					
		Day 2 & 3		Day 20 & 21		Day 37 & 38		Day 2 & 3		Day 20 & 21		Day 37 & 38	
Non-aerated	MP-4R	1.02		0.99		**0.62**	*	1.02		0.97		**0.61**	*
	MP-5R	0.95		**0.61**	*	**0.57**	*	0.80		**0.54**	*	**0.55**	*
	MP-8R	0.96		0.97		**0.66**	*	0.88		0.83		**0.57**	*
	MP-9R	0.98		0.93		**0.14**	*	0.88		**0.78**	*	**0.15**	*
	MP-10R	0.99		**0.61**	*	**0.25**	*	0.93		**0.57**	*	**0.22**	*
	MP-11R	0.98		**0.32**	*	**0.42**	*	1.00		**0.24**	*	**0.36**	*
	MP-13R	0.93		**0.34**	*	**0.73**	*	0.87		**0.27**	*	**0.74**	*
Aerated	MP-4R	0.96		**0.69**	*	0.89		0.95		**0.66**	*	**0.76**	*
	MP-5R	0.94		0.99		0.92		0.90		0.98		0.86	
	MP-8R	0.94		0.95		**0.73**	*	0.91		0.91		**0.70**	*
	MP-9R	0.94		**0.40**	*	0.93		0.91		**0.37**	*	0.89	
	MP-10R	0.98		1.00		**0.60**	*	0.90		0.99		**0.56**	*
	MP-11R	0.99		**0.69**	*	**0.53**	*	0.96		**0.65**	*	**0.45**	*
	MP-13R	1.00		**0.65**	*	0.96		0.98		**0.65**	*	0.97	

* Statistically lower than Reference, shaded cells indicate SQS failure (T/R < 0.8 and statistically significant).
[1] Compared to Control when Reference did not meet acceptability criteria (see text). Control and reference results are shown by batch in Tables 12, 16, and 20.

WERE TOXIC EFFECTS NOTED IN THE MICROTOX® POREWATER TEST BASED ON CHEMICAL TOXICITY OR CONTRIBUTING FACTORS?

The potential impact of chemicals versus interference from contributing factors was addressed through parallel studies with standardized and modified protocols. The side by side comparison showed aeration did increase the number of stations considered acceptable compared to SQS criteria for Run 2 and Run 3. This trend is likely related to the increased sulfide and unionized ammonia concentrations observed with extended holding time.

DO VARYING LENGTHS OF HOLDING TIMES AFFECT MICROTOX® TEST RESULTS?

Samples were tested at three different time points; 2 days, 20 days and 37 days after field collection to assess the impact of holding times on the outcome of the Microtox® test. The results of the tests show holding time did increase the apparent treatment effect. The impact of holding time is probably related to changing conditions within the sediment and may reflect a number of factors including increasing sulfide concentrations, changes in microbial communities and possible changes in ammonia composition with higher concentrations of unionized ammonia increasing with time. These effects (sulfides but not unionized ammonia) can be partially removed via aeration, but not completely. There is no difference in the response of Microtox for either the 5 or 15 minute exposures with or without aeration during the initial tests with newly collected samples. Because of this observation it seems unlikely that biologically active volatile contaminants were lost in the sediments from this site during aeration and losses of these compounds would also not explain the later observations of the effects of aeration in samples held for longer times.

Are ammonia and sulfide levels changing during holding and ultimately affecting the Microtox® test results?

To address the question of ammonia and sulfide interferences, samples were tested with and without aeration and ammonia and sulfide levels were monitored throughout the test using both analytical and laboratory based techniques for measuring sulfides. Figure 3 shows the trends in ammonia, unionized ammonia and sulfide concentrations measured by the NewFields biological laboratory throughout the duration of this study. In general the concentrations of total ammonia increased for most of the samples over time and aeration did not reduce the total ammonia concentrations. The trends for unionized ammonia are much more apparent; unionized ammonia concentrations consistently increased as a result of aeration and this increase became more prominent in Runs 2 and 3.

Sulfides were measured in the sediments by ARI and in the porewater by both ARI and NewFields. The porewater sulfide data collected by NewFields is depicted graphically in Figure 3. Overall trends confirm aeration was successful in reducing porewater sulfide concentrations particularly for Runs 2 and 3. As the sulfides became more pronounced in the porewater over time, aeration reduced sulfides in most of the samples. However, sulfides showed an increasing trend with aeration for three samples (MP-9R, MP-10R, and MP-13R).

ARI conducted total sulfide analysis in sediments and dissolved sulfides in the porewater at three time points to coincide with the Microtox® testing. The porewater samples collected by ARI were processed from sample sediment stored at their facility under similar conditions as those used in the Microtox tests. Figure 4 provides a summary of these sulfide measurements. Total sediment sulfide concentrations were highest for station MP-4R ranging from 996 to 12,900 mg/kg over time. The relative concentrations of total sulfides tended to increase in the non-aerated sediments in most of the samples over time. This is consistent with the hypothesis that sulfides accumulate in sediment under acceptable holding conditions. Dissolved sulfides in porewater were not detected in Run 1 but were detected in three or four samples for Runs 2 and 3, respectively. Again this confirms that concentrations of total sulfides in sediment and porewater may increase as samples are stored prior to testing.

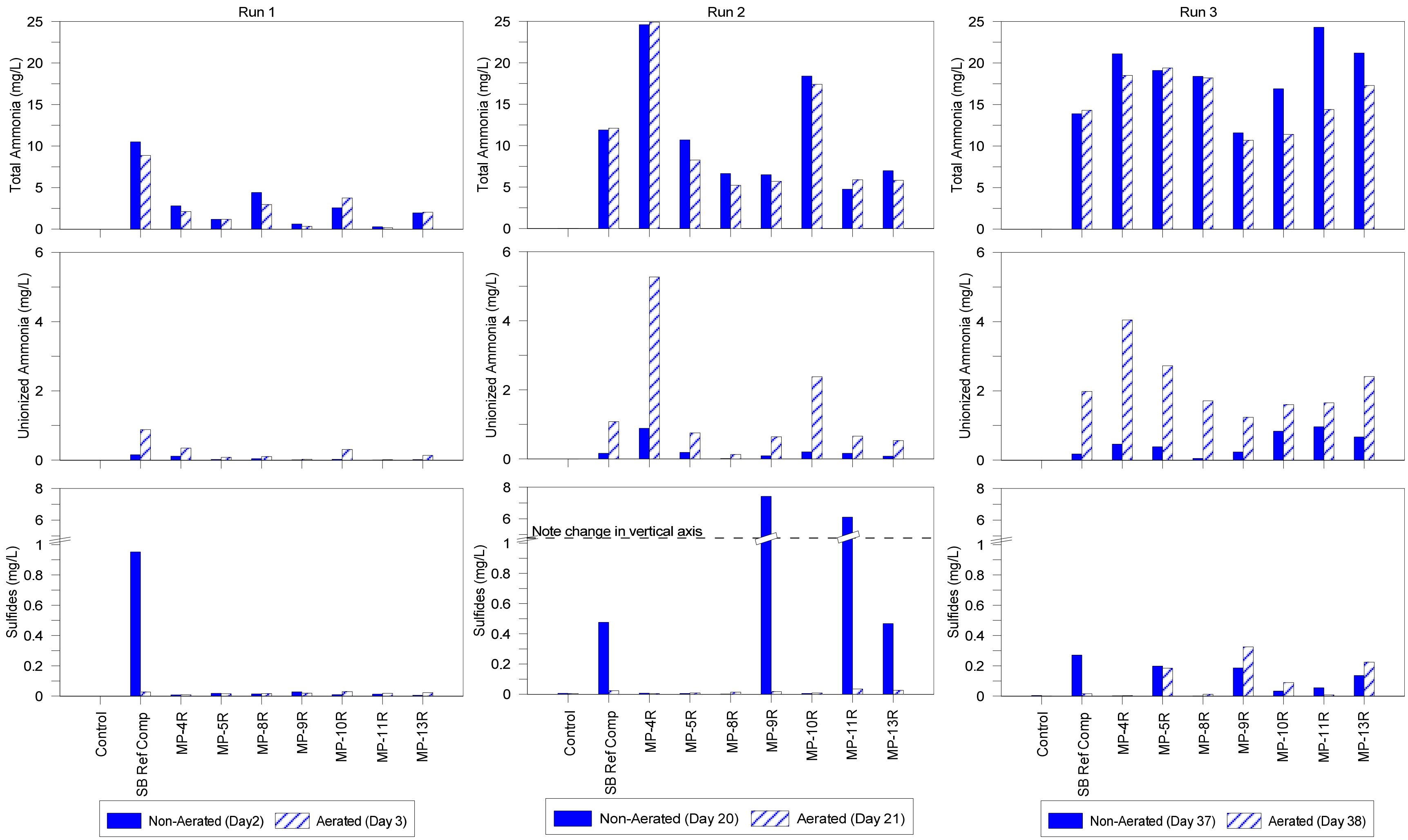

Figure 3 Ammonia and Sulfide Data for Runs 1, 2, and 3

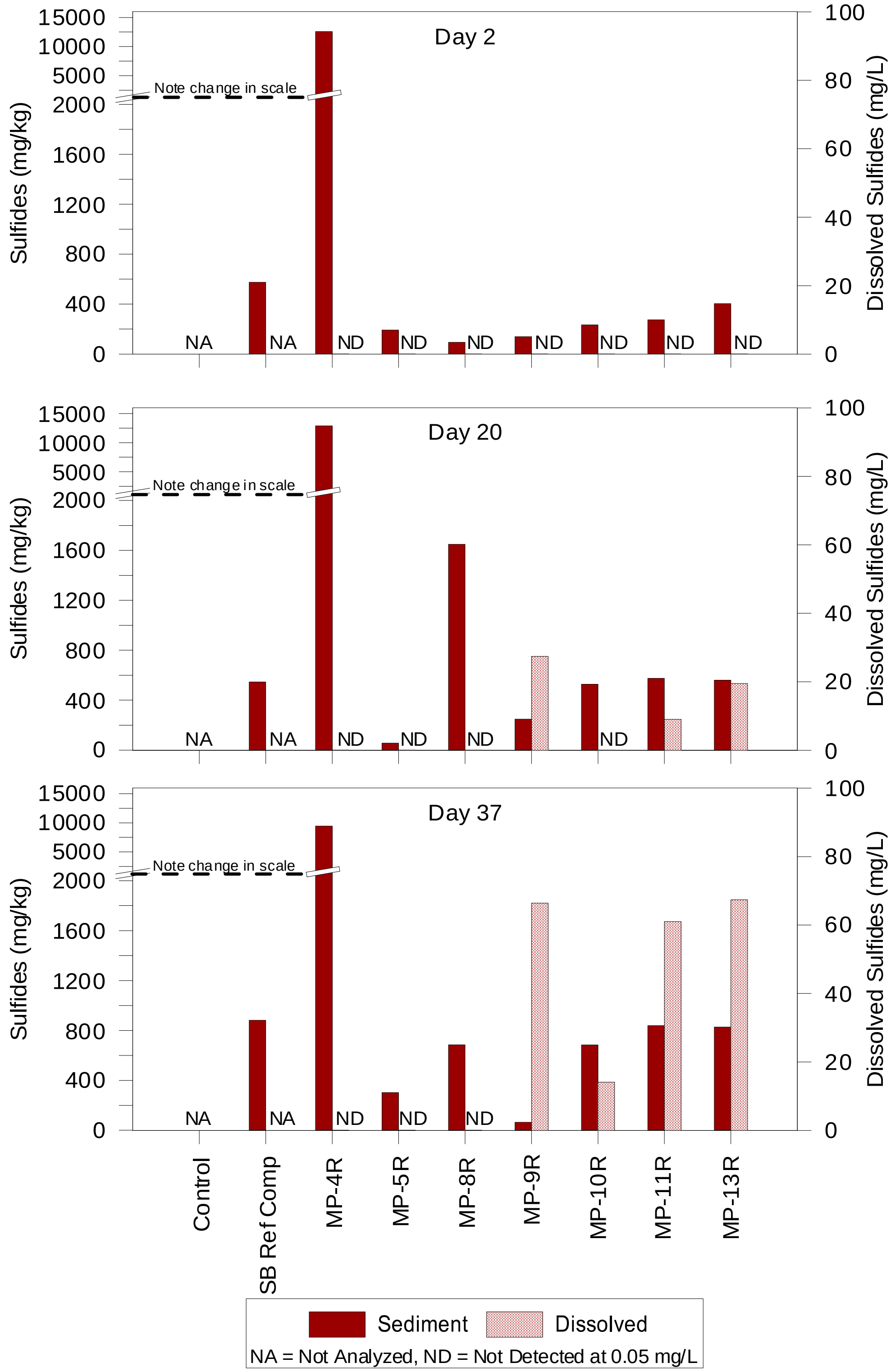

Figure 4 Total Sulfide in Sediment and Dissolved Sulfide in Porewater, data from ARI

The porewater sulfide data generated by NewFields were slightly different than the dissolved sulfide data generated by ARI. The ARI dissolved sulfide data showed higher concentrations in some of the test samples compared to the NewFields data. The difference is most likely related to sample handling and processing. ARI took a sediment sample, centrifuged to obtain porewater and analyzed the sample immediately after centrifugation. NewFields sampled the sediment and centrifuged to obtain porewater, but the sample was not analyzed for sulfides immediately. The samples may have been held for up to two hours after preparation to coincide with the beginning of the Microtox® test to provide a direct measurement of potential effect on the test organisms. Some of the sulfides present in the samples may have volatilized during that time.

IS THE MICROTOX® POREWATER TEST RELIABLE TO INDICATE TOXICITY?

How comparable is the Microtox® test between laboratories? The Tier 1 evaluation with the Microtox® test was conducted approximately 35 days post field collection by Nautilus Environmental. All seven of these test samples failed the SQS criteria for the Microtox® test. The same result was obtained in Tier 2 testing using the comparable data set post field collection of 37 days. This test was conducted by ARI and all seven stations failed the Microtox® test when compared to SQS criteria. Table 23 provides the results for both the Tier 1 (Nautilus) and Tier 2 (ARI) data sets.

Table 23 Comparison of Microtox Results from the Tier 1 and Tier 2 Evaluations

Sample	Tier 2 Results from ARI 37 day After Collection No Aeration 15 Minute Comparisons		Tier 1 Results from Nautilus 35 days After Collection No Aeration 15 Minute Comparisons	
	Numerical Comparison T/R[1]	Statistical Comparison	Numerical Comparison T/R[1]	Statistical Comparison
MP-4R	0.61	*	0.62	*
MP-5R	0.55	*	0.72	*
MP-8R	0.57	*	0.67	*
MP-9R	0.15	*	0.71	*
MP-10R	0.22	*	0.72	*
MP-11R	0.36	*	0.63	*
MP-13R	0.74	*	0.46	*

* Statistically lower than Reference indicate SQS failure (T/R < 0.8 and statistically significant).
[1] Compared to Control when Reference did not meet acceptability criteria

A comparison of the test responses observed for the amphipod test, the larval test, the 20-day *Neanthes* test and the Microtox® test Run 1 (2 days after field collection) provide comparable results for each of the March Point Field stations. These findings suggest the timing for conducting the Microtox® test should be considered and should be conducted within a relatively short time frame after the samples are collected in the field.

CONCLUSION

The results of this investigative Tier 2 evaluation of March Point sediments have led to a series of conclusions.

- First, the responses of the Tier 1 evaluation of sediment using the Microtox® test were related to contributing factors. The responses observed in this study confirm this finding.
- Second, the length of time sediment samples are held in storage negatively impact the outcome of the Microtox® test. The differences in responses observed between Runs 1, 2, and 3 confirm this finding. No samples failed on Run1, five of seven samples failed on Run 2, and all seven samples failed on Run 3 (15 minute endpoint). Consequently, the Microtox® test should be run immediately after field collection to avoid any interference related to holding times.
- Third, ammonia and sulfide concentrations fluctuate with the length of time sediment samples are stored. Sulfide concentrations, which can negatively impact biological test responses, tend to increase with holding time. Aeration reduces sulfide levels but may increase unionized ammonia levels, another negative impact on biological tests. It is likely the sulfide or unionized ammonia concentrations influenced the adverse responses observed in the Microtox® during the previous Tier 1 evaluation. The sediments from the Tier 1 evaluation were held approximately 35 days prior to testing providing ample time for the accumulation of sulfides in the samples. Run 3 of this study was conducted 37 days after collection to compare results with the previous evaluation.

The results of this Tier 2 investigation indicate contributing factors related to holding times and ammonia and sulfide concentrations were likely responsible for the adverse impacts associated with the Tier 1 Microtox® test results. The Tier 2 results for samples run the day after field collection provides an evaluation that minimizes these contributing factors and that coincides with the results of the amphipod, larval, and polychaete biological tests.

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APPENDIX C

Analytical Data Validation Reports

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Sayler Data Solutions, Inc.

DATA VALIDATION REPORT

March Point (Whitmarsh) Landfill Project

Prepared for:
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June 10, 2009

1.0 Introduction

Sixteen sediment samples were collected in August of 2008. These samples were assigned Analytical Resources, Inc laboratory data package numbers NN41, OB29, and OB49, and Columbia Analytical Services laboratory data package number K0808305. Laboratory sample identifiers were assigned to these samples for specific analyses as follows:

Client ID	Sample Date	VOA, SV, Pest, PCB, ICP Metals	Mercury	Sulfide, PTS	Ammonia, TS, TVS	Grainsize	TOC
MP-1	08/28/08		NN41A	OB29A	K0808305-12	K0808305-12	K0808305-12
MP-2	08/26/08		NN41O	OB29J	K0808305-2	K0808305-2	K0808305-2
MP-2D	08/26/08		NN41P				
MP-3	08/26/08		NN41N	OB29I	K0808305-1	K0808305-1	K0808305-1
MP-4	08/27/08		NN41Q	OB29K	K0808305-3	K0808305-3	K0808305-3
MP-4D	08/27/08		NN41R				
MP-5	08/27/08		NN41T	OB29M	K0808305-5	K0808305-5	K0808305-5
MP-6	08/28/08		NN41B	OB29B	K0808305-13	K0808305-13	K0808305-13
MP-6D	08/28/08		NN41C				
MP-7	08/27/08		NN41G	OB29C	K0808305-6	K0808305-6	K0808305-6
MP-8	08/27/08		NN41K	OB29G	K0808305-10	K0808305-10	K0808305-10
MP-9	08/27/08		NN41L	OB29H	K0808305-11	K0808305-11	K0808305-11
MP-9D	08/27/08		NN41M				
MP-10	08/27/08		NN41S	OB29L	K0808305-4	K0808305-4	K0808305-4
MP-11	08/27/08		NN41H	OB29D	K0808305-7	K0808305-7	K0808305-7
MP-12	08/27/08		NN41I	OB29E	K0808305-8	K0808305-8	K0808305-8
MP-13	08/27/08		NN41J	OB29F	K0808305-9	K0808305-9	K0808305-9
MPS-1	08/28/08	OB49A	NN41D/ OB49A	OB49A	OB49A		K0808305-14
MPS-2	08/28/08	OB49B	NN41E/ OB49B	OB49B	OB49B		K0808305-15
MPS-3	08/28/08	OB49C	NN41F/ OB49C	OB49C	OB49C		K0808305-16

Validation: A summary validation was performed for these analyses. Validation was performed by Cari Sayler. Data qualifiers are summarized in section 9.0 of this report.

Requested analyses: Sample chain-of-custodies were reviewed. Reported analyses matched chain of custodies with the following exceptions: VOA, SV, Pest, PCB, and ICP Metals were not analyzed for samples MP-1 through MP-13; and grainsize was not analyzed for samples MPS-1 through MPS-3.

Samples were analyzed by the following methods.

Analysis	Method Used
Volatile Organic Compounds (VOCs)	8260B
Semivolatile Organic Compounds (SVOCs)	8270D/PSDDA
Pesticides	8081
Polychlorinated Biphenyls (PCBs)	8082/PSDDA
Metals	6010B/7471A
Total Solids (TS)	160.3
Preserved Total Solids (PTS)	160.3
Total Volatile Solids (TVS)	160.4/160.4M
Ammonia	350.1M
Sulfide	376.2
Total Organic Carbon (TOC)	PSEP
Grainsize	PSEP

Analytical methods either matched those referenced in the work plan or were considered appropriate substitutes.

Sample number transcription: Sample IDs in the electronic data deliverable (EDD) were compared to the chain-of-custody for each sample and field duplicate. All sample IDs matched the chain-of-custody.

2.0 Volatile Organic Analyses

Laboratory quality control analysis frequencies: The method specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: Method blank, laboratory control sample (LCS), matrix spike (MS), and either matrix spike duplicate (MSD) or laboratory duplicate. In addition, surrogate compounds must be measured in each field and quality control sample.

This batch included a method blank, LCS, LCSD, MS, MSD, and appropriate surrogates.

Holding times: Sediment samples must be analyzed within 14 days. Samples were analyzed between 95 and 98 days after sampling. Volatile results are rejected as unusable for any purpose.

Instrument calibration: Data usability criteria for calibrations include minimum correlation coefficients of 0.990 or maximum RSDs of ±30% for each initial calibration, and maximum % differences of ±25% for each continuing calibration. These criteria were met.

Laboratory and trip blank results: Laboratory performance criteria for method blanks are that analyte concentrations must be below the RL, or below 5% of the lowest associated sample concentration. No target analytes were detected in the method blank or trip blank.

Surrogate recoveries: Surrogates were within laboratory limits.

LCS recoveries: LCS and LCSD recoveries were within laboratory limits.

MS recoveries: MS and MSD recoveries were within laboratory limits.

LCS/LCSD RPDs: LCS/LCSD RPDs were within laboratory limits.

MS/MSD RPDs: MS/MSD RPDs were within laboratory limits.

Laboratory narrative and qualifiers: No additional qualifiers were assigned on the basis of laboratory narrative or laboratory qualifiers.

Volatile organic data are rejected due to grossly exceeded holding times and are unacceptable for use.

3.0 Semivolatile Organic Analyses

Laboratory quality control analysis frequencies: The method specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: Method blank, laboratory control sample (LCS), matrix spike (MS), and either matrix spike duplicate (MSD) or laboratory duplicate. In addition, surrogate compounds must be measured in each field and quality control sample.

This batch included a method blank, LCS, LCSD, and appropriate surrogates. No qualifiers are assigned based on the absence of the MS/D.

Holding times: Refrigerated sediment samples must be extracted within 14 days of collection. Frozen sediment samples must be extracted within one year of collection. Extracts must be analyzed within 40 days of extraction. All samples were extracted and analyzed within holding time.

Instrument calibration: Data usability criteria for calibrations include minimum correlation coefficients of 0.990 or maximum RSDs of ±30% for each initial calibration, and maximum % differences of ±25% for each continuing calibration. Initial calibration criteria were met. Continuing calibration criteria were met with the following exceptions:

Standard	Analyte	% Difference
ICV	N-nitroso-diphenylamine	40.6
CCV 12/3 12:29	Benzoic Acid	-33.2
CCV 12/4 12:13	Benzoic Acid	-33.6

The negative percent differences for benzoic acid indicates a higher response in the continuting calibration. Benzoic acid was not detected in the associated samples and no qualifers are required.

The positive percent difference for n-nitrosodiphenylamine indicates a lower response in the initial calibration verification and this compound is qualified as estimated in the associated samples for both posititive and non-detect results.

Laboratory blank results: Laboratory performance criteria for method blanks are that analyte concentrations must be below the RL, or below 5% of the lowest associated sample concentration. No target analytes were detected in the method blank.

Surrogate recoveries: Surrogates were within laboratory and project limits.

LCS recoveries: LCS and LCSD recoveries were within laboratory and project limits.

LCS/LCSD RPDs: All RPDs were within laboratory and project limits.

Multiple reported results: Unless quality control results warrant the rejection of one result, multiple reported results are evaluated according to the following guidelines

(1) If both results are non-detects, the lower reporting limit was selected.
(2) If one result was not detected and the other detected, the detection was selected.
(3) If both results were detections, the following additional criteria were applied:
    (a) If one result was off-scale and one was on-scale, the on-scale result was selected.
    (b) If associated QC results indicated high bias, the lower concentration result was selected.
    (c) If associated QC results indicated no, low, or mixed biases, the higher concentration result was selected.

This approach is conservative, and is considered most protective of the environment. The results not selected as the best result to report are qualified R1, rejected due to the availability of better results.

Hexachlorobenzene and hexachlorobutadiene were analyzed by both 8270 and 8081 methods. Lower reporting limits were achieved in the 8081 analyses and the 8270 results are qualified R2, rejected due to the availability of better results.

Laboratory narrative and qualifiers: The butylbenzyl phthalate results in samples MPS-2 and MSP-3 are flagged Y to indicate an elevated reporting limit. These results are qualified “UY” to clarify that the compound was not detected.

Reporting limits: Reporting limits met work plan requirements.

Semivolatile organic data are acceptable for use as qualified.

4.0 Pesticide Analyses

Quality control analysis frequencies: The method specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: method blank, laboratory control sample (LCS), matrix spike (MS), and either MS duplicate (MSD) or laboratory duplicate. In addition, surrogate compounds must be measured in each field and quality control sample.

This batch included a method blank, LCS, LCSD, and appropriate surrogates. No qualifiers are assigned based on the absence of the MS/D.

Holding times: Refrigerated sediment samples must be extracted within 14 days of collection. Frozen sediment samples must be extracted within 1 year of collection. Extracts must be analyzed within 40 days of extraction. These holding times were met.

Instrument calibration: Data usability criteria for calibrations include minimum correlation coefficients of 0.990 or maximum RSDs of ±20% for each initial calibration, and maximum % differences of ±25% for each continuing calibration. These criteria were met.

Laboratory blank results: Criteria for blanks are that analyte concentrations must be below the RL, or below 5% of the lowest associated sample concentration. No target analytes were detected in the method blank.

Surrogate recoveries: Surrogate recoveries were within laboratory and project limits.

LCS recoveries: LCS recoveries were within laboratory and project limits.

LCS/LCSD RPDs: All RPDs were within laboratory and project limits.

Multiple reported results: Hexachlorobenzene and hexachlorobutadiene were analyzed by both 8270 and 8081 methods. No 8081 results were rejected in favor of the 8270 result.

Laboratory narrative and qualifiers: No additional qualifiers were assigned on the basis of laboratory narrative or laboratory qualifiers.

Reporting limits: Reporting limits met work plan requirements.

Pesticide data are acceptable for use as reported.

5.0 PCB Analyses

Quality control analysis frequencies: The method specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: method blank, laboratory control sample (LCS), matrix spike (MS), and either MS duplicate (MSD) or laboratory duplicate. In addition, surrogate compounds must be measured in each field and quality control sample.

This batch included a method blank, LCS, LCSD, and appropriate surrogates. No qualifiers are assigned based on the absence of the MS/D.

Holding times: Refrigerated sediment samples must be extracted within 14 days of collection. Frozen sediment samples must be extracted within 1 year of collection. Extracts must be analyzed within 40 days of extraction. These holding times were met.

Instrument calibration: Data usability criteria for calibrations include minimum correlation coefficients of 0.990 or maximum RSDs of +20% for each initial calibration, and maximum % differences of +25% for each continuing calibration. Initial calibration criteria were met. Continuing calibration criteria were met with the following exceptions:

Standard	Analyte	% Difference
CCV 12/2/08 21:33, ZB35	Aroclor 1016-4	40%
CCV 12/3/08 00:23, ZB35	Aroclor 1016-4	46%

% Differences for these analytes on the ZB5 column were within criteria, and no qualifiers are assigned.

Laboratory blank results: Criteria for blanks are that analyte concentrations must be below the RL, or below 5% of the lowest associated sample concentration. No target analytes were detected in the method blank.

Surrogate recoveries: Surrogate recoveries were within laboratory and project limits.

LCS recoveries: LCS recoveries were within laboratory and project limits.

LCS/LCSD RPDs: All RPDs were within laboratory and project limits.

Multiple reported results: No multiple results were reported with this analysis.

Laboratory narrative and qualifiers: No qualifiers were assigned on the basis of laboratory narrative or laboratory qualifiers.

Reporting limits: Reporting limits met work plan requirements.

PCB data are acceptable for use as reported.

6.0 Metals Analyses

Quality control analysis frequencies: The methods specify that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: method blank, LCS, MS and either MSD or laboratory duplicate.

A method blank, LCS, MS, and laboratory duplicate were analyzed with each batch.

Holding times: Refrigerated ICP metals samples must be analyzed within 6 months of collection. Frozen ICP metals samples must be analyzed within 2 years of collection. Refrigerated and frozen Mercury samples must be analyzed within 28 days of collection. With the exception of the second analysis of MPS-1, MPS-2, and MPS-3, samples were prepared and analyzed within the holding time.

Mercury results from the OB49 analysis of MPS-1, MPS-2, and MPS-3 are rejected in favor of the NN41 analysis.

Instrument calibration: Functional guidelines criteria for calibration verifications is a maximum % difference of ±10% for ICP metals and ±20% for mercury. Criteria for calibration blanks are that analyte concentrations must be between the negative RL and the positive RL. Functional guidelines criterion for detection limit standard recovery is 70-130%. These criteria were met.

Laboratory blank results: Criteria for calibration and method blanks are that analyte concentrations must be below the PQL, or below 5% of the lowest associated sample concentration. These criteria were met.

LCS results: LCS recoveries were within laboratory and project limits.

MS recoveries: MS recoveries were within the laboratory and project limits.

Laboratory duplicate RPDs: Laboratory duplicate RPDs were within the laboratory and project limits.

Field duplicate results: Field duplicate RPDs were within the project limits.

Multiple reported results: Mercury was analyzed in both SDG NN41 and SDG OB49. Due to the exceeded holding times in OB49, results from SDG NN41 should be used. No other multiple results were reported with this analysis.

Laboratory narrative and qualifiers: No additional qualifiers were assigned on the basis of laboratory narrative or laboratory qualifiers.

Reporting limits: Reporting limits (RL) met work plan goals with the following exceptions:

Analyte	Achieved RL (mg/Kg)	Work plan RL (mg/kg)
Arsenic	20	5
Mercury	0.09 – 0.2	0.05
Silver	1	0.3

Qualifiers are not assigned on the basis of elevated reporting limits.

With the exception of OB49 mercury results, metals data are acceptable for use as reported.

7.0 General Chemistry Analyses

Quality control analysis frequencies: The following quality control samples were analyzed in each batch:

Analysis	QC samples
Total Solids(OB49)	Method blank and laboratory triplicate
Total Solids (K0808305)	Laboratory triplicate
Preserved Total Solids	Method blank and laboratory triplicate
Total Volatile Solids	Method blank, and laboratory duplicate

Ammonia	Method blank, SRM, MS, and laboratory triplicate
Total Sulfides	Method blank, LCS, MS, and laboratory duplicate or triplicate
TOC	Method blank, LCS, MS and laboratory triplicate

Quality control samples were sufficient to evaluate precision and accuracy as appropriate for the method.

Holding times: Holding times are as follows:

Analysis	Holding time if refrigerated	Holding time if frozen
Total Solids	14 days	6 months
Preserved Total Solids	14 days	6 months
Total Volatile Solids	14 days	6 months
Ammonia	28 days	NA
Total Sulfides	7 days	NA
TOC	14 days	6 months

Ammonia in samples MPS-1, MPS-2 and MPS-3 were analyzed at 96 days. Ammonia was detected in these samples and results are qualified as estimated

Sulfide samples were analyzed at 88 to 96 days. Sulfide results are rejected as unusable for both positive and non-detect results.

All other samples were analyzed within the holding times.

Instrument calibration: Instrument calibration results were within laboratory and project criteria.

Laboratory blank results: Criteria for method blanks are that analyte concentrations must be below the PQL, or below 10% of the lowest associated sample concentration. This criterion was met for all method blanks.

LCS recoveries: The LCS recoveries were within project and reported laboratory control limits.

SRM results: Laboratory control limit was not reported. The SRM recovery was within the project limit for LCS.

MS recoveries: MS recoveries were within laboratory control limits with the following exceptions:

QC ID	Analyte	Recovery (%)	Laboratory Control Limit
MP-1 MS	Sulfide	31.2	75.0 - 125
MPS-1 MS	Sulfide	24.6	75.0-125

Sulfide results were rejected due to grossly exceeded holding time, and no further qualification is required.

Duplicate and triplicate results: Duplicate RPDs and triplicate RSDs were below 20% with the following exceptions:

QC ID	Analyte	RPD	Laboratory Control Limit
MP-1 LR	Sulfide	39.1	20.0

Sulfide results were rejected due to grossly exceeded holding time, and no further qualification is required.

Laboratory narrative and qualifiers: No additional qualifiers were assigned on the basis of laboratory narrative or laboratory qualifiers.

With the exception of sulfide results, general chemistry data are acceptable for use as qualified.

8.0 Grain Size Analyses

Quality control analysis frequencies: This batch included a laboratory triplicate, meeting frequency requirements.

Holding times: Sediment samples must be analyzed within 6 months of collection. Samples were analyzed within the holding time.

Laboratory triplicate RSDs: Triplicate RSDs were below 20% with five exceptions:

QC ID	Analyte	RSD
MP-13 triplicate	Phi Scale <-1	166%
MP-13 triplicate	Phi Scale -1 to 0	41%
MP-13 triplicate	Phi Scale 0 to 1	75%
MP-13 triplicate	Phi Scale 1 to 2	41%
MP-13 triplicate	Phi Scale 4 to 5	29%

The results for these five fractions are qualified as estimated in all samples.

Laboratory narrative and qualifiers: No additional qualifiers were assigned on the basis of laboratory narrative or laboratory qualifiers.

Grain size data are acceptable for use as qualified.

9.0 Qualifier Summary Table

Client ID	Analyte(s)	Qualifier	Reason
Volatile Organic Analyses			
All samples	All Analytes	R	Hold time grossly exceeded
Semivolatile Organic Analyses			
All Samples	Hexachlorobenzene, Hexachlorobutadiene	R2	Result available from another method
All Samples	N-nitrosodiphenylamine	UJ	Low ICV recovery
MPS-2	Butylbenzylphthalate	UY	Clarification of Y flag
MPS-3	Butylbenzylphthalate	UY	Clarification of Y flag
MPS-3	Phenol	R1	Another result available
MPS-3 DL	All except Phenol	R1	Another result available
Mercury			
All samples from (OB49)	Mercury	R1	Hold time grossly exceeded, Another result available
General Chemistry Analyses			
MPS-1	N-Ammonia	J	Hold time grossly exceeded
MPS-2	N-Ammonia	J	Hold time grossly exceeded

Client ID	Analyte(s)	Qualifier	Reason
MPS-3	N-Ammonia	J	Hold time grossly exceeded
All samples	Sulfide	R	Hold time grossly exceeded
Grainsize Analyses			
All samples	Phi Scale <-1, Phi Scale -1 to 0, Phi Scale 0 to 1, Phi Scale 1 to 2, Phi Scale 4 to 5	J	High ttriplicate RSD

10.0 Abbreviations and Definitions

DV Qualifier	Definition
U	The material was analyzed for, but was not detected above the level of the associated value.
J	The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
UJ	The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R	The sample result is rejected. The presence or absence of the analyte cannot be verified and data are not usable.
R1	This sample result has been rejected in favor of a more accurate and/or precise result. The other result should be used.
R2	This sample result has been rejected in favor of a result from another analysis method. The other result should be used.

Abbreviation	Definition
DV	Data validation
LCS	Laboratory control sample
EDD	Electronic data deliverable
MS	Matrix spike
MSD	Matrix spike duplicate
RPD	Relative percent difference
RRM	Regional reference material
RSD	Relative standard deviations
SRM	Standard reference material
MDL	Method detection limit
RL	Reporting limit

11.0 References

Draft Sediment Investigation Work Plan, March Point (Whitmarsh) Landfill, Skagit County, Washington. Submitted to Skagit County Public Works, Mount Vernan, WA. Submitted by AMEC Geomatrix, Inc., Lynnwood, WA. October 2008.

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Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Puget Sound Water Quality Authority, March 1986.

Recommended Guidelines For Measuring Organic Compounds In Puget Sound Water, Sediment And Tissue Samples, Puget Sound Water Quality Authority, April 1997.

Recommended Guidelines For Measuring Metals In Puget Sound Marine Water, Sediment And Tissue Samples, Puget Sound Water Quality Authority, April 1997.

EcoChem, INC.
Environmental Data Quality

DATA VALIDATION REPORT

Sediment Investigation
March Point (Whitmarsh) Landfill

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PROJECT NARRATIVE

Basis for Data Validation

This report summarizes results from summary data validation (EPA Stage 2B) of sediment and sediment composite samples, and the associated laboratory quality control data. These samples were collected for the Sediment Investigation at the March Point (Whitmarsh) Landfill project. A sample index is provided in **TABLE 1**.

Samples were analyzed by Analytical Resources, Inc., Tukwila, WA. The analytical methods and validation chemists are listed below.

Test	Method	Primary Chemist	Secondary Chemist
Dioxin/Furan Compounds	EPA 1613B	Dorothy Kerlin	Eric Strout
PCB Aroclors	SW8082	Melissa Swanson	Christina Mott

The data were reviewed using quality control criteria documented in the analytical methods and the following guidance documents:

> *USEPA National Functional Guidelines for Organic Data Review* (1999)
>
> *USEPA National Function Guidelines for Chlorinated Dibenzo-p Dioxins (CDD) and Chlorinated Dibenzofurans (CDF) Data Review* (USEPA, 2005)
>
> *Revised Supplemental Information on Polychlorinated Dioxins and Furans (PCDD/F) for Use in Preparing a Quality Assurance Project Plan* (DMMP, Oct 29, 2010 final)
>
> *DMMP Clarification Paper - Polychlorinated Dioxins and Furans (PCDD/F): Revisions to the Supplemental Quality Assurance Project Plan (SQAP)* (DMMP, Oct 29, 2010 final)

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are estimated (J or UJ), data may be used for site evaluation and risk assessment purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the documents and methods referenced above.

Data qualifier definitions, reason codes, and validation criteria are included as **APPENDIX A**. A summary table of all qualified data is presented in **APPENDIX B.** Data Validation Worksheets will be kept on file at EcoChem, Inc.

TABLE 1: SAMPLE INDEX
Sediment Investigation, March Point (Whitmarsh) Landfill

SDG	Sample ID	Lab ID	Dioxins	Aroclors
RM69	MPC-4	10-23086-RM69A	✓	✓
RM69	MPC-5	10-23087-RM69B	✓	✓
RM69	MPC-6	10-23088-RM69C	✓	✓
RM69	MP-25	10-23089-RM69D	✓	✓
RM69	MP-26	10-23090-RM69E	✓	✓
RM69	MP-27	10-23091-RM69F	✓	✓
RM69	MPC-7	10-23092-RM69G	✓	✓
RM69	MPC-8	10-23093-RM69H	✓	✓
RQ03	MPC-1	10-25483-RQ03A	✓	✓
RQ03	MPC-2	10-25484-RQ03B	✓	✓
RQ03	MPC-3	10-25485-RQ03C	✓	✓

DATA VALIDATION REPORT
March Point Landfill
Dioxin/Furan Compounds by Method 1613B

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Tukwila, Washington. Refer to the Sample Index for a list of the individual samples.

SDG	Number of Samples	Validation Level
RM69	3 Sediments and 5 Sediment Composites	Stage 2B
RQ03	3 Sediment Composites	Stage 2B

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

Eight of the samples were sediment composites, as specified by the project work plan. The laboratory provided documentation of the composite preparation for the five composites in SDG RM69, but did not provide documentation for the three composites in SDG RQ03. The laboratory indicated that the scheme outlined in the work plan was used to composite the samples; however, the actual composite preparation was not documented. No action was taken, other than to note the missing documentation.

II. EDD TO HARDCOPY VERIFICATION

A complete (100%) verification of the electronic data deliverable (EDD) results was performed by comparison to the laboratory data package. Laboratory QC results were also verified (10%).

III. TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed in the following table.

1	Sample Receipt, Preservation, and Holding Times	2	Ongoing Precision and Recovery (OPR)
1	System Performance and Resolution Checks	2	Standard Reference Material (SRM)
	Initial Calibration (ICAL)	1	Field Duplicates
	Calibration Verification (CVER)	1	Field Blanks
	Isomer Specificity		Target Analyte List
2	Laboratory Method Blank	2	Reported Results
	Labeled Compound Recovery	2	Compound Identification
1	Matrix Spikes/Matrix Spike Duplicate (MS/MSD)		

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Sample Receipt, Preservation, and Holding Times

SDG RQ03: The samples were collected 405 days before extraction, but were stored under archive conditions prior to extraction. Method 1613b does not specify an extraction holding time. Due to the stability of the dioxin/furans; the holding time did not impact data quality; therefore no qualifiers were assigned. All extracts were analyzed within two days of extraction.

System Performance and Resolution Checks

The method requires the analysis of an isomer-specificity test solution. The analysis of this solution (performed near the beginning of an analytical sequence) demonstrates that the GC column can successfully separate 2,3,7,8-TCDD (on the DB5 column) and 2,3,7,8-TCDF (on the DB225 or equivalent column) from closely eluting non-target isomers. The method criteria for evaluating the isomer-specificity test is that the peak-to-valley ratio between the 2,3,7,8-isomer and the closest eluting non-target isomer must be less than or equal to 25%.

However, the laboratory does not perform second column analysis because the Rtx-Dioxin 2 column used by the laboratory is capable of separating both the TCDD and TCDF isomers. To demonstrate this, the laboratory analyzes a TCDF isomer-specificity solution, and uses a continuing calibration solution that includes the TCDD co-elution.

The peak-to-valley ratio for TCDD was less than 10%, and the ratio for TCDF was less than 15%. This demonstrates that the analytical system provided adequate resolution, and no further action was necessary.

Laboratory Method Blank

Method blanks were analyzed at the appropriate frequency. In order to assess the impact of blank contamination on the reported sample results, action levels are established at five times the blank concentrations. If the concentrations in the associated field samples are less than the action levels, the results are qualified as not detected (U-7). No action is taken if the sample concentrations are greater than the action levels, or for non-detected results.

Various target analytes were reported in the method blanks; however, only the following data were qualified based on method blank contamination:

SDG RM69: 1,2,3,6,7,8-HxCDF (2 results), 2,3,4,6,7,8-HxCDF (6 results), and 1,2,3,4,6,7,8-HpCDF (1 result).

The laboratory assigned Y-flags to analyte values when a peak was detected but did not meet identification criteria. These values cannot be considered as positive identifications, but are "estimated maximum possible concentrations". When these occurred in the method blank the results were considered as false positives. No action levels were established for these analytes.

Matrix Spike/Matrix Spike Duplicate

No matrix spike/matrix spike duplicate (MS/MSD) analyses were performed. Accuracy was assessed using labeled compound recoveries and ongoing precision and recovery (OPR) samples. Precision could not be evaluated.

Ongoing Precision and Recovery

All of the OPR analyte recoveries were within the acceptance limits except for the following:

SDG RM69: The percent recovery (%R) value for 1,2,3,4,6,7,8-HpCDF (at 141%) was greater than the 132% upper control limit. Results for this analyte were estimated (J-10).

Standard Reference Material

The laboratory extracted and analyzed NIST standard reference material SRM-1944. The criteria for standard reference material (SRM) recovery are that the reported result is within ±20% of the 95% confidence interval of the true value. The following outliers were noted:

SDG RM69: The concentrations of five analytes (1,2,3,7,8-PeCDD, 1,2,3,4,7,8-HxCDD, 1,2,3,6,7,8-HxCDD, 1,2,3,4,6,7,8-HpCDD and 2,3,4,6,7,8-HxCDF) were greater than the upper control limits specified by the SRM certificate. Due to the potential high bias, positive results for these analytes were estimated (J-12) in the associated samples.

Field Duplicates

No sample identified as a field duplicate was submitted to the laboratory.

Field Blanks

No sample identified as a field blank was submitted to the laboratory.

Reported Results

SDG RM69: OCDD was detected in Sample MP-25 at a concentration greater than the calibrated linear range of the instrument. The sample was reanalyzed at a 10x dilution, and the OCDD concentration was within the linear range. Both sets of data were reported.

To indicate which result should not be used, the OCDD result from the initial analysis was qualified do not report (DNR-11).

Compound Identification

The method requires the confirmation of 2,3,7,8-TCDF detects using an alternate GC column.

The DB5 column that is typically used cannot fully separate 2,3,7,8-TCDF from closely eluting non-target TCDF isomers. The laboratory did not perform a second column confirmation; however the laboratory uses an RTX-Dioxin 2 column. This modified column has been proven to adequately resolve the TCDF isomers. Since the 2,3,7,8-TCDF resolution was acceptable, no further action was necessary.

For all samples, the laboratory reported EMPC or "estimated maximum possible concentrations" values for one or more of the target analytes. These results were “Y” flagged by the laboratory. As required by the method, an EMPC value is reported when a peak was detected but did not meet quantitation criteria; therefore, the result cannot be considered as positive identification for the analyte. To indicate that the reported result is essentially an elevated detection limit, the EMPC values were qualified as not detected (U-22) at the reported values.

The laboratory assigned “XY” flags to several of the reported homologue group totals to indicate that a diphenyl ether (X) interference was present, which may result in a high bias (Y) to the reported result. All homologue group totals that were “XY” flagged by the laboratory were estimated (J-14).

IV. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the labeled compound and OPR %R values, and the SRM results with the exceptions noted above. Precision could not be evaluated.

Data were qualified as not detected based on method blank contamination, and to indicate that EMPC values represent elevated detection limits. Data were estimated based on OPR and SRM recovery outliers, and due to a potential high bias caused by interference from diphenyl ethers.

Results were flagged DNR to indicate which result, from multiple analyses (dilutions, etc.), should not be used. Results that were qualified DNR should not be used for any reason.

All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
March Point Landfill
PCB Aroclors by Method SW8082

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Tukwila, Washington. Refer to the Sample Index for a list of the individual samples.

SDG	Number of Samples	Validation Level
RM69	3 Sediments and 5 Sediment Composites	Stage 2B
RQ03	3 Sediment Composites	Stage 2B

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

Eight of the samples were sediment composites, as specified by the project work plan. The laboratory provided documentation of the composite preparation for the five composites in SDG RM69, but did not provide documentation for the three composites in SDG RQ03. The laboratory indicated that the scheme outlined in the work plan was used to composite the samples; however, the actual composite preparation was not documented. No action was taken, other than to note the missing documentation.

II. EDD TO HARDCOPY VERIFICATION

A complete (100%) verification of the electronic data deliverable (EDD) results was performed by comparison to the laboratory data package. Laboratory QC results were also verified (10%).

III. TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed in the following table.

1	Sample Receipt, Preservation, and Holding Times	1	Matrix Spike/Matrix Spike Duplicates (MS/MSD)
	Initial Calibration (ICAL)	1	Field Duplicates
	Continuing Calibration (CCAL)		Internal Standards
	Laboratory Method Blanks		Target Analyte List
	Surrogate Compounds		Reporting Limits
	Laboratory Control Samples (LCS/LCSD)	2	Reported Results
1	Reference Material (RM)		Compound Identification

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Sample Receipt, Preservation, and Holding Times

SDG RQ03: The samples were collected 402 days before extraction, but were stored under archive conditions prior to extraction. The current SW846 methods do not specify a holding time for PCB Aroclors. Due to the stability of the PCB Aroclors; the holding time did not impact data quality; therefore no qualifiers were assigned.

Reference Material

SDG RM69: The Sequim Bay reference material SQ-1 was analyzed with the samples. The recovery for Aroclor 1254 was within the reference range.

Matrix Spike/Matrix Spike Duplicate

SDG RQ03: The matrix spike/matrix spike duplicate (MS/MSD) analysis was performed using Sample MPC-2. There were a significant number of interfering peaks in the sample, the MS, and the MSD. The MS/MSD recovery values could not be adequately quantitated and were not reported by the laboratory. There was no measure of precision with the SDG. Accuracy was measured by surrogate and laboratory control sample (LCS) percent recovery (%R) values.

Field Duplicates

No sample identified as a field duplicate was submitted to the laboratory.

Reported Results

SDG RQ03: For Samples MPC-1 and MPC-2, the chromatograms for Aroclor 1248 and Aroclor 1254 indicated non-target background interferences. For Sample MPC-3, the chromatogram for Aroclor 1232 indicated non-target background interferences. These results were "Y" flagged by the laboratory. The "Y" flagged results were qualified as not detected (U-22) to indicate that the analyte was not-detected at an elevated reporting limit.

IV. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate and LCS percent recovery values. Precision could not be assessed.

Reporting limits were elevated based on matrix interferences.

All data, as qualified, are acceptable for use.

EcoChem, INC.
Environmental Data Quality

APPENDIX A

DATA QUALIFIER DEFINITIONS, REASON CODES, AND CRITERIA TABLES

DATA VALIDATION QUALIFIER CODES
Based on National Functional Guidelines

The following definitions provide brief explanations of the qualifiers assigned to results in the data review process.

U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents the approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following is an EcoChem qualifier that may also be assigned during the data review process:

DNR	Do not report; a more appropriate result is reported from another analysis or dilution.

DATA QUALIFIER REASON CODES

1	Holding Time/Sample Preservation
2	Chromatographic pattern in sample does not match pattern of calibration standard.
3	Compound Confirmation
4	Tentatively Identified Compound (TIC) (associated with NJ only)
5A	Calibration (initial)
5B	Calibration (continuing)
6	Field Blank Contamination
7	Lab Blank Contamination (e.g., method blank, instrument, etc.)
8	Matrix Spike(MS & MSD) Recoveries
9	Precision (all replicates)
10	Laboratory Control Sample Recoveries
11	A more appropriate result is reported (associated with “R” and “DNR” only)
12	Reference Material
13	Surrogate Spike Recoveries (a.k.a., labeled compounds & recovery standards)
14	Other (define in validation report)
15	GFAA Post Digestion Spike Recoveries
16	ICP Serial Dilution % Difference
17	ICP Interference Check Standard Recovery
18	Trip Blank Contamination
19	Internal Standard Performance (e.g., area, retention time, recovery)
20	Linear Range Exceeded
21	Potential False Positives
22	Elevated Detection Limit Due to Interference (i.e., laboratory, chemical and/or matrix)

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler/Storage Temperature	Waters/Solids < 4°C Tissues <-10°C	EcoChem PJ, see TM-05	1
Holding Time	Extraction - Water: 30 days from collection *Note:* Under CWA, SDWA, and RCRA the HT for H2O is 7 days* Extraction - Soil: 30 days from collection Analysis: 40 days from extraction	J(+)/UJ(-) if ext > 30 days J(+)/UJ(-) if analysis > 40 Days EcoChem PJ, see TM-05	1
Mass Resolution	>=10,000 resolving power at m/z 304.9824 Exact mass of m/z 380.9760 w/in 5 ppm of theoretical value (380.97410 to 380.97790) . Analyzed prior to ICAL and at the start and end of each 12 hr. shift	R(+/-) if not met	14
Window Defining Mix and Column Performance Mix	Window defining mixture/Isomer specificity std run before ICAL and CCAL Valley < 25% (valley = (x/y)*100%) x = ht. of TCDD y = baseline to bottom of valley For all isomers eluting near 2378-TCDD/TCDF isomers (TCDD only for 8290)	J(+) if valley > 25%	5A (ICAL) 5B (CCAL
Initial Calibration	Minimum of five standards %RSD < 20% for native compounds %RSD <30% for labeled compounds (%RSD <35% for labeled compounds under 1613b)	J(+) natives if %RSD > 20%	5A
	Abs. RT of $^{13}C_{12}$-1234-TCDD >25 min on DB5 >15 min on DB-225	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10 for all native and labeled compounds in CS1 std.	If <10, elevate Det. Limit or R(-)	

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Continuing Calibration	Analyzed at the start and end of each 12 hour shift. %D+/-20% for native compounds %D +/-30% for labeled compounds (Must meet limits in Table 6, Method 1613B) (If %Ds in the closing CCAL are w/in 25%/35% the avg RF from the two CCAL may be used to calculate samples per Method 8290, Section 8.3.2.4)	Do not qualify labeled compounds. Narrate in report for labeled compound %D outliers. For native compound %D outliers: 8290: J(+)/UJ(-) if %D = 20% - 75% J(+)/R(-) if %D > 75% 1613: J(+)/UJ(-) if %D is outside Table 6 limits J(+)/R(-) if %D is +/- 75% of Table 6 limit	5B
	Abs. RT of $^{13}C_{12}$-1234-TCDD and ^{13}C12-123789-HxCDD +/- 15 sec of ICAL.	EcoChem PJ, see ICAL section of TM-05	
	RRT of all other compounds must meet Table 2 of 1613B.	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10	If <10, elevate Det. Limit or R(-)	
Method Blank	One per matrix per batch No positive results	If sample result <5X action level, qualify U at reported value.	7
Field Blanks (Not Required)	No positive results	If sample result <5X action level, qualify U at reported value.	6
LCS / OPR	Concentrations must meet limits in Table 6, Method 1613B or lab limits.	J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) using PJ if %R <<LCL (< 10%)	10
MS/MSD (recovery)	May not analyze MS/MSD %R should meet lab limits.	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8
MS/MSD (RPD)	May not analyze MS/MSD RPD < 20%	J(+) in parent sample if RPD > CL	9

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Lab Duplicate	RPD <25% if present.	J(+)/UJ(-) if outside limts	9
Labeled Compounds / Internal Standards	*Method 8290:* %R = 40% - 135% in all samples -- *Method 1613B:* %R must meet limits specified in Table 7, Method 1613	J(+)/UJ(-) if %R = 10% to LCL J(+) if %R > UCL J(+)/R(-) if %R < 10%	13
Quantitation/ Identification	Ions for analyte, IS, and rec. std. must max w/in 2 sec. S/N >2.5 IA ratios meet limits in Table 9 of 1613B or Table 8 of 8290 RRTs w/in limits in Table 2 of 1613B	If RT criteria not met, use PJ (see TM-05) If S/N criteria not met, J(+). if unlabelled ion abundance not met, change to EMPC If labelled ion abundance not met, J(+).	21
EMPC (estimated maximum possible concentration)	If quantitation idenfication criteria are not met, laboratory should report an EMPC value.	If laboratory correctly reported an EMPC value, qualify with U to indicate that the value is a detection limit.	14
Interferences	PCDF interferences from PCDPE	If both detected, change PCDF result to EMPC	14
Second Column Confirmation	All 2378-TCDF hits must be confirmed on a DB-225 (or equiv) column. All QC specs in this table must be met for the confirmation analysis.	Report lower of the two values. If not performed use PJ (see TM-05).	3
Field Duplicates	Use QAPP limits. If no QAPP: Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate and qualify if required by project (EcoChem PJ)	9
Two analyses for one sample	Report only one result per analyte	"DNR" results that should not be used	11

EcoChem Validation Guidelines for Pesticides, PCBs, Herbicides, and Phenol by GC/ECD
(Based on Organic NFG 1999 & EPA SW-846 Methods 8081/8082/8041/8151)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler Temperature	4°C ±2°	J(+)/UJ(-) if greater than 6 deg. C (EcoChem PJ)	1
Holding Time	Water: 7 days from collection Soil: 14 days from collection Analysis: 40 days from extraction	J(+)/UJ(-) if ext/analyzed > HT J(+)/R(-) if ext/analyzed > 3X HT (EcoChem PJ)	1
Resolution Check	Beginning of ICAL Sequence Within RTW Resolution >90%	Narrate (Use Professional Judgement to qualify)	14
Instrument Performance (Breakdown)	DDT Breakdown: < 20% Endrin Breakdown: <20% Combined Breakdown: <30% Compounds within RTW	J(+) DDT NJ(+) DDD and/or DDE R(-) DDT - If (+) for either DDE or DDD J(+) Endrin NJ(+) EK and/or EA R(-) Endrin - If (+) for either EK or EA	5A
Retention Times	Surrogates: TCX (+/- 0.05); DCB (+/- 0.10) Target compounds: elute before heptachlor epoxide (+/- 0.05) elute after heptachlor epoxide (+/- 0.07)	NJ(+)/R(-) results for analytes with RT shifts For full DV, use PJ based on examination of raw data	5B
Initial Calibration	Pesticides: Low=CRQL, Mid=4X, High=16X Multiresponse - one point Calibration %RSD<20% %RSD<30% for surr; two comp. may exceed if <30% Resolution in Mix A and Mix B >90%	J(+)/UJ(-)	5A
Continuing Calibration	Alternating PEM standard and INDA/INDB standards every 12 hours (each preceeded by an inst. Blank) %D < 25% Resolution >90% in IND mixes; 100% for PEM	J(+)/UJ(-) J(+)R(-) if %D > 90% PJ for resolution	5B
Method Blank	One per matrix per batch No results > CRQL	U(+) if sample result is < CRQL and < 5X rule (raise sample value to CRQL) U(+) if sample result is > or equal to CRQL and < 5X rule (at reported sample value)	7
Instrument Blanks	Analyzed at the beginning of every 12 hour sequence No analyte > 1/2 CRQL	Same as Method Blank	7
Field Blanks	Not addressed by NFG No results > CRQL	Apply 5X rule; U(+) < action level	6

EcoChem Validation Guidelines for Pesticides, PCBs, Herbicides, and Phenol by GC/ECD
(Based on Organic NFG 1999 & EPA SW-846 Methods 8081/8082/8041/8151)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
MS/MSD (recovery)	One set per matrix per batch Method Acceptance Criteria	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8
MS/MSD (RPD)	One set per matrix per batch Method Acceptance Criteria	J(+) in parent sample if RPD > CL	9
LCS	One per SDG Method Acceptance Criteria	J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) using PJ if %R <<LCL (< 10%)	10
LCS/LCSD *(if required)*	One set per matrix and batch of 20 samples RPD < 35%	J(+)/UJ(-) assoc. cmpd. in all samples	9
Surrogates	TCX and DCB added to every sample %R = 30-150%	J(+)/UJ(-) if both %R = 10 - 60% J(+) if both >150% J(+)/R(-) if any %R <10%	13
Quantitation/ Identification	Quantitated using ICAL calibration factor (CF) RPD between columns <40%	J(+) if RPD = 40 - 60% NJ(+) if RPD >60% EcoChem PJ - See TM-08	3
Two analyses for one sample	Report only one result per analyte	"DNR" results that should not be used to avoid reporting two results for one sample	11
Sample Clean-up	GPC required for soil samples Florisil required for all samples Sulfur is optional Clean-up standard check %R within CLP limits	J(+)/UJ(-) if %R < LCL J(+) if %R > UCL	14
Field Duplicates	Use QAPP limits. If no QAPP: Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate (Qualifiy if required by project QAPP)	9

EcoChem, INC.
Environmental Data Quality

APPENDIX B
QUALIFIED DATA SUMMARY TABLE

QUALIFIED DATA SUMMARY TABLE
AMEC Geomatrix
Sediment Investigation, March Point (Whitmarsh) Landfill

Sample ID	Lab ID	Method	Analyte	Result	Units	Lab Qual	DV Qual	DV Reason
MPC-4	10-23086-RM69A	EPA 1613B	Total TCDF	8.43	pg/g	BXY	J	14
MPC-4	10-23086-RM69A	EPA 1613B	2,3,7,8-TCDD	0.147	pg/g	JY	U	22
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,7,8-PeCDF	0.261	pg/g	JY	U	22
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,7,8-PeCDD	0.756	pg/g	J	J	12
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,6,7,8-HxCDF	0.430	pg/g	BJ	U	7
MPC-4	10-23086-RM69A	EPA 1613B	2,3,4,6,7,8-HxCDF	0.537	pg/g	BJ	U	7
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,4,7,8-HxCDD	0.710	pg/g	JY	U	22
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,6,7,8-HxCDD	2.59	pg/g	J	J	12
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,4,6,7,8-HpCDF	6.39	pg/g	B	J	10
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,4,7,8,9-HpCDF	0.410	pg/g	JY	U	22
MPC-4	10-23086-RM69A	EPA 1613B	1,2,3,4,6,7,8-HpCDD	41.0	pg/g	B	J	12
MPC-5	10-23087-RM69B	EPA 1613B	Total TCDF	8.10	pg/g	BXY	J	14
MPC-5	10-23087-RM69B	EPA 1613B	2,3,7,8-TCDD	0.164	pg/g	JY	U	22
MPC-5	10-23087-RM69B	EPA 1613B	2,3,4,7,8-PeCDF	0.298	pg/g	BJY	U	22
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,7,8-PeCDD	0.865	pg/g	J	J	12
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,6,7,8-HxCDF	0.477	pg/g	BJY	U	22
MPC-5	10-23087-RM69B	EPA 1613B	2,3,4,6,7,8-HxCDF	0.684	pg/g	BJ	U	7
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,7,8,9-HxCDF	0.124	pg/g	JY	U	22
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,4,7,8-HxCDD	0.978	pg/g	J	J	12
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,6,7,8-HxCDD	2.87	pg/g	J	J	12
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,4,6,7,8-HpCDF	8.75	pg/g	B	J	10
MPC-5	10-23087-RM69B	EPA 1613B	1,2,3,4,6,7,8-HpCDD	50.1	pg/g	B	J	12
MPC-6	10-23088-RM69C	EPA 1613B	Total TCDF	7.68	pg/g	BXY	J	14
MPC-6	10-23088-RM69C	EPA 1613B	2,3,7,8-TCDD	0.171	pg/g	JY	U	22
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,7,8-PeCDF	0.231	pg/g	JY	U	22
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,7,8-PeCDD	0.996	pg/g	J	J	12
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,6,7,8-HxCDF	0.438	pg/g	BJY	U	22
MPC-6	10-23088-RM69C	EPA 1613B	2,3,4,6,7,8-HxCDF	0.625	pg/g	BJ	U	7
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,7,8,9-HxCDF	0.151	pg/g	JY	U	22
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,4,7,8-HxCDD	1.09	pg/g	J	J	12
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,6,7,8-HxCDD	3.18	pg/g	J	J	12
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,4,6,7,8-HpCDF	7.74	pg/g	B	J	10
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,4,7,8,9-HpCDF	0.444	pg/g	JY	U	22
MPC-6	10-23088-RM69C	EPA 1613B	1,2,3,4,6,7,8-HpCDD	50.2	pg/g	B	J	12
MP-25	10-23089-RM69D	EPA 1613B	Total TCDF	15.7	pg/g	BXY	J	14
MP-25	10-23089-RM69D	EPA 1613B	1,2,3,7,8-PeCDD	9.65	pg/g		J	12
MP-25	10-23089-RM69D	EPA 1613B	2,3,4,6,7,8-HxCDF	9.91	pg/g	B	J	12
MP-25	10-23089-RM69D	EPA 1613B	1,2,3,4,7,8-HxCDD	17.7	pg/g		J	12
MP-25	10-23089-RM69D	EPA 1613B	1,2,3,6,7,8-HxCDD	64.5	pg/g		J	12
MP-25	10-23089-RM69D	EPA 1613B	1,2,3,4,6,7,8-HpCDF	143	pg/g	B	J	10
MP-25	10-23089-RM69D	EPA 1613B	1,2,3,4,6,7,8-HpCDD	1,390	pg/g	B	J	12
MP-25	10-23089-RM69D	EPA 1613B	OCDD	15,000	pg/g	BE	DNR	11
MP-26	10-23090-RM69E	EPA 1613B	2,3,7,8-TCDD	0.134	pg/g	JY	U	22
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,7,8-PeCDD	0.556	pg/g	J	J	12
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,6,7,8-HxCDF	0.298	pg/g	BJY	U	22
MP-26	10-23090-RM69E	EPA 1613B	2,3,4,6,7,8-HxCDF	0.512	pg/g	BJ	U	7
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,7,8,9-HxCDF	0.233	pg/g	JY	U	22
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,4,7,8-HxCDD	0.634	pg/g	J	J	12

QUALIFIED DATA SUMMARY TABLE
AMEC Geomatrix
Sediment Investigation, March Point (Whitmarsh) Landfill

Sample ID	Lab ID	Method	Analyte	Result	Units	Lab Qual	DV Qual	DV Reason
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,6,7,8-HxCDD	1.75	pg/g	J	J	12
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,4,6,7,8-HpCDF	6.54	pg/g	B	J	10
MP-26	10-23090-RM69E	EPA 1613B	1,2,3,4,6,7,8-HpCDD	37.6	pg/g	B	J	12
MP-27	10-23091-RM69F	EPA 1613B	2,3,7,8-TCDF	0.0446	pg/g	BJY	U	22
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,7,8-PeCDD	0.0938	pg/g	JY	U	22
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,4,7,8-HxCDF	0.0633	pg/g	BJY	U	22
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,6,7,8-HxCDF	0.0885	pg/g	JY	U	22
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,4,7,8-HxCDD	0.248	pg/g	J	J	12
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,6,7,8-HxCDD	0.454	pg/g	J	J	12
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,4,6,7,8-HpCDF	1.99	pg/g	BJ	U	7
MP-27	10-23091-RM69F	EPA 1613B	1,2,3,4,6,7,8-HpCDD	11.7	pg/g	B	J	12
MPC-7	10-23092-RM69G	EPA 1613B	Total TCDF	8.52	pg/g	BXY	J	14
MPC-7	10-23092-RM69G	EPA 1613B	2,3,7,8-TCDD	0.197	pg/g	JY	U	22
MPC-7	10-23092-RM69G	EPA 1613B	2,3,4,7,8-PeCDF	0.343	pg/g	BJY	U	22
MPC-7	10-23092-RM69G	EPA 1613B	Total PeCDF	5.11	pg/g	BXY	J	14
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,7,8-PeCDD	0.832	pg/g	J	J	12
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,6,7,8-HxCDF	0.353	pg/g	BJY	U	22
MPC-7	10-23092-RM69G	EPA 1613B	2,3,4,6,7,8-HxCDF	0.552	pg/g	BJ	U	7
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,7,8,9-HxCDF	0.106	pg/g	JY	U	22
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,4,7,8-HxCDD	0.838	pg/g	J	J	12
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,6,7,8-HxCDD	2.63	pg/g	J	J	12
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,4,6,7,8-HpCDF	6.90	pg/g	B	J	10
MPC-7	10-23092-RM69G	EPA 1613B	1,2,3,4,6,7,8-HpCDD	50.2	pg/g	B	J	12
MPC-8	10-23093-RM69H	EPA 1613B	Total TCDF	8.89	pg/g	BXY	J	14
MPC-8	10-23093-RM69H	EPA 1613B	2,3,7,8-TCDD	0.159	pg/g	JY	U	22
MPC-8	10-23093-RM69H	EPA 1613B	2,3,4,7,8-PeCDF	0.375	pg/g	BJY	U	22
MPC-8	10-23093-RM69H	EPA 1613B	1,2,3,7,8-PeCDD	0.769	pg/g	J	J	12
MPC-8	10-23093-RM69H	EPA 1613B	1,2,3,6,7,8-HxCDF	0.421	pg/g	BJ	U	7
MPC-8	10-23093-RM69H	EPA 1613B	2,3,4,6,7,8-HxCDF	0.581	pg/g	BJ	U	7
MPC-8	10-23093-RM69H	EPA 1613B	1,2,3,4,7,8-HxCDD	0.753	pg/g	J	J	12
MPC-8	10-23093-RM69H	EPA 1613B	1,2,3,6,7,8-HxCDD	2.42	pg/g	J	J	12
MPC-8	10-23093-RM69H	EPA 1613B	1,2,3,4,6,7,8-HpCDF	6.38	pg/g	B	J	10
MPC-8	10-23093-RM69H	EPA 1613B	1,2,3,4,6,7,8-HpCDD	38.1	pg/g	B	J	12
MPC-1	10-25483-RQ03A	EPA 1613B	2,3,7,8-TCDD	0.277	pg/g	JY	U	22
MPC-1	10-25483-RQ03A	EPA 1613B	1,2,3,7,8-PeCDD	1.26	pg/g	JY	U	22
MPC-1	10-25483-RQ03A	SW8082	Aroclor 1248	9.9	ug/kg	Y	U	22
MPC-1	10-25483-RQ03A	SW8082	Aroclor 1254	9.9	ug/kg	Y	U	22
MPC-2	10-25484-RQ03B	EPA 1613B	2,3,7,8-TCDD	0.220	pg/g	JY	U	22
MPC-2	10-25484-RQ03B	EPA 1613B	2,3,4,7,8-PeCDF	0.521	pg/g	JY	U	22
MPC-2	10-25484-RQ03B	EPA 1613B	1,2,3,4,7,8-HxCDF	0.968	pg/g	JY	U	22
MPC-2	10-25484-RQ03B	SW8082	Aroclor 1248	160	ug/kg	Y	U	22
MPC-2	10-25484-RQ03B	SW8082	Aroclor 1254	79	ug/kg	Y	U	22
MPC-3	10-25485-RQ03C	EPA 1613B	2,3,7,8-TCDD	0.269	pg/g	JY	U	22
MPC-3	10-25485-RQ03C	EPA 1613B	1,2,3,7,8-PeCDF	0.473	pg/g	JY	U	22
MPC-3	10-25485-RQ03C	SW8082	Aroclor 1232	6.0	ug/kg	Y	U	22

APPENDIX D

Dioxins in Samples Adjacent to the Whitmarsh/March Point Landfill

ARCADIS U.S., Inc.
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MEMO

To:
Whitmarsh / March Point Landfill
Potentially Liable Parties

From:
Matthew Butcher

Date:
July 1, 2012

ARCADIS Project No.:
B0046256.0004.00100

Subject:
Dioxins in Samples Adjacent to the Whitmarsh / March Point Landfill

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Executive Summary

This technical memorandum presents an evaluation of the dioxin and furan compounds (PCDDs/Fs) from sediment samples collected adjacent to the former Whitmarsh / March Point Landfill located near Anacortes, Washington (Whitmarsh Landfill). This evaluation supplements a January 4, 2012, presentation to the Washington State Department of Ecology (Ecology). One sample (MP-25) collected near the location of a stormwater culvert (SE Culvert, see AMEC Figure 1) unrelated to the Whitmarsh Landfill had PCDDs/Fs concentrations substantially higher than any other sample, and it was this sample that prompted further investigation of the distribution and nature of PCDDs/Fs in the sediment samples collected during remedial investigation of the Whitmarsh Landfill.

The key findings are as follows:

- The signatures of PCDDs/Fs in all collected samples are clearly distinguished from those associated with PCDDs/Fs from wood burning, trash burning, and municipal solid waste incineration, as derived from the PCDDs/Fs literature cited below.

- The signatures of PCDDs/Fs in collected samples can be accounted for by a mixture of signatures for typical marine sediments near stormwater outfalls and regional background samples from nearby Padilla Bay and Fidalgo Bay, as derived from the literature cited below. Samples closer to the culvert located adjacent to the southeast corner of the Whitmarsh Landfill (SE Culvert, see AMEC Figure 1) are more similar to the PCDDs/Fs signature of stormwater runoff. More distant samples in the lagoon have a PCDDs/Fs signature more closely resembling Puget Sound regional background data (Figure 1). This gradient of signature, from stormwater outfall to background, reflects the spatial arrangement of the samples moving away from the SE Culvert.

- Total PCDDs/Fs concentrations in the samples collected display a decreasing concentration gradient from the SE Culvert to the receiving ditch, to the inner lagoon and, finally, to the outer lagoon (Figure 2).

- This gradient is also reflected in the proportional contribution of octa-chlorinated dioxin, which accounts for the majority of the PCDDs/Fs in collected samples and Puget Sound regional background samples (Figure 3).

- A watershed assessment conducted as part of the Whitmarsh Landfill remedial investigation indicate that the SE Culvert (where MP-25 was obtained) drains surface water runoff from areas upgradient of the Whitmarsh Landfill (AMEC Figure 2).

These findings provide multiple lines of evidence that: 1) sources unrelated to the Whitmarsh Landfill are the source of PCDDs/Fs in the samples associated with the ditch draining away from the SE Culvert; and 2) PCDDs/Fs in the lagoon adjacent to the Whitmarsh Landfill are more similar in signature and concentration to data from nearby regional background bays.

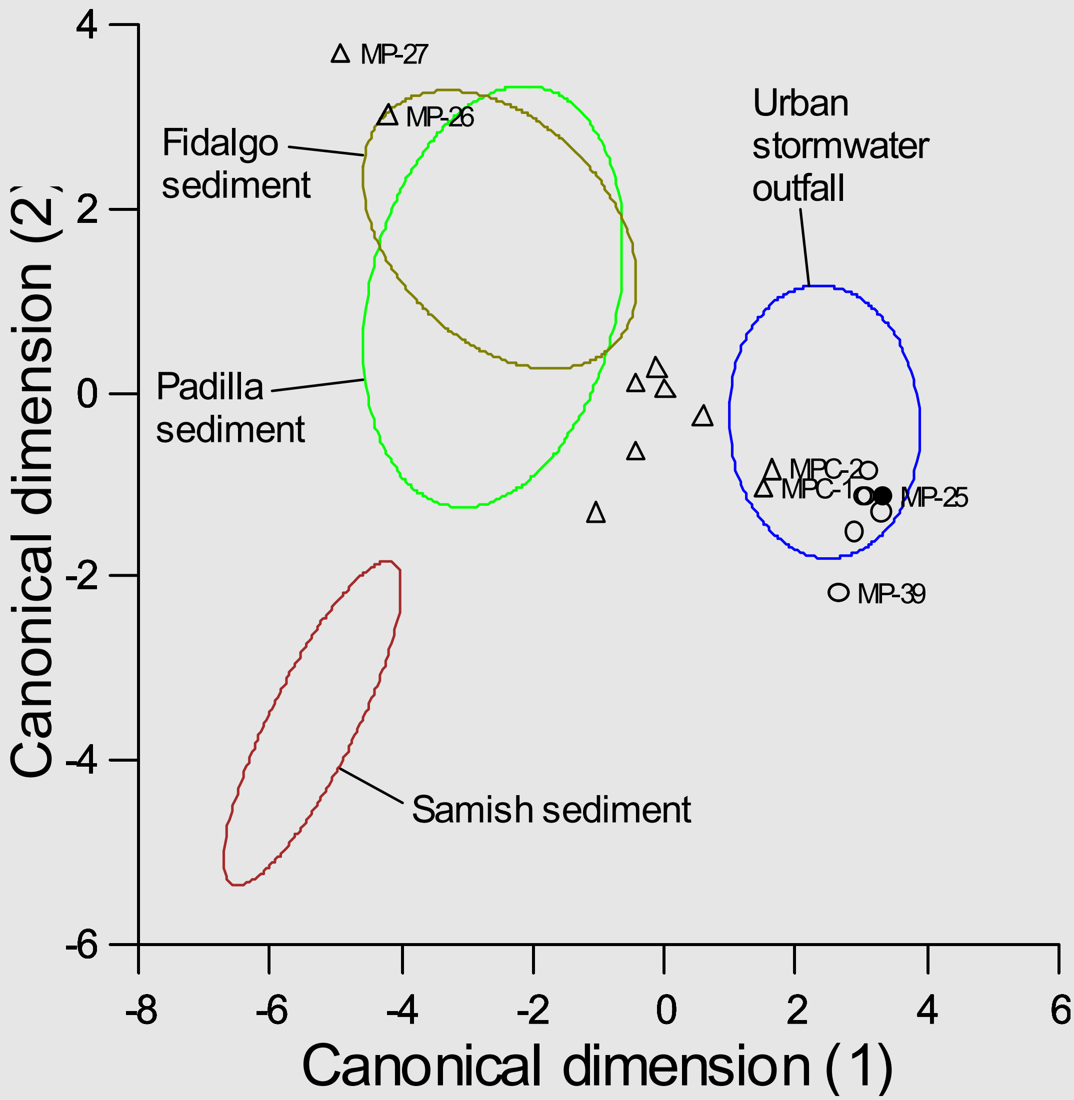

Figure 1. Linear discriminant results based on reduced data set, with Whitmarsh data.

Ellipses are from the training data set (see explanation on page 8), by identified type. Triangles are Whitmarsh lagoon and nearshore samples; open circles are Whitmarsh ditch samples MP-34 through MP-39; filled circle is Whitmarsh culvert sample MP-25 (see AMEC Figure 1 for locations).

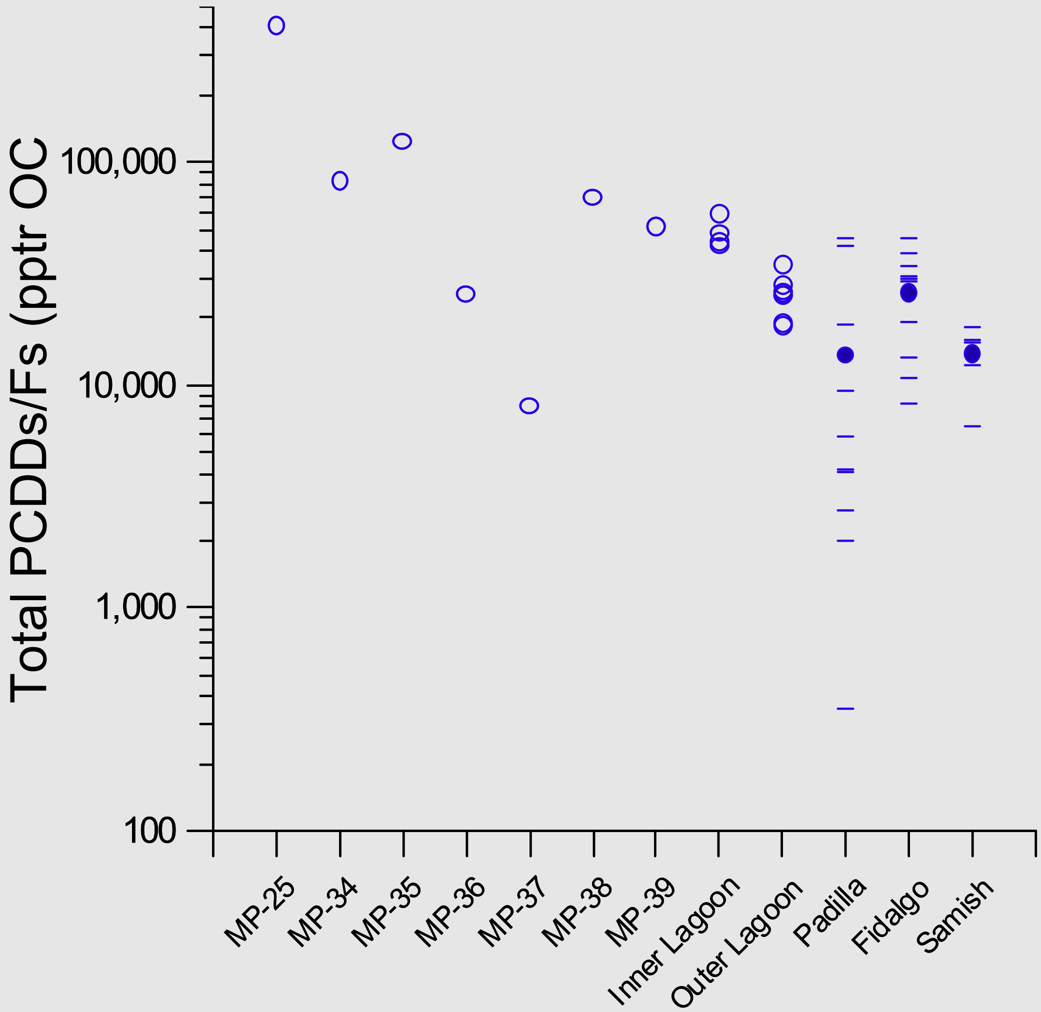

Figure 2. Total PCDD/Fs in Whitmarsh and Puget Sound regional background data.

Open circles are Whitmarsh samples (see AMEC Figure 1 for locations); dashes are Puget Sound regional background samples; filled circles are mean concentrations for each regional background data set. Concentrations are normalized to total organic carbon content of sample.

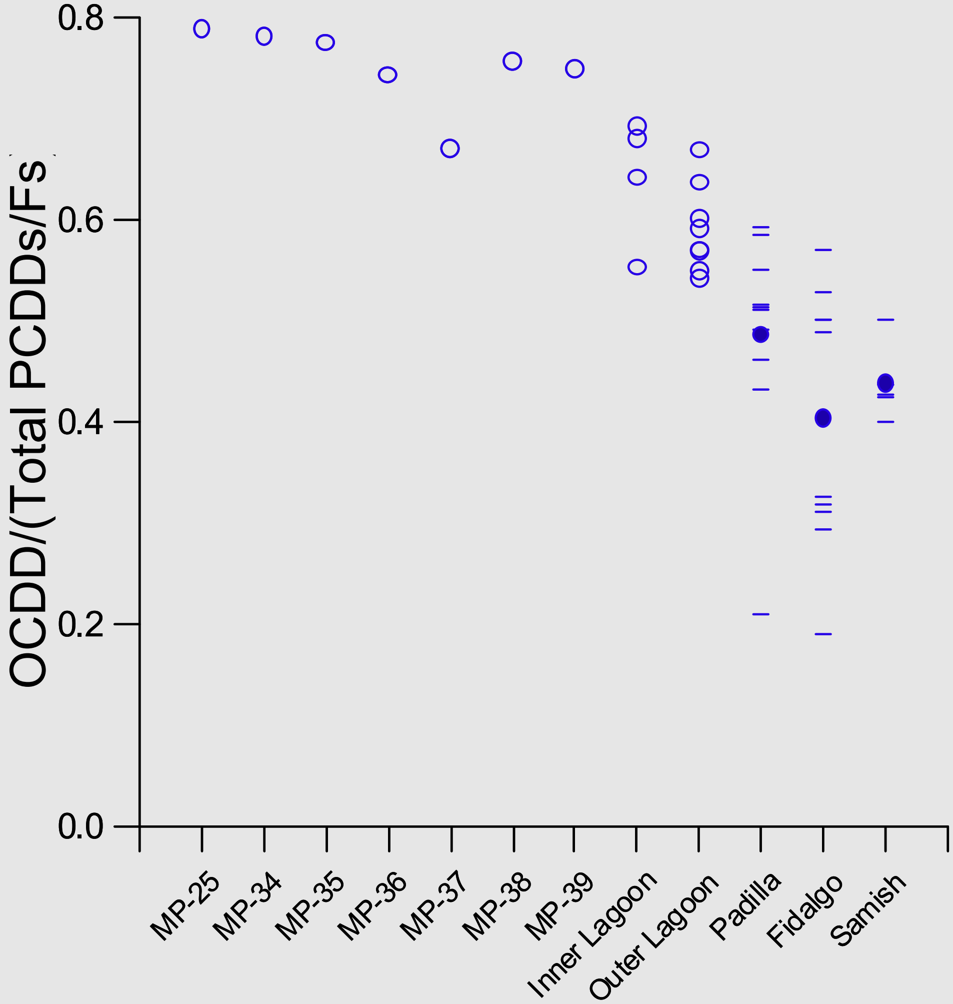

Figure 3. Proportion OCDD in Whitmarsh and Puget Sound regional background data.

Open circles are Whitmarsh samples (see AMEC Figure 1 for locations); dashes are Puget Sound regional background samples; filled circles are mean proportions for each regional background data set.

Introduction and PCDDs/Fs Investigation Summary

The Whitmarsh Landfill (Site) is located north of South March Point Road at the base of a bluff in the tidelands area of Padilla Bay (AMEC Figure 1). It is bounded by South March Point Road to the south, the Burlington Northern Santa Fe railroad and Padilla Bay to the north and northeast, and the Swinomish Indian Reservation (including a casino resort, trucking depot, gasoline service station, seasonal fireworks stands, and other retail establishments) to the east and southeast. State Highway 20 runs about 800 feet southeast of the Site beyond South March Point Road.

Several rounds of sediment samples have been collected from throughout the lagoon and nearshore Padilla Bay during the Site remedial investigation (RI). Those sampling efforts have been (or soon will be) detailed in the pending RI reports. To summarize those results (Table 1), typical concentrations of PCDD/Fs in samples from the lagoon and nearshore bay samples range from 0.4 to 4.0 picograms per gram (pg/g; parts per trillion [pptr]) toxic equivalency (TEQ) (Van den Berg et al. 2006). Concentrations of PCDDs/Fs in samples from the ditch ranged from 0.69 to 47 pptr. Sample MP-25, however, collected nearest to the SE Culvert near the Site, was the exception to this range, with 47.8 pptr TEQ. The concentration of PCDDs/Fs found in sample MP-25 prompted further evaluation of the PCDDs/Fs data collected at the Site.

Table 1. PCDD/F Concentrations in TEQs

Location ID	Location	TEQ (1/2 U [pptr dry weight])
MP-25	Ditch	47.82
MP-34	Ditch	5.88
MP-35	Ditch	13.62
MP-36	Ditch	1.23
MP-37	Ditch	0.69
MP-38	Ditch	11.19
MP-39	Ditch	5.83
MPC-1	Inner Lagoon	3.79
MPC-2	Inner Lagoon	4.17

Location ID	Location	TEQ (1/2 U [pptr dry weight])
MPC-3	Inner Lagoon	3.84
MPC-4	Outer Lagoon	2.19
MPC-5	Outer Lagoon	2.54
MPC-6	Outer Lagoon	2.78
MC-26	Outer Lagoon	1.80
MC-27	Outer Lagoon	0.36
MPC-7	Nearshore	2.42
MPC-8	Nearshore	2.14

This memorandum presents the statistical analyses conducted for these data, and has two purposes: 1) to compare the profiles, or signatures, of PCDD/Fs compounds identified in samples from the ditch to the samples collected in nearby regional background locations, as well as to profiles reported in the literature; and 2) to consider the spatial pattern of PCDDs/Fs concentrations in samples collected from the ditch, lagoon, and nearshore of Padilla Bay.

Dioxin/Furan Classification

PCDD/Fs concentrations are typically reported by congener. Each congener is a unique arrangement of four or more chlorine atoms on two benzene rings of the dioxin or furan compound. Of 209 possible PCDD/Fs congeners, 17 are known to be preferentially retained by organisms and bioaccumulated. Typically, no more than these 17 are analyzed for in samples. The 17 congeners are assigned toxic equivalency factors (TEFs) used for the calculation of TEQ (Van den Berg et al. 2006). However, for the purposes of recognizing the profile of the PCDD/Fs in a given set of samples, the 17 congeners are sufficient if:

- Essentially all PCDD/Fs concentrations are found in those 17 congeners across all samples
- Or the proportions of the remaining 192 congeners (209 – 17 = 192) remain essentially unchanged between samples.

With such a limited representation of all possible congeners, neither of these conditions is seldom satisfied, and the composition of the total PCDD/Fs concentration is typically not well characterized by the 17 TEF congeners. Therefore, the alternative approach described below is typically used to characterize congener profiles and their sources.

Another taxonomy of the PCDD/Fs is based on the number of chlorine atoms attached to the dioxin or furan rings – 4 (tetra), 5 (penta), 6 (hexa), 7 (septa), or 8 (octa) chlorination – on a dioxin or furan compound. Each of these 10 groups is a homologue group. While a homologue group can contain several or many congeners, thereby representing a mixture of compounds, the 10 homologues are a comprehensive account of all dioxins and furans, unlike the 17 TEF congeners. As importantly, homologue analytical measurements are usually available from laboratory results for the reported congeners.

Thus, the profile, or fingerprint, of a particular source of PCDD/Fs may be represented by the composition of its homologues. The homologue concentrations for a given sample are normalized by dividing each by the total PCDD/Fs concentration, resulting in the proportion each homologue contributes to the total PCDD/Fs concentration for a given sample. This normalization of the data is done to eliminate the effect of differences in total concentrations between samples.

Puget Sound Regional Background Data

PCDDs/Fs are ubiquitous in the environment and are formed in many chemical processes, including the combustion of gasoline and diesel fuels in engines, emissions from oil and wood burning, and incineration of household and other wastes. In addition to the samples collected adjacent to the Site, data from the literature were included in the statistical analyses. The data from the literature represented various sources of PCDDs/Fs and include:

- Open trash burning (Lemieux et al. 2000)
- Wood burning (Lemieux et al. 2000)
- Municipal solid waste incineration (U.S. Environmental Protection Agency [USEPA] 2001)
- Urban stormwater runoff (Wenning 1999)
- Regional background from Padilla and Fidalgo Bays (SAIC 2010)
- Regional background from Samish Bay (USEPA 2008).

The complete data set containing the reference data and Whitmarsh Landfill investigation data is provided in Attachment 1.

Data Analysis

Discriminant analysis (Morrison 1976) was used to classify the Site sediment samples based on their profiles of tetra- through octa-chlorinated homologue classes of PCDDs/Fs. This method derives a set of linear functions that translate the original variables into new variables that emphasize the differences between observations from different categories. The analysis is based on a training data set in which the category membership of each observation is known *a priori*. A set of linear discriminant functions defines regions that demarcate those categories and allow new observations to be classified by them.

The source term training data set was constructed from data reported in the literature and data from regional background sediment samples collected from nearby bays in the Puget Sound.

For each source term sample, homologue data were transformed into proportions of the total tetra- through octa-chlorinated PCDDs/Fs. Proportions were used to remove the influence of differences in concentrations between samples and between different sources. Analyses were conducted with SYSTAT Version 13.0 (SYSTAT 2009).

A key measure of the performance of the discriminant functions is how accurately they classify data from the training data set. That is, when the discriminant functions are applied to the training data set, are the data correctly classified by category? Are data from some categories classified incorrectly more frequently than others? To answer these questions, a test classification table was constructed from the training data set using the jackknife method. In this technique, a set of discriminant functions is generated using a subset of all observations in the training data set except the one being classified, and these functions are then applied to the missing observation; the process is repeated for each observation. Jackknifed classification tables are more conservative than conventional tables in estimating the rate of classification error because the observation in question has no influence over the discriminant functions used to classify it (Manly 1986).

Results of Discriminant Analyses

When the discriminant functions were applied to the training data set, 86 percent of all observations were correctly classified into their original group (Table 2; full output is provided in an attachment). Padilla Bay and Fidalgo Bay regional background areas were most frequently misclassified (i.e., incorrectly analyzed as being from a different source). Most of their misclassified observations, however, were members of another Puget Sound regional background bay data set: four of the five misclassified observations of Fidalgo Bay were classified as being Padilla Bay samples and three of the four misclassified observations of Padilla Bay were classified as being either Fidalgo or Samish Bay samples. Aside from those misclassifications between regional background data, the results for the training data set are over 90 percent accurate. This inability to distinguish between Puget Sound regional background areas does not diminish the ability of the analyses to determine the probable source(s) of PCDDs/Fs in samples collected adjacent to the Whitmarsh Landfill because all are considered background sediment sources free from significant anthropogenic influence.

Table 2. Jackknifed Classification Matrix for Full Source Training Data Set

Location	Stormwater Outfall	Bold	Fidalgo Bay	MSW Burn	Padilla Bay	Trash Burn	Wood Burn	Percent Correct
Stormwater Outfall	31	0	0	1	0	0	0	97
Bold	0	4	0	0	1	0	0	80
Fidalgo Bay	1	0	5	0	4	0	0	50
MSW Burn	0	0	0	41	1	2	0	93
Padilla Bay	0	2	1	0	6	0	1	60
Trash Burn	0	0	0	0	0	15	1	94
Wood Burn	0	0	0	1	0	2	10	77
Total	**32**	**6**	**6**	**43**	**12**	**19**	**12**	**86**

When the source data are plotted in the first two canonical variable scores, wood burning, trash burning, and municipal solid waste incineration are separated from samples from sediment sources, whether these were samples from Puget Sound regional background areas or associated with stormwater outfalls (Figure 4). As will be shown below, all Site samples are associated with the sediment sources. Based on the separation of burning and sediment sources, and the classification of the Site samples, the data associated with burning sources were set aside, and the discriminant functions were recalculated using only Puget Sound regional background data and stormwater sediment data (reduced training data set). This second analysis provides a closer examination of the relationships between: 1) those source data that appear more likely associated with Site data, and 2) regional background data and the Site data.

When the discriminant functions were applied to the reduced training data set, 82 percent of all observations were correctly classified into their original group (Table 3; full output is provided in an attachment). Training data for Padilla Bay and Fidalgo Bay regional background areas were, again, most frequently misclassified, with only 60 and 50 percent, respectively, of the observations correctly assigned; like the analysis of the full data set, most misclassified observations were from another Puget Sound regional background bay. These misclassifications between Puget Sound regional background samples indicate the similarity of the homologue profiles of their PCDDs/Fs; consequently they do not reduce the utility of the results for the analysis of the Site data. In the analysis of the reduced training data set, the Samish regional background data become more distinct from the nearby regional background bays (Figure 5).

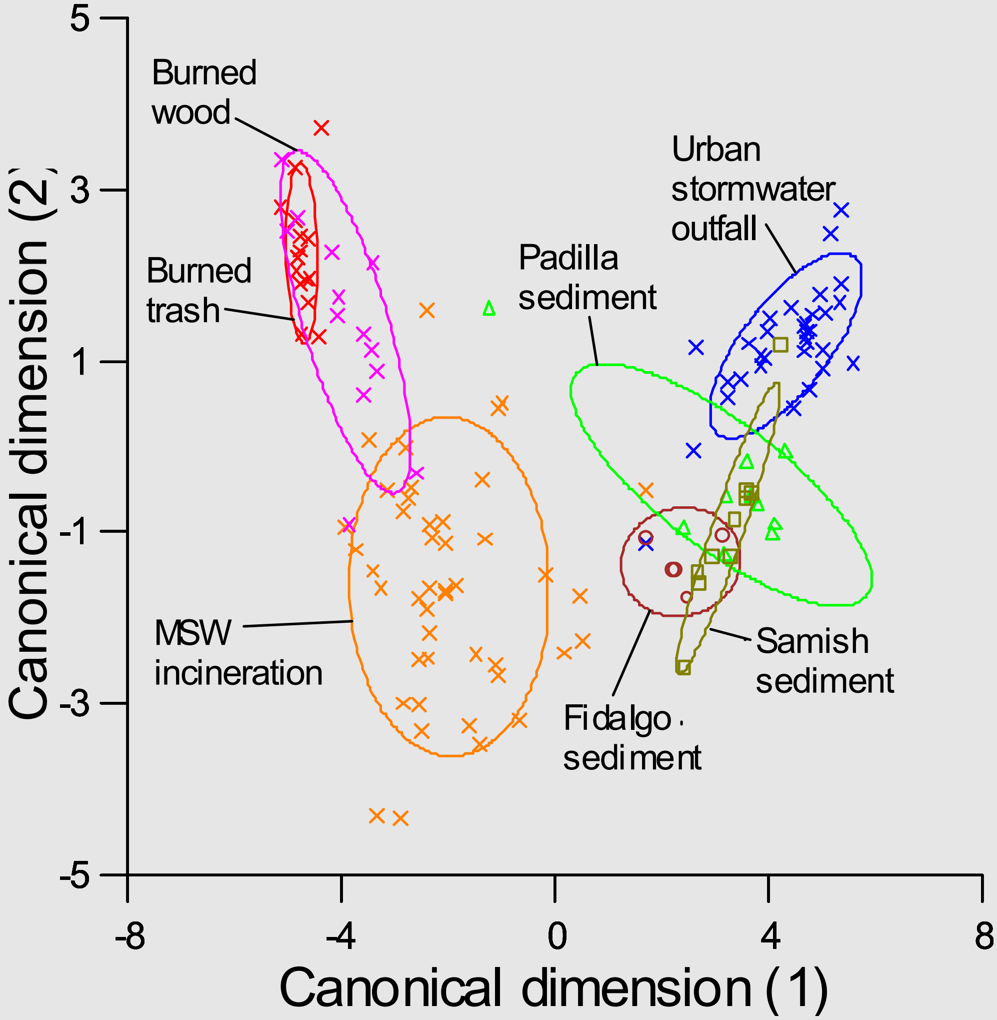

Figure 4. Linear discriminant analysis based on full source data set.

Axes represent the first and second canonical dimensions, or factors, of the discriminant functions. Crosses represent observations from the literature used for the training data set in each source type; open symbols represent Puget Sound regional background data (references provided in text). The ellipses are Gaussian bivariate distributions based on the observations in each type; the area of the ellipse captures ± 1 standard deviation, P (|Z| • 1) = 0.683.

Table 3. Jackknifed Classification Matrix for Reduced Training Data Set

Location	Stormwater Outfall	Fidalgo Bay	Padilla Bay	Samish Bay	Percent Correct
Stormwater Outfall	31	1	0	0	97
Fidalgo Bay	1	5	4	0	50
Padilla Bay	0	3	6	1	60
Samish Bay	0	0	0	5	100
Total	**32**	**9**	**10**	**6**	**82**

Classification of Site Samples

The discriminant functions developed from both the full and reduced training data sets were applied to sediment sample data from the ditch, lagoon and nearshore Padilla Bay. Using the results from the full training data set, all of the Site samples were classified as either stormwater outfall or Padilla Bay regional background (Figure 6). When the discriminant functions derived from the reduced training data set of sediment sources were applied to the Site samples, all samples were classified as stormwater outfall or one of the nearby regional background bays (Padilla or Fidalgo) (Figure 1; Table 4). Examination of the plotted positions of the Site data in the first two dimensions of the discriminant analysis of the reduced training data set shows that results from sample MP-25 (see AMEC Figure 1) and the ditch draining away from that sample are identified as more like stormwater than Puget Sound regional background data (Figure 1). Lagoon samples nearest the ditch (MPC-1 and MPC-2) plot in a location on the figure that is intermediate between the ditch samples and the bulk of Site samples. The remaining composite lagoon and nearshore samples plot as intermediate between the signatures of the stormwater outfall and the nearby regional background bay data. Two lagoon samples (MP-26 and MP-27) plot away from all other Site samples and are classified as Padilla Bay regional background. To summarize, samples located closer to the SE Culvert are more characteristic of stormwater outfall sediments and samples located closer to the outer lagoon and nearshore bay are more like Puget Sound regional background sediments.

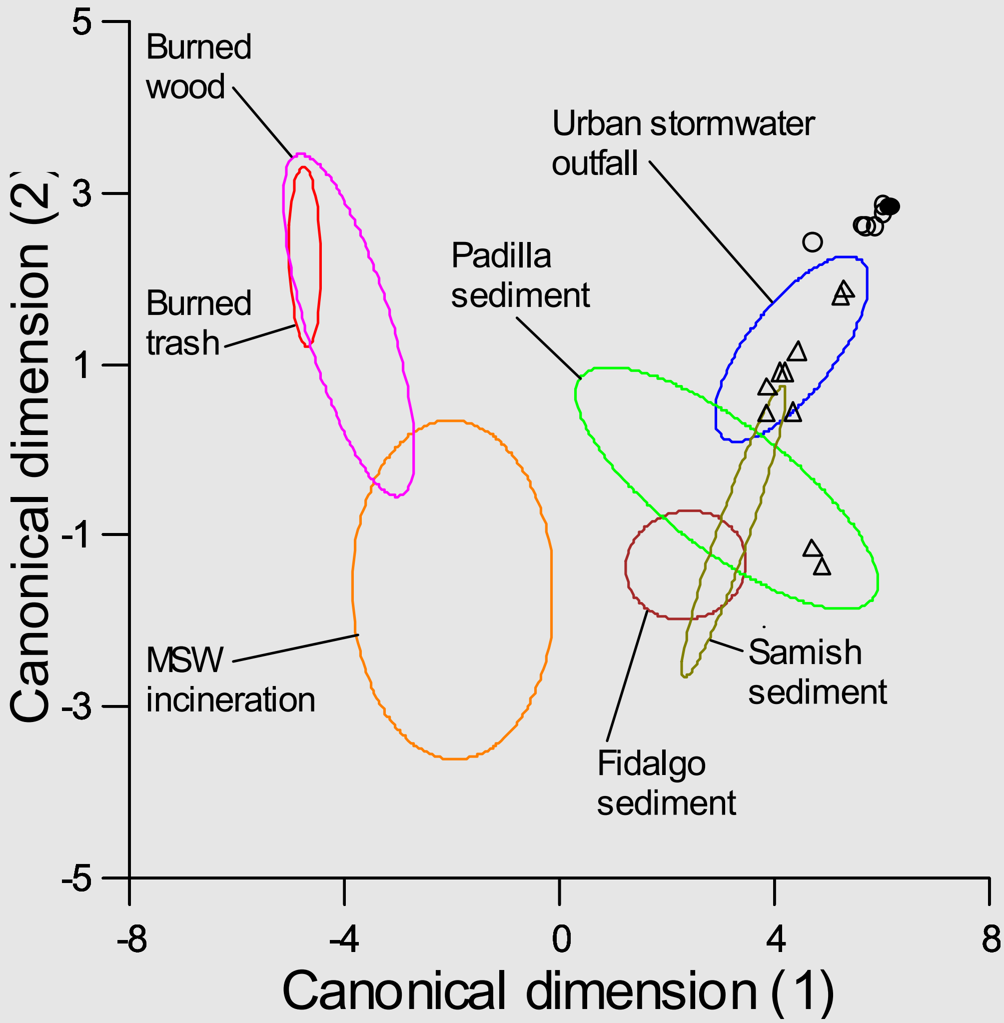

Figure 6. Linear discriminant results based on full source data set, with Whitmarsh data.

Ellipses are from the training data set, by type, with the same color coding as AMEC Figure 1. Triangles are Whitmarsh lagoon and nearshore samples; open circles are Whitmarsh ditch samples MP-34 through MP-39; filled circle is Whitmarsh culvert sample MP-25.

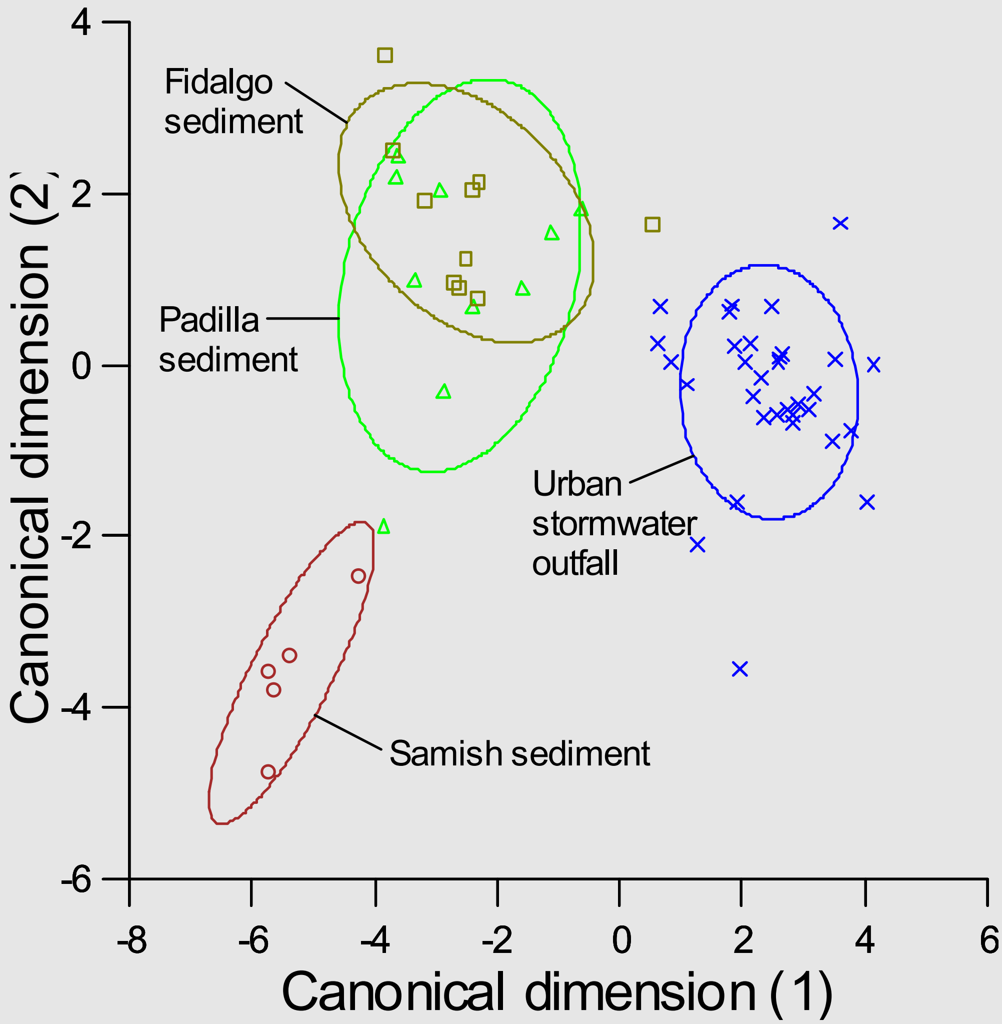

Figure 5. Linear discriminant analysis based on reduced data set.

Axes represent the first and second canonical dimensions, or factors, of the discriminant functions. Crosses represent observations from the literature used for the training data set in each source type; open symbols represent Puget Sound regional background data (references provided in text). The ellipses are Gaussian bivariate distributions based on the observations in each type; the area of the ellipse captures ± 1 standard deviation, P (|Z| • 1) = 0.683.

Table 4. Classification Results for Sediment Source Data Set

Location	Stormwater Outfall	Fidalgo Bay	Padilla Bay
MP-25	1	0	0
MP-26	0	0	1
MP-27	0	0	1
MP-34	1	0	0
MP-35	1	0	0
MP-36	1	0	0
MP-37	1	0	0
MP-38	1	0	0
MP-39	1	0	0
MPC-1	1	0	0
MPC-2	1	0	0
MPC-3	0	0	1
MPC-4	1	0	0
MPC-5	1	0	0
MPC-6	1	0	0
MPC-7	1	0	0
MPC-8	0	1	0
Total	**13**	**1**	**3**

PCDDs/Fs Concentrations in Site and Regional Background Samples

Total PCDDs/Fs concentrations were normalized to their organic carbon (OC) content and compared between different locations within the Site and regional background areas. The rationale for OC normalization is based on consideration of exploratory analyses of the Site and regional background bay data, which indicated that PCDDs/Fs concentrations are closely correlated with total OC concentrations. This correlation is corroborated by an Ecology guidance document, which notes that nonpolar organic compounds are associated with the organic materials in sediments and, therefore, spatial relationships between sample concentrations are better represented by OC-normalized data (Ecology 1992).

When Site PCDDs/Fs OC-normalized data are plotted in a way that represents their geographical arrangement on the Site, a pattern emerges (Figure 2).

- MP-25, closest to the discharge point of the SE Culvert, has the highest concentration.
- The six samples, MP-34 through MP-39, collected from the ditch draining away from MP-25 generally decrease in concentration from the head of the ditch at MP-34 to the mouth of the ditch at MP-39 in the inner lagoon. The decrease in PCDDs/Fs OC from MP-25 to MP-39 is roughly an order of magnitude.
- PCDDs/Fs OC concentrations in inner lagoon samples are comparable to that of nearby MP-39.
- Sediment samples from the outer lagoon and nearshore Padilla Bay have PCDDs/Fs OC concentrations that are generally half that of samples from the inner lagoon; these concentrations are in the range of regional background sample values from nearby Padilla and Fidalgo Bays.

In summary, concentrations are highest at the head of the ditch in MP-25, decreasing down the ditch, into the inner lagoon, and then into the outer lagoon, where concentrations are at regional background.

Proportional Contributions of PCDDs/Fs Homologues in Site and Regional Background Samples

For Site and regional background samples, octa-chlorinated dioxins (OCDD) account, on average, for more of the total PCDDs/Fs concentration than any other PCDDs/Fs homologue. Examination of OCDD contributions in Site and regional background samples, arranged in the same geographical order as Figure 2, how a trend in proportional contribution of OCDD to the total: samples collected from the ditch near the SE Culvert are approximately 75 percent OCDD, lagoon samples are approximately 60 percent OCDD, and nearby regional background samples (Padilla Bay) are approximately 50 percent OCDD (Figure 2).

With increasing distance from the SE Culvert, lower-chlorinated PCDDs become a larger fraction of the total PCDDs/Fs concentration. Samples collected from the lagoon are intermediate, between the ditch and regional background samples, in their OCDD fraction.

Conclusions

Based on linear discriminant analyses, the signatures of Site PCDDs/Fs do not resemble those of burning trash, wood, or municipal solid waste incineration. Rather, their signatures are indicative of a mixture of stormwater and Puget Sound regional background data, with signatures of samples closer to the SE Culvert being similar to stormwater; and signatures of samples from the outer bay being similar to a mix of stormwater and nearby regional background data.

PCDDs/Fs OC-normalized concentrations in the samples collected near the Site may be arranged in a decreasing gradient from highest in MP-25 located nearest to the SE Culvert discharge point, to the ditch, to the inner lagoon, and, finally to the outer lagoon. This pattern of transition is also reflected in the proportional contribution of the homologue accounting for the majority of PCDDs/Fs in Site samples.

Watershed studies conducted as part of the site investigation show that the SE Culvert immediately adjacent to MP-25 drains storm water runoff from areas upgradient of the Whitmarsh Landfill (AMEC 2012). These results provide multiple lines of evidence that a source unrelated to the Whitmarsh Landfill is contributing to PCDDs/Fs in the ditch and the lagoon adjacent to the Site, and that its influence decreases moving away from MP-25.

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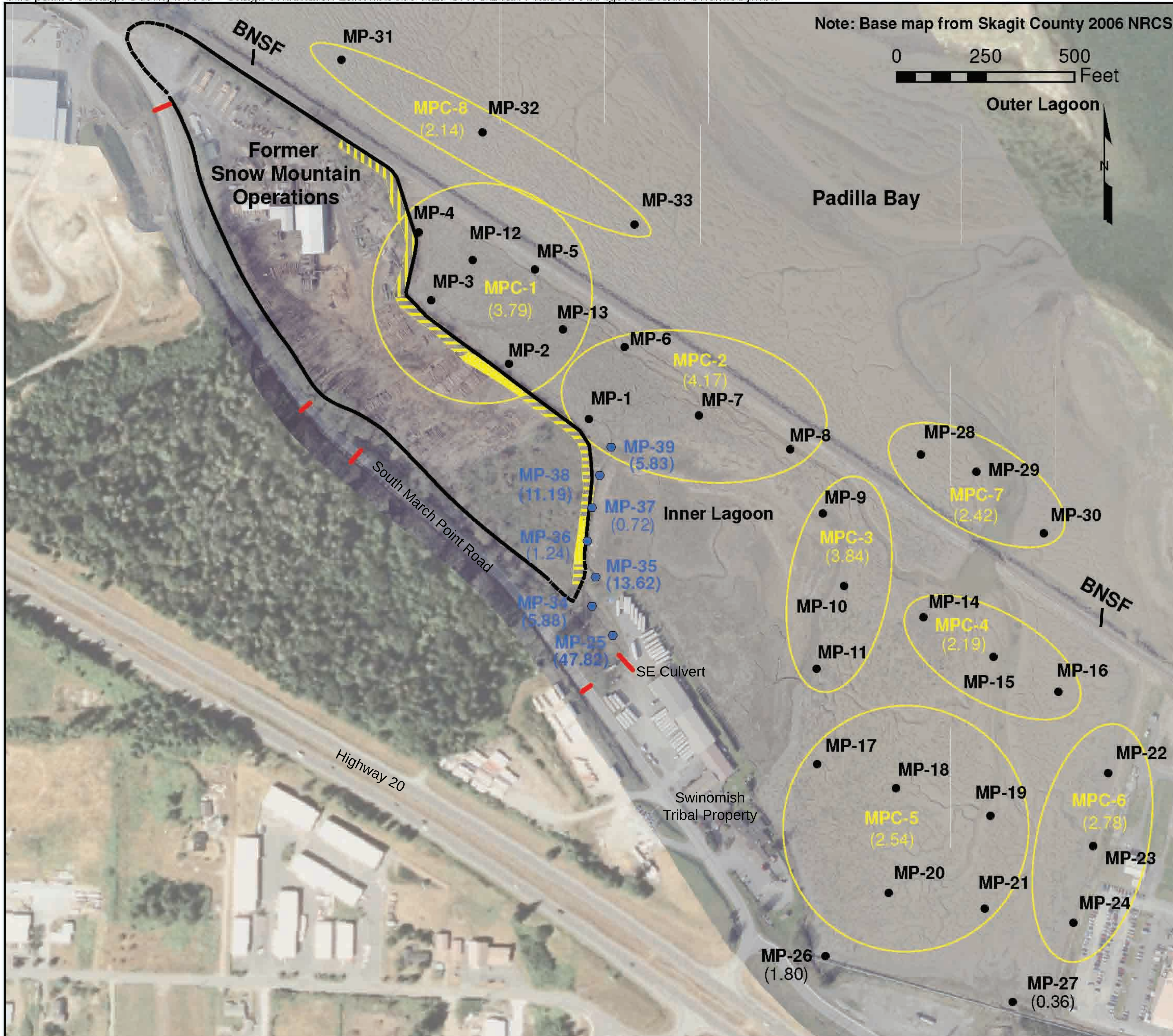

Sediment Sampling

Sediment sampling locations

Composite samples
Dioxin/furans expressed in pptr TEQ

Dike Feature

Area of no observed seeps (location of dike observed in historic photos)

Location of dike confirmed in test pits and borings during the Phase I and II Investigation

Area of observed seeps

Note:
Dioxin/furan concentrations expressed in parts per trillion Toxicity Equivalency Quotient using WHO 2005 TEFs

Some locations in ditch along east margin of the landfill were moved to match the aerial photograph. Locations were moved within ± 1m which is the accuracy of the GPS.

DIOXINS/FURANS (PPTR TEQ)

March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 3/22/2012	Project No. 014159.000.0
amec		Figure 1

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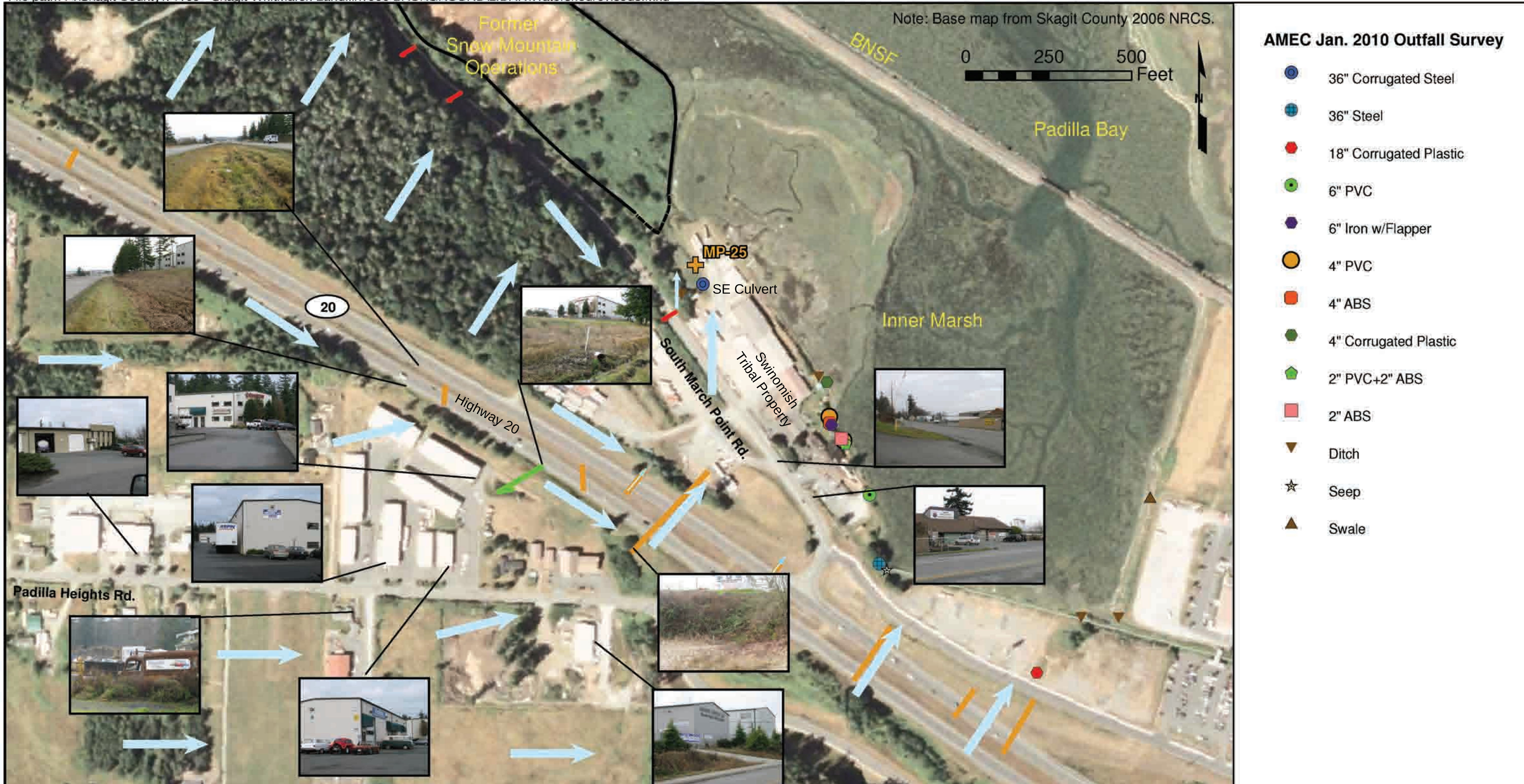


AMEC Field Survey 12/19/11

Outfall/Drain pipe

State Route 20 Culverts (provided by WSDOT 12/8/11)

Roadway Culvert(s)

AMEC Sediment Sampling (September 2010)

Dioxin Sample
MP-25

City of Anacortes Culverts (provided by City 11/28/11)

18" Culvert(s)

Site Boundary

Generalized Flow

Watershed Draining into Inner Marsh
March Point (Whitmarsh) Landfill Site
Skagit County, Washington

By: RHG	Date: 12/21/11	Project No. 014159.000.0
AMEC Geomatrix		Figure 2

LOCATION	GROUP	TOC	FINES	TCDD	PECDD	HXCDD	HPCDD	OCDD	TCDF	PECDF	HXCDF	HPCDF	OCDF	TOTAL	TOC_NORM	FINES_NORM	TOTFURAN	TOTDIOXIN	POCDD
MP-25	culvert	4.64	44	10.9	36.3	325	2440	15000	15.7	49.1	240	475	432	19024	410	432.36	1211.8	17812.2	0.788
MP-34	ditch	2.49	19.1	3.42	7.27	39.3	252	1600	8.17	14.4	33.3	48.5	42.2	2048.56	82.27	107.25	146.57	1901.99	0.781
MP-35	ditch	3.66	48.5	8.98	15.9	93.9	597	3510	17	25.6	62.5	98.5	97.7	4527.08	123.69	93.34	301.3	4225.78	0.775
MP-36	ditch	1.07	3.5	1.01	0.657	5.97	35.2	203	3.14	3.06	5.75	7.91	7.72	273.417	25.55	78.12	27.58	245.837	0.742
MP-37	ditch	1.01	1.5	0.825	0.773	2.11	10.8	54.8	2.41	2.19	2.9	2.74	2.16	81.708	8.09	54.47	12.4	69.308	0.671
MP-38	ditch	5.23	61.6	8.1	15.7	75.8	492	2760	16.1	24	53.2	96.2	103	3644.1	69.68	59.16	292.5	3351.6	0.757
MP-39	ditch	3.27	23.4	12	21.8	44.2	215	1260	11.3	14.7	26.9	38.2	38.2	1682.3	51.45	71.89	129.3	1553	0.749
MPC-2	other	2.08	77.9	8.26	10.4	43.6	229	827	10.2	10.6	20.8	30.4	26.3	1216.56	58.49	15.62	98.3	1118.26	0.680
MPC-1	other	3.19	80.23	9.78	14.2	50.2	229	930	14.5	12	18	32.6	32.8	1343.08	42.10	16.74	109.9	1233.18	0.692
MPC-3	other	1.54	75.5	13.8	17.6	49.7	135	374	14.6	13.1	14.7	22.9	20.2	675.6	43.87	8.95	85.5	590.1	0.554
MPC-4	other	2.89	73.3	11.8	7.56	28.1	125	302	8.43	5.23	9.3	16.7	17	531.12	18.38	7.25	56.66	474.46	0.569
MPC-5	other	2.12	63.5	11.3	7.97	29.4	119	359	8.1	5.96	10.8	22	23.7	597.23	28.17	9.41	70.56	526.67	0.601
MPC-6	other	3.14	77.3	5.68	9.56	36.2	138	337	7.68	5.52	10.8	19.7	20.6	590.74	18.81	7.64	64.3	526.44	0.570
MPC-7	other	2.57	79	19.3	10.4	33.3	179	369	8.52	5.11	9.46	18.3	19.2	671.59	26.13	8.50	60.59	611	0.549
MPC-8	other	1.89	77.5	13.6	8.33	28.7	113	260	8.89	5.77	9.31	15.8	16	479.4	25.37	6.19	55.77	423.63	0.542
MP-26	other	2.17	47.1	2.61	4.06	90.7	16.2	363	4.54	4.29	8.13	27.2	49.3	570.03	26.27	12.10	93.46	476.57	0.637
MP-27	other	0.327	2.4	0.188	0.212	20.1	3.06	76	0.142	0.423	2.04	4.82	6.57	113.555	34.73	47.31	13.995	99.56	0.669
				0.022	0.490	0.220	0.170	0.150	1.600	1.700	1.100	0.250	0.14	5.84			4.79		0.026
				0.107	0.145	0.164	0.141	0.172	0.439	0.313	0.190	0.308	0.06	2.04			1.31		0.084
				0.510	0.440	0.260	0.360	0.450	3.640	5.500	1.600	0.290	0.059	13.109			11.09		0.034
				2.178	95.100	3.848	3.565	1.379	11.163	8.606	3.772	1.403	0.20	131.22			25.15		0.011
				0.307	0.751	0.563	0.758	2.194	2.109	1.305	0.917	0.809	0.71	10.42			5.85		0.211
				0.359	0.876	0.645	0.806	2.560	2.409	1.501	1.040	0.892	0.83	11.92			6.67		0.215
				1.572	1.882	3.542	2.962	3.129	6.709	6.888	4.041	2.059	0.90	33.68			20.60		0.093
				0.840	1.530	3.633	5.248	3.608	6.440	4.250	3.418	2.746	0.92	32.63			17.77		0.111
				0.872	1.598	3.804	5.510	3.708	6.663	4.419	3.547	2.867	0.97	33.96			18.46		0.109
				0.680	1.408	2.848	4.366	5.302	2.860	2.679	1.927	1.410	1.30	24.78			10.18		0.214
				0.490	0.700	0.950	0.700	5.800	0.285	0.900	0.550	0.800	3.4	14.575			5.935		0.398
				1.430	2.860	2.780	6.210	6.150	5.090	3.850	3.360	9.640	3.06	44.43			25		0.138
				0.485	0.700	0.700	0.750	6.300	0.290	0.650	0.490	0.700	3	14.065			5.13		0.448
				24	4	4	6	7	281	98	38	10	4	476			431		0.015
				1.38	2.66	5.11	7.86	7.13	5.05	6.80	10.46	11.63	4.31	62.39			38.25		0.114
				0.6	0.335	0.46	3.5	7.8	0.345	0.55	0.495	0.495	3.2	17.78			5.085		0.439
				3.58	5.79	9.05	7.88	8.87	9.66	8.57	5.81	3.80	1.51	64.52			29.34		0.137
				21	3	3	5	11	176	40	21	4	9	293			250		0.038
				1.55	4.75	4.11	6.03	11	1.43	2.23	3.05	11.2	2.73	48.08			20.64		0.229
				93	137	33	30	12	549	287	126	38	11	1316			1011		0.009
				0.385	0.7	0.95	5.9	15	0.275	0.65	0.7	0.6	3.8	28.96			6.025		0.518
				2.97	9.21	9.95	17.12	15.29	21.71	21.31	19.12	15.99	5.84	138.52			83.98		0.110
				0.465	0.65	0.85	7.2	16	0.275	0.55	0.65	0.65	18	45.29			20.125		0.353
				60	39	37	19	16	771	354	126	34	6	1462			1291		0.011
				1.88	4.45	5.29	9.58	18.4	1.08	2.56	2.6	10.1	4.48	60.42			20.82		0.305
				0.325	0.23	0.43	6.5	19	0.145	0.255	0.49	9.2	4.2	40.775			14.29		0.466
				7	13	19	13	19	30	27	22	29	19	198			127		0.096
				12	20	24	14	22	24	25	23	25	17	206			114		0.107
				11	19	15	16	23	36	52	25	31	22	250			166		0.092
				23	52	69	19	23	53	46	39	36	34	394			208		0.058
				408	272	205	85	30	4444	2508	1307	382	40	9681			8681		0.003
				15	23	31	21	33	55	57	37	41	39	352			229		0.094
				13.44	23.05	49.05	56.66	46.73	95.86	65.81	35.78	14.84	3.43	404.64			215.71		0.115
				0.65	0.34	1.2	18	47	0.25	0.435	3.9	7.8	7.2	86.775			19.585		0.542
				130	98	123	83	48	1652	915	516	205	44	3814			3332		0.013
				0.45	0.6	1	20	51	0.33	0.6	0.75	4.7	4.3	83.73			10.68		0.609
				20.62	12.92	13.46	18.28	53.44	114.60	52.10	24.23	23.74	21.18	354.56			235.85		0.151
				1210	704	491	183	56	3199	1980	847	274	56	9000			6356		0.006
				1.9	0.85	1.5	16	60	0.75	1	1.35	0.95	2.9	87.2			6.95		0.688
				492	437	368	193	63	5917	2993	1655	586	64	12768			11215		0.005
				100.20	153.70	250.68	171.27	63.11	597.94	405.44	281.76	169.13	2.57	2195.79			1456.83		0.029
				13	23	33	38	64	46	60	41	48	45	411			240		0.156
				14	230	290	125	65	288	214	164	178	68	1636			912		0.040
				31	37	66	73	73	56	74	177	141	110	838			558		0.087
				6.65	12.4	33.9	62.9	75.7	9.63	19.6	26.9	65.3	28.2	341.18			149.63		0.222
				672	369	478	253	81	6610	4567	1964	614	74	15682			13829		0.005
				25.2	2.3	2.3	81.4	84.1	81.1	22.2	3.5	88	0.005	390.105			194.805		0.216
				606	463	456	225	96	3721	1823	931	319	54	8694			6848		0.011
				9.57	14.93	34.81	62.10	97.00	139.28	181.16	120.08	103.94	32.66	795.53			577.12		0.122
				0.425	0.65	1.6	35	100	0.445	0.95	2.9	9.5	8.4	159.87			22.195		0.626
				32.7	61.7	62.1	79.5	100	28.1	42.9	43	139	34.8	623.8			287.8		0.160
				19	35	46	63	109	74	93	80	64	43	626			354		0.174
				0.5	0.75	1.05	22	110	0.22	0.445	7.6	30	15	187.565			53.265		0.586
				0.48	0.47	9.5	40	110	0.325	0.7	4.1	11	9	185.575			25.125		0.593
				27.5	119.1	129.3	209.8	110.7	543.7	327.9	108.1	23.7	15.6	1615.4			1019		0.069
				68.6	159	216	244	115	76.5	151	182	359	66.2	1637.3			834.7		0.070
				979	593	492	256	168	2921	1759	1167	519	132	8986			6498		0.019

LOCATION	GROUP	TOC	FINES	TCDD	PECDD	HXCDD	HPCDD	OCDD	TCDF	PECDF	HXCDF	HPCDF	OCDF	TOTAL	TOC_NORM	FINES_NORM	TOTFURAN	TOTDIOXIN	POCDD
				2820	1520	118.2	414.7	197.8	21200	10160	2350	656.2	200.6	39637.5			34566.8		0.005
				141.072	253.668	267.371	270.628	208.368	502.785	489.556	442.948	270.055	59.750	2906.201			1765.09		0.072
				0.6	0.65	17	66	270	0.235	3.1	19	18	37	431.585			77.335		0.626
				1.95	2.9	5	110	310	1.35	2.2	4.2	15	24	476.6			46.75		0.650
				0.405	2	33	120	350	0.225	2.8	18	15	20	561.43			56.025		0.623
				3832	2607	2275	1063	353	17459	11597	6159	2540	536	48421			38291		0.007
				683	701	1391	1045	365	1046	620	890	692	749	8182			3997		0.045
				43	112	161	351	371	102	103	101	100	74	1518			480		0.244
				2000	1130	1100	516.2	426.8	20700	5970	2320	545	91.6	34799.6			29626.6		0.012
				1127	2089	3805	2884	631	2846	2261	2928	1414	382	20367			9831		0.031
				3975	2767	2061	1047	633	9767	6664	4323	2421	710	34368			23885		0.018
				950	1640	2600	1200	640	7740	4290	1690	1020	210	21980			14950		0.029
				0.465	0.75	35	200	680	8.8	43	65	52	80	1165.015			248.8		0.584
				0.5	2.2	43	190	750	0.6	13	37	74	60	1170.3			184.6		0.641
				2.1	1.25	54	220	780	2	14	41	68	55	1237.35			180		0.630
				0.55	4.4	78	310	780	0.255	11	45	36	39	1304.205			131.255		0.598
				1.75	1.25	48	230	810	1.4	16	34	29	56	1227.4			136.4		0.660
				17300	8500	8200	1900	967.3	66700	70700	21100	4800	593.6	200760.9			163893.6		0.005
				398.438	967.679	1553.935	1116.217	1006.306	2781.124	2868.977	2366.545	1973.167	442.12	15474.50			10431.93		0.065
				287.907	506.386	1101.527	1298.339	1008.850	827.090	787.398	909.776	728.937	366.53	7822.74			3619.73		0.129
				3	12	85	330	1100	36	99	80	110	92	1947			417		0.565
				283.207	733.689	1340.279	899.323	1106.672	2010.827	2422.732	2147.720	1935.211	430.38	13310.04			8946.87		0.083
				1.7	10.3	37.5	777	1140	9.5	39.7	149	887	398	3449.7			1483.2		0.330
				4645	4625	5039	3166	1264	50943	36329	25277	11214	2396	144898			126159		0.009
				0.75	15	130	360	1300	36	110	170	160	100	2381.75			576		0.546
				20.1	82.3	316	1120	1310	105	296	515	1670	500	5934.4			3086		0.221
				2.15	1.7	81	400	1600	12	41	83	150	130	2500.85			416		0.640
				0.6	7	89	440	1600	20	77	150	230	210	2823.6			687		0.567
				0.45	1.25	75	420	1700	17	60	75	110	88	2546.7			350		0.668
				0.9	5.6	85	430	1700	5.5	45	81	160	190	2703			481.5		0.629
				61.7	4.6	4.2	1010	1700	128	53.1	10.2	645	115	3731.8			951.3		0.456
				0.75	16	110	770	1900	3.3	22	52	88	42	3004.05			207.3		0.632
				6.2	13	200	910	1900	67	170	310	400	190	4166.2			1137		0.456
				475.61	859.07	1952.37	2425.41	1954.59	1056.24	1169.36	1537.80	1288.75	730.49	13449.69			5782.63		0.145
				22570	17266	16020	7298	2119	41390	32818	25014	11897	2088	178480			113207		0.012
				445.55	943.11	2108.36	2691.11	2609.73	1202.52	1452.81	1801.31	1630.21	586.42	15471.13			6673.27		0.169
				2.15	13	160	820	3400	22	63	180	350	300	5310.15			915		0.640
				2745.79	4896.98	6613.84	5046.64	3454.15	12859.63	15504.71	16065.24	6792.15	1558.17	75537.31			52779.91		0.046
				11	31	300	1500	4100	250	760	870	590	500	8912			2970		0.460
				12714	12183	14035	9164	4331	86087	75322	57162	28119	7641	306758			254331		0.014
				11400	6140	8510	12120	4390	50930	40710	10680	2620	700	148200			105640		0.030
				10	27	300	1500	4800	120	320	530	460	400	8467			1830		0.567
				8.7	23	230	1100	6200	120	290	400	270	440	9081.7			1520		0.683
				10420	5030	8440	8470	6730	53410	40540	12930	3350	650	149970			110880		0.045
				6410	2730	10640	7810	7570	46830	26180	7400	2320	640	118530			83370		0.064
				9699	11649	11810	14945	11483	47552	51823	25030	6471	1066	191528			131942		0.060
				10800	6720	8780	16590	23650	91170	85570	34430	7360	980	286050			219510		0.083
				25706	191287	105672	59470	40212	321642	499291	398605	91569	60559	1794013			1371666		0.022
PB-01	Background	0.68		0.26	0.73	4.18	8.45	20.40	1.47	0.38	1.09	1.20	1.7	39.866			5.844	34.022	0.512
PB-02	Background	0.17		0.06	0.07	0.14	0.84	1.49	2.86	1.26	0.16	0.10	0.150	7.125			4.522	2.603	0.209
PB-03	Background	1.20		6.96	8.89	25.20	45.50	97.40	11.40	5.20	6.58	10.60	7.160	224.890			40.94	183.95	0.433
PB-04	Background	0.98		0.05	0.05	0.53	0.05	2.07	0.05	0.05	0.16	0.33	0.150	3.487			0.7362	2.7506	0.594
PB-05	Background	0.19		1.14	1.38	7.13	17.35	39.95	3.17	1.82	1.59	4.41	3.230	81.161			14.21	66.95	0.492
PB-06	Background	0.22		0.06	0.05	0.58	0.69	2.44	0.05	0.06	0.09	0.16	0.256	4.440			0.61	3.83	0.550
PB-07	Background	0.42		0.07	0.10	2.14	2.27	9.92	0.17	0.21	0.47	0.87	0.722	16.936			2.44	14.50	0.586
PB-08	Background	0.47		0.80	0.65	3.43	9.95	22.70	1.00	0.77	0.81	2.10	1.790	43.991			6.46	37.53	0.516
PB-09	Background	0.25		0.05	0.05	0.55	1.49	3.51	0.05	0.13	0.19	0.43	0.378	6.824			1.17	5.65	0.514
PB-10	Background	0.94		1.26	0.61	11.30	201.00	196.00	4.61	1.41	1.42	3.30	4.710	425.623			15.45	410.17	0.461
FB-01	Background	0.35		0.36	0.67	4.63	9.95	23.50	1.57	1.09	1.12	2.39	1.580	46.862			7.75	39.112	0.501
FB-02	Background	0.31		0.14	0.10	2.25	10.40	33.70	3.64	2.24	0.65	2.09	3.890	59.101			12.506	46.595	0.570
FB-03	Background	0.48		0.58	0.48	6.02	96.80	26.30	3.54	0.80	0.75	2.10	1.590	138.962			8.782	130.18	0.189
FB-04	Background	0.65		7.08	4.24	20.90	157.00	88.30	7.85	2.66	3.50	2.93	5.690	300.150			22.63	277.52	0.294
FB-05	Background	0.84		0.80	0.91	7.90	22.60	44.80	3.18	1.31	1.80	3.60	2.330	89.221			12.22	77.001	0.502
FB-06	Background	0.53		0.65	0.61	4.39	8.62	22.90	1.22	0.43	0.94	1.91	1.710	43.372			6.202	37.17	0.528
FB-07	Background	0.91		3.44	2.14	11.92	146.00	87.55	6.79	1.26	2.98	7.02	5.965	275.050			24.01	251.04	0.318
FB-08	Background	0.74		2.07	2.09	10.70	141.00	82.50	4.66	1.13	1.69	2.57	4.220	252.630			14.27	238.36	0.327
FB-09	Background	0.82		7.64	4.96	21.10	160.00	101.00	7.36	2.29	4.57	7.75	7.070	323.740			29.04	294.7	0.312
FB-10	Background	1.35		8.39	7.76	33.80	116.00	205.00	7.50	3.83	4.56	16.80	16.500	420.140			49.19	370.95	0.488
R_SAM_0	Background	2.63	82.00	8.74	11.20	24.90	29.40	72.90	4.73	3.31	3.73	7.22	5.910	172.040					0.424
R_SAM_1	Background	1.75	45.20	6.60	14.00	31.10	36.20	94.50	6.93	4.49	4.55	9.86	7.630	215.860					0.438
R_SAM_3	Background	1.24	85.30	3.61	7.95	23.60	32.60	96.30	7.16	3.72	3.94	8.03	5.430	192.340					0.501
R_SAM_4	Background	1.06	83.70	8.03	11.00	27.10	34.60	83.50	7.81	3.25	4.87	8.91	6.160	195.230					0.428
R_SAM_5	Background	1.64	75.10	18.60	17.90	37.20	43.20	104.00	9.40	4.39	5.42	10.70	8.470	259.280					0.401

LOCATION	PHPCDD	PHXCDD	PPECDD	PTCDD	POCDF	PHPCDF	PHXCDF	PPECDF	PTCDF	REFERENCE	DESCRIPTION	TYPE	TOTDIOXN	TOTAL_OC	LNTOTAL	_NTOTAL_OC	LOC	OC_SYM
MP-25	0.128	0.017	0.002	0.001	0.023	0.025	0.013	0.003	0.001					410000.000	9.853	12.924	MP-25	1
MP-34	0.123	0.019	0.004	0.002	0.021	0.024	0.016	0.007	0.004					82271.486	7.625	11.318	MP-34	1
MP-35	0.132	0.021	0.004	0.002	0.022	0.022	0.014	0.006	0.004					123690.710	8.418	11.726	MP-35	1
MP-36	0.129	0.022	0.002	0.004	0.028	0.029	0.021	0.011	0.011					25552.991	5.611	10.149	MP-36	1
MP-37	0.132	0.026	0.009	0.010	0.026	0.034	0.035	0.027	0.029					8089.901	4.403	8.998	MP-37	1
MP-38	0.135	0.021	0.004	0.002	0.028	0.026	0.015	0.007	0.004					69676.864	8.201	11.152	MP-38	1
MP-39	0.128	0.026	0.013	0.007	0.023	0.023	0.016	0.009	0.007					51446.483	7.428	10.848	MP-39	1
MPC-2	0.188	0.036	0.009	0.007	0.022	0.025	0.017	0.009	0.008					58488.462	7.104	10.977	Inner Lagoon	1
MPC-1	0.171	0.037	0.011	0.007	0.024	0.024	0.013	0.009	0.011					42102.821	7.203	10.648	Inner Lagoon	1
MPC-3	0.200	0.074	0.026	0.020	0.030	0.034	0.022	0.019	0.022					43870.130	6.516	10.689	Inner Lagoon	1
MPC-4	0.235	0.053	0.014	0.022	0.032	0.031	0.018	0.010	0.016					18377.855	6.275	9.819	Outer Lagoon	1
MPC-5	0.199	0.049	0.013	0.019	0.040	0.037	0.018	0.010	0.014					28171.226	6.392	10.246	Outer Lagoon	1
MPC-6	0.234	0.061	0.016	0.010	0.035	0.033	0.018	0.009	0.013					18813.376	6.381	9.842	Outer Lagoon	1
MPC-7	0.267	0.050	0.015	0.029	0.029	0.027	0.014	0.008	0.013					26131.907	6.510	10.171	Outer Lagoon	1
MPC-8	0.236	0.060	0.017	0.028	0.033	0.033	0.019	0.012	0.019					25365.079	6.173	10.141	Outer Lagoon	1
MP-26	0.028	0.159	0.007	0.005	0.086	0.048	0.014	0.008	0.008					26268.664	6.346	10.176	Outer Lagoon	1
MP-27	0.027	0.177	0.002	0.002	0.058	0.042	0.018	0.004	0.001					34726.300	4.732	10.455	Outer Lagoon	1
	0.029	0.038	0.084	0.004	0.024	0.043	0.188	0.291	0.274	JOHNSON92	Residential	Wood burn	1.05		1.765			1
	0.069	0.080	0.071	0.052	0.030	0.151	0.093	0.153	0.215	EPA-CDROM	Municipal So	MSW Burn	0.73		0.713			1
	0.027	0.020	0.034	0.039	0.005	0.022	0.122	0.420	0.278	JOHNSON92	Residential	Wood burn	2.02		2.573			1
	0.027	0.029	0.725	0.017	0.002	0.011	0.029	0.066	0.085	EPA-CDROM	Municipal So	MSW Burn	106.07		4.877			1
	0.073	0.054	0.072	0.029	0.068	0.078	0.088	0.125	0.202	EPA-CDROM	Municipal So	MSW Burn	4.57		2.344			1
	0.068	0.054	0.074	0.030	0.069	0.075	0.087	0.126	0.202	EPA-CDROM	Municipal So	MSW Burn	5.25		2.478			1
	0.088	0.105	0.056	0.047	0.027	0.061	0.120	0.205	0.199	EPA-CDROM	Municipal So	MSW Burn	13.09		3.517			1
	0.161	0.111	0.047	0.026	0.028	0.084	0.105	0.130	0.197	EPA-CDROM	Municipal So	MSW Burn	14.86		3.485			1
	0.162	0.112	0.047	0.026	0.028	0.084	0.104	0.130	0.196	EPA-CDROM	Municipal So	MSW Burn	15.49		3.525			1
	0.176	0.115	0.057	0.027	0.053	0.057	0.078	0.108	0.115	EPA-CDROM	Municipal So	MSW Burn	14.60		3.210			1
	0.048	0.065	0.048	0.034	0.233	0.055	0.038	0.062	0.020	Mathur et al	BEN4	Bay Outfall	8.64		2.679			1
	0.140	0.063	0.064	0.032	0.069	0.217	0.076	0.087	0.115	Miyato et al	MSW Incinera	MSW Burn	19.43		3.794			1
	0.053	0.050	0.050	0.034	0.213	0.050	0.035	0.046	0.021	Mathur et al	BEN3	Bay Outfall	8.94		2.644			1
	0.013	0.008	0.008	0.050	0.008	0.021	0.080	0.206	0.590	Lemieux00a	Open Burning	Trash burn	45.00		6.165			1
	0.126	0.082	0.043	0.022	0.069	0.186	0.168	0.109	0.081	EPA-CDROM	Municipal So	MSW Burn	24.14		4.133			1
	0.197	0.026	0.019	0.034	0.180	0.028	0.028	0.031	0.019	Mathur et al	BEN2	Bay Outfall	12.70		2.878			1
	0.122	0.140	0.090	0.056	0.023	0.059	0.090	0.133	0.150	EPA-CDROM	Municipal So	MSW Burn	35.18		4.167			1
	0.017	0.010	0.010	0.072	0.031	0.014	0.072	0.137	0.601	Lemieux00a	Open Burning	Trash burn	43.00		5.680			1
	0.125	0.085	0.099	0.032	0.057	0.233	0.063	0.046	0.030	Miyato et al	MSW Incinera	MSW Burn	27.44		3.873			1
	0.023	0.025	0.104	0.071	0.008	0.029	0.096	0.218	0.417	Lemieux00a	Open Burning	Trash burn	305.00		7.182			1
	0.204	0.033	0.024	0.013	0.131	0.021	0.024	0.022	0.009	Mathur et al	BEN1	Bay Outfall	22.94		3.366			1
	0.124	0.072	0.067	0.021	0.042	0.115	0.138	0.154	0.157	EPA-CDROM	Municipal So	MSW Burn	54.55		4.931			1
	0.159	0.019	0.014	0.010	0.397	0.014	0.014	0.012	0.006	Mathur et al	BEN7	Bay Outfall	25.17		3.813			1
	0.013	0.025	0.027	0.041	0.004	0.023	0.086	0.242	0.527	Lemieux00a	Open Burning	Trash burn	171.00		7.288			1
	0.159	0.088	0.074	0.031	0.074	0.167	0.043	0.042	0.018	Miyato et al	MSW Incinera	MSW Burn	39.60		4.101			1
	0.159	0.011	0.006	0.008	0.103	0.226	0.012	0.006	0.004	Mathur et al	OAK5	Bay Outfall	26.49		3.708			1
	0.066	0.096	0.066	0.035	0.096	0.146	0.111	0.136	0.152	Gizze et al.	Urban MSW In	MSW Burn	71		5.288			1
	0.068	0.117	0.097	0.058	0.083	0.121	0.112	0.121	0.117	Gizze et al.	Urban MSW In	MSW Burn	92		5.328			1
	0.064	0.060	0.076	0.044	0.088	0.124	0.100	0.208	0.144	Gizze et al.	Urban MSW In	MSW Burn	84		5.521			1
	0.048	0.175	0.132	0.058	0.086	0.091	0.099	0.117	0.135	Gizze et al.	Urban MSW In	MSW Burn	186		5.976			1
	0.009	0.021	0.028	0.042	0.004	0.039	0.135	0.259	0.459	Lemieux00a	Open Burning	Trash burn	1000		9.178			1
	0.060	0.088	0.065	0.043	0.111	0.116	0.105	0.162	0.156	Gizze et al.	Urban MSW In	MSW Burn	123		5.864			1
	0.140	0.121	0.057	0.033	0.008	0.037	0.088	0.163	0.237	EPA-CDROM	Municipal So	MSW Burn	188.93		6.003			1
	0.207	0.014	0.004	0.007	0.083	0.090	0.045	0.005	0.003	Mathur et al	OAK4	Bay Outfall	67.19		4.463			1
	0.022	0.032	0.026	0.034	0.012	0.054	0.135	0.240	0.433	Lemieux00a	Open Burning	Trash burn	482		8.246			1
	0.239	0.012	0.007	0.005	0.051	0.056	0.009	0.007	0.004	Mathur et al	BEN6	Bay Outfall	73.05		4.428			1
	0.052	0.038	0.036	0.058	0.060	0.067	0.068	0.147	0.323	EPA-CDROM	Municipal So	MSW Burn	118.71		5.871			1
	0.020	0.055	0.078	0.134	0.006	0.030	0.094	0.220	0.355	Lemieux00a	Open Burning	Trash burn	2644		9.105			1
	0.183	0.017	0.010	0.022	0.033	0.011	0.015	0.011	0.009	Mathur et al	Fairfield	Bay Outfall	80.25		4.468			1
	0.015	0.029	0.034	0.039	0.005	0.046	0.130	0.234	0.463	Lemieux00a	Open Burning	Trash burn	1553		9.455			1
	0.078	0.114	0.070	0.046	0.001	0.077	0.128	0.185	0.272	EPA-CDROM	Municipal So	MSW Burn	738.96		7.694			1
	0.092	0.080	0.056	0.032	0.109	0.117	0.100	0.146	0.112	Gizze et al.	Urban MSW In	MSW Burn	171		6.019			1
	0.076	0.177	0.141	0.009	0.042	0.109	0.100	0.131	0.176	Gizze et al.	Urban MSW In	MSW Burn	724		7.400			1
	0.087	0.079	0.044	0.037	0.131	0.168	0.211	0.088	0.067	Gizze et al.	Urban MSW In	MSW Burn	280		6.731			1
	0.184	0.099	0.036	0.019	0.083	0.191	0.079	0.057	0.028	Miyato et al	MSW Incinera	MSW Burn	191.55		5.832			1
	0.016	0.030	0.024	0.043	0.005	0.039	0.125	0.291	0.422	Lemieux00a	Open Burning	Trash burn	1853		9.660			1
	0.209	0.006	0.006	0.065	0.000	0.226	0.009	0.057	0.208	Yasuhara et	MSW Incinera	MSW Burn	195.3		5.966			1
	0.026	0.052	0.053	0.070	0.006	0.037	0.107	0.210	0.428	Lemieux00a	Open Burning	Trash burn	1846		9.070			1
	0.078	0.044	0.019	0.012	0.041	0.131	0.151	0.228	0.175	EPA-CDROM	Municipal So	MSW Burn	218.41		6.679			1
	0.219	0.010	0.004	0.003	0.053	0.059	0.018	0.006	0.003	Mathur et al	Fairfield	Bay Outfall	137.675		5.074			1
	0.127	0.100	0.099	0.052	0.056	0.223	0.069	0.069	0.045	Miyato et al	MSW Incinera	MSW Burn	336		6.436			1
	0.101	0.073	0.056	0.030	0.069	0.102	0.128	0.149	0.118	Gizze et al.	Urban MSW In	MSW Burn	272		6.439			1
	0.117	0.006	0.004	0.003	0.080	0.160	0.041	0.002	0.001	Mathur et al	OAK3	Bay Outfall	134.3		5.234			1
	0.216	0.051	0.003	0.003	0.048	0.059	0.022	0.004	0.002	Mathur et al	BEN5	Bay Outfall	160.45		5.223			1
	0.130	0.080	0.074	0.017	0.010	0.015	0.067	0.203	0.337	THOMA88	Wood oven ch	Wood burn	596.4		7.387			1
	0.149	0.132	0.097	0.042	0.040	0.219	0.111	0.092	0.047	Miyato et al	MSW Incinera	MSW Burn	802.6		7.401			1
	0.028	0.055	0.066	0.109	0.015	0.058	0.130	0.196	0.325	Lemieux00a	Open Burning	Trash burn	2488		9.103			1

LOCATION	PHPCDD	PHXCDD	PPECDD	PTCDD	POCDF	PHPCDF	PHXCDF	PPECDF	PTCDF	REFERENCE	DESCRIPTION	TYPE	TOTDIOXN	TOTAL_OC	LNTOTAL	_NTOTAL_OC	LOC	OC_SYM
	0.010	0.003	0.038	0.071	0.005	0.017	0.059	0.256	0.535	THOMA88	Wood oven ch	Wood burn	5070.7		10.588			1
	0.093	0.092	0.087	0.049	0.021	0.093	0.152	0.168	0.173	EPA-CDROM	Municipal So	MSW Burn	1141.11		7.975			1
	0.153	0.039	0.002	0.001	0.086	0.042	0.044	0.007	0.001	Mathur et al	OAK2	Bay Outfall	354.25		6.067			1
	0.231	0.010	0.006	0.004	0.050	0.031	0.009	0.005	0.003	Mathur et al	Sunnyvale Ch	Bay Outfall	429.85		6.167			1
	0.214	0.059	0.004	0.001	0.036	0.027	0.032	0.005	0.000	Mathur et al	BEN9	Bay Outfall	505.41		6.330			1
	0.022	0.047	0.054	0.079	0.011	0.052	0.127	0.240	0.361	Lemieux00a	Open Burning	Trash burn	10130		10.788			1
	0.128	0.170	0.086	0.083	0.092	0.085	0.109	0.076	0.128	Gizze et al.	Urban MSW In	MSW Burn	4185		9.010			1
	0.231	0.106	0.074	0.028	0.049	0.066	0.067	0.068	0.067	Gizze et al.	Urban MSW In	MSW Burn	1038		7.325			1
	0.015	0.032	0.032	0.057	0.003	0.016	0.067	0.172	0.595	THOMA88	Wood oven ch	Wood burn	5173		10.457			1
	0.142	0.187	0.103	0.055	0.019	0.069	0.144	0.111	0.140	Gizze et al.	Urban MSW In	MSW Burn	10536		9.922			1
	0.030	0.060	0.081	0.116	0.021	0.070	0.126	0.194	0.284	Lemieux00a	Open Burning	Trash burn	10483		10.445			1
	0.055	0.118	0.075	0.043	0.010	0.046	0.077	0.195	0.352	THOMA88	Wood oven ch	Wood burn	7030		9.998			1
	0.172	0.030	0.001	0.000	0.069	0.045	0.056	0.037	0.008	Mathur et al	OAK1	Bay Outfall	916.22		7.060			1
	0.162	0.037	0.002	0.000	0.051	0.063	0.032	0.011	0.001	Mathur et al	CC Channel	Bay Outfall	985.7		7.065			1
	0.178	0.044	0.001	0.002	0.044	0.055	0.033	0.011	0.002	Mathur et al	CC Channel	Bay Outfall	1057.35		7.121			1
	0.238	0.060	0.003	0.000	0.030	0.028	0.035	0.008	0.000	Mathur et al	BEN10	Bay Outfall	1172.95		7.173			1
	0.187	0.039	0.001	0.001	0.046	0.024	0.028	0.013	0.001	Mathur et al	East Guadalu	Bay Outfall	1091		7.113			1
	0.009	0.041	0.042	0.086	0.003	0.024	0.105	0.352	0.332	THOMA88	Wood oven ch	Wood burn	36867.3		12.210			1
	0.072	0.100	0.063	0.026	0.029	0.128	0.153	0.185	0.180	EPA-CDROM	Municipal So	MSW Burn	5042.57		9.647			1
	0.166	0.141	0.065	0.037	0.047	0.093	0.116	0.101	0.106	EPA-CDROM	Municipal So	MSW Burn	4203.01		8.965			1
	0.169	0.044	0.006	0.002	0.047	0.056	0.041	0.051	0.018	Mathur et al	Guadalupe Ri	Bay Outfall	1530		7.574			1
	0.068	0.101	0.055	0.021	0.032	0.145	0.161	0.182	0.151	EPA-CDROM	Municipal So	MSW Burn	4363.17		9.496			1
	0.225	0.011	0.003	0.000	0.115	0.257	0.043	0.012	0.003	Yasuhara et	MSW Incinera	MSW Burn	1966.5		8.146			1
	0.022	0.035	0.032	0.032	0.017	0.077	0.174	0.251	0.352	Lemieux00a	Open Burning	Trash burn	18739		11.884			1
	0.151	0.055	0.006	0.000	0.042	0.067	0.071	0.046	0.015	Mathur et al	OAK8	Bay Outfall	1805.75		7.776			1
	0.189	0.053	0.014	0.003	0.084	0.281	0.087	0.050	0.018	Miyato et al	MSW Incinera	MSW Burn	2848.4		8.689			1
	0.160	0.032	0.001	0.001	0.052	0.060	0.033	0.016	0.005	Mathur et al	Rheem Creek	Bay Outfall	2084.85		7.824			1
	0.156	0.032	0.002	0.000	0.074	0.081	0.053	0.027	0.007	Mathur et al	OAK11	Bay Outfall	2136.6		7.946			1
	0.165	0.029	0.000	0.000	0.035	0.043	0.029	0.024	0.007	Mathur et al	Sunnyvale Ea	Bay Outfall	2196.7		7.843			1
	0.159	0.031	0.002	0.000	0.070	0.059	0.030	0.017	0.002	Mathur et al	Rheem Creek	Bay Outfall	2221.5		7.902			1
	0.271	0.001	0.001	0.017	0.031	0.173	0.003	0.014	0.034	Yasuhara et	MSW Incinera	MSW Burn	2780.5		8.225			1
	0.256	0.037	0.005	0.000	0.014	0.029	0.017	0.007	0.001	Mathur et al	BEN8	Bay Outfall	2796.75		8.008			1
	0.218	0.048	0.003	0.001	0.046	0.096	0.074	0.041	0.016	Mathur et al	OAK10	Bay Outfall	3029.2		8.335			1
	0.180	0.145	0.064	0.035	0.054	0.096	0.114	0.087	0.079	EPA-CDROM	Municipal So	MSW Burn	7667.05		9.507			1
	0.041	0.090	0.097	0.126	0.012	0.067	0.140	0.184	0.232	Lemieux00a	Open Burning	Trash burn	65273		12.092			1
	0.174	0.136	0.061	0.029	0.038	0.105	0.116	0.094	0.078	EPA-CDROM	Municipal So	MSW Burn	8797.86		9.647			1
	0.154	0.030	0.002	0.000	0.056	0.066	0.034	0.012	0.004	Mathur et al	Alameda	Bay Outfall	4395.15		8.577			1
	0.067	0.088	0.065	0.036	0.021	0.090	0.213	0.205	0.170	EPA-CDROM	Municipal So	MSW Burn	22757.40		11.232			1
	0.168	0.034	0.003	0.001	0.056	0.066	0.098	0.085	0.028	Mathur et al	OAK6	Bay Outfall	5942		9.095			1
	0.030	0.046	0.040	0.041	0.025	0.092	0.186	0.246	0.281	Lemieux00a	Open Burning	Trash burn	52427		12.634			1
	0.082	0.057	0.041	0.077	0.005	0.018	0.072	0.275	0.344	THOMA88	Wood oven ch	Wood burn	42560		11.906			1
	0.177	0.035	0.003	0.001	0.047	0.054	0.063	0.038	0.014	Mathur et al	OAK9	Bay Outfall	6637		9.044			1
	0.121	0.025	0.003	0.001	0.048	0.030	0.044	0.032	0.013	Mathur et al	OAK7	Bay Outfall	7561.7		9.114			1
	0.056	0.056	0.034	0.069	0.004	0.022	0.086	0.270	0.356	THOMA88	Wood oven ch	Wood burn	39090		11.918			1
	0.066	0.090	0.023	0.054	0.005	0.020	0.062	0.221	0.395	THOMA88	Wood oven ch	Wood burn	35160		11.683			1
	0.078	0.062	0.061	0.051	0.006	0.034	0.131	0.271	0.248	THOMA88	Wood oven ch	Wood burn	59586		12.163			1
	0.058	0.031	0.023	0.038	0.003	0.026	0.120	0.299	0.319	THOMA88	Wood oven ch	Wood burn	66540		12.564			1
	0.033	0.059	0.107	0.014	0.034	0.051	0.222	0.278	0.179	THOMA88	Wood oven ch	Wood burn	422347		14.400			1
PB-01	0.212	0.105	0.018	0.007	0.043	0.030	0.027	0.010	0.037			Padilla		5862.647	3.686	8.676	Padilla	13
PB-02	0.118	0.020	0.010	0.008	0.021	0.014	0.022	0.177	0.401			Padilla		4191.176	1.964	8.341	Padilla	13
PB-03	0.202	0.112	0.040	0.031	0.032	0.047	0.029	0.023	0.051			Padilla		18740.833	5.416	9.838	Padilla	13
PB-04	0.014	0.153	0.014	0.014	0.043	0.095	0.045	0.014	0.014			Padilla		355.796	1.249	5.874	Padilla	13
PB-05	0.214	0.088	0.017	0.014	0.040	0.054	0.020	0.022	0.039			Padilla		42716.053	4.396	10.662	Padilla	13
PB-06	0.156	0.132	0.011	0.013	0.058	0.037	0.020	0.013	0.011			Padilla		2018.045	1.491	7.610	Padilla	13
PB-07	0.134	0.126	0.006	0.004	0.043	0.051	0.028	0.012	0.010			Padilla		4032.262	2.829	8.302	Padilla	13
PB-08	0.226	0.078	0.015	0.018	0.041	0.048	0.018	0.017	0.023			Padilla		9359.787	3.784	9.144	Padilla	13
PB-09	0.218	0.081	0.008	0.007	0.055	0.063	0.027	0.019	0.007			Padilla		2729.680	1.920	7.912	Padilla	13
PB-10	0.472	0.027	0.001	0.003	0.011	0.008	0.003	0.003	0.011			Padilla		45279.043	6.054	10.721	Padilla	13
FB-01	0.212	0.099	0.014	0.008	0.034	0.051	0.024	0.023	0.034			Fidalgo		13389.143	3.847	9.502	Fidalgo	13
FB-02	0.176	0.038	0.002	0.002	0.066	0.035	0.011	0.038	0.062			Fidalgo		19064.839	4.079	9.856	Fidalgo	13
FB-03	0.697	0.043	0.003	0.004	0.011	0.015	0.005	0.006	0.025			Fidalgo		28950.417	4.934	10.273	Fidalgo	13
FB-04	0.523	0.070	0.014	0.024	0.019	0.010	0.012	0.009	0.026			Fidalgo		46176.923	5.704	10.740	Fidalgo	13
FB-05	0.253	0.089	0.010	0.009	0.026	0.040	0.020	0.015	0.036			Fidalgo		10621.548	4.491	9.271	Fidalgo	13
FB-06	0.199	0.101	0.014	0.015	0.039	0.044	0.022	0.010	0.028			Fidalgo		8183.396	3.770	9.010	Fidalgo	13
FB-07	0.531	0.043	0.008	0.013	0.022	0.026	0.011	0.005	0.025			Fidalgo		30225.275	5.617	10.316	Fidalgo	13
FB-08	0.558	0.042	0.008	0.008	0.017	0.010	0.007	0.004	0.018			Fidalgo		34139.189	5.532	10.438	Fidalgo	13
FB-09	0.494	0.065	0.015	0.024	0.022	0.024	0.014	0.007	0.023			Fidalgo		39480.488	5.780	10.584	Fidalgo	13
FB-10	0.276	0.080	0.018	0.020	0.039	0.040	0.011	0.009	0.018			Fidalgo		31121.481	6.041	10.346	Fidalgo	13
R_SAM_0	0.171	0.145	0.065	0.051	0.034	0.042	0.022	0.019	0.027			Samish		6541.445	5.148	8.786	Samish	13
R_SAM_1	0.168	0.144	0.065	0.031	0.035	0.046	0.021	0.021	0.032			Samish		12334.857	5.375	9.420	Samish	13
R_SAM_3	0.169	0.123	0.041	0.019	0.028	0.042	0.020	0.019	0.037			Samish		15511.290	5.259	9.649	Samish	13
R_SAM_4	0.177	0.139	0.056	0.041	0.032	0.046	0.025	0.017	0.040			Samish		18417.925	5.274	9.821	Samish	13
R_SAM_5	0.167	0.143	0.069	0.072	0.033	0.041	0.021	0.017	0.036			Samish		15809.756	5.558	9.668	Samish	13

- File: C:\Documents and Settings\mbutcher\My Documents\Project\Chevron\Whitmarsh Landfill\Dioxins\combined.syz

Number of Variables : 38
Number of Cases : 147

LOCATION$	GROUP$	TOC	FINES	TCDD	PECDD
HXCDD	HPCDD	OCDD	TCDF	PECDF	HXCDF
HPCDF	OCDF	TOTAL	TOC_NORM	FINES_NORM	TOTFURAN
TOTDIOXIN	POCDD	PHPCDD	PHXCDD	PPECDD	PTCDD
POCDF	PHPCDF	PHXCDF	PPECDF	PTCDF	REFERENCE$
DESCRIPTION$	TYPE$	TOTDIOXN	TOTAL_OC	LNTOTAL	LNTOTAL_OC
LOC$	OC_SYM				

- File: C:\Documents and Settings\mbutcher\My Documents\Project\Chevron\Whitmarsh Landfill\Dioxins\combined.syz

Number of Variables : 38
Number of Cases : 147

SYSTAT Rectangular file C:\Documents and Settings\mbutcher\My Documents\Project\Chevron\Whitmarsh Landfill\Dioxins\combined.syz,
Created data file Fri May 25 13:31:14 2012 containing variables:

LOCATION$	GROUP$	TOC	FINES	TCDD	PECDD
HXCDD	HPCDD	OCDD	TCDF	PECDF	HXCDF
HPCDF	OCDF	TOTAL	TOC_NORM	FINES_NORM	TOTFURAN
TOTDIOXIN	POCDD	PHPCDD	PHXCDD	PPECDD	PTCDD
POCDF	PHPCDF	PHXCDF	PPECDF	PTCDF	REFERENCE$
DESCRIPTION$	TYPE$	TOTDIOXN	TOTAL_OC	LNTOTAL	LNTOTAL_OC
LOC$	OC_SYM				

- Classical Discriminant Analysis

Between-Groups F-matrix
df: 9 115

	Bay Outfall	**Fidalgo**	**MSW Burn**	**Padilla**	**Samish**	**Trash burn**	**Wood burn**
Bay Outfall	0.000						
Fidalgo	13.740	0.000					
MSW Burn	91.817	32.247	0.000				
Padilla	6.834	4.333	26.363	0.000			
Samish	8.809	5.016	12.793	1.567	0.000		
Trash burn	94.308	52.340	29.534	46.472	27.676	0.000	
Wood burn	71.728	37.979	20.230	33.037	20.920	7.793	0.000

Variable		**F-to-Remove**	**Tolerance**	**Variable**		**F-to-Enter**	**Tolerance**
20	POCDD	17.806	0.392	29	PTCDF	0.000	0.000

	Variable	F-to-Remove	Tolerance		Variable	F-to-Enter	Tolerance
21	PHPCDD	10.628	0.463				
22	PHXCDD	20.545	0.619				
23	PPECDD	3.407	0.571				
24	PTCDD	2.890	0.751				
25	POCDF	7.388	0.673				
26	PHPCDF	11.324	0.654				
27	PHXCDF	5.899	0.508				
28	PPECDF	7.439	0.297				

Eigenvalues

12.670	2.368	1.054	0.475	0.376	0.041

Canonical Correlations

0.963	0.838	0.716	0.568	0.523	0.199

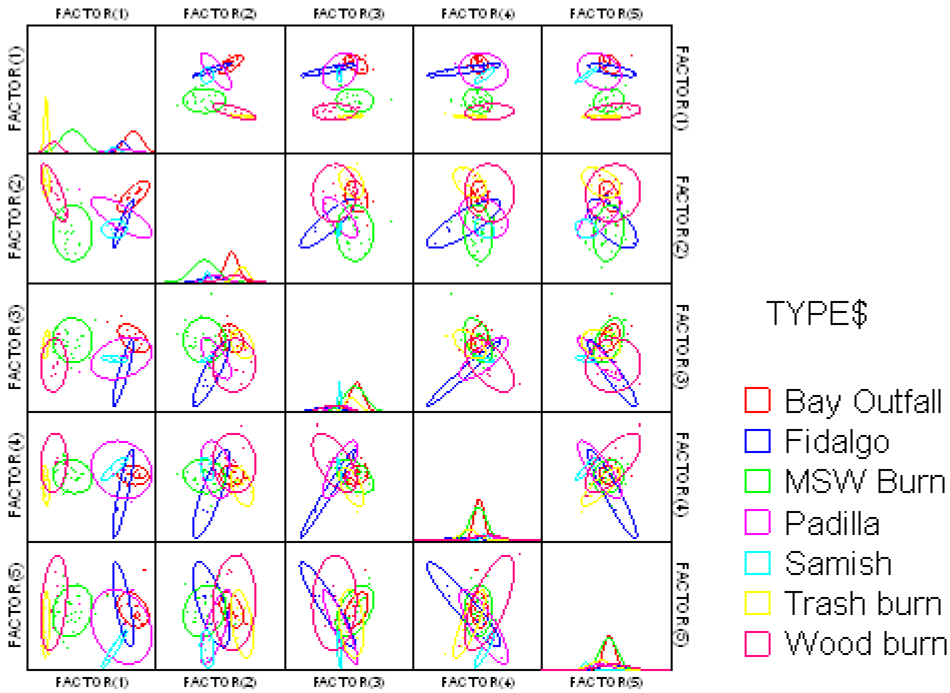
Cumulative Proportion of Total Dispersion

0.746	0.885	0.947	0.975	0.998	1.000

Canonical Scores of Group Means

	1	2	3	4	5	6
Bay Outfall	4.324	1.179	0.786	0.114	0.232	0.057
Fidalgo	3.246	-0.953	-2.221	-1.471	0.544	0.069
MSW Burn	-1.979	-1.635	0.600	0.018	0.159	-0.005
Padilla	3.112	-0.448	-0.918	0.585	-0.781	-0.551
Samish	2.354	-1.348	-0.993	0.672	-2.131	0.592
Trash burn	-4.729	2.256	0.286	-0.891	-0.617	-0.053
Wood burn	-3.921	1.454	-1.520	1.177	0.652	0.084

Canonical Scores Plot



Data, Predicted Group Indicator, and Canonical Discriminant Scores are Saved.
147 cases have been saved.

- File: C:\Documents and Settings\mbutcher\My Documents\Project\Chevron\Whitmarsh Landfill\Dioxins\combined_close.syz

Number of Variables : 38
Number of Cases : 74

SYSTAT Rectangular file C:\Documents and Settings\mbutcher\My Documents\Project\Chevron\Whitmarsh Landfill\Dioxins\combined_close.syz,
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HXCDD	HPCDD	OCDD	TCDF	PECDF	HXCDF
HPCDF	OCDF	TOTAL	TOC_NORM	FINES_NORM	TOTFURAN
TOTDIOXIN	POCDD	PHPCDD	PHXCDD	PPECDD	PTCDD
POCDF	PHPCDF	PHXCDF	PPECDF	PTCDF	REFERENCE$
DESCRIPTION$	TYPE$	TOTDIOXN	TOTAL_OC	LNTOTAL	LNTOTAL_OC
LOC$	OC_SYM				

- Classical Discriminant Analysis

Between-Groups F-matrix
df: 9 45

	Bay Outfall	Fidalgo	Padilla	Samish
Bay Outfall	0.000			
Fidalgo	21.229	0.000		
Padilla	20.371	2.094	0.000	
Samish	29.111	11.724	9.698	0.000

Variable		F-to-Remove	Tolerance	Variable		F-to-Enter	Tolerance
20	POCDD	1.735	0.033	29	PTCDF	0.000	0.000
21	PHPCDD	1.306	0.032				
22	PHXCDD	7.006	0.222				
23	PPECDD	10.546	0.217				
24	PTCDD	1.237	0.260				
25	POCDF	3.164	0.089				
26	PHPCDF	0.662	0.184				
27	PHXCDF	9.527	0.459				
28	PPECDF	0.987	0.046				

Eigenvalues

8.731	2.076	0.377

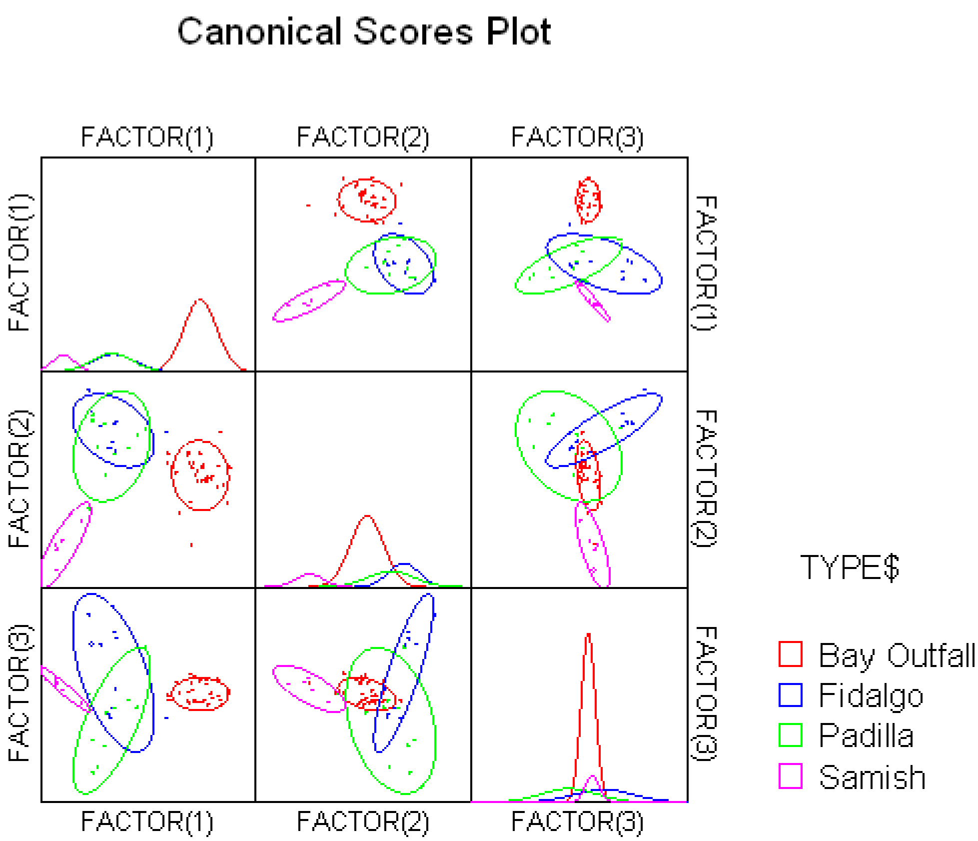
Canonical Correlations

0.947	0.822	0.523

Cumulative Proportion of Total Dispersion

0.781	0.966	1.000

Canonical Scores of Group Means			
	1	2	3
Bay Outfall	2.432	-0.317	0.016
Fidalgo	-2.508	1.770	0.898
Padilla	-2.598	1.042	-1.077
Samish	-5.350	-3.595	0.251



Predicted Group Indicator and Canonical Discriminant Scores are Saved.
74 cases have been saved.

EXPORT successfully completed.

APPENDIX C

Phase I and Phase II Field Investigation Methods

APPENDIX C
FIELD INVESTIGATION METHODS
March Point (Whitmarsh) Landfill
Skagit Count, Washington

1.0 PHASE I AND PHASE II RI ACTIVITIES

During the RI field work completed in October 2008 through July 2009 (Phase I) and April 2010 through August 2013 (Phase II), numerous field activities were conducted at the site, including a geologic reconnaissance, geophysical survey, monitoring well installation, a sediment investigation, water sampling (groundwater, seeps, surface water), test pit excavations, methane monitoring including installation of methane monitoring wells, a tidal study, and site surveying. All Phase I field work was performed in accordance with the Uplands Sampling and Analysis Plan (SAP) that was included as an appendix to the Draft RI/FS Work Plan (AMEC, 2008a) and in accordance with the Sediment Investigation Work Plan (AMEC, 2008b) (Sediment Work Plan). A separate SAP (Uplands Phase II RI Sampling & Analysis Plan, AMEC 2010) was completed and followed during the Phase II activities.

1.1 GEOLOGIC RECONNAISSANCE

On October 2 and 3, 2008, AMEC staff conducted geologic reconnaissance in the vicinity of the site to verify the geologic conditions presented in previous reports, as discussed in the RI/FS Work Plan (AMEC, 2008a). The geologic reconnaissance included:

- hiking and observing conditions in the wooded areas adjacent to the site where access was allowed;
- observation and assessment from South March Point Road and from along the perimeter of the property lines;
- observation and evaluation from a distance of the exposed hillside on the industrial property to the southwest of the site;
- observations while walking along the shoreline at the north and northwest margin of the site; and
- observation and assessment of the Highway 20 road cut south of the site.

As discussed in Sections 3.1 and 3.2 in the RI/FS Work Plan (AMEC, 2008a), the local geology was generally found to be dominated by (1) sand and gravel deposits laid down during the retreat of the latest glaciation in the region and (2) more recent landslide deposits. Much of the site itself is likely underlain by dense silt and clay consistent with Padilla Bay tidelands.

The exposed hillside southwest of the site appears to consist of alternating layers of glacial deposits, such as sands and gravel. Four different units are visible from the road below the current topsoil layer. It appears that these layers are two thinner, predominantly gravel units, and two thicker, predominantly sand units.

1.2 GEOPHYSICAL INVESTIGATION

A geophysical investigation was conducted on September 11 through 14, 2008, to attempt to characterize the landfill material and to locate any subsurface magnetic anomalies (e.g., buried drums) within the landfill. The investigation was conducted in accordance with Section 2.2 of the SAP.

Prior to the geophysical survey, the southern part of the site was cleared of any brush by a local brush-clearing contractor utilizing a track-mounted brush cutter. The brush-clearing contractor was unable to clear some areas with trees and very heavy blackberry brambles, and these areas were excluded from the geophysical survey. Only the southern two-thirds of the site was investigated, as the operating lumber mill and abundant surface metallic litter from mill activities (e.g., buildings, crane, metallic pipes and cables, export containers) present in the northern one-third of the site precluded the interpretation of any geophysical data collected in that area for the presence of subsurface magnetic anomalies.

The geophysical investigation included an electromagnetic (EM) survey utilizing the Geonics EM31 terrain conductivity meter and a magnetic (MAG) survey utilizing the Geometrics G858G magnetometer/gradiometer. The EM survey instrument recorded both quadrature-phase (apparent conductivity) and in-phase data at 0.2-second intervals, corresponding to a distance of approximately 1 foot. The MAG survey instrument was run in “continuous” sampling mode, recording the magnetic field at 0.2-second intervals (approximately 1 foot). Two magnetic sensors spaced 0.5 meter apart, one above the other, were used to obtain the vertical magnetic gradient. Both the MAG and EM surveys were conducted on 10-foot line spacing. A 10-foot line spacing is sufficient to detect drums, washers, water tanks, and other metallic objects of similar size.

1.3 MONITORING WELL INSTALLATION AND DEVELOPMENT

During the Phase I investigation, from October 7 to October 9, 2008, AMEC staff and Cascade Drilling installed three monitoring wells upgradient and cross-gradient from the site. The monitoring wells were installed in accordance with Section 2.5 of the Phase ISAP (AMEC, 2008a). The RI/FS Work Plan had proposed four monitoring wells to be installed, with three wells in the upper aquifer and one well in a lower aquifer. However, only an upper aquifer was encountered during drilling to a total depth of 70 feet below grade.

An additional seven monitoring wells and three piezometers were installed, also by Cascade Drilling, as part of the Phase II investigation. All these wells were located within the site boundary and were installed in accordance with Section 2.5 of the Phase II SAP. A series of ten 1-inch diameter landfill gas probes were installed by Cascade Drilling in September 2011 in accordance with the LFG Monitoring Work Plan.

1.3.1 Methodology

Information regarding the methods used in installing the monitoring wells is discussed in more details below.

1.3.1.1 Phase I Monitoring Well Installation

Well locations MW-01 through MW-04 were drilled from October 7 to October 9 at locations as shown on Figure 5. MW-01 and MW-02 were drilled in adjacent locations, southwest and upgradient from the site. MW-02 was drilled to a total depth of 20 feet below ground surface (bgs) and screened from 8 to 18 feet bgs. MW-03 was drilled next to the entrance to the lumber mill to a total depth of 20.5 feet bgs and screened from 5 to 15 feet bgs. MW-04 was drilled upgradient and southeast from the site along March Point Road to a total depth of 38.5 feet bgs and screened from 15 to 25 feet bgs. MW-02 and MW-04 were completed as flush-mount wells in the shoulder in the east-bound lane of March Point Road. MW-03 was completed as an aboveground well with three protective bollards to protect the well from forklift operations in the area.

Soil boring samples were collected from the borings at monitoring well locations MW-01, MW-03, and MW-04 during well installation. A well was not installed at MW-01 (drilled to a total depth of 70 feet) because a second deeper aquifer was not encountered; however, soil samples were collected and submitted for analysis. Samples were not submitted from MW-02 as it was co-located with MW-01. Samples were collected at depths of 11.5, 20.5, and 37 feet bgs at MW-01. One sample was collected at MW-03 at a depth of 11.5 feet bgs, and two samples were collected at MW-04 at depths of 8.5 and 19 feet bgs.

AMEC staff returned to the site on October 13, 2008, to develop the wells, assisted by Cascade Drilling. All wells were developed by submersible pumps as outlined in Section 2.5.3 in the Phase I SAP. The wells were continuously pumped until water quality parameters had stabilized and the pumped water had no visible turbidity. Results of field water quality parameter measurements are presented in Table 1. Copies of field notes are provided in Appendix C. Approximately 95 gallons of groundwater was removed from MW-02, 115 gallons from MW-03, and 165 gallons from MW-04. Purge water was disposed of in accordance with applicable regulations.

1.3.1.2 Phase II Monitoring Well and Piezometer Installation

Well locations MW-05 through MW-11 and PZ-01 through PZ-03 were drilled from March 29 to April 2, 2010 at locations shown on Figure 5. Wells MW-08 through MW-11 were drilled in the northwestern part of the near the current mill operations. MW-08 and MW-10 were both drilled to a total depth of 34 feet bgs and were both screened from 10-20 feet bgs. These two wells were drilled deeper than the maximum thickness of the refuse to assess the depth to and the thickness of the underlying native bay mud layer. MW-09 and MW-11 were drilled to a total depth of 18 feet bgs and were screened from 6.5 to 16.5 feet bgs and 5 to 15 feet bgs, respectively. All other wells installed (MW-05 through MW-07 and PZ-01 through PZ-03) were drilled in the central and southeastern part of the site away from the majority of the mill operations. MW-05 and MW-07 were drilled to a total depth of 33 feet bgs and 19.5 feet bgs, respectively. Both these wells were drilled through the underlying native bay mud unit and were screened in the native glacial sands below the native bay mud unit at 23 to 33 feet bgs and 13 to 18 feet bgs, respectively. MW-06 was drilled to a total depth of 19.5 feet bgs and screened from 4.5 to 9.5 feet bgs. Two of the piezometers (PZ-01 and PZ-03) were drilled to 13.5 feet bgs and 19.5 feet bgs and screened from 6 to 11 feet bgs and 3 to 8 feet bgs, respectively. The other piezometer, PZ-02 (drilled to 15 feet bgs and screened from 4 to 7 feet bgs), never had any water recharge into the well after drilling. All wells were completed as aboveground wells with three protective bollards.

Soil boring samples for analytical testing were collected from borings at monitoring well locations MW-08 and MW-10 during well installation at depths of 26 feet bgs and 24.5 feet bgs, respectively. Also, a Shelby tube was collected at 24 feet bgs at both these monitoring well locations for geotechnical testing. All these samples were collected from the native bay mud unit underlying the refuse material in this part of the site.

AMEC staff returned to the site on April 5, 2010, to develop the wells, assisted by Cascade Drilling. All wells were developed by submersible pumps as outlined in Section 2.5.3 in the Phase II SAP. The wells were continuously pumped until water quality parameters had stabilized.

The ten methane monitoring wells (or Landfill Gas Probes) were installed throughout the landfill in areas with wood waste and refuse. The probes were equipped with 5-feet of screen and ranged from 9 to 15 feet in depth and were installed above the water table.

1.3.2 Analyses

Where collected the monitoring well soil samples were submitted to Analytical Resources, Inc. (ARI) under chain-of-custody procedures for analysis of metals, TPH as gasoline (TPH-G) and diesel (TPH-D), VOCs, SVOCs PCBs, and organochlorine pesticides.

1.4 LANDFILL TEST PITTING INVESTIGATION

AMEC staff and an excavation subcontractor initially mobilized to the site on October 29, 2008, to prepare for Phase I test pit excavation within the landfill footprint. A total of 11 test pits (G1 through G11) were excavated from October 30 to November 2, 2008. The test pit locations were selected based on anomalies found during the geophysical investigation and are presented on Figure 5.

The goal of the Phase II test pit investigation was to delineate the extent of refuse at the site by excavating test pits along the site perimeter, to determine the nature and extent of landfill near the MW-03 well location, and to characterize the northern part of the landfill. Four test pits (G12 through G14, and G31) where excavated on October 29, 2009 along the site's northern boundary with the BNSF railroad. These test pits were excavated before the rest of the Phase II test pit investigation was started because of the allowable dates set forth in the PLP Group's access agreement with BNSF. The remaining 26 test pits were completed from March 29 through April 5, 2010.

At each perimeter test pit location except the northwestern most test pits (G30, G38, G39, and G40), if refuse was encountered, the excavation was continued laterally towards the edge of the site boundary until no more refuse was encountered. The test pit was backfilled with the materials excavated and the point where no more refuse was encountered was marked with a survey lath for subsequent surveying.

On March 27, 2013, a series of three test pits (G41, G42, and G43) were installed in the area of the landfill near areas where burned refuse was noted during earlier sampling in order to determine the dioxin/furan content of composited soil samples from above and below the refuse in accordance with the Additional Soil and Groundwater Sampling Work Plan which was approved by Ecology in March 2013.

1.4.1 Methodology

Information regarding the methods used during the test pit investigation is discussed in more details below.

1.4.1.1 Phase I Test Pit Investigation

Due to the unknown nature of the waste, a rigorous health and safety protocol was prepared and implemented during test pit excavation. These health and safety protocols are discussed in more detail in the Site-Specific Health and Safety Plan (Appendix C of the RI/FS Work Plan [AMEC, 2008a]).

Prior to excavation, an exclusion zone boundary was established, and the excavator was staged upwind from the proposed excavation location. Site personnel, except the excavator operator who was using supplied air, were kept outside the exclusion zone boundary until the exclusion zone had been properly cleared for dangerous environments by the AMEC site health and safety officer. Once the exclusion zone had been cleared, personnel entered the exclusion zone to characterize excavated soils, log the test pit excavation, collect samples, and take photographs. Some of the health and safety monitoring equipment used are listed below.

- Summa Canisters (monitoring VOCs): Summa canisters were deployed inside the cab of the excavator to monitor air breathed by the operator and in the downwind exclusion zone boundary to assess potential migration of VOCs outside of the exclusion zone.
- Mixed cellulose ester (MCE) filters (monitoring metal and asbestos): The MCE filters were attached to standard industrial hygiene sampling pumps and deployed inside the cab of the excavator to monitor air breathed by the operator breathing and in the downwind exclusion zone boundary to assess potential migration of metals and asbestos as fugitive dust outside the exclusion zone.
- Aerosol Monitor (monitoring fugitive dust): The aerosol monitor was continually deployed at the downwind exclusion zone boundary to assess the potential migration of fugitive dust outside the exclusion zone.
- Radiation Meter (monitoring alpha, beta, and gamma radiation): The radiation meter was used to screen excavated soil from each test pit location to assess the presence of radioactive materials and wastes.
- Four-gas meter (monitoring for hydrogen sulfide, carbon monoxide, oxygen, and lower-explosive limit): The four-gas meter, in conjunction with the photoionization meter, was used to clear the exclusion zone during excavation in order for AMEC personnel to be able to examine the excavated soils and to collect samples.
- Photoionization detector (PID) (real-time monitoring for VOCs): The PID was used with the four-gas meter as described above.

A preliminary review of the health and safety monitoring data indicate that no site workers were exposed to hazardous environments during the test pit excavation investigation. The monitoring information will be used going forward to ensure site worker safety if additional site earthwork is deemed necessary.

Per the RI/FS Work Plan, the goal of the soil sampling portion of the test pit investigation was to collect 5 to 10 samples from the soil cap, fill, and native layers in areas identified as anomalies during the geophysical investigation of the southern portion of the landfill where refuse was not reportedly burned. (The northern portion of the landfill will be investigated during the Phase II RI.) Following the criteria described in the RI/FS Work Plan, a total of four samples were collected from the soil cap, eight samples were collected from the fill, and two samples were collected from the native soil layer from test pits G1, G3, G4, G5, G6, G10, and G11.

Samples of the soil cover were collected from test pits G1, G3, G4, and G5 to provide spatial coverage. All samples were collected from a depth of 1 foot bgs.

Eight samples of soil fill material were collected from test pits G1, G3, G4, G5, G6, and G10. Samples were collected from G1, G3, G4, G6, and G10 at depths of 5.5 feet, 8 feet, 5 feet, 6 feet, and 8 feet bgs, respectively. Samples of the fill material were collected from depths of 5 and 9 feet bgs from test pit GP-5. Samples were collected from test pits G1, G3, G4, and G5 to provide spatial coverage of the southern landfill area. Further, a soil sample was collected at test pit G6 due to odor observed during excavation, and a sample was collected at test pit G10 in soil in contact with unearthed, partially crushed drums. A field duplicate sample was also collected from test pit G6 at 6 feet bgs.

According to the RI/FS Work Plan, native soil samples were to be collected from test pits to provide spatial coverage of the southern portion of the landfill in areas where the native soils were not saturated with groundwater or in which the presence of asbestos-containing material (ACM) in the fill did not cause the test pit to be abandoned. Groundwater was encountered before reaching the native layer in test pits G2, G5, G6, G8, G9, and G10, and ACM was encountered in test pit G1. Consequently, native soil samples were not encountered in these test pits and samples were not collected. In addition, a concrete pad and large cobbles were encountered at a depth of 6 feet bgs in test pit G4, which precluded the collection of a native soil sample at this location.

Native soil was encountered in test pits G3, G7, and G11. In test pit G3, a sand layer was encountered at a depth of 9 feet bgs that extended to a depth of approximately 12 feet bgs. Native clay was encountered beneath the sand at a depth of 12 feet bgs and a sample of the native clay was collected. Native clay was encountered at a depth of approximately 11 feet in test pit G11, where a sample was also collected. In addition, native clay was also encountered at a depth of approximately 8 feet bgs in test pit G7; however, it was decided in the field not to collect a sample of native soil from this test pit due to its proximity to test pits G3 and G11. Consequently, samples of the native soil were collected only from test pits G3 and G11 at depths of 12 feet and 11 feet bgs, respectively.

The samples were collected in accordance with methods outlined in Section 2.4.3 of the Phase I SAP. Samples were recorded on a chain-of-custody form and kept on ice until delivered to the analytical laboratory.

After the proposed depth had been reached, or if groundwater entered the excavation and obscured visibility, all waste was backfilled into the excavation and the test pit was abandoned. Before leaving each location, the test pit location was staked with a survey marker for subsequent surveying.

1.4.1.2 Phase II Test Pit Investigation

AMEC analyzed the data collected during the Phase I test pit investigation and made the appropriate changes to the HASP prior to starting Phase II of the test pit investigation.

A total of twenty-six test pits were dug from March 29, 2010 through April 5, 2010. Test pits were excavated to characterize the presence and depth of the bark debris, the depth of the underlying bay mud, and the possible presence of landfill debris or refuse. Test pits were divided into three types: perimeter test pits, test pits near MW-3 to determine the nature and extent of landfill near this well location, and other northern landfill characterization test pits. The majority of the test pits were perimeter test pits and were excavated to determine the extent of the refuse within the landfill. Based on the refuse encountered in the test pits (G29 and G30) excavated in the northwestern corner (near MW-3) an additional four test pits (G37 through G40) were excavated further to the northwest to fully delineate the extent of refuse.

Two soil samples (at 12 feet bgs in location G32 and at 15 ft bgs at location G35) were collected to evaluate the refuse around the saw mill and to determine contamination present at the northern portion of the landfill. In addition, three soil samples (9 ft bgs at G29, 7 ft bgs at G30, and 10 ft bgs at G37) were collected near MW-3. One drum containing slurry like material was encountered at G30 and a sample of the slurry-like material (G30-D collected at 6 ft bgs) was subsequently collected for analytical testing. Seven soil samples were collected from select perimeter test pits (G15, G16 (two samples), G17.5, G18, G20, and G24) for geotechnical analysis.

In G41, G42, and G43 soil samples from immediately above and below the refuse in each test pit were collected from the excavation bucket from 3 sides of the test pit and thoroughly homogenized to form a single composite soil sample to be analyzed for dioxins and furans in accordance with the Additional Soil and Groundwater Work Plan.

The samples were collected in accordance with methods outlined in Section 2.2.3 of the Phase II SAP. Samples were recorded on a chain-of-custody form and kept on ice until delivered to the analytical laboratory.

After the maximum depth had been reached (limited by excavator reach), or if groundwater entered the excavation and obscured visibility, all waste was backfilled into the excavation and the test pit was abandoned. Before leaving each location, the test pit location was staked with a survey marker for subsequent surveying.

1.4.2 Analyses

Samples were sent to ARI and analyzed for the following constituents: metals, TPH, SVOCs, VOCs, PCBs, organochlorine pesticides, or dioxins and furans as appropriate. Geotechnical analysis was also conducted on select samples.

1.5 GROUNDWATER/SEEP INVESTIGATIONS

Groundwater and seep water samples were collected at nine events during the Phase I and Phase II field investigations in 2008, 2009, 2010, and 2013. The first two sampling events were intended to provide a baseline assessment of chemical concentrations in groundwater and seep water during both dry season and wet season regimes. The third sampling event was intended to provide additional quarterly data to assess site conditions during the transition from the wet season to the dry season. The fourth sampling event was intended to collect additional dry season data. The fifth, sixth, and seventh sampling events were intended to collected a baseline groundwater data set for the monitoring wells installed during the Phase II investigation as well as continued monitoring of the monitoring wells installed during the Phase I investigation.

The first round of groundwater, seep, and surface water samples was collected from October 14 to 15, 2008, and the second round of samples was collected from December 17 to 19, 2008. The October samples were collected during dry conditions before the fall and winter rains, and the December samples were collected during the winter rainy period during wet conditions. The third round of sampling was conducted on April 28 and 29, 2009. The fourth round of sampling was conducted on July 23 and 24, 2009. A total of three monitoring well locations (MW-02, MW-03, and MW-04) and three seep locations (SP-1, SP-2, and SP-3) were sampled during each of the four sampling events. The seep sample locations were selected based on field observations on October 14, 2008, during a site walk with Skagit County. All three seep locations are located along the western-most boundary of the site between the inner lagoon and the landfill. No seeps were observed further south or to the east along the inner lagoon/landfill boundary. Sample locations are shown on Figure 5.

Following the installation of the Phase II monitoring wells (MW-05 through MW-11) three additional quarters of groundwater monitoring for the entire network (Phase I wells, Phase II wells, and the seeps) was completed in April, July, and October 2010. During the March 2013 sampling event groundwater samples were collected from MW-8 and MW-9 and analyzed for the presence of dioxins and furans; additional groundwater samples from these two wells and MW-5, MW-6, and MW-7 were submitted for total and dissolved metals analysis. During the last groundwater sampling event, conducted in August 2013, an additional five groundwater samples from these same wells were submitted for total and dissolved metals analyses only. .

1.5.1 Methodology

The same sampling methodology was used for all groundwater monitoring during the RI investigation. All monitoring wells were purged and analytical samples collected via low-flow sampling techniques utilizing a peristaltic pump and dedicated, polyethylene disposable tubing in accordance with methods outlined in Section 2.6 of the Phase I and Phase II SAP. Water quality parameters were monitored using a properly calibrated Horiba U-22 water quality monitoring instrument, utilizing a flow-through cell, until water quality parameters had stabilized (per the SAPs) indicating that formation water was being extracted from the well and a sample could be collected. In addition, a field duplicate from MW-03 (in 2008 and 2009) and MW-11 (in 2010) and an equipment blank were collected for quality control purposes during each of the sampling events

Samples were collected in precleaned, laboratory-supplied bottles and placed on ice immediately after collection. The samples were labeled following procedures outlined in the project-specific Quality Assurance Project Plan (QAPP) (Appendix B to the RI/FS Work Plan [AMEC, 2008a] and recorded on chain-of-custody logs pending delivery to the analytical laboratory.

Seep samples were collected in accordance with methods outlined in Section 2.7 of the Phase I SAP and Section 2.8 of the Phase II SAP, unless noted differently below. During the October 2008 sampling event, samples collected at SP-01 and SP-03 were collected by gently submerging a polyethylene tube into the seep. Water was collected using a peristaltic pump due to low flow volumes from the seep. The sample collected at SP-02 was obtained by gently submerging precleaned, laboratory-supplied bottles into the seep water.

During the December 2008 sampling event, samples at SP-02 and SP-03 were collected by peristaltic pump due to low flow volumes from the seeps. The sample at SP-01 was collected by gently submerging precleaned, laboratory-supplied bottles into the seep water. During the April and July 2009 sampling events, all three seep samples were collected by peristaltic pump due to low flow volumes from the seeps. Samples were collected via peristaltic pump for all three seeps during the April, July, and October 2010 sampling events.

Prior to seep sampling, water quality parameters were recorded, and a qualitative description of turbidity was noted on the field sheets per the procedures in the SAPs. Samples were recorded on a chain-of-custody form and kept on ice until delivered to the analytical laboratory under standard chain-of-custody procedures.

1.5.2 Analyses

Samples were analyzed by ARI in Tukwila, Washington, in accordance with Table 1 in the SAPs except for the analysis of diethyl ether, which was subcontracted to Columbia Analytical Services in

Kelso, Washington. Samples were analyzed for metals (total and dissolved), TPH, SVOCs, PAHs, VOCs, organochlorine (OC) pesticides, and PCBs. Dioxins and furans were only collected from MW-8 and MW-9 in March 2013.

1.6 SURFACE WATER INVESTIGATIONS

Surface water samples were collected concurrently with groundwater and seep samples during the seven sampling events in 2008, 2009, and 2010.

A total of five surface water locations (SW-01, SW-03, SW-04, SW-05, and SW-06) were sampled during all seven sampling events. An additional surface water location, SW-07, was sampled during the December 2008 and April 2009 events. The location for SW-01 was chosen because it represents stormwater upgradient of the landfill. The locations for SW-02 through SW-04 were chosen because they represent storm water that collects on the southern boundary of the site. The location for SW-05 was chosen because this area collects surface water flowing from the southeast toward the inner lagoon. The location for SW-06 was chosen to represent surface water within the inner lagoon. The location for SW-07 was chosen to represent surface water along the northern boundary of the landfill along the BNSF right-of-way. No surface water was flowing at location SW-07 during the dry season sampling events in October 2008 and July 2009 as well as the three 2010 sampling events; consequently, samples were not collected at SW-07 during these sampling events. Sample locations are shown on Figure 5.

1.6.1 Methodology

All samples were collected by gently submerging precleaned, laboratory-supplied sample bottles into surface water at each sampling location, except for the sample collected at SW-07 during the December 2008 and April 2009 sampling events. Those samples were collected by peristaltic pump due to low flow conditions.

After sampling during the October 2008 event, each surface water sampling location was staked using a survey marker for subsequent surveying. Samples collected during the subsequent sampling events were collected at previously staked locations (all stakes were still present). The new location (SW-07) was not staked in December due to deep snow. Instead, the distance of SW-07 from SP-01 along a specified bearing was measured so that the location could be located at a later time if additional sampling is warranted.

1.6.2 Analyses

Samples were analyzed in accordance with Table 1 in the SAPs by ARI except for the analysis of diethyl ether, which was subcontracted to Columbia Analytical Services in Kelso, Washington. All samples, except as noted in Table 1 of the Phase II SAP, were analyzed for metals (total and dissolved), SVOCs, PAHs, VOCs, OC pesticides, and PCBs.

1.7 METHANE MONITORING

Methane was monitored in the headspace of groundwater monitoring wells as part of the Phase II RI field work. Ecology expressed concern about LFG being generated in the older refuse and wood waste which may cause potential risk to the then-ongoing landfill operations. Measurements of methane as a percentage of the lower explosive limit, hydrogen sulfide, carbon monoxide, and oxygen were collected three times a week for four consecutive weeks from the headspace of monitoring wells, as well as locations within the site buildings. Locations monitored within the buildings included utility penetrations, cracks, floor drains and vaults. Field measurements were made with a PhD Ultra Multi Gas Detector. The building name, the general location of the measurement, time, weather conditions, and meter readings for explosive vapors, oxygen, carbon monoxide, and hydrogen sulfide were recorded in the field notebook. The meter was calibrated before readings were collected and the calibration was recorded in the field notebook.

After the four weeks of monitoring was completed, Ecology requested that additional methane monitoring be performed. AMEC installed a series of 1-inch diameter monitoring landfill gas (LFG) probes around the landfill using hollow-stem auger drilling methods. All of the LFGPs have five-foot long slotted screens and ranged in depth from 9- to 15-feet in depth. LFG readings were collected from the ten LFGPs and two monitoring wells (MW-8 and MW-10) and a piezometer (PZ-01) using a LandTec GEM-2000 LFG meter was connected to the probes or wells using a slip cap with a barb-fitting and flexible tubing. Methane, carbon dioxide, and balance (nitrogen) gas concentrations were monitored as the headspace of the probe or well was evacuated by the GEM-2000. Once the reading indicated that the headspace had been purged, and gas concentrations stabilized, a needle equipped 50-milliliter volume syringe was used to extract a gas sample from a septum-sealed chamber. The syringe was then emptied into an evacuated 40 milliliter glass vial (known as a "Microseeps" vial). Samples of the LFG were collected from selected wells and submitted to Microseeps Analytical, and analyzed for methane, oxygen, carbon dioxide, and volatile organic compounds using proprietary analytical methods. Monitoring of the LFGPs, monitoring wells and the piezometer was done three times—in October 2011, January 2012, and April 2012. Microseep samples were only collected during the first two monitoring events.

APPENDIX D

Geophysical Report

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October 3, 2008
NGA Ref: 683

Mr. David Haddock
CC: Mr. Niklas Bacher
Mr. John Luttinger
Mr. Koorus Tahghighi
AMEC Geomatrix
600 University Street, Suite 1020
Seattle, WA 98101

Re: ***Geophysical Site Investigation***
Whitmarsh Landfill
Anacortes, Washington

Dear Mr. Haddock:

This letter presents the results of the geophysical site investigation that Northwest Geophysical Associates, Inc. (NGA) performed at the Whitmarsh Landfill, Anacortes, Washington (see Figure 1 – Site Location Map). The field work was performed September 11-14, 2008. The purpose of the investigation was to characterize the fill material with the primary objective of identifying anomalies that could be consistent with concentrations of steel drums within the landfill footprint. An interpreted anomaly map is presented in this report as Figure 2.

Scope of Services

NGA conducted a geophysical site investigation, as described below, primarily on the central and southern section of the Whitmarsh Landfill site, measuring approximately 10 acres (Figure 1). The northern portion of the site is currently an active cedar mill and timber storage yard while the southern portion of the site is unoccupied. Northern portions of the site that included substantial surface metallic objects and/or litter (buildings, crane, metallic pipes and cables, export containers) were excluded from the geophysical investigation in consultation with AMEC Geomatrix, Inc. (AMEC) geophysicist, John Luttinger.

Field Methodology

The geophysical investigation included an electromagnetic (EM) survey utilizing the Geonics EM31 terrain conductivity meter and a magnetic (MAG) survey utilizing a Geometrics G858G magnetometer/gradiometer. Basic principles of these techniques are described in Attachment B, *Geophysical Detection of Buried Objects*.

Geophysical Investigation, Mill Operations, and Brush Clearance

Geophysical survey activities were coordinated with mill operations and brush clearance activities throughout the duration of the four survey days. NGA collected geophysical data over the mill and timber storage yard portions of the site during the first few days of the investigation which enabled mill equipment operators to move material stock piles (e.g. log stacks, bark material piles) during the last several days of the investigation. Movement of the material piles allowed NGA to complete the investigation of the site by collecting data in the areas previously covered by the material stock piles.

Also during the first day of the geophysical investigation, the southern third of the site was cleared of brush (e.g. blackberry brambles) which would have prevented the collection of geophysical data. Brush clearance was performed by track mounted, bladed heavy equipment operated by an AMEC subcontractor. NGA collected geophysical data in this area. Some areas with trees and blackberry brambles were left uncleared by the AMEC subcontractor; these were excluded from the geophysical survey.

Magnetic Data Acquisition

The MAG survey was conducted using a Geometrics G858G cesium magnetometer/gradiometer. This instrument was run in the “continuous” sampling mode, recording the magnetic field at 0.2 second intervals (approximately 1 foot). Two magnetic sensors spaced 0.5 meters apart, one above the other, were used to obtain the vertical magnetic gradient. Line spacing for the MAG survey was 10 feet. Magnetic survey lines are shown on Figures 3-5.

Electromagnetic Data Acquisition

EM data were acquired using a Geonics EM-31 terrain conductivity meter. Both quadrature-phase (apparent conductivity) and in-phase data were recorded. Data were recorded at a 0.2 second interval, corresponding to a distance of approximately 1 foot. Data were recorded on an Allegro handheld ruggedized field computer (Windows CE/DOS) running NAV31 software from Geomar of Mississauga, Ontario. EM data points are shown on Figures 6 and 7.

Survey Positioning

Both MAG and EM readings were positioned using individual Trimble AG132 GPS systems. The AG 132 GPS system is a real time differential GPS system using the

Omnistar satellite subscription service for the differential correction. The GPS system has "sub-meter" accuracy; hence positions are generally good to ±1-2 feet, but may be off by 2-3 feet. Positioning data are reported in the UTM zone 10N projection using the WGS 84 datum with units of US survey feet.

Survey Control

Several survey control reference points were located using a Trimble ProXRS DGPS (sub-meter accuracy) system. These Geophysical Survey Reference Points (Table 1 below) were marked in the field with survey lath, and are noted on Figures 1-7.

Table 1 – Geophysical Survey Reference Points
(UTM zone 10N, WGS84, US Survey foot)

Easting	Northing	Geophysical Survey Point
1754372.58	17611200.98	GSP-A
1754215.73	17611108.50	GSP-B
1754825.63	17610762.47	GSP-C
1754882.84	17610607.38	GSP-D
1754927.41	17610460.49	GSP-E
1754718.67	17610638.82	GSP-F
1754525.14	17611089.43	GSP-G
1754304.33	17610943.66	GSP-H

Data Processing

Magnetic (MAG) and electromagnetic (EM) data were gridded and contoured using the Geosoft Oasis Montaj Data Processing and Analysis software system.

Magnetic Field Data

Magnetic data are displayed on three figures, one plot of the analytic signal (Figure 3), the total magnetic signal (Figure 4), and the magnetic vertical gradient (Figure 5). The analytic signal is our preferred presentation as it provides a simplified signature and better resolution of the anomalous areas than unprocessed field data. A high in the analytic signal occurs directly over the magnetic "source." The analytic signal is described below.

The total magnetic field plot shows the data from the top sensor of the G858, which was also used to calculate the analytic signal. The vertical gradient is obtained by taking the difference in the magnetic field as measured by two sensors spaced 0.5 meters apart, one above the other. Anomalies will have both high and low values associated with them.

Analytic Signal

The analytic signal is derived from the total magnetic field data. It is presented here as a more concise display of that data set. On the color contour plot (Figure 3) values of the analytic signal below a threshold value are not colored (i.e., are white) and represent areas where little or no metallic material may be present. Higher amplitude anomalies generally indicate "stronger" source objects. A "stronger" source object may be more magnetic (generally a larger mass of steel), or it may be closer to the surface, or both. The amplitudes of the anomalies also depend upon the orientation of the source objects in the earth's magnetic field. This is especially true for elongate bodies such as pipes and cables.

The analytic signal is defined as the amplitude of the gradient vector of the total magnetic field data. The gradient (rate of change) of the total magnetic field is a vector field. The analytic signal is the magnitude of that vector, or the rate of change in the direction of maximum rate of change. The color contour plot shows the amplitude of the gradient.

Mathematically, the analytic signal can be expressed as:

$$A = \left[\left[\frac{\partial M}{\partial x} \right]^2 + \left[\frac{\partial M}{\partial y} \right]^2 + \left[\frac{\partial M}{\partial z} \right]^2 \right]^{\frac{1}{2}}$$

where:

A	is the analytic signal,
M	is the observed total magnetic field, and
∂	is the partial derivative operator.

Derivatives are calculated in the frequency domain, from the gridded total field data.

Further discussion of the concept of the analytic signal can be found in the following publication:

Roest, W.R., Verhoef, J., and Pilkington, M., 1992, "Magnetic interpretation using the 3-D analytic signal:" Geophysics, vol.57(1); p.116-125.

Electromagnetic Data

Both quadrature phase (conductivity) and in-phase EM data were recorded in the field. Appendix B includes a discussion of these two measured parameters of the EM response. Plots of both data sets are presented on Figures 6 and 7.

Generally, the ground conductivity was moderate, 40-50 millisiemen/meter (mS/m). Hence, any deviation, positive or negative, from that background likely indicates the presence of a metallic conductor or anomalous ground. Likewise the background in-phase response is +5.0 to +6.0 and any deviation, positive or negative, from that background likely indicates the presence of a metallic conductor.

RESULTS AND INTERPRETATION

Electromagnetic and magnetic data plots are presented on Figures 3-7. The interpretation of those data, in terms of possible locations of buried objects is summarized in Figure 2 and discussed below.

Electromagnetic Interpretation - Apparent Conductivity Trend

Electromagnetic data plots are presented on Figures 6 and 7. Three noticeable zones of apparent conductivity are present across the site, divided by two fairly abrupt transition zones. It is likely that these trends can be attributed to past activities at the site (e.g. landfill activities); however, it is just as likely that these trends are the result of more recent activities at the site (e.g. mill activities). Higher apparent conductivity values appearing in the southwest corner of the site may be related to the presence of a drainage ditch (and its contents) adjacent to the western edge of the survey area. Several EM anomalies likely indicative of metallic bodies appear throughout Conductivity Zone B.

Conductivity Zone A:
Figure 6 shows gridded quadrature phase (apparent conductivity) EM data. The northern portion of the site exhibits higher apparent conductivity values, averaging 50 mS/m. This area has been labeled Conductivity Zone A on Figures 2 and 6.

Conductivity Zone B:
An apparent conductivity transition appears in the southern third of the surveyed area where apparent conductivities are lower, averaging 25 mS/m. Both conductivity and in-phase readings are somewhat chaotic through this area, showing considerable small scale variations. This signature is indicative of concentrations of buried debris or landfill deposits. The area of lower apparent conductivity values is labeled as Conductivity Zone B on Figures 2 and 6.

Conductivity Zone C:
Another transition occurs in the southeast corner of the surveyed area, leaving an area of high conductivities, 90 mS/m and higher. The area of high apparent conductivity values is labeled as Conductivity Zone C on Figures 2 and 6.

Magnetic Anomalies

Magnetic Anomalies appear throughout the site, and are concentrated largely in the southern third of the surveyed area. Magnetic data plots are presented on figures 3-5. It is NGA's preference to select anomalies of interest from the analytic signal data, and magnetic anomalies discussed below have been selected from the analytic signal data with consideration being given to the total field and vertical magnetic gradient data.

Small (single source) Magnetic Anomalies:
Individual magnetic anomalies likely indicative of smaller single source bodies appear in abundance throughout the southern end of the site and are likely attributable to near surface landfill materials (e.g. appliances).

Large Magnetic Anomalies:
Several larger magnetic anomalies, displaying magnetic signature across two or more survey transect lines, also appear in this southern section of the site. These are likely attributable to concentrations of landfill materials/metallic items in the near subsurface.

Linear MAG/EM Anomaly:
A long linear anomaly appears in the magnetic analytic signal between GSP-H and the western property survey marker. This anomaly also appears in the conductivity data, and may indicate the presence of a deeper steel pipe, and/or perhaps a reinforced concrete pipe. The anomaly is not consistent with MAG or EM data signatures exhibited by buried drums; such anomalies exhibit much stronger and more chaotic MAG and EM readings than those observed from this linear pipe-like anomaly.

Anomalies of Interest

NGA selected eleven Anomalies of Interest from the MAG and EM geophysical data. The anomalies are listed in Table 2 and discussed below.

Table 2 – Anomalies of Interest Locations
(UTM zone 10N, WGS84, US Survey foot)

TargetID	Easting X	Northing Y	Type
G1	1754679.3	17610635.4	MAG
G2	1754774.4	17610551.6	MAG
G3	1754906.4	17610810.4	MAG
G4	1754869.6	17610593.8	MAG
G5	1754754.7	17610895.9	MAG
G6	1754582.2	17610924.6	MAG
G7	1754924.2	17610532.9	MAG
G8	1754696.4	17610909.1	MAG
G9	1754576.9	17610997.9	EM
G10	1754288.8	17611033.2	EM
G11	1754842.7	17610724.9	EM

Targets G1-G8 were selected from MAG data (primarily from analytic signal data), and are targets which exhibited a magnetic signature across two or more transect survey lines. Anomalies exhibiting signatures across two or more transect survey lines are more likely to be concentrations of metallic debris in the subsurface than single source items. Anomalies G9-G11 were selected from EM data (primarily from the in-phase data), and are anomalies which exhibited EM signatures across two or more data transects, and were consistent with anomalies exhibited by metallic conductive bodies.

Closure

Northwest Geophysical Associates, Inc. performed this work in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No warranty, express or implied, beyond exercise of reasonable care and professional diligence, is made. This report is intended for use only in accordance with the purposes of the study described within.

Please feel free to contact us if you have any questions or comments regarding this information, or if you require further assistance. We appreciated the opportunity to work with you on this project.

Sincerely,

Northwest Geophysical Associates, Inc.

Neil McKay
Project Geophysicist

Attachments: Figures 1-7
Attachment B: Geophysical Detection of Buried Objects

File: Whitmarsh LF_rpt03.doc
NGA Project: 683

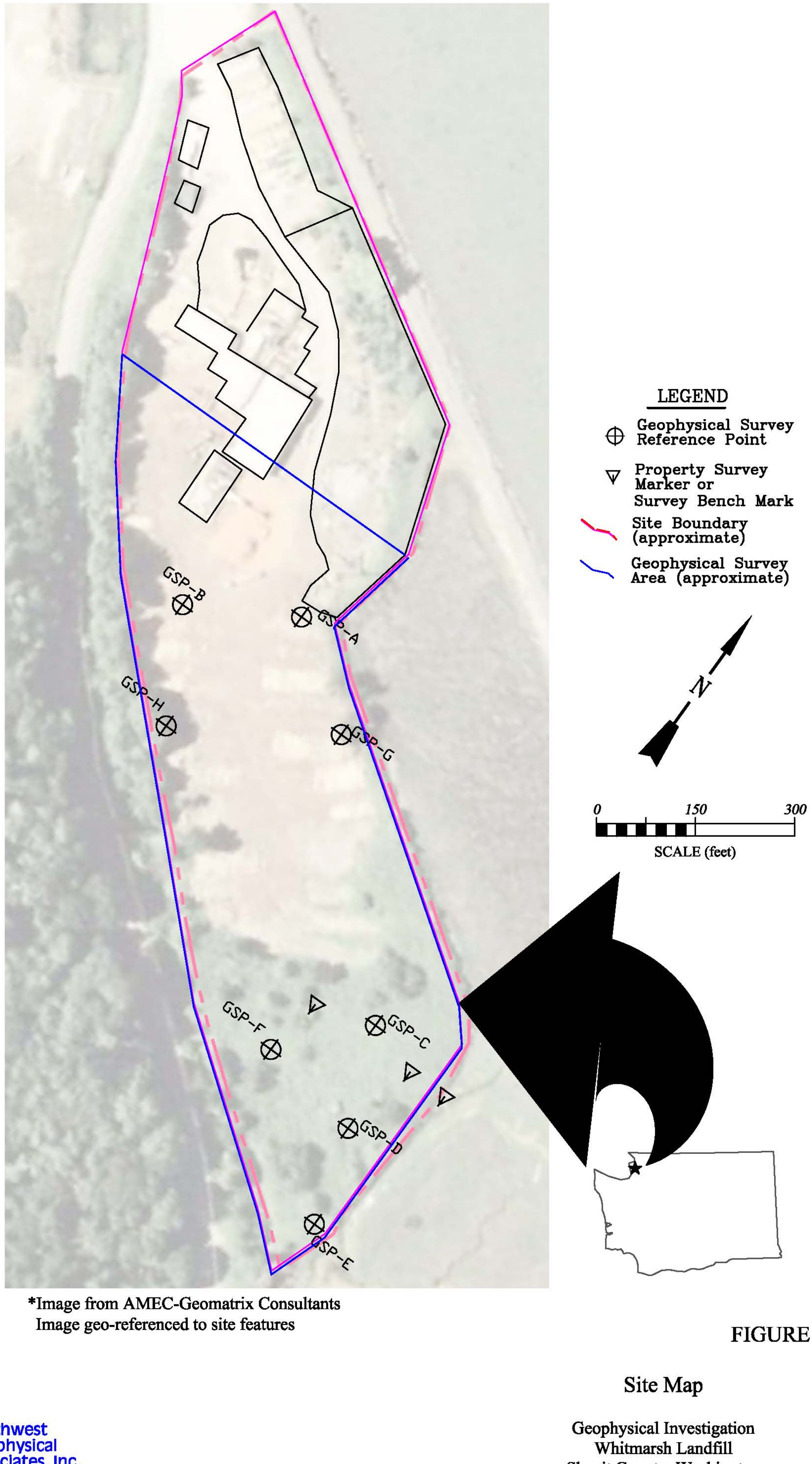


*Image from AMEC-Geomatrix Consultants
Image geo-referenced to site features

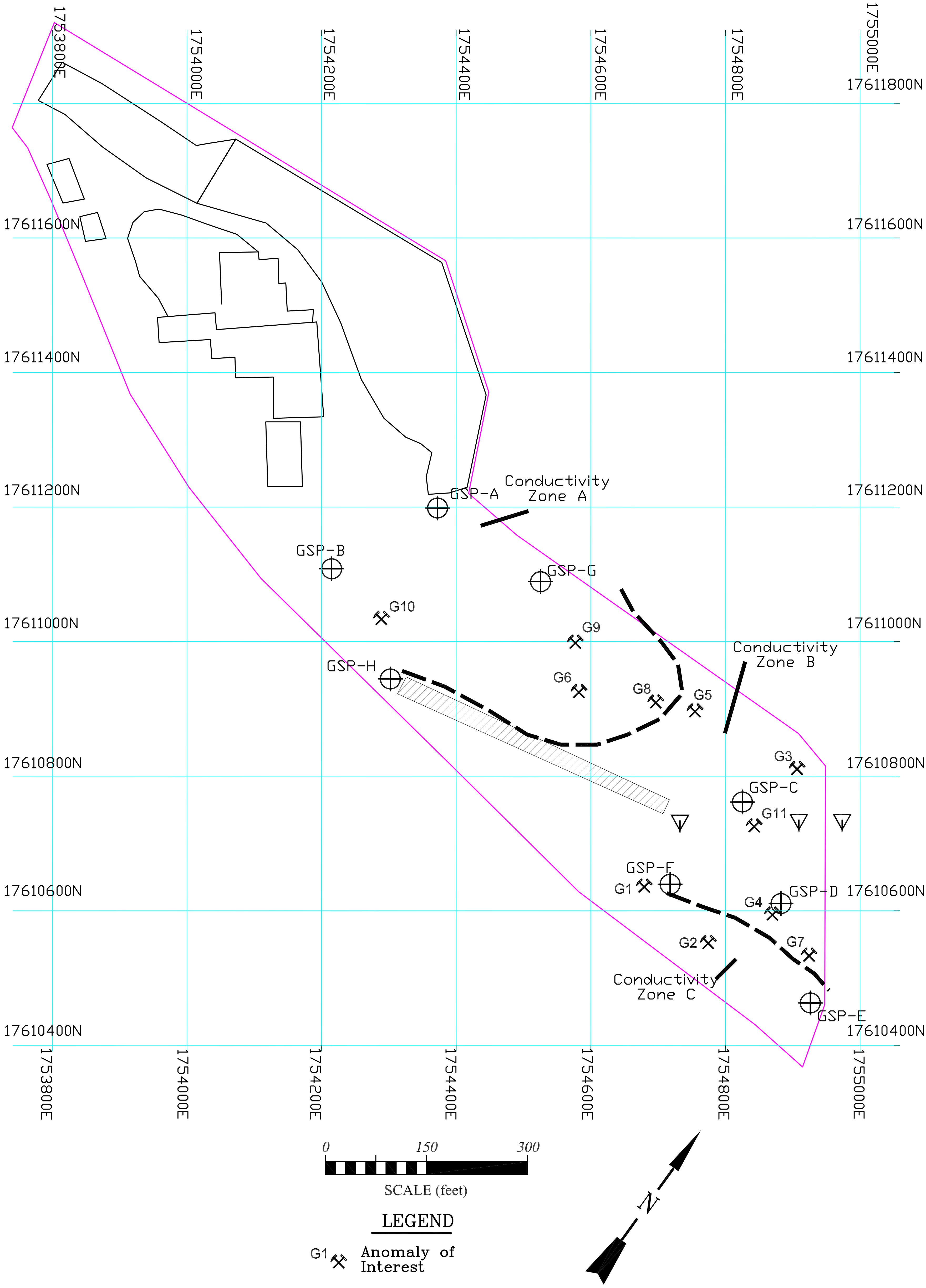
FIGURE 1

Site Map

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

Prepared by:

Northwest Geophysical Associates, Inc.
P.O. Box 1063, Corvallis, Oregon 97339



LEGEND

G1 ⚒ Anomaly of Interest

⊕ Geophysical Survey Reference Point

▽ Property Survey Marker or Survey Bench Mark

Site Boundary (approximate)

Apparent Conductivity Transition

MAG/EM Anomaly

FIGURE 2

Geophysical Interpretation

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

Prepared by:
NGA Northwest Geophysical Associates, Inc.
P.O. Box 1063, Corvallis, Oregon 97339

REVISION: A-17-SEPT-08 DATE: SEPT-2008 FILENAME: Fig 3_AnSig_UTMfeet.map NGA PROJECT #: 683

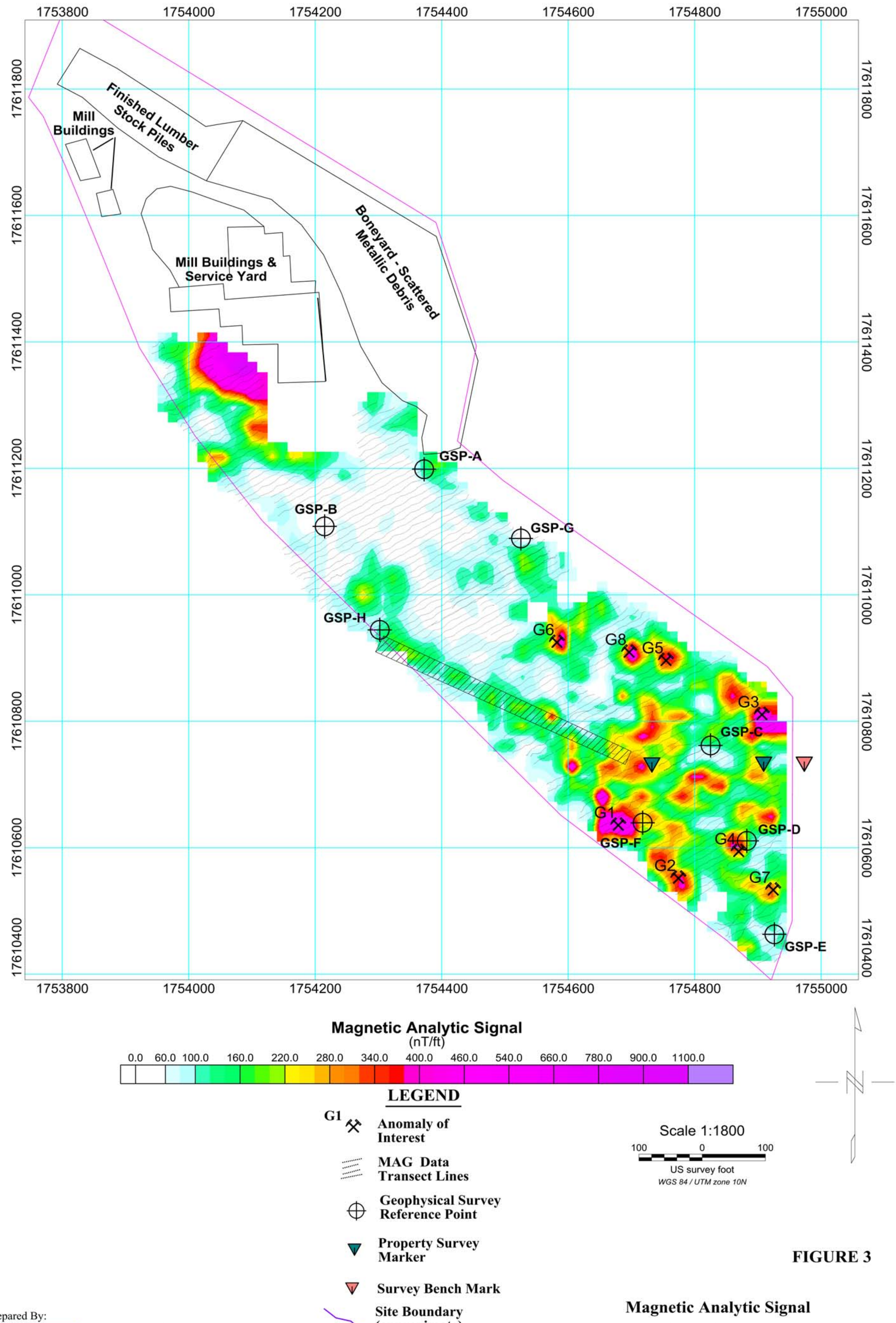


FIGURE 3

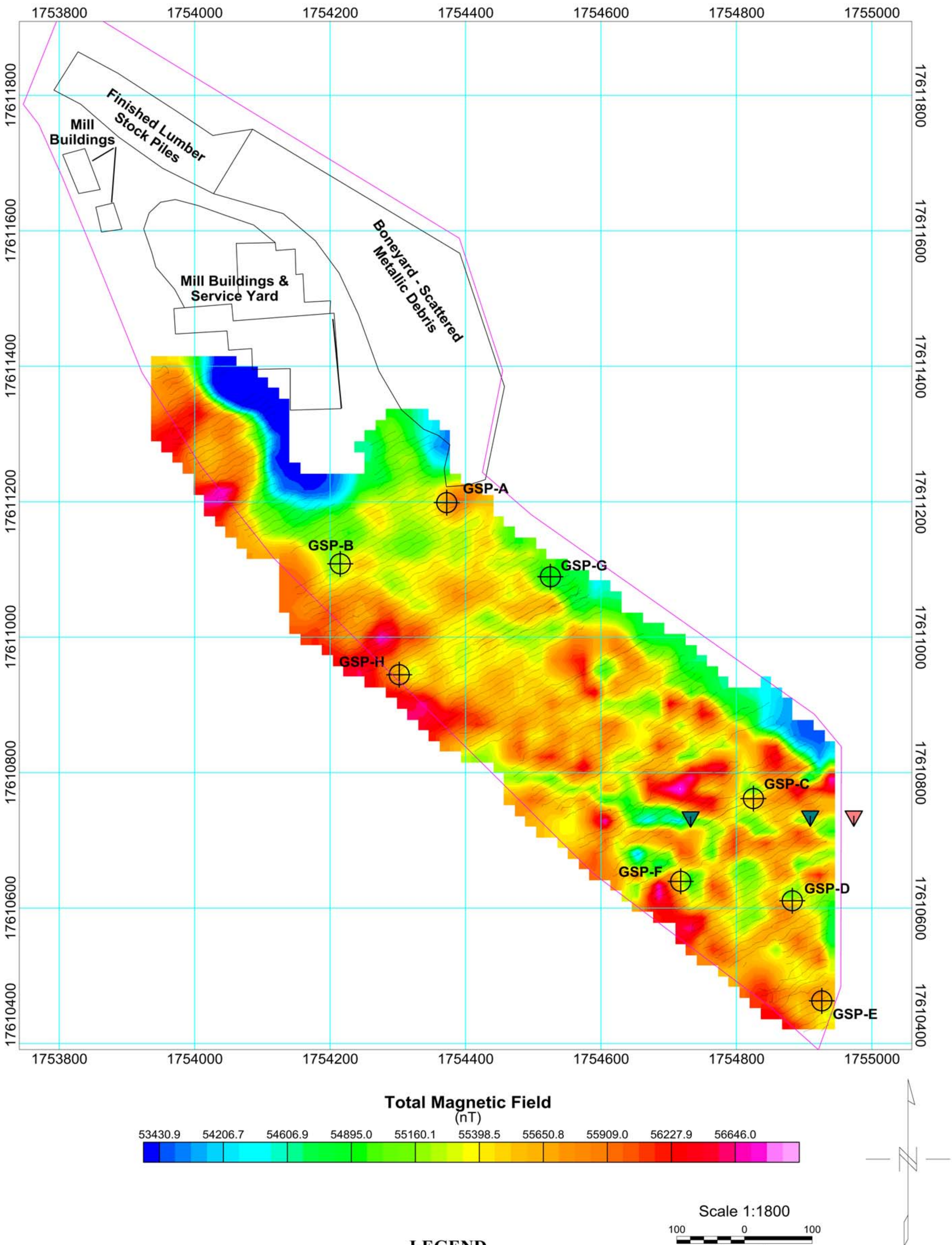
Prepared By:

Northwest Geophysical Associates, Inc.

Magnetic Analytic Signal

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

REVISION: A-17-SEPT-08 DATE: SEPT-2008 FILENAME: Fig 4_TotalFieldTop_UTMfeet.map NGA PROJECT #: 683



LEGEND

MAG Data Transect Lines

Geophysical Survey Reference Point

Property Survey Marker

Survey Bench Mark

Site Boundary (approximate)

Prepared By:

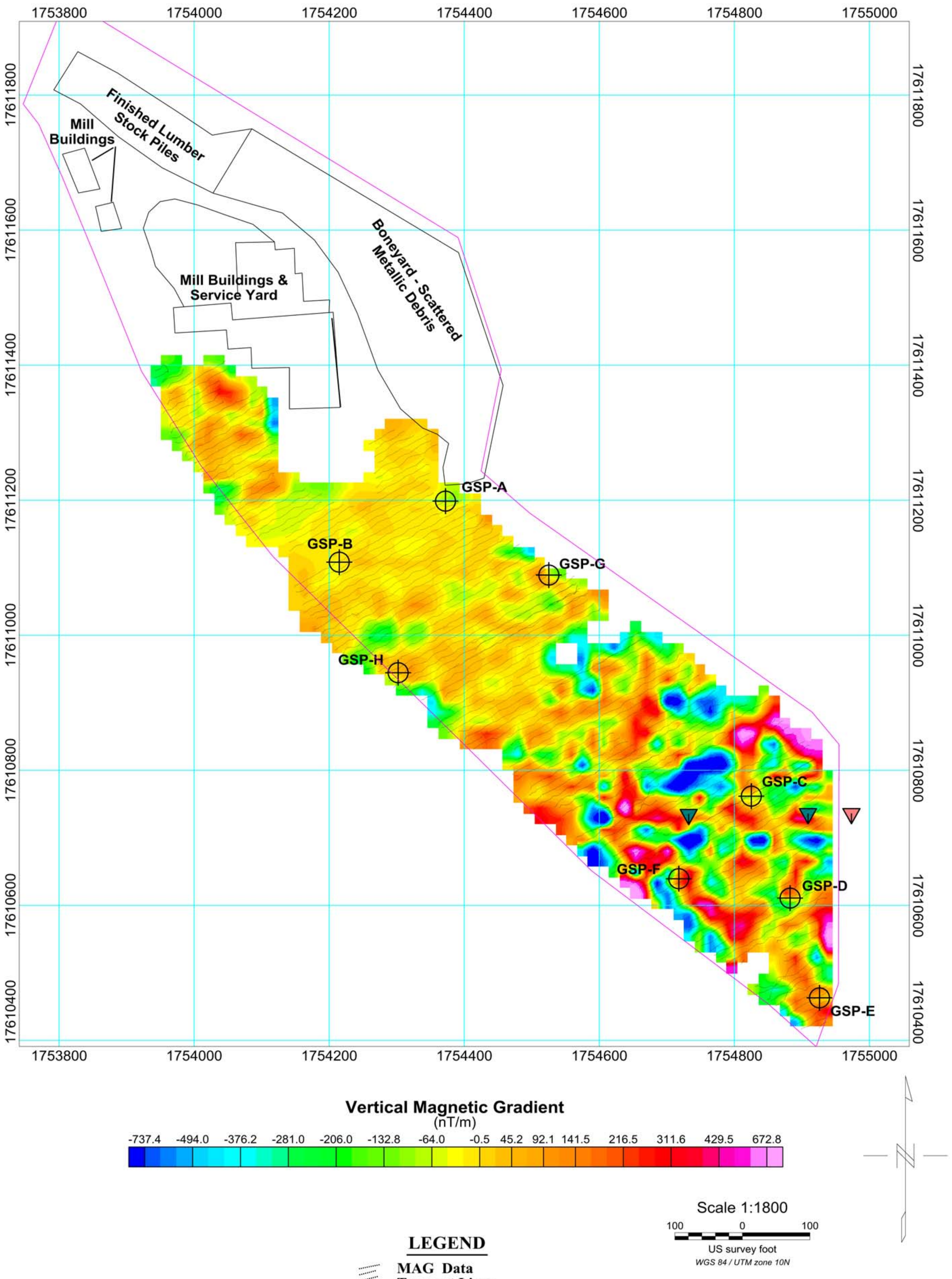
Northwest Geophysical Associates, Inc.

FIGURE 4

Total Magnetic Field
Top Sensor

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

REVISION: A-17-SEPT-08 DATE: SEPT-2008 FILENAME: Fig 5_Vgrad_UTMfeet.map NGA PROJECT #: 683



LEGEND

MAG Data Transect Lines

Geophysical Survey Reference Point

Property Survey Marker

Survey Bench Mark

Site Boundary (approximate)

FIGURE 5

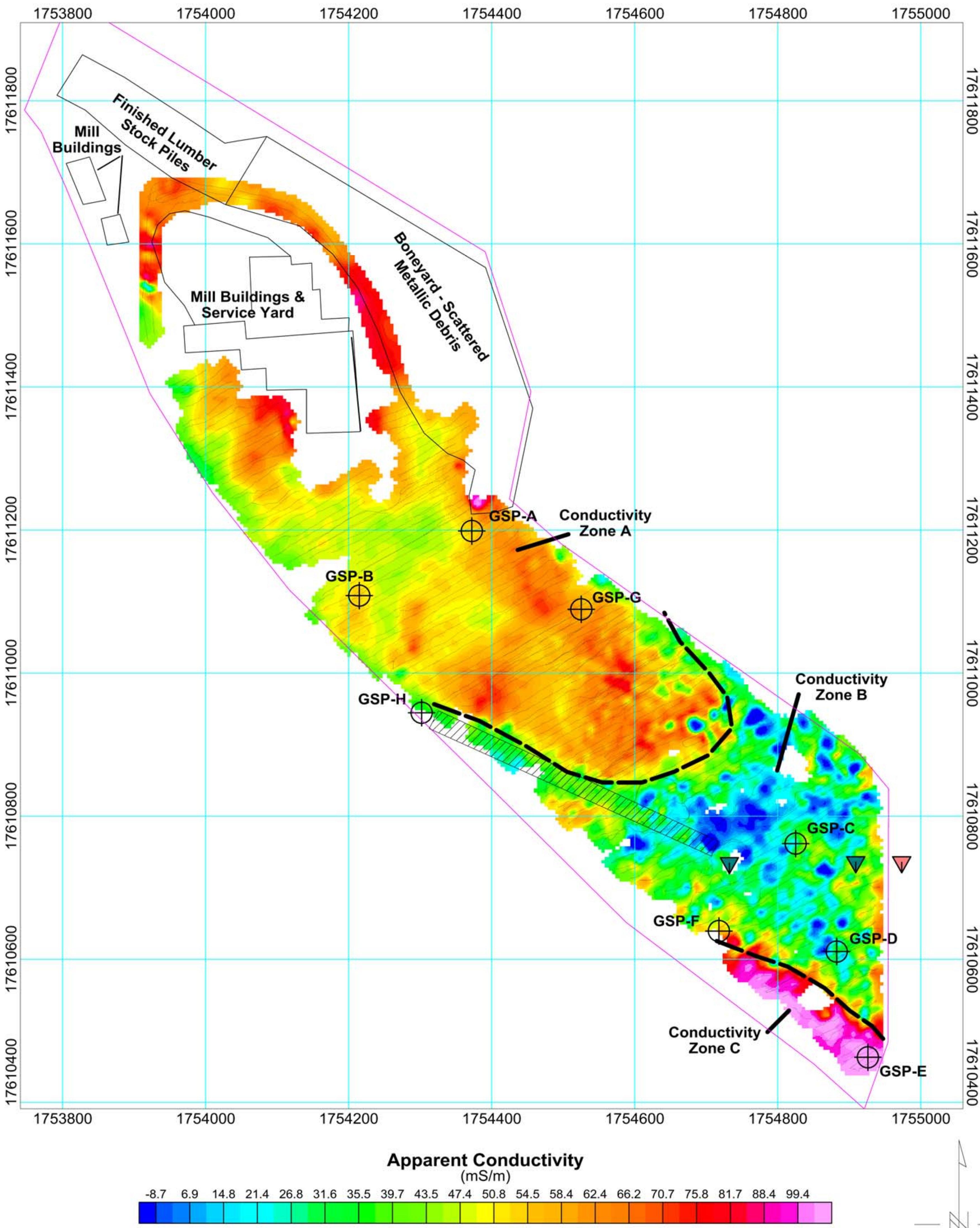
Prepared By:

Northwest Geophysical Associates, Inc.

Vertical Magnetic Gradient

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

REVISION: A-17-SEPT-08 DATE: SEPT-2008 FILENAME: Fig 6_EMQ_UTMfeet.map NGA PROJECT #: 683



LEGEND

- Apparent Couductivity Transition
- EM31 Data Transect Lines
- Geophysical Survey Reference Point
- Property Survey Marker
- Survey Bench Mark
- Site Boundary (approximate)
- Linear MAG/EM Anomaly

Scale 1:1800

100 0 100

US survey foot

WGS 84 / UTM zone 10N

FIGURE 6

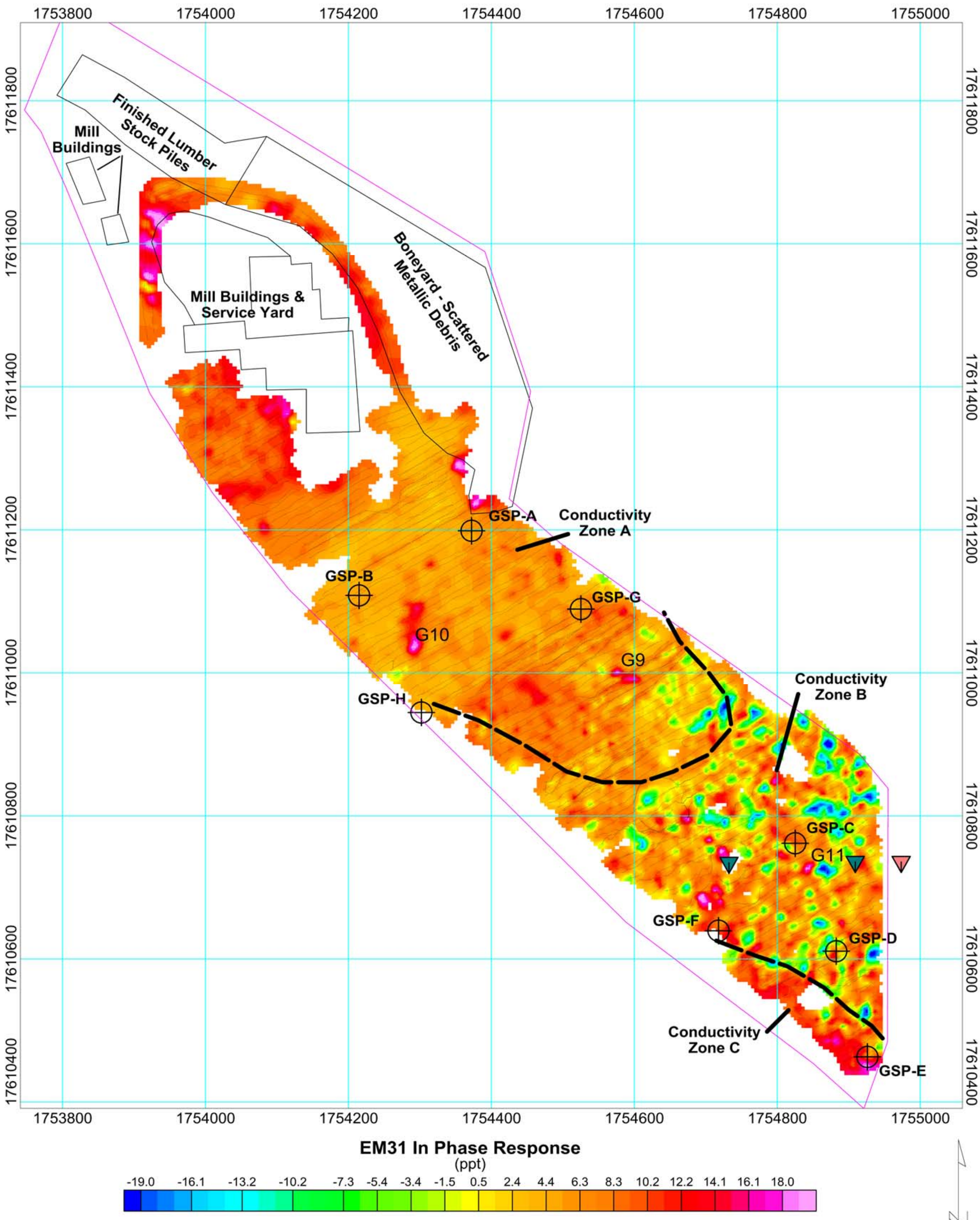
Apparent Conductivity
EM31 Quadrature Response

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

Prepared By:

Northwest Geophysical Associates, Inc.

REVISION: A-17-SEPT-08 DATE: SEPT-2008 FILENAME: Fig 7_EMI_UTMfeet.map NGA PROJECT #: 683



LEGEND

G9 Anomaly of Interest

Apparent Couductivity Transition

EM31 Data Transect Lines

Geophysical Survey Reference Point

Property Survey Marker

Survey Bench Mark

Site Boundary (approximate)

Scale 1:1800

100 0 100

US survey foot

WGS 84 / UTM zone 10N

FIGURE 7

Prepared By:

Northwest Geophysical Associates, Inc.

EM31 In Phase Response

Geophysical Investigation
Whitmarsh Landfill
Skagit County, Washington

Geophysical Site Investigation
Whitmarsh Landfill
Skagit County, Washington

Attachment B

NGA Technical Note

Geophysical Detection of Buried Objects

Geophysical Services

Environmental • **Groundwater** • **Geotechnical**

TECHNICAL NOTE

Geophysical Detection of Buried Objects

Ground Penetrating Radar

Electromagnetics *EM31*

Magnetics

Electromagnetics - *EM61-MK2*

COVER rev.4, JUNE 2006

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GEOPHYSICAL DETECTION

OF BURIED OBJECTS

Revision June 2006

INTRODUCTION

Several geophysical techniques are used for locating buried objects such as underground storage tanks, pipes, utilities, drums and other debris. These techniques are used routinely, and are often recommended or required by state agencies, funding institutions and/or the EPA, particularly on sites where underground burial of steel drums or other debris may have occurred or where underground storage tanks are suspected.

Geophysics is generally used in the early reconnaissance phase of these investigations as a guide to sampling, excavation and/or placement of monitoring wells. In this paper we discribe three of the most common geophysical techniques, electromagnetics (EM), magnetics (MAG) and ground penetrating radar (GPR).

UTILITY OF GEOPHYSICS:

First, a few words about "geophysics" as used for environmental and geotechnical engineering applications. Surface geophysical techniques probe subsurface materials (soils and rock) using surface instruments. This is done by measuring physical signals which have interacted with the earth materials. These signals may be electrical, magnetic, acoustic (seismic) or electromagnetic.

Surface geophysics offers several advantages over other exploration techniques:

1) Surface geophysical methods are *"non-intrusive"* in that they do not disturb the ground surface, or stir up any contaminants which might be in the soil.

2) Geophysical methods *measure earth properties over a large volume*. Whereas drilling only samples the earth at the point of the borehole, the measured geophysical response is affected by earth materials several feet, or tens of feet, away from the instrument sensor. This allows broad areas to be effectively "screened" with a series of surface measurements.

3) Most geophysical equipment used in environmental and geotechnical applications *can be hand carried*. Geophysical surveys do not require vehicular access, but only a walking path, clear of brush and obstacles.

4) Geophysical surveys are relatively *inexpensive* and can be performed quickly.

TYPICAL OBJECTIVES:

Geophysics may be used in either the reconnaissance mode, or in a detailed survey mode. In the reconnaissance mode, geophysics is used to "screen" large areas to determine the presence or absence of buried objects. In more detailed surveys, the location and extent of the object is mapped in greater detail. This facilitates the efficient excavation of tanks or debris, aids the effective placement of monitoring wells, or improves the design of a sampling program.

The techniques discussed here are also useful for objectives other than identifying buried objects. Electromagnetic induction (EM) is especially useful in mapping changes in soil (e.g. sand or gravel channels), mapping clay aquitards and mapping contaminant leachate plumes in groundwater. GPR can be used to map shallow stratigraphy or to map zones of disturbed soils.

GEOPHYSICAL METHODS:

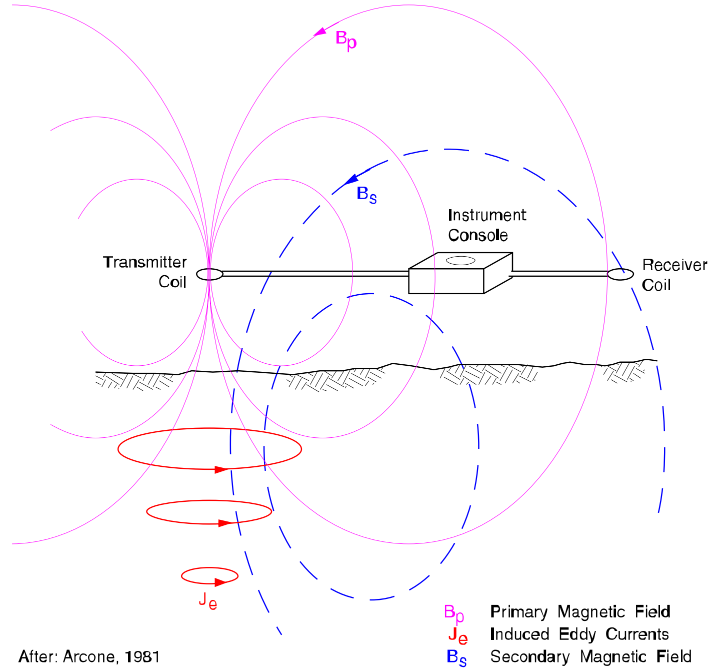
Three geophysical methods are commonly used in the search for buried objects: 1) electromagnetic induction (EM), 2) magnetics (MAG), and 3) ground penetrating radar (GPR). EM and magnetics are complementary methods, most effective in the reconnaissance mode but also useful for more detailed work. GPR is most effective for detailed work, but may also be used in reconnaissance surveys.

Electromagnetic Methods:

The electromagnetic induction (EM) technique measures the electrical conductivity of the earth by inducing a time varying electric current in the earth. This is shown schematically in Figure 1. The EM technique was developed to measure natural soil conductivity to aid in identifying soil types and to measure rock conductivity in order to identify zones of conductive mineralization.

FIGURE 1

PRINCIPLES OF ELECTROMAGNETIC INDUCTION



Man-made metallic objects are generally orders of magnitude more conductive than natural soils. Thus, the electric currents induced in the ground by EM instruments will be dramatically affected by the presence of any man-made metallic object. Examples include pipes, tanks, cables, concrete reinforcing steel, or steel drums. By looking for anomalous signals which cannot be attributed to natural soils, buried metallic objects can readily be identified.

Frequency-domain EM – EM31

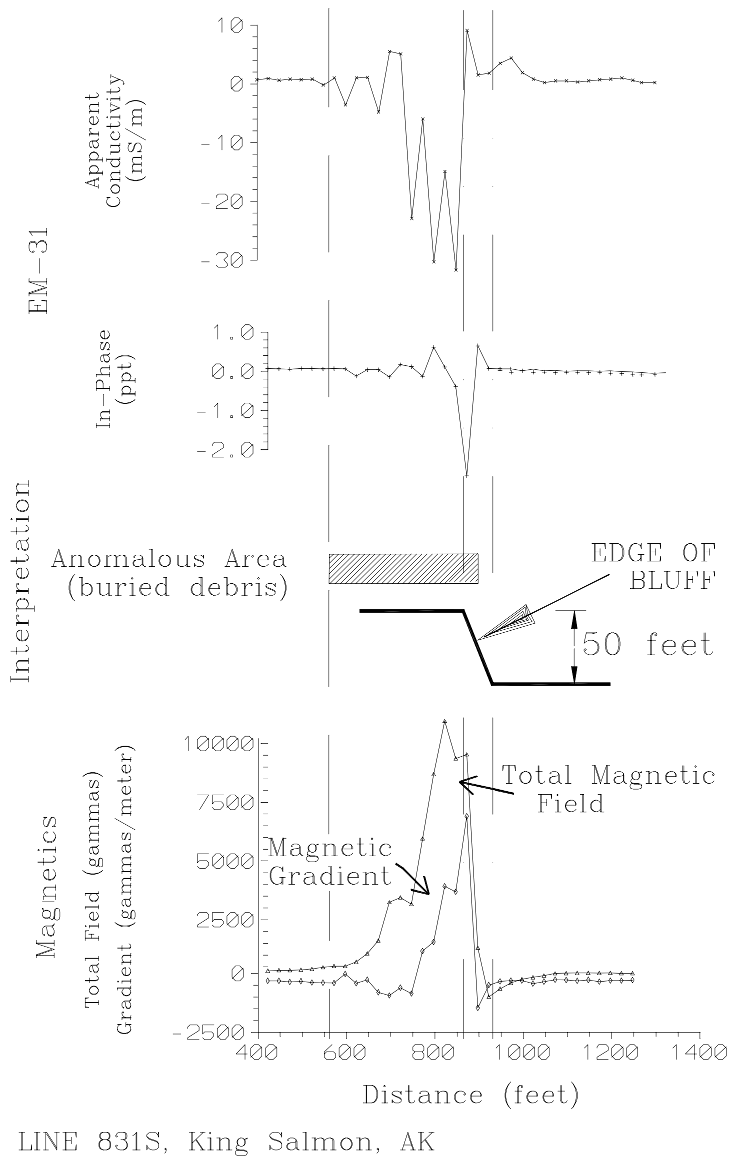
Frequency domain EM systems transmit a sinusoidal waveform at a fixed frequency, or multiple frequencies. The resulting secondary magnetic field may be phase shifted, depending on the nature of the target. Both the in-phase component (in phase with the primary magnetic field) and the quadrature phase component (shifted 90° from the primary field) can be measured to provide the phase shift information.

The Geonics EM-31 is a common frequency domain EM instrument, often used for buried object detection. The upper left photo on the cover shows the EM-31 in a field situation. A transmitter coil is in one end of the boom and a receiver coil in the other end. Depth of investigation is generally 10-15 feet, but the EM-31 may detect large metal objects at a somewhat greater distance. The instrument can quickly cover a wide area, mapping anomalous areas (metallic object locations) as well as changes in the soil character.

Figure 2 shows some sample data over a disposal site where 55 gallon steel drums had been dumped on the edge of a bluff and then covered with soil, extending the bluff for tens of feet (cross hatched block in Figure 2). The noisy and/or negative "apparent" conductivity is a clear indicator of metallic objects. The EM-31 also records an "in-phase response" which aids in identifying metallic conductors. Data in Figure 2 indicate the zone of burial extends from 560 feet to 940 feet along the line of the profile.

FIGURE 2

SAMPLE EM31 & MAGNETIC PROFILES



Time-domain EM – EM61

Time-domain EM systems transmit a magnetic pulse, with a duration in the order of 10s of micro-seconds (µs). That magnetic pulse induces electric currents in the ground as well as in any metallic object which is buried (or on the surface) within its range of influence. Currents induced in metallic conductors decay at a much slower rate than currents induced in the ground. Hence, metallic conductors can be easily identified.

The EM61-MK2 is a time domain metal detector manufactured by Geonics, Ltd., of Toronto, Canada. The EM61-MK2 instrument consists of two horizontal air cored coils, 1.0 meter by 0.5 meters in size. The bottom coil acts as a receiver and transmitter and the top coil as a receiver. The top coil is mounted 28 centimeters above the bottom coil. The instrument weighs about 75 lbs. and is pulled by one operator.

The Geonics EM61-MKII has 4 time gates, to measure the rate of decay of the signal, and two receiver coils, to measure the field gradient. The rate of decay is dependant on the size, shape, and orientation of the metallic object. Generally, they are used to estimate gross target parameters, but can be used for more detailed discrimination of targets, particularly in identifying unexploded ordnance (UXO) materials.

The two receiver coils are very helpful in the recognition of near surface objects from deeper objects. Since the amplitude of the response is highly dependent on the distance between the coil assembly and target, small near surface targets often produce a response orders of magnitude larger than targets having greater size at deeper depths. This masking effect form the near surface materials is drastically reduced by processing output of the two coils, essentially subtracting the bottom coil data from the top coil data. This is referred to as the differential mode or the differential signal.

Figure 3 shows some sample data over a 55 gallon steel drums partially buried, essentially flush with the surface of the ground. The response from the top and bottom coils is indicative of a substantial metallic presence. The relatively weak differential response is indicative of a shallow target.

FIGURE 3

EM61 & MAGNETIC PROFILES OVER PRATIALLY BURRIED 55 GALLON DRUM

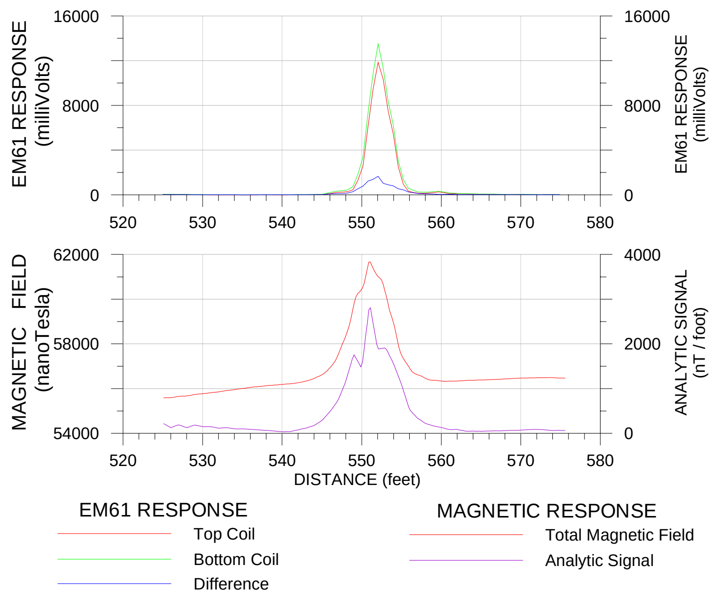
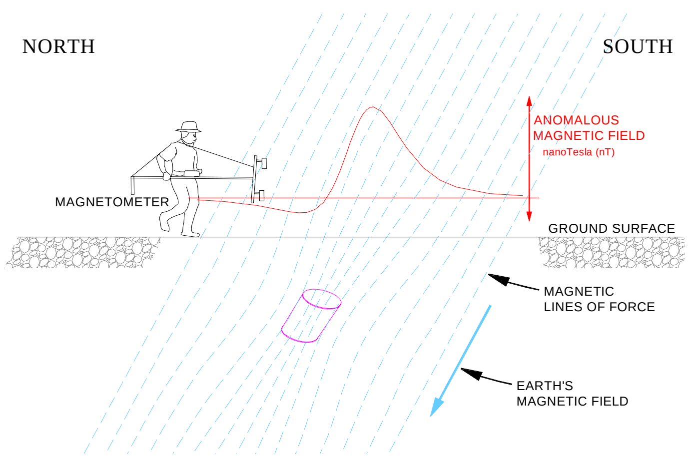


FIGURE 4

PRINCIPLES OF MAGNETIC EXPLORATION



Magnetic Methods:

Magnetic methods measure disturbances in the earth's natural magnetic field. These disturbances are caused by magnetic materials, either magnetic rocks, or man made objects containing iron or steel. This is shown schematically in Figure 4. Most soils have negligible magnetization (both induced and remanent). Thus, most magnetic disturbances from shallow sources can be attributed to iron or steel objects which have been placed there by man's activities.

Magnetometers used for buried object detection usually measure the gradient of the magnetic field. This is done by measuring the difference between the magnetic field at two sensors separated vertically by two or three feet. This configuration is more sensitive to nearby disturbances, and is less effected by disturbances caused by distant objects or shallow bedrock.

The upper right photo on the cover shows a magnetometer/gradiometer. This instrument can also cover wide areas quickly, providing complementary data to the EM. Figure 2 includes total magnetic field data and gradiometer data over the barrel disposal area. The large deviations in both total field and gradient are indicative of steel objects in close proximity.

Ground Penetrating Radar:

Ground penetrating radar (GPR), like other radar techniques, sends out an electromagnetic pulse (radio wave or microwave) which is reflected off a "target" and returns to the receiver. GPR operates at lower frequencies (80-500 MHz) than other radar to obtain better penetration in the earth materials. The antenna is pulled slowly along the ground surface to produce a continuous subsurface profile.

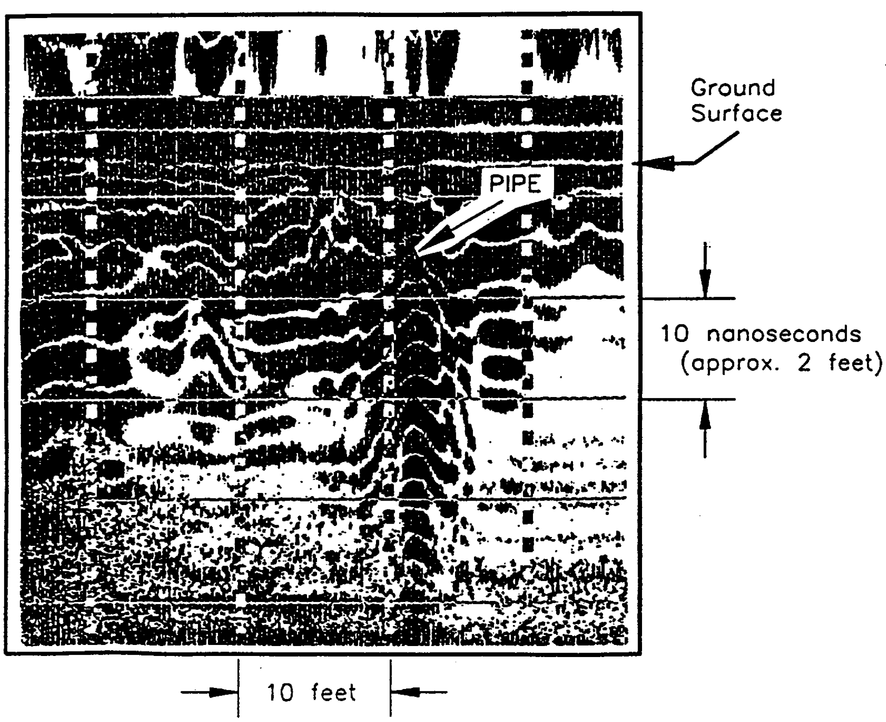
The lower photo on the cover shows a GPR unit in operation. The 500 MHz antenna shown is being pulled along the sidewalk. The control and recording unit, on the tailgate of the truck, is powered by a 12 volt automobile battery.

Figure 4 is an example GPR profile over a shallow pipe. The vertical scale is a time scale, giving the time for the radar pulse to travel down to the reflector and return to the receiver. Knowing the pulse velocity in the soils, we can convert this to depth. The horizontal scale corresponds to distance along the surface. Fiducial time marks on the record are placed at ten foot intervals. The pipe reflector shown appears as a hyperbola on the record. The pipe produces a strong reflection with a characteristic ringing of the electronics, which appears as a dark band below the first arrival from the pipe.

GPR is a tool for looking at selected areas in detail. Its continuous subsurface profiles give a graphic portrayal of subsurface conditions, and often provide an excellent means of accurately locating pipes and tanks. However, the GPR depth of exploration is strongly dependent on soil conductivity and subsurface conditions. In dry, sandy soils useful data may be obtained from depths down to 15 feet, whereas in conductive clay soils, investigation depth is often limited to two or three feet.

FIGURE 4

SAMPLE GPR PROFILE



DISCUSSION:

As we have stressed, EM and magnetics are effective in screening large areas quickly to identify areas where buried objects may be present. Often these techniques can provide a rough estimate of the size and depth of the object causing the anomalous readings.

The choice of frequency domain EM (i.e. EM31) versus time-domain EM (i.e. EM61) depends on the objectives and the site. The EM61 is very effective at identifying small pieces of metal (e.g. unexploded ordnance), and offers some depth and discrimination capability. It is also less sensitive to cultural noise (e.g. buildings, vehicles, etc.) than the EM31. The EM61 can often resolve anomalies which are close together, where the EM31 could not. However, the EM61 requires a tight line spacing, typically 1 meter, to assure the area is covered. Also, the wheeled cart is difficult or impossible to operate on some sites (the EM61 can also be carried on a shoulder harness but is very awkward).

The EM31 is favored over the EM61 on more open sites where the objective is to locate underground tanks, drums, or collections of debris. The broader sphere of influence of the EM31 allows it to be run on a coarser line spacing, typically 5-20 feet depending on the target.

A major limitation of both EM and MAG is their sensitivity to "cultural noise". Buildings, fences, metallic surface debris, and vehicles all create cultural noise. The EM and magnetic instruments respond to any metallic objects, whether buried or in plain view above ground. Thus, areas within 20 to 40 feet of buildings, vehicles or pipelines will be masked by the strong response from those objects. EM and magnetics will not be able to definitively identify other buried objects within that masked zone.

GPR on the other hand is fairly immune to those forms of cultural noise. The radar signal is confined to a broad beam, spreading at roughly a 45° angle, beneath the antenna. Most antennas are well shielded with little upward propagation of the pulse. Thus GPR can be run next to buildings, fences and parked vehicles. GPR may be run inside buildings and even over reinforced concrete.

Because the GPR beam is directional, it does not have the same utility as a reconnaissance tool as the EM and magnetics. Whereas the latter techniques would readily detect a large tank 10 or 20 feet off the survey line, GPR would not detect the tank unless the survey line passed directly over the tank.

CONCLUSIONS

No geophysical technique should be used without some form of "ground truth" by drilling, excavation, or some other form of sampling. The geophysical signature of an underground storage tank may be very similar to that of a buried automobile. However, geophysics can eliminate random drilling or extensive excavation when searching for underground tank or other materials.

To conclude, EM, magnetic and GPR techniques are effective, complimentary techniques used in the detection and delineation of subsurface metallic objects. The choice of technique or techniques depends very much on both site conditions and the survey objective.

FURTHER READING:

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DISCUSSION OF GEOPHYSICAL TECHNIQUES

GEOPHYSICAL DETECTION OF BURIED OBJECTS

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Revision: June 2006

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File: b_b_teq_2006B.doc

APPENDIX E

Field Notes

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Geomatrix

Well ID: MW-02
Sample ID: ______ Duplicate ID: ______
Sample Depth: ~18'
Project and Task No.: ______
Project Name: Whitmarsh
Date: 10/14/08
Sampled By: C.B
Method of Purging: Perastaltic
Method of Sampling: " "

Initial Depth to Water: 5'
Depth to Water after Sampling: ______
Total Depth to Well: ______
Well Diameter: 2"
1 Casing/Borehole Volume: ______ (Circle one)
4 Casing/Borehole Volumes: ______ (Circle one)
Total Casing/Borehole Volumes Removed: ______

Time	Intake Depth	Rate (gpm) ml/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb
recalibr 1156	18	200	0.1	11.6	7.18	9.99	0.00	200	130
1207		200	0.15	11.7	6.72	.584	4.99	198	60
1210			0.2	11.7	6.93	2.42	1.11	189	56
1213			0.25	11.7	7.08	1.85	0.00	182	44
1216			~~0.30~~	11.7	7.15	1.37	0.00	176	35
1219			~2	11.7	7.23	0.93	0.00	167	26
1222			~2.2	11.7	7.25	0.54	0.00	161	20
1225			~2.4	11.7	7.27	0.44	0.00	155	21
1228			~2.6	11.7	7.28	0.35	0.00	145	19
1231			~2.8	11.7	7.30	0.30	0.00	137	17
1234			~3	11.7	7.31	0.28	0.00	132	15
1237			3.2	11.7	7.31	0.25	0.00	126	~~13~~ 14

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.: U-22 Horiba

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Time	gallons	temp	pH	cond	DO	ORP	turb
1240	3.5	11.7	7.31	0.24	0.00	123	10
1243	3.7	11.7	7.31	0.22	0.00	120	10
1246		11.8	7.32	0.22	0.00	118	10

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-3

Sample ID: ______ Duplicate ID: ______

Sample Depth: 15 - bfm

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 10/14/08

Sampled By: C.B

Method of Purging: peristaltic

Method of Sampling: " "

Initial Depth to Water: 9.9

Depth to Water after Sampling: ______

Total Depth to Well: ______

Well Diameter: 2"

1 Casing/Borehole Volume: ______ (Circle one)

4 Casing/Borehole Volumes: ______ (Circle one)

Total Casing/Borehole Volumes Removed: ______

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)
1545	15	200	0.2	14.3	7.96	8.01	0.00	-130	Turb 780
1548			0.4	14.5	7.90	5.03	0.00	-143	333
1551			1.0	14.5	7.86	2.06	0.00	-154	193
1554			1.3	14.5	7.86	1.15	0.00	-158	170
1557			1.75	14.4	7.85	0.421	0.00	-161	106
1600			2.2	14.4	7.85	0.314	0.00	-163	67
1603			2.4	14.4	7.85	0.293	0.00	-164	59
1606			2.5	14.5	7.86	0.261	0.00	-166	55
1609			2.6	14.5	7.85	0.225	0.00	-167	35
1612			2.75	14.5	7.86	0.212	0.00	-168	32
1615			2.9	14.5	7.86	0.196	0.00	-169	20
1618			3.2	14.4	7.87	0.180	0.00	-169	16

pH CALIBRATION (choose two) — Model or Unit No.:

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION — Model or Unit No.:

KCL Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

time	gallons	pH	cond	turb	DO	temp	orp
1621	3.3	7.86	0.176	10.7	0.0	14.4	-172
1624	3.5	7.87	.175	9.8	0.0	14.4	-173
1627	3.75	7.87	.169	6.7	0.0	14.4	-175
1630	4.2	7.87	.156	7.7	0.0	14.6	-176

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-04
Sample ID: ______ Duplicate ID: ______
Sample Depth: Btm
Project and Task No.: ______
Project Name: Whitmarsh
Date: 10/14/08
Sampled By: CB
Method of Purging: Parastaltic
Method of Sampling: ______

Initial Depth to Water: 3.8'
Depth to Water after Sampling: 3.65'
Total Depth to Well: ______
Well Diameter: ______
1 Casing/Borehole Volume: ______ (Circle one)
4 Casing/Borehole Volumes: ______ (Circle one)
Total Casing/Borehole Volumes Removed: E 4 gal

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb	Sal %
1358	Btm	200	0	11.4	8.05	1.68	2.86	140	106	2.5
1401			0.2	11.2	8.04		0.00	44	70	
1404			0.4	11.2	8.06		0.00	-16	62	
1407			0.6	11.2	8.07	5.23	0.00	-24	70	
1410			0.8	11.2	8.08	3.25	0.00	-29	45	1.8
1413			1.0	11.2	8.1	1.67	0.00	-73	49	0.9
1416			1.2	11.2	8.1	1.13	0.00	-96	61	0.6
1419			~1.5	11.2	8.09	0.542	0.00	-103	63	0.3
1422			~2.0	11.2	8.09	0.374	0.00	-111	60	0.2
1425			~2.5	11.1	8.09	0.329	0.00	-114	47	0.2
1428			~2.8	11.1	8.09	0.282	0.00	-116	37	0.1
1431			3.1	11.1	8.10	0.278	0.00	-118	35	0.1

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: Cond. acting weird

time	gal	pH	cond	turb	DO	temp	Sal	ORP
1434	3.3	8.09	.186	35	0.00	11.1	0.1	-119

WELL SAMPLING AND/OR DEVELOPMENT RECORD

4 pics

Geomatrix

Well ID: SP-Ø1

Sample ID: ____ Duplicate ID: ____

Sample Depth: ____

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 10/15/08

Sampled By: NB, CB

Method of Purging: ____

Method of Sampling: peristaltic into shallow water

Initial Depth to Water: ____

Depth to Water after Sampling: ____

Total Depth to Well: ____

Well Diameter: ____

1 Casing/Borehole Volume: ____ (Circle one)

4 Casing/Borehole Volumes: ____ (Circle one)

Total Casing/Borehole Volumes Removed: ____

Time	~~Intake Depth~~ Turb NTU	Sal ~~Rate (gpm)~~ %	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; ~~SSCE~~)	Remarks (color, turbidity, and sediment)
1100	100	1.2		10.9	8.08	1925/cm	3.68	53	slightly yellow clearish.

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-02

Sample ID: ____ Duplicate ID: ____

Sample Depth: ____

Project and Task No.: 14159

Project Name: Whitworth

Date: 10/15/08

Sampled By: ____

Method of Purging: ____

Method of Sampling: ____

Initial Depth to Water: ____

Depth to Water after Sampling: ____

Total Depth to Well: ____

Well Diameter: ____

1 Casing/Borehole Volume: ____
(Circle one)

4 Casing/Borehole Volumes: ____
(Circle one)

Total Casing/Borehole Volumes Removed: ____

Time	~~Intake Depth~~ Turb NTU	~~Rate (gpm)~~ Sal %	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment
	43	2.1		13.4	7.57	3.44 S/m	8.90	-5	

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-03

Sample ID: ______ Duplicate ID: ______

Sample Depth: ______

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 11/15/06

Sampled By: ______

Method of Purging: ______

Method of Sampling: ______

Initial Depth to Water: 2"

Depth to Water after Sampling: ______

Total Depth to Well: ______

Well Diameter: ______

1 Casing/Borehole Volume: ______ (Circle one)

4 Casing/Borehole Volumes: ______ (Circle one)

Total Casing/Borehole Volumes Removed: ______

Time	~~Intake Depth~~ Turb NTU	Rate (gpm) Sal %	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)
1240	395	0.1		13.2	7.75	0.193S/m	12.15	~~[illegible]~~ -64	orange cloudy Flocculent, orange OM material.

Peeper failed, screen clogged during purging.

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	
Model or Unit No.:	
Ag/AgCl Electrode (SSCE)	

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	
Model or Unit No.:	

Notes:

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Geomatrix

Well ID: SW-01
Sample ID: ____ **Duplicate ID:** ____
Sample Depth: ____
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 10/14/08 0910
Sampled By: CB, NB
Method of Purging: None,
Method of Sampling: Submerge bottle.

Initial Depth to Water: ____
Depth to Water after Sampling: ____
Total Depth to Well: ____
Well Diameter: ____
1 Casing/Borehole Volume: ____ (Circle one)
4 Casing/Borehole Volumes: ____ (Circle one)
Total Casing/Borehole Volumes Removed: ____

Time	~~Intake Depth~~ Turb NTU	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment
0910	12.8			10.9	6.34	0.234 S/m	11.85	190	

Water is clear, scattered small vegetation petals floating (milfoil?)

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø3

Sample ID: ____ Duplicate ID: ____

Sample Depth: ____

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 10/15/08

Sampled By: ____

Method of Purging: NA

Method of Sampling: submerge bottle

Initial Depth to Water: ____

Depth to Water after Sampling: ____

Total Depth to Well: ____

Well Diameter: ____

1 Casing/Borehole Volume: ____ (Circle one)

4 Casing/Borehole Volumes: ____ (Circle one)

Total Casing/Borehole Volumes Removed: ____

Time	~~Intake Depth~~ Turb NTU	~~Rate (gpm)~~ Salinity %	~~Cum. Vol. (gal)~~	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen ~~(ppm)~~ mg/L	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)
0940	50	0.2		6.3	9.20	0.340 S/m	11.63	47	slight yellow tint, trace OM material floating around.

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-04
Initial Depth of Water: 3"
Sample ID:
Duplicate ID:
Depth to Water after Sampling:
Sample Depth:
Total Depth to Well:
Project and Task No.: 14159
Well Diameter:
Project Name: Whitmarsh
1 Casing/Borehole Volume: (Circle one)
Date: 10/15/08
Sampled By: NB, CB
4 Casing/Borehole Volumes: (Circle one)
Method of Purging: None
Total Casing/Borehole Volumes Removed:
Method of Sampling: Submerge bottle.

Time	~~Intake Depth~~ Turb NTU	~~Rate (gpm)~~ Salinity	~~Cum. Vol. (gal.)~~	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)
0800	220	0.2%		4.4	8.00	0.417 S/m	11.45	143	very light brown, Few small pieces of OM floating. ~~des~~ water is clear though

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-05
Sample ID: ____ Duplicate ID: ____
Sample Depth: ____
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 10/15/08
Sampled By: NB, CB
Method of Purging: ____
Method of Sampling: submerge bottle.

Initial Depth ~~to~~ of Water: 5"
Depth to Water after Sampling: ____
Total Depth to Well: ____
Well Diameter: ____
1 Casing/Borehole Volume: ____ (Circle one)
4 Casing/Borehole Volumes: ____ (Circle one)
Total Casing/Borehole Volumes Removed: ____

Time	~~Intake Depth~~ Turb NTU	~~Rate (gpm)~~ Sal %	~~Cum Vol. (gal.)~~	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)
0832	107	1.7		5.1	8.07	~~3~~ 3.08 S/m	9.37	97	clear, slight yellow tint.

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø6
Sample ID: ______ Duplicate ID: ______
Sample Depth: ______
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 10/15/08
Sampled By: NB, CB
Method of Purging: ______
Method of Sampling: Submerge bottle

Initial Depth ~~to~~ of Water: 10"
Depth to Water after Sampling: ______
Total Depth to Well: ______
Well Diameter: ______
1 Casing/Borehole Volume: ______ (Circle one)
4 Casing/Borehole Volumes: ______ (Circle one)
Total Casing/Borehole Volumes Removed: ______

Time	~~Intake Depth~~ Turb NTU	~~Rate (gpm)~~ Sal %	~~Cum. Vol. (gal.)~~	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (~~µg~~/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)
0900	29.0	2.3		6.7	7.93	3.61 S/m	8.68	76	Clear, live wired to water quality parameters

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

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CHAIN-OF-CUSTODY RECORD

SEA 10405

PROJECT NAME: Whitmarsh Landfill			DATE: 10/14/08 — PAGE 1 OF 1
PROJECT NUMBER: 14159	LABORATORY NAME: ARI	CLIENT INFORMATION: Skagit County	REPORTING REQUIREMENTS:
RESULTS TO: Nick Bacher	LABORATORY ADDRESS: Tukwila, WA		
TURNAROUND TIME: Standard			
SAMPLE SHIPMENT METHOD: hand delivered	LABORATORY CONTACT: Mark Harris		GEOTRACKER REQUIRED YES NO
	LABORATORY PHONE NUMBER:		SITE SPECIFIC GLOBAL ID NO.

SAMPLERS (SIGNATURE): [signatures]

DATE	TIME	SAMPLE NUMBER	VOCs	SVOCs	Phenols	PAHs	PCBs	OC Pesticides	Carbonyl	HCID (TPH)	TPH-Gx	TPH-Dx	Diss. Metals	Total Metals	pH	TDS		CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
10/14/08	0910	SW-Ø1-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		Various	W	No				18	Diss. Met not filtered
10/14/08	1250	MW-Ø2-1ØØ8	X	X	X	X	X	X	X	X	X	X	X	X	X	X		"	W	Yes				18	
10/14/08	1455	MW-Ø4-1ØØ8	X	X	X	X	X	X	X	X	X	X	X	X	X	X		"	W	Yes				18	
10/14/08	1640	MW-Ø2-1ØØ8	X	X	X	X	X	X	X	X	X	X	X	X	X	X		"	W	Yes				18	
10/14/08	1710	MW-1Ø3-1ØØ8	X	X	X	X	X	X	X	X	X	X	X	X				"	W	Yes				16	
10/15/08	0800	SW-Ø4-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	Diss. Met not filtered
10/15/08	0832	SW-Ø5-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	"
10/15/08	0900	SW-Ø6-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	"
10/15/08	0940	SW-Ø3-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	"
10/15/08	1100	SP-Ø1-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	"
10/15/08	1200	SP-Ø2-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	"
10/15/08	1240	SP-Ø3-1ØØ8	X	X	X	X	X	X	X				X	X	X	X		"	W	No				18	"
10/15/08	1520	EB-Ø1-1ØØ8	X	X	X	X	X	X	X	X	X	X	X	X	X	X		"	W	No				18	"
		TB-Ø1-1ØØ8	X								X							40 mL	W	Yes				8	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	
SIGNATURE: [signature]	10/15/08	1748	SIGNATURE: [signature]	10/15/08	1748	TOTAL NUMBER OF CONTAINERS:
PRINTED NAME: Nick Bacher			PRINTED NAME: Jonathon Walte			SAMPLING COMMENTS: (*) Diss. Metals NOT field filtered for all samples starting with SW. Please filter in lab.
COMPANY: AMEC GMX			COMPANY: ARI			
SIGNATURE:			SIGNATURE:			Please see Mark Harris & QAPP for combination of analyses (SVOCs, phenols, PAHs, etc.)
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			
SIGNATURE:			SIGNATURE:			
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			

One Union Square, 600 University Street, Suite 1020
Seattle, Washington 98101-4107
Tel 206.342.1760 Fax 206.342.1761

Geomatrix

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-Ø2

Sample ID: MW-02-1208 Duplicate ID: ______

Sample Depth: ______

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/18/08

Sampled By: NB, CB

Method of Purging: peristaltic

Method of Sampling: peristaltic

Initial Depth to Water: 7.83'

Depth to Water after Sampling: ______

Total Depth to Well: ______

Well Diameter: ______

1 Casing/Borehole Volume: ______ (Circle one)

3 Casing/Borehole Volumes: ______ (Circle one)

Total Casing/Borehole Volumes Removed: ______

Time	Turb ~~Intake Depth~~	ORP ~~Rate (gpm)~~ mV	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	DO mg/L	DTW	Remarks (color, turbidity, and sediment)
0955	179	251	0.15	6.4	5.60	67.8	3.71	7.89	clear
1000	163	244	0.65	8.7	6.32	61.6	2.54	7.89	clear
1005	211	250	0.9	9.6	7.31	60.2	1.94	7.88	clear
1008	199	261	1.2	10.0	7.00	58.7	1.66	7.88	clear
1011	221	266	1.5	10.0	7.03	58.2	1.51	7.88	clear
1014	220	271	1.9	10.1	7.03	58.2	1.39	7.88	clear
1017	221	276	2.2	10.0	7.05	58.1	1.26	7.88	clear
1024	218	278	2.8	10.0	7.01	58.7	1.09	7.88	clear
1027	206	274	3.0	9.9	7.03	59.1	1.02	7.88	clear
1030	213	273	3.2	9.9	7.05	58.9	1.01	7.88	clear

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.: Sample time 1040

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Water is really clear. Turb meter might be fouled.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-03

Sample ID: MW-03-1208 Duplicate ID: MW-103-1208

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/15/08

Sampled By: MB, CB

Method of Purging:

Method of Sampling:

Initial Depth to Water: 8.02

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Turb ~~Intake Depth~~ NTU	ORP ~~Rate (gpm)~~ mV	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/cm	DO mg/L	Remarks (color, turbidity, and sediment)
1252	40.2	-3	Ø	7.4	9.31	43.2	4.06	clear
1255	46.0	-16	0.25	7.6	10.12	43.3	3.12	clear
1258	47.3	-32	0.5	7.5	9.91	43.5	2.48	clear
1301	47.9	-47	0.75	7.6	9.83	42.7	1.20	clear
1304	34.5	-54	1	7.9	9.94	42.7	0.84	clear
1307	37.8	-62	1.3	7.3	10.11	42.8	0.54	clear
1310	26.6	-68	1.55	7.8	10.41	42.5	0.33	clear
1313	16.1	-72	1.9	7.8	10.65	42.6	0.34	clear
1316	9.6	-76	2.2	7.9	10.89	42.6	0.20	clear
1319	9.9	-77	2.5	7.9	10.91	41.9	0.18	clear
1322	4.7	-78	2.8	7.9	10.90	41.8	0.18	clear

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.: Sample @ 1330

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.: Sample @ 1340

Notes:

Sandman, motel 8 regent inn

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-04
Sample ID: MW-04-1208 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 12/19/08
Sampled By: NB, CB
Method of Purging: peristaltic
Method of Sampling: peristaltic.

Initial Depth to Water: 3.37
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
3 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Remarks (color, turbidity, and sediment) turb	DO	ORP
1037			0.4	8.5	8.87	48.1	3.2	4.06	274
1040			0.5	8.7	9.15	46.6	0.0	3.51	275
1043			0.7	9.0	9.37	46.1	0.0	3.24	261
1046			0.9	9.0	9.38	46.1	0.0	3.23	257
1049			1.1	9.1	9.42	45.9	0.0	3.14	241
1052			1.4	9.1	9.38	45.8	0.0	2.76	177
1055			1.7	9.2	9.46	45.8	0.0	2.37	109
1058			2.0	9.2	9.65	47.2	0.0	2.12	63
1101			2.2	9.3	9.73	46.3	0.0	1.84	18
1104			2.5	9.3	9.74	44.7	0.0	1.81	7
1107			2.7	9.3	9.74	47.1	0.0	1.64	-8
1110			2.9	9.3	9.75	47.3	0.0	1.32	-31

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.: Horiba U-22

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

	vol	pH	cond	turb	dO	temp	orp
1113	3.1	9.76	46.7	0.0	1.15	9.3	-41
1116	3.3	9.84	46.3	0.0	1.08	9.2	-48
1119	3.5	9.87	46.4	0.0	1.05	9.2	-49
1122	3.7	9.88	46.4	0.0	1.05	9.2	-51
1125	3.9	9.89	46.4	0.0	1.01	9.2	-54

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-Ø1
Sample ID: SP-Ø1-1208 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmark LF
Date: 12/17/08
Sampled By: NB, CB
Method of Purging: ~~SB~~ NA
Method of Sampling: submerge bottle

Initial Depth to Water: —
Depth to Water after Sampling: —
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
3 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Turb. ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance (~~µS/cm~~) mS/cm	Remarks (color, turbidity, and sediment)
1150	~~[illegible]~~ 113	9.42	83	0.5	8.66	99.7	orange cloudy (slight)

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.: Horiba U-22

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sample @ 1155

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-Ø2

Sample ID: SP-Ø2-1208 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/18/~~20~~08

Sampled By: NB, CB

Method of Purging: /

Method of Sampling: peristaltic

Initial Depth to Water:

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Turb ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
1555	78	6.92	73	0.1	10.02	1.23	slightly cloudy

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sampled @ 1600

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-Ø3

Sample ID: SP-Ø3-1208 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: whitmarsh LF

Date: 12/18/08

Sampled By: AB, CB

Method of Purging: /

Method of Sampling: peristaltic

Initial Depth to Water:

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Turb ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/cm	Remarks (color, turbidity, and sediment)
1640	363	11.95	95	0.3	10.15	0.43	slightly orange.

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sampled @ 1645

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-1

Sample ID: SW-Ø1-1208 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/17/08

Sampled By: NB, CB

Method of Purging: —

Method of Sampling: submerging bottle

Initial Depth to Water:

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

~~Time~~	Turb ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal.)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
1300	26.7	8.41	142	0.9	7.45	21.4	clear, some floating organic matter

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sample @ 1355

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-3

Sample ID: SW-Ø3-1208 Duplicate ID: ______

Sample Depth: ______

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/17/08

Sampled By: NB, CB

Method of Purging: /

Method of Sampling: submerged bottle

Initial Depth to Water:

Depth to Water after Sampling: ______

Total Depth to Well: ______

Well Diameter: ______

1 Casing/Borehole Volume: ______
(Circle one)

3 Casing/Borehole Volumes: ______
(Circle one)

Total Casing/Borehole Volumes Removed: ______

Time	Turb ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
1515	125	8.99	163	1.9	6.83	1.35	slighty brown

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sample @ 1520

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø4

Sample ID: SW-Ø4-1208 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/18/08

Sampled By: CB, NB

Method of Purging: /

Method of Sampling: submerged bottle.

Initial Depth to Water:

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Turb ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal.)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
1510	198	8.99	163	9.8	6.8	0.903	slightly brown

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sampled @ 1515

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø5

Sample ID SW-Ø5-1208 Duplicate ID: ____

Sample Depth: ____

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/17/08

Sampled By: NB, CB

Method of Purging: /

Method of Sampling: submerge bottle

Initial Depth to Water:

Depth to Water after Sampling: ____

Total Depth to Well: ____

Well Diameter: ____

1 Casing/Borehole Volume: ____ (Circle one)

3 Casing/Borehole Volumes: ____ (Circle one)

Total Casing/Borehole Volumes Removed: ____

Time	Turb ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
1505	133	9.03	175	2.2	6.78	0.791	slightly yellow

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sample @ 1510

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø6

Sample ID: SW-Ø6-1208 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/17/08

Sampled By: CB, NB

Method of Purging: –

Method of Sampling: submerged bottle

Initial Depth to Water:

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Turb. ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ S/m	Remarks (color, turbidity, and sediment)
1540	43	9.10	206	0.9	6.57	2.15	clear.

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sampled @ 1545

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø7

Sample ID: SW-Ø7-1208 Duplicate ID: ____

Sample Depth: ____

Project and Task No.: 14159

Project Name: Whitmarsh LF

Date: 12/17/08

Sampled By: NB, CB

Method of Purging: NA

Method of Sampling: peristaltic

Initial Depth to Water:

Depth to Water after Sampling: ____

Total Depth to Well: ____

Well Diameter: ____

1 Casing/Borehole Volume: ____ (Circle one)

3 Casing/Borehole Volumes: ____ (Circle one)

Total Casing/Borehole Volumes Removed: ____

Time	Turb. ~~Intake Depth~~ NTU	DO ~~Rate (gpm)~~ mg/L	ORP ~~Cum. Vol. (gal.)~~ mV	Temp. (°C)	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
1240	91.3	10.08	108	3.8	8.20	60.6	slightly orange

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

Sample @ 1245

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: AMEC Geomatrix	Phone: 206-342-1760
Client Contact: Nick Bacher	
Client Project Name: Whitmarsh Landfill	
Client Project #: 14159	Samplers: Nick Bacher, Chris Brown

Page: 1	of 2
Date: 12/17/08	Ice Present?
No. of Coolers:	Cooler Temps:

Analysis Requested

Sample ID	Date	Time	Matrix	No. Containers	VOCs	SVOCs	Phenols	PAHs	PCBs	OC Pest.	HCID (TPH)	TPH-Gx	TPH-Dx	Diss. Met	Tot. Met	pH	TDS	Carbonyl		Notes/Comments
SP-1-1208	12/17/08	1155	H_2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
SW-7-1208	12/17/08	1245	H_2O	25	X	X	X	X	X	X				X	X	X	X	X		
SW-1-1208	12/17/08	1355	H_2O	25	X	X	X	X	X	X				X	X	X	X	X		
SW-5-1208	12/17/08	1510	H_2O	25	X	X	X	X	X	X				X	X	X	X	X		
SW-3-1208	12/17/08	1520	H_2O	25	X	X	X	X	X	X				X	X	X	X	X		
SW-6-1208	12/17/08	1545	H_2O	25	X	X	X	X	X	X				X	X	X	X	X		
MW-02-1208	12/18/08	1040	H_2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
MW-03-1208	12/18/08	1330	H_2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
MW-103-1208	12/18/08	1340	H_2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
SW-04-1208	12/18/08	1515	H_2O	25	X	X	X	X	X	X				X	X	X	X	X		

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Nick Bacher	(Signature) Jami Heyes	(Signature)	(Signature)
	Printed Name: Nick Bacher	Printed Name: Jami Heyes	Printed Name:	Printed Name:
	Company: AMEC GMX	Company: ARI	Company:	Company:
	Date & Time: 12/19/08 1553	Date & Time: 12/19/08 1553	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: AMEC Geomatrix	Phone: 206-342-1760
Client Contact: Nick Bacher	
Client Project Name: Whitmarsh Landfill	
Client Project #: 14159	Samplers: Nick Bacher, Chris Brown

Page: 2	of 2
Date: 12/18/08	Ice Present?
No. of Coolers:	Cooler Temps:

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	VOCs	SVOCs	Phenols	PAHs	PCBs	OC Pest.	HCID (TPH)	TPH-Gx	TPH-Dx	Diss. Met	Tot. Met	pH	TDS	Carbonyl		Notes/Comments
SP-02-1208	12/18/08	1600	H2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
SP-03-1208	12/18/08	1645	H2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
MW-04-1208	12/18/08	1145	H2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
EB-1208	12/19/08	1515	H2O	25	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Trip Blank	—	—	H2O	6	X															

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) Nick Bacher	(Signature) Dani Hayes	(Signature)	(Signature)
	Printed Name: Nick Bacher	Printed Name: Dani Hayes	Printed Name:	Printed Name:
	Company: AMEC GMX	Company: ARI	Company:	Company:
	Date & Time: 12/19/08 1553	Date & Time: 12/19/08 1553	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW02

Project Name: Skagit Whitmarsh Landfill

Date: 4/29/09

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 7.56

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1147	7.65	0.241	13.00	145	2.44	15	
	1150	7.44	0.144	11.65	139	1.38	11	
	1153	7.37	0.100	10.72	140	0.72	14	
	1156	7.23	mS/m 84.1	10.72	138	0.63	15	
	1159	7.13	73.9	10.56	142	0.39	15	
	1203	7.05	71.0	10.44	146	0.24	16	
	1206	7.02	68.5	10.42	146	0.14	22	
	1210	6.99	66.7	10.46	147	0.02	27	
	1213	6.99	63.2	10.30	147	0.00	31	
	1216	6.97	63.2	10.33	146	0.00	36	
	1219	6.97	62.7	10.32	146	0.00	37	
	1222	6.97	62.3	10.43	145	0.00	37	

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 1145

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1230

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-03

Project Name: Skagit Whitmarsh Landfill

Date: 4/28/09

Project Number: 14159

Weather Conditions: Ocast 50's

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: —

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 7.86

Wellhead Condition: OK

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
7.87	914	7.39	84.2	11.20	-122	3.67	19.4	
7.88	917	7.23	71.2	10.09	-124	0.23	12.6	
7.87	920	7.09	68.9	9.81	-128	0.35	6.3	
7.88	923	6.99	65.5	9.45	-129	0.00	1.9	
7.88	926	6.97	64.8	9.41	-130	0.00	~~27.3~~ 2.6	
7.89	929	6.94	64.3	9.40	-133	0.00	0.1	

Sample ID No.: MW-03-0409, MW-103-0409

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 913

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 930 / 1020

Purging Method: Peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Duplicate collected

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-04

Project Name: Skagit Whitmarsh Landfill

Date: 4/29/09

Project Number: 14159

Weather Conditions: P. Sunny 50'S

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 2.95

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	846	7.54	51.6	10.15	24	3.42	0	
	849	7.30	51.8	10.25	-80	0.00	0	
	852	7.22	51.7	10.32	-95	0.00	1.1	
	855	7.20	51.6	10.40	-101	0.00	0	
	858	7.26	51.5	10.45	-107	0.00	0	
	901	7.24	51.3	10.51	-112	0.00	0	
	904	7.26	51.3	10.52	-116	0.00	0	

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 845

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: ~~940~~ 920

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-01

Project Name: Skagit Whitmarsh Landfill

Date: ______

Project Number: 14159

Weather Conditions: ______

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: ______

WELL INFORMATION

Casing Diameter (in): N/A

Top of Casing Elevation (ft): N/A

Initial Depth to Water (ft): N/A

Wellhead Condition: ______

Groundwater Elevation (ft): ______

Depth of Well Casing (ft): ______

Actual Purge Volume (gal): ______

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1315	7.31	74.9	13.61	-26	5.45	13.7	

Sample ID No.: ______

Water Level Ind. Model & No.: ______

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: N/A

Sampling Equipment Used: ______

Purge Start Time: ______

Purge Completion Time: ______

Average Purge Rate (mL/min): ______

Analytical Lab: ______

Sample Collection Time: 1315

Purging Method: ______

Sample Containers Used: ______

Chemical Analyses: ______

Other Field Observations: ______

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-07

Project Name: Skagit Whitmarsh Landfill

Date: ______

Project Number: 14159

Weather Conditions: ______

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: ______

WELL INFORMATION

Casing Diameter (in): NA
Top of Casing Elevation (ft): NA
Initial Depth to Water (ft): NA
Wellhead Condition: ______

Groundwater Elevation (ft): ______
Depth of Well Casing (ft): ______
Actual Purge Volume (gal): ______

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1405	6.99	0.132	13.84	-86	7.60	9.0	

Sample ID No.: ______
Water Level Ind. Model & No.: ______
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used: ______
Sampling Equipment Used: ______

Purge Start Time: 1405
Purge Completion Time: ______
Average Purge Rate (mL/min): ______
Analytical Lab: ______

Sample Collection Time: 1415
Purging Method: ______
Sample Containers Used: ______
Chemical Analyses: ______

Other Field Observations: ______

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-03

Project Name: Skagit Whitmarsh Landfill

Date: 4/28/09

Project Number: 14159

Weather Conditions: P. Sunny 60°

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: ____________

WELL INFORMATION

Casing Diameter (in): NA

Top of Casing Elevation (ft): NA

Initial Depth to Water (ft): NA

Wellhead Condition: ____________

Groundwater Elevation (ft): ____________

Depth of Well Casing (ft): ____________

Actual Purge Volume (gal): ____________

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (μs/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1509	6.95	0.129	14.31	-66	5.48	145	

Sample ID No.: ____________

Water Level Ind. Model & No.: ____________

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: ____________

Sampling Equipment Used: ____________

Purge Start Time: 1510

Purge Completion Time: ____________

Average Purge Rate (mL/min): ____________

Analytical Lab: ARI

Sample Collection Time: 1520

Purging Method: ____________

Sample Containers Used: ____________

Chemical Analyses: ____________

Other Field Observations: ____________

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-Ø1

Project Name: Skagit Whitmarsh Landfill

Date: 4/28/07

Project Number: 14159

Weather Conditions: overcast, 50s

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): NA

Top of Casing Elevation (ft): NA

Initial Depth to Water (ft): NA

Wellhead Condition: NA

Groundwater Elevation (ft): NA

Depth of Well Casing (ft): NA

Actual Purge Volume (gal): NA

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
/	1020	6.97	46.0	10.56	76	8.76	4.1	clear, some algae in water

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1000

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-03

Project Name: Skagit Whitmarsh Landfill

Date: 4/29/09

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): N/A

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (mS/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1004	7.82	0.221	16.34	90	14.09	15	

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1020

Purging Method: dunk

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Stagnant water w/ foam & oily sheen on surface

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-04

Project Name: Skagit Whitmarsh Landfill

Date: 4/29/09

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (µs/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	923	6.74	.755	12.49	66	7.52	17.2	

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 940

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-05

Project Name: Skagit Whitmarsh Landfill

Date: 4/29/09

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (mS/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1041	7.54	.682	16.47	95	10.55	4	

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1100

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-06

Project Name: Skagit Whitmarsh Landfill

Date: 4/29/09

Project Number: 14159

Weather Conditions: ____

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: ____

WELL INFORMATION

Casing Diameter (in): ____

Top of Casing Elevation (ft): ____

Initial Depth to Water (ft): ____

Wellhead Condition: ____

Groundwater Elevation (ft): ____

Depth of Well Casing (ft): ____

Actual Purge Volume (gal): ____

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1053	7.41	1.83	16.81	115	13.85	14	

Sample ID No.: ____

Water Level Ind. Model & No.: ____

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: ____

Sampling Equipment Used: ____

Purge Start Time: ____

Purge Completion Time: ____

Average Purge Rate (mL/min): ____

Analytical Lab: ____

Sample Collection Time: 1100

Purging Method: ____

Sample Containers Used: ____

Chemical Analyses: ____

Other Field Observations: ____

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-02
Sample ID: MW-2-0709 Duplicate ID:
Sample Depth: btm
Project and Task No.: 14159
Project Name: ~~FF~~ Whitmarsh
Date: 7/24/09
Sampled By: C.B., I.O
Method of Purging: Parastaltic
Method of Sampling: " "

Initial Depth to Water: 8.20
Depth to Water after Sampling: 8.24
Total Depth to Well:
Well Diameter: 2"
1 Casing/Borehole Volume:
(Circle one)
3 Casing/Borehole Volumes:
(Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate ~~(gpm)~~ mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Remarks (color, turbidity, and sediment) Turb DO ORP
849	btm	200	0	11.8	6.77	1.14	25 8.80 201
852			0.2	11.8	6.61	over	13 0.0 206
855			0.4	11.8	6.50	over	11 0.0 210
858			0.7	11.8	6.42	over	11 0.0 210
901			1.0	11.8	6.40	over	9.7 0.0 211
904			1.3	12.5	6.39	over	14.7 0.07 210
907			1.7	12.1	6.38	over	13.2 0.0 209
912			1.9	12.1	6.37	over	13.3 0.0 209
915			2.1	12.1	6.36	over	11.5 0.0 207
919			2.3	12.2	6.36	over	10.2 0.0 206

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Seems the conductivity is not working correctly again, and is out of range, recalibration efforts didn't help.
sample collected @ 920

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Sample 1805

Dup 1915

Well ID: MW-03

Sample ID: MW-03-0709 Duplicate ID: MW-103-0709

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 7/23/09

Sampled By: C.B. T.O.

Method of Purging: Parastaltic

Method of Sampling: " "

Initial Depth to Water: 9.40 ~~5.236~~

Depth to Water after Sampling:

Total Depth to Well: 17.52

Well Diameter: 2" →8.12'

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate ~~(gpm)~~ mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment) Turb DO ORP
1730 ~~1640~~	btm	200	0.1	16.5	7.02 ~~8.3~~	—	16 1.16 -53
1733			0.15	16.0	7.09	9.99 +	6.8 3.19 -100
1737			0.2	16.0	7.11	9.44	6.9 7.84 -115
1741			0.5	16.0	7.11	4.38	7.3 8.28 -133
1744			0.6	15.9	7.11	3.20	8.5 8.51 -137
1747			0.8	15.9	7.12	2.02	8.0 8.64 -144
1751			1.1	15.8	7.12	1.51	8.5 8.67 -147
1754			1.4	15.8	7.14	1.18	9.3 8.61 -152
1758			1.7	15.8	7.14	0.30	10.3 8.54 -156
1801			2.0	15.7	7.15	0.162	11.6 8.48 -160

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: After recalibrating instrument, we cannot get Cond. sensor to work right, may be damaged. ~~Sample~~ Sample collected @ 1805, Dup. collected @ 1915.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-04
Sample ID: MW-04-0709 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 7/24/09
Sampled By: CB, TO
Method of Purging: Peristaltic
Method of Sampling: " "

Initial Depth to Water: 3.05
Depth to Water after Sampling: 3.07
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
3 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment) Turb	DO	ORP
10:47				14.0	7.20	7.0 mS/cm	4.2	9.58	193
10:50				13.6	7.26	0.350	3.3	9.43	176
10:54				13.2	7.30	5.90	3.7	7.44	129
10:57				13.2	7.31	4.05	2.6	7.72	100
11:01				13.0	7.31	3.55	2.6	8.0	79
11:04				13.1	7.29	2.43	2.6	8.15	44
11:07				13.1	7.33	2.43	3.3	8.12	13
11:10				13.1	7.33	1.55	3.4	8.37	-14
11:14				12.9	7.32	0.93	2.8	8.61	-42
11:18				12.8	7.33	0.17	2.9	8.82	-52
11:21				12.7	7.33	0.128	2.8	8.87	-64
11:24				12.6	7.33	0.103	2.8	8.87	-69

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @ 11:30.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-01

Sample ID: SP-01-0709 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 7/24/09

Sampled By: CB, TD

Method of Purging: Peristaltic

Method of Sampling: " "

Initial Depth to Water: ⊖

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment) Turb. / DO / ORP
13:58				16.0	7.37	0.308	14.0 / 12.90 / 133

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @ 14:00.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-02

Sample ID: SP-02-0709 Duplicate ID:

Sample Depth: -0-

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 7/24/09

Sampled By: CB TO

Method of Purging: Peristaltic

Method of Sampling: " "

Initial Depth to Water:

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume: (Circle one)

3 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)
							Turb DO ORP
~~1555~~	1555			18.6	7.26	0.152	55 11.63 54

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample Collection @ 1600

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-03

Sample ID: SP-03-0709 Duplicate ID:

Sample Depth: ⊖

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 7/24/09

Sampled By: CB, TO

Method of Purging: Peristaltic

Method of Sampling: " "

Initial Depth to Water: ⊖

Depth to Water after Sampling:

Total Depth to Well:

Well Diameter:

1 Casing/Borehole Volume:
(Circle one)

3 Casing/Borehole Volumes:
(Circle one)

Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Remarks (color, turbidity, and sediment) Turb / DO / ORP
15:05				19.3	6.86	0.206	45.0 / 11.65 / 41

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (μS/cm=μmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @ 15:10.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-01

Sample ID: SW-01-0709 Duplicate ID: ______

Sample Depth: ______

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 7/23/09

Sampled By: C. Brown

Method of Purging: ~~dunk~~ NA

Method of Sampling: dunk

Initial Depth to Water:

Depth to Water after Sampling: ______

Total Depth to Well: ______

Well Diameter: ______

1 Casing/Borehole Volume: ______
(Circle one)

3 Casing/Borehole Volumes: ______
(Circle one)

Total Casing/Borehole Volumes Removed: ______

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)
10:34				16.0	6.81	0.250*	57.0 NTU, 7.72 g/L, 4.0‰ -71mV

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

* S/m

Sample collected @ 10:35.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-03
Sample ID: SW-03-0709 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 7/23/09
Sampled By: CB, TO
Method of Purging: NA
Method of Sampling: Dunk

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
3 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Remarks (color, turbidity, and sediment) turb DO ORP
11:25				17.4	6.79	9.99+	20.0 1.52 137

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @ 11:30.

\\sf3\ppingree$\FORMATS\WELL SAMPLING Record.doc

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-04
Sample ID: SW-04-0709 Duplicate ID: ____
Sample Depth: ____
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 7/23/09
Sampled By: CB, TO
Method of Purging: NA
Method of Sampling: Dunk

Initial Depth to Water:
Depth to Water after Sampling: ____
Total Depth to Well: ____
Well Diameter: ____
1 Casing/Borehole Volume: ____ (Circle one)
3 Casing/Borehole Volumes: ____ (Circle one)
Total Casing/Borehole Volumes Removed: ____

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Remarks (color, turbidity, and sediment) Turb | DO | ORP | SAL
15:15				22.7	8.27	9.99	~~90.4~~ | 2.59 | 57mV | 4.0%
							45.7

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @ 15:20

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-05
Sample ID: SW-05-0709 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 7/23/09
Sampled By: CB, TD
Method of Purging: NA
Method of Sampling: Dunk

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
3 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)
							Turb | DO | ORP | SAL
14:38				26.4	8.66	~~6. 9.18~~	12.3 | 4.18 | 74mV | 4.0%
						3.13	

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-06
Sample ID: SW-06-0709 Duplicate ID: ______
Sample Depth: ______
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 7/23/09
Sampled By: CB, TD
Method of Purging: NA
Method of Sampling: Dunk

Initial Depth to Water:
Depth to Water after Sampling: ______
Total Depth to Well: ______
Well Diameter: ______
1 Casing/Borehole Volume: ______ (Circle one)
3 Casing/Borehole Volumes: ______ (Circle one)
Total Casing/Borehole Volumes Removed: ______

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment) Turb. / ~~Cond~~ / DO / ORP
14:00				23.5	7.62	9,994.0	27 / ~~9994~~ / 3.76mg/L / 150

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: Sample collected @ 14:05

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: AMEC Geomatrix, Inc.	Phone: 206-342-1760
Client Contact: Nikolas Bacher	
Client Project Name: Whitmarsh Landfill	
Client Project #: 14159	Samplers: Chris Brown (CB), Toni Olson (TO)

Page: 1	of 2
Date: 7/24/06	Ice Present?
No. of Coolers:	Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	VOC / Diethyl ether	SVOCs	Pest	Total Metals	PCBs	Dissolved Metals	TPH-Dx	pH/TDS	TPH-HCID	TPH-G	Total Hg	Dissolved Hg	PAHs	Notes/Comments
SW-01-0709	7/23/09	10:35	W	16	X	X	X	X	X	X		X			X	X	X	~~2~~ 4, 6, 4, 7
SW-03-0709	7/23/09	11:30	W	16	X	X	X	X	X	X		X			X	X	X	4, 6, 7
SW-06-0709	7/23/09	14:05	W	18	X	X	X	X	X	X		X			X	X	X	4, 6, 7
SW-05-0709	7/23/09	14:40	W	18	X	X	X	X	X	X		X			X	X	X	4, 6, 7
SW-04-0709	7/23/09	15:20	W	18	X	X	X	X	X	X		X			X	X	X	4, 6, 7
MW-03-0709	7/23/09	18:05	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	3, 6, 7
MW-103-0709	7/23/09	19:05	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	3, 6, 7
MW-02-0709	7/24/09	9:20	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	4, 2, 6, 7
MW-04-0709	7/24/09	11:30	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	2, 6, 7, 3
~~MW~~ SP-01-0709	7/24/09	14:00	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	2, 6, 7, 3

Comments/Special Instructions
1 - Tot. Metals Samp. Need Pres. Added
2 - Total Hg Samp. Needs Pres. Added
3 - Diss Met. = Field-filtered
4 - Diss Met. = Not field-filtered
5 - Diss Hg = Field-filtered
6 - Diss Hg = Not field-filtered
7 - Sub out diethyl ether analysis

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Toni Olson	Printed Name: Jonathon Walter	Printed Name:	Printed Name:
Company: AMEC GMX	Company: ARI	Company:	Company:
Date & Time: 7/25/09 8:10	Date & Time: 7/25/09 8:10	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: AMEC Geomatrix, Inc.	Phone: 206-342-1760
Client Contact: Nikolas Bacher	
Client Project Name: Whitmarsh Landfill	
Client Project #: 14159	Samplers: CB, TD

Page: 2 of 2	
Date: 7/24/09	Ice Present?
No. of Coolers:	Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	VOC	Diethyl Ether	SVOC	Pest	Total metals	PCBs	Dissolved Metals	TPH-Dx	pH/TDS	TPH-HCID	TPH-G	Total Hg	Dissolved Hg	PAHs		Notes/Comments
SP-03-0709	7/24/09	15:10	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3, 2, 6, 7
MW-05-0709	7/24/09	17:05	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	X		1, 4, 6, 7
SP-02-0709	7/24/09	16:00	W	26	X	X	X	X	X	X	X	X	X	X	X	X	X	X		2, 6, 7, 3
Trip Blanks	—	—	W	11	X															

Comments/Special Instructions
1-Tot. Metals Sample needs preserv.
2-Tot. Hg Sample Needs Preserv.
3-Diss. Met. = Field-filtered
4-Diss. Met. = Not field-filtered
5-Diss. Hg. = Field-filtered
6-Diss. Hg. = Not field-filtered
7-Sub out diethyl ether analysis

	Relinquished by	Received by	Relinquished by	Received by
(Signature)	[signature]	[signature]		
Printed Name:	Toni Olson	Jonathon Walter		
Company:	Amec Geomatrix	ARI		
Date & Time:	7/25/09 8:10	7/25/09 810		

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

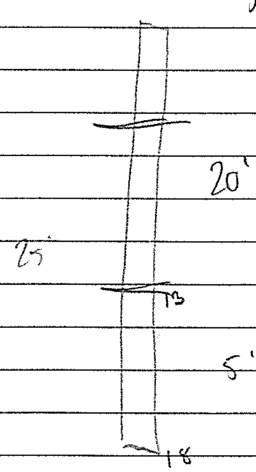
PROJECT: Whitmarsh Ph. II Inv.		Log of Boring No. MW-07	
BORING LOCATION: MW-07		ELEVATION AND DATUM:	
DRILLING CONTRACTOR: CDI		DATE STARTED: 3/31/10	DATE COMPLETED: 3/31/10
DRILLING METHOD: HSA		TOTAL DEPTH:	MEASURING POINT:
DRILLING EQUIPMENT: CME 75 on Marooka		DEPTH TO WATER: 8' atd	DEPTH TO FREE WATER ATC:
SAMPLING METHOD: split spoon		LOGGED BY: N. Bacher	
BOREHOLE DIAMETER:		HAMMER TYPE/SYSTEM: 300" / 30" drop	

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
1	~~100~~ 100		2/3/3		SM: brown, ~~trace~~ scattered oxi mottling, 20% wood debris (roots) 80/20 sand med.							↑ cover soil
2	50		3/2/10		SM: as above. less roots 5%.							
3–4	80		3/4/5		SM: as above but with white plastic garbage starting @4'							↓ 4'
5	50		2/4/4		SM as above with few rounded gravel, scattered white plastic trash. 70/20/10 gravel up to 1".							↑ refuse
6–7	15%		4/5/5		SM: as above. moist							
8	0		2/2/3		No recovery, SM/SP material like above in shoe.							▽8' atd
9–10	5%		2/3/3		Limited recovery, material is gray ~~SP~~ SM 85/15 with few gravel rounded to 1". trace wood shreds & plastic debris							
11–12	50		5/6/7		SM/SP or SW: gray, sand med cr., trace wood chunks (native?), few gravel 85/15 → 1/4" or less brown.							
13	100		10/12/14		SW: gray, sand is fn-cr, 15% gravel rounded <10% fines, trace brown wood chunks							
14	100		7/11/13		SW: as above. no wood chunks							
15												

PROJECT:

Log of Boring No. MW-07

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
16	100		10/12/16		SW as above							
17	100		8/22/24		SW as above (took picture of spoon)							
18												
19	100		15/14/24		SW as above.							
20					TD = 19.5							
					no clay.							
21					Screen 13-18							
22					Sand 12-18							
					Chip 3-12							
23					Cement 0-3							
24					Cut off: 4.04							
25					5' screen + 20' blank.							
26												
27					Sticking up 7							
28					cut off 4.04							
					stickup 2.97							
29					+13							
30					15.97							
					20.97							
31												
32												
33												
34												



Project No. | Geomatrix | Page 2 of ___

1/3/5
5/5/5

PROJECT: Whitmarsh Ph. II Inv.

Log of Well No. MW-08

4/2/10

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches	DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16 (0–1.5)	0		1/3/5	No recovery							
17 (1.5–3)	75		5/5/5	WOOD: saw dust, bark, wood chips brown							
3 18–19 (3–4.5)	75		7/8/8	WOOD as above.							Wood
20 (4.5–6)	75		7/8/8	WOOD as above, few pea gravel.							
6 21–22 (6–7.5)	75		7/20/20	WOOD to 7', then SM: gray, 10% rounded grav 65/25 sand med.							7'
23 (7.5–9)	50		10/15/12	SM: as above, 5% gravel. 70/25							
9 24–25 (9–10.5)	5		8/4/4	Shoe material is SM like above, otherwise no recovery.							cover soil
26 (10.5–12)	75		10/8/8	SM material as above, metal debris (old can?) in shoe.							12'
12 27–28 (12–13.5)	80		18/20/20	SM: gray, 80/20, white plastic bags, pieces of metal (can?), tile, cored through plywood sheet @ 13.							∇ 13' atd
29 (13.5–15)	5		32/19/20	SP/SM: gray, very low recovery, 80/20, no apparent garbage							
15 30–31 (15–16.5)	16		8/10/15	SM as above, plastic garbage, metal wires, trace wood debris (slough)							refuse
32 (16.5–18)	10		4/4/5	SM/SP: reddish brown and white, low recovery, small red plastic pieces 85/15 ish 90/10							
18 33–34 (18–19.5)	10		7/8/8	SP/SM as above, reddish brown, plastic fell of sampler as it came up through auger							

PROJECT: Whitmarsh Ph. II MV.

Log of Well No. MW-08

DEPTH (feet)	Sample No.	Sample	Blows/ 6 inches	DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
20 [16]	10		12/15/16	SP/SM as above, white pieces of tile, brown & green glass shards	refuse ↓
21 [17]	50		10/15/17	SP/SM as above, glass shards small crumpled up pieces of Aluminium.	
22.5 [18]	100		3/4/4	SP/SM as above 23. then CL: gray, soft, mod. plast (took picture)	23'
24 [19–20]				Shelby pushed from 24-26 decent Shelby 60% full CL in bottom.	↑ bay mud
26 [21–22]	75		6/8/8	CL as above, trace sand MW08-26-27.5 sample.	Put conductor casing to 26'.
27.5 [23]				No sample 27.5-28	↓
[24]	100		4/4/4	ML: gray, soft, few pea gravel, crushed shells 80/20 some clay. 10% sand med-cr (took picture)	
29.5 [25]	100		7/8/8	SM: gray, 55/30/15 gravel rounded, trace crushed shells	30'
31 [27]	100		10/12/12	SM/SM: gray 65 sand, 25 gravel, 10% fines (took picture)	↑ lower aquifer
32.5 [28]	75		12/18/24	SW/GW: gray, sand fn-cr, gravel up to 1", 60 sand, 30% gravel 10% fines.	
34 [30]				TD = 34'	
35.5 [31]					Screen 10-20
[32]					Sand 9-20
37 [33]					Chip 3-9
					Cement 0-3
					10' screen + 15' blank
[34]					Cutoff = 1.81'
					3.19

FIELD-ESTIMATED %: Gravel (Coarse, Fine); Sand (Coarse, Medium, Fine); Fines — no entries.

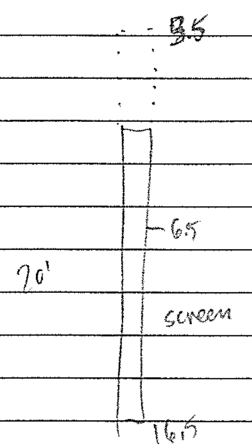
PROJECT: Whitmarsh Ph. II investigation	Log of Boring No. MW-09
BORING LOCATION: MW-09	ELEVATION AND DATUM:
DRILLING CONTRACTOR: CDI	DATE STARTED: 3/29/10 — DATE COMPLETED:
DRILLING METHOD: HSA	TOTAL DEPTH: — MEASURING POINT:
DRILLING EQUIPMENT: CME85 on Marooka	DEPTH TO WATER: 9' atd — DEPTH TO FREE WATER ATC:
SAMPLING METHOD: split spoon 18"x2.5"	LOGGED BY: N. Bacher
BOREHOLE DIAMETER:	HAMMER TYPE/SYSTEM: 300# / 18" drop.

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
0–1.5	50%		3/4/5		WOOD: bark, shreds, fresh wood chunks. brown, moist, sawdust.							Wood cover (0–3.5')
1.5–3	75%		3/4/5		WOOD: as above.							
3–4.5	100%		7/46/8		WOOD as above to 4', then SM: gray, moist, 65% sand, 20% silt, 15% fn. gravel							
4.5–6	100%		6/15/20		SM: as above, but no gravel 80/20 hard wood board pieces, thin @ 5.5'							daily cover (4.5–7.5')
6–7.5	0%		11/11/11		NR: no recovery							
7.5–9	10%		6/8/9		WOOD: brown, shreded wood/bark, sawdust slough?? trace plastic garbage @ 8'							▽ 9' atd
9–10.5	100%		6/12/18		WOOD to 9.5 then SM like 4.5-6 with plastic bag garbage (white)							land fill material (8–12.5')
10.5–12	0		5/6/7		NR: no recovery. trace SM material as above with garbage odor.							
12–13.5	10%		4/5/5		SM as above with trace plastic and garbage odor. and black							
13.5–15	20%		8/32/50		SM: black, loose, garbage odor, trace plastic garbage (white), metal debris.							wire stuck in shoe

BoringLogForm (111306)

PROJECT: Whitmarsh Ph. II.	Log of Boring No. MW-Ø9

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
16	100%		45/32/50		SM/SP: black, sand or, 25% wood chunks, copper wire, plastic							garbage
17	15%		3/3/5		CL: soft, gray, mod. plasty, trace shells.							marine bay mud
18												
19					TD = 18'							
20					Screen 6.5-16.5'							
					Sand 5.5-16.5							
21					Bentonite 3-5.5							
					Cement 0-3							
22					Stickup completion							
23					One drum							
24					MW09 3/29/10							
25					Cut off = 0.62							
26					10' screen + 10' riser							
27												
28					3.5 − 0.62 = 2.88							
29												
30					2.88 + 6.5 = 9.38							
31					19.38							
32												
33												
34												



Project No.	Geomatrix	Page 2 of ___

BoringLogForm (111306)

PROJECT: Whitmarsh Ph. II Inv. | Log of Well No. MW-10

4/1/10

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	FIELD-ESTIMATED %: Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	0		50/6"		No recovery. Cobbles to 1.5' based on driller							cobbles (arrow to 1.5)
1.5	752		9/10/15		WOOD: bark, sawdust, wood chips, brown.							1.5
3	50		32/50/50		WOOD as above.							
4.5	15		9/12/18		WOOD as above							
6	50		8/6/8		Wood as above, few rounded gravel to 3/4".							Wood
7.5	75		9/15/15		WOOD as above to 10', then SM: gray, 80/20, sand med-fn, trace pea gravel, rounded (took picture)							
9	100		9/5/8									10
10.5	100		13/4/5		SM as above to 11.5. then SP/SM black, glass shards, white pockets of silty material, putty like 10-15% gravel 80/25 sand med-cr 70/20/10 gravel.							cover soil (arrow to 11.5); ▽ 11' atd
12	100		7/8/8		SM as above, black, metal wire, piece of tile (porcelain), slight garbage odor							
13.5	100		2/3/3		SP/GP: black, 60% sand, 30% gravel, 10% fines, glass shards, metal pieces, sl garbage odor	→ similar to MW-03						
15	100		3/3/4		SP/SM: black, 70% sand, 15% gravel 15% fines, glass shards, alum. foil pieces.							refuse
16.5	75		2/3/3		SP/SM as above, clear glass pieces (took picture)							
18	50		2/2/3		SP/SM as above but reddish brown, sl. garbage odor							
19.5												

Project No. | Geomatrix | Page ___ of ___

WellLogForm (111306)

PROJECT: Whitmarsh Ph. II inv.

Log of Well No. MW-10

4/1/10

DEPTH (feet)	Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	25		1/2/2		SP/SM as above, but reddish brown gray, metal wire pieces, 5% glass shards							
21	50		2/2/3		SP/SM as above, blackish gray, wire stuck in shoe, ~~copper wire crimp~~, glass shards							refuse ↓
22.5 (50%?)			2/2/2		SP/SM as above but black to 23.5 then							23.5
24					CL: silty clay, gray, soft, low to med plast.							↑ bay mud
					24-26 Pushed Shelby tube							
26					CL: silty clay in shoe of shelby trace shells. @1020							Chipped 24-27 to set conductor casing to 25.5
	100		2/2/2		CL/ML: as above sampled 26-27.5 @ 1025							
27.5												
28					No sample							
	100		1/2/2		CL/ML: silty clay to clayey silt as above, trace organic material and crushed shells LOPT like (took picture)							
29.5	100		2/3/3		←							↓ 30.25
31					CL/ML as above to 30.25 then							gradational
	100			8/10/12	SM: gray 75/25, 5% crushed shells ~~sand med,~~ (took picture) few rounded gravel to ½"							32
32.5	100		7/8/8		(took picture)							↑ glacial aquifer
34					SM as above grading to SW @ 32, gray, sand fn-med, 10-15% rounded gravel to 1", 10% fines							
					SW as above, ~~trace~~ crushed shells (could be slough)							↓
	10 screen + 15' blank				TD=34'							
					Screen 10-20							
	Cutoff = 1.86'				Sand 9-20							3.14
					Plug 3-9							
					Cement 0-3							

Project No.

Geomatrix

WellLogForm (111306)

PROJECT: Whitmarsh Ph. II Investigation	Log of Boring No. MW-11
BORING LOCATION:	ELEVATION AND DATUM:
DRILLING CONTRACTOR: CDI	DATE STARTED: 3/29/10 — DATE COMPLETED: 3/29/10
DRILLING METHOD: HSA	TOTAL DEPTH: — MEASURING POINT:
DRILLING EQUIPMENT: CME 85	DEPTH TO WATER: 8' — DEPTH TO FREE WATER ATC:
SAMPLING METHOD: split spoon 18" x 2.5"	LOGGED BY: N. Backer
BOREHOLE DIAMETER:	HAMMER TYPE/SYSTEM: 300 # / 30" drop.

DEPTH (feet)	Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
1	100		3/5/14		ML: gray, stiff, 20% med. sand 15% wood shreds, non-plast. 65% fines, dry							cover
2–3	100		10/14/16		SAA: but moist, 2" gray course sand lense ~~2.8~~-3.0							
4	75%		7/8/9		SP: gray, coarse, 85% sand, 15% fines to 4', then brown ML 80/20 with wood shreds trace plastic debris							
5	25%		6/6/6		ML: brown, moist, 80% silt, 10% sand, 20% wood shred, 5% plastic bags							land fill material
6–7	25%		9/23/30		ML as above but 10% plastic bags, trace metal wire, garbage smell.							
8	50%		3/4/4		SM: brown, 10% garbage, metal scraps, 70% sand, 15% garbage 15% fines and wood. strong garbage odor.							▽ 8' ATD
10	50%		3/14/20		SP: black, course, 15% fines, strong garbage odor, ~~slight~~ sheen on sample (organic) trace metal debris & wood shreds.							
11	50%		10/10/10		SP: as above but moderate sheen							
12	15%		2/3/4		SP: as above.							
14	15%		3/4/4		SP: as above							

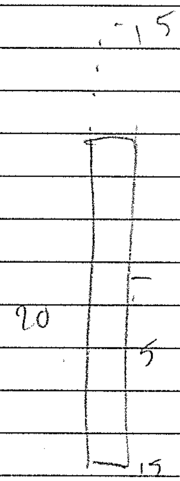
Project No. | Geomatrix |

BoringLogForm (111306)

PROJECT: Whitmarsh Ph - II.

Log of Boring No. MW-11

DEPTH (feet)	Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	REMARKS AND / OR TEST RESULTS
					SP ~~as~~ above to 15.5.							
16	75%		3/4/4		15.5 – CL: moist, soft, mod. plast. trace white crushed shells.							native bay mud
17	X		3/4/4		CL as above.							
18												
19					TD = 18'							
					Screen 5-15'							
20					Sand 4-15							
					Chips 3-4							
21					Cement 0-3							
22					Stick up completion.							
23					Cut off = 1.97' of 20'							
24					12 bags sand 2/12							
					1 bag bentonite.							
25					1 drum of waste generated							
26					MW-11 #1 3/29/10							
27					10' screen + 10' riser.							
28												
29					3.03							
30												
31												
32												
33												
34												



PROJECT: Whitmarsh Ph. II Invest.	Log of Well No. PZ-02	
BORING LOCATION: PZ-02	ELEVATION AND DATUM:	
DRILLING CONTRACTOR: CDI	DATE STARTED: 3/31/10	DATE COMPLETED: 3/31/10
DRILLING METHOD: HSA	TOTAL DEPTH:	MEASURING POINT:
DRILLING EQUIPMENT: CME 75 on Marooka	DEPTH TO FIRST WATER ATD:	DEPTH TO FREE WATER ATC:
SAMPLING METHOD: SS	CASING:	SCREEN INTERVAL:
BOREHOLE DIAMETER:	LOGGED BY: N. Bacher	
HAMMER TYPE/SYSTEM: 300#/30" drop		

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0–1					WOOD: bark, sawdust to 0.5							Cover 1.5'
1	50%		7/8/8		SM: brown, 80/20, wood frags plastic garbage moist							refuse
2	100		0/1/13		SM: brown, as above, white gooey material and plastic garbage to 2.5, @ 2.5 black burnt looking wood particles (flat). ~~SM: gray~~, oxi mottling @ 2.5-3.0							
3–4	75		10/32/40		SM: brownish gray, trace oxi mott, sand fn, 80/20, white plastic garbage. as above							
5	100		12/15/17		SM as above with SP: gray, med sand lens @ 5-5.5, glass shards & wood 5.5-6.0.							
6–7	100		8/10/11		SM/~~=~~ with garbage & glass shards to 7, then PT to 7.5 brown, soft, roots then SP: gray, sand med, few rounded 70/30 pea gravel							
8	100		8/15/4		SP: as above 10% gravel, 5% fines							
9–10	100		15/14/21		SP: as above, trace SM material with roots @ 9-9.5 (slough?)							9' atd glacial water bearing unit
11	100 (X)		12/16/20		SP: as above, trace pea gravel. (took picture)							
12–13	100 (X)		12/15/13		SW: gray, sand fn-cr, 10-15% pea gravel, 5% fines.							Screen 4-7 Sand 3-7
14–15	100		12/13/16		SP/SW as above.							Plug 2-3 Cement 0-2 Cut off = 3.0'

Project No. | Geomatrix | 3' screen + 10' blank | Page 1 of ___

WellLogForm (111306)

PROJECT: Whitmarsh Ph. II investigation	**Log of Well No.** PZ-03
BORING LOCATION: PZ-03	ELEVATION AND DATUM:
DRILLING CONTRACTOR: CDI	DATE STARTED: 3/31/10 — DATE COMPLETED: 3/31/10
DRILLING METHOD: HSA	TOTAL DEPTH: — MEASURING POINT:
DRILLING EQUIPMENT: CME 75 on Marooka	DEPTH TO FIRST WATER ATD: 6 — DEPTH TO FREE WATER ATC:
SAMPLING METHOD: SS	CASING: — SCREEN INTERVAL:
BOREHOLE DIAMETER:	LOGGED BY: N. Backer
HAMMER TYPE/SYSTEM: 300#/30" drop	

DEPTH (feet)	Sample No.	Sample	Blows/ 6 inches		DESCRIPTION NAME (USCS Symbol): color, moisture, plasticity, consistency, structure, cementation, reaction with HCl, geologic interpretation.	Gravel Coarse	Gravel Fine	Sand Coarse	Sand Medium	Sand Fine	Fines	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0–1	15%		3/4/4		SM: 70/30, brownish gray, scattered wood (roots) few gravel. sand is fn.							rough drilling cont. lots of debris upper 3', moved around a lot. restarted hole 15' N.
2	15%		9/12/20		SM: as above, white garbage material, plastic, wood chips							
4	50		5/6/7		SM: plastic drinking straws, brick fragments, wood chunks. SM as above. 15% garbage.							refusal
5	20%		2/2/2		SM: wet, few gravel up to 1", brown, 80/20							▽ 6' atd
7	100%		1/3/5		SM, brown, roots (mat-like) PT plastic garbage in lenses throughout (took picture)							7.5-8
8	100		1/2/2		PT to 8' then SM gray, sand is med-fn 10% fines, few <2% gravel up to ½"							PT / native
10	100		1/3/5		SM as above.							glacial aquifer
11	100		5/6/7		SM as above to 11. then SP/SW gray, 15% gravel to 1" rounded. sand is fn-cr. one wood chunk @ 11.5.							
13	100		10/12/13		SW as above.							
14	100		10/14/12		SW as above							

Project No. — Geomatrix — Page 1 of ___

WellLogForm (111306)

3/30/09 PZ-01 Whitmarsh Ph. II

Blows	Int.	Rec.	Litho	Notes
3/4/4	0-1.5	50%	WOOD brown moist, shreds, bark sawdust gray ML 60/20 @ 1.0	
8/10/15	1.5-3.0	50%	ML: gray 80/20, non-plast trace wood as above	cover
5/6/6	3-4.5	75%	SM gray ~~as above~~ but 70/30 trace wood trace gravel	5'
4/5/5	4.5-6	100	SM as above, white plastic garbage bag & and coolant, trace metal debris	
13/32/50	6-7.5	10%	white garbage bag in shoe trace gray gravelly sand	refuse
32/9/20	7.5-9	10%	plastic garbage set of small keys, metal wire & blue gray sand ... 60/20	▽ 9' atd.
5/5/6	9-10.5	10%	garbage as above gray ... plastic	
1/2/2	10.5-12	100%	garbage to 11 then CL: gray, soft, med plast trace ...	
1/1/1	12-13.5	75%	CL as above	

TD = 13.5'

Screen 6 ...

Cut off 1.05'

5' screen ...

10' ...

1 drum used

3/30/09 MW-05 Whitmarsh Ph. II

Blows	Int	Rec	Litho	Water
2/2/2	0-1.5	75%	SM brown, 80/20 trace wood ..., bark	cover
2/5/20	1.5-3.0	50%	SM as above	
10/12/15	3-4.5	0%	concrete piece in shoe.	
12/6/5	4.5-6	50%	SM as above w/ plastic ... garbage ... concrete chunks	
8/9/9	6-7.5	15%	SP brown, 70% sand 20% ... garbage	refuse
8/12/19	7.5-9	Ø	no recovery, gray soft in shoe	▽ 9' atd
5/6"	9-10.5	15%	ML gray, soft, plastic, garbage	10.5
3/3/4	10.5-12	20%	CL gray, ..., med plast ...	
2/3/3	12-13.5	75%	CL as above ... (conductor to 14.5') coil of metal pipe wrapped ...	buried drift log
7/4/4	15-16.5	75%	SP gray, coarse, trace ...	
4/4/4	16.5-18	75%	ML/CL gray ...	bay mud
7/8/9	18-19.5	75%	ML/CL as above	20
10/15/16	19.5-21	50%	SP gray, loose, coarse, 10% ... gravel	glacial ...
10/12/12	21-22.5	15%	as above	
11/10/12	22.5-24	100%	as above	

3/30/09 Whitmarsh Ph II MW-05 cont

Blows	Int.	Rec.	Lith.	Notes
10/12/17	24-25.5	Ø	trace cr. sand as above	
10/14/18	25.5-27	100%	GP/SP: gray, coarse sand & gravel (fn to 1" and subr) 60/40 gravel/sand.	glacial aquifer
10/17/18	27-28.5	Ø	Shoe has as above.	
10/14/15	28.5-30	100%	as above (picture taken)	
[illegible]	30-31.5	50%	SP gray, med-cr., 10% fn gravel loose.	
17/26/30	31.5-33	100%	GP/SP as above	

TD = 33'
Screen 23-33
Sand 22-33
Chip 3-22
Cement 0-3

10' screen +
30' blank.
cut off < 4.0'

piece of [illegible] tire stuck [illegible] of smaller auger below [illegible] could [illegible] [illegible]

3/30/09 Whitmarsh Ph II MW-06

Blows	Int	Rec	Lith	Notes
7/7/8	0-1.5	50%	SM: brown [illegible] wood [illegible]	Cover
11/10/15	1.5-3	[illegible]	as above [illegible]	
7/6/8	3-4.5	15%	ML: 70/30 blackish gray glass shards, wood pieces, plastic garbage	landfill material
3/6/3	4.5-6	10%	ML/SM as above	
[illegible]	6-7.5	Ø	No recovery	
32/30/14	7.5-9	10%	ML/SM as [illegible]	▽ 8'
2/4/10	9-10.5	50%	SM blackish gray, wood chips [illegible] 2" ML [illegible] @ 10.1	10
10/12/15	10.5-12	75%	GP/SP gray sand is cr, gravel to [illegible] subr.	glacial [illegible]
8/12/13	12-13.5	50%	SW gray, [illegible]	
7/8/10	13.5-15	100%	SW as above	
8/10/11	15-16.5	50%	SW as above	
8/10/10	16.5-18	80%	SW as above	
8/10/12	18-19.5	25%	SW as above	

5' screen
+10' riser
Cut off = 2.51'

Screen [illegible]
Sand 4-9.5
Plug 2-4
concrete 0-2
plug hole back up to 9.5 [illegible] screen.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-05
Initial Depth to Water: 11.32
Sample ID: ______ Duplicate ID: ______
Depth to Water after Sampling: ______
Sample Depth: ______
Total Depth to Well: 36.02
Project and Task No.: ______
Well Diameter: ______
Project Name: ______
1 Casing/Borehole Volume: ______ (Circle one)
Date: ______
Sampled By: ______
3 Casing/Borehole Volumes: ______ (Circle one)
Method of Purging: ______
Method of Sampling: ______
Total Casing/Borehole Volumes Removed: ______

Time	~~Intake Depth~~ ORP mV	NTU ~~Rate (gpm)~~	Cum. Vol. (gal.)	Temp. (°C)	DO	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ S/m	Remarks (color, turbidity, and sediment)
1220			∅					gray, silty.
1222	-69	NA	20	13.8	7.71	6.75	0.211	gray, silty

tried to purge 5 times and each time roughly 10-15 gals were pumped.

Stopped purging after 65 gallons when water was gray, cloudy and didn't clean up anymore.

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.: @ 1302 35.50' @ 1303 33.80 @ 1304 33.15

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: ran dry twice before 20 gals.
then ran dry @ ~ 74 gals after 8 min of pumping.
Started up again @ 1252, water @ ~14.2'
ran dry @ 1301.

MW-07
10.91
21.06

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PZ-02 dry, dt bottom 10.75'
[illegible] purged 5 times for a [illegible]

AMEC Geomatrix

GROUNDWATER SAMPLING LOG

~~Low Flow Sampling~~ Development

MONITORING WELL/PIEZOMETER NUMBER MW-Ø6

Project Name: Whitmarsh Ph. II Investigation

Date: 4/5/10

Project Number: 14159

Weather Conditions: sunny, 40s

Location:

Sampler: N. Bachm

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): 2"

Groundwater Elevation (ft):

Top of Casing Elevation (ft):

Depth of Well Casing (ft): 12.55

Initial Depth to Water (ft): 8.55

Actual Purge Volume (gal): 55 gals.

Wellhead Condition: good, new.

PURGING MEASUREMENTS

Volume ~~WL (ft btoc)~~	Time	pH (std. units)	S/m SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
24	1336	7.54	0.159	13.2	-52	5.05	76.2	yellow tint
28	1342	7.20	0.158	11.9	-75	4.93	56.4	"
32	1346	7.01	0.158	11.4	-74	4.87	33.5	"
36	1348	7.03	0.157	11.3	-71	4.95	32	"
40	1352	6.81	0.157	11.4	-70	4.84	28.5	"
43	1355	6.75	0.158	11.3	-70	4.79	25.4	"
46	1358	6.74	0.158	11.3	-71	4.78	25	"
49	1401	6.74	0.158	11.3	-70	4.81	25	"
52	1404	6.75	0.157	11.3	-71	4.85	25	"

Sample ID No.:

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.:

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Sample Collection Time:

Purge Completion Time:

Purging Method:

Average Purge Rate (mL/min):

Sample Containers Used:

Analytical Lab:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG

~~Low Flow Sampling~~ Development

MONITORING WELL/PIEZOMETER NUMBER MW-07

Project Name: ____________________

Date: ____________________

Project Number: ____________________ **Weather Conditions:** ____________________

Location: ____________________

Sampler: ____________________ **Wind Speed/Direction:** ____________________

WELL INFORMATION

Casing Diameter (in): ____________________ **Groundwater Elevation (ft):** ____________________

Top of Casing Elevation (ft): ____________________ **Depth of Well Casing (ft):** 21.60

Initial Depth to Water (ft): 10.91 **Actual Purge Volume (gal):** ____________________

Wellhead Condition: ____________________

PURGING MEASUREMENTS

gals ~~WL (ft btoc)~~	Time	pH (std. units)	S/m SC ~~(ms/cm)~~	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
Ø								gray, silty
20	1430	6.93	0.405	14.4	31	2.81	365	cloudy, yellow-gray
24	1433	7.05	0.402	14.6	-13	4.55	124	sl. cloudy, yellow
28	1436	7.10	0.397	14.0	-32	4.03	79.3	yellow tint
32	1439	7.12	0.402	14.6	-34	4.47	62.4	"
36	1442	7.12	0.399	14.0	-35	4.40	50.1	"
40	1445	7.13	0.396	14.1	-35	4.35	43.6	"
43	1448	7.13	0.392	14.1	-36	4.47	33	"
46	1451	7.12	0.392	14.1	-35	4.38	31	"
49	1454	7.12	0.393	14.1	-35	4.41	32	"
52	1457	7.13	0.392	14.1	-35	4.37	31	"

Sample ID No.: ____________________

Water Level Ind. Model & No.: ____________________

ORP/DO Meter Model & No.: ____________________

Purge Equipment Used: ____________________

Sampling Equipment Used: ____________________

Purge Start Time: ____________________ **Sample Collection Time:** ____________________

Purge Completion Time: ____________________ **Purging Method:** ____________________

Average Purge Rate (mL/min): ____________________ **Sample Containers Used:** ____________________

Analytical Lab: ____________________ **Chemical Analyses:** ____________________

Other Field Observations: dry after 1 gallon (gray silty water)

AMEC Geomatrix

~~WELL SAMPLING~~ ~~AND/OR~~ DEVELOPMENT RECORD

Well ID: MW. Ø8
Sample ID: ____ Duplicate ID: ____
Sample Depth: ____
Project and Task No.: ____
Project Name: ____
Date: ____
Sampled By: ____
Method of Purging: ____
Method of Sampling: ____

Initial Depth to Water: 15.93
Depth to Water after Sampling: ____
Total Depth to Well: 23.25
Well Diameter: ____
1 Casing/Borehole Volume: ____ (Circle one)
3 Casing/Borehole Volumes: ____ (Circle one)
Total Casing/Borehole Volumes Removed: ____

Time	ORP ~~Intake Depth~~	NTU ~~Rate (gpm)~~	Cum. Vol. (gal.)	Temp. (°C)	DO	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
0950			Ø					dark, sheen, garbage odor
1014	-76	689	20	11.4	6.79	7.08	84.4	cloudy, dark, garbage odor
1018	-89	344	24	11.4	8.35	7.10	86.1	cloudy, garbage odor.
1023	-86	209	28	11.5	8.15	7.13	84.5	sl. cloudy, odor
1027	-88	144	32	11.6	8.12	7.14	83.3	sl. cloudy, odor.
1031	-92	128	36	11.7	8.07	7.08	83.3	~~clear~~ sl. cloudy,
1034	-92	95	40	11.7	8.12	7.12	83.0	clearing up.
1040	-94	59	43	11.7	8.06	7.15	82.8	clear
1044	-97	35.7	46	11.8	8.26	7.12	82.1	clear
1048	-92	32.8	49	11.8	8.09	7.12	82.0	clear
1052	-93	33.0	52	11.8	8.10	7.13	82.1	Clear

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-Ø9

Sample ID: ____ Duplicate ID: ____

Sample Depth: ____

Project and Task No.: ____

Project Name: ____

Date: ____

Sampled By: ____

Method of Purging: ____

Method of Sampling: ____

Initial Depth to Water: 12.68

Depth to Water after Sampling: ____

Total Depth to Well: 19.42

Well Diameter: ____

1 Casing/Borehole Volume: ____
(Circle one)

3 Casing/Borehole Volumes: ____
(Circle one)

Total Casing/Borehole Volumes Removed: ____

Time	~~Intake Depth~~ ORP	Rate (gpm) NTU	Cum. Vol. (gal.)	Temp. (°C) / DO	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)
1054			Ø				black, dark, sl. sheen.
1057	-52	384	24	12.6 / 7.46	7.21	78.8	black, cloudy, odor
1058	-63	196	28	12.1 / 6.36	6.81	78.8	cloudy, gray, odor
1100	-62	128	32	12.1 / 6.59	6.78	78.4	sl. cloudy, gray, odor
1102	-64	140	36	12.0 / 6.85	6.73	78.0	— " —
1104	-62	89	40	12.1 / 6.93	6.78	77.4	sl. cloudy, starting to clear
1107	-60	86	42	12.1 / 6.65	6.76	77.5	clearing up
1109	-61	65.7	44	12.1 / 6.67	6.72	77.6	clear, sl. odor.
1111	-63	63	48	12.1 / 6.16	6.72	77.3	clear, sl. odor
1113	-61	59.9	52	12.1 / 6.21	6.75	77.0	clear, sl. odor
1115	-63	59.9	55	12.1 / 6.14	6.72	77.5	— " —

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

AMEC Geomatrix

~~WELL SAMPLING~~ ~~AND/OR~~ DEVELOPMENT RECORD

Well ID: MW-10
Sample ID: ____ Duplicate ID: ____
Sample Depth: ____
Project and Task No.: 14159.086.0
Project Name: Whitmarsh Ph. II
Date: 4/5/10
Sampled By: N. Bacher
Method of Purging: ____
Method of Sampling: NA

Initial Depth to Water: 16.21
Depth to Water after Sampling: ____
Total Depth to Well: 23.20
Well Diameter: 2"
1 Casing/Borehole Volume: ____ (Circle one)
3 Casing/Borehole Volumes: ____ (Circle one)
Total Casing/Borehole Volumes Removed: ____

Time	ORP ~~Intake Depth~~ mV	~~Rate (gpm)~~ turb	Cum. Vol. (gal.)	Temp. (°C)	S/L DO	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/m	Remarks (color, turbidity, and sediment)
0826			Ø					black, garbage odor, sl/lt sheen
0836	-85	238	18	11.2	2.80	7.24	66.6	sl. cloudy, garbage odor
0840	-101	82.7	21	11.1	7.92	7.16	63.0	clear, sl. garbage odor
0842	-109	57.2	24	11.1	7.35	7.13	62.6	clear, sl. garbage odor
0845	-116	46.3	27	11.1	7.33	7.17	62.6	— " —
0849	-115	39.7	31	11.1	7.29	7.19	62.6	— " —
0854	-118	42.1	35	11.1	7.20	7.14	62.9	— " —
0859	-119	42.0	40	11.1	7.19	7.14	62.7	— " —
0901	-115	44.4	42	11.0	7.23	7.18	63.0	clear, sl. garbage odor
0904	-118	39.1	45	11.1	7.20	7.14	63.1	* clear, sl. garb—

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: DTW = 16.21'
TD = 23.20 > ~6.99 ft of H_2O = 14 gals per bore volume.

① 10 volume
② free of sed.
③ 3 cons. of all param w/in 10%

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Surge 5, 2 bore hole, Temp, pH, S.C, DO, ORP, turb.

AMEC Geomatrix

~~WELL SAMPLING~~ ~~AND/OR~~ DEVELOPMENT RECORD

Well ID: MW-11

Sample ID: ______ Duplicate ID: ______

Sample Depth: ______

Project and Task No.: ______

Project Name: ______

Date: 4/5/10

Sampled By: ______

Method of Purging: ______

Method of Sampling: ______

Initial Depth to Water: 9.58

Depth to Water after Sampling: ______

Total Depth to Well: 18.11

Well Diameter: ______

1 Casing/Borehole Volume: ______ (Circle one)

3 Casing/Borehole Volumes: ______ (Circle one)

Total Casing/Borehole Volumes Removed: ______

Time	ORP ~~Intake Depth~~	NTU ~~Rate (gpm)~~	Cum. Vol. (gal.)	Temp. (°C)	DO	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ mS/M	Remarks (color, turbidity, and sediment)
0900			Ø					dark, strong odor, sheen
0915	-107	NA	20	10.4	7.22	7.31	55.8	"
0918	-98	300	23	10.6	8.11	7.15	55.5	cloudy, mod. odor.
0920	-105	156	26	10.6	6.87	7.19	55.3	clear, sl. odor.
0923	-106	88.9	29	10.6	7.46	7.18	55.1	clear, "
0926	-107	67.4	32	10.7	7.07	7.17	54.9	clear, "
0931	-104	50.1	38	10.6	7.34	7.15	54.6	clear, "
0933	-105	44.4	40	10.7	6.35	7.12	54.7	clear, "
0936	-112	38.4	43	10.7	6.21	7.12	54.6	clear "
0939	-111	33.6	46	10.7	6.23	7.12	54.4	clear, "
0943	-105	29.0	49	10.6	6.37	7.11	54.3	clear, "

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes: DTW = 9.58
TD = 18.11

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: PZ-Ø1
Sample ID: ____ Duplicate ID: ____
Sample Depth: ____
Project and Task No.: ____
Project Name: ____
Date: ____
Sampled By: ____
Method of Purging: ____
Method of Sampling: ____

Initial Depth to Water: 10.29
Depth to Water after Sampling: ____
Total Depth to Well: 13.99
Well Diameter: ____
1 Casing/Borehole Volume: ____ (Circle one)
3 Casing/Borehole Volumes: ____ (Circle one)
Total Casing/Borehole Volumes Removed: ____

Time	ORP ~~Intake Depth~~ mV	NTU ~~Rate (gpm)~~	Cum. Vol. (gal.)	Temp. (°C)	S/L 20	pH (units)	Specific Electrical Conductance ~~(µS/cm)~~ S/m	Remarks (color, turbidity, and sediment)
1128			Ø					gray, cloudy
1148	-1	677	20	12.9	6.37	7.10	0.127	gray, cloudy
1152	-50	267	24	12.7	6.66	6.62	0.128	gray, cloudy, getting cleaner
1156	-53	145	28	12.6	6.55	6.55	0.128	sl. yellowish gray,
1200	-55	62.7	32	12.7	6.80	6.55	0.127	sl. yellow tint
1204	-56	45.5	36	12.6	6.74	6.54	0.125	sl. yellow tint
1208	-57	44.9	40	12.8	6.53	6.52	0.127	v. sl. yel. tint
1212	-57	39.5	44	12.8	6.57	6.45	0.126	v. sl. yel. tint
1216	-49	31.5	48	12.9	6.57	6.47	0.126	"
1220	-49	41.2	52	12.9	6.42	6.49	0.126	"

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-Ø2
Sample ID: ______ Duplicate ID: ______
Sample Depth: ______
Project and Task No.: 14159.006
Project Name: Whitmarsh Ph. II
Date: 4/13/10
Sampled By: N. Bacher, C. Brown
Method of Purging: low-flow peri.
Method of Sampling: low-flow peri.

Initial Depth to Water: 7.66'
Depth to Water after Sampling: ______
Total Depth to Well: 17.71'
Well Diameter: 2"
1 Casing/Borehole Volume: ______ (Circle one)
4 Casing/Borehole Volumes: ______ (Circle one)
Total Casing/Borehole Volumes Removed: ______

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb
1035	2' off	250		9.8	6.78	0.090	0.00	87	244
1038	btm			9.7	6.75	0.090	0.00	92	113
1041				9.7	6.75	0.090	0.00	89	58
1107				9.7	6.32	0.090	0.00	176	25 Field check calibration
1110				9.7	6.46	0.090	0.00	162	10.1
1113				9.7	6.59	0.090	0.00	148	0.00
1116				9.7	6.64	0.090	0.0	148	0.00
1119				9.7	6.70	0.090	0.00	141	0.00
1121				9.7	6.71	0.090	0.00	140	0.0

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading	4.0			

Model or Unit No.: U-22, calibrated w/ pH 4 soln. for Auto Cal may have thrown off other calibrations

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: Landtec GEM 2000
CH_4: 0.0%
CO_2: 1.7%
O_2: 6.8% lowest
Bal: 91.5%

Sample @ 1130

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2×1L, 2×500mL, 2×500 mL poly (HNO3×1)

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-Ø3
Sample ID: MW-03 Duplicate ID:
Sample Depth: 2' off btm
Project and Task No.: 14159.006
Project Name: Whitmarsh LF Ph. II
Date: 4/13/10
Sampled By: D. Backer, C. Brown
Method of Purging: low-flow peristaltic
Method of Sampling: low-flow peristaltic

Initial Depth to Water: 8.22'
Depth to Water after Sampling: 8.24'
Total Depth to Well: 17.53'
Well Diameter: 2"
1 Casing/Borehole Volume:
(Circle one)
4 Casing/Borehole Volumes:
(Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	~~Rate (gpm)~~ Turb NTU	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (~~mg/l~~)	Redox Potential (mV; ~~SSCE~~)	Remarks (color, turbidity, and sediment)
0841		221	Ø	9.4	5.90	0.09	2.94	-95	clear
848		13.7	0.1	9.3	6.82	99.9 mS/m	0.00	-166	
851		9.7	0.2	9.3	6.92	99.9	0.00	-175	
854		12.2	0.3	9.3	7.02	99.9	0.00	-181	
857		41.1	0.5	9.3	7.13	0.090 S/m	0.00	-188	
900		34.1	0.7	9.4	7.14	99.9	0.00	-190	
903		39.1	0.9	9.3	7.14	99.9	0.00	-193	
906		25.0	1.2	9.3	7.25	99.9	0.00	-195	
909		23.0	1.5	9.3	7.25	99.9	0.00	-197	
912		24.6		9.4	7.34	99.9	0.00	-198	

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.: Horiba U-22

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:
Purging @ 250mL/min
Sample @0920

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2x 1L, 2x500mL, 2x500mL w/ HNO_3 (diss: FF)

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-04

Sample ID: MW-04-0410 Duplicate ID:

Sample Depth:

Project and Task No.: 14159.006

Project Name: Whitmarsh Ph. II

Date: 4/13/10

Sampled By: N. Bacher, C. Braun

Method of Purging: low-flow peri

Method of Sampling: low-flow peri

Initial Depth to Water: 3.09'

Depth to Water after Sampling: 3.16'

Total Depth to Well: 24.91'

Well Diameter: 2"

1 Casing/Borehole Volume: (Circle one)

4 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (~~gpm~~) mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV) SSCE)	Remarks (color, turbidity, and sediment) Turb
1212		250	0.2	10.2	7.36	0.09	5.49	-119	0.0
1215			0.4	10.2	7.44	0.09	0.09	-133	0.0
1218			0.5	10.1	7.43	0.09	0.00	-142	0.0
1221			0.6	10.2	7.47	0.09	0.00	-148	9.0
1224			0.8	10.2	7.50	0.09	0.00	-153	10.3
1227			1.0	10.2	7.46	0.090	0.00	-155	9.5
1230			1.2	10.3	7.58	0.090	0.00	-157	9.7

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: Landtec GEM 2000

CH_4: 0%

CO_2: 0.7%

O_2: 11.3% lowest

Bal: 88%

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collect @ 1240 2×1L, 2×500mL, 2×500mL poly (1 w/ HNO_3)

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-05
Sample ID: MW-05-0410 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 4/14/10
Sampled By: CB
Method of Purging: Peristaltic
Method of Sampling: "   "

Initial Depth to Water: 12.94
Depth to Water after Sampling: ~~[illegible]~~ 13.86
Total Depth to Well: 36.07
Well Diameter: 2"
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

start @1410

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV, SSCE)	Remarks (color, turbidity, and sediment) turb
1412		250		13.9	6.95	0.218	3.19	-35	103
1415				13.7	6.94	0.218	0.80	-42	90
1418				13.7	6.94	0.218	0.88	-44	85
1421				13.7	6.94	0.218	0.60	-46	101
1424				13.7	6.94	0.217	0.51	-54	101
1427				13.7	6.93	0.217	0.44	-64	108
1430				13.6	6.92	0.217	0.17	-75	209
1433				13.7	6.92	0.217	0.00	-77	147
1436				13.7	6.93	0.217	0.00	-79	169
1444				13.8	6.94	0.210	0.00	-82	113
1447				13.8	6.93	0.210	0.00	-86	198
1450				13.8	6.93	0.212	0.00	-88	361

NB approves sampling w/o stable turb.

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.: U-22

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.: sample @ 1500

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: 2
CH_4: 5.7
CO_2: 7.7 100.0
O_2: 12.8 26.2
Bal: 73.8

Water appears clear but turbidity is unstable and high

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Cleaned instrument, turbidity is v. low but instrument has climbing values

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-06
Sample ID: MW-06-0410 Duplicate ID: ______
Sample Depth: ______
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 4/15/10
Sampled By: CB, NB
Method of Purging: Peristaltic
Method of Sampling: ______

Initial Depth to Water: 8.71
Depth to Water after Sampling: ~~12.55~~ 8.72
Total Depth to Well: 12.55
Well Diameter: 2"
1 Casing/Borehole Volume: ______ (Circle one)
4 Casing/Borehole Volumes: ______ (Circle one)
Total Casing/Borehole Volumes Removed: ______

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) turb
857		250	0.1	11.21	6.57	1.61	5.39	121	30.8
900			0.3	11.19	6.53	1.61	2.90	40	23.2
903			0.5	11.15	6.55	1.61	1.88	-25	17
906			0.8	11.16	6.53	1.61	1.49	-47	16
909			1.1	11.18	6.53	1.61	1.28	-57	15
912			1.5	11.19	6.53	1.61	1.19	-62	16
915			1.7	11.20	6.54	1.61	1.11	-67	15
918			1.9	11.22	6.54	1.61	1.04	-72	15
921			2.1	11.22	6.55	1.61	0.97	-77	15
924			2.3	11.23	6.56	1.61	0.92	-81	15
927			2.5	11.25	6.57	1.61	0.89	-84	15

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION		DISSOLVED OXYGEN CALIBRATION	
Standard Solution	468 mV	Salinity %	
Field Temperature °C		Altitude	
Instrument Reading		Instrument Reading	
Model or Unit No.:		Model or Unit No.:	
Ag/AgCl Electrode (SSCE)			

Notes: CH_4 9.1
CO_2 12.9
O_2 2.9
Bal.

Sample @ 930

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AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-07
Sample ID: MW-07 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmers SL
Date: 4/15/10
Sampled By: CB NB
Method of Purging: Peristaltic
Method of Sampling:

Initial Depth to Water: 11.86
Depth to Water after Sampling:
Total Depth to Well: 21.07
Well Diameter: 2"
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb
1158		250		13.74	7.22	2.57	7.60	11	89
1201			0.3	13.76	6.92	3.16	2.66	4	34
1204			0.5	13.80	6.89	4.00	1.90	-8	20
1207			0.7	13.79	6.88	4.13	1.56	-18	19
1210			1.0	13.78	6.87	4.15	1.37	-25	19
1213			1.2	13.81	6.86	4.15	1.22	-31	17
1216			1.4	13.85	6.86	4.14	1.10	-37	18
1219			1.6	13.84	6.86	4.14	1.03	-40	41
1222			1.8	13.84	6.86	4.13	0.98	-44	32
1225			2.1	13.85	6.86	4.11	0.93	-47	33
1228			2.5	13.85	6.86	4.10	0.92	-50	32

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Full Suite
23 btls.

Notes: CH_4 0.0
CO_2 0.1
O_2 20.4
bal. 79.5
Sample @ 1245

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-08
Sample ID: MW-08-0410 Duplicate ID:
Sample Depth: 2' off btm.
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 4/14/10
Sampled By: CB NB
Method of Purging: Peristaltic
Method of Sampling: " "

Initial Depth to Water: 15.88
Depth to Water after Sampling: 15.88
Total Depth to Well: 23.23
Well Diameter: 2"
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Start @1155
Finish @1345

Time	Intake Depth	Rate (~~gpm~~) mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV) SSCE	Remarks (color, turbidity, and sediment) Turb
1159		250	0.1	12.2	6.51	0.176	4.29	-116	228
1202			0.3	12.0	6.48	0.174	3.59	-118	159
1205			0.5	12.0	6.48	0.172	2.93	-120	330
1208			0.7	12.0	6.52	0.170	2.44	-124	248
1211			1.0	12.0	6.57	0.166	2.25	-128	195
1214			1.2	12.0	6.58	0.164	2.27	-129	124
1217			1.4	12.1	6.61	0.158	2.09	-131	88
1220			1.6	12.1	6.62	0.155	2.13	-131	72
1223			1.8	12.1	6.63	0.153	1.92	-132	47
1226			2.0	12.1	6.65	0.147	1.93	-132	33
1229			2.2	12.0	6.66	0.145	1.86	-133	29
1232			2.4	12.1	6.68	0.142	1.65	-134	16

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.: U-22

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: CH_4: ~~[illegible]~~ 58.5
CO_2: ~~[illegible]~~ 20.4
O_2: ~~[illegible]~~ 3.3
bal: 17.8

Sample @ ~~1230~~ 1300
full suite

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AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-09
Sample ID: MW-09-0410 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 4/14/10
Sampled By: C. Brown
Method of Purging: Peristaltic
Method of Sampling: " "

Initial Depth to Water: 12.76
Depth to Water after Sampling:
Total Depth to Well: 19.44
Well Diameter: 2"
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

start @845

Time	Intake Depth	Rate ~~(gpm)~~ mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) turb
847		250		10.8	6.95	0.090	0.00	-127	282
850			0.2	10.9	6.88	0.090	0.00	-133	196
853			0.4	11.0	6.85	0.090	0.00	-138	132
856			0.6	11.1	6.90	0.090	0.00	-140	133
859			0.8	11.1	6.92	0.090	0.00	-144	95.5
902			1.0	11.1	6.91	0.090	0.00	-145	94.2
905			1.2	11.1	6.89	0.090	0.00	-146	106
908			1.5	11.3	6.92	0.090	0.00	-149	103
911			1.8	11.2	6.92	0.090	0.00	-149	106
								water	is very
								clear.	

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C	Cond. range seems		
Instrument Reading	incorrect.		

Model or Unit No.:

REDOX CALIBRATION		DISSOLVED OXYGEN CALIBRATION	
Standard Solution	468 mV	Salinity %	
Field Temperature °C		Altitude	
Instrument Reading		Instrument Reading	
Model or Unit No.:		Model or Unit No.:	
Ag/AgCl Electrode (SSCE)			

Notes: Landtec GEM 2000
CH_4 ~~25~~ 2.2%
CO_2 20.8%
O_2 1.18%
Bal 52.9

@ 920
Full suite

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AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: MW-10

Sample ID: MW-10-0410 Duplicate ID:

Sample Depth:

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 4/15/10

Sampled By: CB, NB

Method of Purging: Peristaltic

Method of Sampling:

Initial Depth to Water: 16.19

Depth to Water after Sampling: 16.19

Total Depth to Well: 23.22

Well Diameter: 2"

1 Casing/Borehole Volume: (Circle one)

4 Casing/Borehole Volumes: (Circle one)

Total ~~Casing/Borehole~~ Volumes Removed: ~3.0 gal.

Time	Intake Depth	Rate ~~(gpm)~~ mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance mS/cm	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) turb
1331		250	0.1	11.54	8.06	0.655	5.55	-46	78
1334			0.3	11.41	7.84	0.653	2.87	-100	76
1337			0.4	11.35	7.76	0.655	1.70	-133	64
1340			0.6	11.30	7.70	0.646	1.28	-145	48
1343			0.7	11.34	7.67	0.640	1.00	-156	42
1346			0.8	11.32	7.66	0.638	0.89	-165	39
1349			1.0	11.30	7.66	0.639	0.78	-169	37
1352			1.1	11.30	7.66	0.640	0.69	-176	32
1355			1.3	11.29	7.66	0.637	0.63	-180	30
1358			1.4	11.27	7.67	0.638	0.57	-183	28
1401			1.5	11.26	7.67	0.635	0.52	-187	28
1404				11.25	7.68	0.633	0.47	-190	27

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: CH_4 48.5
CO_2 16.5
O_2 2.6
bal.
Sample @ 1430
23 bottles full suite.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

start @ 1534 1815 Finish

Well ID: MW-11

Sample ID: MW-11-0410 Duplicate ID: MW-110-0410

Sample Depth: @1600 @1630

Project and Task No.: 14159

Project Name: Whitmarsh

Date: 4/15/10

Sampled By: CB

Method of Purging: Peristaltic

Method of Sampling:

Initial Depth to Water: 9.58

Depth to Water after Sampling: 9.58

Total Depth to Well: 18.1

Well Diameter: 2"

1 Casing/Borehole Volume: (Circle one)

4 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed: ~3.0 gal.

Time	Intake Depth	Rate ~~(gpm)~~ mL/min	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (mS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) turb
1534		250	0	11.40	7.63	0.552	4.31	-34	123
1537				11.28	7.57	0.547	1.91	-76	58
1540				11.21	7.54	0.545	1.20	-110	35
1543				11.31	7.53	0.544	0.88	-133	28
1546				11.64	7.52	0.550	0.73	-143	24
1549			1.2	11.89	7.57	0.552	0.67	-149	22
1552				11.62	7.53	0.545	0.59	-155	21
1555				11.69	7.53	0.549	0.54	-160	19
1558				11.76	7.53	0.544	0.49	-165	22
1601				11.65	7.53	0.548	0.49	-169	23

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION		DISSOLVED OXYGEN CALIBRATION	
Standard Solution	468 mV	Salinity %	
Field Temperature °C		Altitude	
Instrument Reading		Instrument Reading	
Model or Unit No.:		Model or Unit No.:	
Ag/AgCl Electrode (SSCE)			

Notes: CH_4 20.1
CO_2 11.7
O_2 5.8
bal

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-Ø1

Sample ID: SP01-0410 Duplicate ID: ______

Sample Depth: ______

Project and Task No.: Whitmarsh Ph. II

Project Name: 14159.006

Date: 4/14/10

Sampled By: N. Backer, C. Brown

Method of Purging: dank bottle

Method of Sampling: — " —

Initial Depth to Water: /

Depth to Water after Sampling: /

Total Depth to Well: /

Well Diameter: /

1 Casing/Borehole Volume: / (Circle one)

4 Casing/Borehole Volumes: / (Circle one)

Total Casing/Borehole Volumes Removed: /

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (~~mg~~/l)	Redox Potential (mV; ~~SSCE~~)	turb Remarks (~~color~~, turbidity, and sediment)
1020				12	6.96	0.090	7.56	-109	6.3 Sal. 0.1%

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:

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2x1000mL, 4x500 mL, 2x500 mL HDPE

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-02
Sample ID: SP-02-0410 Duplicate ID:
Sample Depth:
Project and Task No.:
Project Name:
Date: 4/15/10
Sampled By:
Method of Purging:
Method of Sampling:

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume:
(Circle one)
4 Casing/Borehole Volumes:
(Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb
1111				12.8	7.16	0.194	13.06	-107	52

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: @ 1130

10 bottles

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AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SP-03

Sample ID: SP-03-0410 Duplicate ID:

Sample Depth:

Project and Task No.:

Project Name:

Date: 4/15/10

Sampled By: CB NB

Method of Purging: Peristaltic

Method of Sampling:

Initial Depth to Water: –

Depth to Water after Sampling: –

Total Depth to Well: –

Well Diameter: –

1 Casing/Borehole Volume: (Circle one)

4 Casing/Borehole Volumes: (Circle one)

Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance mS/cm	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb
1050				16.67	6.93	5.10	6.45	72	90

pH CALIBRATION (choose two)				
Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION			
KCL Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION	
Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION	
Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: Collect @ 1050

9-bottles

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AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-01
Sample ID: SW-01-0410 Duplicate ID:
Sample Depth: Surf.
Project and Task No.: 14159
Project Name: Whitmass
Date: 4/13/10
Sampled By: CB
Method of Purging: dunk
Method of Sampling: dunk

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (μS/cm)	Dissolved Oxygen (mg/l)	Redox Potential (mV SSCE)	Remarks (color, turbidity, and sediment)
925	1'	–	–	9.8	7.00	97.9	7.13	-58	333 turb

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: Sampled @ 1000

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2x1L 2x500mL 1x500mL Poly HNO_3

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-03
Sample ID: SW-03-0410 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 4/13/10
Sampled By: C. Brown
Method of Purging:
Method of Sampling:

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV, SSCE)	Remarks (color, turbidity, and sediment)
				12.4	7.42	0.486	13.33	-85	turb 621

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:
Sample @ 1315 with peristaltic

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2x 1L, 2x 500mL, 2x 500mL HDPE 1 pres 1 not.

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-04
Sample ID: SW-04-0410 Duplicate ID:
Sample Depth:
Project and Task No.: 14159
Project Name: Whitmarsh
Date: 4/13/10
Sampled By: CB
Method of Purging: ~~Peristaltic~~
Method of Sampling: dunk

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume:
(Circle one)
4 Casing/Borehole Volumes:
(Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance ( )	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment)

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: @1430

AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-05
Sample ID: SW-05-0410 Duplicate ID:
Sample Depth:
Project and Task No.:
Project Name: Whitmarsh
Date: 4/13/10
Sampled By: CB
Method of Purging:
Method of Sampling:

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance S/M	Dissolved Oxygen (mg/l)	Redox Potential (mV; SSCE)	Remarks (color, turbidity, and sediment) Turb
1415				10.5	8.06	0.150	9.70	-2	1.0

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (μS/cm=μmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:

Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes: @ 1415

diss metals not preserved. Not Field filt.

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AMEC Geomatrix

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: SW-Ø6
Sample ID: SW-06-0410 Duplicate ID:
Sample Depth: 4"
Project and Task No.:
Project Name: Whitmarsh
Date: 4/13/10
Sampled By:
Method of Purging:
Method of Sampling:

Initial Depth to Water:
Depth to Water after Sampling:
Total Depth to Well:
Well Diameter:
1 Casing/Borehole Volume: (Circle one)
4 Casing/Borehole Volumes: (Circle one)
Total Casing/Borehole Volumes Removed:

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (S/m)	Dissolved Oxygen (mg/l)	Redox Potential (mV, SSCE)	Remarks (color, turbidity, and sediment)
1357				13.5	7.94	.694	12.57	56	Turb 5.8

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Field Temperature °C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C	
Field Temperature °C			
Instrument Reading			

Model or Unit No.:

REDOX CALIBRATION

Standard Solution	468 mV
Field Temperature °C	
Instrument Reading	

Model or Unit No.:
Ag/AgCl Electrode (SSCE)

DISSOLVED OXYGEN CALIBRATION

Salinity %	
Altitude	
Instrument Reading	

Model or Unit No.:

Notes:
Sample @ 1355.

2x1L, 2x500mL, 2x500mL diss not preserved not field filt.

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Whitmarsh Landfill Phase II | DATE: 4/13/10 | PAGE 1 OF 1

PROJECT NUMBER: 14159.006

RESULTS TO: Nick Bacher/Crystal Nierby

TURNAROUND TIME: standard

SAMPLE SHIPMENT METHOD: ARI courier

LABORATORY NAME: ARI

LABORATORY ADDRESS: Tukwila, WA

LABORATORY CONTACT: Cheronne O.

LABORATORY PHONE NUMBER: 206-695-6200

CLIENT INFORMATION: Whitmarsh PLP Group

REPORTING REQUIREMENTS: Please see project specific QAPP or contact Crystal Nierby.

GEOTRACKER REQUIRED: YES / NO (NO circled)

SITE SPECIFIC GLOBAL ID NO.:

SAMPLERS (SIGNATURE): [signature]

DATE	TIME	SAMPLE NUMBER	PCBs (8082 LL)	OC Pest. (8081)	Manchester	Tot. Metals ①	Diss. Metals ②	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
4/13/10	0920	MW03-0410	X	X		X	X	2×1L, 4×500mL	W	Y	HNO_3	Y		6	
4/13/10	1000	SW01-0410	X	X		X	X	2×1L, 4×500mL	W	N	HNO_3	Y		6	not field filtered
4/13/10	1130	MW02-0410	X	X		X	X	2×1L, 4×500mL	W	Y	HNO_3	Y		6	
4/13/10	1240	MW04-0410	X	X		X	X	2×1L, 4×500mL	W	Y	HNO_3	Y		6	
4/13/10	1315	SW03-0410	X	X		X	X	2×1L, 4×500mL	W	N	HNO_3	Y		6	not field filtered
4/13/10	1355	SW06-0410	X	X		X	X	2×1L, 4×500mL	W	N	HNO_3	Y		6	not field filtered
4/13/10	1415	SW05-0410	X	X		X	X	2×1L, 4×500mL	W	N	HNO_3	Y		6	not field filtered
4/13/10	1430	SW04-0410	X	X		X	X	2×1L, 4×500mL	W	N	HNO_3	Y		6	not field filtered

TOTAL NUMBER OF CONTAINERS: 48

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: [signature]	4/14/10	1305	SIGNATURE: [signature]	4/14/10	1305
PRINTED NAME: N. Bacher			PRINTED NAME: Rich Hudson		
COMPANY: AMEC			COMPANY: ARI		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

SAMPLING COMMENTS:

① Only analyze for arsenic, lead, mercury, thallium. in accordance with QAPP methods.

② All SWXX-0410 samples needs to be filtered in lab before dissolved metals analysis.

One Union Square, 600 University Street, Suite 1020
Seattle, Washington 98101-4107
Tel 206.342.1760 Fax 206.342.1761

amec

PLEASE EMAIL SCAN OF COC TO CRYSTAL NIERBY ASAP.

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Whitmarsh Landfill Phase II | DATE: 4/14/10 | PAGE 1 OF 1

PROJECT NUMBER: 14159.006

RESULTS TO: Nick Bacher/Crystal Nierby

TURNAROUND TIME: standard

SAMPLE SHIPMENT METHOD: ARI courier

LABORATORY NAME: ARI

LABORATORY ADDRESS: Tukwila, WA

LABORATORY CONTACT: Cheronne O.

LABORATORY PHONE NUMBER: 206-695-6200

CLIENT INFORMATION: Whitmarsh PLP Group

REPORTING REQUIREMENTS: Please see project specific QAPP or contact Crystal Nierby

GEOTRACKER REQUIRED: YES / NO (NO circled)

SITE SPECIFIC GLOBAL ID NO.:

SAMPLERS (SIGNATURE): [signature]

DATE	TIME	SAMPLE NUMBER	VOCs (8260B)	SVOCs (8230 D)	PAHs (8230-SIM)	PCBs (8082 LL)	OC Pest. (8081 Mauch...)	NWTPH - HCID	NWTPH - Dx SG ①	NWTPH - Gx	Carbaryl	Tot. metals ③	Diss. Metals ③④	pH	TDS	Phenols	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
4/14/10	0920	MW09-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X	various	W	Y	HNO_3	Y		22	
4/14/10	1020	SP01-0410				X	X		X			X	X				2x1L, 6x500mL	W	N	HNO_3	Y		8	not field filtered ②
		Trip Blank																					2	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: [signature]	4/14/10	1306	SIGNATURE: [signature]	4/14/10	1306
PRINTED NAME: N. Bacher			PRINTED NAME: Rich Hudson		
COMPANY: AMEC			COMPANY: ARI		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

TOTAL NUMBER OF CONTAINERS: 32

SAMPLING COMMENTS: ① Do silica gel cleanup on all TPH-Dx. ② SP01-0410 needs to be filtered prior to diss. metals analysis ③ SP01-0410 only to be analyzed for As, Pb, Hg, Th. ④ MW09-0410 to be analyzed for antimony, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Th, V, and Zn.

One Union Square, 600 University Street, Suite 1020
Seattle, Washington 98101-4107
Tel 206.342.1760 Fax 206.342.1761

amec

PLEASE EMAIL SCAN OF COC TO CRYSTAL NIERBY ASAP

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Whitmarsh Landfill Phase II

DATE: 4/15/10 — PAGE 1 OF 1

PROJECT NUMBER: 14159.006

LABORATORY NAME: ARI

CLIENT INFORMATION: Whitmarsh PLP Group

REPORTING REQUIREMENTS: Please see project specific QAPP or contact Crystal Nierby.

RESULTS TO: Nick Bacher / Crystal Nierby

LABORATORY ADDRESS: Tukwila, WA

TURNAROUND TIME: Standard

SAMPLE SHIPMENT METHOD: ARI courier

LABORATORY CONTACT: Cheronne O.

LABORATORY PHONE NUMBER: 206-695-6200

GEOTRACKER REQUIRED YES NO

SITE SPECIFIC GLOBAL ID NO.

SAMPLERS (SIGNATURE): [signature]

ANALYSES

DATE	TIME	SAMPLE NUMBER	VOCs (8260 B)	SVOCs (8270 D)	PAHs (8270 SIM)	PCBs (8082 LL)	OC Pest. (8081 Mod.)	NWTPH-HCID	NWTPH-Dx w/ S.G ①	NWTPH-Gx	Carbonyl	Tot. metals ③④	Diss. Metals ③④	pH	TDS	Phenols		CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
4/14/10	1300	MW08-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X		various	W	Y	HNO3	Y		22	
4/14/10	1500	MW05-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X		various	W	Y	HNO3	Y		22	
4/15/10	0930	MW06-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X		various	W	Y	HNO3	Y		22	
4/15/10	1050	SP03-0410				X	X		X			X	X					various	W	N	HNO3	Y		9	not field filtered ②
4/15/10	1130	SP02-0410				X	X		X			X	X					various	W	N	HNO3	Y		10	not field filtered ②
		Trip Blank																						2	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: [signature] PRINTED NAME: Nicholas Bacher COMPANY: AMEC	4/15/10	1300	SIGNATURE: [signature] PRINTED NAME: Rich Hudson COMPANY: ARI	4/15/10	1300
SIGNATURE: PRINTED NAME: COMPANY:			SIGNATURE: PRINTED NAME: COMPANY:		
SIGNATURE: PRINTED NAME: COMPANY:			SIGNATURE: PRINTED NAME: COMPANY:		

TOTAL NUMBER OF CONTAINERS: 87

SAMPLING COMMENTS:
① Do silica gel cleanup on all TPH-Dx.
② SP02 & SP03 needs to be filtered prior to diss. met. analysis
③ SP02 & SP03 only analyzed for As, Pb, Hg, and Th.
④ MW05, 06, 08 only analyzed for antimony, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn.

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PLEASE EMAIL SCAN OF COC TO CRYSTAL NEIRBY ASAP.

CHAIN-OF-CUSTODY RECORD

PROJECT NAME: Whitmarsh Landfill Phase II			DATE: 4/15/10 PAGE 1 OF 1
PROJECT NUMBER: 14159.006	LABORATORY NAME: ARI	CLIENT INFORMATION:	REPORTING REQUIREMENTS:
RESULTS TO: Nick Bacher / Crystal Neirby	LABORATORY ADDRESS: Tukwila, WA	Whitmarsh PLP Group	Please see project specific QAPP or contact Crystal Neirby
TURNAROUND TIME: Standard			
SAMPLE SHIPMENT METHOD: hand delivered	LABORATORY CONTACT: Cheronne O.		GEOTRACKER REQUIRED YES (NO)
	LABORATORY PHONE NUMBER: 206-695-6200		SITE SPECIFIC GLOBAL ID NO.

SAMPLERS (SIGNATURE):

ANALYSES

DATE	TIME	SAMPLE NUMBER	VOCs (8260 B)	SVOCs (8270 D)	PAHs (8270 SIM)	PCBs (8082 LL)	OC Pest. (8081 [illegible])	NWTPH-HCID	NWTPH-Dx w/S.G. (1)	NWTPH-Gx	Carbanyl	Total Metals (2)	Diss. Metals (2)	pH	TDS	Phenols	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
4/15/10	1245	MW07-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X	various	W	Y	HNO_3	Y		23	
4/15/10	1430	MW10-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X	various	W	Y	HNO_3	Y		23	
4/15/10	1600	MW11-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X	various	W	Y	HNO_3	Y	Y	69	
4/15/10	1630	MW110-0410	X	X	X	X	X	X	X	X	X	X	X			X	various	W	Y	HNO_3	Y		21	
4/15/10	1815	EB-0410	X	X	X	X	X	X	X	X	X	X	X	X	X	X	various	W	Y	HNO_3	Y		23	
		Trip Blank																					2	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE:	4/16/10	1452	SIGNATURE:	4/16/10	1452
PRINTED NAME: N. Bacher			PRINTED NAME: C. ORUEC		
COMPANY: AMEC			COMPANY: ARI		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

TOTAL NUMBER OF CONTAINERS: 163

SAMPLING COMMENTS: (1) Do silica gel cleanup on all TPH-Dx.
(2) Analyzed for antimony, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, and Zn.

One Union Square, 600 University Street, Suite 1020
Seattle, Washington 98101-4107
Tel 206.342.1760 Fax 206.342.1761

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PLEASE EMAIL SCAN OF COC TO CRYSTAL NEIRBY ASAP.

AMEC Geomatrix

PROJECT NO. 14159
ROUTE: ☐
FILE NO. 6010.04 ☐
cc FILE NO.

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-01

Project Name: Skagit Whitmarsh Landfill

Project Number: 14159
Date: 7/15/10
Location: Anacortes, WA
Weather Conditions:
Sampler: Chris Brown & Nik ~~Bacher~~ Emily Scott
Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):
Top of Casing Elevation (ft):
Groundwater Elevation (ft):
Initial Depth to Water (ft):
Depth of Well Casing (ft):
Wellhead Condition:
Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
		5.98	80.4	12.5	50	8.97	31.6	

Sample ID No.: SP-01-0710
Water Level Ind. Model & No.:
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used:
Sampling Equipment Used:

Purge Start Time:
Purge Completion Time:
Sample Collection Time: 8:45
Average Purge Rate (mL/min):
Purging Method:
Analytical Lab:
Sample Containers Used:
Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP02

Project Name: Skagit Whitmarsh Landfill

Date: 7/15/10

Project Number: 14159

Weather Conditions: Fog 60°

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	9:25	6.44	.350 S/m	14.5	-55	9.32	14.9	

Sample ID No.: SP-02-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 945

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-03

Project Name: Skagit Whitmarsh Landfill

Date: 7/15/10

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	10:10	6.60	.160 S/m	14.9	-71	9.72	121.0	

Sample ID No.: SP-03-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1030

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-2

Project Name: Skagit Whitmarsh Landfill

Date: 7/13/10

Project Number: 14159

Weather Conditions: M. Cloudy 60°

Location: Anacortes, WA

Sampler: ~~Chris Brown & Nik Bacher~~ Emily Scott

Wind Speed/Direction: —

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 8.09

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 2.5

PURGING MEASUREMENTS

0.1 1090 — 10 1090 1090

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
8.15	8:12	5.89	56.9 mS/m	12.2	250	8.45	2.4	
8.15	8:15	6.09	56.4	11.8	242	7.13	0	
8.15	8:18	6.15	55.4	11.6	236	6.76	0	
8.15	8:21	6.16	54.2	11.6	230	6.62	0	
8.15	8:24	6.19	52.7	11.6	225	6.48	0	
8.15	8:27	6.22	51.2	11.6	220	6.36	0	
8.15	8:30	6.27	50.3	11.6	213	6.25	0	
8.15	8:33	6.28	50.1	11.6	208	6.19	0	
8.15	8:36	6.32	49.8	11.6	203	6.14	0	

Sample ID No.: MW-2-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic

Sampling Equipment Used: " "

Purge Start Time: 8:10 am

Purge Completion Time:

Average Purge Rate (mL/min): 300

Analytical Lab: ARI

Sample Collection Time: 845

Purging Method: Peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-03

Project Name: Skagit Whitmarsh Landfill

Date: 7/13/2010

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~ Emily Scott

Wind Speed/Direction: —

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 8.85

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
8.83	10:49	7.12	53.6	15.5	-173	8.89	120.0	
8.84	10:52	7.07	52.7	15.1	-178	8.15	67.2	
8.86	10:55	7.01	52.2	15.0	-177	7.67	39.9	
8.86	10:58	6.97	51.8	15.0	-176	7.19	32.0	
8.86	11:01	6.96	51.6	15.0	-179	6.83	18.5	
8.86	11:04	6.97	51.5	15.1	-179	6.54	12.0	
8.86	11:07	6.97	51.5	15.0	-181	6.36	7.8	
8.86	11:10	6.99	51.4	15.1	-182	6.17	4.3	
8.86	11:13	6.99	51.3	15.3	-184	6.03	4.9	

Sample ID No.: MW-03-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 10:46 am

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 11:30 am

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-04

Project Name: Skagit Whitmarsh Landfill

Date: 7/13/2009

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 3.15

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 2

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
3.21	9:30	6.70	51.6	13.5	-59	9.18	17.4	
3.25	9:33	6.81	50.7	12.5	-97	7.82	9.2	
3.28	9:36	6.88	49.5	12.2	-116	7.53	3.5	
3.28	9:39	6.95	48.6	12.1	-128	7.36	0.3	
3.28	9:42	7.00	48.3	12.1	-135	7.22	0	
3.29	9:45	7.02	48.3	12.1	-140	7.09	0	
3.29	9:48	7.05	48.2	12.0	-143	7.00	0	

Sample ID No.: MW-04-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 9:28 am

Purge Completion Time: 1024

Average Purge Rate (mL/min): 300

Analytical Lab: ARI

Sample Collection Time: 10:00 am

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-Ø5

Project Name: Skagit Whitmarsh Landfill

Date: 7/14/2010

Project Number: 14159

Weather Conditions: Sunny and clear

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~ Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 12.79

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.79	8:30	6.22	.238 S/m	14.2	-38	6.61	1.8	
13.08	8:33	6.31	.237	14.1	-62	5.95	.2	
13.15	8:36	6.36	.237	14.1	-72	5.78	.1	
13.20	8:39	6.39	.236	14.1	-77	5.67	.1	
13.25	8:42	6.41	.236	14.0	-81	5.56	0	
13.27	8:45	6.42	.236	14.0	-86	5.61	0	

Sample ID No.: MW-05-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 0826

Purge Completion Time:

Average Purge Rate (mL/min): 300

Analytical Lab:

Sample Collection Time: 900

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-06

Project Name: Skagit Whitmarsh Landfill

Date: 7/14/10

Project Number: 14159

Weather Conditions: Sunny and clear

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~ Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 8.68

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
8.68	9:52	6.34	.183 S/m	14.4	-109	8.35	26.2	
8.68	9:55	6.26	.177	14.3	-114	7.67	16.4	
8.68	9:58	6.24	.176	14.3	-119	7.29	9.0	
8.68	10:01	6.23	.175	14.3	-122	7.08	6.4	
8.68	10:04	6.23	.175	14.3	-125	6.91	2.9	

Sample ID No.: MW-06-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 0951

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1015

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-Ø7

Project Name: Skagit Whitmarsh Landfill

Date: 7/14/2010

Project Number: 14159

Weather Conditions: Sunny and clear

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bach~~er Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 11.43

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
11.43	11:06	6.84	.179 S/m	15.0	-51	10.15	46.0	
11.44	11:09	6.69	.174	14.8	-69	9.88	33.4	
11.45	11:12	6.58	.182	14.7	-71	8.63	24.2	
11.46	11:15	6.57	.233	14.7	-75	8.42	16.8	
11.48	11:18	6.58	.267	14.7	-82	8.30	14.7	
11.48	11:21	6.59	.282	14.7	-85	7.94	11.9	
11.49	11:24	6.59	.288	14.8	-88	7.68	9.4	
11.50	11:27	6.60	.290	14.8	-90	7.43	6.3	
	11:30	6.61	.292	14.8	-92	7.30	5.5	

Sample ID No.: SW-07-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 1104

Purge Completion Time:

Average Purge Rate (mL/min): 300

Analytical Lab:

Sample Collection Time: 1200

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-08

Project Name: Skagit Whitmarsh Landfill

Date: 7/13/10

Project Number: 14159

Weather Conditions: partly sunny

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~ Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 16.38

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
16.37	2:10	6.42	.173 S/m	12.9	-115	9.63	61.6	
16.36	2:13	6.37	.165	12.6	-121	8.90	45.3	
16.36	2:16	6.37	.161	12.6	-125	8.33	34.7	
16.38	2:19	6.39	.157	12.5	-128	7.93	37.1	
16.37	2:22	6.41	.153	12.4	-131	7.55	34.1	
16.38	2:25	6.43	.146	12.4	-133	7.26	20.3	
16.38	2:28	6.43	.143	12.4	-136	6.98	17.5	
16.39	2:31	6.45	.139	12.4	-137	6.82	18.0	
16.39	2:34	6.47	.137	12.4	-138	6.65	16.9	
16.39	2:37	6.47	.135	12.4	-139	6.50	22.4	
16.39	2:40	6.49	.132	12.3	-140	6.41	19.0	
16.39	2:43	6.50	.130	12.3	-140	6.32	19.5	
16.39	2:47	6.51	.128	12.3	-142	6.24	19.3	

Sample ID No.: MW-08-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 208 pm

Purge Completion Time:

Average Purge Rate (mL/min): 300

Analytical Lab:

Sample Collection Time: 1500

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW - Ø9

Project Name: Skagit Whitmarsh Landfill

Date: 7/13/10

Project Number: 14159

Weather Conditions: partly cloudy

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~ Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 12.94

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.94	12:20	6.60	92.3	13.8	-111	9.18	45.4	
12.98	12:23	6.60	90.1	13.4	-119	8.50	34.0	
12.98	12:26	6.59	88.7	13.3	-122	8.01	22.9	
12.98	12:29	6.61	88.0	13.3	-127	7.63	15.4	
12.98	12:32	6.63	87.7	13.3	-130	7.33	11.3	
12.98	12:35	6.63	87.5	13.4	-131	7.12	9.8	
12.98	12:38	6.63	87.5	13.3	-133	6.98	11.4	
12.98	12:41	6.60	87.6	13.2	-135	6.93	10.8	
12.98	12:44	6.62	87.4	13.2	-135	6.86	10.5	
12.98	12:47	6.64	87.1	13.2	-137	6.76	9.2	

Sample ID No.: MW-09-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 12:17

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1:15pm

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-10

Project Name: Skagit Whitmarsh Landfill

Date: 7/13/10

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Baecher~~ Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 16.67

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
16.68	4:00	7.21	67 mS/m	12.1	-170	9.27	45.5	
16.68	4:03	7.25	65.4	12.1	-182	8.70	36.2	
16.68	4:06	7.30	65.2	11.9	-195	8.07	21.7	
16.68	4:09	7.32	64.6	11.9	-200	7.70	15.3	
16.68	4:12	7.34	64.6	11.8	-205	7.36	10.3	
16.68	4:15	7.35	64.4	11.8	-209	7.09	7.1	
16.68	4:18	7.36	64.1	11.9	-213	6.79	6.5	
16.68	4:21	7.37	64.2	11.9	-214	6.63	6.2	
16.68	4:24	7.38	64.0	11.9	-216	6.57	4.9	

Sample ID No.: MW-10-0716

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 3:57 pm

Purge Completion Time:

Average Purge Rate (mL/min): 300

Analytical Lab:

Sample Collection Time: 4:40 pm

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-11

Project Name: Skagit Whitmarsh Landfill

Date: 7/14/2010

Project Number: 14159

Weather Conditions: Sunny and Clear

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~ Emily Scott

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 10.17

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
10.17	1306	7.31	64.7 mS/m	13.2	-173	8.75	29.7	
10.18	1309	7.22	62.7	13.0	-184	8.22	17.4	
10.18	1312	7.18	61.8	12.9	-190	7.81	10.0	
10.18	1315	7.17	61.5	13.0	-196	7.47	3.7	
10.18	1318	7.15	61.3	13.0	-199	7.24	4.3	
10.18	1321	7.16	61.3	12.9	-201	7.15	2.7	
10.18	1324	7.17	61.2	12.9	-204	7.04	4.5	

Sample ID No.: MW-11-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time: 1302

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1340

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Duplicate MW-110-0710 @ 1600

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-01

Project Name: Skagit Whitmarsh Landfill

Date: 7/12/10

Project Number: 14159

Weather Conditions: P. Cloudy 60's

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: W 10

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1239	6.17	64.8	17.5	1	8.48	9.1	

Sample ID No.: SW-01-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1250

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-03

Project Name: Skagit Whitmarsh Landfill

Date: 7/12/10

Project Number: 14159

Weather Conditions: Clear 60's

Location: Anacortes, WA

Sampler: Chris Brown & ~~Nik Bacher~~

Wind Speed/Direction: W 5

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1330	6.97	2.53	26.1	-58	9.64	149	

Sample ID No.: SW-03-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1340

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-04

Project Name: Skagit Whitmarsh Landfill

Date: 7/12/10

Project Number: 14159

Weather Conditions: Sun 60'S

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: W- 5 mph

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
—	3:57pm	7.78	2.14 S/m	21.1	162	7.33	3.7NTU	

Sample ID No.: SW-04-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1600

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-05

Project Name: Skagit Whitmarsh Landfill

Date: 7/12/10

Project Number: 14159

Weather Conditions: Sun S-5

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction: ____

WELL INFORMATION

Casing Diameter (in): ____

Top of Casing Elevation (ft): ____

Initial Depth to Water (ft): ____

Wellhead Condition: ____

Groundwater Elevation (ft): ____

Depth of Well Casing (ft): ____

Actual Purge Volume (gal): ____

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	4:21 pm	8.74	2.36 s/m	26.1	157	12.44	22.7	

Sample ID No.: SW-05-0710

Water Level Ind. Model & No.: ____

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: ____

Sampling Equipment Used: ____

Purge Start Time: ____

Purge Completion Time: ____

Average Purge Rate (mL/min): ____

Analytical Lab: ____

Sample Collection Time: 1620

Purging Method: ____

Sample Containers Used: ____

Chemical Analyses: ____

Other Field Observations: ____

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-06-0710

Project Name: Skagit Whitmarsh Landfill

Date: 7/12/10

Project Number: 14159

Weather Conditions:

Location: Anacortes, WA

Sampler: Chris Brown & Nik Bacher

Wind Speed/Direction:

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1430	8.29	36.9	26.4	187	6.09	133	

Sample ID No.: SW-06-0710

Water Level Ind. Model & No.:

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used:

Sampling Equipment Used:

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab:

Sample Collection Time: 1430

Purging Method:

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Amec Geomatrix	Phone: 206 342 1760
Client Contact: Nik Bacher	
Client Project Name: Skagit Whitmarsh	
Client Project #: 14159	Samplers: Chris Brown Emily Scott

Page: 1	of
Date: 7/15/10	Ice Present?
No. of Coolers:	Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	VOCs 8260C	SVOCs 8270	PAHs 8270-SIM	PCBs 8082	Total Metals	OC Pesticides 8081	HCID NWTPH-HCID	TPH-Dx NWTPH-Dx	TPH-G NWTPH-G	Dissolved Metals	pH	TDS	Notes/Comments
MW-09-0710	7/13/10	1315	W	25	X	X	X	X	X	X	X	X	X	X	X	X	TPH-D: Acid wash and Silica gel cleanup. Dissolved metals are field filtered. Metals preserved w/ HNO3 VOAs preserved w/ HCl
MW-08-0710	↓	1500	W	25	X	X	X	X	X	X	X	X	X	X	X	X	
MW-10-0710	↓	1640	W	25	X	X	X	X	X	X	X	X	X	X	X	X	
MW-05-0710	7/14/10	0900	W	25	X	X	X	X	X	X	X	X	X	X	X	X	
MW-06-0710	↓	1015	W	25	X	X	X	X	X	X	X	X	X	X	X	X	
MW-07-0710	↓	1700	W	25	X	X	X	X	X	X	X	X	X	X	X	X	
MW-11-0710	↓	1320	W	~~75~~ 74	X	X	X	X	X	X	X	X	X	X	X	X	MS/MSD
MW-110-0710	↓	1600	W	25	X	X	X	X	X	X	X	X	X	X	X	X	
Trip blank	—	—	W	6	X												

Comments/Special Instructions: Metals: As, Sb, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, Zn.

	Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature)	Chris Brown	[signature]		
Printed Name:	Chris Brown	Rich Hudson		
Company:	Amec	ARI		
Date & Time:	7/15/10 1200	7/15/10 1200		

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Amec Geomatrix	Phone: 206 342 [illegible]
Client Contact: ~~Due~~ Nik Bacher	
Client Project Name: Skagit Whitmarsh	
Client Project #: 14159	Samplers: [illegible] E Scott

Page: 2	of
Date: 7/15/10	Ice Present?
No. of Coolers:	Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	Total Metals	Diss. Metals	[illegible]	[illegible]	TPH-Dx NWTPH-Dx				Notes/Comments: TPH-Dx Acid wash and silica gel cleanup.
SW-06-0710	7/14/10	1706	W	1	X	X							unpreserved
SW-05-0710	↓	1711	W	1	X	X							↓
SW-04-0710	↓	1714	W	1	X	X							↓
SW-01-0710	↓	1725	W	1	X	X							↓
SP-01-0710	7/15/10	845	W	12	X	X	X	X	X				field filtered metals
SP-02-0710	↓	945	W	12	X	X	X	X	X				unpreserved
SP-03-0710	↓	1030	W	12	X	X	X	X	X				w/ HNO_3
SW-03-0710	7/14/10	1730	W	1	X	X							unpreserved

Comments/Special Instructions: Metals: As, Pb, Hg, Tl

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature)	(Signature)	(Signature)
Printed Name: Chris B[illegible]	Printed Name: Rick Hub[illegible]	Printed Name:	Printed Name:
Company: Amec	Company: ARI	Company:	Company:
Date & Time: 7/15/10 1200	Date & Time: 7/15/10 1200	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

e Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate on schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:

Turn-around Requested: Standard

Page: 1 of

ARI Client Company: Amec Geomatrix

Phone: 206 342 1760

Date: 7/13/10

Ice Present?

Client Contact: Nik Bacher

No. of Coolers:

Cooler Temps:

Client Project Name: Skagit Whitmarsh

Client Project #: 14159

Samplers: Chris Brown, Emily Scott

Sample ID	Date	Time	Matrix	No. Containers	PCB 8082	Pesticide 8081	Total Metals 6010	Diss Metals 6010				Notes/Comments: Dissolved metals NOT Field filtered. Not preserved. Total metals Preserved w/ HNO_3
SW-01-0710	7/12/10	1250	W	10	X	X	X	X				Not field filtered
SW-03-0710	↓	1340	↓	10	X	X	X	X				↓
SW-06-0710	↓	1430	↓	10	X	X	X	X				↓
SW-04-0710	↓	1600	↓	10	X	X	X	X				↓
SW-05-0710	↓	1620	↓	10	X	X	X	X				↓
MW-07-0710	7/13/10	845	W	10	X	X	X	X				Field filtered
MW-04-0710	7/13/10	1000	W	10	X	X	X	X				Field filtered
MW-03-0710	7/13/10	1130	W	10	X	X	X	X				Field filtered
				[signature]								

Comments/Special Instructions: Please Email Nik w/cooler check-in information. Metals: As, Pb, Hg, Tl

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Chris Brown	Printed Name: Rich Hudson	Printed Name:	Printed Name:
Company: Amec	Company: ARI	Company:	Company:
Date & Time: 7/13/10 1225	Date & Time: 7/13/10 1225	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Amec Geomatrix	Phone: 206 347 1760
Client Contact: Nik Bacher	
Client Project Name: Skagit Whitmarsh	
Client Project #: 14159	Samplers: C. Brown, E. Scott
Page: 1 of 1	
Date: 7/16/10	Ice Present?
No. of Coolers:	Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	VOC 8260C	SVOC 8270	PAHs 8270-SIM	PCBs 8082	OC Pest 8081	NWTPH-HCID	NWTPH-Dx	NWTPH-G	Total Metals	Dissolved Metals Field Filtered	Notes/Comments
EB-01-0710	7/15/10	1515	W		X	X	X	X	X	X	X	X	X	X	TPH-Dx: Silica gel and acid wash cleanup. Metals preserved w/ HNO3
Tripblank	—	—	W	2	X										
															VOAs preserved w/ HCl

Comments/Special Instructions: Metals: As, Sb, Be, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, V, Zn

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Chris Brown	Printed Name: Nikka Malumba	Printed Name:	Printed Name:
Company: Amec	Company: ARI	Company:	Company:
Date & Time: 7/16/10 1345	Date & Time: 7/16/10 1345	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-03

Project Name: March Point (Whitmarsh) Landfill

Project Number: 14159/Task 6
Location: Anacortes, WA
Sampler: Emerald Erickson, Toni Olson

Date: 10/4/10
Weather Conditions: Cloudy
Wind Speed/Direction: 0-5 mph /NW

WELL INFORMATION

Casing Diameter (in): NA
Top of Casing Elevation (ft): NA
Initial Depth to Water (ft): NA
Wellhead Condition: NA

Groundwater Elevation (ft): NA
Depth of Well Casing (ft): NA
Actual Purge Volume (gal): NA

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
1320 →		6.14	0.116	15.2	229	7.44	24.1	

Sample ID No.: SP-03-1010
Water Level Ind. Model & No.: Horiba U-22
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used: Peristaltic pump
Sampling Equipment Used: Peristaltic pump

Purge Start Time:
Purge Completion Time:
Average Purge Rate (mL/min):
Analytical Lab: ARI

Sample Collection Time:
Purging Method: low-flow w/peristaltic
Sample Containers Used:
Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-3

Project Name: March Point (Whitmarsh) Landfill

Date: 10/5/10

Project Number: 14159/Task 6

Weather Conditions: Sunny – 60s °F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph S

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 9.10

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 2.5

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
9.10	1603	6.99	55.5	16.8	-92	6.17	0.0	
9.10	1606	7.00	55.5	16.7	-130	6.05	0.0	
9.10	1609	7.02	55.5	16.7	-150	5.95	0.0	
9.10	1612	7.03	55.6	16.7	-156	5.89	4.6	
9.10	1620	7.00	55.6	16.7	-163	5.79	4.1	
9.10	1624	7.03	55.5	16.7	-169	5.40	0.0	
9.10	1627	7.05	55.5	16.7	-171	5.25	0.0	
9.10	1630	7.05	55.5	16.7	-173	5.19	0.0	

(margin note, between 1612 and 1620 rows:) eristaltic attery ailure

Sample ID No.: MW-3-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1600

Purge Completion Time: 1715

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1635

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Final Depth to Water = 9.10 ft below TOC @ 1715

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-4

Project Name: March Point (Whitmarsh) Landfill

Date: 10/5/10

Project Number: 14159/Task 6

Weather Conditions: Sunny, low 50s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 5mph / W

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 3.65

Wellhead Condition: OK

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 4.5

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
3.77	1327	6.70	49.6	12.7	374	9.24	1.7	
3.79	1330	6.90	50.4	12.3	356	6.76	0.9	
3.80	1333	6.97	50.5	12.1	312	6.27	0.0	
3.80	1336	7.04	50.7	12.0	236	6.05	0.2	
3.80	1339	7.07	50.9	12.0	156	5.87	0.0	
3.79	1342	7.11	50.9	12.2	52	5.69	3.3	
3.78	1345	7.12	50.9	12.1	~~50~~ 5	5.66	2.4	
3.78	1348	7.14	50.9	12.0	-26	5.63	4.9	
3.76	1351	7.16	50.9	12.1	-52	5.64	8.0	
3.75	1354	7.17	50.9	12.1	-67	5.56	8.2	
3.75	1357	7.17	51.0	12.2	-80	5.52	8.7	
3.75	1400	7.18	51.0	12.1	-87	5.50	9.3	
3.72	1403	7.19	50.8	12.4	-93	5.43	9.0	
3.71	1415	7.17	51.1	12.4	-106	5.40	15.2	

PUMP BATT. FAILURE

Sample ID No.: MW-4-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1325

Purge Completion Time: 1517

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1430

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Final Depth to water = 3.96 @ 1517

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-2

Project Name: March Point (Whitmarsh) Landfill

Date: 10/05/10

Project Number: 14159/Task 6

Weather Conditions: Sunny - 60°s F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph S

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 8.29

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 3

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
8.35	1136	7.09	54.0	12.7	338	8.22	29.9	
8.35	1139	6.73	53.6	12.6	345	7.40	20.7	
8.35	1142	6.61	53.3	12.6	345	7.10	14.0	
8.35	1145	6.54	53.1	12.6	345	6.76	11.8	
8.35	1148	6.50	52.8	12.6	343	6.44	~~2~~4.7	
8.35	1151	6.~~49~~	52.4	12.6	340	6.24	7.6	
8.35	1154	6.48	52.2	12.6	337	6.11	12.2	
8.35	1157	6.48	52.2	12.6	336	6.03	12.6	
8.35	1200	6.48	52.2	12.6	335	5.93	7.1	
8.35	1203	6.48	52.0	12.6	332	5.81	~~0.0~~ 3.2	
8.35	1204	6.48	52.0	12.6	330	5.76	3.1	
8.35	1208	6.48	52.0	12.5	329	5.70	3.7	
8.35	1211	6.48	52.0	12.6	327	5.66	3.3	
8.35	1214	6.48	51.9	12.6	326	5.62	3.0	

Sample ID No.: MW-2-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1130

Purge Completion Time: 1308

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1220

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-03

Project Name: March Point (Whitmarsh) Landfill

Date: 10/05/10

Project Number: 14159/Task 6

Weather Conditions: Sunny – 60s °F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-9 mph S.

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	~~SC~~ (~~ms/cm~~)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	1020	7.70	0.999	13.6	342	11.99	24.8	DO is high

Sample ID No.: SW-03-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1020

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: lots of debris from plants in water and ~~and~~ wildlife

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-01

Project Name: March Point (Whitmarsh) Landfill

Date: 10/05/10

Project Number: 14159/Task 6

Weather Conditions: Cloudy - High 50's °F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph to S

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
	0950	6.26	63.0	11.6	346	12.20	10.9	DO high?

Sample ID No.: SW-01-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 0930

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Large amount of plants & debris in water.

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-07

Project Name: March Point (Whitmarsh) Landfill

Date: ______

Project Number: 14159/Task 6

Weather Conditions: ______

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: ______

WELL INFORMATION

Casing Diameter (in): ______

Top of Casing Elevation (ft): ______

Initial Depth to Water (ft): ______

Wellhead Condition: ______

Groundwater Elevation (ft): ______

Depth of Well Casing (ft): ______

Actual Purge Volume (gal): ______

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes

Sample ID No.: ______

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: ______

Purge Completion Time: ______

Average Purge Rate (mL/min): ______

Analytical Lab: ARI

Sample Collection Time: ______

Purging Method: low-flow w/peristaltic

Sample Containers Used: ______

Chemical Analyses: ______

Other Field Observations: ______

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-05

Project Name: March Point (Whitmarsh) Landfill

Date: 10/06/10

Project Number: 14159/Task 6

Weather Conditions: Sunny - high 60s F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph

WELL INFORMATION

Casing Diameter (in): ______

Groundwater Elevation (ft): ______

Top of Casing Elevation (ft): ______

Depth of Well Casing (ft): ______

Initial Depth to Water (ft): ______

Actual Purge Volume (gal): ______

Wellhead Condition: ______

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
NA	1108	8.09	0.465	16.8	198	10.18	19.6	

Sample ID No.: SW-05-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: ______

Sample Collection Time: 1110

Purge Completion Time: ______

Purging Method: low-flow w/peristaltic

Average Purge Rate (mL/min): ______

Sample Containers Used: ______

Analytical Lab: ARI

Chemical Analyses: ______

Other Field Observations: ______

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-04

Project Name: March Point (Whitmarsh) Landfill

Date: 10/06/10

Project Number: 14159/Task 6

Weather Conditions: Sunny - high 60's F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
NA	1040	7.60	0.399	16.0	187	10.20	11.5	

Sample ID No.: SW-04-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1045

Purging Method: ~~low-flow w/peristaltic~~ EE

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-02

Project Name: March Point (Whitmarsh) Landfill

Date: 10/6/10

Project Number: 14159/Task 6

Weather Conditions: Clear, 50s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 5-10mph/NW

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
NA	0852	6.84	0.931	12.8	31	10.37	8.6	

Sample ID No.: SP-02-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 0900

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SP-01

Project Name: March Point (Whitmarsh) Landfill

Date: 10/6/10

Project Number: 14159/Task 6

Weather Conditions: Clear, Low 50s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph / NW

WELL INFORMATION

Casing Diameter (in): ____

Top of Casing Elevation (ft): ____

Initial Depth to Water (ft): ____

Wellhead Condition: ____

Groundwater Elevation (ft): ____

Depth of Well Casing (ft): ____

Actual Purge Volume (gal): ____

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/~~cm~~ TD)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
NA	0818	6.42	72.4	12.1	284	10.56	9.5	

Sample ID No.: SP-01-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: ____

Purge Completion Time: ____

Average Purge Rate (mL/min): ____

Analytical Lab: ARI

Sample Collection Time: 0820

Purging Method: low-flow w/peristaltic

Sample Containers Used: ____

Chemical Analyses: ____

Other Field Observations: Field-filtered dissolved metals sample.

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-11

Project Name: March Point (Whitmarsh) Landfill

Date: 10/8/10

Project Number: 14159/Task 6

Weather Conditions: Rainy, 50s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph / NW

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 10.41

Wellhead Condition: OK

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 2.5

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
10.41	0751	6.34	64.6	13.1	381	7.83	7.5	
10.41	0754	6.69	64.2	13.3	369	5.60	14.9	
10.41	0757	6.90	64.0	13.5	276	5.04	5.4	
10.41	0800	6.96	64.0	13.5	165	4.93	~~7~~ 5.7	
10.41	0803	7.01	63.9	13.5	45	4.86	5.5	
10.41	0806	7.05	63.9	13.6	-54	4.78	3.8	
10.41	0809	7.09	63.8	13.6	-98	4.72	4.3	
10.41	0812	7.12	63.8	13.6	-120	4.68	4.5	
10.41	0815	7.13	63.8	13.6	-127	4.68	4.0	
10.41	0818	7.16	63.9	13.6	-143	4.63	4.7	
10.41	0821	7.18	63.8	13.6	-153	4.60	5.6	
10.41	0824	7.19	63.8	13.7	-158	4.59	4.9	
10.41	0827	7.21	63.8	13.7	-164	4.57	5.0	
10.41	0830	7.21	63.8	13.7	-167	4.55	5.0	

Sample ID No.: MW-11-1010, MW-11-1010 ~~DUP~~ TD -X

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 0748

Purge Completion Time: 1200

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 0835, 1105

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-8

Project Name: March Point (Whitmarsh) Landfill

Date: 10/7/10

Project Number: 14159/Task 6

Weather Conditions: Cloudy, Rain, 50s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 10mph/SE

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 16.41

Wellhead Condition: OK

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 3

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
16.39	1715	7.07	0.0	13.2	179	7.14	181.0	
16.40	1718	6.46	0.176	12.9	140	6.22	101.0	
16.40	1721	6.43	0.175	12.8	85	5.93	80.0	
16.40	1724	6.39	0.172	12.8	25	5.70	67.7	
16.40	1727	6.38	0.169	12.8	-8	5.52	56.1	
16.40	1730	6.37	0.164	12.8	-34	5.43	48.1	
16.40	1733	6.37	0.162	12.8	-42	5.38	44.2	
16.40	1736	6.37	0.159	12.8	-55	5.33	37.0	
16.40	1739	6.38	0.156	12.8	-65	5.27	43.5	
16.40	1742	6.38	0.154	12.8	-68	5.21	31.4	
16.40	1745	6.39	0.151	12.8	-73	5.18	23.3	
16.40	1748	6.39	0.148	12.8	-78	5.17	25.3	
16.40	1751	6.40	0.145	12.8	-82	5.13	25.0	

Sample ID No.: MW-8-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1710

Purge Completion Time: 1847

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1755

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Final DTW = 16.40 ft below TOC.

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-5

Project Name: March Point (Whitmarsh) Landfill

Date: 10/07/10

Project Number: 14159/Task 6

Weather Conditions: Cloudy - high 50's°F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 5-10 mph S

WELL INFORMATION

Casing Diameter (in): 2

Groundwater Elevation (ft):

Top of Casing Elevation (ft):

Depth of Well Casing (ft):

Initial Depth to Water (ft): 12.97

Actual Purge Volume (gal): 3.5

Wellhead Condition: good

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	~~EC~~ SC ee (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
13.54	1503	6.30	0.232	14.7	197	6.43	7.2	
13.54	1506	6.38	0.232	14.5	175	6.07	4.4	
13.53	1509	6.35	0.232	14.4	143	5.88	3.8	
13.52	1512	6.41	0.232	14.3	102	5.71	7.0	
13.52	1515	6.42	0.231	14.2	41	5.49	8.0	
13.52	1518	6.42	0.231	14.2	28	5.44	8.8	
13.52	1521	6.43	0.231	14.2	8	5.33	9.9	
13.52	1524	6.43	0.231	14.2	-11	5.26	9.4	
13.50	1527	6.44	0.231	14.1	-23	5.20	8.1	
13.50	1530	6.45	0.231	14.1	-33	5.15	7.8	
13.49	1533	6.45	0.231	14.1	-41	5.10	8.5	
13.48	1536	6.46	0.231	14.1	-49	5.05	8.0 ee	
13.47	1539	6.46	0.231	14.1	-55	5.03	8.6	
13.45	1542	6.47	0.231	14.1	-60	5.02	8.2	
13.45	1545	6.47	0.232	14.1	-63	4.98	7.5	
13.43	1548	6.48	0.232	14.1	-67	4.97	8.0	

Sample ID No.: MW-05-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1500

Sample Collection Time: 1555

Purge Completion Time: 1640

Purging Method: low-flow w/peristaltic

Average Purge Rate (mL/min):

Sample Containers Used:

Analytical Lab: ARI

Chemical Analyses:

Other Field Observations: ~~WL mo~~ ee Tide is coming in while sampling and might be the ~~reason for~~ ee reason the increasing WL. Final DTW = 12.77 ft below TOC.

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-6

Project Name: March Point (Whitmarsh) Landfill

Date: 10/7/10

Project Number: 14159 / Task 6

Weather Conditions: Cloudy, 50s

Location: Anacortes, WA

Sampler: T. Olson, E. Erickson

Wind Speed/Direction: 0-5 mph / SE

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft): ~~25~~ TD

Actual Purge Volume (gal): 2.5

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/~~cm~~ TC)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
9.73	1256	6.13	0.178	16.1	211	7.37	21.3	
9.73	1259	6.17	0.178	16.1	118	6.60	8.9	
9.73	1302	6.19	0.177	16.1	9	6.15	TC ~~7~~ 2.6	
9.74	1305	6.20	0.177	16.1	-44.0	5.86	1.7	
9.74	1308	6.22	0.177	16.1	-62.0	5.72	1.5	
9.74	1311	6.23	0.177	16.1	-75.7	5.55	1.6	
9.74	1314	6.24	0.177	16.2	-81.6	5.45	1.5	
9.74	1317	6.24	0.177	16.1	-88.7	5.34	1.5	
9.74	1320	6.25	0.177	16.2	-92.4	5.30	1.6	
9.74	1323	6.25	0.177	16.2	-96.4	5.23	1.6	

Sample ID No.: MW-6-1010

Water Level Ind. Model & No.: Solonist Model 101

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1255

Purge Completion Time: 1424

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1330

Purging Method: low flow / peristaltic pump

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Final DTW = 9.73ft below TOC.

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-6

Project Name: March Point (Whitmarsh) Landfill

Date: 10/6/10

Project Number: 14159/Task 6

Weather Conditions: Clear, 60s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 5-10mph /NW

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 9.64

Wellhead Condition: OK

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
9.67	1529	6.64	0.176	16.4	9	7.93	58.1	
9.67	1532	6.50	0.173	16.4	-42	6.91	21.8	
9.69	1535	6.46	0.172	16.3	-61	6.38	8.0	
9.69	1538	6.44	0.172	16.4	-73	6.04	2.0	
9.69	1544	6.44	0.171	17.3	-87	5.39	0.6	

peristaltic not working properly

Sample ID No.: ~~MW-6-1010~~ Not collected

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1525

Purge Completion Time: 1545

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time:

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Attempt #1 - Peristaltic Pump Failure, could not complete sampling.

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-9

Project Name: March Point (Whitmarsh) Landfill

Date: 10/07/10

Project Number: 14159/Task 6

Weather Conditions: Partly Cloudy - 60's °F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph/S

WELL INFORMATION

Casing Diameter (in): 2

Groundwater Elevation (ft):

Top of Casing Elevation (ft):

Depth of Well Casing (ft):

Initial Depth to Water (ft): 12.92 @ 0936

Actual Purge Volume (gal): ~2.5

Wellhead Condition: good

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm) us	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.94	0949	6.49	90.5	13.7	179	7.92	10.0	
12.94	0952	6.46	90.1	13.3	111	6.25	10.1	
12.94	0955	6.49	89.5	12.8	1	5.61	13.3	
12.94	0958	6.50	89.3	12.8	-31	5.53	9.5	
12.95	1001	6.51	89.0	12.7	-57	5.40	6.6	
12.95	1004	6.52	89.0	12.7	-67	5.35	5.0	
12.95	1007	6.53	88.8	12.7	-79	5.28	3.5	
12.95	1010	6.54	88.7	12.7	-88	5.19	3.2	
12.95	1013	6.54	88.6	12.7	-92	5.17	3.0	
12.95	1016	6.54	88.6	12.7	-96	5.14	2.8	
12.95	1019	6.54	88.6	12.8	-100	5.10	2.8	

Sample ID No.: MW-9-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 0946

Sample Collection Time: 1025

Purge Completion Time:

Purging Method: low-flow w/peristaltic

Average Purge Rate (mL/min):

Sample Containers Used:

Analytical Lab: ARI

Chemical Analyses:

Other Field Observations: Final depth to water = 12.95 ft below TOC.

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-10

Project Name: March Point (Whitmarsh) Landfill

Date: 10/07/10

Project Number: 14159/Task 6

Weather Conditions: partly cloudy - 50s°F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph/S

WELL INFORMATION

Casing Diameter (in): 2

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 16.69

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): ~2

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC us (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
16.69	0733	6.22	71.1	11.2 ~~24.1~~	324	7.12	23.7	
16.69	0736	6.64	71.1	11.4	287	5.27	10.0	
16.69	0739	6.82	71.1	11.5	104	4.78	7.1	
16.69	0742	6.87	71.1	11.5	37	4.74	6.6	
16.69	0745	6.98	71.2	11.6	-79	4.65	4.7	
16.69	0749	7.04	71.1	11.7	-124	5.91	9.4	
16.69	0751	7.07	71.1	11.6	-131	5.52	7.4	
16.69	0754	7.10	71.0	11.6	-152	4.80	2.6	
16.69	0757	7.12	70.9	11.6	-164	4.69	2.6	
16.69	0800	7.13	70.9	11.6	-172	4.66	2.7	
16.69	0803	7.14	70.9	11.6	-179	4.63	2.6	

Sample ID No.: MW-10-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 0730

Purge Completion Time: 0910

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 0810

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Final depth to water is 16.69 ft below top of casing @ 0912

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-7

Project Name: March Point (Whitmarsh) Landfill

Date: 10/6/10

Project Number: 14159/Task 6
Weather Conditions: Sunny, 60s

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson
Wind Speed/Direction: 5-10mph /

WELL INFORMATION

Casing Diameter (in): 2
Groundwater Elevation (ft):
Top of Casing Elevation (ft):
Depth of Well Casing (ft):
Initial Depth to Water (ft): 12.27
Actual Purge Volume (gal):
Wellhead Condition: OK

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.27	1209	7.42	0.236	15.2	179	6.63	27.6	
12.27	1212	7.18	0.231	15.2	146	6.20	14.5	
12.28	1215	7.04	0.227	15.2	98	5.95	6.4	
12.27	1218	6.97	0.224	15.3	41	5.67	0.0	
12.27	1221	6.93	0.219	15.4	-1	5.55	3.1	
12.27	1224	6.90	0.217	15.5	-25	5.41	6.7	
12.27	1227	6.89	0.218	15.3	-34	5.41	4.2	
12.27	1230	6.89	0.218	15.3	-38	5.37	4.7	
12.27	1233	6.88	0.216	15.4	-42	5.31	5.3	
12.27	1236	6.88	0.214	15.4	-47	5.29	5.2	
12.27	1239	6.87	0.213	15.3	-53	5.24	5.0	

Sample ID No.: MW-7-1010
Water Level Ind. Model & No.: Horiba U-22
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used: Peristaltic pump
Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1205
Sample Collection Time: 1295
Purge Completion Time: 1411
Purging Method: low-flow w/peristaltic
Average Purge Rate (mL/min):
Sample Containers Used:
Analytical Lab: ARI
Chemical Analyses:

Other Field Observations: Final depth to water after sampling is 12.05 ft below TOC @ 1412

Updated 3/7/06

AMEC Geomatrix

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER SW-06

Project Name: March Point (Whitmarsh) Landfill

Date: 10/06/10

Project Number: 14159/Task 6

Weather Conditions: Sunny - high 60s F

Location: Anacortes, WA

Sampler: Emerald Erickson, Toni Olson

Wind Speed/Direction: 0-5 mph S

WELL INFORMATION

Casing Diameter (in):

Top of Casing Elevation (ft):

Initial Depth to Water (ft):

Wellhead Condition:

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal):

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
—	1120	7.94	~~0.999~~	16.9	234	~~10.31~~	10.1	
			1.16			10.07		

Sample ID No.: SW-06-1010

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time:

Purge Completion Time:

Average Purge Rate (mL/min):

Analytical Lab: ARI

Sample Collection Time: 1130

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-9

Project Name: Whitmarsh

Date: 3/26/13

Project Number: 14159

Weather Conditions: Sunny 60°

Location: South March Point Rd

Sampler:

Wind Speed/Direction: No wind

WELL INFORMATION

Casing Diameter (in): –

Top of Casing Elevation (ft): –

Initial Depth to Water (ft): 12.29

Wellhead Condition: Good

Groundwater Elevation (ft): –

Depth of Well Casing (ft): –

Actual Purge Volume (gal): 2 gal

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.29	1640	6.18	.759	12.44	-118	2.57	11.4	
12.52	1643	6.48	.995	12.14	-135	0.45	11.5	
12.30	1646	6.68	.757	12.06	-148	0.00	15.9	
12.30	1649	6.72	.728	12.05	-149	0.00	17.8	
12.29	1652	6.75	.718	12.03	-151	0.00	19.0	
12.30	1655	6.77	.714	11.98	-151	0.00	19.7	

Sample ID No.: MW-9-01/02-0813

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1640

Purge Completion Time: 1815

Average Purge Rate (mL/min): 200

Analytical Lab: ARI

Sample Collection Time: 1700

Purging Method: low-flow w/peristaltic

Sample Containers Used: 8X 1L AG, 8x 500mL HDPE

Chemical Analyses: Dioxin/Furan, Total and Dissolved metals

Other Field Observations:

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-5

Project Name: Whitmarsh Landfill
Date: 3/28/2013
Project Number: 14159
Weather Conditions: Sunny 60
Location: South March Point Road
Sampler: CJ
Wind Speed/Direction: South

WELL INFORMATION

Casing Diameter (in): –
Top of Casing Elevation (ft): –
Initial Depth to Water (ft): 12.48
Wellhead Condition: Good
Groundwater Elevation (ft): –
Depth of Well Casing (ft): –
Actual Purge Volume (gal): 2 gal

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.48	0718	6.84	1.96	10.78	-124	4.65	5.05	
12.85	0721	6.78	1.96	10.95	-123	1.67	42.5	
12.96	0724	6.75	2.01	11.43	-123	0.86	48.0	
13.04	0727	6.77	2.04	11.67	-127	0.52	30.7	
13.10	0730	6.77	1.98	11.95	-129	0.18	41.6	
13.16	0733	6.78	1.97	12.01	-130	0.14	28.3	
13.17	0736	6.78	1.97	12.18	-130	0.15	26.8	

Sample ID No.: MW-5-01-0313
Water Level Ind. Model & No.: Horiba U-22
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used: Peristaltic pump
Sampling Equipment Used: Peristaltic pump

Purge Start Time: 0715
Purge Completion Time: 0745
Average Purge Rate (mL/min): 200
Analytical Lab: ARI
Sample Collection Time: 0745
Purging Method: low-flow w/peristaltic
Sample Containers Used: 2x500mL HDPE
Chemical Analyses: total and dissolved metals

Other Field Observations:

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-8

Project Name: Whitmarsh Landfill
Date: 3/26/13
Project Number: 14159
Weather Conditions: Sunny, 60°
Location: March Point Rd South
Sampler: CJ, NM
Wind Speed/Direction: SE

WELL INFORMATION

Casing Diameter (in): –
Top of Casing Elevation (ft): –
Initial Depth to Water (ft): 14.15
Wellhead Condition: Good
Groundwater Elevation (ft): –
Depth of Well Casing (ft): –
Actual Purge Volume (gal): 2 gal

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
14.15	1520	6.30	1.46	14.70	-107	6.47	X	Turb out of range
15.43	1523	6.50	1.40	13.71	-112	1.63	X	" "
15.44	1526	6.52	1.34	13.21	-112	0.34	X	" "
15.44	1529	6.55	1.33	13.07	-109	0.05	649	
15.44	1532	6.55	1.33	12.92	-110	0.00	550	
15.44	1535	6.56	1.33	12.87	-116	0.00	502	

Sample ID No.: MW-8-07-0313
Water Level Ind. Model & No.: Horiba U-22
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used: Peristaltic pump
Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1520
Purge Completion Time: 1600
Average Purge Rate (mL/min): 200
Analytical Lab: ARI
Sample Collection Time: 1540
Purging Method: low-flow w/peristaltic
Sample Containers Used: 4x 1L AG
Chemical Analyses: Dioxin / Furan

Other Field Observations: Purge water very turbid when purging began. Solids possibly and organic.

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-7

Project Name: Whitmarsh Landfill
Date: 3/26/13
Project Number: 14159
Weather Conditions: Sunny, 60°
Location: South Marsh Point Road
Sampler: CJ, NM
Wind Speed/Direction: No wind.

WELL INFORMATION

Casing Diameter (in): –
Groundwater Elevation (ft): –
Top of Casing Elevation (ft): –
Depth of Well Casing (ft): –
Initial Depth to Water (ft): 11.35
Actual Purge Volume (gal): 2 gal
Wellhead Condition: Good

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
11.35	1855	6.92	6.28	12.61	-108	3.04	34.5	
11.40	1858	6.98	6.42	12.46	-116	0.62	14.2	
11.40	1901	7.00	6.29	12.42	-121	0.49	9.6	
11.40	1904	7.01	5.98	12.35	-124	0.34	7.5	
11.41	1907	7.01	5.91	12.30	-127	0.13	5.6	

Sample ID No.: MW-7-01-0313
Water Level Ind. Model & No.: Horiba U-22
ORP/DO Meter Model & No.: Horiba U-22
Purge Equipment Used: Peristaltic pump
Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1855
Sample Collection Time: 1915
Purge Completion Time: 1920
Purging Method: low-flow w/peristaltic
Average Purge Rate (mL/min): 200
Sample Containers Used: 2×500mL HDPE, HNO_3 2×500mL HDPE
Analytical Lab: ARI
Chemical Analyses: Dissolved and total metals

Other Field Observations: .10 foot of product. Likely organic sheen.

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-6

Project Name: Whitmarsh Landfill

Date: 3/28/13

Project Number: 14159

Weather Conditions: Sunny 60°

Location: South March Point Road

Sampler: Chelsea Jefferson

Wind Speed/Direction: No wind

WELL INFORMATION

Casing Diameter (in): –

Top of Casing Elevation (ft): –

Initial Depth to Water (ft): 8.10

Wellhead Condition: Good

Groundwater Elevation (ft): –

Depth of Well Casing (ft): –

Actual Purge Volume (gal): 2 gal

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
8.10	0815	6.78	1.57	9.93	-128	7.09	37.4	
8.24	0818	6.61	1.38	9.87	-125	0.56	40.4	
8.22	0821	6.61	1.43	9.87	-126	0.58	43.9	
8.22	0824	6.59	1.56	9.94	-127	0.30	34.8	
8.23	0827	6.58	1.46	9.89	-123	0.07	27.1	
8.23	0830	6.57	1.38	9.84	-123	0.00	32.5	
8.23	0833	6.57	1.33	9.79	-124	0.00	23.9	

Sample ID No.: MW-6-07-0313

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 0812

Purge Completion Time: 0845

Average Purge Rate (mL/min): 200

Analytical Lab: ARI

Sample Collection Time: 0845

Purging Method: low-flow w/peristaltic

Sample Containers Used: 2 x 500mL HDPE, HNO_3

Chemical Analyses: Total, Dissolved metals

Other Field Observations:

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-06

Project Name: Skagit Whitmarsh Landfill

Date: Saturday, 8/17/2013

Project Number: 014159000.06

Weather Conditions: Clear, Hot, muggy

Location: Anacortes, WA

Sampler: Nathan Moxley

Wind Speed/Direction: —

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 9.05

Wellhead Condition: good

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): ~2

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
9.29	1205	6.72	1.29	16.7	-88.7	3.65	2.9	clear w/ yellowish color
9.25	1211	6.71	1.29	16.7	-91.8	2.72	22.6	"
9.24	1215	6.70	1.29	16.6	-94.4	2.19	4.4	"
9.22	1220	6.68	1.29	16.7	-96.5	1.88	0.9	"
9.20	1224	6.68	1.29	16.6	-95.2	1.73	3.1	"
9.19	1229	6.68	1.29	16.6	-94.8	1.68	3.9	"
9.19	1233	6.68	1.29	16.6	-94.6	1.59	4.0	"

Sample ID No.: MW-06-01-0813 @ 1235 MS/MSD

Water Level Ind. Model & No.: ~~Horiba U-22~~ In-Situ

ORP/DO Meter Model & No.: ~~Horiba U-22~~ YSI 650 MDS

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: ~1200

Purge Completion Time: 1235

Average Purge Rate (mL/min): ~ 216

Analytical Lab: ARI

Sample Collection Time: 1235

Purging Method: low-flow w/peristaltic

Sample Containers Used: 6

Chemical Analyses: total metals + dissolved metals

Other Field Observations: Clear w/ slight yellowish color, no odor/~~sheen~~ NM
Slight organic sheen visible on purge water

2 gal = 7570 ml / 35 ≈ 216 ml/min

Updated 3/7/06

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GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-07

Project Name: Whitmarsh

Date: Sat. 8/17/2013

Project Number: 0141590000.06

Weather Conditions: p. cloudy, warm, muggy

Location: Anacortes, WA

Sampler: Nathan Moxley

Wind Speed/Direction: –

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 12.04

Wellhead Condition: ok, path and well completely overgrown w/ blackberries

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 2.0

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.08	1325	7.26	2.25	16.6	-35.0	5.44	6.4	Clear, very slight yellow tint to color
12.07	1329	7.09	2.22	16.3	-35.4	2.21	6.2	"
~~12~~ 12.07	1334	6.90	2.09	15.1	-37.8	~~2.09~~ 1.62	4.4	"
12.06	1338	6.89	1.87	14.7	-42.6	1.13	2.6	"
12.06	1343	6.90	1.86	14.7	-44.1	1.04	3.2	"
12.05	1349	6.92	1.85	14.8	-45.1	0.99	4.1	"
12.05	1354	6.92	1.85	14.8	-45.8	0.92	4.0	"

Sample ID No.: MW-07-02-0813 @ 1400

Water Level Ind. Model & No.: ~~Horiba U-22~~ Insitu

ORP/DO Meter Model & No.: ~~Horiba U-22~~ YSI 650 MDS

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: ~1322

Purge Completion Time: 1354

Average Purge Rate (mL/min): ~236

Analytical Lab: ARI

Sample Collection Time: 1400

Purging Method: low-flow w/peristaltic

Sample Containers Used: 2

Chemical Analyses: Dissolved Metals + Total Metals

Other Field Observations: no sheen/odor, clear, mostly colorless (slight yellowish tint)

2 gal ~ 7570 ml / 32 min ≈ 236

Updated 3/7/06

amec

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-05

Project Name: Skagit Whitmarsh

Date: Sat. 8/17/2013

Project Number: 0141590000.06

Weather Conditions: Clear, Hot, muggy

Location: Anacortes, WA

Sampler: Nathan Moxley

Wind Speed/Direction: —

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 12.81

Wellhead Condition: Good, well is completely overgrown w/ blackberries

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): 2.0

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.89 ~~1455~~	1455	7.46	1.68	16.9	-25.5	3.53	13.1	Clear, w/ slight yellow tint
12.91	1459	7.45	1.68	16.1	-73.0	2.05	4.2	"
12.88	1504	7.36	1.68	15.8	-95.0	1.58	4.9	"
12.88	1509	7.36	~~[illegible]~~ 1.68	15.7	-97.1	1.55	4.4	"
12.87	1513	7.33	1.68	15.6	-101.3	1.35	4.8	"
12.86	1517	7.31	1.68	15.3	-106.7	1.15	2.2	"
12.86	1521	7.31	1.68	15.3	-106.8	1.13	2.4	"
12.85	1524	7.30	1.68	15.4	-106.5	1.10	2.6	"
12.85	1528	7.30	1.68	15.4	-106.3	1.09	2.4	"

Sample ID No.: MW-05-03-0813 @ 1530

Water Level Ind. Model & No.: ~~Horiba U-22~~ Insitu

ORP/DO Meter Model & No.: ~~Horiba U-22~~ YSI 650 MDS

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1450

Purge Completion Time: 1528

Average Purge Rate (mL/min): ~200

Analytical Lab: ARI

Sample Collection Time: 1530

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations: Clear w/ slight yellow tint, no odor/sheen

Updated 3/7/06

7570 ml / 38 min ≈ 200

amec

GROUNDWATER SAMPLING LOG
Low Flow Sampling

MONITORING WELL/PIEZOMETER NUMBER MW-09

Project Name: Skagit Whitmarsh

Date: ~~8~~ Sat. 8/17/13

Project Number: 014150900000.06

Weather Conditions: Clear, Hot, muggy

Location: Anacortes, WA

Sampler: Nathan Moxley

Wind Speed/Direction: —

WELL INFORMATION

Casing Diameter (in): 2"

Top of Casing Elevation (ft):

Initial Depth to Water (ft): 12.90

Wellhead Condition: Good, well is completely overgrown w/ blackberries

Groundwater Elevation (ft):

Depth of Well Casing (ft):

Actual Purge Volume (gal): ~2

PURGING MEASUREMENTS

WL (ft btoc)	Time	pH (std. units)	SC (ms/cm)	Temp. (°C)	ORP (mv)	DO (mg/L)	Turbidity (NTUs)	Notes
12.95	1608	7.15	0.84	15.2	-88.2	3.89	33.1	Clear, colorless
12.96	1612	7.07	0.81	15.1	-93.4	1.80	20.1	"
12.96	1616	7.00	0.81	14.8	-93.2	1.40	18.3	"
12.96	1620	6.98	0.80	14.3	-94.1	1.03	8.6	"
12.95	1624	6.92	0.79	14.1	-95.1	0.92	3.7	"
12.95	1629	6.92	0.79	14.0	-95.6	0.89	3.4	"
12.95	1633	6.92	0.79	14.0	-95.7	0.88	3.3	"

Sample ID No.: MW-09-04-0813 @ 1635

Water Level Ind. Model & No.: Horiba U-22

ORP/DO Meter Model & No.: Horiba U-22

Purge Equipment Used: Peristaltic pump

Sampling Equipment Used: Peristaltic pump

Purge Start Time: 1605

Purge Completion Time: 1633

Average Purge Rate (mL/min): ~270

Analytical Lab: ARI

Sample Collection Time:

Purging Method: low-flow w/peristaltic

Sample Containers Used:

Chemical Analyses:

Other Field Observations:

7570 ml / 28 min ≈ 270

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorpora[ted]
Analytical Chemists and Consultan[ts]
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	
Turn-around Requested:	Standard
ARI Client Company:	AMEC
Phone:	
Client Contact:	Crystal Neirby / John Long
Client Project Name:	Skagit Whitmarsh Landfill
Client Project #:	0141590000.06
Samplers:	Nathan Moxley
Page:	1 of 1
Date:	Sat. 8/17/13
Ice Present?	Y
No. of Coolers:	1
Cooler Temps:	0.4

Sample ID	Date	Time	Matrix	No. Containers	Total Metals	Dissolved Metals	Hardness Cations						Notes/Comments
MW-06-01-0813	8/17/13	1235	Water	6	X	X	X						MS/MSD
MW-07-02-0813	↓	1400	↓	2	↓	↓	↓						
MW-05-03-0813	↓	1530	↓	2	↓	↓	↓						
MW-09-04-0813	↓	1635	↓	2	↓	↓	↓						

Comments/Special Instructions: Metals include: antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium and zinc

	Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature)	[signature]	[signature]		
Printed Name:	Nathan Moxley	Ky Langstreeter		
Company:	AMEC	ARI		
Date & Time:	8/19/13 1215	8-19-13 1215		

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

APPENDIX F

Test Pit Logs and Boring Logs

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-1**
TEST PIT LOCATION: N: 537747.4; E: 1229054.8	ELEVATION AND DATUM: 15.57 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 11/1/08 — DATE FINISHED: 11/1/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 5.5 — MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST ND — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi — REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.57 feet	REMARKS
0–1.5	TP-G-1-1-1008	■ (1–1.5)		COVER SOIL: WELL GRADED SAND WITH GRAVEL (SW): brown (10YR 4/3), moist, 75% fine to coarse sand, 20% fine to coarse gravel, < 5% non-plastic fines, roots, 2x3 foot metal (oil) pan, 3 pieces of appliance (e.g. washer)	
1.5–5.5	TP-G-1-4-1008	■ (4)		HOUSEHOLD GARBAGE: plastics, cans, bottles, paper, cardboard with interbedded soil pieces of asbestos containing insulation present (at 3)	50-70% Garbage Soil sample TP-G-1-4-1008 contained 23% crysotile.
5.5	TP-G-1-5.5-1008	■ (5.5–6)		Bottom of test pit at 5.5 feet. Terminated due to asbestos containing material in test pit.	

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-2

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	Test Pit Log No. G-2
TEST PIT LOCATION: N: 537661.3; E: 1229148.8	ELEVATION AND DATUM: 15.37 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 10/30/08 — DATE FINISHED: 10/30/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 8.0 — MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST 7.5 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi — REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.37 feet	REMARKS
0–3				COVER SOIL: POORLY GRADED SAND with SILT (SP-SM): light brown (7.5YR 6/3), moist, 90% fine to coarse sand, 10% non-plastic fines, roots, garbage, 3 appliances (e.g. washer)	Layer thickness increased from 2 feet on the north to 3 feet on the south.
3–8				HOUSEHOLD GARBAGE: soil interbedded with bottles, plastics, and metal pieces concrete foundation with I-beam; appliances present on the south sidewall CONTAINER/TANK: approximately 30 gallon capacity perforated tank at 6 feet below ground surface ▼ wet	20-30% Garbage
8				Bottom of test pit at 8.0 feet. Terminated due to groundwater entering test pit.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Test Pit Log No. G-3

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	
TEST PIT LOCATION: N: 537903.6; E: 1229285.1	ELEVATION AND DATUM: 17.87 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 10/31/08 — DATE FINISHED: 10/31/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 12.0 — MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST 11.5 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi — REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 17.87 feet	REMARKS
0–2	TP-G-3-1-1008	■ (1.0–1.5)		COVER SOIL: WELL GRADED SAND (SW): brown (10YR 4/3), moist, 90% fine to medium sand, < 5% fine gravel, < 5% non-plastic fines, roots, metal sink, plate, lawn mower	
2–9				HOUSEHOLD GARBAGE: bottles, plastics, rags, wood, metallic tub in south side wall with white fibrous material below	White fibrous material extended from the south wall to the north side of test pit. Possible dry wall.
~4.3				Greater concentration of garbage on the north side of test pit.	
~5.0–5.5				SANDY SILT (ML): moist, bluish gray (10B 6/1), petroleum odor	
~6.0				plastic sheeting with other miscellaneous waste	
8	TP-G-3-8-1008	■ (8.0–8.5)			
9–11.5				WELL GRADED SAND (SW): light bluish gray (5B 7/1), moist, 90% fine to coarse sand, < 5% fine gravel, < 5% non-plastic fines	
11.5–12.0	TP-G-3-12-1008	■ (12.0–12.5)		LEAN CLAY (CL): light bluish gray (5B 7/1), moist, 90% fines, < 5% fine sand, < 5% roots, low plasticity, native	
12.0				Bottom of test pit at 12.0 feet. Terminated in native deposit.	

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Test Pit Log No. G-4	
TEST PIT LOCATION: N: 537696.3; E: 1229236.7	ELEVATION AND DATUM: 15.27 feet MLLW	
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 10/31/08	DATE FINISHED: 10/31/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 6.0	MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST ND	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi	REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.27 feet	REMARKS
0–1				COVER SOIL: WELL GRADED SAND (SW): brown (10YR 4/3), moist, 95% fine to medium sand, < 5% non-plastic fines, appliance	
1–6	TP-G-4-1-1008 (1–1.5 ft)	■		HOUSEHOLD GARBAGE: soil interbedded with bottles, cans, metallic pieces, plastics, clothes	70-80% Garbage
5	TP-G-4-5-1008 (5–5.5 ft)	■		washing machine drum	
6				CONCRETE PAD - COBBLES	
				Bottom of test pit at 6.0 feet. Terminated due to concrete pad in test pit.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. TP-G-5**
BORING LOCATION: N: 538006.3; E: 1229133.7	TOP OF CASING ELEVATION AND DATUM: Ground Surface
DRILLING CONTRACTOR: Philip Services Corporation	DATE STARTED: 11/2/08 · DATE FINISHED: 11/2/08
DRILLING METHOD: John Rodriquez	TOTAL DEPTH (ft.): 9.0 · SCREEN INTERVAL (ft.): NA
DRILLING EQUIPMENT: CAT 320C	DEPTH TO WATER (ft.): FIRST 9.0 · COMPL. NA · CASING:
SAMPLING METHOD: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
HAMMER WEIGHT: Grab · DROP: NA	RESPONSIBLE PROFESSIONAL: K. Tahghighi · REG. NO. P.E. 32240

DEPTH (feet)	Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 16.87 feet MLLW	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0					LOG BARK	
0–3	TP-G-5-1-1008 (1.0–1.5)				WELL GRADED SAND (SW): brown (10YR 4/3), moist, 85% fine to coarse sand, <10% fine to coarse gravel, < 5% non-plastic fines, garbage including an appliance (refridgerator), metal siding, and bed frame	
3–9					HOUSEHOLD GARBAGE: bottles, rags, pipes mixed with soil	
5	TP-G-5-5-1008 (5.0–5.5)				three pieces of rounded wood chunks (from power poles?)	
7					sheen, chemical odor	
9	TP-G-5-9-1008 (9.0–9.5)				Bottom of test pit at 9.0 feet. Terminated due to groundwater entering test pit.	

OAKWELLV_TOC (REV. 8/2011)

Test Pit Log No. G-6

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-6**
TEST PIT LOCATION: N: 538032.9; E: 1228965.4	ELEVATION AND DATUM: 18.87 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 11/1/08 — DATE FINISHED: 11/1/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 10.0 — MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST 10.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi — REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 18.87 feet	REMARKS
0–4				LOG BARK	
4–10				WELL GRADED SAND with SILT (SW-SM): light bluish gray (10B 7/1), moist, 90% fine to coarse sand, 10% non-plastic fines with household garbage (plastics, metal debris, bottles, wood), petroleum/organic odor	
6–6.5	TP-G-6-6-1008	■			
8				burnt material with 50-100 foot industrial air hose	
9					Excavated 5.0 feet on the south sidewall perpendicular to the pit to explore for more metallic objects. Metal plate found ~2 feet to 4 feet in diameter.
10				Bottom of test pit at 10.0 feet. Terminated due to groundwater entering test pit.	

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-7

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	
TEST PIT LOCATION: N: 537638.4; E: 1229297.3	ELEVATION AND DATUM: 14.57 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 10/30/08 | DATE FINISHED: 10/30/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 8.0 | MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST ND | NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi | REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 14.57 feet	REMARKS
0–1				COVER SOIL: WELL GRADED SAND WITH SILT (SW-SM): brown (10YR 4/3), moist, 90% fine to coarse sand, 10% non-plastic fines, appliance	
1–7.5				POORLY GRADED SAND (SP) interbedded with household garbage (bottles, metal pieces, rags, automotive parts, wood, tires)	30-50% Garbage
7.5–8				LEAN CLAY (CL): gray (10YR 6/1), moist, 95% fines, < 5% sand, trace organics, low plasticity, native	
8				Bottom of test pit at 8.0 feet. Terminated in native deposit.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-8**	
TEST PIT LOCATION: N: 538017.9; E: 1229080.9	ELEVATION AND DATUM: 16.97 feet MLLW	
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 11/2/08	DATE FINISHED: 11/2/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 8.0	MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST 8.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi	REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 16.97 feet	REMARKS
0–1					LOG BARK	
1–2					WELL GRADED SAND with SILT (SP-SM): light brown (7.5YR 6/3), moist, 85% fine to coarse sand, 10% non-plastic fines, < 5% fine gravel, automotive bumper and front end	
2					COMMERCIAL WOODWASTE: cellulose based wood strips	
5.5					treated wood with chemical odor	
7.5					pipe/hose	
8					Bottom of test pit at 8.0 feet. Terminated due to groundwater entering test pit.	

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-9**
TEST PIT LOCATION: N: 538110.8; E: 1228962.5	ELEVATION AND DATUM: 19.07 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 11/2/08 — DATE FINISHED: 11/2/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 9.5 — MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST 9.5 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi — REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 19.07 feet	REMARKS
0–1				LOG BARK	
1–3				WELL GRADED SAND with GRAVEL (SW): brown (10YR 4/3), moist, 75% fine to coarse sand, 20% fine to coarse gravel, < 5% non-plastic fines	
3				miscellaneous trash including a tire, wood, and metal pieces	
4				partially crushed drum containing fiberglass and solidified resin	
5				chemical odor	
8				WOODWASTE: plywood and lumber, chemical odor, sheen	
9.5				Bottom of test pit at 9.5 feet. Terminated due to groundwater entering test pit.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington		**Test Pit Log No. G-10**	
TEST PIT LOCATION: N: 538156.1; E: 1228669.9		ELEVATION AND DATUM: 22.57 feet MLLW	
EXCAVATION CONTRACTOR: Philip Services Corporation		DATE STARTED: 11/1/08	DATE FINISHED: 11/1/08
OPERATOR: John Rodriquez		TOTAL DEPTH (ft): 9.0	MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C		DEPTH TO WATER: FIRST 9.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket		LOGGED BY: K. Tahghighi	
SAMPLING METHOD: Grab		RESPONSIBLE PROFESSIONAL: K. Tahghighi	REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 22.57 feet	REMARKS
0 – 5.5				LOG BARK	
5.5 – 6.5				SILTY SAND (SM): light bluish gray (10B 7/1), moist, 85% fine to coarse sand, 15% non-plastic fines, odor	
6.5 – 9.0	TP-G-10-8-1008	8.0 – 8.5		MISCELANEOUS WASTE: woodwaste, 5 to 6 crushed drums, plastics mixed with soil	Steel drums. One poly inside steel drum. Drum labels included *Amoco 543*, *Nalco*, *UOP Polymerization Catalyst*
9				rust colored oxidation in groundwater	
				Bottom of test pit at 9.0 feet. Terminated due to groundwater entering test pit.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-11

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	**Test Pit Log No. G-11**
TEST PIT LOCATION: N: 537826.2; E: 1229212.9	ELEVATION AND DATUM: 18.27 feet MLLW
EXCAVATION CONTRACTOR: Philip Services Corporation	DATE STARTED: 10/31/08 / DATE FINISHED: 10/31/08
OPERATOR: John Rodriquez	TOTAL DEPTH (ft): 11.0 / MEASURING POINT: Ground Surface
EXCAVATION EQUIPMENT: CAT 320C	DEPTH TO WATER: FIRST 10.5 / NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: K. Tahghighi
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: K. Tahghighi / REG. NO. P.E. 32240

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 18.27 feet	REMARKS
0–3				WELL GRADED SAND (SW): brown (10YR 4/3), moist, 85% fine to medium sand, < 5% gravel, < 5% non-plastic fines, < 5% garbage	
3–4				POORLY GRADED SAND (SP) interbedded with household garbage (bottles, rags, plastics)	
4–6				AUTOMOTIVE DEBRIS: automotive parts including car hood from 4 to 6 feet below ground surface	
6–7				POORLY GRADED SAND (SP): brown (10YR 4/3), moist, 90% fine to medium sand, < 5% gravel, < 5% non-plastic fines, interbedded garbage	
7–8				SILT with SAND (ML): bluish gray (10B 6/1), dry to moist, 85% fines, 15% fine to coarse sand, moderate plasticity, stiff, petroleum odor	
8–10.5				MISCELANEOUS GARBAGE: soil interbedded with burned garbage and woodwaste	
10.5–11	TP-G-11-11-1008	■ (11–11.5)		LEAN CLAY (CL): gray (10YR 5/1), moist, 90% fines, < 5% fine sand, < 5% roots/organics, moderate plasticity, native	
11				Bottom of test pit at 11.0 feet. Terminated in native deposit.	

Test Pit Log No. G-12

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	
TEST PIT LOCATION: N 538914.4; E 1228415.3	ELEVATION AND DATUM: 20.6 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 10/29/09 — DATE FINISHED: 10/29/09
OPERATOR: Rodney	TOTAL DEPTH (ft): 17.0 — MEASURING POINT: 20.6 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: N. Bacher
SAMPLING METHOD:	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.6 feet	REMARKS
0				SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines	
2				REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines. 80% refuse material	
3				5% refuse	
5				REFUSE MATERIAL: SILTY SAND (SM): brownish gray, moist, 70% fine to coarse sand, 15% non-plastic fines. 15% refuse, burned appearance, concrete chunks, milled wood pieces, crushed dryer and water tank, two creosoted pilings (6' long), odor	
7				wet, sheen on water	
8					
9					
10					
11					
12					
13					
14					
15					

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-12 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17					ELASTIC SILT (ML): gray, wet, 100% fines, medium plasticity, trace shells, scattered fine gravel (bay mud)		
18					Bottom of test pit at 17.0 feet. Test pit backfilled with excavated soil and refuse.		
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
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32							
33							

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington		# Test Pit Log No. G-13	
TEST PIT LOCATION: N 538814.4; E 1228579.3		ELEVATION AND DATUM: 19.8 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.		DATE STARTED: 10/29/09	DATE FINISHED: 10/29/09
OPERATOR: Rodney		TOTAL DEPTH (ft): 14.0	MEASURING POINT: 19.8 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200		DEPTH TO WATER: FIRST 5.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket		LOGGED BY: N. Bacher	
SAMPLING METHOD:		RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: 19.8 feet	REMARKS
0				SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines, roots from nearby trees	
2			1.8	REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines. 80% refuse, mufflers, intertube, tire, scattered cans, glass bottles, concrete chunks	
5				(water level symbol) black, wet, burnt appearance, plastic, bottles, cans, scrap metal pieces, bricks, plywood pieces	
6			1.8		
12			1.8		
14				ELASTIC SILT (ML): gray, wet, 100% fines, medium plasticity	
				Bottom of test pit at 14.0 feet. Test pit backfilled with excavated soil and refuse.	

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-14

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	Test Pit Log No. G-14
TEST PIT LOCATION: N 538696.4; E 1228748.7	ELEVATION AND DATUM: 14.9 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 10/29/09 — DATE FINISHED: 10/29/09
OPERATOR: Rodney	TOTAL DEPTH (ft): 14.0 — MEASURING POINT: 14.9 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 5.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: N. Bacher
SAMPLING METHOD:	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 14.9 feet	REMARKS
0–1					SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines	
1					REFUSE MATERIAL: SILTY SAND: (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines. 65% garbage (tires, plastic, wood debris), 2 rusted and crushed dryers	
2				0.8		
3						
4						
5					(water level ▽) black, wet, musky odor, burned appearance, plywood debris, 3' long tank (water), metal scraps, tires, bottles, long thin strips of wood	
6				0.8		
7						
8						
9						
10						
11						
12				0.8		
13						
14					ELASTIC SILT (ML): gray, wet, 100% fines, medium plasticity, trace shells	
15						

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-14 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
					Bottom of test pit at 14.0 feet. Backfilled with excavated soil and refuse.		
16							
17							
18							
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OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-15**

TEST PIT LOCATION: N 538292.6; E 1228837.3	ELEVATION AND DATUM: 17.9 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10	DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 17.9 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 11.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 17.9 feet	REMARKS
0				WOOD: brown, moist, 100% wood debris (strips, chunks)	
2				SILTY SAND (SM): light brown, moist, 75% fine to coarse sand, 25% low plasticity fines	
4				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): dark brown, moist, 55% fine to coarse sand, 25% fine and coarse gravel, 20% non-plastic fines. 20% refuse (concrete, wires, tires, springs, wood debris)	
11				wet, 50% refuse (cans, bottles, plywood)	
14				black	
14.5–15	G15-15	■			

OAKTESTPIT (REV. 6/03)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16					SILT (ML): gray, moist, 100% fines, low plasticity, scattered grass and shells, scattered fine gravel		
17							
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		
19							
20							
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33							

Test Pit Log No. G-16

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington			
TEST PIT LOCATION: N 538075.3; E 1228837.3	ELEVATION AND DATUM: 15.1 feet NAVD 88		
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10	DATE FINISHED: 3/29/10	
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 10.0	MEASURING POINT: 15.1 feet NAVD 88	
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 9.0	NA	
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown		
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher		REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.1 feet	REMARKS
0–4				REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): light brown, moist, 70% fine to coarse sand, 20% fine and coarse gravel, 10% non-plastic fines. 30% refuse (wire, bottles, bike wheel)	
3				burned appearance	
4–7	G16-7	■ (6.5–7)		SILT with SAND (ML): brown, moist, 70% fines, 30% fine to coarse sand, low plasticity	
7–9.5				POORLY GRADED SAND with GRAVEL (SP): gray, moist, 80% fine to coarse sand, 20% fine gravel	
9				wet	
9.5–10	G16-10	■ (9.5–10)		ELASTIC SILT (MH): gray, moist, 100% fines, medium plasticity	
10				Bottom of test pit at 10.0 feet. Test pit backfilled with excavated refuse and soil.	

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-17.5

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	Test Pit Log No. G-17.5
TEST PIT LOCATION: N 537853.7; E 1229328.9	ELEVATION AND DATUM: 15.5 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10 / DATE FINISHED: 4/1/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 12.0 / MEASURING POINT: 15.5 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 9.0 / NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.5 feet	REMARKS
0–5				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 30% refuse (plastic, glass, cans, hoses)	
1.5–2.5				crushed, rusted drum labelled "Test Product" on lid, black and yellow painted	
5–7	G17.5-7	■ (6.5–7)		SILTY SAND (SM): brown, moist, 70% fine to coarse sand, 30% low plasticity fines	
7–9				ELASTIC SILT (MH): gray, moist, 95% fines, 5% fine sand, medium plasticity, scattered red roots, orange and black mottling	
9–12				POORLY GRADED GRAVEL with SAND (GP): dark gray, wet, 60% fine and coarse gravel, 40% fine to coarse sand, sub-rounded	
12				Bottom of test pit at 12.0 feet. Test pit backfilled with refuse and soil.	

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-17**	
TEST PIT LOCATION: N 537676.4; E 1229319.9	ELEVATION AND DATUM: 15.5 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10	DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 15.5 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 10.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.5 feet	REMARKS
0–1					REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): light brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 30% refuse (wood pieces, bottles)	
3					55% fine to coarse sand, 30% non-plastic fines, 15% fine and coarse gravel. 0% refuse	
5					15% refuse (plastic sheeting, tubing, straps)	
6					yellow 5 gallon steel bucket	
9					wet, round peeled timbers 6" diameter, 5-6' long, 30% refuse	
15						

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-17 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16–18					POORLY GRADED GRAVEL with SAND (GP): dark gray, wet, 65% fine and coarse gravel, 30% fine to coarse sand, 5% non-plastic fines		Walls caving and undermining.
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		

Depth scale: 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-18**	
TEST PIT LOCATION: N 537611.3; E 1229315.2	ELEVATION AND DATUM: 14.8 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10	DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 14.8 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 14.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 14.8 feet	REMARKS
0–8				REFUSE MATERIAL: POORLY GRADED SAND with SILT (SP-SM): brown, moist, 90% fine to coarse sand, 10% non-plastic fines. 30% refuse (composite shingles, plastic, car parts, bottles)	
7.5–8	G18-8	■			
8–14				ELASTIC SILT (MH): dark gray, wet, 90% fines, 10% fine sand, medium to high plasticity, organics (roots, small wood pieces), orange mottling (dike-like feature)	
14–15				POORLY GRADED SAND with GRAVEL (SP): gray, wet, 60% fine to coarse sand, 35% fine and coarse gravel, 5% non-plastic fines, trace clam shell	

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Log of Boring No. G-18 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Test Pit Log No. G-19	
TEST PIT LOCATION: N 537568.1; E 1229255.1	ELEVATION AND DATUM: 13.7 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10	DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 14.0	MEASURING POINT: 13.7 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 13.7 feet	REMARKS
0–2					SILTY SAND (SM): dark brown, moist, 70% fine to coarse sand, 20% non-plastic fines, 10% fine gravel, scattered roots	
2–9					REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine gravel. 30% refuse (plastic sheeting, bottles, wires, red brick, tires, wood pieces)	
7					▼ wet, wood timbers, large cobbles	
8						sidewalls caving under water table
9–13					ELASTIC SILT (MH): gray, moist, 90% fines, 10% fine sand, scattered roots, orange mottling, black mottling	
13–14					POORLY GRADED GRAVEL with SAND (GP): gray, wet, 70% fine and coarse gravel, 30% fine to coarse sand	
14					Bottom of test pit at 14.0 feet. Test pit backfilled with refuse and soil.	

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-20

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	
TEST PIT LOCATION: N 537691.2; E 1229065.4	ELEVATION AND DATUM: 15.8 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10 — DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 12.0 — MEASURING POINT: 15.8 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 9.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 15.8 feet	REMARKS
0				REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 80% fine to coarse sand, 20% non-plastic fines. 30% refuse (glass, plastic)	
6				creosote wooden piling	
9				wet, black, slight sheen	
10				heating oil tank: empty and punctured, no sheen	
11.5–12	G20-12	■			
12				ELASTIC SILT (MH): gray, moist, 100% fines, scattered organics and roots, orange mottling	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-20 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16					Bottom of test pit at 16.0 feet. Backfilled with refuse and soil.		
17							
18							
19							
20							
21							
22							
23							
24							
25							
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31							
32							
33							

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-21

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	**Test Pit Log No. G-21**
TEST PIT LOCATION: N 537803.4; E 1228934.6	ELEVATION AND DATUM: 14.9 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10 / DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 16.0 / MEASURING POINT: 14.9 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 8.0 / NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 14.9 feet	REMARKS
0–2					SILTY SAND (SM): dark brown, moist, 80% fine to coarse sand, 20% non-plastic fines	
2–12					REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): gray, moist, 65% fine to coarse sand, 25% fine and coarse gravel, 10% fines. 50% refuse (tarps, hoses, glass, aluminum scraps, wood scraps)	
8					▽ wet	
12–14					SILTY SAND with GRAVEL (SM): gray, wet, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel	
14–15					POORLY GRADED GRAVEL with SAND (GP): dark gray wet, 60% fine and coarse gravel, 40% fine to coarse sand	

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-21 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16					Bottom of test pit at 16.0 feet. Test pit backfilled with refuse and soil.		Test pit sidewalls caving, water rushing in to hole.
17							
18							
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OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Test Pit Log No. G-22	
TEST PIT LOCATION: N 537944.8; E 1228630.1	ELEVATION AND DATUM: 16.6 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/29/10	DATE FINISHED: 3/29/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 16.6 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 13.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 16.6 feet	REMARKS
0–7				REFUSE MATERIAL: POORLY GRADED SAND with SILT (SP-SM): reddish brown, moist, 80% fine to coarse sand, 20% non-plastic fines, 30% refuse (bottles, plastic, concrete, glass,tires, mattress)	
6				15% refuse (wood pieces)	
7–10				POORLY GRADED SAND with GRAVEL (SP): gray, moist, 70% fine to coarse sand, 30% fine and coarse gravel, large wood pieces (1-2' dia.)	
10–12				SILTY SAND (SM): gray, moist, 60% fine sand, 40% fines, compressible, scattered roots	
12–				POORLY GRADED GRAVEL with SAND (GP): gray, moist, 65% fine and coarse gravel, 35% fine and coarse sand, sub-rounded	
13				wet	gravels are caving and undermining the sidewalls

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-22 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		
19							
20							
21							
22							
23							
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OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-23**
TEST PIT LOCATION: N 538070.5; E 1228630.1	ELEVATION AND DATUM: 16.6 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/30/10 · DATE FINISHED: 3/30/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 14.0 · MEASURING POINT: 16.6 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 8.5 · NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher · REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 16.6 feet	REMARKS
0–2				WOOD:moist, 100% wood waste (strips, chips)	
2–9				REFUSE MATERIAL: (SILTY SAND) (SM): brown, moist, 85% fine to coarse sand, 20% non-plastic fines, 5% fine gravel. 30% refuse (tires, plastic, tubing, glass, wood debris, car muffler) wet (water at 8.5)	
9–14				POORLY GRADED GRAVEL with SILT and SAND (GP-GM): very dark gray, wet, 60% fine and coarse gravel 35% fine to coarse sand, 5% non-plastic fines	Test pit sidewalls caving quickly
14				Bottom of test pit at 14.0 feet. Backfilled with excavated soil and refuse.	

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington		Test Pit Log No. G-24	
TEST PIT LOCATION: N 538157.9; E 1228537.9		ELEVATION AND DATUM: 18.9 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.		DATE STARTED: 3/30/10	DATE FINISHED: 3/30/10
OPERATOR: Andrew Hinton		TOTAL DEPTH (ft): 18.0	MEASURING POINT: 18.9 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200		DEPTH TO WATER: FIRST 10.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket		LOGGED BY: C. Brown	
SAMPLING METHOD: Grab		RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 18.9 feet	REMARKS
0					WOOD: brown, moist, 100% wood waste (bark strips, sticks, logs)	
6					REFUSE MATERIAL: SILTY SAND (SM): gray, moist, 75% fine to coarse sand, 20% non-plastic fines, 5% fine gravel. 5% refuse (bottles, cans, plastic)	
10					wet, 30% refuse (heating oil tank, bottles, tires, hoses, moderate metallic sheen, newspaper from 1971)	
13					50% refuse	
15						

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-24 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	REMARKS
16	G24-16	■		ELASTIC SILT (MH): gray, moist, 80% fines, 20% fine and coarse gravel, medium plasticity, rounded to sub-rounded gravel, scattered red roots	
17					
18				Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.	
19					
20					
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Test Pit Log No. G-25

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	Test Pit Log No. G-25
TEST PIT LOCATION: N 538385.5; E 1228384.1	ELEVATION AND DATUM: 25.1 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/30/10 — DATE FINISHED: 3/30/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 19.0 — MEASURING POINT: 25.1 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 10.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: 25.1 feet	REMARKS
0–6				WOOD: brown, moist, 100% wood, scraps, peeled logs, sawdust	
6–13				REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): gray, moist, 70% fine to coarse sand, 20% fine gravel, 10% non-plastic fines. 10% refuse (metal pieces, bricks, shingles, hoses)	
10				▽ wet	
13–15				POORLY GRADED SAND (SP): gray, wet, 100% fine sand	

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-25 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							
18							No standing water in the bottom of the test pit. Fine sand appears well draining.
19					Bottom of test pit at 19.0 feet. Test pit backfilled with refuse and soil.		
20							
21							
22							
23							
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OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-26**	
TEST PIT LOCATION: N 538535.4; E 1228308.2	ELEVATION AND DATUM: 21.6 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/30/10	DATE FINISHED: 3/30/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 21.6 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 10.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 21.6 feet	REMARKS
0–3				SILTY SAND with GRAVEL (SM): dark brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel up to 4" in diameter, scattered wood pieces	
3–6				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): dark brown, moist, 50% fine to coarse sand, 30% fine and coarse gravel, 20% non-plastic fines. 10% refuse (cans, bottles)	
6–10				SILTY SAND (SM): gray, moist, 80% fine to coarse sand, 20% non-plastic fines	
10–15				POORLY GRADED SAND (SP): very dark gray, wet, 100% fine sand, slight metallic sheen	

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	Log of Boring No. G-26 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		
19							
20							
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OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-27**
TEST PIT LOCATION: N 538697.9; E 1228261.2	ELEVATION AND DATUM: 22.9 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10 — DATE FINISHED: 4/1/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 3.0 — MEASURING POINT: 22.9 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST NA — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 22.9 feet	REMARKS
0–2.5					REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark brown, moist, 75% fine to coarse sand, 15% fine gravel, 10% non-plastic fines. 10% refuse (plastic, wood pieces, scattered cobbles)	
2.5					Bottom of test pit at 2.5 feet due to the excavator digging through utilities. The excavator dug through a compressed air line the line was repaired and the test pit was backfilled with the excavated soil.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-28**	
TEST PIT LOCATION: N 538855.5; E 1228201.6	ELEVATION AND DATUM: 21.5 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10	DATE FINISHED: 4/1/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 10.0	MEASURING POINT: 21.5 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 21.5 feet	REMARKS
0–2					SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel	
2–7					REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): very dark brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 30% refuse (yellow bricks, hoses, plastic, bottles, heating oil tank, rusty weathering, burned areas)	
5					▽ 55% fine to coarse sand, 30% non-plastic fines, 15% fine and coarse gravel, orange mottling, 20% refuse	
7–10					POORLY GRADED GRAVEL with SAND (GP): gray, wet, 65% fine and coarse gravel, 35% fine to coarse sand, subrounded	
10					Bottom of test pit at 10.0 feet. Test pit backfilled with refuse and soil.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-29

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	
TEST PIT LOCATION: N 538996.2; E 1228143.2	ELEVATION AND DATUM: 20.5 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/31/10 — DATE FINISHED: 3/31/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 10.0 — MEASURING POINT: 20.5 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 6.5 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.5 feet	REMARKS
0–2				SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel	
2–5				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 5% refuse (red brick, wire, wood, glass)	
5–6.5				REFUSE MATERIAL: POORLY GRADED SAND with GRAVEL (SP): brown, moist, 70% fine to coarse sand, 30% fine and coarse gravel. 50% refuse (metal scraps, wire, glass), rusty weathering	
6.5–10	G29-9	■		POORLY GRADED SAND with GRAVEL (SP): gray, wet, 70% fine to coarse sand, 30% fine and coarse gravel, moderate oily sheen, strong petroleum-like odor, light brown free product on water	
10				Bottom of test pit at 10.0 feet. Test pit backfilled with refuse and soil.	

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-30**
TEST PIT LOCATION: N 539038.3; E 1228186.6	ELEVATION AND DATUM: 20.0 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/31/10 — DATE FINISHED: 3/31/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 7.5 — MEASURING POINT: 20.0 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.0 feet	REMARKS
0–3.5				SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel	
3.5–7				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 10% refuse (cans, tubing, crushed yellow brick)	
5				gray and black, strong petroleum odor, heavy sheen	
6.5–7	G30-7	■			Small piece of drum, oozing sediment. Sample of ooze collected G30-D.
7–7.5				SILT (ML): dark gray, wet, 100% fines, low plasticity, black oily sheen, free product on water	Test pit abandoned due to caving sidewalls and very wet conditions
7.5				Bottom of test pit at 7.5 feet. Test pit backfilled with refuse and soil.	

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-31**	
TEST PIT LOCATION: N 539012.1; E 1228251.2	ELEVATION AND DATUM: 20.1 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 10/29/09	DATE FINISHED: 10/29/09
OPERATOR: Rodney	TOTAL DEPTH (ft): 16.0	MEASURING POINT: 20.1 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.1 feet	REMARKS
0–2				SILTY SAND (SM): light brown, moist, 85% fine to coarse sand, 15% non-plastic fines, scattered roots	
2–7				REFUSE MATERIAL:SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines, scattered roots. 75% refuse (inner tube, bottles, 3" conduit, large wood chunks, sheet aluminum, hydraulic hose)	
7–15				REFUSE MATERIAL: SILTY SAND (SM): black, wet, 85% fine to coarse sand, 15% low plasticity fines, moderate sheen, strong odor. 5% refuse	
13				very dark gray, 25% fines, no refuse	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

OAKTESTPIT (REV. 6/03)

Log of Boring No. G-31 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	REMARKS
					SILTY SAND (SM): Cont.	
16					ELASTIC SILT (ML): gray, wet, 100% fines, medium plasticity	
					Bottom of test pit at 16.0 feet. Test pit backfilled with excavated soil and refuse.	
17						
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32						
33						

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Test Pit Log No. G-32		
TEST PIT LOCATION: N 538741.8; E 1228251.2	ELEVATION AND DATUM: 23.8 feet NAVD 88		
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10	DATE FINISHED: 4/1/10	
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 23.8 feet NAVD 88	
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 10.0	NA	
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown		
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher		REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 23.8 feet	REMARKS
0				WOOD: brown, moist, 80% wood waste, 20% cobbles (2-4" quarry spall)	
2				SILTY SAND with GRAVEL (SM): gray, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine gravel and cobbles	
4				REFUSE MATERIAL: SILTY SAND with GRAVEL: (SM): gray, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine gravel and cobbles. 30% refuse (wood debris, glass, tires, plastic, paper)	
10				wet, slight silvery sheen	
11				crushed 5-gallon bucket, mattress springs, scrap metal pieces	
11.5–12	G20-12	■			
12				petroleum odor	
14					Hole caving and undermining. Abandon due to instability.

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-32 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		
19							
20							
21							
22							
23							
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33							

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-33

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-33**
TEST PIT LOCATION: N 538664.7; E 1228325.5	ELEVATION AND DATUM: 23.3 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/2/10 / DATE FINISHED: 4/2/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 3.0 / MEASURING POINT: 23.3 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST NA / NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 23.3 feet	REMARKS
0–3				POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark brown, moist, 75% fine to coarse sand, 15% fine gravel, 10% non-plastic fines, scattered cobbles	
3				Bottom of test pit at 3.0 feet due to utilities. Excavator dug through three power lines, power lines were repaired and test pit backfilled with excavated soil.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington			# Test Pit Log No. G-34
TEST PIT LOCATION: N 538666.5; E 1228620.1	ELEVATION AND DATUM: 23.9 feet NAVD 88		
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10	DATE FINISHED: 4/1/10	
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0	MEASURING POINT: 23.9 feet NAVD 88	
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 10.0	NA	
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown		
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528	

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 23.9 feet	REMARKS
0				WOOD: brown, moist, 100% wood (sawdust, wood chips, large wood pieces)	
6				scattered pieces of asphalt, cable	
7				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): gray, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 50% refuse (cans, plastic, bottles, cables, hubcap, plywood, composite shingles) burned black appearance	
10				wet	
15					

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-34 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.		
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Test Pit Log No. G-35		
TEST PIT LOCATION: N 538439.9; E 1228448.1	ELEVATION AND DATUM: 25.4 feet NAVD 88		
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10	DATE FINISHED: 4/1/10	
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 19.0	MEASURING POINT: 25.4 feet NAVD 88	
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 13.0	NA	
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown		
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher		REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 25.4 feet	REMARKS
0				WOOD: reddish brown, 100% wood waste (strips, chips, branches)	
6.5				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): gray, 65% fine to coarse sand, 20% non-plastic fines, 15% fine gravel. 40% refuse (bottles, red brick, springs, oven door, steel pipe) burnt appearance	
11.5				REFUSE MATERIAL: POORLY GRADED SAND (SP): light gray, 95% fine sand, 5% non-plastic fines. 10% refuse (rusted 5 gallon bucket, bottles, cans, small burnt pieces of wood, box of insecticide), strong burnt odor	
13				▽ wet	
15					

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-35 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	REMARKS
	G35-15	■			
16					Test pit is caving and undermining in the sand unit.
17					
18					
19				Bottom of test pit at 19.0 feet. Test pit backfilled with refuse and soil.	
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					

OAKTESTPIT (REV. 6/03)

Test Pit Log No. G-36

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	**Test Pit Log No. G-36**
TEST PIT LOCATION: N 538383.8; E 1228710.9	ELEVATION AND DATUM: 24.9 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/1/10 — DATE FINISHED: 4/1/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0 — MEASURING POINT: 24.9 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 11.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: 24.9 feet	REMARKS
0–6				WOOD: reddish brown, moist, 100% wood waste (wood strips, sawdust, logs), scattered cobbles	
6–8				SILTY SAND with GRAVEL (SM): gray, moist, 60% fine to coarse sand, 20% low plasticity fines, 20% fine gravel, scattered coarse gravel, small water seeps	
8–15				REFUSE MATERIAL: SILTY SAND (SM): gray, moist, 80% fine to coarse sand, 20% non-plastic fines. 50% refuse (plastic bottles, glass, paper, water heater, hoses, wood pieces)	
10					sidewalls caving
11				▽ wet, metallic sheen, strong landfill odor	

OAKTESTPIT (REV. 6/03)

Log of Boring No. G-36 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	REMARKS
					Rolling Stone Magazine, April 1973	
16						
17						
18					Bottom of test pit at 18.0 feet. Test pit backfilled with refuse and soil.	
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-37**	
TEST PIT LOCATION: N 539088.3; E 1228121.6	ELEVATION AND DATUM: 20.3 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 3/31/10	DATE FINISHED: 3/31/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 14.0	MEASURING POINT: 20.3 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.3 feet	REMARKS
0–2				SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel	
2–5				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to medium sand, 20% non-plastic fines, 15% fine and coarse gravel. 10% refuse (pieces of wood, concrete), strong petroleum odor, black weathering	
5–9				POORLY GRADED SAND with GRAVEL (SP): gray, moist, 60% fine to coarse sand, 40% fine and coarse gravel	
7				▽ wet, heavy yellowish brown sheen, free product floating on water	
9–14	G37-10	■ (9.5–10)		POORLY GRADED GRAVEL with SAND (GP): gray, moist, 55% fine and coarse gravel, 40% fine to coarse sand, 5% fines, scattered roots in fines, strong petroleum-like odor	Test pit sidewalls caving in (13)
14				Bottom of test pit at 14.0 feet. Test pit backfilled with refuse and soil.	

Test Pit Log No. G-38

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-38**
TEST PIT LOCATION: N 539088.3; E 1228082.9	ELEVATION AND DATUM: 20.5 feet NAVD 88
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/5/10 — DATE FINISHED: 4/5/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 18.0 — MEASURING POINT: 20.5 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 7.0 — NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: 20.5 feet	REMARKS
0–3				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): brown, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine and coarse gravel. 20% refuse (plastic bottles, asphalt, creosote covered railroad ties, car radiator)	
3–5				REFUSE MATERIAL: POORLY GRADED GRAVEL with SILT and SAND (GP-GM): gray, moist, 65% fine and coarse gravel, 25% fine to coarse sand, 10% non-plastic fines. 10% refuse	
5–15				POORLY GRADED GRAVEL with SAND (GP): gray, moist, 50% fine and coarse gravel, 30% fine to coarse sand, 20% cobbles	
7				▽ wet	
12					Test pit sidewalls are staying vertical.

OAKTESTPIT (REV. 6/03)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Boring No. G-38 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		REMARKS
16							
17							Gravels below water table are sloughing in, excavator not making progress digging deeper.
18					Bottom of test pit at 18.0 feet. Test pit backfilled with excavated soil.		
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Test Pit Log No. G-39	
TEST PIT LOCATION: N 539047.9; E 1228069.6	ELEVATION AND DATUM: 21.2 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/5/10	DATE FINISHED: 4/5/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 14.0	MEASURING POINT: 21.2 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 12.5	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	Sample		OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 21.2 feet	REMARKS
0–1					POORLY GRADED GRAVEL with SILT and SAND (GP-GM): gray, moist, 65% fine and coarse gravel, 25% fine to coarse sand, 10% non-plastic fines	
1.5–4					REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 70% fine to coarse sand, 30% non-plastic fines. 20% refuse (wood debris, glass, yellow brick, metal scraps)	
4					POORLY GRADED GRAVEL with SAND (GP): gray, moist, 70% fine and coarse gravel, 30% fine to coarse sand, strong petroleum-like odor, heavy sheen	
12					wet, brown free-product on surface of water	Test pit abandoned when gravels are washing into the bottom underneath the water table.
14					Bottom of test pit at 14.0 feet. Test pit backfilled with refuse and soil.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Test Pit Log No. G-40**	
TEST PIT LOCATION: N 539014.9; E 1228107.2	ELEVATION AND DATUM: 21.2 feet NAVD 88	
EXCAVATION CONTRACTOR: Clearcreek Contractors Inc.	DATE STARTED: 4/5/10	DATE FINISHED: 4/5/10
OPERATOR: Andrew Hinton	TOTAL DEPTH (ft): 12.0	MEASURING POINT: 21.2 feet NAVD 88
EXCAVATION EQUIPMENT: Hitachi 200	DEPTH TO WATER: FIRST 9.0	NA
EXCAVATION BUCKET DIMENSIONS: 1.5 Cubic Yard Bucket	LOGGED BY: C. Brown	
SAMPLING METHOD: Grab	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 21.2 feet	REMARKS
0–2				POORLY GRADED GRAVEL with SILT and SAND (GP-GM): gray, moist, 65% fine and coarse gravel, 25% fine to coarse sand, 10% non-plastic fines	
1.5–4				REFUSE MATERIAL: SILTY SAND with GRAVEL (SM): gray, moist, 55% fine to coarse sand, 30% fine and coarse gravel, 15% non-plastic fines. 10% refuse (wood debris, glass, yellow brick, concrete)	
4–12				POORLY GRADED GRAVEL with SAND (GP): brown, moist, 70% fine and coarse gravel, 30% fine to coarse sand	
9				▽ wet	
12				Bottom of test pit at 12.0 feet. Test pit backfilled with excavated refuse and soil.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

OAKTESTPIT (REV. 6/03)

Log of Well No. LFGP-01

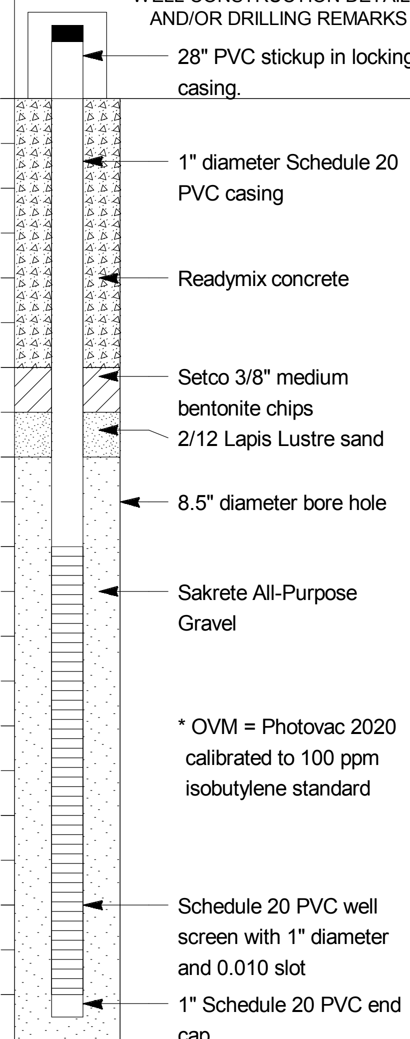
PROJECT: LFG Installation 2011 Whitmarsh Landfill	Log of Well No. LFGP-01
BORING LOCATION: 538948.1 N, 1228311.8 E	GROUND SURFACE ELEVATION AND DATUM: 23.72 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/26/11; DATE FINISHED: 9/26/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 10.5; SCREEN INTERVAL (ft.): 5-10'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 9; COMPL. NA; CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér; REG. NO. LG 2528

DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.

Surface Elevation: 23.72 (TOC), NAVD 88

DEPTH (feet)	Sample Blows/Foot	OVM Reading	DESCRIPTION
0–2	4, 6, 12; 6, 7, 3		POORLY GRADED SAND with GRAVEL (SP): reddish brown (5YR 4/4), moist, 70% medium-fine sand, 30% fine gravel
2–4	6, 5, 3		POORLY GRADED SAND with GRAVEL (SP): gray (5YR 5/1), moist, 80% medium sand, 20% fine gravel, anthropogenic debris at base
4–5	4, 6, 12		POORLY GRADED SAND with GRAVEL (SP): yellowish brown (5YR 5/4), moist, 75% medium sand, 25% fine gravel
5–6			POORLY GRADED SAND with GRAVEL (SP): dark yellowish brown (5YR 4/4), moist, 75% medium sand, 25% fine gravel, wood debris (~15%)
6–9	11, 16, 24; 5, 6, 7		POORLY GRADED SAND with GRAVEL (SP): very dark gray (7.5YR 3/1), moist, 80% medium sand, 20% fine gravel, processed wood, anthropogenic debris (~20%)
9–10.5	3, 2, 3		SILTY SAND (SM): dark reddish brown (5YR 3/4), wet, 80% medium sand, 20% low plasticity fines
10.5			Bottom of boring at 10.5'. WSDOE well tag = AAF 801.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



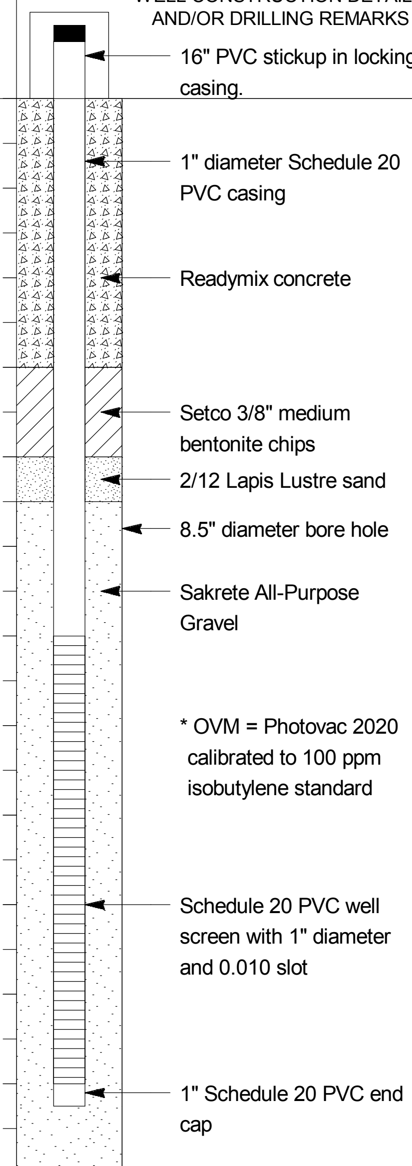
* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

OAKWELLV (REV. 8/2011)

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-02**		
BORING LOCATION: 538667.0 N, 1228452.2 E	GROUND SURFACE ELEVATION AND DATUM: 25.17 (TOC), NAVD 88		
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/26/11	DATE FINISHED: 9/26/11	
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 12.0	SCREEN INTERVAL (ft.): 6-11'	
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 10.5 / COMPL. NA	CASING: 1" Sch. 20 PVC	
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly		
HAMMER WEIGHT: 300 lbs. DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér	REG. NO. LG 2528	

DEPTH (feet)	Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 25.17 (TOC), NAVD 88
0			12 11 16		POORLY GRADED SAND with GRAVEL (SP): brown (5YR 5/2), moist, 75% medium sand, 25% fine gravel
1			11 10 9		POORLY GRADED SAND (SP): gray (5YR 6/1), moist, 90% medium sand, 10% fine gravel
2				52.6	POORLY GRADED SAND with SILT (SP-SM): gray (5YR 6/1), moist, 90% fine-medium sand, 10% low plasticity fines
3			6 4 3	37.8	
4			5 6 6		
5					wood
6			12 7 8	45.6	POORLY GRADED SAND (SP): very dark gray (7.5YR 3/1), moist, 100% medium sand
6–7					SILT with SAND (ML): gray (7.5YR 6/1), moist, 80% moderate plasticity fines, 20% fine sand, anthropogenic waste (glass, cement, metal)
7			9 5 4	40.3	wood
9			3 3 3		
10			4 6 4		SILT (ML): very dark brown (10YR 2/2), wet, 90% low plasticity fines, 10% fine sand
12					Bottom of boring at 12'. WSDOE well tag= AAF 803.
13					
14					
15					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

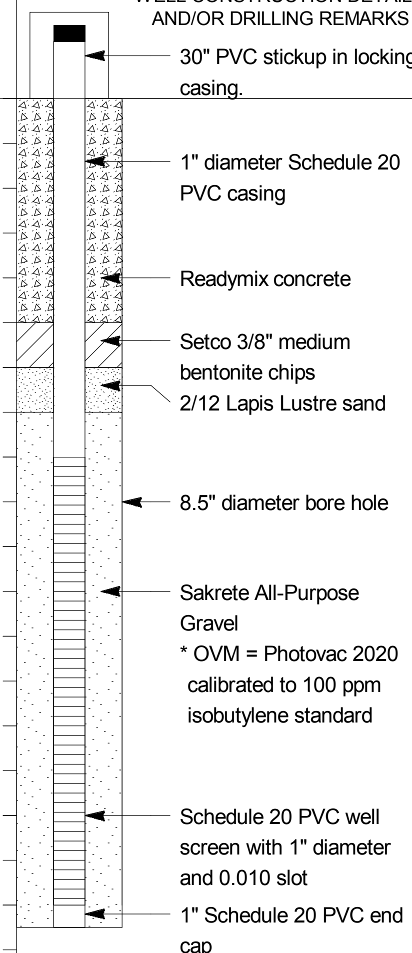
OAKWELLV (REV. 8/2011)

PROJECT: LFG Installation 2011 Whitmarsh Landfill	# Log of Well No. LFGP-03
BORING LOCATION: 538647.4 N, 1228722.6 E	GROUND SURFACE ELEVATION AND DATUM: 20.75 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/29/11 — DATE FINISHED: 9/29/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 9.0 — SCREEN INTERVAL (ft.): 4-9'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 7 — COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	Sample No.	Sample Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.75 (TOC), NAVD 88
0		2 3 14		wood waste, slight gravel
1.5		13 17 7		POORLY GRADED SAND with GRAVEL (SP): brown (7.5YR 5/3), moist, 80% medium sand, 20% very poorly sorted gravel (wide size variety)
3		2 4 2	0.0	POORLY GRADED SAND (SP): gray (7.5YR 5/1), moist, 90% fine-medium sand, 10% coarse gravel, some anthropogenic waste (treated wood, rubber)
4.5		2 4 6	0.0	
6		4 2 6		refuse
7				wet
7.5		7 9 4	0.0	
9				Bottom of boring at 9'. WSDOE well tag= AAF 010.

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

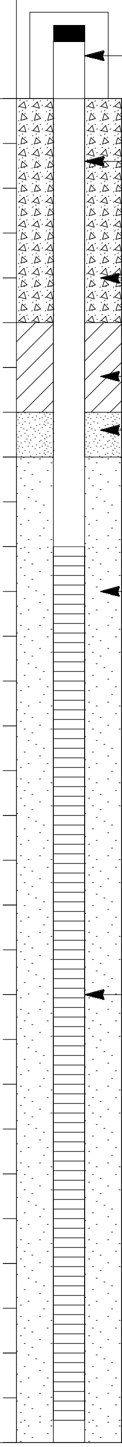
OAKWELLV (REV. 8/2011)

Log of Well No. LFGP-04

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-04**
BORING LOCATION: 538250.6 N, 1228665.6 E	GROUND SURFACE ELEVATION AND DATUM: 27.23 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/28/11 — DATE FINISHED: 9/28/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 15.0 — SCREEN INTERVAL (ft.): 5-15'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 4.5 — COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	Sample No.	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 27.23 (TOC), NAVD 88
0		2 2 3		moist, wood waste
1.5		4 4 6		
2.5				large rock (Darrington phyllite)
3		5 6 8	0.0	
4.5		4 8 8	90.2	wet
6		2 5 7		indurated, back to moist
7	LFGP-04-7-0911			
7.5		4 5 5		SILT with SAND (ML): dark gray (7.5YR 4/1), moist, 80% moderate plasticity fines, 20% fine sand, orange mottling, anthropogenic waste (plastic, metal fragments)
9		4 9 14		
10			102	
10.5		5 7 9		wood waste, plastic/metal fragments, cardboard
12		6 5 4		POORLY GRADED SAND (SP): dark gray (7.5YR 4/1), moist, 100% medium sand, orange mottling
13.5		6 5 4		POORLY GRADED SAND (SP): dark gray (7.5YR 4/1), moist, 100% fine sand, anthropogenic waste (paper, plastic), orange mottling
15				Bottom of boring at 15'. WSDOE well tag= AAF 809.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



30.5" PVC stickup in locking casing.

1" diameter Schedule 20 PVC casing

Readymix concrete

Setco 3/8" medium bentonite chips

2/12 Lapis Lustre sand

8.5" diameter bore hole

Sakrete All-Purpose Gravel

* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

Schedule 20 PVC well screen with 1" diameter and 0.010 slot

* LFGP-04-7-0911 (1x4 oz jar) collected for moisture content analysis.

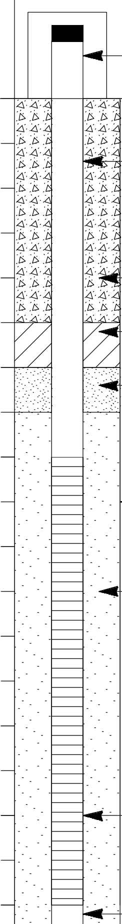
1" Schedule 20 PVC end cap

OAKWELLV (REV. 8/2011)

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-05**
BORING LOCATION: 537955.6 N, 1228988.3 E	GROUND SURFACE ELEVATION AND DATUM: 20.19 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/27/11 — DATE FINISHED: 9/27/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 9.0 — SCREEN INTERVAL (ft.): 4-9'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 9 — COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	Sample No.	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.19 (TOC), NAVD 88
0		3 4 4		moist, wood waste
1.5		5 5 9		
3		7 4 5	0.0	
4.5	LFGP-05-4.5-0911	7 7 4		POORLY GRADED SAND (SP): dark gray (7.5YR 4/1), moist, 100% medium sand, plentiful anthropogenic waste (cloth, plastic, metal, glass)
6		7 4 3	1.2	SILTY SAND (SM): gray (7.5YR 5/1), moist, 60% fine sand, 40% moderate plasticity fines, orange mottling, anthropogenic waste
7.5		1 2 3	10.0	SANDY SILT (ML): black (7.5YR 2.5/1), moist, 30% fine sand, 70% moderate plasticity fines, wood/ anthropogenic waste, orange mottling
9				wet Bottom of boring at 9'. WSDOE well tag= AAF 805.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

* LFGP-05-4.5-0911 (1x4 oz jar) collected for moisture content analysis.

OAKWELLV (REV. 8/2011)

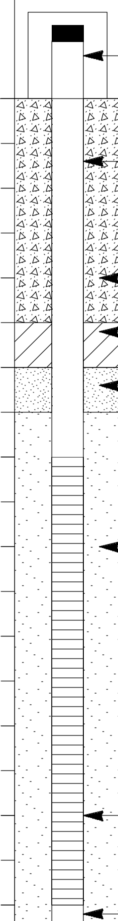
Log of Well No. LFGP-06

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-06**
BORING LOCATION: 538106.7 N, 1229044.1 E	GROUND SURFACE ELEVATION AND DATUM: 19.05 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/28/11 — DATE FINISHED: 9/28/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 9.0 — SCREEN INTERVAL (ft.): 4-9'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 8 — COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 19.05 (TOC), NAVD 88
0		2 2 3		moist, wood waste
1.5		1 3 4		POORLY GRADED SAND with GRAVEL (SP): dark gray (7.5YR 4/1), moist, 80% medium sand, 20% coarse gravel, gravel grades down in size with depth, slight anthropogenic waste
3		2 2 2		
4			0.0	
4.5		1 4 4	0.0	SILT (ML): gray (7.5YR 5/1), moist, 90% moderate plasticity fines, 10% fine sand, wood waste, orange mottling
5.5		5 1 1		SILTY SAND (SM): very dark gray (7.5YR 3/1), moist, 80% fine-medium sand with quartz lithics, 20% low plasticity fines, wood waste
7			0.0	
7.5		1 1 2		
8	LFGP-06-8.5-0911			wet
9				Bottom of boring at 9'. WSDOE well tag= AAF 806.

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

* LFGP-06-8.5-0911 (1x4 oz jar) collected for moisture content analysis.

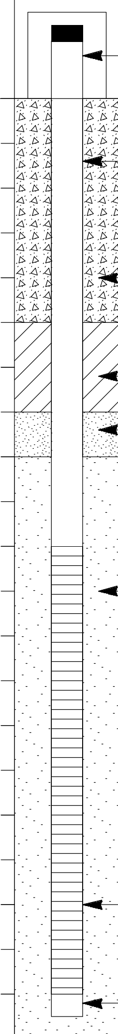
OAKWELLV (REV. 8/2011)

Log of Well No. LFGP-07

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-07**
BORING LOCATION: 537643.9 N, 1229287.9 E	GROUND SURFACE ELEVATION AND DATUM: 16.32 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/27/11 — DATE FINISHED: 9/27/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 10.5 — SCREEN INTERVAL (ft.): 5-10'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 10, COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	Sample No.	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 16.32 (TOC), NAVD 88
0		5 8 17		automotive debris, metal, tires, chains
1.5		Overdriven		POORLY GRADED SAND with SILT (SP-SM): brown (7.5YR 5/4), dry, 90% fine sand, 10% non-plastic fines, anthropogenic waste (glass, metal fragments)
3		2 2 2		
4.5		10 12 11		
5.5			14.2	POORLY GRADED SAND (SP): dark brown (7.5YR 3/3), moist, 100% fine-medium sand, wood/ anthropogenic debris (glass, plastic)
6		1 1 2	15.7	SILT (ML): brown (7.5YR 4/3), moist, 90% moderate plasticity fines, 10% fine sand
7	LFGP-07-7-0911			
7.5		1 1 2	0.0	POORLY GRADED SAND (SP): very dark gray (7.5YR 3/1), moist, 100% medium sand, wood fragments, rounded lithic grains
9		2 3 5		
10				wet
10.5				Bottom of boring at 10.5'. WSDOE well tag= AAF 804.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



- 30" PVC stickup in locking casing.
- 1" diameter Schedule 20 PVC casing
- Readymix concrete
- Setco 3/8" medium bentonite chips
- 2/12 Lapis Lustre sand
- 8.5" diameter bore hole
- Sakrete All-Purpose Gravel
- * OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard
- Schedule 20 PVC well screen with 1" diameter and 0.010 slot
- 1" Schedule 20 PVC end cap
- * LFGP-07-7-0911 (1x4 oz jar) collected for moisture content analysis.

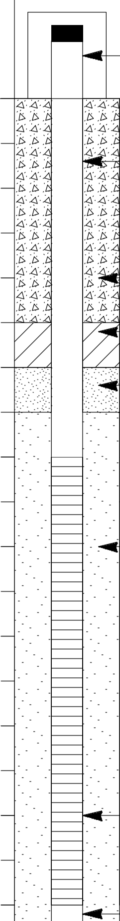
OAKWELLV (REV. 8/2011)

PROJECT: LFG Installation 2011 Whitmarsh Landfill		**Log of Well No. LFGP-08**		
BORING LOCATION: 537980.9 N, 1228790.0 E		GROUND SURFACE ELEVATION AND DATUM: 19.79 (TOC), NAVD 88		
DRILLING CONTRACTOR: Cascade Drilling, Inc.		DATE STARTED: 9/28/11	DATE FINISHED: 9/28/11	
DRILLING METHOD: Hollow-stem auger		TOTAL DEPTH (ft.): 9.0	SCREEN INTERVAL (ft.): 4-9'	
DRILLING EQUIPMENT: CME 75		DEPTH TO WATER: FIRST ND, COMPL. NA	CASING: 1" Sch. 20 PVC	
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]		LOGGED BY: D. O'Reilly		
HAMMER WEIGHT: 300 lbs.	DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér	REG. NO. LG 2528	

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 19.79 (TOC), NAVD 88
0			4 7 7		dark brown (7.5YR 4/3), moist, 70% wood waste, 30% coarse gravel
1			5 6 3		POORLY GRADED SAND with GRAVEL (SP): dark gray (7.5YR 4/1), moist, 80% medium sand, 20% coarse gravel, some wood waste and slight refuse
3			2 1 2		
4.5	LFGP-08-5-0911		6 6 17		POORLY GRADED SAND with GRAVEL (SP): dark brown (7.5YR 3/3), moist, 85% medium sand, 15% coarse gravel, anthropogenic waste (tires, rubber, plastic), wood, concrete chunks
6			Overdriven		
8			9 10 6		
9					Bottom of boring at 9'. WSDOE well tag= AAF 807.

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



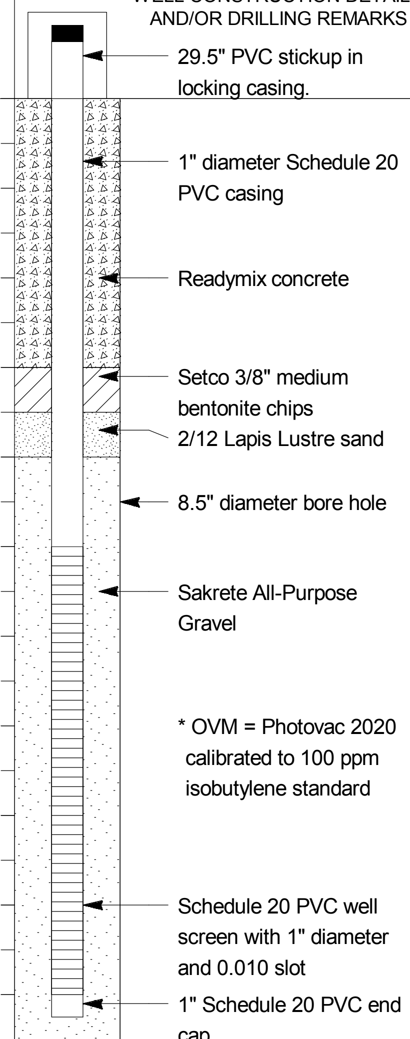
- 30" PVC stickup in locking casing.
- 1" diameter Schedule 20 PVC casing
- Readymix concrete
- Setco 3/8" medium bentonite chips
- 2/12 Lapis Lustre sand
- 8.5" diameter bore hole
- Sakrete All-Purpose Gravel
- * OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard
- Schedule 20 PVC well screen with 1" diameter and 0.010 slot
- 1" Schedule 20 PVC end cap
- * LFGP-08-5-0911 (1x4 oz jar) collected for moisture content analysis.

Log of Well No. LFGP-09

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-09**
BORING LOCATION: 538255.9 N, 1228481.7 E	GROUND SURFACE ELEVATION AND DATUM: 27.02 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/28/11 — DATE FINISHED: 9/28/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 10.5 — SCREEN INTERVAL (ft.): 5.5-10.5'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST ND — COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	Sample No.	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. — Surface Elevation: 27.02 (TOC), NAVD 88
0		1 2 6		moist, wood waste
1.5		6 6 7		
3		5 7 13		
4.5		4 8 14		POORLY GRADED SAND (SP): very dark brown (7.5YR 2.5/2), moist, 100% fine sand, refuse (paper, metal fragments), wood waste
6	LFGP-09-6-0911	3 4 5		moist, fine-grained wood waste (likely sawdust), pulp, paper, slight refuse
7.5		3 2 2	2000+	
9		6 4 3	936	POORLY GRADED SAND (SP): dark gray (7.5YR 4/1), moist, 100% medium sand, slight refuse (treated wood, metal), quartz lithics
10			907	SILT (ML): very dark gray (7.5YR 3/1), moist, 90% moderate plasticity fines, 10% fine sand, refuse (metal fragments, cloth, paper)
10.5				Bottom of boring at 10.5'. WSDOE well tag= AAF 808.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

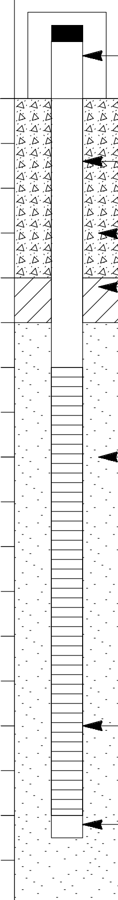
* LFGP-09-8.5-0911 (1x4 oz jar) collected for moisture content analysis.

OAKWELLV (REV. 8/2011)

Log of Well No. LFGP-10

PROJECT: LFG Installation 2011 Whitmarsh Landfill	**Log of Well No. LFGP-10**
BORING LOCATION: 538628.9 N, 1228287.1 E	GROUND SURFACE ELEVATION AND DATUM: 25.56 (TOC), NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/26/11 — DATE FINISHED: 9/26/11
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 9.0 — SCREEN INTERVAL (ft.): 3-8'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER: FIRST 9 — COMPL. NA — CASING: 1" Sch. 20 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: D. O'Reilly
HAMMER WEIGHT: 300 lbs. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bachér — REG. NO. LG 2528

DEPTH (feet)	Sample No.	Sample Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 25.56 (TOC), NAVD 88
0		3 11 2		brown (7.5YR 4/3), moist, wood waste
1.5		5 5 5		
2.5				SILTY SAND with GRAVEL (SM): gray (7.5YR 5/1), moist, 65% medium sand, 20% low plasticity fines, 15% fine gravel
3		4 4 8		
3.5				SILT (ML): gray (7.5YR 5/1), moist, 90% moderate plasticity fines, 10% low plasticity fines
4.5		5 9 9		SANDY SILT (ML): gray (7.5YR 5/1), moist, 60% moderate plasticity fines, 40% medium sand, anthropogenic debris (glass), black organics, rip-up clasts
6		10 7 4	575	
7.5	LFGP-10-7.5-0911	1 1 1	400	
8				SILTY SAND with GRAVEL (SM): dark reddish gray (7.5YR 3/1), wet, 40% medium sand, 40% moderate plasticity fines, 20% fine gravel, wood debris
9			200	Bottom of boring at 9'. WSDOE well tag= AAF 802.



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

- 30" PVC stickup in locking casing.
- 1" diameter Schedule 20 PVC casing
- Readymix concrete
- Setco 3/8" medium bentonite chips
- 8.5" diameter bore hole
- Sakrete All-Purpose Gravel
- * OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard
- Schedule 20 PVC well screen with 1" diameter and 0.010 slot
- 1" Schedule 20 PVC end cap
- * LFGP-10-7.5-0911 (1x4 oz jar) collected for moisture content analysis.

PROJECT: Skagit Whitmarsh Landfill Additional Soil and GW Sampling Anacortes, Washington			**Log of Boring No. G-41**		
BORING LOCATION:			ELEVATION AND DATUM:		
DRILLING CONTRACTOR: Wyser Construction			DATE STARTED: 3/27/13	DATE FINISHED: 3/27/13	
DRILLING METHOD: David Strasberg			TOTAL DEPTH (ft.): 10.8	MEASURING POINT:	
DRILLING EQUIPMENT: Kobelco 135			DEPTH TO WATER (ft.)	FIRST 10.75	COMPL. NA
SAMPLING METHOD: 1.5 Cubic Yard Bucket			LOGGED BY: C. Jefferson		
HAMMER WEIGHT: Grab	DROP: NA		RESPONSIBLE PROFESSIONAL: J. Long		REG. NO. L.Hg. 1354

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	REMARKS
0–2				0.0 0.4 0.2	POORLY-GRADED GRAVEL (GP): dark gray (7.5YR 4/1), moist, 100% gravel angular to subangular gravel high organic content	The top 2 feet of crushed rock and gravel was considered clean cover and segregated from other excavated material.
2–5.5				0.2 0.2 0.0	WOOD brown moist, 100% wood waste consisting of cedar bark	excavated wood waste material segregated from other materials encountered.
5.5–9	G-41-10-0313 (8–9)			0.0 0.2 0.0	CLAYEY SAND (SC): very dark gray (7.5YR 3/1), moist, 70% fine sand, 30% low plasticity fines fines content increases	Silty clay segregated from other excavated materials.
9–10.75					REFUSE MATERIAL: CLAYEY SAND (SC): very dark gray (7.5YR 3/1), moist, 60% refuse (plastic, bottles, newspaper), 30% fine sand, 10% low plasticity fines	Refuse mixed with silty clay segregated from other materials.
10.75					Bottom of test pit at 10.75 feet due to encounter with groundwater. All excavated materials placed back in excavation, along with visqueen sheeting used, in original configuration.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Additional Soil and GW Sampling Anacortes, Washington		**Log of Boring No. G-42**	
BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR: Wyser Construction		DATE STARTED: 3/27/13	DATE FINISHED: 3/27/13
DRILLING METHOD: David Strasberg		TOTAL DEPTH (ft.): 11.8	MEASURING POINT:
DRILLING EQUIPMENT: Kobelco 135		DEPTH TO WATER (ft.)	FIRST 11.75 / COMPL. NA
SAMPLING METHOD: 1.5 Cubic Yard Bucket		LOGGED BY: C. Jefferson	
HAMMER WEIGHT: Grab	DROP: NA	RESPONSIBLE PROFESSIONAL: J. Long	REG. NO. L.Hg. 1354

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	REMARKS
0–5.75				0.1 0.0 0.0	WOOD brown moist, 100% wood waste consisting of cedar bark	The top 2 feet of wood waste was considered clean cover and segregated from other excavated material. excavated wood waste material segregated from other materials encountered.
5.75–7.75	G-42-11-0313	■ (6.75–7.75)		0.2 0.1 0.0	CLAYEY SAND (SC): very dark gray (7.5YR 3/1), moist, 70% fine to medium sand, 30% low plasticity fines	Silty clay segregated from other excavated materials.
7.75–11.75				0.4 0.0 0.0	REFUSE MATERIAL: CLAYEY SAND (SC): very dark gray (7.5YR 3/1), moist, 75% refuse (plastic, clothing, bottles, newspaper), 20% fine to medium sand, 5% low plasticity fines	Refuse mixed with silty clay segregated from other materials.
11.75					Bottom of test pit at 11.75 feet due to encounter with groundwater. All excavated materials placed back in excavation, along with visqueen sheeting used, in original configuration.	

OAKBOREV (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Additional Soil and GW Sampling Anacortes, Washington	**Log of Boring No. G-43**
BORING LOCATION:	ELEVATION AND DATUM:
DRILLING CONTRACTOR: Wyser Construction	DATE STARTED: 3/27/13 / DATE FINISHED: 3/27/13
DRILLING METHOD: David Strasberg	TOTAL DEPTH (ft.): 8.3 / MEASURING POINT:
DRILLING EQUIPMENT: Kobelco 135	DEPTH TO WATER (ft.) FIRST 8.33 / COMPL. NA
SAMPLING METHOD: 1.5 Cubic Yard Bucket	LOGGED BY: C. Jefferson
HAMMER WEIGHT: Grab / DROP: NA	RESPONSIBLE PROFESSIONAL: J. Long / REG. NO. L.Hg. 1354

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM READING (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	REMARKS
0–4.5				0.8, 0.8, 0.8	WOOD brown moist, 100% wood waste consisting of cedar bark	The top 2 feet of wood waste was considered clean cover and segregated from other excavated material. excavated wood waste material segregated from other materials encountered.
4.5–5.7	G-43-8-0313			0.8, 1.0, 1.2	CLAYEY SAND (SC): very dark gray (7.5YR 3/1), moist, 75% fine to medium sand, 25% low plasticity fines	Silty clay segregated from other excavated materials.
5.7–8.33				1.0, 0.8, 1.0	REFUSE MATERIAL: CLAYEY SAND (SC): very dark gray (7.5YR 3/1), moist, 75% refuse (plastic, tires, bottles), 20% fine to medium sand, 5% low plasticity fines	Refuse mixed with silty clay segregated from other materials.
8.33					Bottom of test pit at 8.33 feet due to encounter with groundwater. All excavated materials placed back in excavation, along with visqueen sheeting used, in original configuration.	

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. MW-01**
BORING LOCATION: Not Measured	TOP OF CASING ELEVATION AND DATUM: Ground Surface (not surveyed)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 10/7/08 · DATE FINISHED: 10/7/08
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 70.0 · SCREEN INTERVAL (ft.):
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 9.5 · COMPL. NA · CASING: NA
SAMPLING METHOD: Dames & Moore (1.5' x 3.25")	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 · DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher · REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Blows/Foot	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: NM	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0			Postholed through roadbase to 4 feet below ground surface.	Well MW-01 was not constructed. Borehole used to log lithology for adjacent well MW-02.
4		17 21 30	POORLY GRADED SAND with SILT (SP-SM): olive brown (2.5Y 4/3), dry, 80% fine sand, 10% non-plastic fines, oxidized mottling no mottling	
5.5		12 21 24		
6.5			POORLY GRADED SAND (SP): grayish brown (10YR 5/2), moist, 95% fine sand, 5% non-plastic fines	
7		20 21 24		
7.5			WELL GRADED SAND with GRAVEL (SW): light gray (10R 7/1), moist, 80% fine to coarse sand, 20% fine gravel	
8.5		21 23 27	POORLY GRADED SAND (SP): grayish brown (10YR 5/2), moist, 95% fine sand, 5% non-plastic fines, oxidized SILTY SAND (SM) SILTY SAND (SM) wet	
10	MW-01-10-11.5	24 27 22		
11.5		50/6"		
14.5		24 50/6"		
15				

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-01 (cont'd)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16			22 50/6"		POORLY GRADED SAND with GRAVEL (SP): grayish brown (10YR 5/2), wet, 80% medium sand, 15% fine subangular gravel, 5% non-plastic fines	
17			50/6"			
18					80% medium to coarse sand, 15% fine gravel, 5% non-plastic fines 75% medium to coarse sand, 20% fine gravel, 5% non-plastic fines	
19	MW-01-19-20.5		19 50/6"			
20			50/6"			
21						
22			50/6"			
23			50/6"			
24						
25			50/6"			
26			50/6"		WELL GRADED GRAVELS (GW)	
27						
28			50/6"			
29			50/6"			
30						
31			50/6"		SILTY SAND (SM): bluish gray (10B 5/1), wet, 70% fine to coarse sand, 15% fine gravel, 15% non-plastic fines increasing fines	
32						
33						

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-01 (cont'd)

DEPTH (feet)	Sample No.	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33		50/6"		LEAN CLAY (CL): bluish gray (10B 5/1), wet, 100% fines, non-plastic, very stiff	
35		50/6"			
35.5	MW-01-35.5-37	17 22 25			
37		10 15 20			
38.5		19 24 25			
40		10 14 25			
41.5		12 19 50/6"			
42				wet, 95% fines, 5% fine sand, non-plastic	
43		19			
44		50/6"			
44.5		14 21 24			
46		16 20 22			
47.5		18 24 30			
49		16 22 25			
50.5		10 18			

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-01 (cont'd)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
			27		LEAN CLAY (CL): cont'd.	
52			12 18 23			
					fine sand laminations	
53						
			10 19 26			
54					fine sand laminations	
55			12 20 25			
56						
			12 21 28			
57						
					fine sand laminations	
58			16 20 22			
59						
			12 18 21			
60						
61			12 20 26			
62						
			14 22 27			
63						
64			18 20 25			
65					fine sand laminations	
			12 21 26			
66						
67			16 20 22			
68						
			13 20			
69						

OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-01 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
			22		LEAN CLAY (CL): cont'd.	
70					Bottom of Boring at 70 feet. Shallow well MW-02 installed 4 feet east of MW-01.	
71						
72						
73						
74						
75						
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80						
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84						
85						
86						
87						

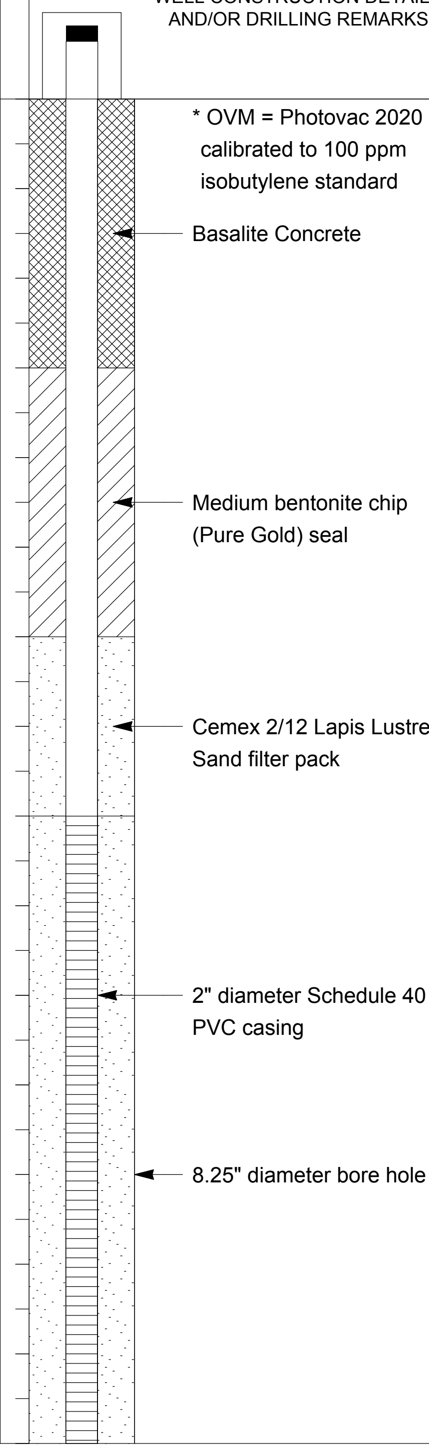
OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-02

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. MW-02**
BORING LOCATION: N: 538427.9; E: 1228251.8	TOP OF CASING ELEVATION AND DATUM: 27.7 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 10/8/08 — DATE FINISHED: 10/8/08
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 20.2 — SCREEN INTERVAL (ft.): 8-18
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 9.5 — COMPL. NA — CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Dames & Moore (1.5' x 3.25")	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 28.04 feet NAVD 88	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0–15					See boring log for MW-01 for lithology.	* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15



Log of Well No. MW-02 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16						Schedule 40 PVC well screen with 2" diameter and 0.010" slot
17						
18						2" diameter Schedule 40 PVC end cap
19						
20					Bottom of boring at 20.2 feet.	
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. MW-03**	
BORING LOCATION: N: 538979.1; E: 1228187.2	TOP OF CASING ELEVATION AND DATUM: 21.1 feet NAVD 88	
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 10/9/08	DATE FINISHED: 10/9/08
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 20.5	SCREEN INTERVAL (ft.): 5-15
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 6 ft; COMPL. NA	CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Dames & Moore (1.5' x 3.25")	LOGGED BY: N. Bacher	
HAMMER WEIGHT: 300 DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 23.76 feet NAVD88	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0				Postholed through roadbase to 4 feet below ground surface.	* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard
1.5					Basalite Concrete
3					Medium bentonite chip (Pure Gold) seal
4		17 15 50/6"		SILTY SAND with GRAVEL (SM): brown (10YR 4/3), dry, 70% fine to medium sand, 15% fine subrounded gravel, 15% non-plastic fines, oxidized mottling	
5.5		1 1 1			Cemex 2/12 Lapis Lustre Sand filter pack
6				wet	
7				wood fragment, black	
7.3		1 2 3			
8					2" diameter Schedule 40 PVC casing
8.5		4 2 2		SILTY SAND (SM): black (N 2.5/), wet, 70% medium sand, 20% non-plastic fines, 10% fine gravel, wood fragments, glass decreasing wood content	
10	MW-03-10.5-1008	7 6 18			
11.5		5 3 2			
12					8.25" diameter bore hole
14.5		7 9			

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-03 (cont'd)

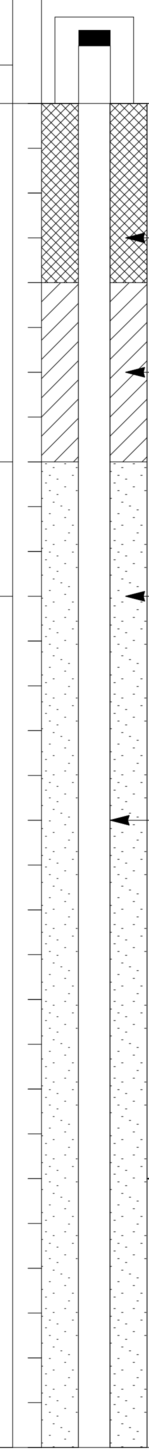
DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
			11		SILTY SAND (SM): cont'd.	2" diameter Schedule 40 PVC end cap
					increasing wood content, glass fragments	*10% Wood*
16			5 5 2			
17					wet, 75% fine sand, 25% non-plastic fines	*15% Wood*
			4 7 7		wet, 50% fine to medium sand, 25% non-plastic fines, 10% fine subrounded gravel	
18						
					LEAN CLAY (CL): dark bluish gray (5B 3/1), wet, 95% non-plastic fines, 5% fine gravel, very stiff	
19			50/6"			
					fine sand laminations	
20						
					Bottom of boring at 20.5 feet.	
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-04

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	
BORING LOCATION: N: 537393.7; E: 1229202.5	TOP OF CASING ELEVATION AND DATUM: 20.3 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 7/16/08 / DATE FINISHED: 7/16/08
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 38.5 / SCREEN INTERVAL (ft.): 15-25
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 15.5 / COMPL. NA / CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Dames & Moore (1.5' x 3.25")	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 / DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 20.6 feet NAVD 88	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0					Postholed through roadbase to 4 feet below ground surface.	* OVM = Photovac 2020 calibrated to 100 ppm isobutylene standard
1.5						Basalite Concrete
3						Medium bentonite chip (Pure Gold) seal
4			8 14 21		SILTY SAND (SM): olive brown (2.5Y 4/3), dry, 80% fine sand, 20% non-plastic fines	
5.5					SILT (ML): gray (10YR 5/1), dry to moist, 90% fines, 10% fine sand, non-plastic, contains metallic flecks	Cemex 2/12 Lapis Lustre Sand filter pack
7			8 20 32			
8					peat lenses, light brown, contains metallic flecks	2" diameter Schedule 40 PVC casing
9			19 50/6"			
10					PEAT (PT), dark brown	
10.5			22 50/6"			
11.5					brownish gray, 20% peat fragments, contains metallic flecks	
12			50/6"			8.25" diameter bore hole
13			12 16 18		gray, contains metallic flecks, fine sand laminations	
14.5			20 43			



PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-04 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
			25		SILTY SAND (SM): gray (10YR 5/1), moist, 75% fine sand, 25% non-plastic fines wet	*10% Wood*
16			17 50/6"		POORLY GRADED SAND (SP): gray (10YR 5/1), wet, 95% fine sand, 5% non-plastic fines	Schedule 40 PVC well screen with 2" diameter and 0.010" slot *15% Wood*
17			18 50/6"			
18						
19			50/6"			
20			8 12 20		WELL GRADED SAND with GRAVEL (SW): gray (10YR 5/1), wet, 75% fine to medium sand, 25% fine subrounded gravel	
21						
22			16 50/6"			
23						
24			50/6"			
25			14 50/6"			2" diameter Schedule 40 PVC end cap
26						
27			50/6"			
28			15 50/6"		POORLY GRADED SAND (SP): gray (10YR 5/1), wet, 90% medium sand, 10% fine gravel	Cemex 2/12 Lapis Lustre Sand filter pack
29						
30			50/6"			
31			12 17 22			
32			50/6"			
33						

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-04 (cont'd)

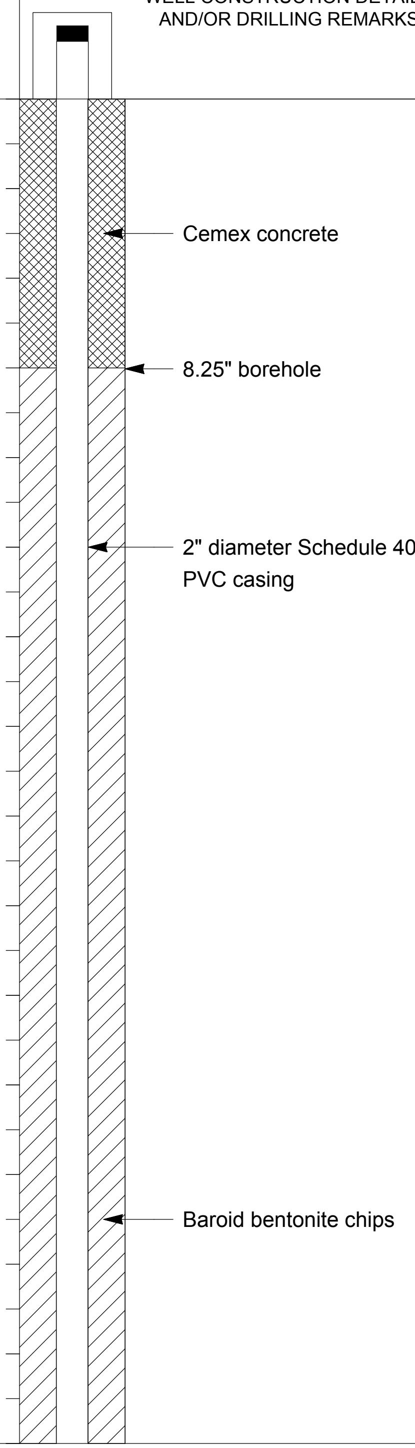
DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					POORLY GRADED SAND (SP): cont'd.	
34			50/6"			
35			17 50/6"			Cemex 2/12 Lapis Lustre Sand filter pack
36						
37			19 50/6"			
38					LEAN CLAY (CL): bluish black (10B 2.5/1), wet, 100% fines, trace fine gravel, non-plastic, very stiff	
39					Bottom of boring at 38.5 feet	
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	# Log of Well No. MW-05	
BORING LOCATION: N 538166.5; E 1228999.6	TOP OF CASING ELEVATION AND DATUM: 16.7 feet NAVD 88	
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/30/10	DATE FINISHED: 3/30/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 33.0	SCREEN INTERVAL (ft.): 23-33'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 9.0; COMPL. NA	CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher	
HAMMER WEIGHT: 300 lb. DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

Surface Elevation: 19.49 feet NAVD 88 TOC

DEPTH (feet)	Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
0–5			2 2 2; 2 5 20; 10 12 15		SILTY SAND (SM): brown, moist, 80% fine sand, 20% non-plastic fines, trace wood shreds and bark
3					scattered concrete pieces
5–6			12 6 5		REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 80% fine sand, 20% non-plastic fines, trace wood shreds and bark, scattered refuse (plastic, glass)
6–9			8 9 9; 8 12 19		REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): brown, moist, 70% fine sand, 20% fine gravel, 10% non-plastic fines, scattered refuse
9–10.5			50/6		REFUSE MATERIAL: SILT with SAND (ML): gray, wet, 70% fines, 30% fine sand, low plasticity, soft
10.5–15			3 3 4; 2 3 3		SILT (ML): gray, wet, 90% fines, 10% fine sand, low plasticity, soft
13.5–15					no sample due to conductor seal

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-05 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15.5			7 4 4			
16					Silt (ML): Cont.	Baroid bentonite chips
17			4 4 4			8.25" borehole
18					trace crushed shells	
18.5			7 8 9			
20			10 12 16		POORLY GRADED SAND with GRAVEL (SP): gray, wet, 70% fine to coarse sand, 25% fine gravel, 5% non-plastic fines	
21.5			10 12 12			
22						Cemex Lapis Lustre #2/12 filter sand
23			11 10 12			
24.5			10 12 17			
25.5					lenses of increased fine gravel	
26			10 14 18			
27.5			10 17 18			2" diameter Schedule 40 PVC (0.010-inch slot size) screen
29			10 14 15			
30.5			20 26 30		10% fine gravel	
32			17 26 30		60% gravel	2" diameter Schedule 40

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Bottom of boring at 33.0 feet.		PVC endcap
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							

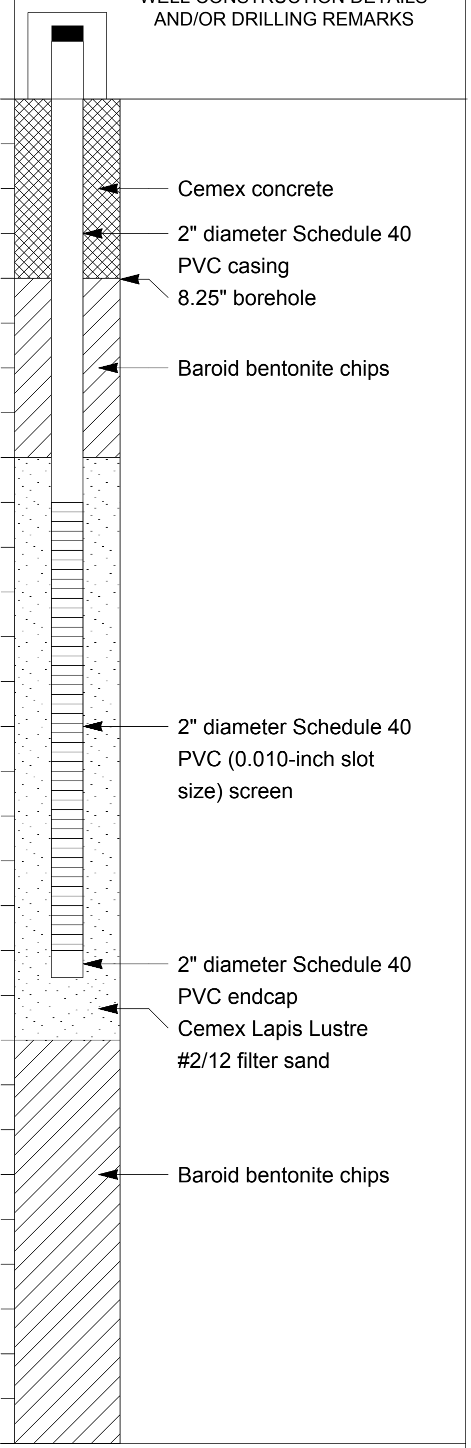
Log of Well No. MW-06

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	Log of Well No. MW-06
BORING LOCATION: N 537988.5; E 1229151.3	TOP OF CASING ELEVATION AND DATUM: 15.3 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/30/10 / DATE FINISHED: 3/30/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 19.5 / SCREEN INTERVAL (ft.): 4.5-9.5'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 8.0 / COMPL. NA / CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb. / DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

Surface Elevation: 18.03 feet NAVD 88 TOC

DEPTH (feet)	Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
0–1			7 7 8		SILTY SAND (SM): brown moist, 80% fine sand, 20% non-plastic fines, scattered wood pieces
1–3			11 10 15		REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 70% fine sand, 30% non-plastic fines, scattered wood pieces, scattered refuse (plastic)
3–9			7 8 8		REFUSE MATERIAL: SILT with SAND (ML): very dark gray, moist, 70% fines, 30% fine sand, low plasticity, refuse (glass, wood, plastic)
			3 6 3		
			13 22 50		
7.5					black
8			32 50/4		wet
9–10			2 4 10		REFUSE MATERIAL: SILTY SAND (SM): very dark gray, wet, 70% fine sand, 30% non-plastic fines, scattered wood pieces, refuse (glass, plastic)
10–10.5					ELASTIC SILT (MH): gray, wet, 100% fines, medium plasticity, soft
10.5–15			10 12 15		WELL GRADED SAND with SILT (SW-SM): gray, wet, 80% fine to coarse sand, 10% non-plastic fines, 10% fine gravel
			8 12 13		
			7 8 10		

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-06 (cont'd)

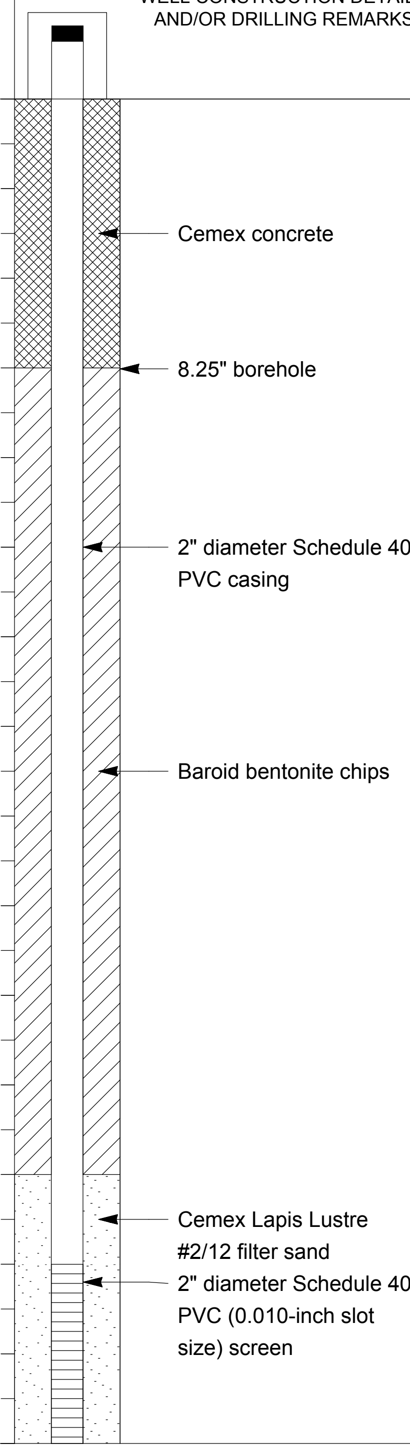
DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16			8 10 11		WELL GRADED SAND with SILT (SW-SM): Cont.	Baroid bentonite chips
17			8 10 10			8.25" borehole
18						
19			8 10 12			
20					Bottom of boring at 19.5 feet.	
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. MW-07**
BORING LOCATION: N 537724.2; E 1229310.9	TOP OF CASING ELEVATION AND DATUM: 15.1 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/31/10 — DATE FINISHED: 3/31/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 19.5 — SCREEN INTERVAL (ft.): 13-18'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 8.0 — COMPL. NA — CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 17.89 feet NAVD 88 TOC
0–1	2 3 3		SILTY SAND (SM): gray, moist, 60% medium sand, 20% low plasticity fines, 20% wood debris (roots)
2	3 24 40		5% wood debris
3	3 4 5		
4			REFUSE MATERIAL: SILTY SAND (SM): gray, moist, 80% medium sand, 20% low plasticity fines, white plastic refuse
5	2 4 4		10% gravel to 1"
6–7	4 5 5		
8	2 2 3		wet
9			scattered gravel
10	2 3 3		
11	5 6 7		
12	10 12 14		WELL GRADED SAND (SW): gray, wet, 80% fine to coarse sand, 15% fine gravel rounded, 5% non-plastic fines, trace brown wood chunks
14	7 11 13		
14.5			no wood chunks
15			

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

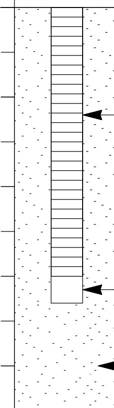


OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-07 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16			10 23 28		WELL GRADED SAND (SW): Cont.	2" diameter Schedule 40 PVC (0.010-inch slot size) screen
17			8 22 24			8.25" borehole
18			15 19 24			2" diameter Schedule 40 PVC endcap
19						Cemex Lapis Lustre #2/12 filter sand
19.5					Bottom of boring at 19.5 feet.	



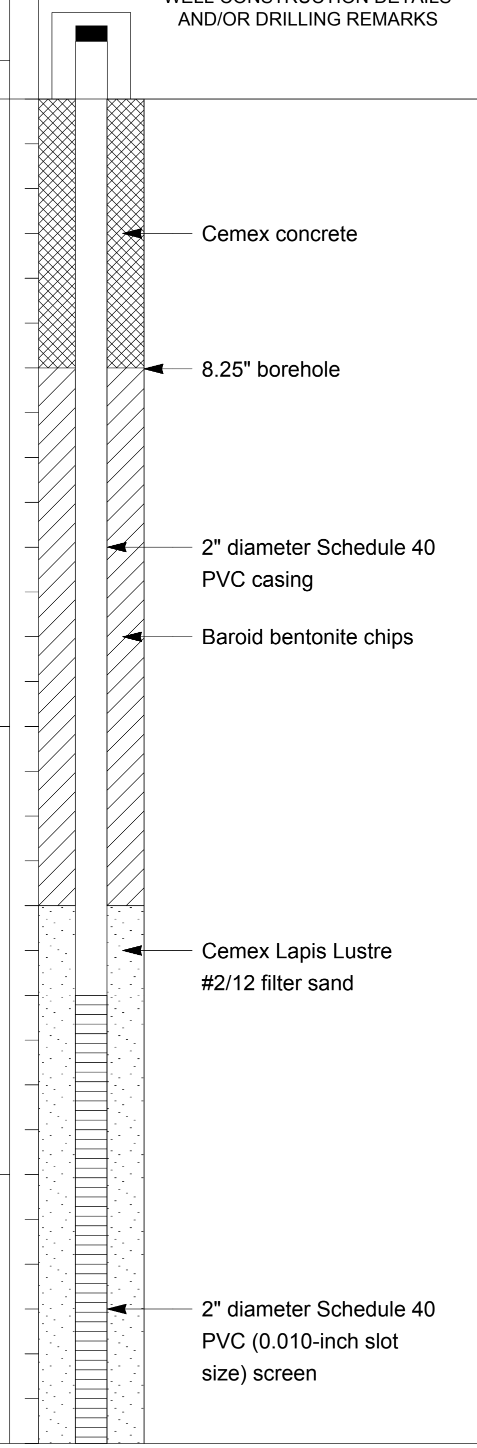
20 21 22 23 24 25 26 27 28 29 30 31 32 33

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. MW-08**	
BORING LOCATION: N 538469.3; E 1228626.6	TOP OF CASING ELEVATION AND DATUM: STET feet NAVD 88	
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 4/2/10	DATE FINISHED: 4/2/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 34.0	SCREEN INTERVAL (ft.): 10-20'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 13.0 COMPL. NA	CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher	
HAMMER WEIGHT: 300 lb. DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher	REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 28.50 feet NAVD 88 TOC
0			1 3 5		WOOD: brown, moist, 100% wood waste (saw dust, bark, wood chips)
1					
2			5 5 5		
3			7 8 8		
4					
5			7 8 8		
6			7 25 28		
7					SILTY SAND (SM): gray, moist, 65% medium sand, 25% low plasticity fines, 10% fine gravel
8			10 15 12		5% fine gravel
9			8 4 4		
10					
11			10 8 8		
12			18 20 20		REFUSE MATERIAL: SILTY SAND (SM): gray, moist, 80% medium sand, 20% low plasticity fines, scattered refuse (plastic, metal, tile, plywood)
13					wet
14			32 50 50		
15					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-08 (cont'd)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16			8 10 13		REFUSE MATERIAL: SILTY SAND (SM): Cont.	
17			4 4 5		REFUSE MATERIAL: POORLY GRADED SAND with SILT (SP-SM): reddish brown, wet, 90% fine to coarse sand, 10% non-plastic fines, scattered refuse (plastic pieces, glass, tile, aluminum)	Cemex Lapis Lustre #2/12 filter sand; 8.25" borehole
18			7 8 8			2" diameter Schedule 40 PVC (0.010-inch slot size) screen
19						
20			12 15 16			2" diameter Schedule 40 PVC endcap
21			10 15 17			
22						
23			3 4 4		LEAN CLAY (CL): gray, wet, 100% fines, medium plastiticy, soft	
24						
25		S				
26			6 8 8		trace fine sand	
27						Baroid bentonite chips
28			4 4 4		trace fine rounded gravel, crushed shells	
29						
30			7 8 8		WELL GRADED SAND with SILT and GRAVEL (SW-SM): gray, wet, 65% fine to coarse sand, 25% fine gravel, 10% non-plastic fines	
31			10 12 12			
32						
33						

OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-08 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
			12 18 24			8.25" borehole
34					Bottom of boring at 34.0 feet.	
35						
36						
37						
38						
39						
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42						
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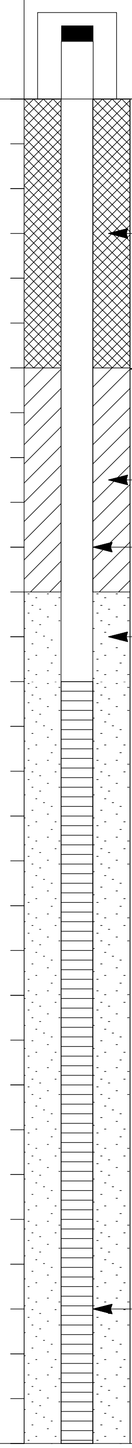
OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-09

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. MW-09**
BORING LOCATION: N 538523.9; E 1228765.3	TOP OF CASING ELEVATION AND DATUM: 20.5 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/29/10 · DATE FINISHED: 3/29/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 18.0 · SCREEN INTERVAL (ft.): 6.5-16.5'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 9.0 · COMPL. NA · CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb. · DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher · REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 23.19 feet NAVD 88 TOC
0–4			3 4 5 / 3 4 5 / 7 8 8		WOOD: brown, moist, 100% wood debris (bark, shreds, fresh wood chunks, sawdust)
4–5					SILTY SAND with GRAVEL (SM): gray, moist, 65% fine to coarse sand, 20% non-plastic fines, 15% fine gravel
5–6.3			6 15 20		SILTY SAND (SM): gray, moist, 80% fine to coarse sand, 20% non-plastic fines, scattered small pieces of wood
6.3–11.2			11 11 11 / 6 8 9 / 6 12 18		REFUSE MATERIAL: WOOD brown, moist, 100% wood (shredded, bark, sawdust)
9					wet
11.2–15			4 5 5 / 8 32 50		REFUSE MATERIAL: SILTY SAND (SM): black, wet, 75% fine to coarse sand, 20% non-plastic fines, 25% wood and refuse debris (metal, plastic, wire)



OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-09 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	Sample	Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16			45 32 50		REFUSE MATERIAL: SILTY SAND (SM): Cont.	Cemex Lapis Lustre #2/12 filter sand
17			5 5 5		LEAN CLAY (CL): gray, moist, 100% fines, medium plasticity, trace shells	2" diameter Schedule 40 PVC endcap 8.25" borehole
18					Bottom of boring at 18.0 feet.	
19						
20						
21						
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24						
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27						
28						
29						
30						
31						
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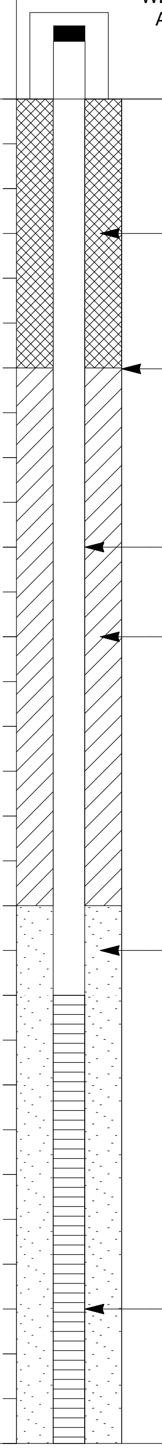
OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington		**Log of Well No. MW-10**		
BORING LOCATION: N 538677.2; E 1228557.5		TOP OF CASING ELEVATION AND DATUM: 26.1 feet NAVD 88		
DRILLING CONTRACTOR: Cascade Drilling, Inc.		DATE STARTED: 4/1/10		DATE FINISHED: 4/1/10
DRILLING METHOD: Hollow-stem auger		TOTAL DEPTH (ft.): 34.0		SCREEN INTERVAL (ft.): 10-20'
DRILLING EQUIPMENT: CME 75		DEPTH TO WATER (ft.): FIRST 11.0	COMPL. NA	CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]		LOGGED BY: N. Bacher		
HAMMER WEIGHT: 300 lb.	DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher		REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 28.87 feet NAVD 88 TOC
0–1.5			50/6		POORLY GRADED GRAVEL (GP): gray, moist, 100% gravel and cobbles
1.5–10			9 18 15		WOOD: brown, moist, 100% wood (bark, sawdust, wood chips)
			32 50 50		
			19 12 18		
			8 6 8		
			9 15 15		
			9 8 8		
10–11.5			13 8 5		SILTY SAND (SM): gray, moist, 80% fine to medium sand, 20% non-plastic fines, trace fine gravel wet (at 11)
11.5–			7 8 8		REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): black, wet, 60% fine to medium sand, 30% fine and coarse gravel, 10% non-plastic fines, scattered refuse (glass, aluminum)
			2 3 3		

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

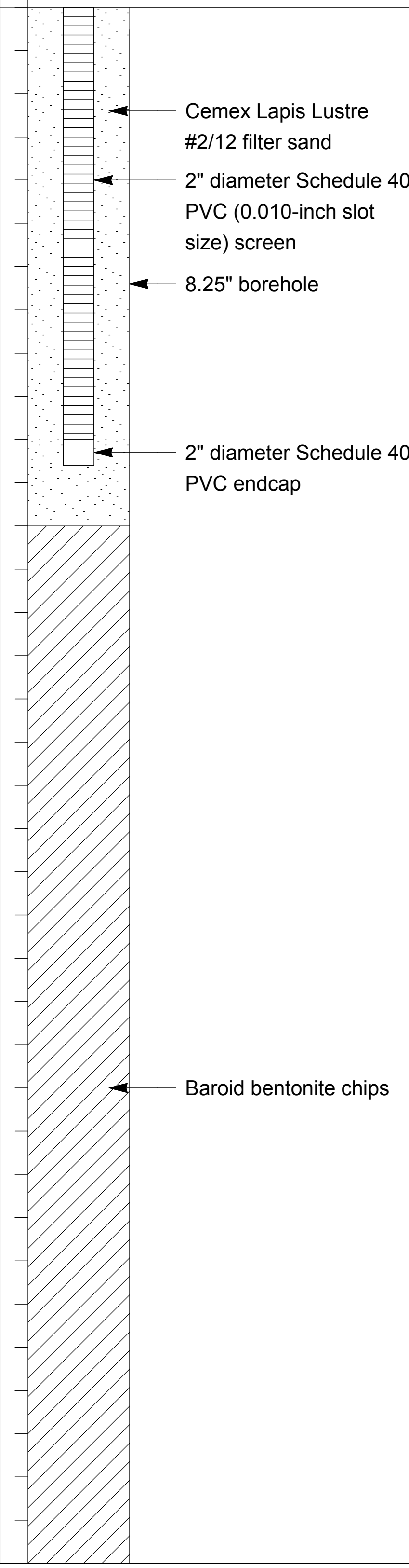


OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-10 (cont'd)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
16			3 4 4		REFUSE MATERIAL: POORLY GRADED SAND with SILT and GRAVEL (SP-SM): Cont.
17			2 3 3		
18			2 2 3		reddish brown
19					
20			1 2 2		
21			2 2 3		
22					
23			2 2 2		
24					LEAN CLAY (CL): gray, moist, 100% fines, medium plasticity, soft
25		S			
26					
27			2 2 2		
28					trace organics and crushed shells
29			1 2 2		
30			2 3 3		SILTY SAND (SM): gray, wet, 75% medium sand, 25% low plasticity fines, 5% crushed shells, scattered rounded gravel to 1/2"
31					
32			8 10 12		WELL GRADED SAND with SILT (SW-SM): gray, wet, 75% fine to coarse sand, 15% rounded gravel to 1.0", 10% non-plastic fines
33					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV_TOC (REV. 8/2011)

Log of Well No. MW-10 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
			7 8 8		WELL GRADED SAND with SILT (SW-SM): Cont.	Baroid bentonite chips
34					Bottom of boring at 34.0 feet.	
35						
36						
37						
38						
39						
40						
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42						
43						
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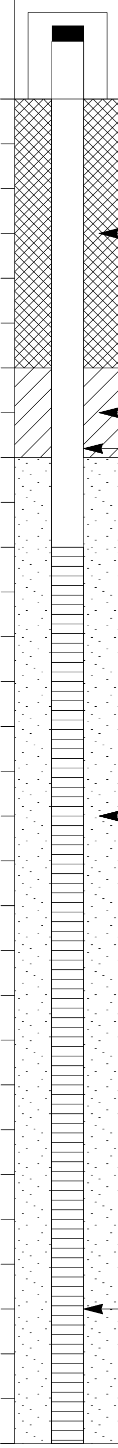
51						

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington		**Log of Well No. MW-11**		
BORING LOCATION: N 538961.3; E 1228298.9		TOP OF CASING ELEVATION AND DATUM: 21.4 feet NAVD 88		
DRILLING CONTRACTOR: Cascade Drilling, Inc.		DATE STARTED: 3/29/10		DATE FINISHED: 3/29/10
DRILLING METHOD: Hollow-stem auger		TOTAL DEPTH (ft.): 18.0		SCREEN INTERVAL (ft.): 5-15'
DRILLING EQUIPMENT: CME 75		DEPTH TO WATER (ft.): FIRST 8.0	COMPL. NA	CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]		LOGGED BY: N. Bacher		
HAMMER WEIGHT: 300 lb.	DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher		REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 24.21 feet NAVD 88 TOC	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0–1			3 5 14		SILT with SAND (ML): gray, dry, 80% fines, 20% medium sand, 15% wood debris, non-plastic	
1.5						Cemex concrete
2			10 14 16		moist	
3					coarse sand	8.25" borehole
3.5			7 8 9		POORLY GRADED SAND (SP): gray, moist, 85% coarse sand, 15% non-plastic fines	Baroid bentonite chips
4					REFUSE MATERIAL: SILT (ML): brown, moist, 90% fines, 10% fine sand, 20% wood debris, 5% refuse (plastic bags)	2" diameter Schedule 40 PVC casing
5			6 6 6			
6.5			9 23 30		10% refuse (metal wire, plastic bags)	
7.5					REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 85% fine to coarse sand, 15% non-plastic fines, 15% wood and refuse	
8			3 4 4		Wet	Cemex Lapis Lustre #2/12 filter sand
9.5			3 14 20		REFUSE MATERIAL: POORLY GRADED SAND (SP): black, wet, 85% coarse sand, 15% non-plastic fines, trace metallic debris, strong landfill odor, slight sheen on sample	
11			10 10 10			
11.5					moderate sheen	
12.5			2 3 4			
13.5						2" diameter Schedule 40 PVC (0.010-inch slot size) screen
14			3 4 4			
15						



OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. MW-11 (cont'd)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
						2" diameter Schedule 40 PVC endcap
16			3 4 4		LEAN CLAY (CL): gray, moist, 100% fines, medium plasticity, soft, trace white crushed shells	Cemex Lapis Lustre #2/12 filter sand
17			3 4 4			
18					Bottom of boring at 18.0 feet.	8.25" borehole
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

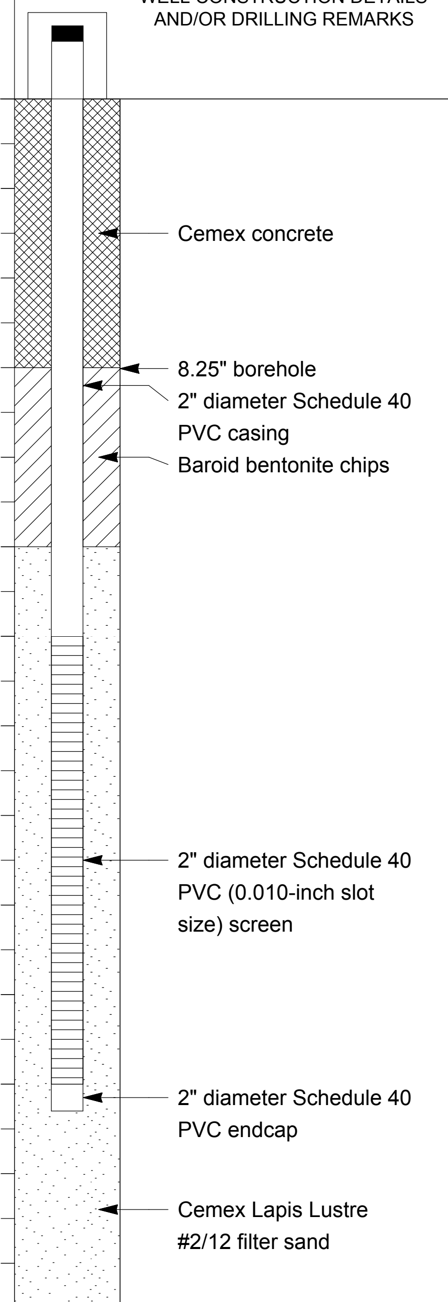
OAKWELLV_TOC (REV. 8/2011)

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. PZ-01**
BORING LOCATION: N 538227.9; E 1228881.5	TOP OF CASING ELEVATION AND DATUM: 17.9 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/30/10 — DATE FINISHED: 3/30/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 13.5 — SCREEN INTERVAL (ft.): 6-11'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 9.0 — COMPL. NA — CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

Surface Elevation: 19.99 feet NAVD 88 TOC

DEPTH (feet)	Blows/Foot	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
0–1	3 4 4	WOOD: brown, moist, 100% wood (shreded, bark, sawdust)
1–3	8 10 15	SILT with SAND (ML): gray, moist, 80% fines, 20% fine sand, non-plastic, trace wood material
3–5	5 6 6	SILTY SAND (SM): gray, moist, 70% fine sand, 30% non-plastic fines, trace gravel, trace wood fragments
5–11	4 5 5; 12 32 50; 32 50 50; 5 5 6	REFUSE MATERIAL: SILTY SAND (SM): gray, moist, 70% fine sand, 30% non-plastic fines, trace gravel, trace wood fragments, refuse (trace metal debris, garbage bag, wire)
7		scattered gravel
9		wet
11–13.5	1 2 2; 1 1 1	SILT (ML): gray, moist, 100% fines, medium plasticity, soft, trace shells
13.5		Bottom of boring at 13.5 feet.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV_TOC (REV. 8/2011)

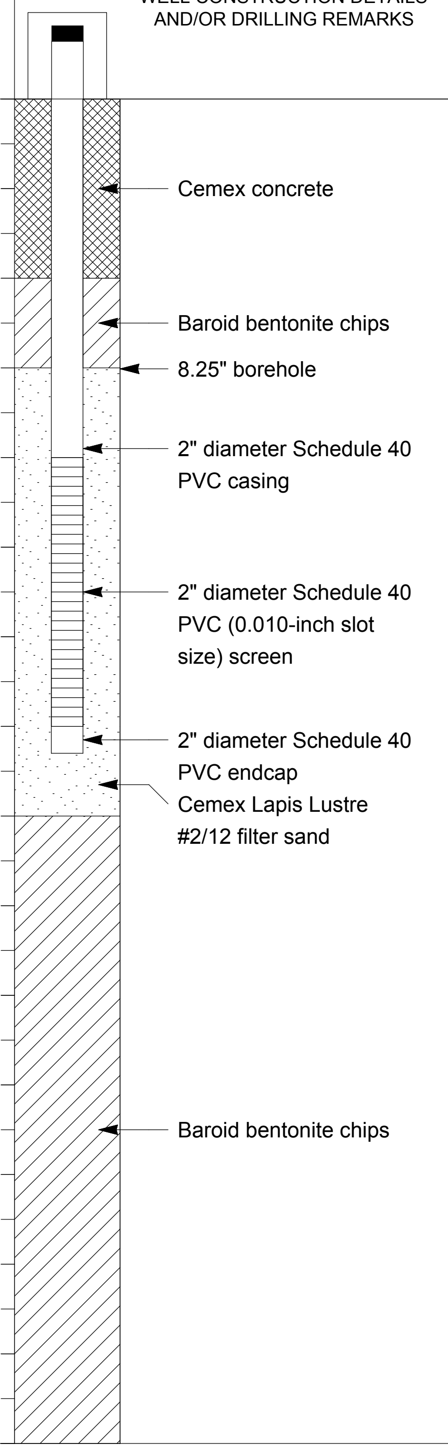
amec — Project No. 14159.000.0 —

Log of Well No. PZ-02

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation Anacortes, Washington	**Log of Well No. PZ-02**
BORING LOCATION: N 537930.1; E 1228846.2	TOP OF CASING ELEVATION AND DATUM: 16.6 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/31/10 — DATE FINISHED: 3/31/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 15.0 — SCREEN INTERVAL (ft.): 4-7'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 9.0 — COMPL. NA — CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 19.41 feet NAVD 88 TOC
0					WOOD: brown, moist, 100% wood (bark, sawdust)
1			7 8 8		SILTY SAND (SM): brown, moist, 80% fine to coarse sand, 20% non-plastic fines, scattered wood fragments
2			0 1 13		REFUSE MATERIAL: SILTY SAND (SM): brown, moist, 80% fine sand, 20% non-plastic fines, scattered refuse (plastic, white gooey material)
3					black, burnt appearance, wood particles, oxidization mottling
4			10 32 40		brownish gray
5			12 15 17		POORLY GRADED SAND (SP): gray, medium sand
6					glass shards and wood
7			8 10 11		POORLY GRADED SAND (SP): gray, moist, 85% medium sand, 10% fine gravel, 5% non-plastic fines
8			8 5 4		
9					wet
10			15 18 21		
11			12 16 20		
12					WELL GRADED SAND with GRAVEL (SW): gray, wet, 80% fine to coarse sand, 15% fine gravel, 5% non-plastic fines
13			12 15 13		
14			12 13 16		
15					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV_TOC (REV. 8/2011)

Log of Well No. PZ-02 (cont'd)

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.		WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Bottom of boring at 15.0 feet.		
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							

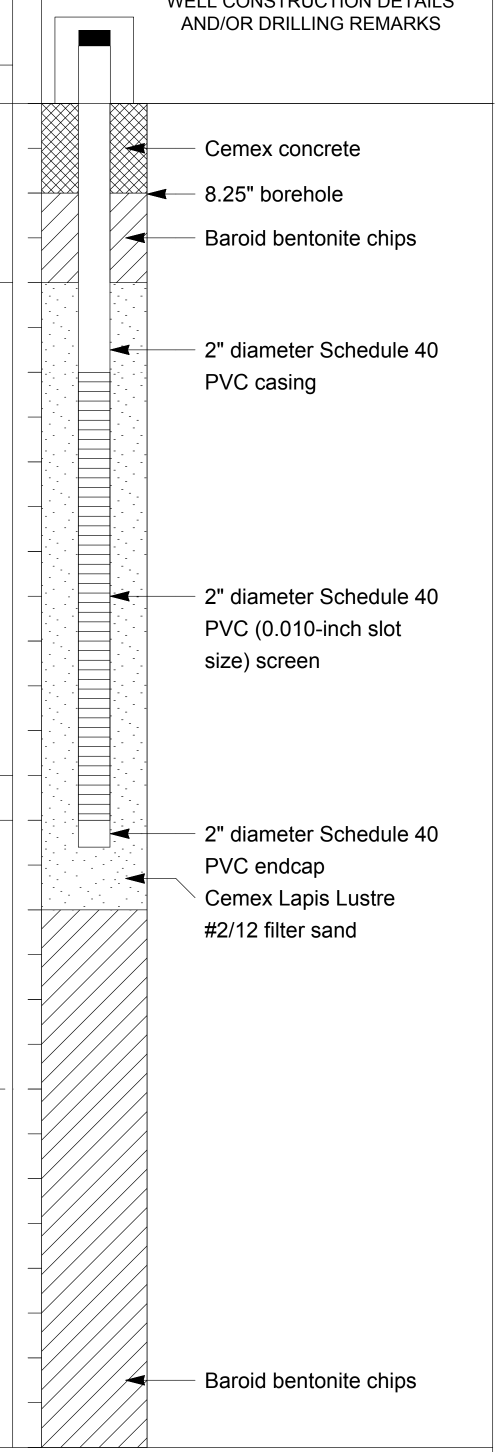
OAKWELLV_TOC (REV. 8/2011)

Log of Well No. PZ-03

PROJECT: Skagit Whitmarsh Landfill Phase II Investigation, Anacortes, Washington	Log of Well No. PZ-03
BORING LOCATION: N 537590.4; E 1229255.4	TOP OF CASING ELEVATION AND DATUM: 12.8 feet NAVD 88
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/31/10 — DATE FINISHED: 3/31/10
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 19.5 — SCREEN INTERVAL (ft.): 3-8'
DRILLING EQUIPMENT: CME 75	DEPTH TO WATER (ft.): FIRST 6.0; COMPL. NA — CASING: 2" Sch. 40 PVC
SAMPLING METHOD: Split-spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb. — DROP: 30"	RESPONSIBLE PROFESSIONAL: N. Bacher — REG. NO. L.G. 2528

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. (Surface Elevation: 16.18 feet NAVD 88 TOC)
0–2			3 4 4		SILTY SAND (SM): reddish gray, moist, 70% fine sand, 30% low-plasticity fines, scattered fine gravel
2–7.5			8 12 20		REFUSE MATERIAL: SILTY SAND (SM): reddish gray, moist, 70% fine sand, 30% low-plasticity fines, scattered fine gravel, scattered refuse (plastic and brick), wood waste
			5 6 7		
			2 2 2		
6			1 3 5		wet
7.5–8			1 2 2		ELASTIC SILT (MH): gray, wet, 100% fines, medium plasticity, trace roots
8–11					SILTY SAND (SM): gray, wet, 85% medium to fine sand, 15% non-plastic fines, trace fine gravel
			1 3 5		
11–15			5 6 7		WELL GRADED SAND with GRAVEL (SW): gray, wet, 85% fine to coarse sand, 15% fine rounded gravel
					small piece of wood
			10 12 13		
			10 18 12		

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



PROJECT: Skagit Whitmarsh Landfill Phase II Investigation
Anacortes, Washington

Log of Well No. PZ-03 (cont'd)

DEPTH (feet)	Sample No.	Sample	Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					20% fine rounded gravel	
16			12 22 30		WELL GRADED SAND with GRAVEL (SW): Cont.	Baroid bentonite chips
17			15 23 26			8.25" borehole
18			15 19 27			
19						
20					Bottom of boring at 19.5 feet.	
21						
22						
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OAKWELLV_TOC (REV. 8/2011)

APPENDIX G

Transducer Data Package
(To be included in separate compact disc)

APPENDIX H

Methane Monitoring Memoranda and Data

August 25, 2010

Project 0141590000.00007

Ms. Sandra Caldwell
Project Representative
Washington State Department of Ecology
Toxics Cleanup Program
P.O. Box 47600
Olympia, Washington 98504

Subject: Methane Detection/Monitoring
Whitmarsh Landfill RI/FS
Skagit County, Washington

Dear Ms. Caldwell:

In response to your letter of June 4, 2010, and on behalf of the March Point (Whitmarsh) Landfill PLP Group, this letter provides results for the methane monitoring in the interior areas of all buildings and in the wells and piezometers at the Whitmarsh Landfill site. This site is listed on the Washington State Department of Ecology (Ecology) Hazardous Sites List as Facility ID 2662.

SAMPLING PROCEDURES

As proposed in the Methane Monitoring Plan submitted to you on June 25, 2010, AMEC performed 12 visits to the site to perform the gas monitoring. Generally, site visits were on a Monday, Wednesday, Friday schedule. A holiday weekend caused one of the weeks to be sampled on Tuesday and Friday. AMEC left all wells and piezometers vented prior to sampling, due to pressure transducers located in the wells and piezometers. General weather descriptions and barometric readings from a pressure transducer located on site were collected to show any weather influence on gas readings.

Using the PhD Ultra Multi Gas Detector, Model 13-037, a calibration was performed before and after the well and building sampling using instructions provided in the Biosystems Reference Manual. Calibration gas contained Hydrogen Sulfide (H_2S), Carbon Monoxide (CO), Methane (CH_4), and Air.

AMEC collected readings from well headspace and from enclosed buildings. The results of these monitoring events are shown in Table 1, with the building and well locations shown in Figure 1. The building between the sawmill and the mechanic shop is an open structure and was not monitored. Throughout the sampling rounds, all wells and piezometers were sampled, as well as building airspace from the mechanic shop, office, and sawmill, when accessible. Sampling events that occurred on a Friday (July 2, 16, and 23) did not include air monitoring inside the office because mill personnel were not available to unlock the office door. There are three enclosed rooms in the sawmill: a fire suppression room, an electrical room, and a saw

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AMEC Geomatrix

repair room. All three were tested. The concrete slab floor of the sawmill was covered with sawdust preventing a total inspection; however, in the parts of the floor that were not obscured AMEC could not find any cracks or fractures. The only penetration observed in the sawmill slab was where a water line came into the building for the fire suppression system. This 6-inch-diameter water pipe was plugged with expanding foam all around where it came into the building and no detections of any gas were detected at this penetration. The mechanics shop and office had solid floors and upon scanning all corners and low spots with the gas meter, no detections of explosive gas were observed.

RESULTS

Explosive gas (% of lower explosive limit [LEL]), carbon monoxide, and hydrogen sulfide were not detected in any of these buildings or the enclosed rooms in the buildings. Oxygen (O_2) levels in the buildings were consistently 20.9%. The wells and piezometers with the highest levels of explosive vapors were MW-08, MW-09, and MW-10. For the period monitored, these wells averaged greater than 50% of the LEL. Wells MW-02, MW-03, and MW-04 had the lowest levels of explosive vapors measured and other wells and piezometers were intermediate between the two groups.

Please let me know if you have any questions about these data or this report.

Sincerely yours,
AMEC Geomatrix, Inc.

David Haddock, L.Hg.
Project Manager

CB/acjs
r:\14159 - skagit whitmarsh landfill\029\methane reporting_sx.doc

Attachment: Table 1 – Site Gas Readings
Figure 1 – Methane Detection / Sampling

cc: Peter Adolphson, Ecology
Mark Myers, Williams Kastner
Stephen Fallquist, Skagit County
Gary Stoyka, Skagit County
Panjini Balaraju, Ecology
Matthew Butcher, for Chevron/Texaco
Jeff Goold, for Shell
Tim Goodman, for DNR
Project File

TABLE 1

SITE GAS READINGS [1]
Whitmarsh Landfill
Skagit County, Washington

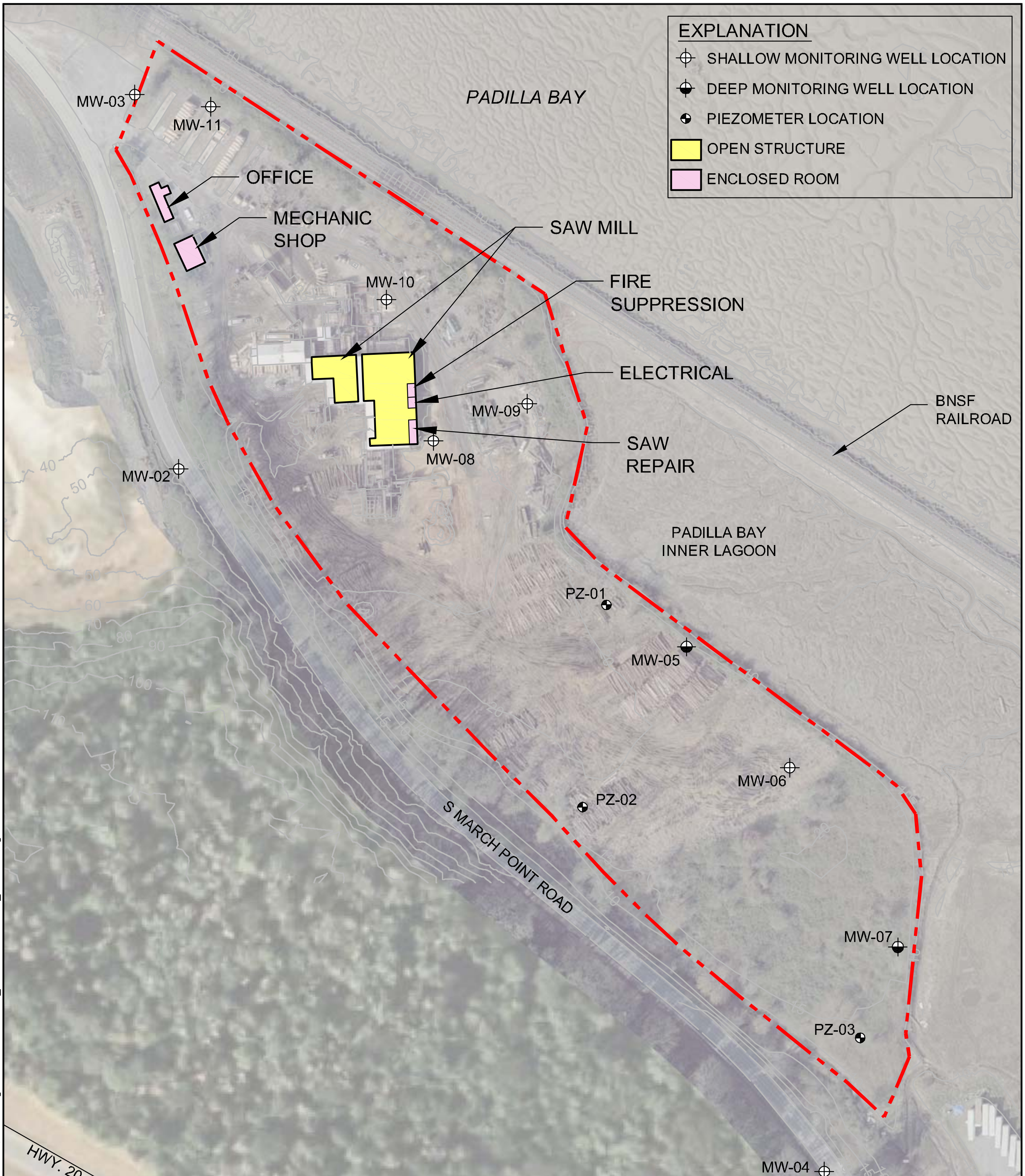
Location or Monitoring Well ID	6/24/2010				6/28/2010				6/30/2010				7/2/2010				7/6/2010				7/9/2010			
	Weather: Sun, 70°				Weather: Overcast, 65°				Weather: P. Cloudy, 55°				Weather: P Cloudy, 55°				Weather: Sun, 75°				Weather: Clear, 60°			
	Barometer[2]: 14.788 psi				Barometer: 14.738 psi				Barometer: 14.847 psi				Barometer: 14.741 psi				Barometer: 14.813 psi				Barometer: 14.745 psi			
	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)
Office	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Shop	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Fire Suppression	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Electrical	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Saw Repair	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
MW-02	0	0	20.9	0	0	0.0	20.9	0.0	0	0.0	20.9	0.0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
MW-03	0	0	20.9	0	0	2.2	20.9	0.2	0	1.4	20.9	0.0	0	0	20.9	0	0	0.6	20.9	0	0	0	20.7	0
MW-04	0	0	20.9	0	0	0.0	20.9	0.0	0	0.0	20.9	0.0	0	0	20.9	0	0	0	20.9	0	0	0.2	20.9	0
MW-05	0	0	20.9	0	5	1.1	20.7	0.0	0	0.0	21.1	0.0	5	1.5	20.9	0	66	0	19.7	0	12	0.9	20.9	0
MW-06	0	0	20.9	0	0	0.7	20.4	0.0	0	0.0	20.7	0.2	0	1.5	20.6	0	17	0	20.6	0	8	1	20.6	0
MW-07	0	0	20.9	0	0	1.0	20.9	0.0	0	0.5	20.9	0.0	0	2.4	20.7	0	9	1.4	20.5	0.2	0	1.2	20.7	0
MW-08	42	0	20.1	0	>100	0.7	20.9	0.0	6	2.0	20.9	0.4	48	0	20.4	0	>100	0	19.9	0	60	1	20.1	0
MW-09	53	2	19.4	2	>100	0.8	17.7	0.2	>100	1.5	20.9	0.3	>100	1.7	15.9	0.5	58	0	20.1	0	>100	2.8	17	0.2
MW-10	>100	2	17.2	0	>100	2.5	15.8	0.2	0	2.0	20.9	0.0	>100	1.1	18.2	0	87	0.5	20.3	0	3	1.8	20.7	0
MW-11	0	1	17.2	0	16	1.8	19.9	0.2	0	1.2	20.9	0.0	0	1.2	20.9	0	0	0	20.9	0	2	1.2	20.7	0
PZ-01	0	0	20.9	0	9	0.0	20.7	0.0	0	0.0	20.9	0.0	46	0.7	20.4	0	>100	0	17.9	0	94	0.3	20.7	0
PZ-02	20	2	20.0	2	37	0.0	19.8	0.0	0	0.0	20.9	0.0	21	0.3	20.1	0	0	1.5	20.7	0.2	22	0	20	0
PZ-03	0	0	20.9	0	0	1.2	20.7	0.0	0	0.8	20.9	0.0	0	1.7	20.9	0	4	1.3	20.7	0.3	0	0.9	20.9	0

TABLE 1

SITE GAS READINGS [1]
Whitmarsh Landfill
Skagit County, Washington

Location or Monitoring Well ID	7/12/2010				7/14/2010				7/16/2010				7/19/2010				7/21/2010				7/23/2010			
	Weather: P. Cloudy, 70°				Weather: Clear, 75°				Weather: P. Cloudy, 60°				Weather: P. Cloudy, 60°				Weather: Clear 60-70°				Weather: Clear 60-70°			
	Barometer: 14.745 psi				Barometer: 14.832 psi				Barometer: 14.822 psi				Barometer: 14.848 psi				Barometer: 14.760 psi				Barometer: 14.847 psi			
	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)	LEL %	CO (ppm)	O_2 %	H_2S (ppm)
Office	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Shop	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Fire Suppression	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Electrical	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
Saw Repair	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
MW-02	2	1.5	20.7	0	0	0	20.9	0	1	0.2	20.9	0	0.2	0	20.7	0	1	0.2	20.7	0	1	0.4	20.7	0
MW-03	0	0	20.9	0	0	0	20.9	0	0	1.2	20.7	0	0	1.4	20.1	0	0	1.6	20.7	0	0	0	20.9	0
MW-04	0	1.6	20.3	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0	0	0	20.9	0
MW-05	0	0	20.9	0	55	0	20.6	0	0	0.5	20.7	0	11	0.4	20.4	0.2	0	1	20.7	0	0	0	20.7	0
MW-06	0	0.3	20.9	0	0	0	20.9	0	3	2.1	19.9	0	6	0	20.7	0	0	1.9	20.9	0	0	1	20.9	0
MW-07	0	0.6	20.9	0	3	1.2	20.7	0	0	1.1	20.9	0	0	1.1	20.9	0	0	2	20.9	0	0	0.5	20.9	0.2
MW-08	14	0	20.9	0	>100	1.9	18.9	0.4	>100	0	14.7	0	>100	1.3	11.3	0.2	>100	0	18	0	73	1	18.7	0
MW-09	25	0.2	19.3	0	>100	1.4	17	0.2	>100	1.3	6.3	0.7	>100	1.5	12.6	0.6	>100	4	5.4	0.7	>100	0.9	15.7	0.8
MW-10	0	0	20.9	0	>100	0	18.7	0	>100	2.1	6.5	0	>100	1.9	14.2	0.3	>100	3.2	7.3	0	0	0.3	20.9	0
MW-11	0	0	20.9	0	12	0	20.2	0	8	0	20.4	0	22	1.2	19.8	0	27	2.7	19.8	0	6	0	20.6	0
PZ-01	0	1.3	20.9	0	>100	1.3	19.1	0.2	3	1.2	20.3	0	>100	1.8	7.9	0.3	4	1.2	19.8	0	40	1	15.8	0.2
PZ-02	0	0.7	20.7	0	0	0	20.9	0	70	0	18	0	91	1.7	17.4	0	37	0.8	19.8	0	91	1.1	17.8	0
PZ-03	0	1.6	20.7	0	0	0.5	20.4	0	0	2.1	19.4	0.3	0	1.5	19.4	0	0	0	20	0	0	0.4	20.4	0

Notes
1. Readings from 6/24/2010 to 7/23/2010, collected with PhD Ultra Multi Gas Detector, Model 13-037.
2. Barometer readings collected barometric transducer located in MW-7.



Aerial Photo Courtesy of USDA/FSA Aerial Photography Field office (2006) and Skagit County (2008)

Contours generated from Skagit County aerial photo, 2008. Vertical datum: MLLW

Note: No monitoring well was installed at MW-01 since deep groundwater was not encountered.

EXPLANATION

APPROXIMATE LANDFILL BOUNDARY

N

0 100 200

APPROXIMATE SCALE IN FEET

METHANE DETECTION / SAMPLING
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 08/13/10	Project No. 14159
AMEC Geomatrix		Figure 1

Plot Date: 08/13/10 - 2:53pm, Plotted by: adam.stenberg
Drawing Path: S:\14159\008_MethaneDetection\, Drawing Name: Whitmarsh_MethaneDetection_081310.dwg

CLIENT DRAFT

Memo

To:	March Point Landfill PLP Group	Project:	0141590000
From:	Nik Bacher	cc:	Dave Haddock, AMEC
Tel:	(206) 342-1760		John Long, AMEC
Fax:	(206) 342-1761		Project File
Date:	April 26, 2012		

Subject: **Methane Monitoring Results**
March Point (Whitmarsh) Landfill
Skagit County, Washington

AMEC Environment & Infrastructure, Inc. (AMEC), installed a series of 10 landfill gas probes at the Whitmarsh Landfill in late September and early October 2011 as part of the Phase II Remedial Investigation (RI) field activities. The landfill gas probes (LFGPs) were installed according to the LFG Monitoring Work Plan (AMEC, 2011). Figure 1 shows the location of the gas probes.

Approximately one week after installation, AMEC visited the site and collected readings of methane (CH_4), carbon dioxide (CO_2), and oxygen (O_2) concentrations using a GEM-2000 meter. Readings were collected from all ten of the LFG probes and three of the groundwater monitoring wells (PZ-01, MW-8 and MW-10) that contained methane during the previous methane monitoring completed in 2010 (AMEC, 2010). In addition to the methane monitoring, AMEC also collected three LFG samples from LFGP-02 and LFGP-03, which were analyzed for CH_4, CO_2, O_2, and volatile organic compounds (VOCs). A duplicate Microseeps sample was collected from LFGP-03. Microseeps samples are collected using a small 40-milliliter (mL) evacuated glass vial equipped with a septum. After collection of the GEM-2000 readings, a 50-mL syringe is used to collect a gas sample from the probe. All sampling was conducted in accordance with the LFG Monitoring Work Plan (AMEC, 2011).

AMEC returned to the site in January 2012 and again collected CH_4, CO_2, and O_2 readings using a GEM-2000 meter. In addition to the methane monitoring in January, AMEC also collected an additional three LFG samples from LFGP-02 and LFGP-04, which were analyzed for CH_4, CO_2, and O_2. A duplicate Microseeps sample was collected from LFGP-04. AMEC returned to the site in April 2012 for a third collection of CH_4, CO_2, and O_2 readings using a GEM-2000 meter. No Microseeps sampling was conducted during the April monitoring event.

Table 1 compares the CH_4, CO_2, and O_2 readings, and the associated Microseeps analytical results. The GEM-2000 CH_4, CO_2, and O_2 readings are very similar to Microseeps' CH_4, CO_2, and O_2 analytical results for both October 2011 samples and the LFGP-02 sample from January 2012; the readings and the analytical results are generally within 1 percent of each other. The GEM-2000 CH_4, CO_2, and O_2 readings are significantly higher than Microseeps' analytical results for the LFGP-04 primary and duplicate samples from January 2012; the samples showed low pressure when analyzed by the laboratory, potentially indicating that sample volume was lost during transport. Copies of Microseeps' analytical data packages for your review are included this memorandum as Attachment A.

Figure 2 shows a contour map created from the measured methane concentrations in the ten LFG probes in October 2011. Figure 3 shows a contour map created from the measured methane concentrations in the ten LFG probes in April 2012. The greatest methane concentrations during both monitoring events were measured in the central part of the site at LFGP-04, which is near the area where logs and hog fuel were being stored by the saw mill operator. It is possible that the high methane concentrations in the vicinity of the former saw mill operations is connected to decomposing saw dust and debris in this area. The southern part of the former landfill, which was not used during saw mill operations, has lower methane concentrations. The majority of methane production in a closed landfill occurs early after closure and only a minor amount of methane is expected to be produced 30 years post-closure. Table 2 shows the screened interval of the LPG probes and the materials (woodwaste or old refuse) observed in the borings at those screen intervals. It is not clear from our current site information if the methane concentrations observed are mostly related to decomposing woodwaste or old refuse.

VOC data are presented on Table 3. No VOCs were detected above the reporting limit with the exception of a single chorobenzene detection in the October 2011 primary LFGP-03 sample at 0.14 parts per million by volume (ppmv). Chlorobenzene was not detected in the secondary sample from LFGP-03, but the reporting limit for this sample was higher than the concentration reported in the primary sample. Chlorobenzene has been detected in groundwater and seep samples at the landfill at concentrations between 0.2 to 12 micrograms per liter (µg/L), which is well below the preliminary screening level for chlorobenzene of 1,600 µg/L.

These analytical results indicate that the GEM-2000 provides accurate readings of the CH_4, CO_2, and O_2 concentrations in the gas probes, and that additional laboratory analyses are not necessary to quantify these compounds. In addition, Microseeps' VOC results showed that the LFG at the site did not contain VOCs above the reporting limits.

AMEC recommends that the quarterly methane monitoring of the new LFGPs proceed in accordance with the LFG Monitoring Work Plan (AMEC, 2011) and that methane readings should be collected using a GEM-2000 meter. The quarterly methane readings and the LFG analytical data will be included in the revised Phase II RI report. Based on the existing information, we believe it necessary that all woodwaste be removed before a complete assessment can be made in order to determine how much methane is being produced in the old refuse.

REFERENCES

AMEC (AMEC Geomatrix, Inc.), 2010, Methane Detection/Monitoring Memo, prepared for the Whitmarsh PLP Group, August 25.

AMEC, 2011, Landfill Gas Monitoring Work Plan, prepared for the Whitmarsh PLP Group, July 7.

Attachments:	Table 1	Comparison of Field Readings (GEM-2000) vs. Analytical Results in Landfill Gas Probes
	Table 2	Whitmarsh LFG Probe and Well Field LFG Readings, Screen and Refuse Intervals
	Table 3	Landfill Gas Volatile Organic Compound Analytical Results
	Figure 1	LFG Monitoring Locations
	Figure 2	Methane Concentrations, October 2011
	Figure 3	Methane Concentrations, April 2012
	Attachment A	Microseeps Laboratory Analytical Data Packages

TABLES

CLIENT DRAFT

TABLE 1

COMPARISION OF FIELD READINGS (GEM-2000) VS. ANALYTICAL RESULTS IN LANDFILL GAS PROBES [1]

March Point (Whitmarsh) Landfill
Skagit County, Washington

Gas Probe - Date	Method	CH_4 (%)	CO_2 (%)	O_2 (%)	BAL (%)
LFGP-02 - 10/05/11	GEM-2000	39.4	2.1	0.0	58.4
	Microseeps	39.0	2.0	1.8	57.2
LFGP-03 - 10/05/11	GEM-2000	16.9	11.2	0.0	71.9
	Microseeps	16.0	12.0	1.4	70.6
	Microseeps Dup.	16.0	12.0	1.6	70.4
LFGP-02 - 1/24/12	GEM-2000	38.7	2.1	0.0	59.2
	Microseeps	41.0	1.8	1.3	55.9
LFGP-04 - 1/24/12 [2]	GEM-2000	67.3	32.6	0.0	11.0
	Microseeps	1.0	0.45	23.0	75.6
	Microseeps Dup.	1.6	0.76	22.0	75.6

Notes
1. Microseeps used Method AM20GAX for CH_4, CO_2, and O2 analytical results.
2. Sample showed low pressure when analyzed by the laboratory, potentially indicating that sample volume was lost during transport to the laboratory.

Abbreviations
CH_4 = Methane
CO_2 = carbon dioxide
O_2 = oxygen
BAL = presumed to be primarily nitrogen; BAL % is read by GEM-2000
and calculated for Microseeps' results
LFPG = landfill gas probe

CLIENT DRAFT

TABLE 2

WHITMARSH LFG PROBE AND WELL FIELD LFG READINGS, SCREEN, AND REFUSE INTERVALS

March Point (Whitmarsh) Landfill
Anacortes, Washington

Date	Sampling Location	CH_4 (%)	CO_2 (%)	O_2 (%)	N_2 (%)[1]	Relative Pressure (inches of water)	Barometric Pressure (inches of mercury)	Depth (feet bgs)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Woodwaste Intervals (feet bgs)	Refuse Interval (feet bgs)
10/5/2011	LFGP-001	32.0	12.2	0.0	55.3	-0.29	29.53	10.5	5	10	0-2	4-9
1/24/2012		29.1	10.2	0.5	60.2	0.49	29.59					
4/3/2012		30.8	9.1	0.1	60.0	-0.05	29.70					
10/5/2011	LFGP-002	39.4	2.1	0.0	58.4	-0.29	29.52	11	6	11	0-1	6-10.5
1/24/2012		38.7	2.4	0.0	58.9	-0.51	29.44					
4/3/2012		40.2	4.3	0.7	54.8	-0.33	29.67					
10/5/2011	LFGP-003	16.9	11.2	0.0	71.9	-0.51	29.60	9	4	9	0-1.5	3-9
1/24/2012		17.8	9.8	0.0	72.4	-0.78	29.48					
4/3/2012		11.0	9.7	0.0	79.3	-0.66	29.67					
10/5/2011	LFGP-004	70.6	29.3	0.0	0.1	-0.43	29.58	15	5	15	0-7.5	7.5-15
1/24/2012		67.3	32.6	0.0	11.0	-0.51	29.44					
4/3/2012		68.2	31.7	0.0	0.1	-0.48	29.66					
10/5/2011	PZ-01	1.0	2.9	19.6	76.2	1.34	29.60	13.5	6	11	0-1	5-11
1/24/2012		0.1	0.0	21.2	78.7	-0.51	29.48					
4/3/2012		0.1	0.1	21.1	78.7	-0.09	29.67					
10/5/2011	LFGP-006	10.8	22.7	0.0	66.3	-0.39	29.61	9	4	9	0-1.5, 4.5-5.5	1.5-5.5
1/24/2012		5.3	16.0	0.0	78.7	-0.78	29.48					
4/3/2012		5.5	11.1	0.3	83.1	-0.52	29.70					
10/5/2011	LFGP-007	0.1	9.2	12.9	77.8	-0.41	29.61	10	5	10	NA	0-6
1/24/2012		0.2	8.7	14.2	76.8	-38.6	29.59					
4/3/2012		0.0	8.2	14.3	77.5	-0.82	29.70					

CLIENT DRAFT

TABLE 2

WHITMARSH LFG PROBE AND WELL FIELD LFG READINGS, SCREEN, AND REFUSE INTERVALS
March Point (Whitmarsh) Landfill
Anacortes, Washington

Date	Sampling Location	CH_4 (%)	CO_2 (%)	O_2 (%)	N_2 (%)[1]	Relative Pressure (inches of water)	Barometric Pressure (inches of mercury)	Depth (feet bgs)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Woodwaste Intervals (feet bgs)	Refuse Interval (feet bgs)
10/5/2011	LFGP-005	29.4	16.9	0.0	53.6	-0.38	29.61	9	4	9	0-4.5	4.5-9
1/24/2012		33.2	13.2	0.0	53.5	-38.6	29.59					
4/3/2012		29.5	12.0	0.0	58.5	-0.61	29.70					
10/5/2011	LFGP-008	18.1	22.2	0.0	59.7	-0.38	29.61	9	4	9	0-4.5	1-9
1/24/2012		66.8	24.0	0.0	9.0	-38.6	29.59					
4/3/2012		31.6	18.5	0.0	49.9	-0.82	29.70					
10/5/2011	LFGP-010	22.3	14.0	0.0	63.6	-0.43	29.62	8	3	8	0-2.5	4.5-8
1/24/2012		69.7	9.4	0.0	20.6	0.49	29.59					
4/3/2012		58.3	13.3	0.1	28.3	0.05	29.70					
10/5/2011	LFGP-009	40.4	32.5	0.0	27.0	-0.52	29.62	10.5	5	10	0-9	6-10.5
1/24/2012		44.3	27.6	0.0	28.1	0.49	29.59					
4/3/2012		39.8	25.8	0.2	34.2	0.10	29.70					
10/5/2011	MW-08	0.5	0.5	21.1	77.9	-0.39	29.62	34	10	20	0-7	12-23
1/24/2012		3.9	1.6	20.0	75.1	-0.78	29.48					
4/3/2012		1.0	0.6	20.9	77.5	-0.20	29.67					
10/5/2011	MW-10	0.1	0.1	21.5	78.3	-0.42	29.62	34	10	20	1.5-10	11.5-23.5
1/24/2012		32.0	18.8	0.0	49.1	-0.78	29.48					
4/3/2012		0.1	0.1	21.1	78.7	-0.21	29.67					

Note
1. GEM-2000 reports N_2 % as “balance,” the majority of which is assumed to represent atmospheric nitrogen.

Abbreviation(s)
bgs = below ground surface
CH_4 = methane
CO_2 = carbon dioxide
LFGP = landfill gas probe
MW = monitoring well
N_2 = nitrogen
O_2 = oxygen
PZ = piezometer

CLIENT DRAFT

TABLE 3

LANDFILL GAS
VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS[1,2,3,4]

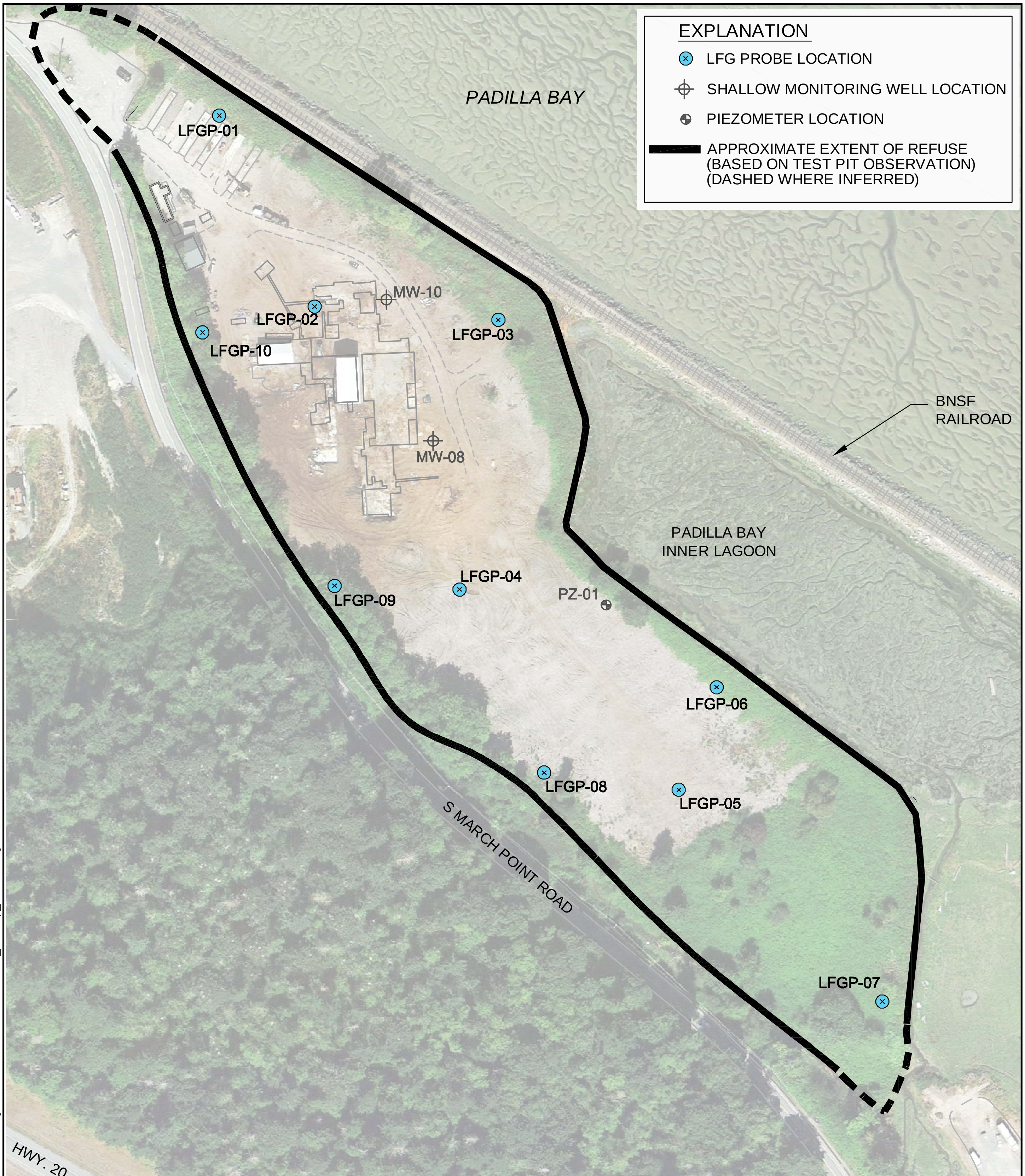
March Point (Whitmarsh) Landfill
Skagit County, Washington

Volatile Organic Compounds	LFG Probe		
	LFGP-02	LFGP-03 Primary	LFGP-03 Duplicate
Chloromethane	<2.0	<2.0	<4.0
Vinyl Chloride	<1.0	<1.0	<2.0
Bromomethane	<1.0	<1.0	<2.0
Chloroethane	<1.0	<1.0	<2.0
Trichlorofluoromethane	<0.0050	<0.0050	<0.010
1 ,1-Dichloroethene	<0.010	<0.010	<0.020
Methylene Chloride	<2.0	<2.0	<4.0
trans-1,2-Dichloroethane	<0.010	<0.010	<0.020
1 ,1-Dichloroethane	<0.020	<0.020	<0.040
cis-1,2-Dichloroethene	<0.020	<0.020	<0.040
Chloroform	<0.0050	<0.0050	<0.010
1,1,1-Trichloroethane	<0.0050	<0.0050	<0.010
Carbon Tetrachioride	<0.0050	<0.0050	<0.010
1,2-Dichloroethane	<0.020	<0.020	<0.040
Benzene	<0.10	<0.10	<0.20
Trichloroethene	<0.010	<0.010	<0.020
1 ,2-Dichloropropane	<0.020	<0.020	<0.040
Bromodichloromethane	<0.010	<0.010	<0.020
cis-1 ,3-Dichloropropene	<0.010	<0.010	<0.020
Toluene	<0.10	<0.10	<0.20
trans-1,3-Dichloropropene	<0.020	<0.020	<0.040
1,1,2-Trichloroethane	<0.010	<0.010	<0.020
Tetrachloroethene	<0.010	<0.010	<0.020
Chlorodibromomethane	<0.010	<0.010	<0.020
Chlorobenzene	<0.10	0.14	<0.20
Ethylbenzene	<0.10	<0.10	<0.20
m,p-Xylene	<0.20	<0.20	<0.40
o-Xylene	<0.10	<0.10	<0.20
Bromoform	<0.010	<0.010	<0.020
1,1,2,2-Tetrachloroethane	<0.010	<0.010	<0.020
1,3-Dichlorobenzene	<0.10	<0.10	<0.20
1,4-Dichlorobenzene	<0.10	<0.10	<0.20
1,2-Dichlorobenzene	<0.10	<0.10	<0.20

Notes
1. Samples collected October 5, 2011.
2. "<" indicates that analytical result is below the reporting limit shown to the right.
3. All analyses were performed using Microseeps AM4.02 analytical method.
4. All units in parts per million by volume (ppmv).

Abbreviations
LFGP = landfill gas probe

FIGURES



Aerial Photo Courtesy of Google Earth
(August 25, 2011)

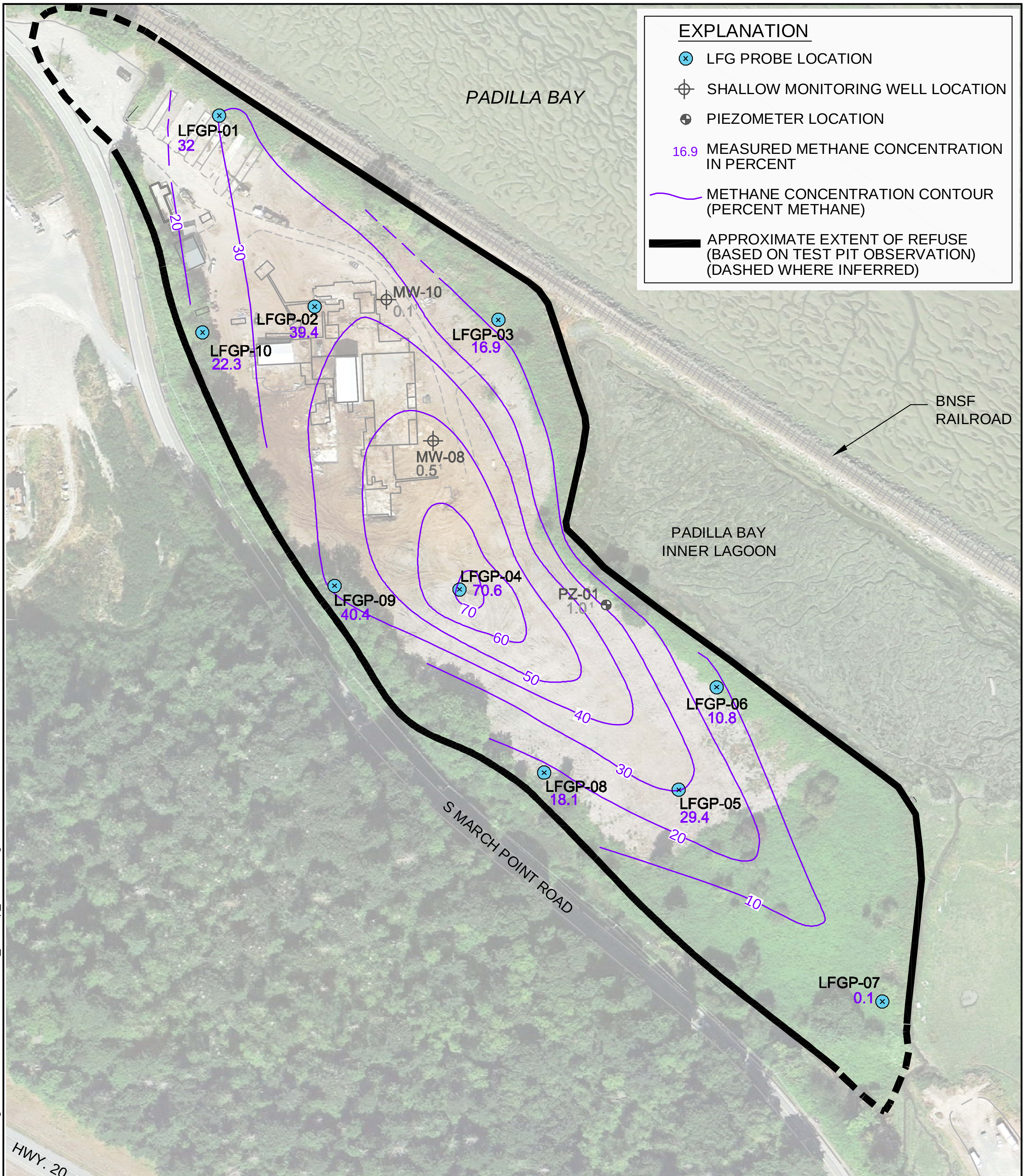
N

0 100 200
APPROXIMATE SCALE IN FEET

LFG MONITORING LOCATIONS
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 04/10/12	Project No. 14159
amec		Figure 1

Plot Date: 04/10/12 - 9:16pm, Plotted by: adam.stenberg
Drawing Path: S:\14159\009_LFG-WP\CAD\, Drawing Name: Whitmarsh-MarchPoint_SiteMap_112811.dwg



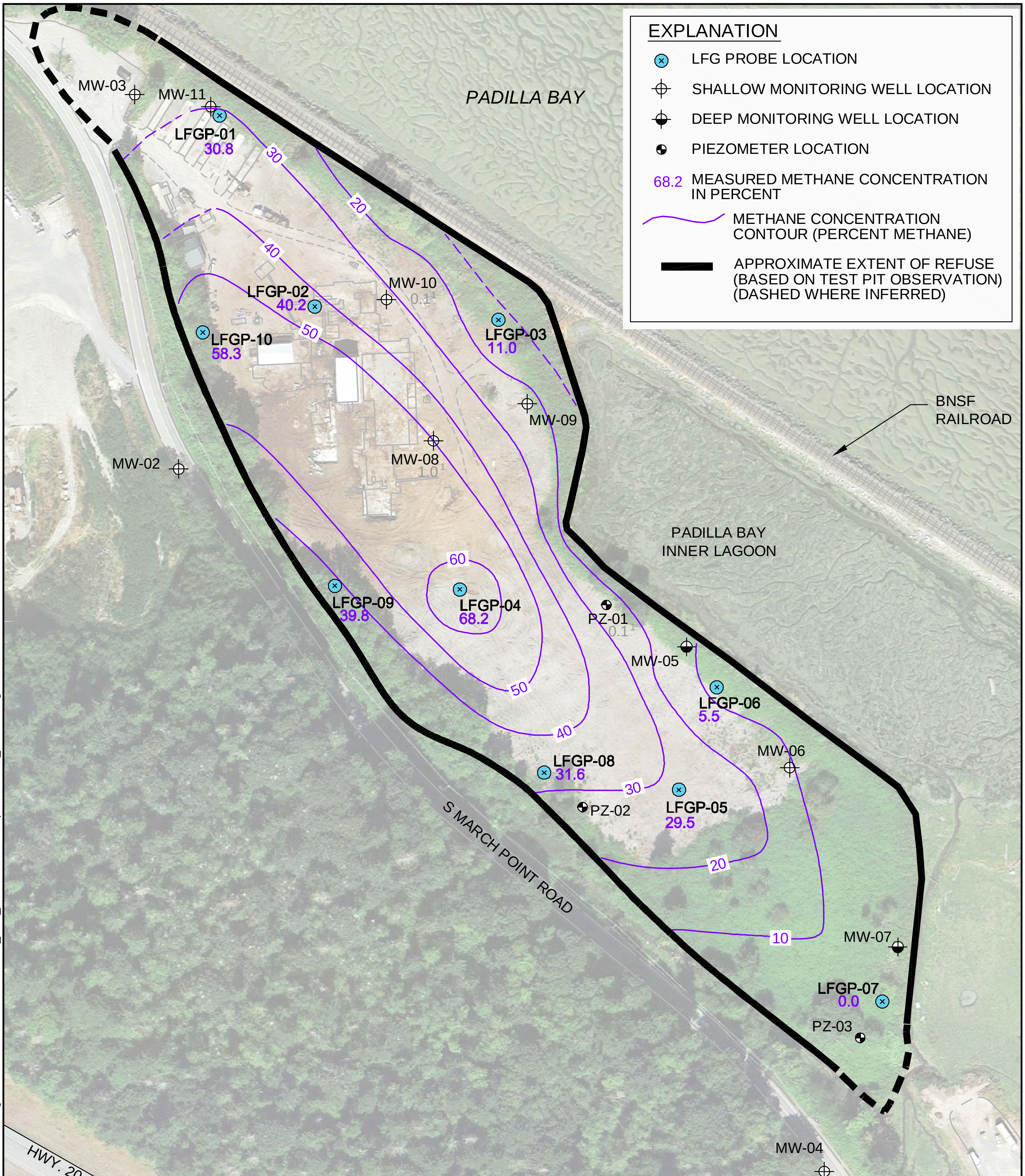
Aerial Photo Courtesy of Google Earth
(August 25, 2011)

NOTE:
1) Methane concentrations from groundwater monitoring wells not used to generate contours.

METHANE CONCENTRATIONS, OCTOBER 2011
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 04/10/12	Project No. 14159
	amec	Figure 2

Plot Date: 04/10/12 - 9:15pm, Plotted by: adam.stenberg
Drawing Path: S:\14159\009_LFG-WP\CAD\, Drawing Name: Whitmarsh-MarchPoint_SiteMap_112811.dwg



Aerial Photo Courtesy of Google Earth
(August 25, 2011)

N

NOTE:
1) Methane concentrations from groundwater monitoring wells not used to generate contours.

0 100 200
APPROXIMATE SCALE IN FEET

METHANE CONCENTRATIONS, APRIL 2012
March Point (Whitmarsh) Landfill
Skagit County, Washington

By: APS	Date: 04/10/12	Project No. 14159
amec		Figure 3

Plot Date: 04/10/12 - 9:17pm, Plotted by: adam.stenberg
Drawing Path: S:\14159\010_Phase2-RI\CAD\, Drawing Name: Whitmarsh-MarchPoint_LFG_MethaneConcentApril2012-GW_040912.dwg

APPENDIX A

Microseeps Laboratory Analytical Data Packages

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

Received
NOV 1 2011
SEATTLE ORG. 6009

October 25, 2011

John Long
AMEC
600 University St.
Suite 600
Seattle, WA 98101

RE: **WHITMARSH LFG / 14159**

Microseeps Workorder: 2861

Dear John Long:

Enclosed are the analytical results for sample(s) received by the laboratory on Saturday, October 08, 2011. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Heather Hauser 10/25/2011
hhauser@microseeps.com

Enclosures

Total Number of Pages 8

CERTIFICATE OF ANALYSIS

nelac

3004.1.0.0

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

LABORATORY ACCREDITATIONS & CERTIFICATIONS

Accreditor:	Pennsylvania Department of Environmental Protection, Bureau of Laboratories
Accreditation ID:	02-00538
Scope:	NELAP Non-Potable Water and Solid & Hazardous Waste
Accreditor:	NELAP: State of Florida, Department of Health, Bureau of Laboratories
Accreditation ID:	E87832
Scope:	Clean Water Act (CWA) Resource Conservation and Recovery Act (RCRA)
Accreditor:	South Carolina Department of Health and Environmental Control, Office of Environmental Laboratory Certification
Accreditation ID:	89009003
Scope:	Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA)
Accreditor:	NELAP: State of Louisiana, Department of Environmental Quality
Accreditation ID:	04104
Scope:	Solid and Chemical Materials; Non-Potable Water
Accreditor:	NELAP: New Jersey, Department of Environmental Protection
Accreditation ID:	PA026
Scope:	Non-Potable Water; Solid and Chemical Materials
Accreditor:	NELAP: New York, Department of Health Wadsworth Center
Accreditation ID:	11815
Scope:	Non-Potable Water; Solid and Hazardous Waste
Accreditor:	State of Connecticut, Department of Public Health, Division of Environmental Health
Accreditation ID:	PH-0263
Scope:	Clean Water Act (CWA) Resource Conservation and Recovery Act (RCRA)
Accreditor:	NELAP: Texas, Commission on Environmental Quality
Accreditation ID:	T104704453-09-TX
Scope:	Non-Potable Water
Accreditor:	State of New Hampshire
Accreditation ID:	299409
Scope:	Non-potable water
Accreditor:	State of Georgia
Accreditation ID:	Chapter 391-3-26
Scope:	As per the Georgia EPD Rules and Regulations for Commercial Laboratories, Microseeps is accredited by the Pennsylvania Department of Environmental Protection Bureau of Laboratories under the National Environmental Laboratory Approval Program (NELAC).

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

SAMPLE SUMMARY

Workorder: 2861 WHITMARSH LFG / 14159

Lab ID	Sample ID	Matrix	Date Collected	Date Received
28610001	LFGP002-100511	Vapor	10/5/2011 12:45	10/8/2011 11:30
28610002	LFGP-03-100511-1	Vapor	10/5/2011 13:15	10/8/2011 11:30
28610003	LFGP-03-100511-2	Vapor	10/5/2011 13:20	10/8/2011 11:30

CERTIFICATE OF ANALYSIS

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 2861 WHITMARSH LFG / 14159

Lab ID: **28610001** Date Received: 10/8/2011 11:30 Matrix: Vapor
Sample ID: **LFGP002-100511** Date Collected: 10/5/2011 12:45

Parameters	Results	Units	RDL	MDL	DF	Prepared	By	Analyzed	By	Qual	RegLmt
RISK											
Analysis Desc: AM20GAX			Analytical Method: AM20GAX								
Methane	390000	ppmv	0.20	0.059	1			10/20/2011 13:18	GT		
Carbon Dioxide	2.0	%	0.20	0.0090	1			10/20/2011 13:18	GT		
Oxygen	1.8	%	0.10	0.013	1			10/20/2011 13:18	GT		
Carbon Monoxide	<0.20	%	0.20	0.033	1			10/20/2011 13:18	GT		
Analysis Desc: AM4.02 Vapors			Analytical Method: AM4.02 Vapors								
Chloromethane	<2.0	ppmv	2.0	0.0060	1			10/14/2011 05:49	SL		
Vinyl Chloride	<1.0	ppmv	1.0	0.095	1			10/14/2011 05:49	SL		
Bromomethane	<1.0	ppmv	1.0	0.0040	1			10/14/2011 05:49	SL		
Chloroethane	<1.0	ppmv	1.0	0.0050	1			10/14/2011 05:49	SL		
Trichlorofluoromethane	<0.0050	ppmv	0.0050	0.00010	1			10/14/2011 05:49	SL		
1,1-Dichloroethene	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
Methylene Chloride	<2.0	ppmv	2.0	0.19	1			10/14/2011 05:49	SL		
trans-1,2-Dichloroethene	<0.010	ppmv	0.010	0.0080	1			10/14/2011 05:49	SL		
1,1-Dichloroethane	<0.020	ppmv	0.020	0.0040	1			10/14/2011 05:49	SL		
cis-1,2-Dichloroethene	<0.020	ppmv	0.020	0.0070	1			10/14/2011 05:49	SL		
Chloroform	<0.0050	ppmv	0.0050	0.0010	1			10/14/2011 05:49	SL		
1,1,1-Trichloroethane	<0.0050	ppmv	0.0050	0.0010	1			10/14/2011 05:49	SL		
Carbon Tetrachloride	<0.0050	ppmv	0.0050	0.0010	1			10/14/2011 05:49	SL		
1,2-Dichloroethane	<0.020	ppmv	0.020	0.0020	1			10/14/2011 05:49	SL		
Benzene	<0.10	ppmv	0.10	0.037	1			10/14/2011 05:49	SL		
Trichloroethene	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
1,2-Dichloropropane	<0.020	ppmv	0.020	0.0020	1			10/14/2011 05:49	SL		
Bromodichloromethane	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
cis-1,3-Dichloropropene	<0.010	ppmv	0.010	0.0030	1			10/14/2011 05:49	SL		
Toluene	<0.10	ppmv	0.10	0.029	1			10/14/2011 05:49	SL		
trans-1,3-Dichloropropene	<0.020	ppmv	0.020	0.0030	1			10/14/2011 05:49	SL		
1,1,2-Trichloroethane	<0.010	ppmv	0.010	0.0020	1			10/14/2011 05:49	SL		
Tetrachloroethene	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
Chlorodibromomethane	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
Chlorobenzene	<0.10	ppmv	0.10	0.024	1			10/14/2011 05:49	SL		
Ethylbenzene	<0.10	ppmv	0.10	0.026	1			10/14/2011 05:49	SL		
m,p-Xylene	<0.20	ppmv	0.20	0.053	1			10/14/2011 05:49	SL		
o-Xylene	<0.10	ppmv	0.10	0.025	1			10/14/2011 05:49	SL		
Bromoform	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
1,1,2,2-Tetrachloroethane	<0.010	ppmv	0.010	0.0010	1			10/14/2011 05:49	SL		
1,3-Dichlorobenzene	<0.10	ppmv	0.10	0.028	1			10/14/2011 05:49	SL		
1,4-Dichlorobenzene	<0.10	ppmv	0.10	0.026	1			10/14/2011 05:49	SL		
1,2-Dichlorobenzene	<0.10	ppmv	0.10	0.018	1			10/14/2011 05:49	SL		

CERTIFICATE OF ANALYSIS

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 2861 WHITMARSH LFG / 14159

Lab ID: **28610002** Date Received: 10/8/2011 11:30 Matrix: Vapor

Sample ID: **LFGP-03-100511-1** Date Collected: 10/5/2011 13:15

Parameters	Results	Units	RDL	MDL	DF	Prepared	By	Analyzed	By	Qual	RegLmt
RISK											
Analysis Desc: AM20GAX			Analytical Method: AM20GAX								
Methane	160000	ppmv	0.20	0.059	1			10/20/2011 13:35	GT		
Carbon Dioxide	12	%	0.20	0.0090	1			10/20/2011 13:35	GT		
Oxygen	1.4	%	0.10	0.013	1			10/20/2011 13:35	GT		
Carbon Monoxide	<0.20	%	0.20	0.033	1			10/20/2011 13:35	GT		
Analysis Desc: AM4.02 Vapors			Analytical Method: AM4.02 Vapors								
Chloromethane	<2.0	ppmv	2.0	0.0060	1			10/14/2011 06:57	SL		
Vinyl Chloride	<1.0	ppmv	1.0	0.095	1			10/14/2011 06:57	SL		
Bromomethane	<1.0	ppmv	1.0	0.0040	1			10/14/2011 06:57	SL		
Chloroethane	<1.0	ppmv	1.0	0.0050	1			10/14/2011 06:57	SL		
Trichlorofluoromethane	<0.0050	ppmv	0.0050	0.00010	1			10/14/2011 06:57	SL		
1,1-Dichloroethene	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
Methylene Chloride	<2.0	ppmv	2.0	0.19	1			10/14/2011 06:57	SL		
trans-1,2-Dichloroethene	<0.010	ppmv	0.010	0.0080	1			10/14/2011 06:57	SL		
1,1-Dichloroethane	<0.020	ppmv	0.020	0.0040	1			10/14/2011 06:57	SL		
cis-1,2-Dichloroethene	<0.020	ppmv	0.020	0.0070	1			10/14/2011 06:57	SL		
Chloroform	<0.0050	ppmv	0.0050	0.0010	1			10/14/2011 06:57	SL		
1,1,1-Trichloroethane	<0.0050	ppmv	0.0050	0.0010	1			10/14/2011 06:57	SL		
Carbon Tetrachloride	<0.0050	ppmv	0.0050	0.0010	1			10/14/2011 06:57	SL		
1,2-Dichloroethane	<0.020	ppmv	0.020	0.0020	1			10/14/2011 06:57	SL		
Benzene	<0.10	ppmv	0.10	0.037	1			10/14/2011 06:57	SL		
Trichloroethene	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
1,2-Dichloropropane	<0.020	ppmv	0.020	0.0020	1			10/14/2011 06:57	SL		
Bromodichloromethane	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
cis-1,3-Dichloropropene	<0.010	ppmv	0.010	0.0030	1			10/14/2011 06:57	SL		
Toluene	<0.10	ppmv	0.10	0.029	1			10/14/2011 06:57	SL		
trans-1,3-Dichloropropene	<0.020	ppmv	0.020	0.0030	1			10/14/2011 06:57	SL		
1,1,2-Trichloroethane	<0.010	ppmv	0.010	0.0020	1			10/14/2011 06:57	SL		
Tetrachloroethene	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
Chlorodibromomethane	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
Chlorobenzene	0.14	ppmv	0.10	0.024	1			10/14/2011 06:57	SL		
Ethylbenzene	<0.10	ppmv	0.10	0.026	1			10/14/2011 06:57	SL		
m,p-Xylene	<0.20	ppmv	0.20	0.053	1			10/14/2011 06:57	SL		
o-Xylene	<0.10	ppmv	0.10	0.025	1			10/14/2011 06:57	SL		
Bromoform	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
1,1,2,2-Tetrachloroethane	<0.010	ppmv	0.010	0.0010	1			10/14/2011 06:57	SL		
1,3-Dichlorobenzene	<0.10	ppmv	0.10	0.028	1			10/14/2011 06:57	SL		
1,4-Dichlorobenzene	<0.10	ppmv	0.10	0.026	1			10/14/2011 06:57	SL		
1,2-Dichlorobenzene	<0.10	ppmv	0.10	0.018	1			10/14/2011 06:57	SL		

CERTIFICATE OF ANALYSIS

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 2861 WHITMARSH LFG / 14159

Lab ID: **28610003** Date Received: 10/8/2011 11:30 Matrix: Vapor
Sample ID: **LFGP-03-100511-2** Date Collected: 10/5/2011 13:20

Parameters	Results	Units	RDL	MDL	DF	Prepared	By	Analyzed	By	Qual	RegLmt
RISK											
Analysis Desc: AM20GAX			Analytical Method: AM20GAX								
Methane	160000	ppmv	0.20	0.059	1			10/20/2011 13:48	GT		
Carbon Dioxide	12	%	0.20	0.0090	1			10/20/2011 13:48	GT		
Oxygen	1.6	%	0.10	0.013	1			10/20/2011 13:48	GT		
Carbon Monoxide	<0.20	%	0.20	0.033	1			10/20/2011 13:48	GT		
Analysis Desc: AM4.02 Vapors			Analytical Method: AM4.02 Vapors								
Chloromethane	<4.0	ppmv	4.0	0.012	2			10/14/2011 08:05	SL		
Vinyl Chloride	<2.0	ppmv	2.0	0.19	2			10/14/2011 08:05	SL		
Bromomethane	<2.0	ppmv	2.0	0.0080	2			10/14/2011 08:05	SL		
Chloroethane	<2.0	ppmv	2.0	0.010	2			10/14/2011 08:05	SL		
Trichlorofluoromethane	<0.010	ppmv	0.010	0.00020	2			10/14/2011 08:05	SL		
1,1-Dichloroethene	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
Methylene Chloride	<4.0	ppmv	4.0	0.39	2			10/14/2011 08:05	SL		
trans-1,2-Dichloroethene	<0.020	ppmv	0.020	0.016	2			10/14/2011 08:05	SL		
1,1-Dichloroethane	<0.040	ppmv	0.040	0.0080	2			10/14/2011 08:05	SL		
cis-1,2-Dichloroethene	<0.040	ppmv	0.040	0.014	2			10/14/2011 08:05	SL		
Chloroform	<0.010	ppmv	0.010	0.0020	2			10/14/2011 08:05	SL		
1,1,1-Trichloroethane	<0.010	ppmv	0.010	0.0020	2			10/14/2011 08:05	SL		
Carbon Tetrachloride	<0.010	ppmv	0.010	0.0020	2			10/14/2011 08:05	SL		
1,2-Dichloroethane	<0.040	ppmv	0.040	0.0040	2			10/14/2011 08:05	SL		
Benzene	<0.20	ppmv	0.20	0.074	2			10/14/2011 08:05	SL		
Trichloroethene	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
1,2-Dichloropropane	<0.040	ppmv	0.040	0.0040	2			10/14/2011 08:05	SL		
Bromodichloromethane	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
cis-1,3-Dichloropropene	<0.020	ppmv	0.020	0.0060	2			10/14/2011 08:05	SL		
Toluene	<0.20	ppmv	0.20	0.058	2			10/14/2011 08:05	SL		
trans-1,3-Dichloropropene	<0.040	ppmv	0.040	0.0060	2			10/14/2011 08:05	SL		
1,1,2-Trichloroethane	<0.020	ppmv	0.020	0.0040	2			10/14/2011 08:05	SL		
Tetrachloroethene	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
Chlorodibromomethane	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
Chlorobenzene	<0.20	ppmv	0.20	0.048	2			10/14/2011 08:05	SL		
Ethylbenzene	<0.20	ppmv	0.20	0.052	2			10/14/2011 08:05	SL		
m,p-Xylene	<0.40	ppmv	0.40	0.11	2			10/14/2011 08:05	SL		
o-Xylene	<0.20	ppmv	0.20	0.050	2			10/14/2011 08:05	SL		
Bromoform	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
1,1,2,2-Tetrachloroethane	<0.020	ppmv	0.020	0.0020	2			10/14/2011 08:05	SL		
1,3-Dichlorobenzene	<0.20	ppmv	0.20	0.056	2			10/14/2011 08:05	SL		
1,4-Dichlorobenzene	<0.20	ppmv	0.20	0.052	2			10/14/2011 08:05	SL		
1,2-Dichlorobenzene	<0.20	ppmv	0.20	0.036	2			10/14/2011 08:05	SL		

CERTIFICATE OF ANALYSIS

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS QUALIFIERS

Workorder: 2861 WHITMARSH LFG / 14159

PARAMETER QUALIFIERS

U Indicates the compound was analyzed for, but not detected.

J Estimated concentration greater than the set method detection limit (MDL) and less than the set reporting limit (RDL).

Microseeps Lab. Proj. # 2861

CHAIN - OF - CUSTODY RECORD

Microseeps COC cont. #

Phone: (412) 826-5245 Microseeps, Inc. - 220 William Pitt Way - Pittsburgh, PA 15238 Fax No.: (412) 826-3433

Company : AMEC
Co. Address : 600 UNIVERSITY ST / SUITE 600
Phone # : (360) 342-1779 Fax # :
Proj. Manager : DAVE HADDOCK
Proj. Name/Number : WHITMARSH LFG / 14159
Sampler's signature : [signature]

Results to : JOHN LONG/AMEC
600 UNIVERSITY ST/SUITE 600
SEATTLE, WA
98101
Invoice to : SAME

Cooler Temp.:

Sample ID	Sample Description	Sample Type: Water	Sample Type: Vapor	Sample Type: Solid	Date	Time	# bottles	~~METHANE by ASTM 3416~~	~~O2, CO2, CO by ASTM 1945~~	~~VOCs by EPA TO-15~~	~~METHANE~~	O2, CO2, CO, CH4 by AM20GAX	VOCs by 8260						Remarks :
LFGP002-100511			X		10/05/11	1245	2	X	X	X		X	X						
LFGP03-100511-1			X		↓	1315	2	X	X	X		X	X						
LFGP-03-100511-2			X		↓	1320	2	X	X	X		X	X						

[initials] 10/06/11

Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
DEVIN O'REILLY	AMEC	10/06/11	1130	FEDEX 7975 9924 5377	FEDEX	10/6/11	130
7975 9924 5377	FEDEX	10/6/11		[signature]	MS	10/8/11	1130

WHITE COPY : Accompany Samples YELLOW COPY : Laboratory File PINK COPY : Submitter

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

February 10, 2012

John Long
AMEC Environment & Infrastructure, Inc.
600 University St.
Suite 600
Seattle, WA 98101

RE: **WHITMARSH / 0141590000.00007**

Microseeps Workorder: 3977

Dear John Long:

Enclosed are the analytical results for sample(s) received by the laboratory on Thursday, January 26, 2012. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Heather Hauser 02/10/2012
hhauser@microseeps.com

Enclosures

Total Number of Pages 9

CERTIFICATE OF ANALYSIS

nelac

3004.1.0.0

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

LABORATORY ACCREDITATIONS & CERTIFICATIONS

Accreditor:	Pennsylvania Department of Environmental Protection, Bureau of Laboratories
Accreditation ID:	02-00538
Scope:	NELAP Non-Potable Water and Solid & Hazardous Waste
Accreditor:	NELAP: State of Florida, Department of Health, Bureau of Laboratories
Accreditation ID:	E87832
Scope:	Clean Water Act (CWA) Resource Conservation and Recovery Act (RCRA)
Accreditor:	South Carolina Department of Health and Environmental Control, Office of Environmental Laboratory Certification
Accreditation ID:	89009003
Scope:	Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA)
Accreditor:	NELAP: State of Louisiana, Department of Environmental Quality
Accreditation ID:	04104
Scope:	Solid and Chemical Materials; Non-Potable Water
Accreditor:	NELAP: New Jersey, Department of Environmental Protection
Accreditation ID:	PA026
Scope:	Non-Potable Water; Solid and Chemical Materials
Accreditor:	NELAP: New York, Department of Health Wadsworth Center
Accreditation ID:	11815
Scope:	Non-Potable Water; Solid and Hazardous Waste
Accreditor:	State of Connecticut, Department of Public Health, Division of Environmental Health
Accreditation ID:	PH-0263
Scope:	Clean Water Act (CWA) Resource Conservation and Recovery Act (RCRA)
Accreditor:	NELAP: Texas, Commission on Environmental Quality
Accreditation ID:	T104704453-09-TX
Scope:	Non-Potable Water
Accreditor:	State of New Hampshire
Accreditation ID:	299409
Scope:	Non-potable water
Accreditor:	State of Georgia
Accreditation ID:	Chapter 391-3-26
Scope:	As per the Georgia EPD Rules and Regulations for Commercial Laboratories, Microseeps is accredited by the Pennsylvania Department of Environmental Protection Bureau of Laboratories under the National Environmental Laboratory Approval Program (NELAC).

Microseeps, Inc
220 William Pitt Way
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SAMPLE SUMMARY

Workorder: 3977 WHITMARSH / 0141590000.00007

Lab ID	Sample ID	Matrix	Date Collected	Date Received
39770001	LFGP-02	Vapor	1/24/2012 14:10	1/26/2012 13:54
39770002	LFGP-04	Vapor	1/24/2012 14:30	1/26/2012 13:54
39770003	LFGP-104	Vapor	1/24/2012 14:35	1/26/2012 13:54

Microseeps, Inc
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Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

PROJECT SUMMARY

Workorder: 3977 WHITMARSH / 0141590000.00007

Sample Comments

Lab ID: 39770002 **Sample ID:** LFGP-04 **Sample Type:** N

Sample headspace vial not sufficiently pressurized for analysis. Vial pressurized with an equal volume of UHP Helium and analyzed. Results reported at a dilution.

Lab ID: 39770003 **Sample ID:** LFGP-104 **Sample Type:** N

Sample headspace vial not sufficiently pressurized for analysis. Vial pressurized with an equal volume of UHP Helium and analyzed. Results reported at a dilution.

CERTIFICATE OF ANALYSIS

Microseeps, Inc
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 3977 WHITMARSH / 0141590000.00007

Lab ID: **39770001** Date Received: 1/26/2012 13:54 Matrix: Vapor
Sample ID: **LFGP-02** Date Collected: 1/24/2012 14:10

Parameters	Results	Units	RDL	MDL	DF	Prepared	By	Analyzed	By	Qual	RegLmt
RISK - MICR											
Analysis Desc: AM20GAX		Analytical Method: AM20GAX									
Methane	**410000**	ppmv	0.20	0.059	1			2/2/2012 13:53	GT		
Carbon Dioxide	**1.8**	%	0.20	0.0090	1			2/2/2012 13:53	GT		
Oxygen	**1.3**	%	0.10	0.013	1			2/2/2012 13:53	GT		
Carbon Monoxide	**<0.20**	%	0.20	0.033	1			2/2/2012 13:53	GT		

CERTIFICATE OF ANALYSIS

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Pittsburgh, PA 15238
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ANALYTICAL RESULTS

Workorder: 3977 WHITMARSH / 0141590000.00007

Lab ID: **39770002** Date Received: 1/26/2012 13:54 Matrix: Vapor
Sample ID: **LFGP-04** Date Collected: 1/24/2012 14:30

Parameters	Results	Units	RDL	MDL	DF	Prepared	By	Analyzed	By	Qual	RegLmt
RISK - MICR											
Analysis Desc: AM20GAX		Analytical Method: AM20GAX									
Methane	**10000**	ppmv	0.40	0.12	2			2/9/2012 16:36	GT		
Carbon Dioxide	**0.45**	%	0.40	0.018	2			2/9/2012 16:36	GT		
Oxygen	**23**	%	0.20	0.026	2			2/9/2012 16:36	GT		
Carbon Monoxide	**<0.40**	%	0.40	0.066	2			2/9/2012 16:36	GT		

CERTIFICATE OF ANALYSIS

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Pittsburgh, PA 15238
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ANALYTICAL RESULTS

Workorder: 3977 WHITMARSH / 0141590000.00007

Lab ID: **39770003** Date Received: 1/26/2012 13:54 Matrix: Vapor
Sample ID: **LFGP-104** Date Collected: 1/24/2012 14:35

Parameters	Results	Units	RDL	MDL	DF	Prepared	By	Analyzed	By	Qual	RegLmt
RISK - MICR											
Analysis Desc: AM20GAX	Analytical Method: AM20GAX										
Methane	**16000**	ppmv	0.40	0.12	2			2/2/2012 14:26	GT		
Carbon Dioxide	**0.76**	%	0.40	0.018	2			2/2/2012 14:26	GT		
Oxygen	**22**	%	0.20	0.026	2			2/2/2012 14:26	GT		
Carbon Monoxide	**<0.40**	%	0.40	0.066	2			2/2/2012 14:26	GT		

CERTIFICATE OF ANALYSIS

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Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS QUALIFIERS

Workorder: 3977 WHITMARSH / 0141590000.00007

PARAMETER QUALIFIERS

U	Indicates the compound was analyzed for, but not detected.
J	Estimated concentration greater than the set method detection limit (MDL) and less than the set reporting limit (RDL).

Microseeps Lab. Proj. # 3977

CHAIN - OF - CUSTODY RECORD

Microseeps COC cont. #

Phone: (412) 826-5245 | Microseeps, Inc. - 220 William Pitt Way - Pittsburgh, PA 15238 | Fax No. : (412) 826-3433

Company : AMEC Environment & Infrastructure
Co. Address : 600 University, Suite 600 Seattle, WA
Phone # : (206) 342-1760 Fax # : (206) 342-1761
Proj. Manager : Devin O'Reilly
Proj. Name/Number : Whitmarsh Landfill #4159000000007
Sampler's signature : [signature]
Cooler Temp.:

Results to : Devin O'Reilly 600 University Suite 600, Seattle WA devin.oreilly@amec.com
Invoice to : see above

Sample ID	Sample Description	Water	Vapor	Solid	Date	Time	# bottles	Methane per AM20GAX	CO2 AM20GAX	CO AM20GAX	O2 AM20GAX								Remarks :
LFGP-02	2x40mL micro		X		1/24/12	1410	2	X	X	X	X								
LFGP-04	2x40mL micro		X		1/24/12	1430	2	X	X	X	X								
LFGP-104	2x40mL micro		X		1/24/12	1435	2	X	X	X	X								

Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
[signature]	AMEC	1/25/12	1050	[signature]	MS	1/26/12	1300

WHITE COPY : Accompany Samples YELLOW COPY : Laboratory File PINK COPY : Submitter

APPENDIX I

Archaeological Reports and Recommendations

February 20, 2009
8-915-16558-0

AMEC E&E Geomatrix
One Union Square, Suite 1020
600 University Street
Seattle, Washington 98101-4107

Attention: Dave Haddock

Subject: Archaeological Monitoring of RIFS Sampling in the Whitmarsh Landfill, Skagit County, Washington

Dear Dave:

AMEC-Geomatrix conducted subsurface investigations for an Uplands Remedial Investigation/Feasibility Study (RIFS) at the March Point (Whitmarsh) Landfill in Anacortes, Washington, between October 29 and November 2, 2008. In a letter to you dated October 16, 2008, I reviewed the potential for RIFS activities to affect archaeological resources that might underlie or exist at the surface adjacent to the project area. I stated my finding as follows:

"It is my professional opinion that there is a low potential for archaeological resources in the tide flat beneath the waste deposits. Although that is the case, I advise that a qualified archaeologist should be present during the test pitting to ensure that no unanticipated effects occur to archaeological resources. The observations of the monitoring archaeologist will also serve as an archaeological survey of the landfill area itself."

AMEC-Geomatrix followed that recommendation. Emily Gantz from the Bothell office of AMEC Earth & Environmental, Inc. monitored the excavations at the landfill site at all times and kept a daily record of her monitoring activities and observations (Attachment A). Her observations are summarized below.

Monitoring Observations.

Eleven test pits, numbered G-1 through G-11, were opened using an excavator. Each pit was excavated into native tide flat sediments or to the water table, whichever was encountered first. All pits contained an upper deposit of soil mixed with residential and industrial waste (Attachment B, Photos 1 and 2). Nine of the eleven pits reached groundwater before encountering native tide-flat sediments. Only pits G-7 and G-11 encountered native sediments. Native sediments were encountered at 8 to 10 feet (ft) below ground surface in G-7 (Photo 2) and in G-11 at approximately 8 ft. Sediments consisted of a poorly sorted mix of gravel, sand, and mud reduced to a gray color. No shells or archaeological material of any kind was observed in either of the pits.

Conclusion and Recommendations

Results of archaeological monitoring show that no archaeological resources were affected by RIFS activities at the Whitmarsh Landfill. Because the RIFS excavations reached native sediments at only two points, however, these results cannot be considered to be a full archaeological survey of the underlying landform. They provide no information about the land adjacent to the tide flat, which has a much higher potential for archaeological resources. Therefore, I recommend that to alleviate the concerns of the Suquamish and Swinomish tribes about possible archaeological impacts of later remediation efforts, two actions should be taken.

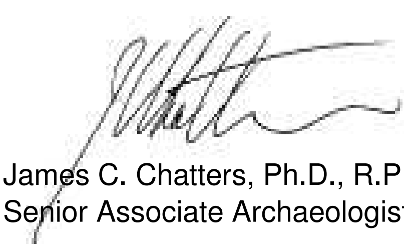
- An archaeological survey should be conducted along the historic western shoreline of Padilla Bay at the edge of the landfill deposit to identify and document any sites that might be affected by remediation activities. Cost of this activity would be approximately $7,500.
- AMEC-Geomatrix should consider including an archaeological monitor during at least the initial stages of any remediation that entailed removal of landfill material to the contact with natural tide flats. This monitoring would be intended to complete the equivalent of archaeological survey under the landfill deposits and establish with confidence that no archaeological resources are being affected by excavation of contaminated materials. Costs would be dependent on the scale and duration of excavation activities.

If these actions are taken, it is my professional opinion that no significant cultural resources will be affected by remediation activities.

Please feel free to contact me if you have any additional questions.

Sincerely,

AMEC Earth & Environmental, Inc.



James C. Chatters, Ph.D., R.P.A.
Senior Associate Archaeologist

Attachments: Attachment A – Archaeological Monitoring Logs
Attachment B – Photographs

ATTACHMENT A

Archaeological Monitoring Logs

ARCHAEOLOGICAL MONITORING LOG

Date 10/29/08 Monitor's Name/Initials: Emily Scott

Work area # WHITE MARSH (note location of today's monitoring areas on the attached site map)

Description of abatement/demolition work being done
(also note time of day, weather conditions, work performed by construction crew)

Met Nik Bacher (AMEC Geomatrix) at the site a little before 1pm. Went over site access and safety with PSC personnel (?) or PCS). Completed a walk over of the test pit locations and measured test pits based from GPS points previously taken.

Total hours: 5.5 hrs (including drive time)

Photographic Documentation: roll # DIGITAL

Description of sediments and cultural resources (if any)

Surface sediments included a thick area of woody debris (near test pit locations G-6, G-8, G-9, and G-10). SURFACE SEDIMENTS AT The other test pit locations consisted of obviously disturbed sediments, fill, and lots of surface garbage.

Other notes (continue on back, if necessary)

Completed a visual survey of the site boundary nearest Padilla Bay Lagoon: no cultural materials noticed (besides modern garbage). The project area is located on a manmade rise over a tidal flat.

Pictures of the project area were taken.

Met with the Project Health & Safety Officer, Tim Reinhardt, and learned about the Ludlum radiation gauge.

ARCHAEOLOGICAL MONITORING LOG

Date 10/30/08 Monitor's Name/Initials: Emily Scott

Work area # Whitman (note location of today's monitoring areas on the attached site map)

G-2, G-7

Description of abatement/demolition work being done
(also note time of day, weather conditions, work performed by construction crew)

Met the project crew at a little before 8am. Went over safety procedures and policies. Planned to begin test pit excavation as soon as equipment was ready. Delay with the water truck.

Total hours: 9.5 hrs

Photographic Documentation: roll # DIGITAL

Description of sediments and cultural resources (if any)

@ G-7: Top sediment was a dark brown silty loam w/ ≈30% gravels and modern trash underlaid by the land fill deposits with native sediments at ≈ 8ft bgs → 10 ft bgs. No cultural materials of significance observed.
@ G-2: Had a similar sedimentology (all fill) until water level prior to native sediments. No cultural materials of significance were observed.

Other notes (continue on back, if necessary)

No cultural materials of significance were observed during the monitoring of G-7 and G-2.

ARCHAEOLOGICAL MONITORING LOG

Date 10/31/08 Monitor's Name/Initials: Emily Scott

Work area # Whitmarsh (note location of today's monitoring areas on the attached site map)

G-4, G11, G-3

Description of abatement/demolition work being done
(also note time of day, weather conditions, work performed by construction crew)

Met project crew prior to 8am for safety meeting. Continuation of test pit excavation and soil sampling.

TOTAL HOURS: 9 hrs

Photographic Documentation: roll # DIGITAL

Description of sediments and cultural resources (if any)

@ G-4: Top sediment consisted of dark brown fill w/ some modern trash over land fill deposits. Reached maximum required depth of test pit. No significant cultural materials observed.
@ G-11: Had similar sediment deposits as previous test pit, with the native tidal flat visible at maximum depth. No significant cultural materials observed.
@ G-3: Sediments same as G-4, with test pit excavation terminated at water level. No significant cultural materials observed.

Other notes (continue on back, if necessary)

No cultural materials of significance were observed during the monitoring of G-4, G-11, and G-3.
Sediments over the native tidal flat consist of fill materials.

ARCHAEOLOGICAL MONITORING LOG

Date 1/1/08 Monitor's Name/Initials: Emily Scott

Work area # Utwork (note location of today's monitoring areas on the attached site map)

G-1, G-6, G-10

Description of abatement/demolition work being done
(also note time of day, weather conditions, work performed by construction crew)

Met project crew prior to 8am for safety meeting.
Continuing of test pit excavation.

Total Hours: 10 hrs

Photographic Documentation: roll # DIGITAL

Description of sediments and cultural resources (if any)

@ G-1: Top sediments consisted of med brown to dark brown fill sediment underlaid by land fill materials. Excavation ended at required depth. No significant cultural materials observed.
@ G-6: Top sediments consisted of med. brown to dark brown fill sediments underlain by landfill deposits. Excavation halted at water level. No significant cultural materials observed.
@ G-10: Top sediments consisted of med. med to dark brown fill sediments underlaid by land fill deposits. Excavation ended at required depth. Drums were observed, but no cultural materials.

Other notes (continue on back, if necessary)

No significant cultural materials were observed during the monitoring of G-1, G-6 and G-10.
Sediments other than the native tidal flat consists of fill materials.

ARCHAEOLOGICAL MONITORING LOG

Date 11/2/08 **Monitor's Name/Initials:** Emily Scott

Work area # Whitmarsh (note location of today's monitoring areas on the attached site map)

G·5, G·8, G·9

Description of abatement/demolition work being done
(also note time of day, weather conditions, work performed by construction crew)

Met project crew prior to 7am for safety meeting.
Continuing of test pit excavations.

Photographic Documentation: roll # DIGITAL

Description of sediments and cultural resources (if any)

@ G·5: Top sediments consisted of wood debris, then med. brown to dark brown fill underlain by land fill deposits. Excavation ended at water level. No significant cultural resources were observed.
@ G·8: " same as G·5 "

@ G·9: "same as G·5 and G·8"
encountered a smashed drum.

Other notes (continue on back, if necessary)

No significant cultural materials were observed during the monitoring of G·9, G·8 and G·5.

Sediments other than the native tidal flat consisted of fill materials

ATTACHMENT B

Photographs

Photo 1. An example of landfill deposits excavated at Whitmarsh Landfill.

Photo 2. Native tide-flats exposed beneath landfill material in test pit G-7 (arrow).

CULTURAL RESOURCES REPORT COVER SHEET

Authors: Cooper, Jason B., M.A., RPA and Emily Scott

Title of Report: Results of an Archaeological Survey at the March Point (Whitmarsh) Landfill, City of Anacortes, Skagit County, Washington

Date of Report: June 22, 2011

County: Skagit Section: 3 Township: 34 Range: 2E

Quad: Anacortes South Acres: 14

PDF of report submitted (REQUIRED) ☒ Yes

Historic Property Export Files submitted? ☐ Yes ☒ No

Archaeological Site(s)/Isolate(s) Found or Amended? ☐ Yes ☒ No

TCP(s) found? ☐ Yes ☒ No

Replace a draft? ☐ Yes ☒ No

Satisfy a DAHP Archaeological Excavation Permit requirement? ☐ Yes # ☒ No

DAHP Archaeological Site #:

- Submission of paper copy is required.
- Please submit paper copies of reports ***unbound.***
- Submission of PDFs is required.
- Please be sure that any PDF submitted to DAHP has its cover sheet, figures, graphics, appendices, attachments, correspondence, etc., compiled into one single PDF file.
- Please check that the PDF displays correctly when opened.

June 22, 2011
Project No. 0-915-17033-0

AMEC Earth & Environmental Geomatrix
One Union Square, Suite 1020
600 University Street
Seattle, Washington 98101-4107

Attention: Dave Haddock

Subject: Results of an Archaeological Survey at the March Point (Whitmarsh) Landfill, City of Anacortes, Skagit County, Washington
AMEC Earth & Environmental Cultural Resources Short Report No. 26

Dear Dave:

AMEC Earth & Environmental, Inc. (AMEC), in association with AMEC Geomatrix, conducted a subsurface archaeological investigation at the March Point (Whitmarsh) Landfill, in Skagit County, Washington. AMEC Geomatrix was contracted by the Whitmarsh Landfill Potential Liable Party Group (PLP Group) to create a draft Remedial Investigation/Feasibility Study (RI/FS) work plan for the former Whitmarsh Landfill. The purpose of the RI/FS was to evaluate the nature and extent of contamination at the site based on the landfill's listing in the Washington State Department of Ecology Hazardous Sites List. March Point (Whitmarsh) Landfill is listed as Facility Site ID 2662 and is one of several sites within the Fidalgo Bay area of Anacortes scheduled for investigation and contamination abatement.

Beginning in 2008, AMEC Geomatrix began sampling work at the potentially hazardous site to determine the extent and source of any groundwater, surface water, soil, and/or sediment contamination. As part of this investigation, monitoring wells, soil borings, and test pits were placed within the landfill. Commenting on the draft work plan for the site, the Swinomish Indian Tribal Community requested that the archaeological potential of the area be considered during any subsurface investigations. In this capacity, AMEC provided an archeological monitor to observe the sampling process and test pitting associated with Phases I and II of the RI/FS (AMEC Geomatrix, Inc. 2008). No archaeological materials were observed during Phases I and II.

In May 2010, AMEC was contracted to further investigate the extent of the landfill sediments through active subsurface investigations along its southern border, near South March Point Road. This

AMEC Earth & Environmental, Inc.
11810 North Creek Parkway N
Bothell, Washington 98011
(425) 368-1000 Phone
(425) 368-1001 Facsimile
www.amec.com

investigation consisted of a pedestrian survey and the excavation of 15 shovel test probes/scrapes situated along the southern border of the landfill. No archaeological materials were observed during this investigation. The report and full findings are presented below.

If you have further questions about the results presented below, please contact Jason B. Cooper at 425-368-1000, or at jason.cooper@amec.com.

Sincerely,

AMEC Earth & Environmental, Inc.

Jason B. Cooper, M.A., R.P.A.
Cultural Resources Lead

ERS/LS

MANAGEMENT SUMMARY

AMEC Earth & Environmental, Inc. (AMEC), in association with AMEC Geomatrix, conducted a pedestrian survey and subsurface archaeological investigation of the March Point (Whitmarsh) Landfill in Skagit County, Washington (**Figure 1**). The landfill is located near the City of Anacortes, just 800 feet northwest of State Highway 20. The project area is accessible from South March Point Road, and bordered by a railroad grade and the tide flats of Padilla Bay. The Area of Potential Effects (APE) consists of the footprint of the landfill property in both its horizontal and vertical extents (**Figure 2**). The landfill is located within an area of low to moderate potential for archaeological materials, but within an area traditionally utilized by the Swinomish Indian Tribe. However, the landfill was created on top of an active tide flat, and therefore contains very limited potential for archaeological deposits beneath the landfill. Non-tidal native sediments could be present along the base of the uplands slope, located along the landfill's southern border. Therefore, the subsurface investigation consisted of the excavation of shovel test probes (STPs) and shovel scrapes along the southeastern and southern boundary of the landfill (**Figure 3**). No archaeological materials were observed during this investigation.

ADMINISTRATIVE DATA

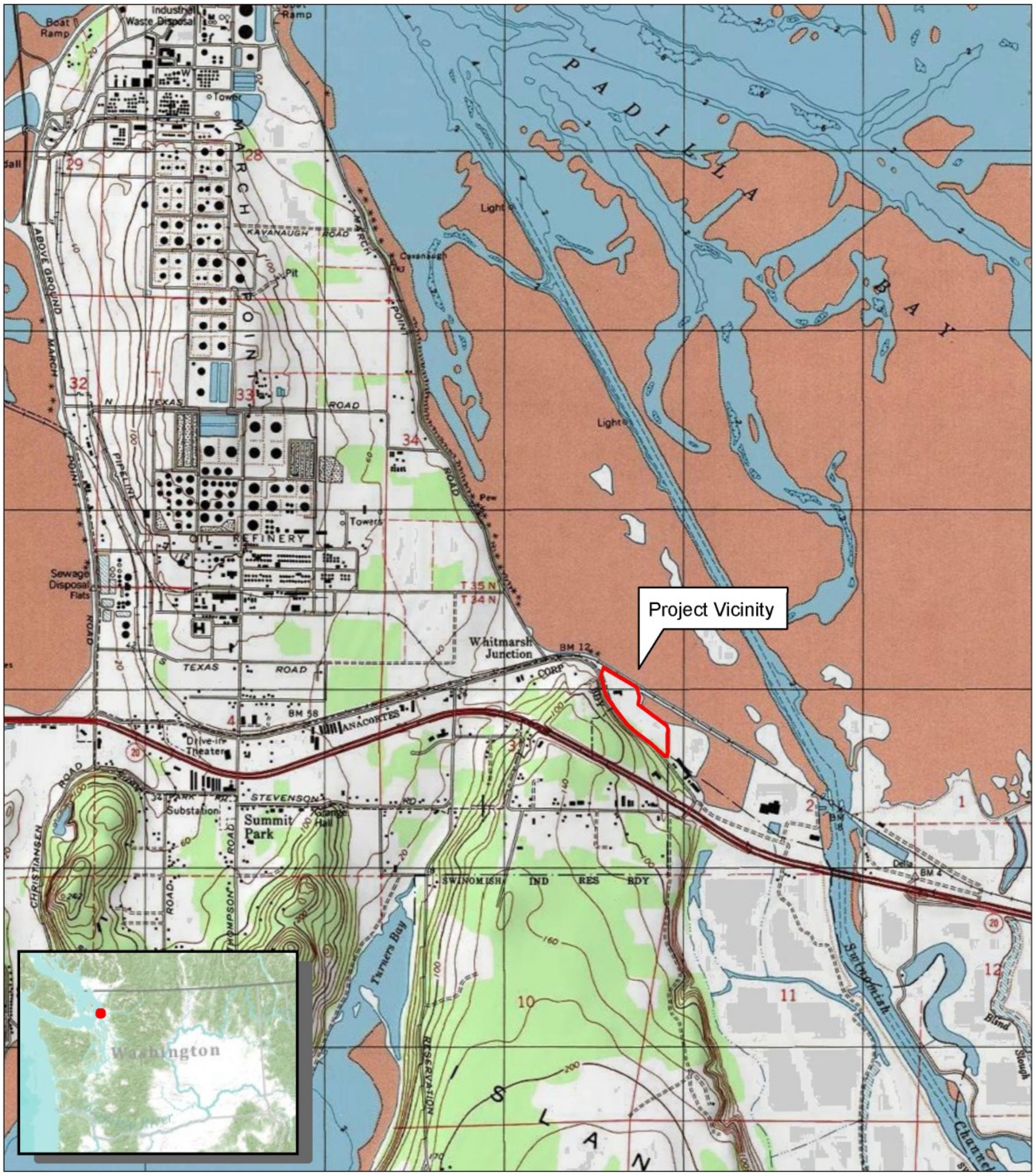
Report Title: Results of an Archaeological Survey at the March Point (Whitmarsh) Landfill, City of Anacortes, Skagit County, Washington
Author(s): Jason B. Cooper, M.A., R.P.A. and Emily R. Scott
Report Date: June 22, 2011

LOCATION

Cities: Anacortes *Counties*: Skagit *State Route(s)*: State Highway 20

¼ Section	Section	Township	Range
NE	3	34 North	2 East

USGS 7.5' Topographic Quadrangle(s): Anacortes South, Washington (1978)



Source: ESRI (2009); USGS Topographic Map: Anacortes South, WA (1978)

N

0 250 500 1,000 Meters

Project Vicinity

FIGURE 1

Project Vicinity Map

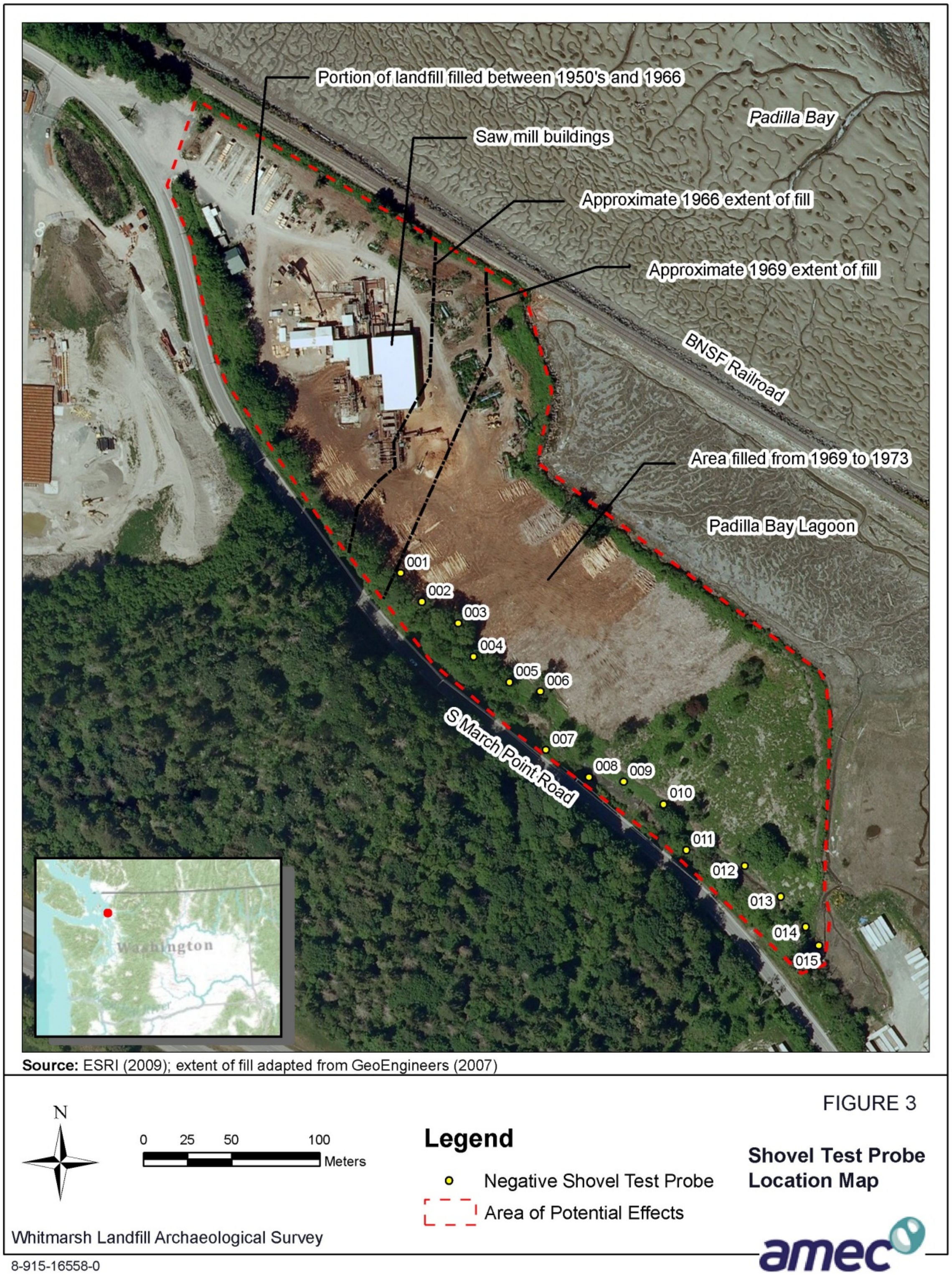
Whitmarsh Landfill Archaeological Survey

Section 3, Township 34 N, Range 2 E

8-915-16558-0

FIGURE 2

APE Map


Portion of landfill filled between 1950's and 1966
Saw mill buildings
Approximate 1966 extent of fill
Approximate 1969 extent of fill
Padilla Bay
BNSF Railroad
Area filled from 1969 to 1973
Padilla Bay Lagoon
S March Point Road
001
002
003
004
005
006
007
008
009
010
011
012
013
014
015
Washington
Source: ESRI (2009); extent of fill adapted from GeoEngineers (2007)
N
0 25 50 100
Meters
Legend
Negative Shovel Test Probe
Area of Potential Effects
FIGURE 3
Shovel Test Probe Location Map
Whitmarsh Landfill Archaeological Survey
8-915-16558-0
amec

PROJECT DESCRIPTION

In 2008, in response to a request by the Swinomish Indian Tribal Community to Skagit County, AMEC archaeologists conducted a record search and literature review for the landfill area and monitored subsurface activities related to the Remedial Investigation/Feasibility Study (RI/FS) (AMEC Geomatrix, Inc. 2008). These efforts found that no previously recorded archaeological sites were located within the landfill's vicinity, and that prior to the landfill the APE was an active tideland. Further research illustrated that the possibility of any archaeological deposits beneath the landfill would be very low. However, the southern boundary of the landfill did abut the natural slope of the uplands and as a result maintained a higher probability for unknown and significant cultural resources. Therefore, the subsurface investigation focused along the southern boundary of the landfill (**Figure 3**). The series of subsurface explorations began at the top elevation of the landfill slope and ended at water inundation along a drainage near the tidal flat interface (**Figure 4**). The former landfill's elevation ranges between 6 and 25 feet above mean lower low water.

REGULATORY ENVIRONMENT

Federal and State Agencies: Washington State Department of Ecology, Environmental Protection Agency

☒ Section 106
☐ Governor's Executive Order 05-05
☐ Other:

The former Whitmarsh Landfill is currently listed on the Washington State Department of Ecology (Ecology) Hazardous Site List as Facility Site ID 2662. As part of an investigation for Potentially Liable Parties, Ecology requested that the PLP Group perform an RI/FS to assess the contamination at the landfill and propose options for remediation and mitigation to these hazards. The proposed work plan suggested several subsurface investigations during Phases I and II of the RI/FS. Federal funds or federal permits may be required for this project which makes it a federal undertaking and is subject to the provisions of Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended and associated regulations 36 CFR 800 regarding the protection of cultural and historic resources.

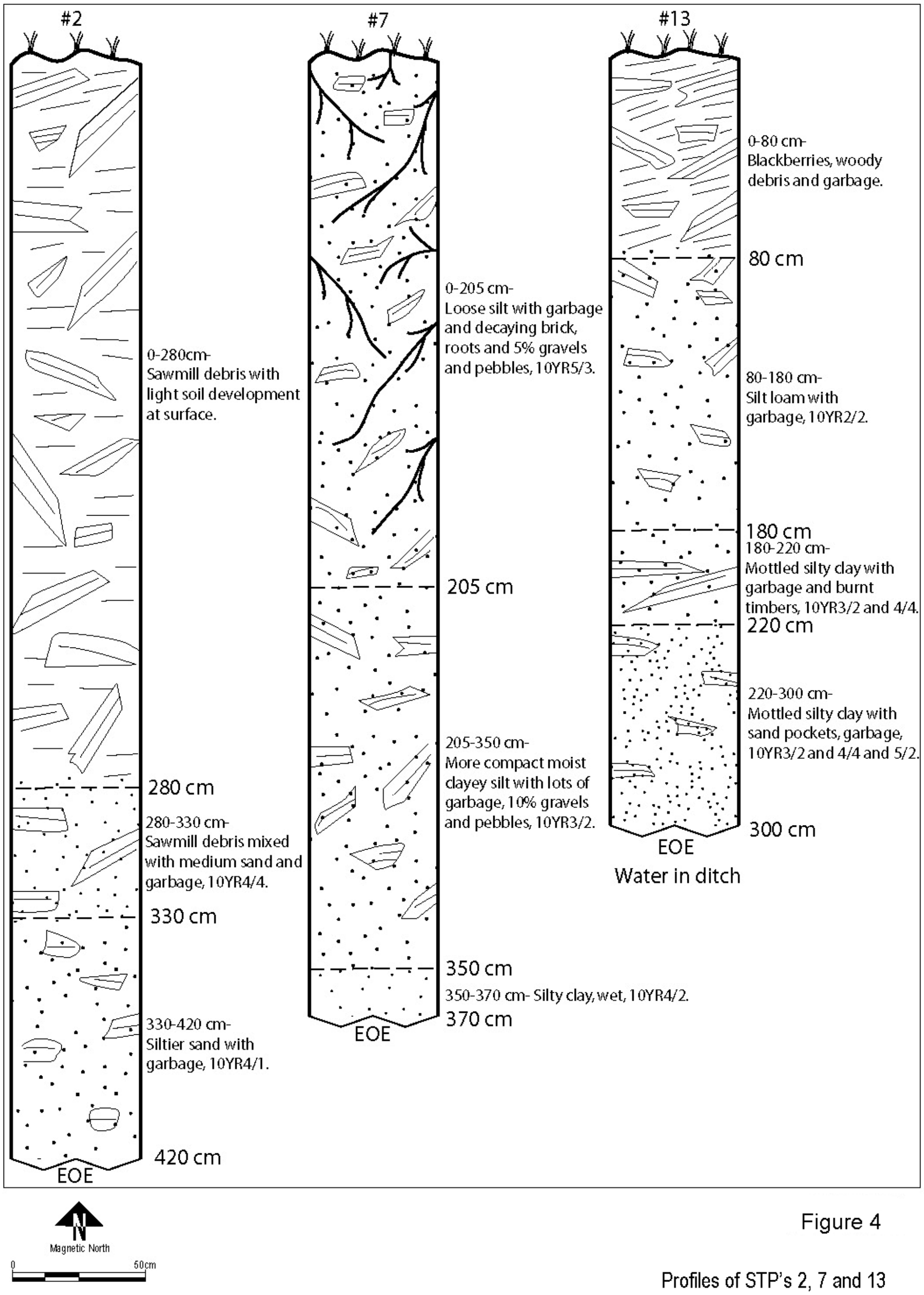


Figure 4

Profiles of STP's 2, 7 and 13

March Point (Whitmarsh) Landfill
0-915-17033-0

AREA OF POTENTIAL EFFECTS

Total Project Area (Acres): ~14 acres

APE Description and Justification: The March Point (Whitmarsh) Landfill is located within the southwest corner of Padilla Bay (**Figure 1**; **Figure 2**). The landfill is bounded to the south by South March Point Road, to the northeast and north by the Burlington Northern Santa Fe (BNSF) railroad and Padilla Bay, and the Swinomish Channel to the east and southeast (**Photographs 1, 2, and 3**). Drainage channels run along its north and south sides with tidelands to the east. The APE is situated on five Skagit County tax parcels (P19676, P19684, P19707, P19713, and P19761).

CONSULTATION WITH DAHP, TRIBES, AND OTHER INTERESTED PARTIES

Skagit County contacted the Swinomish Indian Tribal Community to address concerns related to the potential for buried archaeological deposits at the March Point (Whitmarsh) Landfill (Email K. Tahghighi to J. Chatters, October 2, 2008). A copy of this report will be sent to Washington State DAHP and Cultural Resources representatives for the Swinomish Tribe for review and comment. Any information gathered during DAHP consultation and tribal coordination will be included in the final version of this report, if applicable.

BACKGROUND RESEARCH

Emily Scott, AMEC archaeologist, conducted a record search and literature review for this project by consulting the DAHP Washington Information Systems for Architectural and Archeological Data (WISAARD) and by reviewing historic records, maps, and aerial photographs. Based on this review, it was determined that there have been no previously conducted cultural resources surveys within or adjacent to the project's APE and that no previously documented archaeological sites are recorded within the APE.

The March Point (Whitmarsh) Landfill was originally undeveloped tidelands owned by the Washington State Department of Natural Resources (DNR). In 1884, a historic map shows the Padilla Bay shoreline along the southwest and southern boundary of the landfill (GLO 1884). Land filling activities began in the 1950s, when this area was used as an unregulated dump for local residents (AMEC Geomatrix, Inc. 2008). In 1961, Skagit County received a lease from the state to operate a controlled dump at this location. Skagit County operated a burn dump at this site until 1969, when it converted to a sanitary landfill. Between 1969 and 1973, the landfill operated as the primary waste disposal facility for the cities of Anacortes, Burlington, La Conner, Mount Vernon, and Sedro-Wooley (Skagit County Health Department 1990). This facility was eventually closed in 1973 when the Inman Landfill went operational.

Sources Consulted:

☒ DAHP GIS Database
☒ General Land Office Maps
☒ Metsker's Maps
☒ NRCS Soil Survey
☒ Other: Historic Aerial Photographs

Previous Cultural Resources Surveys in or near the APE:

☐ None
☒ Listed Below

Three cultural resources surveys have been conducted within 1 mile of the project's APE (**Table 1**). These surveys are located south and southeast of the APE (Bush 2009; Regan 2000; Blukis-Onat 1996). Only one significant site (45KI225) was recorded during these surveys and is located more than a mile from the APE (see **Table 2**).

In 1996, Astrida Blukis-Onat of BOAS, Inc. reported on a survey of approximately 640 acres of Skagit River floodplains located to the southeast and east of the project's APE. The BOAS survey was located south of State Highway 20 and east of the Swinomish Channel and focused on the tidal slough and cultivated fields. Blukis–Onat (1996) describes this area as traditionally being used by *Sbdidi'abac*, a Swinomish family group. These tidal areas underwent massive dredging and fill episodes during the 20th century, which greatly altered the landscape. BOAS' survey consisted of pedestrian surface transects on recently plowed fields and transects parallel to slough channels. STPs were excavated at any possible features and along the upland/slough interface. Site 45SK225 was discovered within this upland/slough interface and consisted of a shell midden.

Table 1. Previous cultural resources surveys near or within 1 mile of the APE.

Author	Date	NADB #	Title	Distance from Current Project APE	Findings Relevant to the Current Project
Blukis–Onat, A.	1996	1345955	Cultural Resources Survey of the Swinomish Channel Marina South Highway 20	<1 mile	45SK225
Regan, D.	2000	1345937	A Cultural Resources Survey of SR 20, Swinomish Slough Bridges, MP 50.84 to 51.51, Near Anacortes	<1 mile	No new findings
Bush, K.	2009	1352459	Archaeological Investigation Report: Turners Bay Salt Marsh Restoration Project	>1 mile	No new findings

In 2000, Dennis Regan conducted a pedestrian survey of 5.1 acres to the east of the project's APE. Regan's survey focused on the footprint of the Swinomish Slough Bridge. His survey resulted in the finding of no archaeological deposits, due to the layers of dredge sediments and fill deposited onto the native tide flats. Regan (2000) refers to two large dredging episodes by the US Army Corps of Engineers in 1893 and 1935.

In 2009, Kelly Bush and Tamela Smart conducted a survey around Similk Bay for a marsh restoration project. Bush (2009) surveyed areas adjacent to roadways utilizing STPs and push probes. In total they excavated 5 STPs and 13 push probes. The subsurface excavation resulted in finding several historic artifact fragments (e.g., glass and ceramic) mixed with the fill deposits. No prehistoric cultural materials were observed during their survey.

Table 2. Previous recorded sites near or within 1 mile of the APE.

Site Number	Description	Distance from Current Project APE	NRHP Eligibility
45KI140	Lithic Scatter	1.2 miles	Not Evaluated
45KI149	Shell Midden	1 mile	Not Evaluated
45KI225	Shell Midden	.75 mile	Not Evaluated

Recorded Archaeological Sites in or near the APE:

☐ None

☒ Listed Below

No previously recorded archaeological sites are located within or directly adjacent to the project's APE. Three archaeological sites are located near or within 1 mile of the APE (**Table 2**). These sites are located to the west and south of the project area.

Site 45KI140 consists of a large lithic scatter situated approximately 1.2 miles west of the project's APE. This site was originally reported in the early 1970s by the land owner, Roger Moore. Moore reported finding several large stemmed projectile points within a pasture located in a "low broad valley between Padilla Bay and Fidalgo Bay" (Mattson 1980). In 1980, Mattson interviewed Moore and investigated his lithic collection. The archaeological finds associated within this site include several large projectile points and knife points possibly belonging to the Olcott, Coast Salish and/or Straits of Georgia Tradition (Mattson 1980).

Site 45KI149 is located approximately 1 mile southwest of the APE within the northeastern mud flats of Similk Bay. The site consists of a shell midden with fire modified rock (FMR) and charcoal. The site was recorded in 1982 by H. Jackson of Western Washington University (Jackson 1983). The site was reported as being intact and “relatively undisturbed” with portions of the site protected by gravel caps from old logging roads (Jackson 1983). Site 45KI149 was recommended for further testing.

Site 45KI225 consists of a shell midden and is situated approximately 0.75 miles south of the APE. The site is located just west of a slough within the interface between a delta and glacial uplands. This area is considered to have ethnographic importance to Swinomish history as a place for resource exploitation and occupation. However, this area has undergone several dredging, infill, and environmental changes that have severely modified the traditional landscape. The site is currently in close proximity to cultivated farmlands, developed areas, and transportation byways. The archaeological materials found at this site included large quantities of marine shells, fish and mammal bone, charcoal, and FMR. The site was originally recorded in 1996 during a survey for the Swinomish Channel Marina (Bishop 1996; BOAS 1996). Subsequent testing by BOAS provided a generalized date of between 1500 BP to early historic times, although no historic artifacts were found, no charcoal samples underwent analysis, and no diagnostic elements related to the site were observed.

All of these archaeological sites described above are within the traditional ethnographic areas used by the Swinomish Indian Tribal Community for resource procurement and associated occupations. According to the Washington Statewide Archaeological Predictive Model, the APE is within an area of moderate to high archaeological potential. However, changes in land-use and the historic development of transportation corridors within and nearby the APE have altered the context of any intact archaeological deposits or buried them. Archaeological monitoring efforts (AMEC 2008) and the subsequent subsurface investigations presented within this report have failed to locate any archaeological deposits within the March Point (Whitmarsh) Landfill APE.

Recorded Historic Buildings or Structures in the APE:

☒ None

☐ Listed Below

There are no historic buildings or structures within 1 mile of the project’s APE that are listed or eligible for listing in the National Register of Historic Places (NRHP).

Soils:

The landfill is located at the base of a bluff that lies in the tidelands of Padilla Bay. The US Geological Survey (USGS) geologic map for the area (USGS 2000) indicates that the area of the landfill consists of “artificial fill.” Mapped soils in the APE include Olympia non-glacial deposits consisting of gravelly, organic-rich and/or silty sand, silt, clay, and peat; landslide deposits; and glacial till.

The APE surface geology consists of fill material used to cap the landfill during closure. The cover fill material is approximately 2 to 3 feet thick, and below the fill is landfill refuse (GeoEngineers 2007). A substantial layer of wood waste/debris, originating from the on-going lumber mill operations at the site, has been placed over the soil cap. The thickness of the wood waste layer is unknown.

Environmental and Cultural Context Summary:
Refer to Bush (2009), Blukis-Onat (1996), Willis (1975) and Sampson (1972) for an overview of the Pre-contact, ethnographic and historic contexts for this portion of Skagit County.

FIELDWORK

Dates of Survey: May 10 – 11, 2010
Field Personnel: Emily Scott and Tim Gerrish
Weather and Surface Visibility: Mostly sunny and clear. Visibility ranged from generally good to poor, with some high water inundation and environmental obstacles (e.g., blackberries, thick shrubs).
Methods: Pedestrian Survey, Shovel scrapes

The landfill has a relatively flat surface, with a sloping elevation of between 6 to 25 feet above mean lower low water. The landfill has a higher elevation along its northern and northeastern border, which slopes down towards the drainage channels along South March Point Road. The surface consists of woody sawmill debris, with slight soil development and thick vegetation along the drainage boundary and southern portion (**Photographs 1, 2, and 3**). The drainage runs parallel to South March Point Road (**Photograph 4**) and consists of steep slopes off from the road prism and landfill edge. The STPs were placed at regular intervals along the bank slope of the landfill and drainage interface to evaluate the possibility of the presence of native sediments and archaeological deposits (**Photographs 5 and 6**). No STPs were placed within the main landfill area since it consists of 100 percent non-native sediments and associated landfill debris which extends down to the former active mud flat sediments beneath. The covered mud flat sediments have a low potential for archaeological deposits since this was formerly an active tidal zone (GLO 1884).

AMEC archaeologists traversed along the landfill slope, north of South March Point Road, conducting a pedestrian survey in conjunction with the excavation of 15 STPs (**Figure 3; Table 3**). Theses STPs, in essence shovel scrapes, began at the top elevation of the exposed slope and ended at the base of the drainage, or until water inundation made it impossible to continue (**Photographs 7 and 8**). Each subsurface exploration location was documented with GPS, photographed, and recorded on AMEC Shovel/Auger Probe Forms.

Subsurface Tests:

☐ None

☒ Described Below

Encountered sediments within the shovel scrapes consisted mainly of sawmill debris, garbage, and silts and clays (**Figure 4; Table 3**). The sawmill debris was composed of large woody fragments and sawdust creating a large cap on top of the landfill sediments. Often, this sawmill layer was followed by a mottled layer of mixed fill consisting of garbage deposits and burned sediment with silt. The burned sediment and charcoal flecks are associated with the use of the landfill as a "burn dump" during the years 1961 to about 1969 (Skagit County Health Department 1990). The mixed sediments within the landfill layers are also a result of the use of fill being dispersed and moved on the landfill between 1969 to 1973, during the "sanitary dump" phase. At the base of several STPs, the sediments become more clayey. All the sediments encountered appear to be of extremely mixed context and hold little potential for intact archaeological deposits.

No archaeological materials were observed during the pedestrian survey or excavation of STPs. No intact native sediments were observed; all sediments appear to be fill deposits and of mixed context.

Table 3. Subsurface exploration descriptions and results

STP Number	Findings	Total Depth	Sediments	Sediment Interpretation
01	Negative	220 cm	0-220 cm: Sawmill debris (wood and sawdust); light surface vegetation, loose (10YR3/3)	Non-native
02	Negative	420 cm	0-280 cm: Sawmill debris 280-330 cm: sawmill debris with medium sand, garbage (10YR4/4) 330-420 cm: Finer silty sand with garbage (10YR3/1)	Non-native
03	Negative	580cm	0-90 cm: Sawmill debris (10YR3/3) 90-200 cm: Moist, loose silty sand with sawmill debris (10YR2/2) 200-280 cm: Mottled landfill burn layer, ash, fine silty sand with garbage (10YR5/3, 10YR4/1) 280-580 cm: Mottled medium sand, moist, loose, with pebbles (10YR3/1)	Non-native
04	Negative	540 cm	0-290 cm: Sawmill debris, garbage (10YR 3/3) 290-540 cm: Loose clayey silt, sawmill debris, garbage, pebbles (10YR2/2)	Non-native
05	Negative	430 cm	0-60 cm: Sawmill debris 60-200 cm: Fine/medium sand with sawmill debris, garbage, gravels and pebbles (10YR 3/2) 200-430 cm: fine/medium loose sand, gravels (10YR3/2)	Non-native
06	Negative	570 cm	0-320 cm: Loose medium sand, gravels and pebbles, roots (10YR3/2) 320-570 cm: Moist mottled clayey med sand, garbage (10YR5/1, 10YR3/1)	Non-native
07	Negative	370 cm	0-205 cm: Loose silt, garbage, roots, gravels (10YR5/3) 205-350cm: Compact moist clayey silt, garbage, gravels (10YR3/2) 350-370 cm: Wet silty clay (10YR4/2)	Non-native
08	Negative	340 cm	0-185 cm: Loam, sawmill debris, garbage (10YR3/2) 185-300 cm: Mottled clayey silt (10YR 2/1, 10YR4/1) 300-340 cm: Mottled wet clay (10YR4/1, 10YR4/6)	Non-native
09	Negative	480 cm	0-200 cm: Sawmill debris, garbage 200-270 cm: Silt, roots, gravels (10YR3/2) 270-380 cm: Clay, 45% gravels/pebbles (2.5Y5/1) 380-430 cm: Wet clay, charcoal flecking (10YR4/2)	Non-native
10	Negative	540 cm	0-220 cm: Sawmill debris, garbage 220-420 cm: Silty sand, garbage (10YR3/2) 420-540 cm: Mottled silty clay, clay pockets, garbage (2.5Y5/1, 10YR4/2)	Non-native

STP Number	Findings	Total Depth	Sediments	Sediment Interpretation
11	Negative	430 cm	0-110 cm: Sawmill debris, garbage (10YR3/2) 100-230 cm: Silt clay, gravel/pebbles, garbage (10YR3/3) 203-310 cm: Mottled clayey silt, charcoal flecking, garbage (10YR3/2, 10YR4/4) 310-430 cm: Compacted mottled silty clay, sand pockets, gravels/pebbles/cobbles, (10YR4/2, 10YR3/2, 7.5YR4/6)	Non-native
12	Negative	340 cm	0-200 cm: Sawmill debris, garbage (10YR2/1) 200-280 cm: Mix silt and clay (10YR2/2) 280-340 cm: Sitcky wet silty clay, charcoal flecking (10YR4/1, 10YR4/3)	Non-native
13	Negative	300 cm	0-80 cm: Sawmill debris, garbage 80-180 cm: silt, garbage (10YR2/2) 180-220 cm: Mottled silty clay, garbage, burnt garbage (10YR3/2, 10YR4/4) 220-300 cm: Mottled silty clay, sand pockets, garbage (10YR3/2, 10YR, 4.4, 10YR5.2)	Non-native
14	Negative	200 cm	0-200 cm: Mottled sticky silty clay, compact clay pockets, charcoal flecking, gravels/pebbles (10YR2.2, 10YR4/6, 2.5Y5/2)	Non-native
15	Negative	39 cm	0-39 cm: Wet sticky clay, charcoal flecking and lots of roots, organics (10YR3/2)	Mudflat, out of context

CULTURAL RESOURCES IDENTIFIED

Archaeological Resources:

☒ None

☐ Listed Below

The record search, literature review, and subsurface survey of the March Point (Whitmarsh) Landfill APE resulted in the identification of no new cultural resources. The landfill is composed of mainly artificial fill deposits related to its use as a waste disposal facility during the 1950s through 1973, and subsequently capped by sanitary fill and sawmill debris. The native sediments beneath the landfill consist of tidal mud flats, with a low potential for archaeological deposits. The subsurface investigation was conducted within areas adjacent to the upland slopes, and therefore might have a higher potential for native sediments and archaeological deposits. No cultural materials, or undisturbed sediments, were observed during the survey.

Buildings or Structures:

☒ None

☐ Listed Below

There are no historic buildings or structures within 1 mile of the project's APE that are listed or eligible for listing in the NRHP.

CONCLUSIONS

The following are: ☐ Determinations ☒ Recommendations

☒ No Historic Properties Affected

☐ No Adverse Effects to Historic Properties

☐ Adverse Effects to Historic Properties

Other Conclusions and Recommendations:

AMEC conducted a pedestrian survey and subsurface archaeological investigation of the March Point (Whitmarsh) Landfill in Skagit County, Washington. The landfill is located within an area of low to moderate potential for archaeological materials, but within an area traditionally utilized by the region's Native Americans. However, the landfill was created on top of an active tide flat, and therefore contains very limited potential for archaeological deposits beneath the landfill. Non-tidal native sediments could be present along the base of the uplands slope, located along the landfill's southern border. Therefore, the subsurface investigation consisted of the excavation of STPs along the southeastern and southern boundary of the landfill. No archaeological materials were observed during this investigation.

If cultural resources (e.g., artifacts such as stone tools, bottles [> 50 years old], ceramics [> 50 years old], bone, or shell) are discovered during project related excavation that are not associated with the historic land fill, all work in the vicinity should stop. The County should work with a professional archaeologist and the Washington State DAHP to evaluate the significance of the find. State statues RCW 27.44.055, 68.60.055, and 68.50.645 require any individual discovering human remains to report them to county law enforcement immediately.

ATTACHMENTS:

☒ Location Map (Figure 1)

☒ APE Map (Figure 2)

☒ Shovel Test/Transect Map (Figure 3)

☐ Historic Property Inventory Form(s)

☐ Archaeological Inventory Form(s)

☐ EZ-1 or EZ-2 Form(s)

☒ Photos (See Attachment)

☒ Other: Shovel Test Profiles (Figure 4)

CERTIFICATION

We certify that:

- We are AMEC Earth & Environmental Cultural Resources Specialists meeting all applicable state and federal professional qualification standards;
- We have reviewed, evaluated, and documented the methods and observations prepared here; and
- This report is accurate to the best of our knowledge.

Name: Jason B. Cooper, M.A., R.P.A. and Emily Scott
Signatures:

Date: June 7, 2011

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Photo 1. View looking west-southwest toward Whitmarsh Landfill, circa 1977. Project area located within polygon.

Photo 2. View looking down at Whitmarsh Landfill, circa 2006. The entire project area is not visible in this oblique aerial.

Photo 3. View looking down at Whitmarsh Landfill, circa 2009. The entire project area is not visible in this oblique aerial. This area was the focus of our field investigation.

Photo 4. View looking southeast along S. March Point Road. Project area is located left of the road.

Photo 5. View looking north-northwest toward Whitmarsh Landfill Archaeological Survey Area.

Photo 6. View looking north during shovel testing for the Whitmarsh Landfill Archaeological Survey near the southeastern corner of the APE.

Photo 7. AMEC archaeologist Tim Gerrish inspecting overgrown bank for the Whitmarsh Landfill Archaeological Survey.

Photo 8. View looking northeast toward exposed bank above ditch that runs parallel to South March Point Road. Fieldwork was geared toward identifying native sediment vs. fill material within APE.

APPENDIX J

Soil Cleanup Calculations

TABLE J-1

SOIL CLEANUP LEVEL CALCULATIONS FOR THE PROTECTION OF MARINE SURFACE WATER

March Point (Whitmarsh) Landfill
Skagit County, Washington

		Constants					
		DF	**UCF**	**F_{oc}**	**Θ_w**	**Θ_a**	**ρ_b**
		20	0.001	0.001	0.3	0.13	1.5
		Dimensionless	mg/µg	g/g	ml/ml	ml/ml	kg/L
		Chemical Specific Constants					
		C_w	**K_{oc}**[1]	**K_d**[2]	**H_{cc}**[3]		**C_s**[4]
Chemical	**CAS**	µg/l	ml/g	L/kg	Dimensionless		mg/kg
Inorganics							
Aluminum	7429-90-5	8.7E+01	--[5]	--	--	--	--
Antimony	7440-36-0	5.6E+00	--	4.5E+01	0.0E+00	--	5.1E+00
Arsenic	7440-38-2	2.0E-01	--	2.9E+01	0.0E+00	--	1.2E-01
Barium	7440-39-3	1.0E+03	--	4.1E+01	0.0E+00	--	8.2E+02
Beryllium	7440-41-7	4.0E+00	--	7.9E+02	0.0E+00	--	6.3E+01
Cadmium	7440-43-9a	2.5E-01	--	6.7E+00	0.0E+00	--	3.5E-02
Chromium (total)	7440-47-3	7.4E+01	--	1.0E+03	0.0E+00	--	1.5E+03
Copper	7440-50-8	2.4E+00	--	2.2E+01	0.0E+00	--	1.1E+00
Iron	7439-89-6	1.0E+03	--	--	--	--	--
Lead	7439-92-1	5.4E-01	--	1.0E+04	0.0E+00	--	1.1E+02
Manganese	7439-96-5	5.0E+01	--	--	0.0E+00	--	--
Mercury	7439-97-6	2.0E-02	--	5.2E+01	4.7E-01	--	2.1E-02
Molybdenum	7439-98-7	8.0E+01	--	--	--	--	--
Nickel	7440-02-0	8.2E+00	--	6.5E+01	0.0E+00	--	1.1E+01
Strontium	7440-24-6	9.6E+03	--	--	--	--	--
Titanium	7782-49-2	--	--	5.0E+00	0.0E+00	--	--
Vanadium	7440-62-2	1.1E+00	--	1.0E+03	0.0E+00	--	2.2E+01
Zinc	7440-66-6	8.1E+01	--	6.2E+01	0.0E+00	--	1.0E+02
TPH							
Diesel	NA	5.0E+02	--	--	--	--	--
Gasoline	86290-81-5	8.0E+02	--	--	--	--	--
Heavy Oil	NA	5.00E+02	--	--	--	--	--

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TABLE J-1

SOIL CLEANUP LEVEL CALCULATIONS FOR THE PROTECTION OF MARINE SURFACE WATER
March Point (Whitmarsh) Landfill
Skagit County, Washington

		Constants					
		DF	UCF	F_{oc}	Θ_w	Θ_a	ρ_b
		20	0.001	0.001	0.3	0.13	1.5
		Dimensionless	mg/µg	g/g	ml/ml	ml/ml	kg/L
		Chemical Specific Constants					
		C_w	K_{oc}[1]	K_d[2]	H_{cc}[3]		C_s[4]
Chemical	**CAS**	µg/l	ml/g	L/kg	Dimensionless		mg/kg
SVOCs							
Acenaphthene	83-32-9	6.4E+02	4.9E+03	4.9E+00	6.4E-03	--	6.55E+01
Acenaphthylene	208-96-8	--	--	--	--	--	--
Anthracene	120-12-7	8.3E+03	2.3E+04	2.3E+01	2.7E-03	--	3.93E+03
Benzo(a)anthracene	56-55-3	1.0E-02	3.6E+05	3.6E+02	1.4E-04	--	7.20E-02
Benzo(a)pyrene	50-32-8	1.0E-02	9.7E+05	9.7E+02	4.6E-05	--	1.94E-01
Benzo(b)fluoranthene	205-99-2	1.0E-02	1.2E+06	1.2E+03	4.6E-03	--	2.40E-01
Benzo(ghi)perylene	191-24-2	--	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	1.0E-02	1.3E+06	1.3E+03	3.4E-05	--	2.52E-01
Benzoic acid	65-85-0	6.4E+04	6.0E-01	6.0E-04	6.3E-05	--	2.57E+02
Butyl benzyl phthalate	85-68-7	8.2E+00	1.4E+04	1.4E+01	5.2E-05	--	2.30E+00
Chrysene	218-01-9	1.0E-02	4.0E+05	4.0E+02	3.9E-03	--	8.00E-02
o-Cresol (2-methylphenol)	95-48-7	4.0E+02	9.1E+01	9.1E-02	4.9E-05	--	2.33E+00
Dibenzofuran	132-64-9	1.6E+01	6.9E+01	6.90E-02	3.1E-05	--	8.61E-02
Dichlorodifluoromethane	75-71-8	1.6E+03	--	--	--	--	--
Di-n-butyl phthalate	84-74-2	2.0E+03	1.6E+03	1.60E+00	3.9E-08	--	7.20E+01
Dimethyl phthalate[7]	131-11-3	0.0E+00	1.6E+00	1.56E-03	1.1E-07	--	0.00E+00
2,4-Dimethylphenol	105-67-9	3.80E+02	2.09E+02	2.09E-01	8.20E-05	--	3.11E+00
bis(2-Ethylhexyl) phthalate	117-81-7	1.2E+00	1.1E+05	1.10E+02	4.2E-06	--	2.64E+00
Fluoranthene	206-44-0	9.0E+01	4.9E+04	4.9E+01	6.6E-04	--	8.89E+01
Fluorene	86-73-7	1.1E+03	7.7E+03	7.7E+00	2.6E-03	--	1.74E+02
1-Methylnaphthalene	90-12-0	1.51E+00	--	--	--	--	--
2-Methylnaphthalene	91-57-6	3.20E+01	--	--	--	--	--
4-Methylphenol	106-44-5	4.0E+01	--	--	--	--	--
N-Nitrosodiphenylamine	86-30-6	3.3E+00	1.3E+03	1.3E+00	2.1E-04	--	9.90E-02
Naphthalene	91-20-3	1.6E+02	1.2E+03	1.2E+00	2.0E-02	--	4.46E+00
Phenanthrene	85-01-8	0.0E+00	--	--	--	--	--
Phenol	108-95-2	1.0E+04	2.9E+01	2.9E-02	1.6E-05	--	4.58E+01
Pyrene	129-00-0	8.3E+02	6.8E+04	6.8E+01	4.5E-04	--	1.13E+03
VOCs							
Acetone	67-64-1	7.2E+03	5.8E-01	5.75E-04	1.6E-03	--	2.89E+01
Benzene	71-43-2	1.2E+00	6.2E+01	6.20E-02	2.3E-01	--	6.76E-03
2-Butanone (MEK)	78-93-3	4.80E+03	--	--	--	--	--
n-Butylbenzene	104-51-8	6.1E+01	--	--	--	--	--
sec-Butylbenzene	135-98-8	6.1E+01	--	--	--	--	--
tert-Butylbenzene	98-06-6	6.1E+01	--	--	--	--	--
Carbon disulfide	75-15-0	4.0E+02	4.6E+01	4.57E-02	1.2E+00	--	2.83E+00
Chlorobenzene	108-90-7	1.3E+02	2.2E+02	2.24E-01	1.5E-01	--	1.14E+00
1,2-Dichlorobenzene	95-50-1	4.20E+02	3.79E+02	3.79E-01	7.79E-02	--	4.92E+00
1,4-Dichlorobenzene	106-46-7	6.30E+01	6.16E+02	6.16E-01	9.96E-02	--	1.04E+00
Ethylbenzene	100-41-4	5.3E+02	2.0E+02	2.0E-01	3.2E-01	--	4.58E+00
p-Isopropyltoluene (p-cymene)	99-87-6	--	--	--	--	--	--
4-Methyl-2-pentanone	108-10-1	6.40E+02	--	--	--	--	--
Isopropylbenzene	98-82-8	8.00E+02	--	--	--	--	--
Methylene Chloride	75-09-2	4.6E+00	1.0E+01	1.0E-02	9.0E-02	--	2.00E-02
n-Propylbenzene[7]	103-65-1	8.0E+02	3.6E+00	3.6E-03	1.1E-02	--	3.27E+00

TABLE J-1

SOIL CLEANUP LEVEL CALCULATIONS FOR THE PROTECTION OF MARINE SURFACE WATER

March Point (Whitmarsh) Landfill
Skagit County, Washington

		Constants					
		DF	UCF	F_{oc}	Θ_w	Θ_a	ρ_b
		20	0.001	0.001	0.3	0.13	1.5
		Dimensionless	mg/µg	g/g	ml/ml	ml/ml	kg/L
		Chemical Specific Constants					
		C_w	K_{oc} [1]	K_d [2]	H_{cc} [3]		C_s [4]
Chemical	**CAS**	µg/l	ml/g	L/kg	Dimensionless		mg/kg
Tetrachloroethene	127-18-4	6.9E-01	2.7E+02	2.7E-01	7.5E-01	--	7.38E-03
1,1,2-Trichloroethane	79-00-5	5.90E-01	7.50E+01	7.50E-02	3.74E-02	--	3.28E-03
1,2,4-Trimethylbenzene	95-63-6	2.40E+01	--	--	--	--	--
1,3,5-Trimethylbenzene	108-67-8	2.50E+01	--	--	--	--	--
Toluene	108-88-3	1.3E+03	1.4E+02	1.4E-01	2.7E-01	--	9.45E+00
m,p-Xylene	106-42-3	6.7E+02	3.1E+02	3.1E-01	3.1E-01	--	7.19E+00
o-Xylene	95-47-6	4.4E+02	2.4E+02	2.4E-01	2.1E-01	--	4.04E+00
PCBs/Pesticides							
Aldrin	309-00-2	6.3E-04	4.9E+04	4.9E+01	7.0E-03	--	6.15E-04
alpha-BHC	319-84-6	2.6E-03	--	--	--	--	--
beta-BHC	319-85-7	9.1E-03	2.1E+03	2.1E+00	3.1E-05	--	4.19E-04
delta-BHC	319-86-8	1.2E-02	--	--	--	--	--
alpha-Chlordane	103-71-9	--	--	--	--	--	--
gamma-Chlordane	12789-03-6	--	--	--	--	--	--
4,4'-DDD	72-54-8	1.3E-03	4.6E+04	4.6E+01	1.6E-04	--	1.16E-03
4,4'-DDE	72-55-9	1.3E-03	8.6E+04	8.6E+01	8.6E-04	--	2.16E-03
4,4'-DDT	50-29-3	1.3E-03	6.8E+05	6.8E+02	3.3E-04	--	1.70E-02
Dieldrin	60-57-1	1.3E-03	2.6E+04	2.6E+01	6.2E-04	--	6.55E-04
Endosulfan I [6]	959-98-8	8.7E-03	2.0E+03	2.0E+00	4.6E-04	--	3.83E-04
Endrin	72-20-8	0.0023	1.10E+04	1.1E+01	3.1E-04	--	5.15E-04
Heptachlor	76-44-8	0.0005	9.50E+03	9.5E+00	4.50E-02	--	9.70E-05
Heptachlor epoxide	1024-57-3	0.0005	8.30E+04	8.3E+01	3.90E-04	--	8.32E-04
Hexachlorobenzene	118-74-1	0.00125	--	--	--	--	--
Polychlorinated biphenyls, total	1336-36-3	0.07	3.10E+05	3.1E+02	--	--	--

Notes:

1. K_{oc} values were provided by the Washington State Department of Ecology CLARC online database.
2. If K_d values for inorganic constituents were provided by the Washington State Department of Ecology CLARC online database. Kd values for all other constituents were calculated using MTCA Equation 747-2.
3. Henry's law constants are values provided by the Washington State Department of Ecology CLARC online database.
4. Soil concerntrations for marine surface water protection calculated using MTCA Equation 747-1.
5. -- = not available
6. Distribution coefficient (K_d) from EPA, 2005. Henry's law constant (Hcc) from Sander, 1999.
7. Distribution coefficient (K_d) and Henry's law constant (Hcc) from Syracuse Research: http://www.srcinc.com/what-we-do/databaseforms.aspx?id=381.

Abbreviations:

C_s = Soil concentration
C_w = Groundwater cleanup level
F_{oc} = Soil fraction of organic carbon
H_{cc} = Henry's law constant
K_d = Distribution coefficient
K_{oc} = Soil organic carbon-water particioning coefficient
ρ_b = Dry bulk soil density
Θ_a = Air filled soil porosity
Θ_w = Water-filled soil porosity

µg = micrograms
kg = kilograms
CAS = Chemical Abstract Service Registry Number
DF = Dilution factor
g = grams
L = Liter
mg = milligrams
mL = milliliter
UCF = Unit conversion factor

TABLE J-2

SOIL TOTAL RISK CALCULATIONS
March Point (Whitmarsh) Landfill
Skagit County, Washington

concentrations in milligrams per kilogram (mg/kg)

Analyte[1]	CAS No.	Preliminary Cleanup Level[2]	Adjusted Preliminary Cleanup Level[3]	Method B Equation Carcinogen Value[4]	Method B Equation Non-Carcinogen Value[4]	Cancer Risk PCL/Method B Carcinogen Value[5]	HQ PCL/Method B Non-Carcinogen Value[6]	Final Cleanup Level[7]
Metals								
Antimony	7440-36-0	5.1	3.0	NV	32	NV	0.09375	**3.00**
Barium	7440-39-3	102	NV	NV	16,000	NV	0.006375	**102**
Cadmium	7440-43-9	1.0	NV	NV	NV	NV	NV	**1.0**
Lead	7439-92-1	108	NV	NV	NV	NV	NV	**108**
Mercury	7439-97-6	0.07	NV	NV	NV	NV	NV	**0.07**
Vanadium	7440-62-2	22	4.9	NV	6	NV	0.875	**4.9**
Zinc	7440-66-6	101	NV	NV	24,000	NV	0.0041985	**101**
SVOCs								
2,4-Dimethylphenol	105-67-9	3.10	1.00	NV	1,600	NV	0.000625	**1.00**
2-Methylphenol	95-48-7	2.33	2.00	NV	4,000	NV	0.0005	**2.00**
Benzo(a)anthracene	56-55-3	0.07	0.100	1	NV	5.26E-07	NV	**0.10**
Benzo(a)pyrene	50-32-8	0.19	0.100	0.14	NV	7.30E-06	NV	**0.10**
Bis(2-ethylhexyl) phthalate	117-81-7	2.60	2.00	71	1,600	2.80E-07	0.001625	**2.00**
Chrysene	218-01-9	0.08	0.050	137	NV	3.65E-09	NV	**0.05**
Dibenzofuran	132-64-9	0.09	NV	NV	80	NV	0.001076011	**0.09**
Phenol	108-95-2	46.0	0.10	NV	24,000	NV	4.16667E-06	**0.10**
VOCs								
Benzene	71-43-2	0.0068	NV	18	320	3.74E-09	0.00002125	**0.0068**
Pesticides (Organochlorine)		--						
Methoxylchlor	72-43-5	3100	1.00	NV	400.00	NV	0.0025	**1.00**
					TOTAL RISK[8]	8.11E-06	0.985674927	

Notes
1. Constituents obtained from Table 13. Constituents set to background or PQL not included in total risk calculation and not shown in this table.
2. Values obtained from Table 4.
3. Value adjusted downward to use in total risk calculations
4. Values obtained from CLARC database
5. Cancer risk is calculated as the preliminary cleanup level divided by the MTCA Method B carcinogenic value multiplied by 1×10^{-5}.
6. HQ is derived by dividing the preliminary cleanup level by the MTCA Method B non-carcinogenic value.
7. Final cleanup level is either the preliminary cleanup level from the RI or the adjusted cleanup level used in the total risk calculations.
8. Total cancer risk is the sum all of the cancer risks . Total HQ is the sum all of the HQs.

Abbreviations
CAS = Chemical Abstracts Service
HQ = Hazard quotient
MTCA - Model Toxics Control Act
NV = no value
PCL = preliminary cleanup level
PQL = Practical Quantitation Limit
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE J-3

GROUNDWATER TOTAL RISK CALCULATIONS

March Point (Whitmarsh) Landfill
Skagit County, Washington

Concentrations in micrograms per liter (µg/L)

Analyte[1]	CAS No.	Preliminary Cleanup Level[2]	Adjusted Preliminary Cleanup Level[3]	Method B Equation Carcinogen Value[4]	Method B Equation Non-Carcinogen Value[4]	Cancer Risk PCL/Method B Carcinogen Value[5]	HQ PCL/Method B Non-Carcinogen Value[6]	Final Cleanup Level[7]
Metals								
Copper	7440-50-8	2.4	0.5	640.00	640	7.81E-10	0.00078125	0.50
Iron	7439-89-6	1000	20.0	11,200.00	11,200	1.79E-09	0.001785714	20
Manganese	7439-96-5	50.0	0.5	2,240.00	2,240	2.23E-10	0.000223214	0.50
Silver	7440-22-4	1.9	0.5	80.00	80	6.25E-09	0.00625	0.50
Vanadium	7440-62-2	1.1	0.4	1.12	1.12	3.57E-07	0.357142857	0.40
SVOCs								
1-Methylnaphthalene	90-12-0	1.51	0.10	1.51	NV	6.62E-08	NV	0.10
2,4-Dimethylphenol	105-67-9	380.0	1.0	160.00	160	6.25E-09	0.00625	1.00
4-Methylphenol (p-cresol)	106-44-5	40.0	0.1	40.00	40	1.25E-09	0.00125	0.10
VOCs								
Benzene	71-43-2	1.2	0.1600	0.80	32	2.01E-07	0.005	0.16
Pesticides (Organochlorine)								
a-Hexachlorocyclohexane	319-84-6	0.002600	0.005	0.0139	NV	3.60E-07	NV	0.01
					TOTAL RISK[8]	1.00E-06	0.378683036	

Notes
1. Constituents obtained from Table 14. Constituents set to background or PQL not included in total risk calculation and not shown in this table.
2. Values obtained from Table 5.
3. Value adjusted downward to use in total risk calculations
4. Values obtained from CLARC database
5. Cancer risk is calculated as the preliminary cleanup level divided by the MTCA Method B carcinogenic value multiplied by 1×10^{6}.
6. HQ is derived by dividing the preliminary cleanup level by the MTCA Method B non-carcinogenic value.
7. Final cleanup level is either the preliminary cleanup level from the RI or the adjusted cleanup level used in the total risk calculations.
8. Total cancer risk is the sum all of the cancer risks. Total HQ is the sum all of the HQs.

Abbreviations
CAS = Chemical Abstracts Service
HQ = Hazard quotient
MTCA - Model Toxics Control Act
NV = no value
PCL = preliminary cleanup level
PQL = Practical Quantitation Limit
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE J-4

SURFACE WATER TOTAL RISK CALCULATIONS

March Point (Whitmarsh) Landfill
Skagit County, Washington

Concentrations in micrograms per liter (µg/L)

Analyte[1]	CAS No.	Preliminary Cleanup Level[2]	Adjusted Preliminary Cleanup Level[3]	Method B Equation Carcinogen Value[4]	Method B Equation Non-Carcinogen Value[4]	Cancer Risk PCL/Method B Carcinogen Value[5]	HQ PCL/Method B Non-Carcinogen Value[6]	Final Cleanup Level[7]
Metals								
Copper	7440-50-8	2.4	NV	NV	2,880.0	NV	0.000833333	2.40
Lead	7439-92-1	0.5	NV	NV	NV	NV	NV	2.5
Manganese	7439-96-5	50.0	NV	NV	NV	NV	NV	50.00
Nickel	7440-02-0	8.2	NV	NV	1,103.2	NV	0.007432714	52
Silver	7440-22-4	1.9	NV	NV	25,925.9	NV	7.32857E-05	1.90
SVOCs								
Butyl benzyl phthalate	85-68-7	8.2	7.90	8.24	1,250.00	9.59E-07	0.006592	7.90
VOCs								
Benzene	71-43-2	1.2	1.00	22.66	1,990.00	4.41E-08	0.000603015	1.00
					TOTAL RISK[8]	1.00E-06	0.015534348	

Notes
1. Constituents obtained from Table 15. Constituents set to background or PQL not included in total risk calculation and not shown in this table.
2. Values obtained from Table 6.
3. Value adjusted downward to use in total risk calculations
4. Values obtained from CLARC database
5. Cancer risk is calculated as the preliminary cleanup level divided by the MTCA Method B carcinogenic value multiplied by 1×10^6.
6. HQ is derived by dividing the preliminary cleanup level by the MTCA Method B non-carcinogenic value.
7. Final cleanup level is either the preliminary cleanup level from the RI or the adjusted cleanup level used in the total risk calculations.
8. Total cancer risk is the sum all of the cancer risks. Total HQ is the sum all of the HQs.

Abbreviations
CAS = Chemical Abstracts Service
HQ = Hazard quotient
MTCA - Model Toxics Control Act
NV = no value
PCL = preliminary cleanup level
PQL = Practical Quantitation Limit
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

APPENDIX K

Site Photographs

APPENDIX K

WASTE PHOTOGRAPHS
March Point (Whitmarsh) Landfill
Skagit County, Washington

Photograph 1 Drum at TP-G-9.

Photograph 2 Drum at TP-G-9

APPENDIX K

WASTE PHOTOGRAPHS
March Point (Whitmarsh) Landfill
Skagit County, Washington

Photograph 3 Drum at TP-G-10.

Photograph 4 Drum at TP-G-10

APPENDIX K

WASTE PHOTOGRAPHS
March Point (Whitmarsh) Landfill
Skagit County, Washington

Photograph 5 Washing machine at TP-G-1.

Photograph 6 Tank at TP-G-2.

APPENDIX K

WASTE PHOTOGRAPHS

March Point (Whitmarsh) Landfill
Skagit County, Washington

Photograph 7 Washing machine at TP-G-4.

Photograph 8 Metal siding at TP-G-5.

APPENDIX L

Complete Analytical Data Tables

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID[3]	MW-01			MW-03	MW-04		MW-08	MW-10	G1		G3			G4		G5			G6	
Depth (ft bgs)	11.5	20.5	37	11.5	8.5	19	26-27.5	24.5-26	1	5.5	1	8	12	1	5	1	5	9	6	field dup.
Sample Date	10/7/2008			10/9/2008	10/8/2009		4/2/2010	4/1/2010	11/1/2008		10/31/2008			10/31/2008		11/2/2008			11/1/2008	
Metals (mg/kg)																				
Aluminum	11,900	12,300	29,900	11,500	17,100	11,200	NA	NA	18,600	18,800	16,800	15,200	20,200	17,200	17,700	16,200	16,000	18,500	13,400	14,200
Antimony	6 UJ	6 UJ	20 UJ	10 UJ	6 UJ	6 UJ	20 UJ	7 UJ	6 UJ	10 UJ	5 UJ	5 J	8 UJ	6 UJ	6 UJ	5 UJ	6 UJ	7 UJ	6 UJ	11 J
Arsenic	1.4 J	5.1 J	2.7 J	6.8 J	14 J	4.9 J	20 U	11	3.2	4.3	2.3	3	8.8	2.6	4.7	2.4	2.9	4.7	5.1	4.6
Barium	40.3	40.1	239	117	82.6	47	NA	NA	95.4	115	77.2	74.1	47.3	78.3	259	73.3	85.5	93.8	60.2	69.9
Beryllium	0.1	0.2	0.4	0.3 U	0.2	0.1 U	0.3 U	0.2	0.3	0.4	0.3	0.2	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Cadmium	0.2 U	0.2 U	0.6 U	0.8	0.5	0.2 U	1.3	0.4	0.5	2.6	0.3	0.5	0.5	0.4	2.7	0.4	0.7	0.7	0.5	0.6
Chromium	32.4	28.4	53	55	57.7	33.1	54	47.3	41.2	67	34.6	32.8	54.8	45.8	47.2	35.9	38.6	33.3	39.4	39.3
Copper	18.1	21.4	61	373	44.6	15.8	60.2	28	23.6	76	23.2	76	33.3	26.7	49.3	21.6	29.5	36.4	50	70.8
Iron	19,100	21,900	42,600	39,900	27,100	16,700	55,100	25,400	23,700	34,400	21,900	24,800	30,300	23,800	26,500	22,300	26,800	29,800	28,300	23,200
Lead	2	2 U	7	171	6	2 U	95	9	13	112	4	33	6	3	238	2	31	58	18	49
Manganese	245	315	771	400	352	208	406	270	596	431	280	340	301	318	345	303	351	508	292	253
Mercury	0.04 U	0.05 U	0.06	0.05 U	0.06	0.05 U	0.05	0.04	0.05 U	6.9	0.05 U	0.1	0.08	0.05 U	0.08	0.05 U	0.07	0.26	0.05 U	0.07
Molybdenum	1	1.4	3	4	2.7	2.3	NA	NA	2.1	6	1.6	2	3.9	1.8	2.7	1.8	2.7	2.4	3.7	4.6
Nickel	99	81	56	80	83	60	55 J	39 J	76	90	63	60	45	76	75	62	65	62	69	69
Selenium	6 U	6 U	20 U	10 U	6 U	6 U	20 U	7 U	6 U	10 U	5 U	5 U	8 U	6 U	6 U	5 U	6 U	7 U	6 U	6 U
Silver	0.4 U	0.3 U	1 U	0.9 U	0.4 U	0.4 U	1 U	0.4 U	0.4 U	0.8 U	0.3 U	0.3 U	0.5 U	0.3 U	0.3 U	0.3 U	0.3 U	0.4 U	0.4 U	0.4 U
Strontium	24.4	19.4	72	29.3	35.9	33.2	NA	NA	33.6	33.3	47	29.2	58	46.6	48	47.7	32.1	31.4	26.7	30.9
Thallium	6 U	6 U	20 U	10 U	6 U	6 U	20 U	7 U	6 U	10 U	5 U	5 U	8 U	6 U	6 U	5 U	6 U	7 U	6 U	6 U
Titanium	956	1070	1200	949	1210	911	NA	NA	1,370	1,160	1,070	960	1,450	1,350	1,240	1,330	1,070	878	975	1,110
Vanadium	44.1	57.1	86	45.1	63.9	43.8	64 J	62.2 J	60.3	53.8	55.3	55	67.4	58.9	59.1	60.6	51.9	61.7	52.7	55.6
Zinc	43	39	99	282	84	40	245	75	81	381	63	174	82	79	311	187	225	187	175	345
TPH (mg/kg)																				
Gasoline-Range Organics (TPH-G)	8.3 U	7 U	8.7 U	8.3 U	7.2 U	7 U	19 U	16 U	11 U	5.5 U	6.8 U	6.7 U	13 U	7.1 U	7.8 U	6.1 U	6.5	310 J	6.6 U	7.8 U
Diesel-Range Organics (TPH-D)	NA	NA	NA	NA	NA	NA	7.1 U	7 U	12	61	17	21	11	5.7 U	64	5.4 U	120	280	11	14
Lube Oil (TPH-Oil)	NA	NA	NA	NA	NA	NA	25	14 U	49	330	39	75	45	20	380	11 U	480	670	55	48
SVOCs (µg/kg)																				
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	130	65 U	64 U
2,2'-Oxybis(1-chloropropane)	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
2,4,6-Trichlorophenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
2,4-Dimethylphenol	NA	NA	NA	NA	NA	NA	62 U	160	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
2,4-Dinitrophenol	NA	NA	NA	NA	NA	NA	620 U	610 U	620 U	620 U	610 U	640 U	660 U	630 U	600 U	600 U	650 U	640 U	650 U	640 U
2,4-Dinitrotoluene	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
2,6-Dinitrotoluene	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
2-Chlorophenol	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	140	65 U	64 U
2-Methylphenol	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
2-Nitroaniline	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	MW-01			MW-03	MW-04		MW-08	MW-10	G1		G3			G4		G5			G6	
Depth (ft bgs)	11.5	20.5	37	11.5	8.5	19	26-27.5	24.5-26	1	5.5	1	8	12	1	5	1	5	9	6	field dup.
Sample Date	10/7/2008			10/9/2008	10/8/2009		4/2/2010	4/1/2010	11/1/2008		10/31/2008			10/31/2008		11/2/2008			11/1/2008	
SVOCs (µg/kg) (Continued)																				
2-Nitrophenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
3-Nitroaniline	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
4,6-Dinitro-2-methylphenol	NA	NA	NA	NA	NA	NA	620 U	610 U	620 U	620 U	610 U	640 U	660 U	630 U	600 U	600 U	650 U	640 U	650 U	640 U
4-Bromophenyl phenyl ether	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
4-Chloroaniline	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
4-Methylphenol	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	180	65 U	64 U
4-Nitroaniline	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
4-Nitrophenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
Acenaphthene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Acenaphthylene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	63	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Aniline	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Anthracene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	85	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Benzidine	NA	NA	NA	NA	NA	NA	620 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	270	61 U	64 U	66 U	63 U	60 U	60 U	65 U	130	65 U	64 U
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	240	61 U	64 U	66 U	63 U	60 U	60 U	65 U	120	65 U	64 U
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	160	61 U	64 U	66 U	63 U	60 U	60 U	65 U	100	65 U	64 U
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	71	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	210	61 U	64 U	66 U	63 U	60 U	60 U	65 U	110	65 U	64 U
Benzoic acid	NA	NA	NA	NA	NA	NA	620 U	610 U	620 U	620 U	610 U	640 U	660 U	630 U	600 U	600 U	650 U	640 U	650 U	640 U
Benzyl alcohol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
Bis(2-chloroethoxy)methane	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Bis-(2-chloroethyl) ether	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Bis(2-ethylhexyl) phthalate	NA	NA	NA	NA	NA	NA	110	120	62 U	180	61 U	64 U	97	63 U	490	60 U	230	6,000	65 U	170
Butyl benzyl phthalate	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Carbaryl (Sevin)	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Carbazole	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Chrysene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	320	61 U	64 U	66 U	63 U	60 U	60 U	65 U	180	65 U	64 U
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Dibenzofuran	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Diethyl phthalate	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Dimethyl phthalate	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Di-n-Butyl phthalate	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Di-n-octyl phthalate	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Fluoranthene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	500	61 U	64 U	66 U	63 U	60 U	60 U	65 U	200	65 U	64 U
Fluorene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	72	65 U	64 U
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U

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SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	MW-01			MW-03	MW-04		MW-08	MW-10	G1		G3			G4		G5			G6	
Depth (ft bgs)	11.5	20.5	37	11.5	8.5	19	26-27.5	24.5-26	1	5.5	1	8	12	1	5	1	5	9	6	field dup.
Sample Date	10/7/2008			10/9/2008	10/8/2009		4/2/2010	4/1/2010	11/1/2008		10/31/2008			10/31/2008		11/2/2008			11/1/2008	
SVOCs (µg/kg) (Continued)																				
Hexachloroethane	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Isophorone	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Naphthalene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	280	65 U	64 U
Nitrobenzene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
N-Nitrosodimethylamine	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
N-Nitroso-di-*N*-propylamine	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
N-Nitrosodiphenylamine	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Pentachlorophenol	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
Phenanthrene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	510	61 U	64 U	66 U	63 U	60 U	60 U	120	300	65 U	64 U
Phenol	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	62 U	61 U	64 U	66 U	63 U	60 U	60 U	65 U	64 U	65 U	64 U
Pyrene	NA	NA	NA	NA	NA	NA	62 U	61 U	62 U	530	61 U	64 U	66 U	63 U	60 U	60 U	65 U	230	65 U	64 U
Pyridine	NA	NA	NA	NA	NA	NA	310 U	300 U	310 U	310 U	310 U	320 U	330 U	320 U	300 U	300 U	320 U	320 U	320 U	320 U
VOCs (µg/kg)																				
1,1,1,2-Tetrachloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,1,1-Trichloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,1,2,2-Tetrachloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,1,2-Trichloro-1,2,2-trifluoroethane	2.5 U	2 U	2.7 U	2.2 U	2.3 U	2.1 U	2.8 U	3.1 U	2.8 U	2.2 U	2.4 U	2.3 U	4.2 U	2.5 U	2.7 UJ	2.1 U	2 U	3.3 U	2.1 U	2.9 U
1,1,2-Trichloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,1-Dichloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,1-Dichloroethene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,2,3-Trichlorobenzene	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
1,2,3-Trichloropropane	2.5 U	2 U	2.7 U	2.2 U	2.3 U	2.1 U	2.8 U	3.1 U	2.8 U	2.2 U	2.4 U	2.3 U	4.2 U	2.5 U	2.7 UJ	2.1 U	2 U	3.3 U	2.1 U	2.9 U
1,2,4-Trichlorobenzene	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
1,2,4-Trimethylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	10	30	1.2 U	1.3 UJ	1 U	1 U	690	1 U	1.4 U
1,2-Dibromo-3-chloropropane	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
1,2-Dichlorobenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	15 J	1 U	1.4 U
1,2-Dichloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,2-Dichloropropane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,3,5-Trimethylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	3	18	1.2 U	1.3 UJ	1 U	1 U	240 J	1 U	1.4 U
1,3-Dichlorobenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
1,4-Dichlorobenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	4.9	2.1 U	1.2 U	1.3 UJ	1 U	1.3	20 J	1 U	1.4 U
2-Butanone	6.2 U	5 U	6.7 U	5.6 U	23 J	5.3 U	8.3	7.7 U	41	43	14	22	40	220	540 J	5.2 U	18	37 J	22	14
2-Chloroethyl vinyl ether	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
2-Chlorotoluene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
2-Hexanone	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
4-Chlorotoluene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
4-Isopropyltoluene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4	1.5 U	1.4 U	1.1 U	1.2 U	8.9	26	1.2 U	1.3 UJ	1 U	1 U	61 J	4	2.7
4-Methyl-2-pentanone (MIBK)	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	41	5.9 U	5.6 U	10 U	150	440 J	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
Acetone	16	11	19	36 J	95 J	11	46	24	360	110	160	120	240	240	440 J	37	110	190 J	130	100
Acrylonitrile	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
Benzene	1.2 U	1 U	1.3 U	5.5 J	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	11	1.2 U	1.3 UJ	1 U	1 U	14 J	1 U	1.4 U
Bromobenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Bromodichloromethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Bromoform	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U

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Skagit County, Washington

Sample ID [3]	MW-01			MW-03	MW-04		MW-08	MW-10	G1		G3			G4		G5			G6	
Depth (ft bgs)	11.5	20.5	37	11.5	8.5	19	26-27.5	24.5-26	1	5.5	1	8	12	1	5	1	5	9	6	field dup.
Sample Date	10/7/2008			10/9/2008	10/8/2009		4/2/2010	4/1/2010	11/1/2008		10/31/2008			10/31/2008		11/2/2008			11/1/2008	
VOCs (µg/kg) (Continued)																				
Bromomethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Carbon disulfide	1.2 U	1.4	1.3 U	9.1 J	1.2 U	1 U	10	2.8	1.4 U	1.1 U	1.2 U	1.1 U	21	1.2 U	2.5 J	1 U	29	20 J	1.7	1.4 U
Carbon tetrachloride	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Chlorobenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	3.5	1.2 U	1.3 UJ	1 U	1 U	39 J	1 U	1.4 U
Chloroethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Chloroform	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Chloromethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
cis-1,2-Dichloroethene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
cis-1,3-Dichloropropene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Dibromochloromethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Dichlorodifluoromethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	2.1 J	1 U	1.4 U
Diethyl ether	130 U	130 U	93 U	97 U	99 U	130 U	1.4 U	1.5 U	5.8 U	5.4 U	5 U	5.6 U	9.4 U	6.3 U	6.8 U	5.2 U	130 U	11 U	6.1 U	6.1 U
Ethylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.4	3.6	1.2 U	1.3 UJ	1 U	1 U	33 J	1 U	1.4 U
Ethylene dibromide	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Hexachlorobutadiene	6.2 U	5 U	6.7 U	5.6 U	5.8 U	5.3 U	7 U	7.7 U	6.9 U	5.4 U	5.9 U	5.6 U	10 U	6.3 U	6.7 UJ	5.2 U	4.9 U	8.2 U	5.2 U	7.2 U
Isopropylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.7	8.9	1.2 U	1.3 UJ	1 U	1 U	69 J	1 U	1.4 U
m,p-Xylene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	2.6	1.2 U	2.8	12	1.8	2.3 J	1 U	1 U	120 J	1 U	1.4 U
Methyl tert-butyl ether	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Methylene chloride	2.5 U	2.4	2.7 U	3.4 J	2.3 U	2.2	2.8 U	3.1 U	2.8 U	2.2 U	2.4 U	2.3 U	4.2 U	2.5 U	2.7 UJ	2.2	2 U	3.3 U	2.5	2.9 U
n-Butylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.2	2.1 U	1.2 U	1.3 UJ	1 U	1 U	79 J	1 U	1.4 U
n-Propylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.5	4.6	1.2 U	1.3 UJ	1 U	1 U	100 J	1 U	1.4 U
o-Xylene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.4	5.3	1.2 U	1.3 UJ	1 U	1 U	64 J	1 U	1.4 U
sec-Butylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	4.9	1.2 U	1.3 UJ	1 U	1 U	59 J	1 U	1.4 U
Styrene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
tert-Butylbenzene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	19 J	1 U	1.4 U
Tetrachloroethene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.5	3	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Toluene	1.2 U	1 U	1.3 U	1.8 J	1.2 U	1 U	1.4 U	1.5 U	1.4 U	9.5	1.2 U	9.9	2.3	61	120 J	1 U	1	19 J	8	4.7
trans-1,2-Dichloroethene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
trans-1,3-Dichloropropene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Trichloroethene	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Trichlorofluoromethane	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U
Vinyl chloride	1.2 U	1 U	1.3 U	1.1 U	1.2 U	1 U	1.4 U	1.5 U	1.4 U	1.1 U	1.2 U	1.1 U	2.1 U	1.2 U	1.3 UJ	1 U	1 U	1.6 U	1 U	1.4 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	MW-01			MW-03	MW-04		MW-08	MW-10	G1		G3			G4		G5			G6	
Depth (ft bgs)	11.5	20.5	37	11.5	8.5	19	26-27.5	24.5-26	1	5.5	1	8	12	1	5	1	5	9	6	field dup.
Sample Date	10/7/2008			10/9/2008	10/8/2009		4/2/2010	4/1/2010	11/1/2008		10/31/2008			10/31/2008		11/2/2008			11/1/2008	
PCBs (µg/kg)																				
Aroclor 1016	NA	NA	NA	3.9 U	NA	NA	3.9 U	3.9 U	3.9 U	110 U	3.8 U	3.8 U	3.9 U	3.9 U	38 U	3.8 U	20 UJ	39 UJ	19 U	3.8 U
Aroclor 1221	NA	NA	NA	3.9 U	NA	NA	3.9 U	3.9 U	3.9 U	110 U	3.8 U	3.8 U	3.9 U	3.9 U	38 U	3.8 U	20 UJ	39 UJ	19 U	3.8 U
Aroclor 1232	NA	NA	NA	3.9 U	NA	NA	5.8 U	3.9 U	3.9 U	110 U	3.8 U	3.8 U	3.9 U	3.9 U	38 U	3.8 U	20 UJ	39 UJ	19 U	3.8 U
Aroclor 1242	NA	NA	NA	3.9 U	NA	NA	3.9 U	3.9 U	3.9 U	110 U	3.8 U	3.8 U	3.9 U	3.9 U	38 U	3.8 U	20 UJ	39 UJ	19 U	3.8 U
Aroclor 1248	NA	NA	NA	28	NA	NA	3.9 U	3.9 U	3.9 U	110 U	3.8 U	20	3.9 U	3.9 U	76 U	3.8 U	29 UJ	120 UJ	19 U	3.8 U
Aroclor 1254	NA	NA	NA	27	NA	NA	3.9 U	3.9 U	3.9 U	110 U	3.8 U	22	3.9 U	3.9 U	240	3.8 U	39 UJ	110 J	76	31
Aroclor 1260	NA	NA	NA	7.8 U	NA	NA	3.9 U	3.9 U	3.9 U	360	3.8 U	13	3.9 U	3.9 U	38 U	3.8 U	39 UJ	39 UJ	19 U	9.9
Total PCBs	NA	NA	NA	55	NA	NA	5.8 U	3.9 U	3.9 U	360	3.8 U	104.6	3.9 U	3.9 U	240	3.8 U	39 UJ	110	76	40.9
Pesticides (µg/kg)																				
4,4'-DDD	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
4,4'-DDE	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	9.4 U	2.9 U	3.1 U	160 U	3 U	3.2 U
4,4'-DDT	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
Aldrin	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	3.3 U	1.6 U	8.1 U	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	390	1.5 U	1.6 U
alpha Chlordane	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
alpha-BHC	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	22 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
beta-BHC	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
delta-BHC	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	9.8	120	1.6 U	1.6 U	16 U	1.5 U	1.6 U	80 U	2.8	3.1
Dieldrin	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	28 U	3.2 U	24	3.2 U	3.2 U	14 U	2.9 U	3.1 U	210	3 U	3.2 U
Endosulfan I	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
Endosulfan II	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
Endosulfan sulfate	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
Endrin	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
Endrin aldehyde	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
Endrin ketone	NA	NA	NA	3.1 U	NA	NA	3.3 U	3.2 U	3.1 U	3 U	3.2 U	16 U	3.2 U	3.2 U	3.1 U	2.9 U	3.1 U	160 U	3 U	3.2 U
gamma-Chlordane	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
gamma-BHC (Lindane)	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
Heptachlor	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	1.5 U	1.6 U	8.1 U	1.6 U	1.6 U	4.8 U	1.5 U	1.6 U	80 U	1.5 U	1.6 U
Heptachlor epoxide	NA	NA	NA	1.6 U	NA	NA	1.6 U	1.6 U	1.6 U	10 U	1.6 U	15 U	1.6 U	1.6 U	14 U	1.5 U	1.6 U	80 U	1.5 U	5.6 U
Methoxychlor	NA	NA	NA	16 U	NA	NA	16 U	16 U	16 U	15 U	16 U	81 U	16 U	71	16 U	15 U	16 U	800 U	15 U	16 U
Toxaphene	NA	NA	NA	160 U	NA	NA	160 U	160 U	160 U	150 U	160 U	810 U	160 U	160 U	160 U	150 U	160 U	8,000 U	150 U	160 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	G10	G11	G17.5	G29	G30		G32	G35	G37
Depth (ft bgs)	8	11	7	9	7	DRUM [4]	12	15	10
Sample Date	11/1/2008	10/31/2008	4/1/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	4/1/2010	3/31/2010
Metals (mg/kg)									
Aluminum	14,300	21,500	NA	NA	NA	NA	NA	NA	NA
Antimony	6 UJ	20 UJ	7 UJ	6 UJ	20 UJ	9 UJ	7 UJ	20 UJ	6 UJ
Arsenic	4.1	13	8	6 U	20 U	9 U	7	70	6
Barium	65	43	NA	NA	NA	NA	NA	NA	NA
Beryllium	0.2	0.4 U	0.3	0.1	0.5 U	0.2 U	0.1 U	0.6	0.1
Cadmium	0.3	0.7 U	0.4	0.3	0.9 U	0.5	0.8	0.9 U	0.3
Chromium	30.1	58	68.4	43.1	31	27.6	32.7	43	34.1
Copper	21.8	23.4	20.5	23.9	15.6	19.2	261	57.5	28.4
Iron	18,200	38,500	25,300	26,000	2,690	4,550	28,300	17,200	26,800
Lead	2 U	7 U	7	3	117	106	67	184	2
Manganese	210	336	282	279	30.7	33.3	330	138	435
Mercury	0.05 U	0.07 U	0.04	0.03	0.04 U	0.04 U	0.13	0.34	0.02 U
Molybdenum	1.9	5	NA	NA	NA	NA	NA	NA	NA
Nickel	67	34	55 J	78 J	211 J	190 J	179 J	495 J	361 J
Selenium	6 U	20 U	7 U	6 U	20 U	9 U	7 U	20 U	6 U
Silver	0.3 U	1 U	0.4 U	0.3 U	1 U	0.6 U	0.4 U	1 U	0.3 U
Strontium	32.8	64.1	NA	NA	NA	NA	NA	NA	NA
Thallium	6 U	20 U	7 U	6 U	20 U	9 U	7 U	20 U	6 U
Titanium	1,120	1,340	NA	NA	NA	NA	NA	NA	NA
Vanadium	53.6	77	66.4 J	56.9 J	98 J	89.1 J	57.3 J	356 J	42.2 J
Zinc	59	73	62	51	27	133	413	149	44
TPH (mg/kg)									
Gasoline-Range Organics (TPH-G)	6.4 U	12 U	26 U	26	32 U	18 U	350	90	13 U
Diesel-Range Organics (TPH-D)	6.1	7.5 U	7.7 U	2,000	9.3 UJ	73	640	140	47
Lube Oil (TPH-Oil)	16	15 U	16 U	3,400	19 UJ	120	270	130	87
SVOCs (µg/kg)									
1-Methylnaphthalene	64 U	64 U	64 U	80 UJ	62 U	110	3100	520	80
2,2'-Oxybis(1-chloropropane)	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
2,4,5-Trichlorophenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
2,4,6-Trichlorophenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
2,4-Dichlorophenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
2,4-Dimethylphenol	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	130,000	58 U
2,4-Dinitrophenol	640 U	640 U	640 U	800 UJ	620 U	620 U	1,200 U	3,800 U	580 U
2,4-Dinitrotoluene	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
2,6-Dinitrotoluene	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
2-Chloronaphthalene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
2-Chlorophenol	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
2-Methylnaphthalene	64 U	64 U	64 U	80 UJ	62 U	62 U	1,700	700	110
2-Methylphenol	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	130,000	58 U
2-Nitroaniline	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	G10	G11	G17.5	G29	G30		G32	G35	G37
Depth (ft bgs)	8	11	7	9	7	DRUM [4]	12	15	10
Sample Date	11/1/2008	10/31/2008	4/1/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	4/1/2010	3/31/2010
SVOCs (μg/kg) (Continued)									
2-Nitrophenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
3,3'-Dichlorobenzidine	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
3-Nitroaniline	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
4,6-Dinitro-2-methylphenol	640 U	640 U	640 U	800 UJ	620 U	620 U	1200 U	3,800 U	580 U
4-Bromophenyl phenyl ether	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
4-Chloro-3-methylphenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
4-Chloroaniline	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
4-Chlorophenyl phenyl ether	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
4-Methylphenol	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	330,000	58 U
4-Nitroaniline	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
4-Nitrophenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
Acenaphthene	64 U	64 U	64 U	80 UJ	62 U	62 U	410	380 U	58 U
Acenaphthylene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Aniline	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Anthracene	64 U	64 U	64 U	240 UJ	62 U	62 U	180	380 U	58 U
Benzidine	NA	NA	640 UJ	800 UJ	620 U	620 U	1,200 UJ	3,800 U	580 U
Benzo(a)anthracene	64 U	64 U	64 U	80 UJ	62 U	62 U	100 J	380 U	58 U
Benzo(a)pyrene	64 U	64 U	64 U	80 UJ	62 U	62 U	64 J	380 U	58 U
Benzo(b)fluoranthene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Benzo(g,h,i)perylene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Benzo(k)fluoranthene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Benzoic acid	640 U	640 U	640 U	800 UJ	620 U	620 U	1,200 U	15,000	580 U
Benzyl alcohol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
Bis(2-chloroethoxy)methane	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Bis-(2-chloroethyl)ether	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Bis(2-ethylhexyl) phthalate	64 U	64 U	52 J	80 UJ	62 U	49 J	92 J	380 U	42 J
Butyl benzyl phthalate	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Carbaryl (Sevin)	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Carbazole	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Chrysene	64 U	64 U	64 U	1,100 J	62 U	32 J	190	380 U	58 U
Dibenz(a,h)anthracene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Dibenzofuran	64 U	64 U	64 U	80 UJ	62 U	31 J	240	380 U	58 U
Diethyl phthalate	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Dimethyl phthalate	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Di-n-Butyl phthalate	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Di-n-octyl phthalate	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Fluoranthene	64 U	64 U	64 U	130 J	62 U	62 U	120 U	380 U	58 U
Fluorene	64 U	64 U	64 U	80 UJ	62 U	74	1,000	380 U	32 J
Hexachlorobenzene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Hexachlorobutadiene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Hexachlorocyclopentadiene	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	G10	G11	G17.5	G29	G30		G32	G35	G37
Depth (ft bgs)	8	11	7	9	7	DRUM [4]	12	15	10
Sample Date	11/1/2008	10/31/2008	4/1/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	4/1/2010	3/31/2010
SVOCs (µg/kg) (Continued)									
Hexachloroethane	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Indeno(1,2,3-cd)pyrene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Isophorone	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
Naphthalene	68	64 U	64 U	80 UJ	62 U	62 U	180	380 U	58 U
Nitrobenzene	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	58 U
N-Nitrosodimethylamine	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
N-Nitroso-di-*N*-propylamine	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
N-Nitrosodiphenylamine	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	380 U	69 U
Pentachlorophenol	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
Phenanthrene	64 U	64 U	64 U	240 UJ	62 U	92	1,900	400	64
Phenol	64 U	64 U	64 U	80 UJ	62 U	62 U	120 U	73,000	58 U
Pyrene	64 U	64 U	64 U	620 J	62 U	62 U	450	380 U	58 U
Pyridine	320 U	320 U	320 U	400 UJ	310 U	310 U	610 U	1,900 U	290 U
VOCs (µg/kg)									
1,1,1,2-Tetrachloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,1,1-Trichloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,1,2,2-Tetrachloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,1,2-Trichloro-1,2,2-trifluoroethane	2.7 U	3.5 U	3.5 U	2.3 UJ	4.6 U	NA	2.6 U	4.5 U	2 U
1,1,2-Trichloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	4.3 U	20 U	1 U
1,1-Dichloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,1-Dichloroethene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,2,3-Trichlorobenzene	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
1,2,3-Trichloropropane	2.7 U	3.5 U	3.5 U	2.3 UJ	4.6 U	NA	2.6 U	4.5 U	2 U
1,2,4-Trichlorobenzene	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
1,2,4-Trimethylbenzene	1.3 U	42	1.8 U	1.1 UJ	2.3 U	NA	36	2.2 U	1 U
1,2-Dibromo-3-chloropropane	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
1,2-Dichlorobenzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,2-Dichloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,2-Dichloropropane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,3,5-Trimethylbenzene	1.3 U	8.3	1.8 U	1.1 UJ	2.3 U	NA	8.9	2.2 U	1 U
1,3-Dichlorobenzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
1,4-Dichlorobenzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
2-Butanone	17	12	10	10 J	12 U	NA	17	53	5.1 U
2-Chloroethyl viny ether	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
2-Chlorotoluene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
2-Hexanone	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
4-Chlorotoluene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
4-Isopropyltoluene	1.3 U	7.2	1.8 U	1.1 UJ	2.3 U	NA	6.2	2.2 U	1 U
4-Methyl-2-pentanone (MIBK)	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
Acetone	130	90	47	52 J	24	NA	81	55	5.1 U
Acrylonitrile	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
Benzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	11	4.4	1 U
Bromobenzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Bromodichloromethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Bromoform	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	G10	G11	G17.5	G29	G30		G32	G35	G37
Depth (ft bgs)	8	11	7	9	7	DRUM [4]	12	15	10
Sample Date	11/1/2008	10/31/2008	4/1/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	4/1/2010	3/31/2010
VOCs (µg/kg) (Continued)									
Bromomethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 UJ	2.2 UJ	1 U
Carbon disulfide	2.2	5	12	22 J	2.3 U	NA	22	9.4	1 U
Carbon tetrachloride	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Chlorobenzene	6.3	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Chloroethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Chloroform	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Chloromethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 UJ	2.2 UJ	1 U
cis-1,2-Dichloroethene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
cis-1,3-Dichloropropene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Dibromochloromethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Dichlorodifluoromethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Diethyl ether	6 U	9.1 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Ethylbenzene	1.3 U	23	1.8 U	1.1 UJ	2.3 U	NA	1.4	2.2 U	1 U
Ethylene dibromide	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Hexachlorobutadiene	6.6 U	8.7 U	8.7 U	5.7 UJ	12 U	NA	6.6 U	11 U	5.1 U
Isopropylbenzene	1.3 U	7.3	1.8 U	1.1 UJ	2.3 U	NA	1.8	2.2 U	1 U
m,p-Xylene	1.3 U	23	1.8 U	1.1 UJ	2.3 U	NA	11	2.2 U	1 U
Methyl tert-butyl ether	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Methylene chloride	2.7 U	3.5 U	6 U	2.6 UJ	4.6 U	NA	2.6 U	4.5 U	2 U
n-Butylbenzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
n-Propylbenzene	1.3 U	4.1	1.8 U	1.1 UJ	2.3 U	NA	4.5	2.2 U	1 U
o-Xylene	1.3 U	8.4	1.8 U	1.1 UJ	2.3 U	NA	6.1	2.2 U	1 U
sec-Butylbenzene	1.3 U	3.1	1.8 U	2.3 J	2.3 U	NA	5.6	2.2 U	1 U
Styrene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
tert-Butylbenzene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Tetrachloroethene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Toluene	1.3 U	1.9	1.8 U	1.1 UJ	2.3 U	NA	9.1	4.1	1 U
trans-1,2-Dichloroethene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
trans-1,3-Dichloropropene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Trichloroethene	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U
Trichlorofluoromethane	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 UJ	2.2 UJ	1 U
Vinyl chloride	1.3 U	1.8 U	1.8 U	1.1 UJ	2.3 U	NA	1.3 U	2.2 U	1 U

TABLE L-1

SUMMARY OF MONITORING WELL AND TEST PIT SOIL SAMPLES
OCTOBER AND NOVEMBER 2008, APRIL 2010[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID [3]	G10	G11	G17.5	G29	G30		G32	G35	G37
Depth (ft bgs)	8	11	7	9	7	DRUM [4]	12	15	10
Sample Date	11/1/2008	10/31/2008	4/1/2010	3/31/2010	3/31/2010	3/31/2010	3/31/2010	4/1/2010	3/31/2010
PCBs (µg/kg)									
Aroclor 1016	4 U	3.9 U	3.9 U	16 U	3.9 U	3.9 U	29 U	78 U	3.8 U
Aroclor 1221	4 U	3.9 U	3.9 U	16 U	3.9 U	3.9 U	29 U	78 U	3.8 U
Aroclor 1232	4 U	3.9 U	3.9 U	16 U	3.9 U	3.9 U	29 U	78 U	3.8 U
Aroclor 1242	4 U	3.9 U	3.9 U	16 U	3.9 U	3.9 U	29 U	78 U	3.8 U
Aroclor 1248	4 U	3.9 U	3.9 U	39 U	39 U	20 U	44	1,200 U	3.8 U
Aroclor 1254	4 U	3.9 U	3.9 U	16 U	3.9 U	39 U	42	1,200 U	3.8 U
Aroclor 1260	8 U	3.9 U	3.9 U	16 U	3.9 U	3.9 U	29 U	78 U	3.8 U
Total PCBs	8 U	3.9 U	3.9 U	39 U	39 U	39 U	86	1,200 U	3.8 U
Pesticides (µg/kg)									
4,4'-DDD	3.1 U	3.1 U	3.2 U	4.4	3.3 U	3.2 U	3.2 U	140 U	3.1 U
4,4'-DDE	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	620	3.1 U
4,4'-DDT	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	5.2 U	8.2 U	3.1 U
Aldrin	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	160 U	1.6 U
alpha Chlordane	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	4.1 U	1.6 U
alpha-BHC	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	7.9 U	1.6 U
beta-BHC	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	27 U	1.6 U
delta-BHC	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	38 U	1.6 U
Dieldrin	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	330 U	3.1 U
Endosulfan I	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	160 U	1.6 U
Endosulfan II	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	49 U	3.1 U
Endosulfan sulfate	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	11 U	3.1 U
Endrin	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	8.2 U	3.1 U
Endrin aldehyde	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	8.2 U	3.1 U
Endrin ketone	3.1 U	3.1 U	3.2 U	3.3 U	3.3 U	3.2 U	3.2 U	8.2 U	3.1 U
gamma-Chlordane	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	220	1.6 U
gamma-BHC (Lindane)	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	4.1 U	1.6 U
Heptachlor	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	160 U	1.6 U
Heptachlor epoxide	1.6 U	1.6 U	1.6 U	1.7 U	1.6 U	1.6 U	1.6 U	160 U	1.6 U
Methoxychlor	16 U	16 U	16 U	17 U	16 U	16 U	16 U	41 U	16 U
Toxaphene	160 U	160 U	160 U	660 U	160 U	160 U	640 U	1,600 U	160 U

Notes
1. Data qualifiers are as follows:
   J = Reported value is an estimate.
   U = analyte was note detected at reporting limit indicated
   UJ = analyte was not detected at the concentration indicated, which is the estimated reporting limit.
2. NA = Not analyzed.
3. MW prefix indicates monitoring well borings; G prefix indicates test pit samples.
4. Material sample found inside a drum in the test pit.

Abbreviations
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
bgs = below ground surface
ft = feet
PCBs = polychlorinated biphenyls
PSL = preliminary screening levels
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE L-2

SUMMARY OF TEST PIT SOIL SAMPLES
DIOXIN AND FURAN RESULTS
MARCH 2013[1,2]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Location Sample ID Depth (ft bgs) Sample Date	Cleanup Level[2]	G-41 G-41-10-0313 10 3/27/2013	G-42 G-42-11-0313 11 3/27/2013	G-43 G-43-8-0313 8 3/27/2013
Dioxins/Furans (pg/g)				
1,2,3,4,6,7,8-HpCDD	NE	34.7	2.08	43.6
1,2,3,4,6,7,8-HpCDF	NE	7.32	0.448 J	6.67
1,2,3,4,7,8,9-HpCDF	NE	0.36 JEMPC	0.0739 U	0.301 JEMPC
1,2,3,4,7,8-HxCDD	NE	0.484 J	0.0579 U	0.0881 U
1,2,3,4,7,8-HxCDF	NE	0.387 J	0.0739 U	0.523 J
1,2,3,6,7,8-HxCDD	NE	3.23	0.142 JEMPC	2.01
1,2,3,6,7,8-HxCDF	NE	0.315 JEMPC	0.0579 J	0.313 J
1,2,3,7,8,9-HxCDD	NE	1.8	0.0619 U	0.742 JEMPC
1,2,3,7,8,9-HxCDF	NE	0.0811 U	0.0999 U	0.227 J
1,2,3,7,8-PeCDD	NE	0.904 J	0.0679 J	0.106 JEMPC
1,2,3,7,8-PeCDF	NE	0.257 JEMPC	0.032 J	0.249 JEMPC
2,3,4,6,7,8-HxCDF	NE	0.505 J	0.0759 U	0.376 JEMPC
2,3,4,7,8-PeCDF	NE	0.426 J	0.046 JEMPC	0.317 JEMPC
2,3,7,8-TCDD	NE	0.320 U	0.136 U	0.346 U
2,3,7,8-TCDF	NE	3.57	0.05 U	1.58
OCDD	NE	292	20.9	558
OCDF	NE	14.9	1.25 JEMPC	16.1
Total TEQ	11	2.58	0.13	1.46
Homolog Group Concentrations				
Total HpCDD	NE	72.1	3.9	96.6
Total HpCDF	NE	19.9 EMPC	1.23 EMPC	26 EMPC
Total HxCDD	NE	27.7 EMPC	1.35 EMPC	13.1 EMPC
Total HxCDF	NE	8.29 EMPC	0.565 EMPC	13 EMPC
Total PeCDD	NE	8.15 EMPC	0.345 EMPC	1.54 EMPC
Total PeCDF	NE	6.06 EMPC	0.33 EMPC	6.53 EMPC
Total TCDD	NE	6.19 EMPC	0.721 EMPC	1.04 EMPC
Total TCDF	NE	12.6 EMPC	0.787 EMPC	5.8 EMPC

Notes
1. Data qualifiers are as follows:
   EMPC = Estimated Maximum Possible Concentration
   J = Reported value is an approximation.
   U = Analyte not detected at the reporting limit shown.
2. Cleanup levels are Washington State Department of Ecology Model Toxics Control Act (MTCA) Method B soil cleanup levels and based on the total toxic equivalent concentration in 2,3,7,8-TCDD equivalents.

Abbreviations
bgs = below ground surface
ft = feet
NE = not established
pg/g = picogram per gram

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW-02							MW-03							MW-03 (duplicate)			
Sample Date	10/14/2008	12/18/2008	4/29/2009	7/23/2009	4/13/2010	7/13/2010	10/7/2010	10/14/2008	12/18/2008	4/28/2009	7/23/2009	4/13/2010	7/13/2010	10/7/2010	10/14/2008	12/18/2008	4/28/2009	7/23/2009
Dissolved Metals (µg/L)																		
Aluminum	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U
Antimony	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U
Arsenic	1.9	2.2	2.3 J-	2.5	2.3	2.9	2.7	4.1	0.5	0.5 J-	4.1	2.5	3.5	4.3	4	0.4	0.5 J-	4.1
Barium	20	12	9 J-	10	NA	NA	NA	50	35	50 J	92	NA	NA	NA	50	36	52 J-	94
Beryllium	1 U	1 U	1 UJ	1 U	NA	NA	NA	1 U	1 U	1 UJ	1 U	NA	NA	NA	1 U	1 U	1 UJ	1 U
Cadmium	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U
Chromium	5 U	5 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U
Copper	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U
Iron	50 U	50 U	50 UJ	50 U	NA	NA	NA	11,800	50 U	370 J-	13,400	NA	NA	NA	12,000	50 U	1,360 J-	13,600
Lead	1 U	1 U	1 UJ	1 U	3	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U
Manganese	41	45	21 J-	25	NA	NA	NA	332	227	276 J-	319	NA	NA	NA	336	226	284 J-	327
Mercury	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ	0.02 U
Molybdenum	11	16	6 J-	6	NA	NA	NA	9	10	5 UJ	5 U	NA	NA	NA	9	10	5 UJ	5 U
Nickel	4.1	4	3.7 J-	4	NA	NA	NA	1.1	0.6	0.8 J-	0.6	NA	NA	NA	1.1	0.6	0.8 J-	0.9
Selenium	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U
Silver	3 U	3 U	3 UJ	3 U	NA	NA	NA	3 U	3 U	3 UJ	3 U	NA	NA	NA	3 U	3 U	3 UJ	3 U
Strontium	154	191	154 J-	137	NA	NA	NA	208	156	186 J-	210	NA	NA	NA	210	159	186 J-	215
Thallium	0.2 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U
Titanium	5 U	5 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U
Vanadium	4	3 U	3 J-	4	NA	NA	NA	3 U	3 U	3 UJ	3 U	NA	NA	NA	3 U	3 U	3 UJ	3 U
Zinc	10 U	10 U	10 UJ	10 U	NA	NA	NA	10 U	10 U	10 UJ	10 U	NA	NA	NA	10 U	10 U	10 UJ	10 U
Total Metals (µg/L)																		
Aluminum	50 U	50 U	80	50	NA	NA	NA	460 J	50 U	50 U	50 U	NA	NA	NA	50 J	50 U	50 U	50 U
Antimony	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U
Arsenic	2	2.2	2.3	2.8	4.8	2.9	2.5	4.9	2.7	2.8	4.1	2.5	3.5	4.1	4.4	2.8	2.7	4
Barium	23	12	9	10	NA	NA	NA	60	63	82	87	NA	NA	NA	53	66	76	90
Beryllium	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	NA	NA	NA	2 U	2 U	2 U	2 U	NA	NA	NA	2 U	2 U	2 U	2 U
Chromium	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
Copper	2 U	2 U	2 U	2 U	NA	NA	NA	3	2 U	2 U	2 U	NA	NA	NA	2 U	2 U	2 U	2 U
Iron	60	50 U	70	80	NA	NA	NA	13,400	12,200	14,600	12,500	NA	NA	NA	12,400	12,300	13,300	12,900
Lead	1 U	1 U	1 U	1 U	2	1 U	1 U	16 J	1 U	1 U	1 U	1 U	1 U	1 U	2 J	1 U	1 U	1 U
Manganese	46	46	47	64	NA	NA	NA	350	254	301	307	NA	NA	NA	349	258	282	316
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	12	15	6	6	NA	NA	NA	8	9	5 U	5 U	NA	NA	NA	9	9	5 U	5 U
Nickel	4.7	3.4	4.4	5.4	NA	NA	NA	2.8 J	0.6	0.8	0.9	NA	NA	NA	1.3 J	0.5	0.9	0.8
Selenium	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U
Silver	3 U	3 U	3 U	3 U	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	NA	3 U	3 U	3 U	3 U
Strontium	163	195	155	130	NA	NA	NA	214	168	196	193	NA	NA	NA	218	172	186	198
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	5 U	5 U	6	7	NA	NA	NA	27 J	5 U	5 U	5 U	NA	NA	NA	5 UJ	5 U	5 U	5 U
Vanadium	4	3 U	4	4	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	NA	3 U	3 U	3 U	3 U
Zinc	10 U	10 U	10 U	10 U	NA	NA	NA	30 J	10 U	10 U	10 U	NA	NA	NA	10 UJ	10 U	10 U	10 U
TPH (mg/L)																		
Gasoline Range Organics	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA	0.25 U	0.25 U	0.25 U	0.25 U
Diesel Range Organics	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA	0.25 U	0.25 U	0.25 U	0.25 U
Lube Oil	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
SVOCs (µg/L)																		
1-Methylnaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2,2'-Oxybis(1-chloropropane)	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
2,4-Dichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
2,4-Dimethylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2,4-Dinitrophenol	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
2-Chloronaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2-Chlorophenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2-Methylnaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
2-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
2-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
3,3'-Dichlorobenzidine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW-02							MW-03							MW-03 (duplicate)			
Sample Date	10/14/2008	12/18/2008	4/29/2009	7/23/2009	4/13/2010	7/13/2010	10/7/2010	10/14/2008	12/18/2008	4/28/2009	7/23/2009	4/13/2010	7/13/2010	10/7/2010	10/14/2008	12/18/2008	4/28/2009	7/23/2009
SVOCs (µg/L) (Continued)																		
3-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U
4-Bromophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
4-Chloro-3-methylphenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
4-Chloroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
4-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
4-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
4-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
Acenaphthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Acenaphthylene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Aniline	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Anthracene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzidine	10 U	R	R	10 U	NA	NA	NA	10 U	R	R	10 U	NA	NA	NA	10 U	R	R	10 U
Benzo(a)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzo(a)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzo(b)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzo(g,h,i)perylene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzo(k)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzoic acid	10 U	R	10 U	10 U	NA	NA	NA	10 U	R	10 U	10 U	NA	NA	NA	10 U	R	R	10 U
Benzyl alcohol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
bis-(2-Chloroethyl) ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
bis(2-Ethylhexyl) phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1.2	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Butyl benzyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Carbaryl (Sevin)	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Carbazole	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Chrysene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Dibenz(a,h)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Dibenzofuran	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Diethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Dimethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Di-n-butyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Di-n-octyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Fluorene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Hexachlorobenzene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Hexachlorobutadiene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Hexachlorocyclopentadiene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
Hexachloroethane	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Isophorone	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Naphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Nitrobenzene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
N- Nitrosodimethylamine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
N- Nitroso-di-N-propylamine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
N- Nitrosodiphenylamine	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Pentachlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
Phenanthrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Phenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Pyrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Pyridine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U
PAHs (µg/L)																		
1-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U
2-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U
Acenaphthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.032	0.017 J	0.012	0.024	NA	NA	NA	0.032	0.017 J	0.013	0.028
Acenaphthylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Benzo(a)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Benzo(a)pyrene	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 UJ	0.01 U	0.01 U
Benzo(b)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Benzo(g,h,i)perylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Benzo(k)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Chrysene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW-02							MW-03							MW-03 (duplicate)			
Sample Date	**10/14/2008**	**12/18/2008**	**4/29/2009**	**7/23/2009**	**4/13/2010**	**7/13/2010**	**10/7/2010**	**10/14/2008**	**12/18/2008**	**4/28/2009**	**7/23/2009**	**4/13/2010**	**7/13/2010**	**10/7/2010**	**10/14/2008**	**12/18/2008**	**4/28/2009**	**7/23/2009**
PAHs (µg/L) (Continued)																		
Dibenz(a,h)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Dibenzofuran	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U
Fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Fluorene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Indeno(1,2,3-cd)pyrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Naphthalene	0.02 U	0.013 UJ	0.011 U	0.01 U	NA	NA	NA	0.015 U	0.013 UJ	0.01 U	0.011 U	NA	NA	NA	0.013 U	0.01 UJ	0.014 U	0.016 U
Phenanthrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Pyrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U
Total Benzofluoranthenes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOCs (µg/L)																		
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,2-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 UJ	0.2 U
1,3-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
1,4-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
2-Butanone	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U
2-Chloroethyl vinyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 UJ	1 U
2-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
2-Hexanone	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U
4-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
4-Isopropyltoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
4-Methyl-2-pentanone (MIBK)	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U
Acetone	4.6	3 U	2.5 U	5 U	NA	NA	NA	3.1	3.6 U	3.4 U	5 U	NA	NA	NA	3.8	8.8 U	2.5 U	5 U
Acrylonitrile	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U
Benzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Bromobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Bromodichloromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Bromoform	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Carbon tetrachloride	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Chlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Chloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Chloroform	1.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Chloromethane	0.4	0.2 U	0.3 U	0.5 U	NA	NA	NA	0.2 U	0.2 UJ	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.5 J	0.2 U	0.5 U
*cis-*1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
*cis-*1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Dibromochloromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Dichlorodifluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Ethyl ether	1 U	NA	1 U	1 U	NA	NA	NA	1 U	NA	1 U	1 U	NA	NA	NA	1 U	NA	1 U	1 U
Ethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Ethylene dibromide	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Hexachlorobutadiene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
Isopropylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
m,p-Xylene	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U
Methyl tert-butyl ether	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U
Methylene chloride	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U
n-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
n-Propylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
o-Xylene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
sec-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Styrene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 UJ	0.2 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	**MW-02**							**MW-03**							**MW-03 (duplicate)**			
Sample Date	**10/14/2008**	**12/18/2008**	**4/29/2009**	**7/23/2009**	**4/13/2010**	**7/13/2010**	**10/7/2010**	**10/14/2008**	**12/18/2008**	**4/28/2009**	**7/23/2009**	**4/13/2010**	**7/13/2010**	**10/7/2010**	**10/14/2008**	**12/18/2008**	**4/28/2009**	**7/23/2009**
VOCs (µg/L) (Continued)																		
tert-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Tetrachloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Toluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
trans-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Trichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Trichlorofluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
Vinyl chloride	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U
PCBs (µg/L)																		
Aroclor 1016	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U
Aroclor 1221	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U
Aroclor 1232	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.029 J	0.019	0.01 U	0.01 U	0.015 U	0.01 U	0.01 U	0.031 J	0.022	0.01 U
Aroclor 1242	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03	0.013 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.031	0.014 J	0.01 U	0.01 U
Aroclor 1248	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.05 U	0.03 U	0.01 U	0.015 U	0.01 U	0.01 UJ	0.01 U	0.04 U
Aroclor 1254	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.015 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U
Aroclor 1260	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U
Total PCBs	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.03	0.042	0.019	0.05 U	0.03 U	0.015 U	0.015 U	0.031	0.045	0.022	0.04 U
Pesticides (µg/L)																		
4,4'-DDD	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	**0.0056 J**	**0.0058**	**0.0075**	**0.0072**	**0.0074**	0.0083 U	0.0033 U	**0.0061 J**	**0.0061**	**0.0082**
4,4'-DDE	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
4,4'-DDT	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
Aldrin	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.0042 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U
alpha-Chlordane	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U
alpha-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	**0.015**	**0.031 J**	**0.041**	**0.016**	**0.026**	**0.034**	**0.027**	**0.015**	**0.036 J**	**0.039**	**0.018**
beta-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0074	0.0075 J	0.0078	0.0041	0.0069	0.009	0.0082	0.007	0.007 J	0.0076	0.0047
cis-Chlordane	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.0042 U	NA	NA	NA	NA
delta-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 UJ	0.0017 U	0.0019 J	0.0012	0.00083 U	0.0008 U	0.0013	0.0042 UJ	0.0017 U	0.0016 J	0.0012	0.00083 U
Dieldrin	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
Endosulfan I	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.0042 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U
Endosulfan II	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
Endosulfan sulfate	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
Endrin	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
Endrin aldehyde	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
Endrin ketone	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0083 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U
gamma-Chlordane	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.0018 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.003 UJ	0.00083 U	0.00083 U
gamma-BHC (Lindane)	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00096	0.00083 U	0.0008 U	0.00083 U	0.0042 U	0.0017 U	0.00083 UJ	0.0011	0.00083 U
Heptachlor	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.0042 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U
Heptachlor epoxide	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.0042 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U
Methoxychlor	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.0083 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.042 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U
Toxaphene	0.17 U	0.083 UJ	0.083 U	0.083 U	0.08 U	0.083 U	0.083 U	0.17 U	0.083 UJ	0.083 U	0.083 U	0.08 U	0.083 U	0.42 U	0.17 U	0.083 UJ	0.083 U	0.083 U
trans-Chlordane	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.0042 U	NA	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW05					MW06					MW07					MW08			MW09					MW09 (duplicate)
Sample Date	**4/14/2010**	**7/14/2010**	**10/7/2010**	**3/28/2013**	**8/17/2013**	**4/15/2010**	**7/14/2010**	**10/7/2010**	**3/28/2013**	**8/17/2013**	**4/15/2010**	**7/14/2010**	**10/7/2010**	**3/26/2013**	**8/17/2013**	**4/14/2010**	**7/13/2010**	**10/7/2010**	**4/14/2010**	**7/13/2010**	**10/7/2010**	**3/26/2013**	**8/17/2013**	**3/26/2013**
Dissolved Metals (µg/L)																								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Arsenic	2.5	2.2	2.3	1.4	1.6	0.7	0.7	0.8	1.2	0.9	0.5 U	0.5 U	0.5 U	1 U	0.9	2.2	1.8	1.6	1.2	1.4	1.4	1.7	1.5	1.7
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chromium	5 U	5 U	5 U	5 U	5 U	6	6	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Copper	3	4	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	5	6	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Iron	4,510	6,980	8,450	20,000	15,500	98,400	102,000	97,700	77,900	92,200	4,520	3,940	2,370	5,820	1,540	34,300	36,600	46,600	19,000	22,400	21,300	22,900	24,500	22,700
Lead	1 U	1 U	1 U	0.1 U	0.1 U	1 U	1 U	1 U	0.2	0.1	1 U	1 U	1 U	0.1 U	0.1	1 U	1 U	1 U	1 U	1 U	1 U	0.1 U	0.1 U	0.1 U
Manganese	294	573	487	664	511	2,730	2,670	2,220	2,310	2,300	579	372	217	673	183	1,680	1,660	2,390	449	543	447	531	565	529
Mercury	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.020 U
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	4.1	4.1	3 J+	3.2	3.9	1.9	2	2 J+	3.6	2.6	2	2.2	1.9	3.6	1	1.1	1.1	1.2 J+	0.5	0.6	2.4	1.8	1.4	1.6
Selenium	50 U	50 U	50	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Silver	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Strontium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	5	3 U	3 U	3 U	3 U	12	13	11	9	12	4	5	5	4	5	3 U	3 U	4	3 U	3 U	3 U	3 U	3 U	3 U
Zinc	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Total Metals (µg/L)																								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Arsenic	1.7	3	2.2	1.4	1.8	1	1.2	0.7	1.2	1	0.5 U	0.9	0.5 U	1 U	1	2.2	1.7	1.8	1.4	1.3	1.4	1.7	1.4	1.8
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chromium	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	35 J	5 U	5 U	5 U	5 U	5 U	5 U
Copper	5	5	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	9	5	2 U	2 U	4	3	2 U	2	3	3	2 U	2 U	2 U	2 U
Iron	4,820	6,020	8,440	20,100	9,590	101,000	102,000	95,700	74,600	91,400	4,590	3,650	2,710	5,720	1,590	38,800	37,300	42,900	19,600	22,800	19,400	22,800	24,000	23,100
Lead	1 U	1 U	1 U	0.1 U	0.1 U	1 U	1 U	1 U	0.5	0.2	1 U	1 U	1 U	0.1 U	0.1 U	3	1 U	1 U	3	1 U	1 U	0.1	0.3	0.1
Manganese	309	570	484	665	341	2,720	2,690	2,270	2,240	2,340	581	356	234	672	185	1,990	1,790	2,140	464	548	411	546	551	555
Mercury	0.02 U	0.02 U	0.0286	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.020 U	0.020 U	0.020 U
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	5.1	3.8	5.4	3.4	4.6	1.8	2	5	3.4	2.8	6.4 J	1.8	2	4	1.2	1.6	1.1	1.6	3.7	0.6	2.6	1.8	1.7	1.8
Selenium	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Silver	7	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Strontium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	6	3 U	3 U	3	3 U	12	13	12	10	12	5	5	6	4	6	4	3	3	6	3 U	3 U	3 U	3 U	3 U
Zinc	10 U	10 U	10 UJ	10 U	10 U	10 U	10	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	20	10	10 U	50 J	10	10 U	10 U	10 U	10 U	10 U
TPH (mg/L)																								
Gasoline Range Organics	0.25 U	0.25 U	0.25 U	NA	NA	0.25 U	0.25 U	0.25 U	NA	NA	0.25 U	0.25 U	0.25 U	NA	NA	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA
Diesel Range Organics	0.25 U	0.1 U	0.1 U	NA	NA	0.25 U	0.1 U	0.1 U	NA	NA	0.25 U	0.1 U	0.1 U	NA	NA	0.25 U	0.1 U	0.1 U	0.25 U	0.1 U	0.1 U	NA	NA	NA
Lube Oil	0.5 U	0.2 U	0.2 U	NA	NA	0.5 U	0.2 U	0.2 U	NA	NA	0.5 U	0.2 U	0.2 U	NA	NA	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.2 U	NA	NA	NA
SVOCs (µg/L)																								
1-Methylnaphthalene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2,4,5-Trichlorophenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2,4,6-Trichlorophenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2,4-Dichlorophenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2,4-Dimethylphenol	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2,4-Dinitrophenol	10 U	10 UJ	10 U	NA	NA	10 U	10 UJ	10 U	NA	NA	10 U	10 UJ	10 U	NA	NA	10 U	10 UJ	10 U	10 U	10 UJ	10 U	NA	NA	NA
2,4-Dinitrotoluene	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2,6-Dinitrotoluene	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2-Chloronaphthalene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2-Chlorophenol	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2-Methylnaphthalene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2-Methylphenol	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
2-Nitroaniline	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2-Nitrophenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
3,3'-Dichlorobenzidine	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW05					MW06					MW07					MW08			MW09					MW09 (duplicate)
Sample Date	4/14/2010	7/14/2010	10/7/2010	3/28/2013	8/17/2013	4/15/2010	7/14/2010	10/7/2010	3/28/2013	8/17/2013	4/15/2010	7/14/2010	10/7/2010	3/26/2013	8/17/2013	4/14/2010	7/13/2010	10/7/2010	4/14/2010	7/13/2010	10/7/2010	3/26/2013	8/17/2013	3/26/2013
SVOCs (µg/L) (Continued)																								
3-Nitroaniline	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	NA	NA	10 U	10 U	10 U	NA	NA	10 U	10 U	10 U	NA	NA	10 U	10 U	10 U	10 U	10 U	10 U	NA	NA	NA
4-Bromophenyl phenyl ether	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
4-Chloro-3-methylphenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chloroaniline	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
4-Methylphenol	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	6.4	1 U	1 U	3.9	1 U	NA	NA	NA
4-Nitroaniline	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
4-Nitrophenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
Acenaphthene	1 U	1 U	1 U	NA	NA	3.5	3.2	4.4	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Acenaphthylene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Aniline	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Anthracene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzidine	R	10 UJ	10 U	NA	NA	R	10 UJ	10 UJ	NA	NA	10 UJ	10 UJ	10 UJ	NA	NA	R	10 UJ	10 UJ	R	10 UJ	10 U	NA	NA	NA
Benzo(a)anthracene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(a)pyrene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(b)fluoranthene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(g,h,i)perylene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(k)fluoranthene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzoic acid	10 U	10 U	10 U	NA	NA	10 U	10 U	10 U	NA	NA	10 U	10 U	10 U	NA	NA	10 U	10 U	10 U	10 U	14	10 U	NA	NA	NA
Benzyl alcohol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
bis-(2-Chloroethyl)ether	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
bis(2-Ethylhexyl) phthalate	1 U	1 U	1 U	NA	NA	1 U	1 U	1.3	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	**2.4**	**NA**	**NA**	**NA**
Butyl benzyl phthalate	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Carbaryl (Sevin)	2 U	2 U	2 U	NA	NA	2 U	2 U	2 U	NA	NA	2 U	2 U	2 U	NA	NA	2 U	2 U	2 U	2 U	2 U	2 U	NA	NA	NA
Carbazole	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Chrysene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenz(a,h)anthracene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenzofuran	1 U	1 U	1 U	NA	NA	1.8	1.7	2	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Diethyl phthalate	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Dimethyl phthalate	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-butyl phthalate	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-octyl phthalate	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Fluoranthene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Fluorene	1 U	1 U	1 U	NA	NA	2.2	2.1	2.9	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobenzene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobutadiene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorocyclopentadiene	5 U	5 U	5 UJ	NA	NA	5 U	5 U	5 UJ	NA	NA	5 U	5 U	5 UJ	NA	NA	5 U	5 U	5 UJ	5 U	5 U	5 UJ	NA	NA	NA
Hexachloroethane	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Isophorone	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Naphthalene	1 U	1 U	1 U	NA	NA	2.1	1.9	2.9	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Nitrobenzene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
N-Nitrosodimethylamine	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
N-Nitroso-Di-N-Propylamine	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
N-Nitrosodiphenylamine	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
Pentachlorophenol	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
Phenanthrene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Phenol	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Pyrene	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Pyridine	5 U	5 U	5 UJ	NA	NA	5 U	5 U	5 UJ	NA	NA	5 U	5 U	5 UJ	NA	NA	5 U	5 U	5 UJ	5 U	5 U	5 UJ	NA	NA	NA
PAHs (µg/L)																								
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	0.01 U	0.016	0.034	NA	NA	3.3	2.5	3.0	NA	NA	0.098	0.11	0.064	NA	NA	0.11	0.12	0.10	0.34	0.46	0.37	NA	NA	NA
Acenaphthylene	0.01 U	0.01 U	0.01 U	NA	NA	0.046	0.049 J	0.038	NA	NA	0.03	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	NA
Anthracene	0.01 U	0.01 U	0.01 U	NA	NA	0.12	0.14 J	0.080	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.015	0.028 J	0.016	0.034	0.059 J	0.041	NA	NA	NA
Benzo(a)anthracene	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 J	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	NA
Benzo(a)pyrene	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	NA
Benzo(b)fluoranthene	0.01 U	NA	NA	NA	NA	0.01 U	NA	NA	NA	NA	0.01 U	NA	NA	NA	NA	0.01 U	NA	NA	0.01 U	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	NA
Benzo(k)fluoranthene	0.01 U	NA	NA	NA	NA	0.01 U	NA	NA	NA	NA	0.01 U	NA	NA	NA	NA	0.01 U	NA	NA	0.01 U	NA	NA	NA	NA	NA
Chrysene	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.010	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.014	0.015	0.011	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW05					MW06					MW07					MW08			MW09					MW09 (duplicate)
Sample Date	4/14/2010	7/14/2010	10/7/2010	3/28/2013	8/17/2013	4/15/2010	7/14/2010	10/7/2010	3/28/2013	8/17/2013	4/15/2010	7/14/2010	10/7/2010	3/26/2013	8/17/2013	4/14/2010	7/13/2010	10/7/2010	4/14/2010	7/13/2010	10/7/2010	3/26/2013	8/17/2013	3/26/2013
PAHs (µg/L) (Continued)																								
Dibenz(a,h)anthracene	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	0.01 U	0.01 U	0.011	NA	NA	0.23	0.31 J	0.14	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.016	0.032 J	0.030	0.028	0.055 J	0.038	NA	NA	NA
Fluorene	0.01 U	0.01 U	0.012	NA	NA	2	1.8	1.8	NA	NA	0.014	0.023	0.011	NA	NA	0.091	0.096	0.058	0.24	0.37	0.29	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	NA	NA	NA
Naphthalene	0.01 U	0.018	0.038 U	NA	NA	1.8	1.4	1.8	NA	NA	0.013 U	0.031	0.022 U	NA	NA	0.073	0.083	0.087	0.06	0.1	0.074	NA	NA	NA
Phenanthrene	0.01 U	0.01 U	0.017	NA	NA	0.28	0.35	0.17	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.14	0.18	0.12	0.38	0.53	0.44	NA	NA	NA
Pyrene	0.01 U	0.01 U	0.012	NA	NA	0.14	0.18	0.093	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.019	0.035	0.031	0.044	0.06	0.042	NA	NA	NA
Total Benzofluoranthenes	NA	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 U	NA	0.01 U	0.01 U	NA	NA	NA
VOCs (µg/L)																								
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,1-Trichloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1-Dichloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1-Dichloroethene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trimethylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.3	0.2 U	0.2 U	0.3	0.2	0.3	NA	NA	NA
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2-Dichlorobenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.3	0.3	0.2	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2	0.2	0.2	NA	NA	NA
1,2-Dichloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dichloropropane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,3,5-Trimethylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,3-Dichlorobenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,4-Dichlorobenzene	0.2 U	0.2 U	0.2 U	NA	NA	3.7	3.6	3	NA	NA	0.2	0.2	0.2 U	NA	NA	1.5	1.6	1.7	0.4	0.4	0.5	NA	NA	NA
2-Butanone	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
2-Chloroethyl vinyl ether	1 U	R	R	NA	NA	1 U	R	R	NA	NA	R	R	1 U	NA	NA	1 U	R	R	1 U	R	1 U	NA	NA	NA
2-Chlorotoluene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
2-Hexanone	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chlorotoluene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
4-Isopropyltoluene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	1.6	1.2	0.7	0.3	0.2	0.2	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	NA	NA
Acetone	5.6	5 UJ	6.8	NA	NA	7	7.3 J	12	NA	NA	5 U	5 UJ	6.9	NA	NA	16	9.6 J	19	6.4	6.9 J	7.6	NA	NA	NA
Acrylonitrile	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA
Benzene	0.2 U	0.7 U	0.9 U	NA	NA	0.9	1.1 U	0.9 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.7	0.6 U	0.6 U	1.1	1 U	1.1	NA	NA	NA
Bromobenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromodichloromethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromoform	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromomethane	0.5 U	1 U	1 U	NA	NA	0.5 U	1 U	1 U	NA	NA	0.5 U	1 U	1 U	NA	NA	0.5 U	1 U	1 U	0.5 U	1 U	1 U	NA	NA	NA
Carbon disulfide	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Carbon tetrachloride	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chlorobenzene	0.2 U	0.2 U	0.2 U	NA	NA	11	12	8.8	NA	NA	3	2.2	2.2	NA	NA	0.3	0.2 U	0.4	1	1.1	1.1	NA	NA	NA
Chloroethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloroform	0.5	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloromethane	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
cis-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	NA	NA	0.2	0.2 U	0.2	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
cis-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Dibromochloromethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Dichlorodifluoromethane	0.2	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Ethyl ether	8.7	7.2	8.2	NA	NA	1	0.8	1.2	NA	NA	1.1	0.8	0.9	NA	NA	0.2	0.2 U	0.2	0.4	0.3	0.4	NA	NA	NA
Ethylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.3	0.2	0.3	0.2 U	0.2 U	0.2 U	NA	NA	NA
Ethylene dibromide	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Hexachlorobutadiene	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
Isopropylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.8	0.9	0.4	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
m,p-Xylene	0.4 U	0.4 U	0.4 U	NA	NA	0.4	0.4 U	0.4	NA	NA	0.4 U	0.4 U	0.4 U	NA	NA	0.5	0.4 U	0.4 U	0.4	0.4 U	0.5	NA	NA	NA
Methyl tert-butyl ether	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
Methylene chloride	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
n-Butylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
n-Propylbenzene	0.2 U	0.2 UJ	0.2 U	NA	NA	0.2	0.2 UJ	0.2 U	NA	NA	0.2 U	0.2 UJ	0.2 U	NA	NA	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 UJ	0.2 U	NA	NA	NA
o-Xylene	0.2 U	0.2 U	0.2 U	NA	NA	0.2	0.2	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.3	0.2 U	0.2	0.2	0.2	0.3	NA	NA	NA
sec-Butylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.3 J	0.3	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Styrene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW05					MW06					MW07					MW08			MW09					MW09 (duplicate)
Sample Date	4/14/2010	7/14/2010	10/7/2010	3/28/2013	8/17/2013	4/15/2010	7/14/2010	10/7/2010	3/28/2013	8/17/2013	4/15/2010	7/14/2010	10/7/2010	3/26/2013	8/17/2013	4/14/2010	7/13/2010	10/7/2010	4/14/2010	7/13/2010	10/7/2010	3/26/2013	8/17/2013	3/26/2013
VOCs (µg/L) (Continued)																								
tert-Butylbenzene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Tetrachloroethene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Toluene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.4 U	0.3 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.3	0.2 U	0.5 U	0.4	0.6 U	6.2	NA	NA	NA
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
trans-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Trichloroethene	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Trichlorofluoromethane	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Vinyl Chloride	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
PCBs (µg/L)																								
Aroclor 1016	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	NA	NA	NA
Aroclor 1221	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	NA	NA	NA
Aroclor 1232	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	NA	NA	NA
Aroclor 1242	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	NA	NA	NA
Aroclor 1248	0.01 U	0.04 U	0.025 U	NA	NA	0.017	0.025 U	0.025 U	NA	NA	0.025 U	0.025 U	0.01 U	NA	NA	0.015	0.015 U	0.04 U	0.15 U	0.45 U	1 U	NA	NA	NA
Aroclor 1254	0.01 U	0.05 U	0.01 U	NA	NA	0.01 U	0.015 U	0.01 U	NA	NA	0.01 U	0.02 U	0.01 U	NA	NA	0.01 U	0.015 U	0.015 U	0.01 U	0.15 U	0.25 U	NA	NA	NA
Aroclor 1260	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	NA	NA	NA
Total PCBs	0.01 U	0.05 U	0.025 U	NA	NA	0.017	0.025 U	0.025 U	NA	NA	0.025 U	0.025 U	0.01 U	NA	NA	0.015	0.015 U	0.04 U	0.15 U	0.45 U	1 U	NA	NA	NA
Pesticides (µg/L)																								
4,4'-DDD	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
4,4'-DDE	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0082 U	0.013 U	0.0058 U	NA	NA	NA
4,4'-DDT	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
Aldrin	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0083 U	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.013 U	0.022 U	0.034 U	NA	NA	NA
alpha-Chlordane	0.00083 UJ	NA	NA	NA	NA	0.00083 U	NA	NA	NA	NA	0.0083 U	NA	NA	NA	NA	0.00083 U	NA	NA	0.00083 U	NA	NA	NA	NA	NA
alpha-BHC	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0083 U	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	NA	NA	NA
beta-BHC	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.013 U	0.0054	0.00083 U	NA	NA	0.0083 U	0.0022 J	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0024 U	0.0046 U	NA	NA	NA
cis-Chlordane	NA	0.00083 U	0.00083 U	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	0.00083 U	0.00083 U	NA	0.00083 U	0.00083 U	NA	NA	NA
delta-BHC	0.00083 UJ	0.00083 U	0.00083 UJ	NA	NA	0.00083 U	0.00083 U	0.00083 UJ	NA	NA	0.0083 U	0.00083 U	0.00083 UJ	NA	NA	0.00083 U	0.00083 U	0.00083 UJ	0.0014 U	0.00083 U	0.00083 UJ	NA	NA	NA
Dieldrin	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
Endosulfan I	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0083 U	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0043 U	0.00083 U	NA	NA	NA
Endosulfan II	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
Endosulfan sulfate	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
Endrin	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
Endrin aldehyde	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	NA	NA	NA
Endrin ketone	0.0017 UJ	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	NA	NA	0.017 U	0.0017 U	0.0017 U	NA	NA	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0037 U	NA	NA	NA
gamma-Chlordane	0.00083 UJ	NA	NA	NA	NA	0.00083 U	NA	NA	NA	NA	0.04 U	NA	NA	NA	NA	0.00083 U	NA	NA	0.0072 U	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0083 U	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	NA	NA	NA
Heptachlor	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0083 U	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	NA	NA	NA
Heptachlor epoxide	0.00083 UJ	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.052 U	0.00083 U	0.00083 U	NA	NA	0.00083 U	0.00083 U	0.00083 U	0.0091 U	0.03 U	0.016 U	NA	NA	NA
Methoxychlor	0.0083 UJ	0.0083 U	0.0083 U	NA	NA	0.0083 U	0.0083 U	0.0083 U	NA	NA	0.083 U	0.0083 U	0.0083 U	NA	NA	0.0083 U	0.0083 U	0.0083 U	0.0083 U	0.0083 U	0.0083 U	NA	NA	NA
Toxaphene	0.083 UJ	0.083 U	0.083 U	NA	NA	0.083 U	0.083 U	0.083 U	NA	NA	0.83 U	0.083 U	0.083 U	NA	NA	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U	NA	NA	NA
trans-Chlordane	NA	0.00083 U	0.00083 U	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	0.00083 U	0.00083 U	NA	0.011 U	0.028 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW10			MW11			MW11 (duplicate)		
Sample Date	4/15/2010	7/13/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010
Dissolved Metals (µg/L)									
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Arsenic	2.8	2.8	3	1.8	1.4	1.9	1.8	1.4	2
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chromium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Copper	2 U	3	2 U	2 U	2	2 U	2 U	3	2 U
Iron	11,300	13,800	13,900	10,600	11,100	13,000	10,800	11,100	12,200
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Manganese	210	200	200	320	271	294	326	272	279
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	0.5 U	0.5 U	2	0.5 U	0.7	0.5 J+	0.7	0.5 U	1 U
Selenium	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Silver	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Strontium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Zinc	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Total Metals (µg/L)									
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Arsenic	2.7	2.7	3	1.8	1.4	1.9	1.9	1.4	1.9
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chromium	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 UJ
Copper	3	2	2 U	2	3	2 U	2	3	2 U
Iron	11,300	13,100	14,100	10,800	9,930	12,500	10,800	10,800	12,100
Lead	3	1 U	2	1 U	1 U	1 U	1 U	1 U	1 U
Manganese	210	190	202	323	240	287	324	264	284
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	0.8 J	0.6	2.4	2.4 J	0.5 U	0.5	1.2 J	0.5 U	0.5
Selenium	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Silver	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Strontium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Zinc	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 UJ
TPH (mg/L)									
Gasoline Range Organics	0.25 U	0.25 U	0.25 U	0.48	0.57	0.35	0.49	0.57	0.63
Diesel Range Organics	0.25 U	0.13	0.1 U	1.2 J	0.77 J	0.27	0.84 J	0.56 J	0.32
Lube Oil	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.2 U	0.5 U	0.2 U	0.2 U
SVOCs (µg/L)									
1-Methylnaphthalene	1 U	1 U	1 U	2.8	2.8	3.1	2.7	2.8	2.6
2,2'-Oxybis(1-chloropropane)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4-Dichlorophenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,4-Dimethylphenol	1 U	1 U	1 U	**640**	120	140	**650**	120	110
2,4-Dinitrophenol	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Chloronaphthalene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Chlorophenol	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Methylnaphthalene	1 U	1 U	1 U	2.3	2	2.1	2.3	2	1.8
2-Methylphenol	1 U	1 U	1 U	120	17	19	120	17	17
2-Nitroaniline	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Nitrophenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
3,3'-Dichlorobenzidine	5 U	5 U	5 U	5 UJ	5 U	5 UJ	5 UJ	5 U	5 UJ

Sample ID	SP-01					
Sample Date	10/15/2008	12/17/2008	4/28/2009	7/23/2009	4/14/2010	7/15/2010	10/7/2010
Dissolved Metals (µg/L)							
Aluminum	60	50 U	50 UJ	50 U	NA	NA	NA
Antimony	50 U	50 U	50 UJ	50 U	NA	NA	NA
Arsenic	0.4	0.5 U	0.4 J-	1.2	0.4	1.2	1.2
Barium	201	181	181 J-	267	NA	NA	NA
Beryllium	1 U	1 U	1 UJ	1 U	NA	NA	NA
Cadmium	2 U	2 U	2 UJ	2 U	NA	NA	NA
Chromium	5 U	5 U	5 UJ	5 U	NA	NA	NA
Copper	2 U	2 U	2 UJ	2 U	NA	NA	NA
Iron	50 U	50 U	50 UJ	12,300	NA	NA	NA
Lead	1 U	1 U	1 UJ	1 U	1 U	1 U	1 U
Manganese	154	233	225 J-	173	NA	NA	NA
Mercury	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	31	23	20 J-	16	NA	NA	NA
Nickel	0.6	0.6	0.7 J-	0.5 U	NA	NA	NA
Selenium	50 U	50 U	50 UJ	50 U	NA	NA	NA
Silver	3 U	3 U	3 UJ	3 U	NA	NA	NA
Strontium	319	398	315 J-	326	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	5 U	5 U	5 UJ	5 U	NA	NA	NA
Vanadium	3 U	3 U	3 UJ	3 U	NA	NA	NA
Zinc	10 U	10 U	10 UJ	10 U	NA	NA	NA
Total Metals (µg/L)							
Aluminum	60	150	50 U	50 U	NA	NA	NA
Antimony	50 U	50 U	50 U	50 U	NA	NA	NA
Arsenic	1.4	1.4	1.3	1.3	1.4	1.3	1.3
Barium	300	279	251	258	NA	NA	NA
Beryllium	1 U	1 U	1 U	1 U	NA	NA	NA
Cadmium	2 U	2 U	2 U	2 U	NA	NA	NA
Chromium	5 U	5 U	5 U	5 U	NA	NA	NA
Copper	2 U	2 U	2 U	2 U	NA	NA	NA
Iron	15,900	22,100	15,500	12,100	NA	NA	NA
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Manganese	173	251	238	163	NA	NA	NA
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	21	24	20	15	NA	NA	NA
Nickel	1.9	1	0.8	0.5 U	NA	NA	NA
Selenium	50 U	50 U	50 U	50 U	NA	NA	NA
Silver	3 U	3 U	3 U	3 U	NA	NA	NA
Strontium	332	419	320	296	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	5 U	14	5	5	NA	NA	NA
Vanadium	3 U	3 U	3 U	3 U	NA	NA	NA
Zinc	10 U	10 U	10 U	10 U	NA	NA	NA
TPH (mg/L)							
Gasoline Range Organics	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA
Diesel Range Organics	0.44	0.56	0.65	0.74	0.25 U	0.1 U	0.1 U
Lube Oil	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U
SVOCs (µg/L)							
1-Methylnaphthalene	1 U	R	1 U	1 U	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	1 U	R	1 U	1 U	NA	NA	NA
2,4,5-Trichlorophenol	5 U	R	5 U	5 U	NA	NA	NA
2,4,6-Trichlorophenol	5 U	R	5 U	5 U	NA	NA	NA
2,4-Dichlorophenol	5 U	R	5 U	5 U	NA	NA	NA
2,4-Dimethylphenol	1 U	R	1 U	1 U	NA	NA	NA
2,4-Dinitrophenol	10 U	R	10 U	10 U	NA	NA	NA
2,4-Dinitrotoluene	5 U	R	5 U	5 U	NA	NA	NA
2,6-Dinitrotoluene	5 U	R	5 U	5 U	NA	NA	NA
2-Chloronaphthalene	1 U	R	1 U	1 U	NA	NA	NA
2-Chlorophenol	1 U	R	1 U	1 U	NA	NA	NA
2-Methylnaphthalene	1 U	R	1 U	1 U	NA	NA	NA
2-Methylphenol	1 U	R	1 U	1 U	NA	NA	NA
2-Nitroaniline	5 U	R	5 U	5 U	NA	NA	NA
2-Nitrophenol	5 U	R	5 U	5 U	NA	NA	NA
3,3'-Dichlorobenzidine	5 U	R	5 U	5 U	NA	NA	NA

Sample ID	SP-02					
Sample Date	10/15/2008	12/18/2008	4/28/2009	7/23/2009	4/15/2010	7/15/2010	10/7/2010
Dissolved Metals (µg/L)							
Aluminum	100 U	50 U	50 UJ	50 U	NA	NA	NA
Antimony	100 U	50 U	50 UJ	50 U	NA	NA	NA
Arsenic	2 U	0.5 U	0.7 J-	1.1	0.5 U	1.3	12
Barium	76	134	89 J-	160	NA	NA	NA
Beryllium	2 U	1 U	1 UJ	1 U	NA	NA	NA
Cadmium	4 U	2 U	2 UJ	2 U	NA	NA	NA
Chromium	10 U	5 U	5 UJ	5 U	NA	NA	NA
Copper	4 U	2 U	2 UJ	2 U	NA	NA	NA
Iron	100 U	50 U	70 J-	18,200	NA	NA	NA
Lead	5 U	1 U	1 UJ	1 U	1 U	1 U	10 U
Manganese	126	364	332 J-	321	NA	NA	NA
Mercury	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	40	13	5 UJ	5 U	NA	NA	NA
Nickel	7	3.5	0.8 J-	0.5 U	NA	NA	NA
Selenium	100 U	50 U	50 UJ	50 U	NA	NA	NA
Silver	11	3 U	3 UJ	3 U	NA	NA	NA
Strontium	3060	692	383 J-	397	NA	NA	NA
Thallium	1 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	2 U
Titanium	10 U	5 U	5 UJ	5 U	NA	NA	NA
Vanadium	6 U	3 U	3 UJ	3 U	NA	NA	NA
Zinc	20 U	10 U	10 UJ	10 U	NA	NA	NA
Total Metals (µg/L)							
Aluminum	270	2,230	680	900	NA	NA	NA
Antimony	100 U	50 U	50 U	50 U	NA	NA	NA
Arsenic	2 U	1.4	1.7	2.4	0.6	0.5	0.9
Barium	63	188	178	185	NA	NA	NA
Beryllium	2 U	1 U	1 U	1 U	NA	NA	NA
Cadmium	4 U	2 U	2 U	2 U	NA	NA	NA
Chromium	10 U	5 U	5 U	5 U	NA	NA	NA
Copper	4 U	5	2	2	NA	NA	NA
Iron	5,890	21,400	25,100	26,400	NA	NA	NA
Lead	5 U	1	1 U	1 U	1 U	1 U	1 U
Manganese	85	409	373	314	NA	NA	NA
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	40	14	5 U	5 U	NA	NA	NA
Nickel	8	5.4	2.4	2.7	NA	NA	NA
Selenium	100 U	50 U	50 U	50 U	NA	NA	NA
Silver	8	3 U	3 U	3 U	NA	NA	NA
Strontium	3,830	787	407	377	NA	NA	NA
Thallium	1 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	20	128	41	54	NA	NA	NA
Vanadium	6 U	7	5	5	NA	NA	NA
Zinc	20 U	10 U	10 U	10 U	NA	NA	NA
TPH (mg/L)							
Gasoline Range Organics	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA
Diesel Range Organics	0.25 U	0.31	0.33	0.51	0.25 UJ	0.1 U	0.1 U
Lube Oil	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.2 U	0.2 U
SVOCs (µg/L)							
1-Methylnaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	1 U	1 U	1 U	1 U	NA	NA	NA
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA
2,4-Dichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA
2,4-Dimethylphenol	1 U	1 U	1 U	1 U	NA	NA	NA
2,4-Dinitrophenol	10 U	10 U	10 U	10 U	NA	NA	NA
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA
2-Chloronaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA
2-Chlorophenol	1 U	1 U	1 U	1 U	NA	NA	NA
2-Methylnaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA
2-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA
2-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
2-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA
3,3'-Dichlorobenzidine	5 U	5 U	5 U	5 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW10			MW11			MW11 (duplicate)			SP-01							SP-02						
Sample Date	4/15/2010	7/13/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/28/2009	7/23/2009	4/14/2010	7/15/2010	10/7/2010	10/15/2008	12/18/2008	4/28/2009	7/23/2009	4/15/2010	7/15/2010	10/7/2010
SVOCs (µg/L) (Continued)																							
3-Nitroaniline	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	R	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA
4-Bromophenyl phenyl ether	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
4-Chloro-3-methylphenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	7.8 J	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chloroaniline	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
4-Methylphenol	1 U	1 U	1 U	280	34	32	280	35	27	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
4-Nitroaniline	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
4-Nitrophenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
Acenaphthene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Acenaphthylene	1 U	1 U	1 U	1 UJ	1 U	1 UJ	1 UJ	1 U	1 UJ	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Aniline	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Anthracene	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U	1 UJ	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzidine	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 U	10 U	R	R	10 U	NA	NA	NA	10 U	R	R	10 U	NA	NA	NA
Benzo(a)anthracene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(a)pyrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(b)fluoranthene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(g,h,i)perylene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(k)fluoranthene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzoic acid	10 U	10 U	10 U	62 J	10 U	10 U	60	10 U	10 U	10 U	R	10 U	10 U	NA	NA	NA	10 U	R	10 U	10 U	NA	NA	NA
Benzyl alcohol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	1 UJ	1 U	1 U	1 UJ	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
bis-(2-Chloroethyl)ether	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
bis(2-Ethylhexyl) phthalate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Butyl benzyl phthalate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.9 J	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Carbaryl (Sevin)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	1.9	3.5 J	2.6	11	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Carbazole	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Chrysene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenz(a,h)anthracene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenzofuran	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Diethyl phthalate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Dimethyl phthalate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-butyl phthalate	1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-octyl phthalate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Fluoranthene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Fluorene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobutadiene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorocyclopentadiene	5 U	5 U	5 UJ	5 U	5 U	5 UJ	5 U	5 U	5 UJ	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
Hexachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Isophorone	1 U	1 U	1 U	1 UJ	1 U	1 UJ	1 UJ	1 U	1 UJ	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Naphthalene	1 U	1 U	1 U	2.2	1.2	1.4	2.1	1.3	1.2	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Nitrobenzene	1 U	1 U	1 U	82 U	1 U	1 U	79 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
N- Nitrosodimethylamine	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitroso-Di-N-Propylamine	1 U	1 U	1 U	1 UJ	1 U	1 UJ	1 UJ	1 U	1 UJ	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitrosodiphenylamine	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U	5 UJ	1 U	R	1 U	1 U	NA	NA	NA	1 U	1.4 J	1.2	1.2	NA	NA	NA
Pentachlorophenol	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
Phenanthrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Phenol	1 U	1 U	1 U	8.6	1.2	1.6	8.4	1.2	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Pyrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	R	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Pyridine	5 U	5 U	5 UJ	5 UJ	5 U	5 UJ	5 UJ	5 U	5 UJ	5 U	R	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
PAHs (µg/L)																							
1-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.38 J	NA	0.32	NA	NA	NA	NA	0.088 J	NA	0.11	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.36 J	NA	0.28	NA	NA	NA	NA	0.024 J	NA	0.03	NA	NA	NA
Acenaphthene	0.14	0.18	0.14	0.31 J	0.34	0.34	0.29 J	0.35	0.28	0.32	0.37 J	0.38	0.38	NA	NA	NA	0.081	0.18 J	0.18	0.14	NA	NA	NA
Acenaphthylene	0.01 U	0.01 U	0.01 U	0.1 U	0.046 J	0.039 J	0.05 U	0.047 J	0.032 J	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Anthracene	0.023	0.01 U	0.01 U	0.1 U	0.019 J	0.01 U	0.05 U	0.028 J	0.01 U	0.024	0.029 J	0.022	0.028	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)anthracene	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.05 U	0.012 J	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)pyrene	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.05 U	0.01 U	0.01 U	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(b)fluoranthene	0.01 U	NA	NA	0.1 UJ	NA	NA	0.05 UJ	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(g,h,i)perylene	0.01 U	0.01 U	0.01 U	0.1 UJ	0.01 U	0.01 U	0.05 UJ	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(k)fluoranthene	0.01 U	NA	NA	0.1 U	NA	NA	0.05 U	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Chrysene	0.01 U	0.01 U	0.01 U	0.1 U	0.01 U	0.01 U	0.05 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW10			MW11			MW11 (duplicate)			SP-01							SP-02						
Sample Date	4/15/2010	7/13/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/28/2009	7/23/2009	4/14/2010	7/15/2010	10/7/2010	10/15/2008	12/18/2008	4/28/2009	7/23/2009	4/15/2010	7/15/2010	10/7/2010
PAHs (µg/L) (Continued)																							
Dibenz(a,h)anthracene	0.01 U	0.01 U	0.01 U	0.1 UJ	0.01 U	0.01 U	0.05 UJ	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.12 J	NA	0.12	NA	NA	NA	NA	0.039 J	NA	0.031	NA	NA	NA
Fluoranthene	0.01 U	0.01 U	0.01 U	0.1 U	0.029 J	0.031 J	0.091	0.021 J	0.024 J	0.028	0.037 J	0.036	0.035	NA	NA	NA	0.01 U	0.026 J	0.021	0.02	NA	NA	NA
Fluorene	0.05	0.071	0.052	0.37	0.46	0.44	0.35	0.5	0.37	0.18	0.24 J	0.21	0.2	NA	NA	NA	0.058	0.12 J	0.1	0.08	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.01 U	0.01 U	0.01 U	0.1 UJ	0.01 U	0.01 U	0.05 UJ	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Naphthalene	0.097	0.11	0.093	1.4 J	1 J	0.56	1.1 J	0.94 J	0.55	0.25	0.57 J	0.62	0.28	NA	NA	NA	0.032 U	0.038 J	0.049 U	0.052 U	NA	NA	NA
Phenanthrene	0.021	0.029	0.024	0.21	0.12	0.098 J	0.2	0.12	0.090 J	0.11	0.11 J	0.15	0.21	NA	NA	NA	0.019	0.035 J	0.026	0.032	NA	NA	NA
Pyrene	0.01 U	0.01 U	0.01 U	0.1 U	0.026	0.023 J	0.05 U	0.033	0.019 J	0.024	0.031 J	0.028	0.03	NA	NA	NA	0.012	0.03 J	0.024	0.028	NA	NA	NA
Total Benzofluoranthenes	NA	0.01 U	0.01 U	NA	0.01 U	0.01 U	NA	0.014	0.01 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOCs (µg/L)																							
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,1-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trimethylbenzene	1	0.8	0.7	6.6	4.2	4	6.5	4.4	4.1	0.8	0.4	0.5	1.1	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.3	0.4	0.4	0.3 J	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,3,5-Trimethylbenzene	0.2	0.2 U	0.2 U	1.4	0.9	0.8	1.4	0.9	0.8	0.2 U	0.2 U	0.2 U	0.3	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,3-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,4-Dichlorobenzene	0.2	0.2	0.2	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.7	0.8	0.6	0.6 J	NA	NA	NA	0.2 U	0.3	0.2	0.3 J	NA	NA	NA
2-Butanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U	2.5 U	5.9	5 U	NA	NA	NA	2.5 U	2.5 U	3.5	5 U	NA	NA	NA
2-Chloroethyl vinyl ether	R	R	1 U	R	R	R	R	R	R	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.4 J	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
2-Hexanone	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA
4-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
4-Isopropyltoluene	0.2 U	0.2 U	0.2 U	0.6	0.4	0.3	0.6	0.3	0.3	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA
Acetone	5 U	5 UJ	7	5 U	5 J	5.7	5 U	5 UJ	6	4.7	5.3 U	10 U	5 U	NA	NA	NA	6.9	8.9 U	14 U	5 U	NA	NA	NA
Acrylonitrile	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzene	2.5 U	2.2 U	2.7	8.3	3.7	6.4	8.6	3.9	5.9	2.6	2.4	1.9	2.2	NA	NA	NA	0.4	0.2 U	0.3	0.2	NA	NA	NA
Bromobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromodichloromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromoform	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromomethane	0.5 U	1 U	1 U	0.5 U	1 U	1 U	0.5 U	1 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
Carbon disulfide	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Carbon tetrachloride	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	7.6	8.2	5.7	6.8	NA	NA	NA	0.3	0.7	0.6	0.8	NA	NA	NA
Chloroethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloroform	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA
cis-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
cis-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Dibromochloromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Dichlorodifluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Ethyl ether	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 U	0.2 UJ	0.2 UJ	0.14 J	NA	0.14 J	0.15 J	NA	NA	NA	0.2 J	NA	0.42 J	0.56 J	NA	NA	NA
Ethylbenzene	0.2 U	0.2 U	0.2 U	3.1	1.3	1.8	3.2	1.3	1.6	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Ethylene dibromide	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Hexachlorobutadiene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
Isopropylbenzene	0.2 U	0.2 U	0.2 U	0.3	0.2	0.2 U	0.3	0.2	0.2	0.2	0.2 U	0.2 U	0.2	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
m,p-Xylene	2	1.6	1.8	11	6.4	7.4	11	6.6	7.4	1.9	1.5	1.2	2.2	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA
Methyl tert-butyl ether	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA
Methylene chloride	0.5 U	0.5 U	0.7	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
n-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.3	0.2	0.4	0.3	0.2	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
n-Propylbenzene	0.2 U	0.2 UJ	0.2 U	0.7	0.3 J	0.4	0.7	0.4 J	0.4	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
o-Xylene	3	2.4	2.8	5.9	3.7	4.4	6	3.8	4.3	2.7	1.7	1.6	3.1	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
sec-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Styrene	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 UJ	0.2 UJ	0.2 U	0.2 UJ	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	MW10			MW11			MW11 (duplicate)			SP-01							SP-02						
Sample Date	4/15/2010	7/13/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	4/15/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/28/2009	7/23/2009	4/14/2010	7/15/2010	10/7/2010	10/15/2008	12/18/2008	4/28/2009	7/23/2009	4/15/2010	7/15/2010	10/7/2010
VOCs (µg/L) (Continued)																							
tert-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Tetrachloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Toluene	2.6 U	2.2 U	2.6	20	8	12	20	8.1	11	1.8	1.4	1.3	1.7	NA	NA	NA	0.6 U	0.2 U	0.3	0.2 U	NA	NA	NA
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
trans-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Trichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Trichlorofluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Vinyl Chloride	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
PCBs (µg/L)																							
Aroclor 1016	1 U	1 U	5 U	1 U	1 U	10 U	1 U	1 U	10 U	0.01 U	0.2 UJ	0.1 U	0.3 U	0.5 U	0.1 U	1 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1221	1 U	1 U	5 U	1 U	1 U	10 U	1 U	1 U	10 U	0.01 U	0.2 UJ	0.1 U	0.3 U	0.5 U	0.1 U	1 U	0.01 U	0.01 UJ	0.01 U	0.05 U	0.01 U	0.01 U	0.01 U
Aroclor 1232	1 U	1 U	5 U	1 U	1 U	10 U	1 U	1 U	10 U	0.01 U	0.2 UJ	0.1 U	0.3 U	0.5 U	0.1 U	1 U	0.01 U	0.02 UJ	0.028	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1242	1 U	1 U	5 U	1 U	1 U	10 U	1 U	1 U	10 U	0.15 U	0.2 UJ	0.1 U	0.3 U	0.5 U	0.1 U	1 U	0.015 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1248	50 U	30 U	62 U	120 U	100 U	150 U	150 U	100 U	150 U	0.01 U	10 UJ	5 U	12 U	18 U	4.5 U	20 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.015 U	0.05 U	0.01 U
Aroclor 1254	5 U	15 U	5 U	5 U	25 U	50 U	10 U	25 U	50 U	0.25 U	1 UJ	2 U	1.2 U	0.5 U	2.5 U	1 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.25 U	0.01 U
Aroclor 1260	1 U	1 U	5 U	1 U	1 U	10 U	1 U	1 U	10 U	0.01 U	0.2 UJ	0.1 U	0.3 U	0.5 U	0.1 U	1 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Total PCBs	50 U	30 U	62 U	120 U	100 U	150 U	150 U	100 U	150 U	0.25 U	10 UJ	5 U	12 U	18 U	4.5 U	20 U	0.015 U	0.02 UJ	0.028	0.05 U	0.015 U	0.25 U	0.01 U
Pesticides (µg/L)																							
4,4'-DDD	0.017 U	**0.0058 J**	0.017 U	0.12 U	0.034 U	0.28 UJ	0.062 U	0.04 U	0.017 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
4,4'-DDE	**0.16**	**0.058 J**	0.094 U	2 U	**0.34 J**	0.017 UJ	1.2 U	**0.32 J**	0.35 UJ	0.06 U	0.17 UJ	0.083 U	0.17 U	0.11 U	**0.082 J**	0.073 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
4,4'-DDT	0.017 U	0.0017 UJ	0.017 U	0.17 U	0.017 U	0.017 UJ	0.017 U	0.017 U	0.017 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Aldrin	0.35 U	0.00083 UJ	1.5 U	0.083 U	0.083 U	1.9 UJ	0.06 U	0.083 U	1.6 UJ	0.0017 U	1.2 UJ	0.042 U	0.083 U	0.095 U	0.13 U	0.21 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
alpha-Chlordane	0.0083 U	NA	NA	0.0083 U	NA	NA	0.0083 U	NA	NA	0.0017 U	0.083 UJ	0.042 U	0.083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	NA	NA
alpha-BHC	0.0083 U	0.00083 UJ	0.0083 U	0.043 U	0.0083 U	0.035 UJ	0.022 U	0.0083 U	0.024 UJ	0.0017 U	0.083 UJ	0.042 U	0.083 U	0.0034 U	0.0083 U	0.0083 U	0.0017 U	0.0017 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
beta-BHC	0.0083 U	0.00083 UJ	0.0083 U	0.083 U	0.069 U	0.063 UJ	0.083 U	0.083 U	0.055 UJ	0.0048 U	0.083 UJ	0.042 U	0.083 U	0.0056 U	0.0083 U	0.0083 U	0.0017 U	0.0029 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
cis-Chlordane	NA	0.00083 UJ	0.0083 U	NA	0.0083 U	0.79 UJ	NA	0.0083 U	0.62 UJ	NA	NA	NA	NA	NA	0.0083 U	0.0083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U
delta-BHC	0.0083 U	0.0024 UJ	0.0083 UJ	0.083 U	0.052 U	0.065 UJ	0.059 U	0.06 U	0.063 UJ	0.0017 U	0.083 UJ	0.042 U	0.083 U	0.0025 U	0.0083 U	0.0083 UJ	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 UJ
Dieldrin	0.017 U	0.0017 UJ	0.017 U	2 U	0.017 U	0.41 UJ	1.2 U	0.017 U	0.41 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.058 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Endosulfan I	0.0083 U	0.09 UJ	0.085 U	0.083 U	0.083 U	0.17 UJ	0.38 U	0.083 U	0.12 UJ	0.0039 U	0.083 UJ	0.042 U	0.083 U	0.028 U	0.037 U	0.012 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
Endosulfan II	0.017 U	0.0017 UJ	0.017 U	0.077 U	0.028 U	0.046 UJ	0.058 U	0.03 U	0.043 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Endosulfan sulfate	0.017 U	0.0017 UJ	0.017 U	0.017 U	0.017 U	0.017 UJ	0.017 U	0.017 U	0.017 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Endrin	0.017 U	0.0017 UJ	0.017 U	0.017 U	0.017 U	0.062 UJ	0.17 U	0.017 U	0.028 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Endrin aldehyde	0.017 U	0.0017 UJ	0.017 U	0.017 U	0.017 U	0.017 UJ	0.017 U	0.017 U	0.017 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
Endrin ketone	0.017 U	0.0017 UJ	0.017 U	0.017 U	0.017 U	0.017 UJ	0.017 U	0.017 U	0.017 UJ	0.0033 U	0.17 UJ	0.083 U	0.17 U	0.0016 U	0.017 U	0.017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U
gamma-Chlordane	0.28 U	NA	NA	0.0083 U	NA	NA	0.083 U	NA	NA	0.0017 U	0.23 UJ	0.042 U	0.16 U	0.031 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	NA	NA
gamma-BHC (Lindane)	0.0083 U	0.00083 UJ	0.0083 U	0.083 U	0.083 U	0.44 UJ	0.083 U	0.083 U	0.54 UJ	0.0017 U	0.083 UJ	0.042 U	0.083 U	0.0008 U	0.0083 U	0.0083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
Heptachlor	0.0083 U	0.00083 UJ	0.0083 U	0.31 U	0.083 U	0.47 UJ	0.05 U	0.083 U	0.48 UJ	0.0017 U	0.083 UJ	0.042 U	0.083 U	0.081 U	0.0083 U	0.0083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
Heptachlor epoxide	0.64 U	0.3 UJ	0.3 U	0.29 U	0.083 U	0.67 UJ	0.077 U	0.083 U	0.54 UJ	0.052 U	0.44 UJ	0.32 U	0.39 U	0.11 U	0.16 U	0.21 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U
Methoxychlor	0.083 U	0.0083 UJ	0.083 U	0.083 U	0.083 U	0.083 UJ	0.083 U	0.083 U	0.083 UJ	0.017 U	0.83 UJ	0.42 U	0.83 U	0.008 U	0.083 U	0.083 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.0083 U	0.0083 U	0.0083 U
Toxaphene	0.83 U	0.083 UJ	0.83 U	0.83 U	0.83 U	0.83 UJ	0.83 U	0.83 U	0.83 UJ	0.26 U	8.3 UJ	4.2 U	8.3 U	0.08 U	0.83 U	0.83 U	0.17 U	0.083 UJ	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U
trans-Chlordane	NA	0.25 UJ	0.22 U	NA	0.0083 U	0.58 UJ	NA	0.0083 U	0.43 UJ	NA	NA	NA	NA	NA	0.11 U	0.12 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SP-03							SW-01							SW-03						
Sample Date	10/15/2008	12/15/2008	4/28/2009	7/24/2009	4/15/2010	7/15/2010	10/7/2010	10/14/2008	12/14/2008	4/28/2009	7/24/2009	4/13/2010	7/12/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/24/2009	4/13/2010	7/12/2010	10/7/2010
Dissolved Metals (µg/L)																					
Aluminum	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	70	50 U	50 UJ	50 U	NA	NA	NA
Antimony	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA
Arsenic	0.8	0.5 U	0.6 J-	0.8	0.5 U	0.5 U	0.8	3.2	2.4	2.9 J-	5.1	2.4	3.8	4.1	1.1	5 U	1.8 J-	1.8	1.3	3.8	1.1
Barium	63	61	72 J-	104	NA	NA	NA	9	6	8 J-	18	NA	NA	NA	3 U	26	10 J-	5	NA	NA	NA
Beryllium	1 U	1 U	1 UJ	1 U	NA	NA	NA	1 U	1 U	1 UJ	1 U	NA	NA	NA	1 U	1 U	1 UJ	1 U	NA	NA	NA
Cadmium	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U	NA	NA	NA
Chromium	5 U	5 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U	NA	NA	NA
Copper	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U	NA	NA	NA	2 U	3	2 UJ	2	NA	NA	NA
Iron	50 U	50 U	3,940 J-	25,800	NA	NA	NA	50 U	120	50 UJ	320	NA	NA	NA	530	60	370 J-	370	NA	NA	NA
Lead	1 U	1 U	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U	1 U	1 U	5 U	1 UJ	1 U	1 U	1 U	1 U
Manganese	434	477	545 J-	444	NA	NA	NA	13	22	391 J-	150	NA	NA	NA	203	335	159 J-	180	NA	NA	NA
Mercury	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	17	12	5 UJ-	5 U	NA	NA	NA	15	6	5 UJ	5 U	NA	NA	NA	15	20	6 J-	5 U	NA	NA	NA
Nickel	2.4	2.7	0.6 J-	0.6	NA	NA	NA	4.5	3.4	5.8 J-	3.6	NA	NA	NA	3	9	5.1 J-	3.8	NA	NA	NA
Selenium	50 U	50 U	50 UJ-	50	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA
Silver	3 U	3 U	3 UJ-	3 U	NA	NA	NA	3 U	3 U	3 UJ	3 U	NA	NA	NA	3 U	3 U	3 UJ	3 U	NA	NA	NA
Strontium	414	582	408 J-	474	NA	NA	NA	196	92	154 J-	196	NA	NA	NA	263	2770	351 J-	800	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 UJ-	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U
Titanium	5 U	5 U	5 UJ-	5 U	NA	NA	NA	5 U	5	5 UJ	5 U	NA	NA	NA	5 U	9	5 UJ	7	NA	NA	NA
Vanadium	3 U	3 U	3 UJ-	3 U	NA	NA	NA	3 U	3 U	3 UJ	3	NA	NA	NA	3 U	3 U	3 UJ	3 U	NA	NA	NA
Zinc	10 U	10 U	10 UJ-	10 U	NA	NA	NA	10 U	10 U	10 UJ	10 U	NA	NA	NA	10 U	10 U	10 UJ	10 U	NA	NA	NA
Total Metals (µg/L)																					
Aluminum	580	50	50 U	80	NA	NA	NA	170	650	440	13,200	NA	NA	NA	290	100	3,080	140	NA	NA	NA
Antimony	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA
Arsenic	1.3	0.5 U	1.1	0.8	0.9	1.5	2.2	4.8	5.8	5	21.3 J	6.6	20.1	6.5	2.2	2 U	3	2.5 J	2	11	1.7
Barium	206	89	165	100	NA	NA	NA	12	13	15	86	NA	NA	NA	7	27	31	7	NA	NA	NA
Beryllium	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Cadmium	2 U	2 U	2 U	2 U	NA	NA	NA	2 U	2 U	2 U	2 U	NA	NA	NA	2 U	2 U	2 U	2 U	NA	NA	NA
Chromium	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	31	NA	NA	NA	5 U	5 U	8	5 U	NA	NA	NA
Copper	2 U	2 U	2 U	2 U	NA	NA	NA	2 U	5	2	38	NA	NA	NA	2 U	4	10	3	NA	NA	NA
Iron	55,300	19,800	41,100	25,400	NA	NA	NA	800	1610	890	16,500	NA	NA	NA	1,790	650	7,920	1,360	NA	NA	NA
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1	1 U	2	1 U	24	2	9	1 U	1 U	5 U	3	1 U	1 U	13	1 U
Manganese	557	495	570	395	NA	NA	NA	50	660	414	313	NA	NA	NA	230	353	276	195	NA	NA	NA
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.0284	0.02 U	0.0649	0.02 U	0.0215	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.071	0.02 U
Molybdenum	8	13	5 U	5 U	NA	NA	NA	10	6	5 U	9	NA	NA	NA	7	22	6	5 U	NA	NA	NA
Nickel	3.2	1.2	0.9	1	NA	NA	NA	5.2	8.1	7.4	72.2 J	NA	NA	NA	4.2	9	12.6	4.6 J	NA	NA	NA
Selenium	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA
Silver	3 U	3 U	3 U	3 U	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	NA
Strontium	452	603	424	407	NA	NA	NA	196	100	164	217	NA	NA	NA	265	2,900	381	820	NA	NA	NA
Thallium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 U	1 U	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U
Titanium	31	7	8	11	NA	NA	NA	10	44	28	777	NA	NA	NA	19	18	156	16	NA	NA	NA
Vanadium	8	3 U	3	3 U	NA	NA	NA	5	5	4	76	NA	NA	NA	3 U	3 U	11	3	NA	NA	NA
Zinc	20	10 U	10 U	10 U	NA	NA	NA	10 U	10	10 U	150	NA	NA	NA	10 U	10 U	20	10 U	NA	NA	NA
TPH (mg/L)																					
Gasoline Range Organics	0.25 U	0.25 U	0.25 U	0.25 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diesel Range Organics	0.4	0.55	0.64	0.76	0.25 UJ	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lube Oil	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.2 U	0.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SVOCs (µg/L)																					
1-Methylnaphthalene	4	5.2	5.3	3.6	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2,2'-Oxybis(1-chloropropane)	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
2,4-Dichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
2,4-Dimethylphenol	1 U	57	13	1.9	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2,4-Dinitrophenol	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
2-Chloronaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Chlorophenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Methylnaphthalene	2.9	4.4	4.2	3.6	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
2-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
3,3'-Dichlorobenzidine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SP-03						
Sample Date	**10/15/2008**	**12/15/2008**	**4/28/2009**	**7/24/2009**	**4/15/2010**	**7/15/2010**	**10/7/2010**
SVOCs (µg/L) (Continued)							
3-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	NA	NA	NA
4-Bromophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA
4-Chloro-3-methylphenol	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chloroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA
4-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA
4-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA
Acenaphthene	1	1.3	1.2	1.1	NA	NA	NA
Acenaphthylene	1 U	1 U	1 U	1 U	NA	NA	NA
Aniline	1 U	1 U	1 U	1 U	NA	NA	NA
Anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzidine	10 U	R	R	10 U	NA	NA	NA
Benzo(a)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(a)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(b)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(g,h,i)perylene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(k)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzoic acid	10 U	R	10 U	10 U	NA	NA	NA
Benzyl alcohol	5 U	5 U	5 U	5 U	NA	NA	NA
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	1 U	NA	NA	NA
bis-(2-Chloroethyl)ether	1 U	1 U	1 U	1 U	NA	NA	NA
bis(2-Ethylhexyl) phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Butyl benzyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Carbaryl (Sevin)	1 U	1 U	1 U	1 U	NA	NA	NA
Carbazole	1 U	1 U	1 U	1 U	NA	NA	NA
Chrysene	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenz(a,h)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenzofuran	1 U	1 U	1 U	1 U	NA	NA	NA
Diethyl phthalate	1 U	1.4	1 U	1 U	NA	NA	NA
Dimethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-butyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-octyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Fluorene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobenzene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobutadiene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorocyclopentadiene	5 U	5 U	5 U	5 U	NA	NA	NA
Hexachloroethane	1 U	1 U	1 U	1 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Isophorone	1 U	1 U	1 U	1 U	NA	NA	NA
Naphthalene	1 U	1 U	1 U	1 U	NA	NA	NA
Nitrobenzene	1 U	1 U	1 U	1 U	NA	NA	NA
N- Nitrosodimethylamine	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitroso-Di-N-Propylamine	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitrosodiphenylamine	1 U	1 U	1 U	1 U	NA	NA	NA
Pentachlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA
Phenanthrene	1 U	1 U	1 U	1 U	NA	NA	NA
Phenol	1 U	1 U	1 U	1 U	NA	NA	NA
Pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Pyridine	5 U	5 U	5 U	5 U	NA	NA	NA
PAHs (µg/L)							
1-Methylnaphthalene	NA	2.8 J	NA	2.8	NA	NA	NA
2-Methylnaphthalene	NA	2.8 J	NA	2.5	NA	NA	NA
Acenaphthene	0.86	0.89 J	1.1	0.91	NA	NA	NA
Acenaphthylene	0.029	0.026 J	0.022 J	0.021 J	NA	NA	NA
Anthracene	0.044	0.059 J	0.047	0.046	NA	NA	NA
Benzo(a)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)pyrene	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(b)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(g,h,i)perylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(k)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Chrysene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA

Sample ID	SW-01						
Sample Date	**10/14/2008**	**12/14/2008**	**4/28/2009**	**7/24/2009**	**4/13/2010**	**7/12/2010**	**10/7/2010**
SVOCs (µg/L) (Continued)							
3-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	NA	NA	NA
4-Bromophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA
4-Chloro-3-methylphenol	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chloroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA
4-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA
4-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA
Acenaphthene	1 U	1 U	1 U	1 U	NA	NA	NA
Acenaphthylene	1 U	1 U	1 U	1 U	NA	NA	NA
Aniline	1 U	1 U	1 U	1 U	NA	NA	NA
Anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzidine	10 U	R	R	10 U	NA	NA	NA
Benzo(a)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(a)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(b)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(g,h,i)perylene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(k)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzoic acid	10 U	R	10 U	10 U	NA	NA	NA
Benzyl alcohol	5 U	5 U	5 U	5 U	NA	NA	NA
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	1 U	NA	NA	NA
bis-(2-Chloroethyl)ether	1 U	1 U	1 U	1 U	NA	NA	NA
bis(2-Ethylhexyl) phthalate	1.5 U	1.6	1 U	1 U	NA	NA	NA
Butyl benzyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Carbaryl (Sevin)	1 U	1 U	1 U	1 U	NA	NA	NA
Carbazole	1 U	1 U	1 U	1 U	NA	NA	NA
Chrysene	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenz(a,h)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenzofuran	1 U	1 U	1 U	1 U	NA	NA	NA
Diethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Dimethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-butyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-octyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Fluorene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobenzene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobutadiene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorocyclopentadiene	5 U	5 U	5 U	5 U	NA	NA	NA
Hexachloroethane	1 U	1 U	1 U	1 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Isophorone	1 U	1 U	1 U	1 U	NA	NA	NA
Naphthalene	1 U	1 U	1 U	1 U	NA	NA	NA
Nitrobenzene	1 U	1 U	1 U	1 U	NA	NA	NA
N- Nitrosodimethylamine	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitroso-Di-N-Propylamine	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitrosodiphenylamine	1 U	1 U	1 U	1 U	NA	NA	NA
Pentachlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA
Phenanthrene	1 U	1 U	1 U	1 U	NA	NA	NA
Phenol	1 U	1 U	1 U	1 U	NA	NA	NA
Pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Pyridine	5 U	5 U	5 U	5 U	NA	NA	NA
PAHs (µg/L)							
1-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA
2-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA
Acenaphthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Acenaphthylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)pyrene	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(b)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(g,h,i)perylene	0.01 U	0.01 UJ	0.01 U	0.022	NA	NA	NA
Benzo(k)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Chrysene	0.01 U	0.01 UJ	0.01 U	0.014	NA	NA	NA

Sample ID	SW-03						
Sample Date	**10/15/2008**	**12/17/2008**	**4/29/2009**	**7/24/2009**	**4/13/2010**	**7/12/2010**	**10/7/2010**
SVOCs (µg/L) (Continued)							
3-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	NA	NA	NA
4-Bromophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA
4-Chloro-3-methylphenol	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chloroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA
4-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA
4-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA
4-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA
Acenaphthene	1 U	1 U	1 U	1 U	NA	NA	NA
Acenaphthylene	1 U	1 U	1 U	1 U	NA	NA	NA
Aniline	1 U	1 U	1 U	1 U	NA	NA	NA
Anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzidine	10 U	R	R	10 U	NA	NA	NA
Benzo(a)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(a)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(b)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(g,h,i)perylene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzo(k)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Benzoic acid	10 U	R	10 U	10 U	NA	NA	NA
Benzyl alcohol	5 U	5 U	5 U	5 U	NA	NA	NA
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	1 U	NA	NA	NA
bis-(2-Chloroethyl)ether	1 U	1 U	1 U	1 U	NA	NA	NA
bis(2-Ethylhexyl) phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Butyl benzyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Carbaryl (Sevin)	1 U	1 U	1 U	1 U	NA	NA	NA
Carbazole	1 U	1 U	1 U	1 U	NA	NA	NA
Chrysene	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenz(a,h)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA
Dibenzofuran	1 U	1 U	1 U	1 U	NA	NA	NA
Diethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Dimethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-butyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Di-n-octyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA
Fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA
Fluorene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobenzene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorobutadiene	1 U	1 U	1 U	1 U	NA	NA	NA
Hexachlorocyclopentadiene	5 U	5 U	5 U	5 U	NA	NA	NA
Hexachloroethane	1 U	1 U	1 U	1 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Isophorone	1 U	1 U	1 U	1 U	NA	NA	NA
Naphthalene	1 U	1 U	1 U	1 U	NA	NA	NA
Nitrobenzene	1 U	1 U	1 U	1 U	NA	NA	NA
N- Nitrosodimethylamine	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitroso-Di-N-Propylamine	5 U	5 U	5 U	5 U	NA	NA	NA
N- Nitrosodiphenylamine	1 U	1 U	1 U	1 U	NA	NA	NA
Pentachlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA
Phenanthrene	1 U	1 U	1 U	1 U	NA	NA	NA
Phenol	1 U	1 U	1 U	1 U	NA	NA	NA
Pyrene	1 U	1 U	1 U	1 U	NA	NA	NA
Pyridine	5 U	5 U	5 U	5 U	NA	NA	NA
PAHs (µg/L)							
1-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA
2-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA
Acenaphthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Acenaphthylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(a)pyrene	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(b)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(g,h,i)perylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Benzo(k)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Chrysene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SP-03							SW-01							SW-03						
Sample Date	10/15/2008	12/15/2008	4/28/2009	7/24/2009	4/15/2010	7/15/2010	10/7/2010	10/14/2008	12/14/2008	4/28/2009	7/24/2009	4/13/2010	7/12/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/24/2009	4/13/2010	7/12/2010	10/7/2010
PAHs (µg/L) (Continued)																					
Dibenz(a,h)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Dibenzofuran	NA	0.3 J	NA	0.31	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA
Fluoranthene	0.064	0.07 J	0.087	0.064	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.011	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Fluorene	0.51	0.62 J	0.61	0.49	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Naphthalene	0.21 U	0.11 J	0.18	0.13 U	NA	NA	NA	0.014 U	0.01 UJ	0.022 U	0.01 U	NA	NA	NA	0.011 U	0.014 UJ	0.01 U	0.01 U	NA	NA	NA
Phenanthrene	0.4	0.42 J	0.52	0.43	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.011	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Pyrene	0.05	0.051 J	0.057	0.045	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.013	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA
Total Benzofluoranthenes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOCs (µg/L)																					
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,1-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,1-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2,4-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
1,2-Dichlorobenzene	0.3	0.3	0.3	0.3 J	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,2-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,3,5-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,3-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
1,4-Dichlorobenzene	1.7	2	1.8	1.6 J	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
2-Butanone	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA
2-Chloroethyl vinyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
2-Hexanone	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA
4-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
4-Isopropyltoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA
Acetone	12	20 U	9.6 U	5 U	NA	NA	NA	3 U	3.5 U	2.5 U	5 U	NA	NA	NA	3.1	7.2 U	4.7 U	5 U	NA	NA	NA
Acrylonitrile	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Benzene	0.8	0.8	0.8	0.6	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromodichloromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Bromoform	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	17	NA	NA	NA
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
Carbon disulfide	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	4.1	NA	NA	NA	0.2 U	0.2 U	0.2	0.2 U	NA	NA	NA
Carbon tetrachloride	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chlorobenzene	4.1	4.5	4	3.9	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloroethane	0.4	0.4	0.3	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloroform	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Chloromethane	0.2 U	0.2	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA
*cis-*1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
*cis-*1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Dibromochloromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.3	NA	NA	NA
Dichlorodifluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Ethyl ether	0.84 J	NA	0.87 J	0.79 J	NA	NA	NA	1 U	NA	1 U	1 U	NA	NA	NA	1 U	NA	1 U	1 U	NA	NA	NA
Ethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Ethylene dibromide	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Hexachlorobutadiene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
Isopropylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
m,p-Xylene	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA
Methyl tert-butyl ether	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA
Methylene chloride	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA
n-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
n-Propylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
o-Xylene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
sec-Butylbenzene	0.2	0.2 U	0.2	0.2	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Styrene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SP-03							SW-01							SW-03						
Sample Date	10/15/2008	12/15/2008	4/28/2009	7/24/2009	4/15/2010	7/15/2010	10/7/2010	10/14/2008	12/14/2008	4/28/2009	7/24/2009	4/13/2010	7/12/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/24/2009	4/13/2010	7/12/2010	10/7/2010
VOCs (µg/L) (Continued)																					
tert-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Tetrachloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Toluene	0.3 U	0.2 U	0.3	0.2 U	NA	NA	NA	0.2 U	0.4	0.2 U	32	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
trans-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Trichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Trichlorofluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
Vinyl Chloride	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA
PCBs (µg/L)																					
Aroclor 1016	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1221	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.015 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1232	0.01 U	0.086 J	0.091	0.1 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1242	0.035 J	0.029 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U
Aroclor 1248	0.01 U	0.01 UJ	0.01 U	0.01 U	0.017 J	0.035 U	0.03 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.025 U	0.01 U
Aroclor 1254	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.025 U	0.015 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Aroclor 1260	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Total PCBs	0.035 J	**0.115**	**0.091**	0.1 U	0.017 J	0.035 U	0.03 U	0.01 U	0.05 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.015 UJ	0.01 U	0.01 U	0.01 U	0.025 U	0.02 U
Pesticides (µg/L)																					
4,4'-DDD	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
4,4'-DDE	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
4,4'-DDT	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
Aldrin	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U
alpha-Chlordane	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA
alpha-BHC	0.0017 U	0.0034 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.0023 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U
beta-BHC	0.0017 U	0.0065 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.01 U	0.00083 U
cis-Chlordane	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U
delta-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 UJ	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 UJ	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U
Dieldrin	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
Endosulfan I	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U
Endosulfan II	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
Endosulfan sulfate	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
Endrin	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
Endrin aldehyde	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
Endrin ketone	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U
gamma-Chlordane	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.0049 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA
gamma-BHC (Lindane)	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0017	0.00083 U	0.00083 U
Heptachlor	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.0049 U	0.00083 U
Heptachlor epoxide	0.0017 U	0.00083 UJ	0.0013 U	0.00083 U	0.00083 U	0.00083 U	0.001 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.00091 U	0.00083 U	0.00083 U
Methoxychlor	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.0083 U	0.0083 U	0.0083 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.0083 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.0083 U
Toxaphene	0.17 U	0.083 UJ	0.083 U	0.083 U	0.083 U	0.083 U	0.083 U	0.17 U	0.083 UJ	0.083 U	0.33 U	0.08 U	0.083 U	0.083 U	0.17 U	0.083 UJ	0.083 U	0.083 U	0.32 U	0.083 U	0.083 U
trans-Chlordane	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SW-04							SW-05							SW-06							SW-07	
Sample Date	10/15/2008	12/18/2008	4/29/2009	7/24/2009	4/13/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/6/2010	12/17/2008	4/28/2009
Dissolved Metals (µg/L)																							
Aluminum	50 U	100 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	100 U	50 U	50 UJ	100 U	NA	NA	NA	50 U	50 UJ
Antimony	50 U	100 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	100 U	50 U	50 UJ	100 U	NA	NA	NA	50 U	50 UJ
Arsenic	2	2 U	2 J-	3	1.4	4.6	1.6	1 U	1 U	1.7 J-	3	0.6	2.5	1.3	3	5 U	4 J-	5	1	3	2	0.5	0.6 J-
Barium	4	33	11 J-	12	NA	NA	NA	13	18	22 J-	20	NA	NA	NA	11	18	14 J-	12	NA	NA	NA	43	71 J-
Beryllium	1 U	2 U	1 UJ	1 U	NA	NA	NA	1 U	1 U	1 UJ	1 U	NA	NA	NA	2 U	1 U	1 UJ	2 U	NA	NA	NA	1 U	1 UJ
Cadmium	2 U	4 U	2 UJ	2 U	NA	NA	NA	2 U	2 U	2 UJ	2 U	NA	NA	NA	4 U	2 U	2 UJ	4 U	NA	NA	NA	2 U	2 UJ
Chromium	5 U	10 U	5 UJ	5 U	NA	NA	NA	5 U	5 U	5 UJ	5 U	NA	NA	NA	10 U	5 U	5 UJ	10 U	NA	NA	NA	5 U	5 UJ
Copper	2 U	5	3 J-	3	NA	NA	NA	2 U	3	2 J-	4	NA	NA	NA	4 U	3	3 J-	6	NA	NA	NA	2 U	2 UJ
Iron	280	100 U	170 J-	180	NA	NA	NA	50 U	300	50 UJ	70	NA	NA	NA	100 U	50 U	50 UJ	100 U	NA	NA	NA	50 U	50 UJ
Lead	1 U	5 U	2 UJ	2 U	1 U	1 U	1 U	1 U	2 U	1 UJ	5 U	1 U	1 U	1 U	5 U	5 U	5 UJ	5 U	1 U	5 U	2 U	1 U	1 UJ
Manganese	68	246	164 J-	55	NA	NA	NA	345	227	795 J-	75	NA	NA	NA	80	132	289 J-	32	NA	NA	NA	229	169 J-
Mercury	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 UJ
Molybdenum	13	40	7 J-	5 U	NA	NA	NA	21	13	5 UJ	5	NA	NA	NA	40	20	8 J-	10 U	NA	NA	NA	24	19 J-
Nickel	2.6	11	5 J-	5	NA	NA	NA	5.8	3	4 J-	6	NA	NA	NA	8	7	6 J-	7	NA	NA	NA	4	1.7 J-
Selenium	50 U	100 U	50 UJ	50 U	NA	NA	NA	50 U	50 U	50 UJ	50 U	NA	NA	NA	100 U	50 U	50 UJ	100 U	NA	NA	NA	50 U	50 UJ
Silver	3 U	6 U	3 UJ	3 U	NA	NA	NA	3 U	3 U	3 UJ	3 U	NA	NA	NA	8	3 U	3 UJ	6 U	NA	NA	NA	3 U	3 UJ
Strontium	425	3750	802 J-	1740	NA	NA	NA	1,340	729	621 J-	2,480	NA	NA	NA	3,630	2,470	1,860 J-	3,650	NA	NA	NA	280	327 J-
Thallium	0.2 U	1 U	0.5 UJ	0.5 U	0.2 U	0.2 U	0.2 U	0.2 U	0.5 U	0.2 UJ	1 U	0.2 U	0.2 U	0.2 U	1 U	1 U	1 UJ	1 U	0.2 U	1 U	0.5 U	0.2 U	0.2 UJ
Titanium	5 U	10 U	5 UJ	7	NA	NA	NA	5 U	5 U	5 UJ	6	NA	NA	NA	10 U	7	7 J-	10	NA	NA	NA	5 U	5 UJ
Vanadium	3 U	6 U	3 J-	4	NA	NA	NA	3 U	3 U	3 UJ	4	NA	NA	NA	6 U	3 U	4 J-	6 U	NA	NA	NA	3 U	3 UJ
Zinc	10 U	20 U	10 UJ	10 U	NA	NA	NA	10 U	20	10 UJ	10 U	NA	NA	NA	20 U	10 U	10 UJ	20 U	NA	NA	NA	10 U	10 UJ
Total Metals (µg/L)																							
Aluminum	1,570	4,240	440	1,090	NA	NA	NA	120	400	190	90	NA	NA	NA	100 U	2,250	370	100 U	NA	NA	NA	110	50 U
Antimony	50 U	100 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA	100 U	50 U	50 U	100 U	NA	NA	NA	50 U	50 U
Arsenic	2.8	8	2	4 J	1.4	5.2	1.6	1.5	0.8	1.6	4 J	1.2	3.2	1.9	3	3	3	5 J	1.4	4	0.8	1.7	1.4
Barium	12	49	13	18	NA	NA	NA	15	18	24	20	NA	NA	NA	14	26	15	14	NA	NA	NA	92	115
Beryllium	1 U	2 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	2 U	1 U	1 U	2 U	NA	NA	NA	1 U	1 U
Cadmium	2 U	4 U	2 U	2 U	NA	NA	NA	2 U	2 U	2 U	2 U	NA	NA	NA	4 U	2 U	2 U	4 U	NA	NA	NA	2 U	2 U
Chromium	5	10	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	10 U	5 U	5 U	10 U	NA	NA	NA	5 U	5 U
Copper	4	12	4	6	NA	NA	NA	2 U	4	3	4	NA	NA	NA	4 U	8	4	7	NA	NA	NA	3	2 U
Iron	3,490	7,580	1,020	2,440	NA	NA	NA	1,700	1,080	2,010	720	NA	NA	NA	490	4620	1370	500	NA	NA	NA	18,000	12,800
Lead	1	5 U	2 U	2 U	1 U	2	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	5 U	5 U	5 U	5 U	1 U	5 U	2 U	1	1 U
Manganese	125	382	176	107	NA	NA	NA	366	243	782	89	NA	NA	NA	90	239	300	38	NA	NA	NA	262	197
Mercury	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Molybdenum	8	40	6	5 U	NA	NA	NA	22	13	5 U	5	NA	NA	NA	40	20	8	10 U	NA	NA	NA	26	18
Nickel	6	17	5	7 J	NA	NA	NA	6.9	4.8	4.1	7 J	NA	NA	NA	8	11	6	10 J	NA	NA	NA	4.7	2
Selenium	50 U	100 U	50 U	50 U	NA	NA	NA	50 U	50 U	50 U	50 U	NA	NA	NA	100 U	50 U	50 U	100 U	NA	NA	NA	50 U	50 U
Silver	3 U	6 U	3 U	3 U	NA	NA	NA	3	3 U	3 U	3 U	NA	NA	NA	7	3 U	3 U	6 U	NA	NA	NA	3 U	3 U
Strontium	431	3,970	805	1,790	NA	NA	NA	1,400	738	606	2,320	NA	NA	NA	3,700	2,530	1,790	3,630	NA	NA	NA	299	347
Thallium	0.2 U	1 U	0.5 U	0.5 UJ	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1 UJ	0.2 U	0.2 U	0.2 U	1 U	1 U	1 U	1 UJ	0.2 U	1 U	0.5 U	0.2 U	0.2 U
Titanium	83	250	29	79	NA	NA	NA	6	21	12	14	NA	NA	NA	10 U	142	27	20	NA	NA	NA	11	5 U
Vanadium	7	9	5	7	NA	NA	NA	3 U	3 U	3 U	4	NA	NA	NA	6 U	7	6	6	NA	NA	NA	3 U	3 U
Zinc	20	20 U	10 U	10 U	NA	NA	NA	20	20	20	10 U	NA	NA	NA	20 U	10 U	10 U	20 U	NA	NA	NA	40	10 U
TPH (mg/L)																							
Gasoline Range Organics	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diesel Range Organics	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lube Oil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SVOCs (µg/L)																							
1-Methylnaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2,2'-Oxybis(1-chloropropane)	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2,4,5-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
2,4,6-Trichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
2,4-Dichlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
2,4-Dimethylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	520 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2,4-Dinitrophenol	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U
2,4-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
2,6-Dinitrotoluene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
2-Chloronaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2-Chlorophenol	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2-Methylnaphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	37 J	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
2-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
3,3'-Dichlorobenzidine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SW-04							SW-05							SW-06							SW-07	
Sample Date	10/15/2008	12/18/2008	4/29/2009	7/24/2009	4/13/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/6/2010	12/17/2008	4/28/2009
SVOCs (µg/L) (Continued)																							
3-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U	10 U	10 U	NA	NA	NA	10 U	10 U
4-Bromophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
4-Chloro-3-methylphenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
4-Chloroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
4-Chlorophenyl phenyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
4-Methylphenol	1 U	1 U	1 U	1 U	NA	NA	NA	55	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
4-Nitroaniline	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
4-Nitrophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
Acenaphthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Acenaphthylene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Aniline	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Anthracene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzidine	10 U	R	R	10 U	NA	NA	NA	10 U	R	R	10 U	NA	NA	NA	10 U	R	R	10 U	NA	NA	NA	R	R
Benzo(a)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzo(a)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzo(b)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzo(g,h,i)perylene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzo(k)fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzoic acid	10 U	R	10 U	10 U	NA	NA	NA	5500	R	10 U	10 U	NA	NA	NA	10 U	R	10 U	10 U	NA	NA	NA	R	10 U
Benzyl alcohol	5 U	5 U	5 U	5 U	NA	NA	NA	600	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
bis(2-Chloroethoxy)methane	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
bis-(2-Chloroethyl)ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
bis(2-Ethylhexyl) phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1.7 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Butyl benzyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	23	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Carbaryl (Sevin)	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1.8	1.2
Carbazole	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Chrysene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Dibenz(a,h)anthracene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Dibenzofuran	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Diethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1.9 J	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Dimethyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Di-n-butyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	2.8	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Di-n-octyl phthalate	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Fluoranthene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Fluorene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Hexachlorobenzene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Hexachlorobutadiene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Hexachlorocyclopentadiene	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
Hexachloroethane	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Indeno(1,2,3-cd)pyrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Isophorone	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Naphthalene	1 U	1 U	1 U	1 U	NA	NA	NA	1.9 J	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Nitrobenzene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
N-Nitrosodimethylamine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
N-Nitroso-Di-N-Propylamine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
N-Nitrosodiphenylamine	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Pentachlorophenol	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
Phenanthrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Phenol	1 U	1 U	1 U	1 U	NA	NA	NA	50	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Pyrene	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Pyridine	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA	5 U	5 U
PAHs (µg/L)																							
1-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	0.15 J	NA
2-Methylnaphthalene	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	0.061 J	NA
Acenaphthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.014	0.016 J	0.064	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01	0.01 U	NA	NA	NA	0.37 J	0.4
Acenaphthylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Benzo(a)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Benzo(a)pyrene	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Benzo(b)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Benzo(g,h,i)perylene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Benzo(k)fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Chrysene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U

TABLE L-3

SUMMARY OF TEST RESULTS FOR MONITORING WELL, SEEP, AND SURFACE WATER SAMPLES
2008, 2009, 2010, AND 2013[1]
March Point (Whitmarsh) Landfill
Skagit County, Washington

Sample ID	SW-04							SW-05							SW-06							SW-07	
Sample Date	10/15/2008	12/18/2008	4/29/2009	7/24/2009	4/13/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/7/2010	10/15/2008	12/17/2008	4/29/2009	7/23/2009	4/13/2010	7/14/2010	10/6/2010	12/17/2008	4/28/2009
PAHs (µg/L) (Continued)																							
Dibenz(a,h)anthracene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Dibenzofuran	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	NA	0.01 UJ	NA	0.01 U	NA	NA	NA	0.065 J	NA
Fluoranthene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.015 J	0.018
Fluorene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.15 J	0.13
Indeno(1,2,3-cd)pyrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 UJ	0.01 U
Naphthalene	0.016 U	0.012 UJ	0.01 U	0.01 U	NA	NA	NA	0.022 U	0.014 UJ	0.019 U	0.01 U	NA	NA	NA	0.015 U	0.016 UJ	0.01 U	0.01 U	NA	NA	NA	0.097 J	0.11
Phenanthrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.059 J	0.062
Pyrene	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 U	0.01 UJ	0.01 U	0.01 U	NA	NA	NA	0.01 J	0.011
Total Benzofluoranthenes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VOCs (µg/L)																							
1,1,1,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,1,1-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,1,2,2-Tetrachloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,1,2-Trichloro-1,2,2-trifluoroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,1,2-Trichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,1-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,1-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,2,3-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
1,2,4-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2	0.8
1,2-Dibromo-3-chloropropane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
1,2-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,2-Dichloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,2-Dichloropropane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,3,5-Trimethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2
1,3-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
1,4-Dichlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
2-Butanone	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U
2-Chloroethyl vinyl ether	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
2-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
2-Hexanone	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U
4-Chlorotoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
4-Isopropyltoluene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
4-Methyl-2-pentanone (MIBK)	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U	2.5 U	5 U	NA	NA	NA	2.5 U	2.5 U
Acetone	3 U	6.2 U	2.6 U	5 U	NA	NA	NA	3 U	5 U	4.8 U	5 U	NA	NA	NA	3 U	7.3 U	4.9 U	5 U	NA	NA	NA	7.3 U	6.5 U
Acrylonitrile	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA	1 U	1 U
Benzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	2.2	3.6
Bromobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Bromodichloromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Bromoform	0.2 U	0.2 U	0.2 U	12	NA	NA	NA	0.2 U	0.2 U	0.2 U	15	NA	NA	NA	0.2 U	0.2 U	0.2 U	12	NA	NA	NA	0.2 U	0.2 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
Carbon disulfide	0.2 U	0.2 U	0.2 U	0.2	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Carbon tetrachloride	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Chlorobenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Chloroethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Chloroform	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Chloromethane	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.5 U	NA	NA	NA	0.2 U	0.2 U
*cis-*1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
*cis-*1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Dibromochloromethane	0.2 U	0.2 U	0.2 U	0.3	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.3	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.3	NA	NA	NA	0.2 U	0.2 U
Dichlorodifluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Ethyl ether	1 U	NA	1 U	1 U	NA	NA	NA	1 U	NA	1 U	1 U	NA	NA	NA	1 U	NA	0.4 J	0.27 J	NA	NA	NA	NA	0.14 J
Ethylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Ethylene dibromide	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Hexachlorobutadiene	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
Isopropylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
m,p-Xylene	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.4 U	0.4 U	0.4 U	0.4 U	NA	NA	NA	0.6	1.6
Methyl tert-butyl ether	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.2 U	0.5 U	0.5 U	NA	NA	NA	0.2 U	0.5 U
Methylene chloride	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.6 U	0.5 U	0.5 U	0.5 U	NA	NA	NA	0.5 U	0.5 U
n-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
n-Propylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
o-Xylene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.9	2.2
sec-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Styrene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U

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VOCs (µg/L) (Continued)																							
tert-Butylbenzene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Tetrachloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Toluene	0.2 U	0.2 U	0.2	0.2 U	NA	NA	NA	0.2 U	0.2	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.8	1.4
trans-1,2-Dichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
trans-1,3-Dichloropropene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Trichloroethene	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Trichlorofluoromethane	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
Vinyl Chloride	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U	0.2 U	0.2 U	NA	NA	NA	0.2 U	0.2 U
PCBs (µg/L)																							
Aroclor 1016	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2 UJ	0.1 U
Aroclor 1221	0.01 U	0.03 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.025 U	0.025 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.025 U	0.01 UJ	0.062 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2 UJ	0.1 U
Aroclor 1232	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2 UJ	0.1 U
Aroclor 1242	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2 UJ	0.1 U
Aroclor 1248	0.01 U	0.01 UJ	0.01 U	0.02 U	0.01 U	0.015 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.015 U	0.01 U	0.01 U	0.01 U	3 UJ	5 U
Aroclor 1254	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2 UJ	0.75 U
Aroclor 1260	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.2 UJ	0.1 U
Total PCBs	0.01 U	0.03 UJ	0.01 U	0.02 U	0.01 U	0.015 U	0.01 U	0.025 U	0.025 UJ	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.025 U	0.01 UJ	0.062 U	0.015 U	0.01 U	0.01 U	0.01 U	3 UJ	5 U
Pesticides (µg/L)																							
4,4'-DDD	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	**0.0019 J**	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
4,4'-DDE	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.34 UJ	0.083 U
4,4'-DDT	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
Aldrin	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.36 UJ	0.042 U
alpha-Chlordane	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0083 UJ	0.042 U
alpha-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.0044 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.0053 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0083 UJ	0.042 U
beta-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.0024 U	0.0008 U	0.0032 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.0018 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.0014 U	0.00083 U	0.055 UJ	0.042 U
cis-Chlordane	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA
delta-BHC	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 UJ	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 UJ	0.0017 U	0.002 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 UJ	0.0083 UJ	0.042 U
Dieldrin	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
Endosulfan I	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.017 UJ	0.042 U
Endosulfan II	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
Endosulfan sulfate	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
Endrin	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
Endrin aldehyde	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
Endrin ketone	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.0033 U	0.0017 UJ	0.0017 U	0.0017 U	0.0016 U	0.0017 U	0.0017 U	0.017 UJ	0.083 U
gamma-Chlordane	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.0064 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	NA	NA	0.0083 UJ	0.042 U
gamma-BHC (Lindane)	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0026	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0083 UJ	0.042 U
Heptachlor	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0083 UJ	0.042 U
Heptachlor epoxide	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0017 U	0.00083 UJ	0.00083 U	0.00083 U	0.0008 U	0.00083 U	0.00083 U	0.0083 UJ	0.16 U
Methoxychlor	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.0083 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.0083 U	0.017 U	0.0083 UJ	0.0083 U	0.0083 U	0.008 U	0.0083 U	0.0083 U	0.083 UJ	0.42 U
Toxaphene	0.17 U	0.083 UJ	0.083 U	0.083 U	0.08 U	0.083 U	0.083 U	0.17 U	0.083 UJ	0.083 U	0.083 U	0.08 U	0.083 U	0.083 U	0.17 U	0.083 UJ	0.083 U	0.083 U	0.08 U	0.083 U	0.083 U	0.83 UJ	4.2 U
trans-Chlordane	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA	NA	NA	NA	0.00083 U	0.00083 U	NA	NA

Notes

1. Data qualifers are as follows:

J = analyte was poistively identified; result is an estimated concentration.
J- = value is estimated with a possible low bias
R = analytical result is rejected based on quality control criteria.
U = analyte was not detected at reporting limit indicated.
UJ = analyte was not detected at the concentration indcated, which is the estimated reporting limit.

Abbreviations

NA = not analyzed
µg/L = micrograms per liter
mg/L = milligrams per liter
NE = not established
PAHs = polyaromatic hydrocarbons
PCBs = polychlorinated biphenyls
PSL = preliminary screening level
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds

TABLE L-4

SUMMARY OF GROUNDWATER SAMPLES
DIOXIN AND FURAN RESULTS
MARCH 2013[1]

March Point (Whitmarsh) Landfill
Skagit County, Washington

Location Sample Date	MW-8 3/26/2013	MW-9 3/26/2013	MW-9 3/26/2013 Field dup.
Dioxins/Furans (pg/L)			
1,2,3,4,6,7,8-HpCDD	2.06 U	1.1 U	3.04 U
1,2,3,4,6,7,8-HpCDF	0.32 U	0.42 U	0.52 U
1,2,3,4,7,8,9-HpCDF	0.54 U	0.66 U	0.88 U
1,2,3,4,7,8-HxCDD	0.58 U	0.54 U	0.52 U
1,2,3,4,7,8-HxCDF	0.4 U	0.4 U	0.38 U
1,2,3,6,7,8-HxCDD	0.58 U	0.58 U	0.54 U
1,2,3,6,7,8-HxCDF	0.38 U	0.38 U	0.34 U
1,2,3,7,8,9-HxCDD	0.6 U	0.6 U	0.56 U
1,2,3,7,8,9-HxCDF	0.58 U	0.56 U	0.54 U
1,2,3,7,8-PeCDD	0.42 U	0.54 U	0.52 U
1,2,3,7,8-PeCDF	0.48 U	0.56 U	0.52 U
2,3,4,6,7,8-HxCDF	0.42 U	0.44 U	0.4 U
2,3,4,7,8-PeCDF	0.52 U	0.6 U	0.6 U
2,3,7,8-TCDD	0.46 U	0.36 U	0.32 U
2,3,7,8-TCDF	0.44 U	0.3 U	0.3 U
OCDD	19.4 U	26.8 U	21.4 U
OCDF	1.66 U	1.6 U	1.24 U
Total TEQ	0	0	0
Homolog Group Concentrations			
Total HpCDD	6.32 EMPC	4.51 EMPC	6.01
Total HpCDF	0.54 U	0.424 EMPC	0.88 U
Total HxCDD	1.83 EMPC	0.802 EMPC	1.35 EMPC
Total HxCDF	0.288	0.56 U	0.54 U
Total PeCDD	1.4 EMPC	0.54 U	1.61 EMPC
Total PeCDF	1.54 EMPC	0.6 U	0.301 EMPC
Total TCDD	2.39 EMPC	0.36 U	1.31 EMPC
Total TCDF	11.7 EMPC	0.79	1.32 EMPC

Notes
1. Data qualifiers are as follows:
   U = Analyte not detected at the reporting limit shown.
   EMPC = Estimated Maximum Possible Concentration.

Abbreviations
pg/L = picograms per liter

APPENDIX M

Geotechnical Analytical Report

Analytical Resources, Incorporated
Analytical Chemists and Consultants

May 27, 2010

AMEC E&E
Received
JUN 1 2010
SEATTLE ORG. 5009

Crystal Neirby
AMEC Geomatrix, Inc.
600 University Street, Suite 1020
Seattle, WA 98101

RE: Project: March Point (Whitmarsh Landfill), 14159
ARI Job No.: QR16

Dear Ms. Neirby:

Please find enclosed the Chain-of-Custody (COC) records, sample receipt documentation, and the final results for samples for the project referenced above. Analytical Resources, Inc. accepted eleven soil samples on April 2, 2010 under ARI job QR16. The samples were archived (unfrozen) upon receipt. For details regarding sample receipt, please refer to the enclosed Cooler Receipt Form.

The samples were removed from archive on April 12, 2010 to be analyzed for various Geotechnical parameters. Detail of these analyses can be found in a laboratory-specific Geotechnical Case Narrative.

An electronic copy of this report and all supporting raw data will remain on file with ARI. Should you have any questions or problems, please feel free to contact me at your convenience.

Sincerely,

ANALYTICAL RESOURCES, INC.

Cheronne Oreiro
Project Manager
(206) 695-6214
cheronneo@arilabs.com
www.arilabs.com

Enclosures

cc: eFile QR16

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard	Page: 1	of 2
ARI Client Company: Amec Geomatrix	Phone: 206 342 1760	Date: 4/2/10	Ice Present?
Client Contact: Dave Haddock		No. of Coolers:	Cooler Temps:
Client Project Name: March Point (Whitmarsh landfill)			
Client Project #: 14159	Samplers: Chris Brown, Nik Bacher		

Sample ID	Date	Time	Matrix	No. Containers	Particle size ASTM D-421/422	Atterberg limits ASTM D4318	Moisture content ASTM D-2216	Triaxial (UU) comp. strength ASTM D-2850	Flex wall hydr. cond. D-5084	Consolidation ASTM D-2435 Meth. B	Swell one-dimensional ASTM D-4546	Organic matter ASTM D-2974	Notes/Comments 4/12/10
615-15	3/29/10	910	S	1	X	X	X						~~Hold~~ NB
616-10	↓	1000	S	1	X	X	X						~~Hold~~ NB
620-12	↓	1530	S	1	X	X	X						~~Hold~~ NB
618-8	3/30/10	1320	S	1	X	X	X						~~Hold~~ NB
616-7	3/29/10	945	S	1	X	X	X						~~Hold~~ NB
624-16	3/30/10	1410	S	1	X	X	X						~~Hold~~ NB
617.5-7	4/1/10	1515	S	2	X	X	X	X	X	X	X	X	~~Hold~~ NB
MW-10-24-26	4/1/10	1020	S	1	X	X	X	X	X	X	X		~~Hold~~ NB
MW-08-24-26	4/2/10	905	S	1	X	X	X	X	X				~~Hold~~ NB
ST-02 4CB	4/2/10	1200	S	2	X	X	X	X	X	X	X		~~Hold~~ NB

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
Hold All until further Notice	(Signature) Emerald Erickson	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Emerald Erickson	Printed Name: Mirka Mulumbu	Printed Name:	Printed Name:
	Company: AMEC	Company: ARI	Company:	Company:
	Date & Time: 4/2/10 14:40	Date & Time: 4/2/10 1440	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

2

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	Turn-around Requested: Standard	Page: 2	of 2
ARI Client Company: Amec Geomatrix	Phone: 206 342 1760	Date: 4/2/10	Ice Present?
Client Contact: Dave Haddock		No. of Coolers: YES	Cooler Temps:
Client Project Name: March Point (Whitmarsh landfill)			
Client Project #: 14159	Samplers: Chris Brown, Nik Bacher		

Sample ID	Date	Time	Matrix	No. Containers	Particle Size ASTM D-421/D-422	Atterberg limit ASTM D4318	Triaxial (UU) Comp. Strength ASTM D2850	Flex wall hydr Cond ASTM D-5084					Notes/Comments
St-01	4/2/10	1130	S	1	X	X	X	X					~~HOLD~~ NB 4/12/10

~~Chris Brown~~

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
Hold all until further Notice	(Signature) Emerald Erickson	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Emerald Erickson	Printed Name: Nikky Chulumba	Printed Name:	Printed Name:
	Company: AMEC	Company: ARI	Company:	Company:
	Date & Time: 4/2/10 14:40	Date & Time: 4/2/10 1440	Date & Time:	Date & Time:

__Limits of Liability:__ ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number: QR16	Turn-around Requested: Standard
ARI Client Company: Amec Geomatrix	Phone: 206 342 1760
Client Contact: Dave Haddock	
Client Project Name: March Point (Whitmarsh landfill)	
Client Project #: 14159	Samplers: Chris Brown, Nik Bacher

Page: 1	of 2
Date: 4/2/10	Ice Present?
No. of Coolers:	Cooler Temps:

Sample ID	Date	Time	Matrix	No. Containers	Particle Size ASTM D-421/422	Atterberg limits ASTM D4318	Moisture content ASTM D-2216	Triaxial comp. strength ASTM D-2850	Flex wall hydr. Cond. ASTM D-5084				Notes/Comments
G15-15	3/29/10	910	S	1	X	X	X						Hold
G16-10	↓	1000	S	1	X	X	X						Hold
G20-12	↓	1530	S	1	X	X	X						Hold
G18-8	3/30/10	1320	S	1	X	X	X						Hold
G16-7	3/29/10	945	S	1	X	X	X						Hold
G24-16	3/30/10	1410	S	1	X	X	X						Hold
G17.5-7	4/1/10	1515	S	CB 2	X	X	X	X	X				Hold
MW-10-24-26	4/1/10	1020	S	1				X	X				Hold
MW-08-24-26	4/2/10	905	S	1				X	X				Hold
ST-02 w/ CB	4/2/10	1200	S	2				X	X				Hold

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
Hold All until further Notice	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Emerald Erickson	Printed Name: Mika Mulumba	Printed Name:	Printed Name:
	Company: AMEC	Company: ARI	Company:	Company:
	Date & Time: 4/2/10 14:40	Date & Time: 4/2/10 1440	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

ARI Assigned Number:	QR16
Turn-around Requested:	STandard
Page:	2 of 2
ARI Client Company:	Amec Geomatrix
Phone:	206 342 1760
Date:	4/2/10
Ice Present?	
Client Contact:	Dave Haddock
No. of Coolers:	
Cooler Temps:	
Client Project Name:	March Point (Whitmarsh landfill)
Client Project #:	14159
Samplers:	Chris Brown, Nik Bacher

Analysis Requested:

Sample ID	Date	Time	Matrix	No. Containers	Particle Size ASTM D-421/422	Atterberg limit ASTM D4318	Triaxial comp. strength ASTM D2850	Flex wall hydr Cond ASTM D-5084					Notes/Comments
St-01	4/2/10	1130	S	1	NO	NO	X	X					HOLD

Comments/Special Instructions: Hold all until further Notice

Relinquished by:	Received by:	Relinquished by:	Received by:
(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
Printed Name: Emerald Erickson	Printed Name: Mikka Mulumba	Printed Name:	Printed Name:
Company: AMEC	Company: ARI	Company:	Company:
Date & Time: 4/2/10 14:40	Date & Time: 4/2/10 1440	Date & Time:	Date & Time:

QR16:00005

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: AMEC Geomatrix

Project Name: March Point

COC No(s): NA (circled)

Delivered by: Fed-Ex UPS Courier **Hand Delivered** (circled) Other: ______

Assigned ARI Job No: QR16

Tracking No: NA (circled)

Preliminary Examination Phase:

Question			
Were intact, properly signed and dated custody seals attached to the outside of to cooler?		YES	**NO** (circled)
Were custody papers included with the cooler?		**YES** (circled)	NO
Were custody papers properly filled out (ink, signed, etc.)		**YES** (circled)	NO

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)....... 3.9 4.6 ____ ____

If cooler temperature is out of compliance fill out form 00070F Temp Gun ID#: 90877952

Cooler Accepted by: MM Date: 4/2/10 Time: 1440

Complete custody forms and attach all shipping documents

Log-In Phase:

Question			
Was a temperature blank included in the cooler?		YES	**NO** (circled)
What kind of packing material was used? ... Bubble Wrap **Wet Ice** (circled) Gel Packs Baggies Foam Block Paper Other: ______			
Was sufficient ice used (if appropriate)?	NA	**YES** (circled)	NO
Were all bottles sealed in individual plastic bags?		YES	**NO** (circled)
Did all bottles arrive in good condition (unbroken)?		**YES** (circled)	NO
Were all bottle labels complete and legible?		**YES** (circled)	NO
Did the number of containers listed on COC match with the number of containers received?		**YES** (circled)	NO
Did all bottle labels and tags agree with custody papers?		**YES** (circled)	NO
Were all bottles used correct for the requested analyses?		**YES** (circled)	NO
Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...	NA	YES	**NO** (circled)
Were all VOC vials free of air bubbles?	**NA** (circled)	YES	NO
Was sufficient amount of sample sent in each bottle?		**YES** (circled)	NO
Date VOC Trip Blank was made at ARI	**NA** (circled)		______

Was Sample Split by ARI : **NA** (circled) YES Date/Time: ______ Equipment: ______ Split by: ______

Samples Logged by: JP Date: 4/2/10 Time: 1615

***** Notify Project Manager of discrepancies or concerns *****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

By: Date:

Small Air Bubbles ~2mm	Small → "sm"
Peabubbles 2-4 mm	Peabubbles → "pb"
LARGE Air Bubbles > 4 mm	Large → "lg"
	Headspace → "hs"

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Client: Amec Geomatrix	**Project No.:** QR16
Client Project: March Point (Whitmarsh Landfill)	**Client Project No.:** 14159

Case Narrative

1. Eleven samples were submitted on April 2, 2010.
2. The grain size analyses were run according to ASTM D422, and the samples were prepared according to ASTM D421. A standard milkshake mixer type device was used to disperse the fine fraction sample before the hydrometer analysis, and an assumed specific gravity of 2.65 was used in the hydrometer calculations.
3. The Unconsolidated, Undrained compressive strength tests were measured according to ASTM D 2850. Due to the very low requested loading rate and running the loader at its minimum setting, the charts exhibit a step-like pattern.
4. The densities were taken according to ASTM D 2937.
5. The hydraulic conductivity testing was run according to ASTM D 5084, and a flexible wall permeameter system was used with tap water for the permeant.
6. The Atterberg limits were run according to ASTM D 4318.
7. The moisture contents were run according to ASTM D 2216.
8. The loss on ignition determination was run according to ASTM D 2974.
9. The one-dimensional consolidation incremental loading tests were run according to ASTM D 2435. Some of these tests were run in two stages; in these cases, the same loaded sample was used between the stages, however the measuring apparatus was reset.
10. Sample ST-01 had to be trimmed to a smaller diameter before running both the D 2850 and D 5084 tests, because of the samples deep lengthwise cavities.
11. The data is provided in summary tables and a plot.
12. There were no other noted anomalies in the samples or methods on this project.

Approved by: [signature]
Lead Technician

Date: May 27, 2010

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

GEOTECHNICAL ANALYSIS DATA SHEET
Moisture Content by Method ASTM D2216

ANALYTICAL RESOURCES INCORPORATED

Data Release Authorized: gs
Reported: 05/11/10
Date Received: 04/02/10
Page 1 of 1

QC Report No: QR16-Amec Geomatrix
Project: March Point (Whitmarsh Landfill)
14159

Client/ ARI ID	Date Sampled	Matrix	Analysis Date	Result
G15-15 QR16A 10-8584	03/29/10	Soil	05/05/10 19:48	39.29
G16-10 QR16B 10-8585	03/29/10	Soil	05/05/10 19:48	57.95
G20-12 QR16C 10-8586	03/29/10	Soil	05/05/10 19:48	63.51
G18-18 QR16D 10-8587	03/30/10	Soil	05/05/10 19:48	77.11
G16-7 QR16E 10-8588	03/29/10	Soil	05/05/10 19:48	29.53
G24-16 QR16F 10-8589	03/30/10	Soil	05/05/10 19:48	73.77
G17.5-7 QR16G 10-8590	04/01/10	Soil	05/05/10 19:48	65.28
MW-10-24-26 QR16H 10-8591	04/01/10	Soil	05/05/10 19:48	37.00
MW-08-24-26 QR16I 10-8592	04/02/10	Soil	05/05/10 19:48	48.01
ST-02 QR16J 10-8593	04/02/10	Soil	05/05/10 19:48	139.6
ST-01 QR16K 10-8594	04/02/10	Soil	05/05/10 19:48	76.82

Reported in Percent

GEOTECHNICAL ANALYSIS DATA SHEET
Organic Matter by Method ASTM D2974

ANALYTICAL RESOURCES INCORPORATED

Data Release Authorized: gs
Reported: 05/11/10
Date Received: 04/02/10
Page 1 of 1

QC Report No: QR16-Amec Geomatrix
Project: March Point (Whitmarsh Landfill)
14159

Client/ ARI ID	Date Sampled	Matrix	Analysis Date	Result
G17.5-7 QR16G 10-8590	04/01/10	Soil	05/05/10 19:48	5.23

Organic/Ash Content Burn Temperature 440 C Per ASTM D2974

GEOTECHNICAL ANALYSIS DATA SHEET
Total Solids by Method ASTM D2974

ANALYTICAL RESOURCES INCORPORATED

Data Release Authorized: gb
Reported: 05/11/10
Date Received: 04/02/10

QC Report No: QR16-Amec Geomatrix
Project: March Point (Whitmarsh Landfill)
14159

Client/ ARI ID	Date Sampled	Matrix	Analysis Date	Result
G17.5-7 QR16G 10-8590	04/01/10	Soil	05/05/10 19:48	60.50

GEOTECHNICAL ANALYSIS DATA SHEET
Ash Content by Method ASTM D2974

ANALYTICAL RESOURCES INCORPORATED

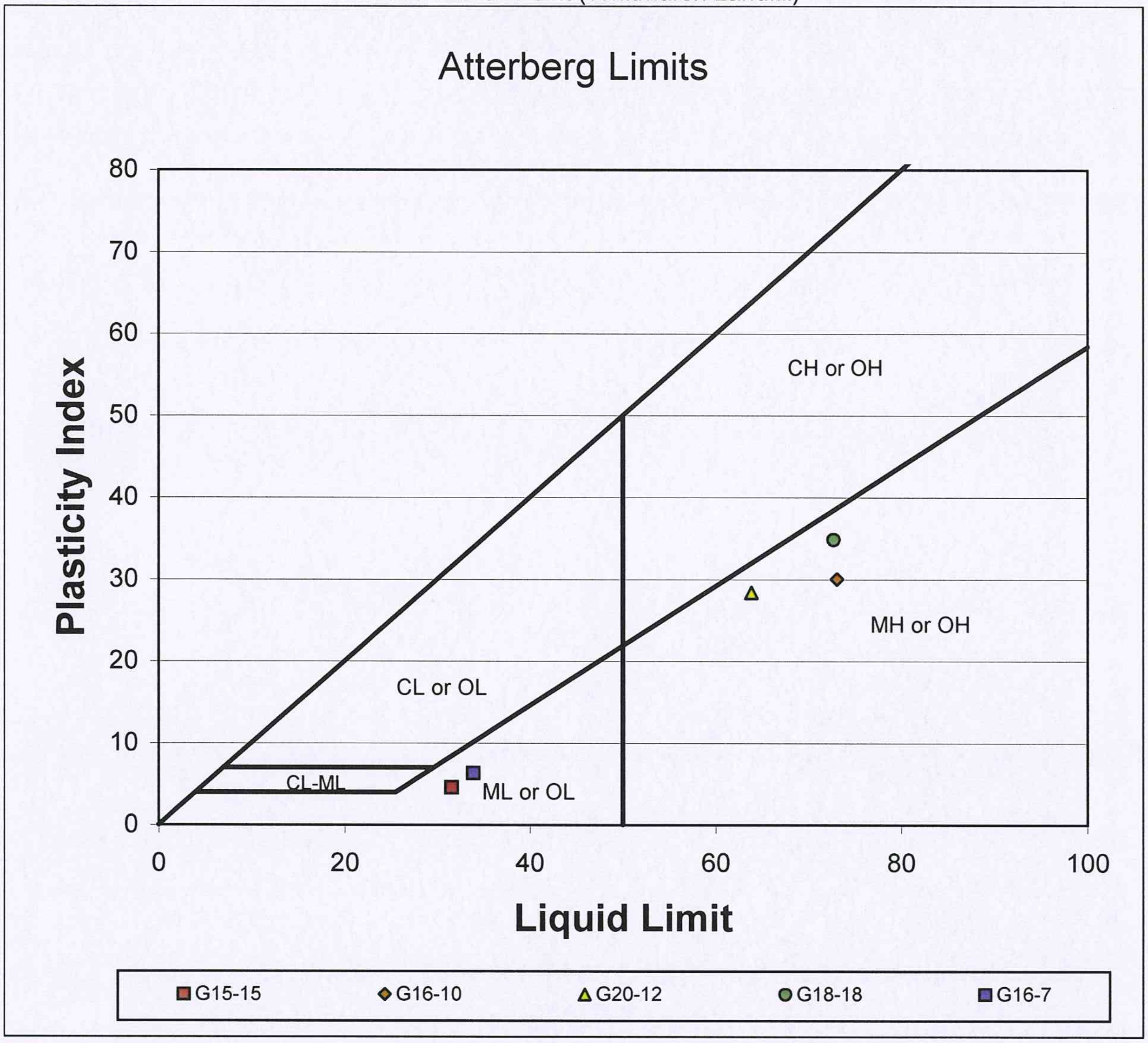
Data Release Authorized: [signature]
Reported: 05/11/10
Date Received: 04/02/10

QC Report No: QR16-Amec Geomatrix
Project: March Point (Whitmarsh Landfill)
14159

Client/ ARI ID	Date Sampled	Matrix	Analysis Date	Result
G17.5-7 QR16G 10-8590	04/01/10	Soil	05/05/10 19:48	94.77

Organic/Ash Content Burn Temperature 440 C Per ASTM D2974

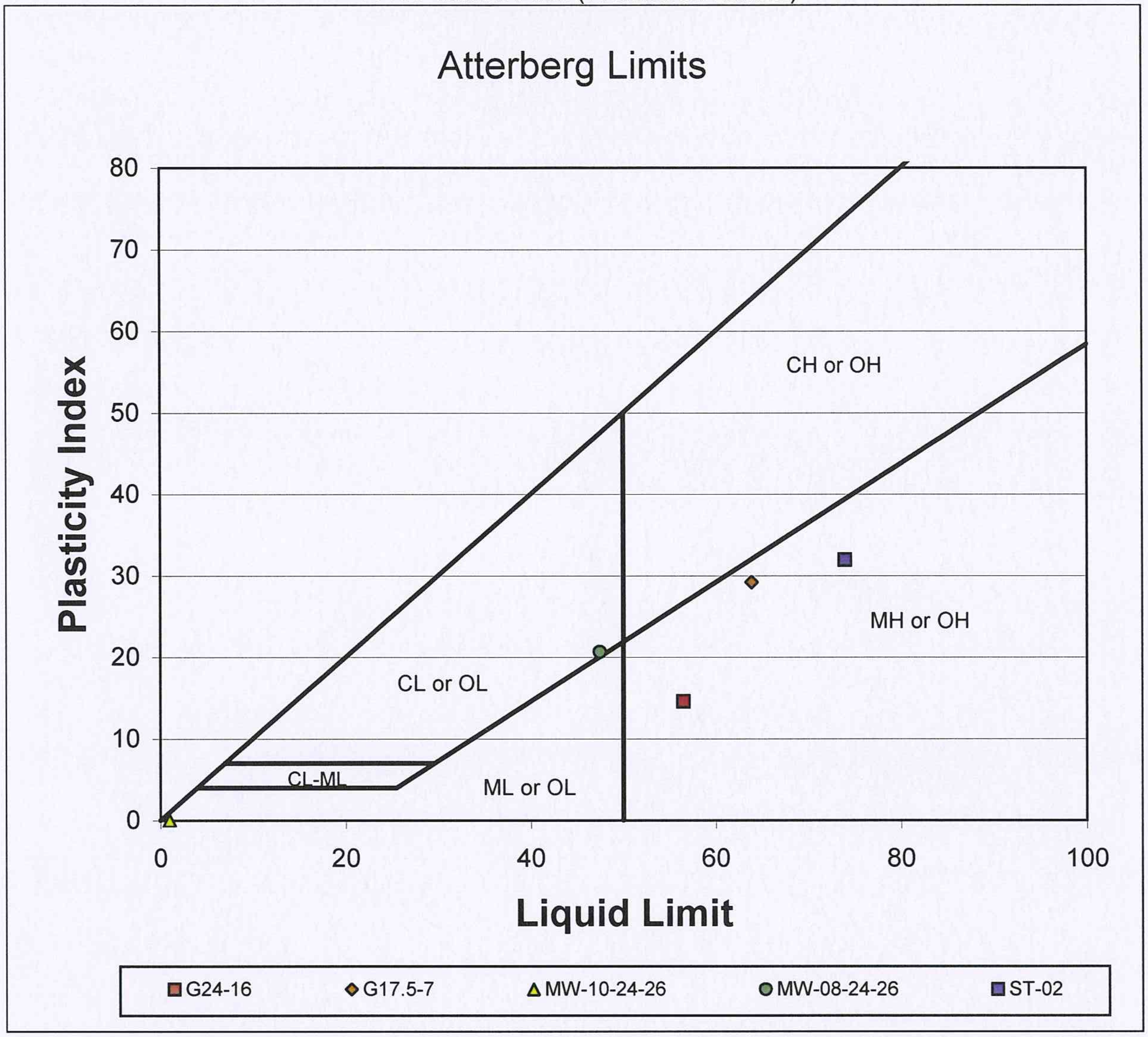
Amec Geomatrix
14159 March Point (Whitmarsh Landfill)



Sample Identification	As-Received Moisture Content	Plasticity Index	Liquid Limit	Plastic Limit	USCS
G15-15	39.29	4.6	31.5	27.0	ML
G16-10	57.95	30.0	73.0	43.0	MH
G20-12	63.51	28.4	63.8	35.4	MH
G18-18	77.11	34.8	72.7	37.8	MH
G16-7	29.53	6.3	33.9	27.6	ML

QR16

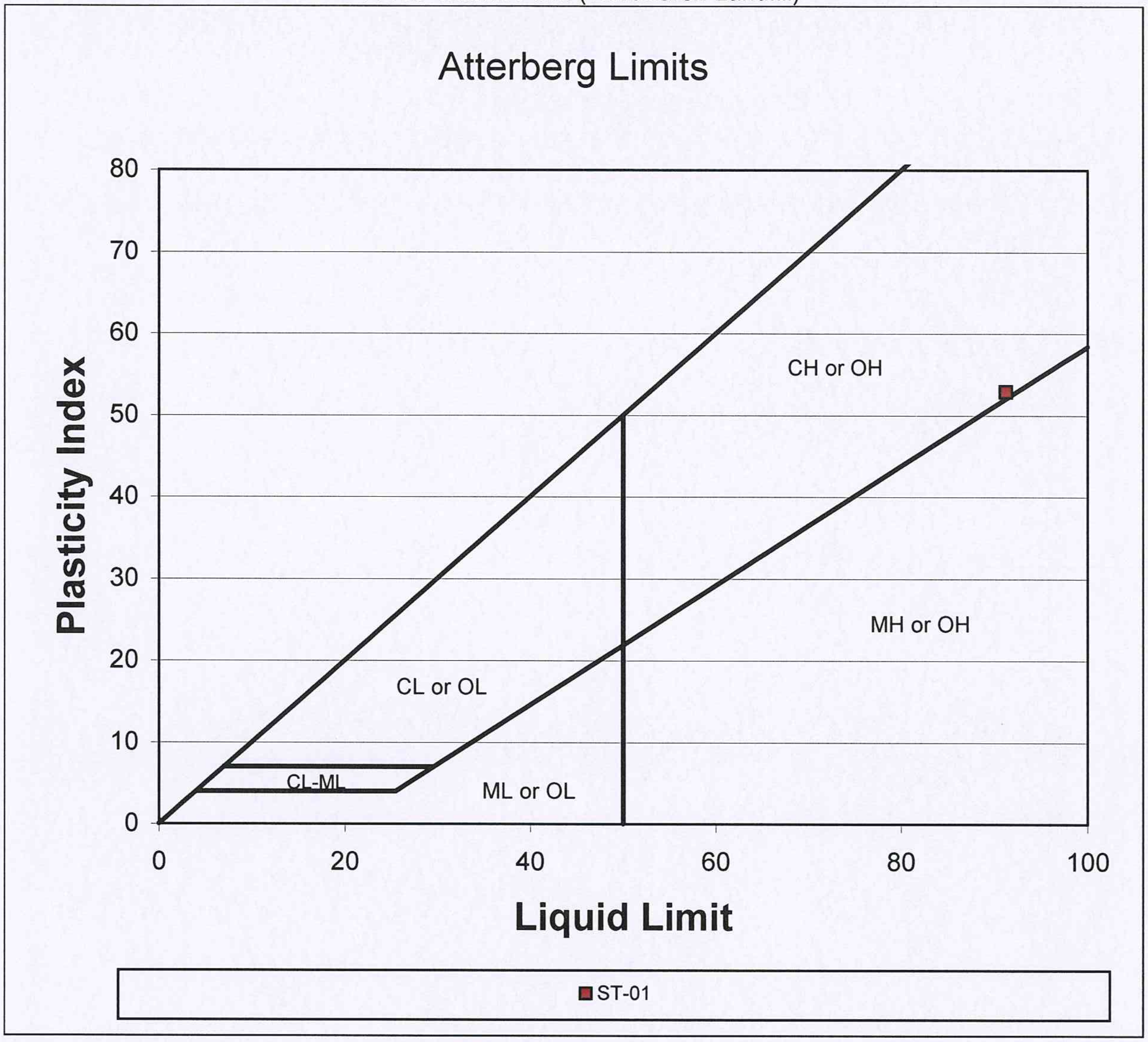
Amec Geomatrix
14159 March Point (Whitmarsh Landfill)



Sample Identification	As-Received Moisture Content	Plasticity Index	Liquid Limit	Plastic Limit	USCS
G24-16	73.77	14.6	56.5	41.9	MH
G17.5-7	65.28	29.2	63.9	34.7	MH
MW-10-24-26	37.00	NA	NA	NA	Non-Plastic
MW-08-24-26	48.01	20.7	47.4	26.8	CL
ST-02	139.58	32.0	74.0	42.0	MH

QR16

Amec Geomatrix
14159 March Point (Whitmarsh Landfill)



Sample Identification	As-Received Moisture Content	Plasticity Index	Liquid Limit	Plastic Limit	USCS
ST-01	76.82	52.9	91.3	38.4	CH

QR16

Amec Geomatrix
March Point (Whitmarsh Landfill)
14159

Percent Finer (Passing) Than the Indicated Size

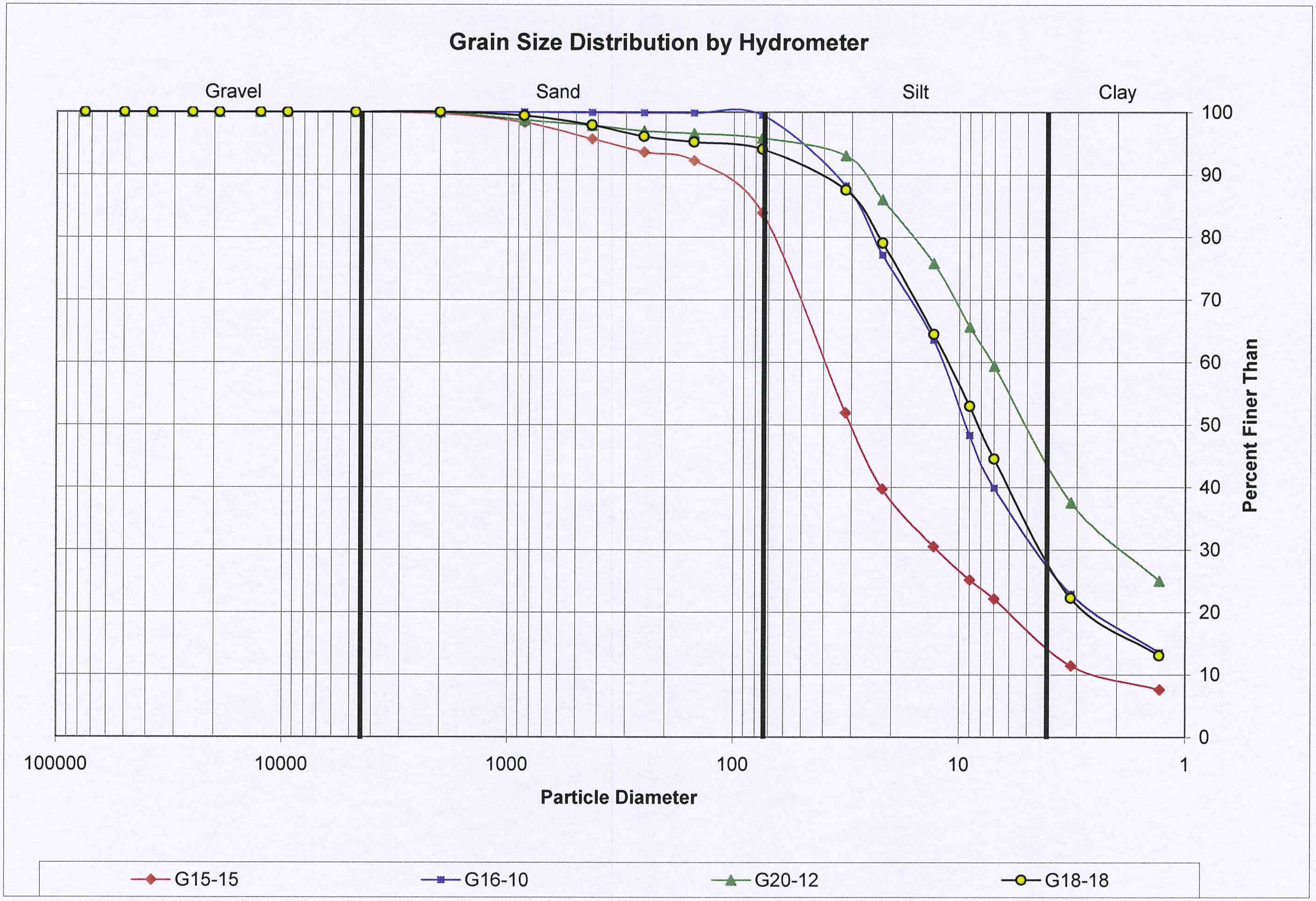
Sieve Size (microns)	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4 (4750)	#10 (2000)	#20 (850)	#40 (425)	#60 (250)	#100 (150)	#200 (75)	32	22	13	9	7	3.2	1.3
G15-15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.7	98.3	95.7	93.6	92.2	83.9	51.9	39.7	30.5	25.2	22.1	11.5	7.6
G16-10	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.9	99.8	99.5	88.2	77.2	63.6	48.3	39.9	22.9	13.6
G20-12	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.7	97.9	97.0	96.6	95.8	93.0	86.0	75.8	65.7	59.4	37.5	25.0
G18-18	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.4	97.9	96.1	95.2	94.1	87.5	79.1	64.5	53.0	44.5	22.3	13.1
G16-7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	67.8	59.8	56.4	52.3	49.9	48.4	41.4	25.8	15.3	13.6	11.8	10.9	5.7	3.5
G24-16	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.8	85.3	83.0	80.3	76.4	72.4	68.6	54.0	43.7	25.7	18.0	13.5	8.4	3.9
G17.5-7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.5	94.6	88.3	85.1	81.8	77.5	73.4	63.2	55.7	46.2	35.3	21.1
MW-10-24-26	100.0	100.0	100.0	100.0	100.0	100.0	99.5	98.8	97.4	96.6	95.5	94.4	92.2	74.9	47.6	37.4	27.2	21.8	19.1	13.6	6.8
MW-08-24-26	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97.0	90.7	83.8	79.0	75.8	73.8	69.9	62.2	51.3	38.5	34.0	26.3	16.7	7.7
ST-02	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.7	98.4	97.5	96.9	96.4	95.7	82.3	73.0	55.1	44.4	37.2	23.6	12.2
ST-01	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.6	99.4	99.1	98.9	98.6	97.9	89.8	77.5	60.4	52.2	45.7	26.9	13.9

Testing performed according to ASTM D421/D422

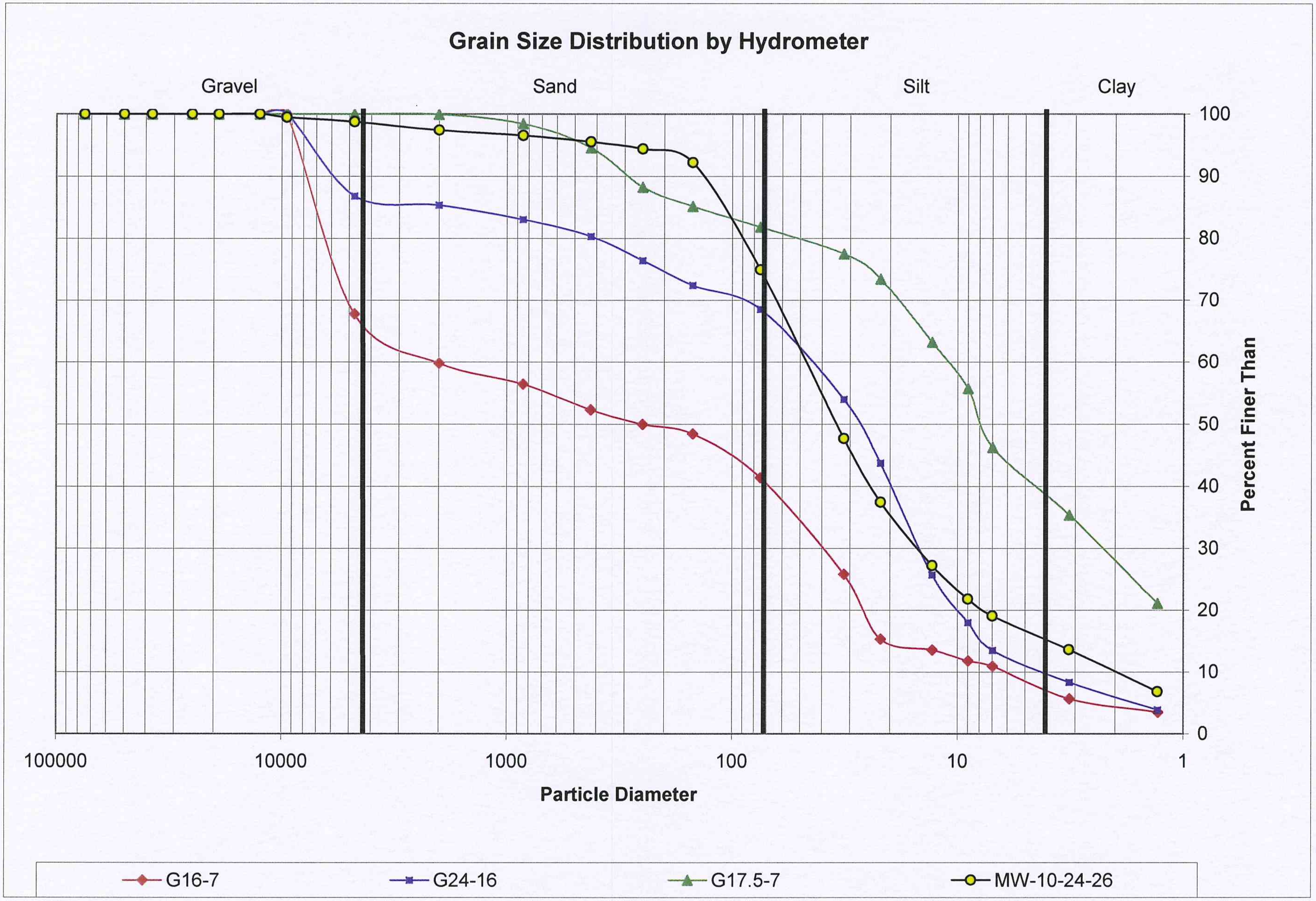
Amec Geomatrix
March Point (Whitmarsh Landfill)
14159

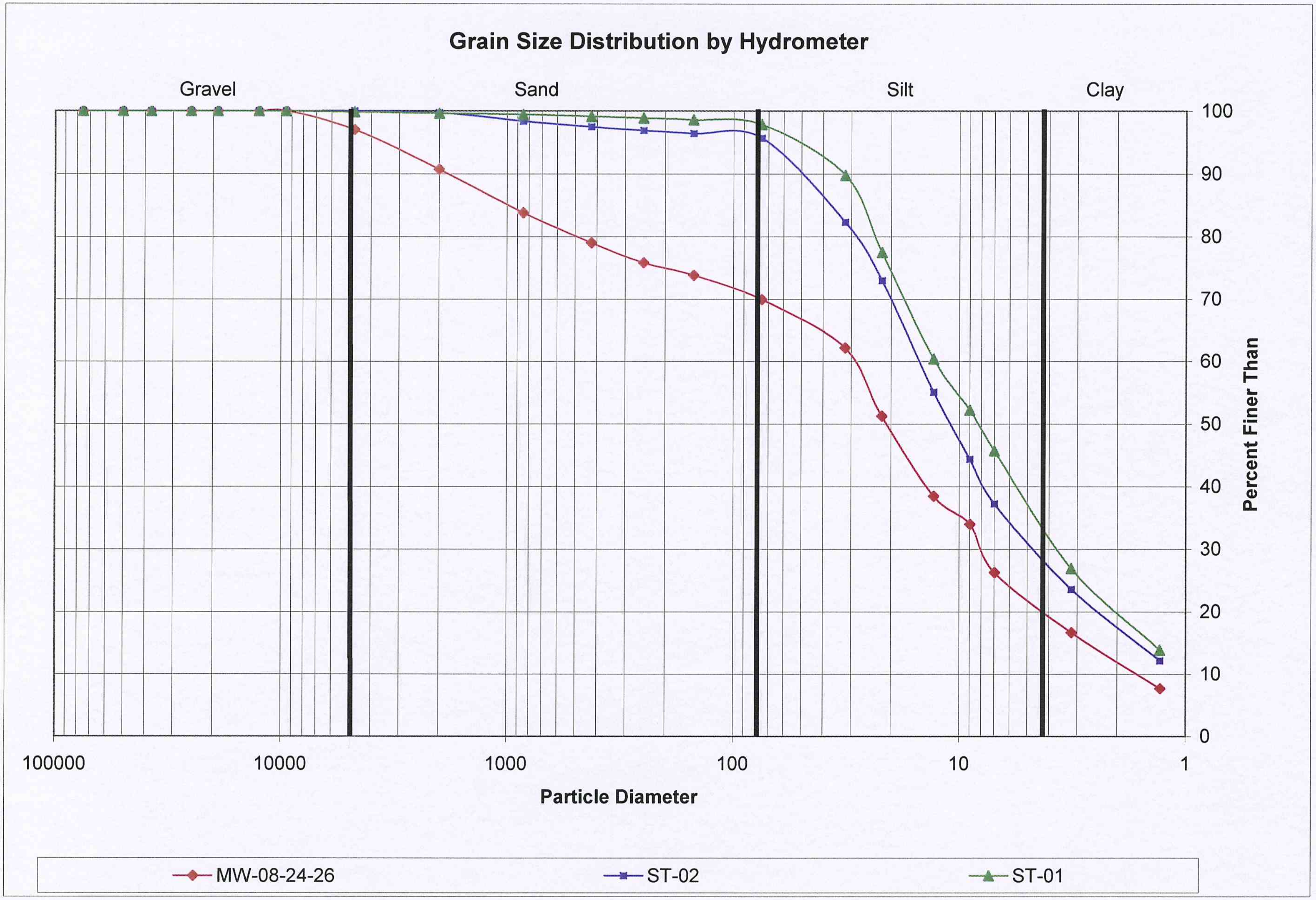
Percent Retained in Each Size Fraction

Description	%Coarse Gravel				% Gravel			% Coarse Sand	% Medium Sand		% Fine Sand			% Very Coarse Silt	% Coarse Silt	% Medium Silt	% Fine Silt	% Fine Silt	% Very Fine Silt	% Clay
Particle Size (microns)	3-2"	2-1 1/2"	1 1/2"-1"	1-3/4"	3/4-1/2"	1/2-3/8"	3/8"-4750	4750-2000	2000-850	850-425	425-250	250-150	150-75	75-32	32-22	22-13	13-9	9-7	7-3.2	<3.2
G15-15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.4	2.7	2.1	1.4	8.3	32.0	12.2	9.2	5.3	3.1	10.7	11.5
G16-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	11.3	11.0	13.6	15.3	8.5	17.0	22.9
G20-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.8	0.9	0.4	0.7	2.8	7.0	10.2	10.2	6.3	21.9	37.5
G18-18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.5	1.8	0.9	1.1	6.5	8.4	14.6	11.5	8.4	22.3	22.3
G16-7	0.0	0.0	0.0	0.0	0.0	0.0	32.2	8.0	3.4	4.1	2.3	1.5	7.0	15.6	10.5	1.8	1.8	0.9	5.3	5.7
G24-16	0.0	0.0	0.0	0.0	0.0	0.0	13.2	1.5	2.3	2.8	3.9	4.0	3.8	14.6	10.3	18.0	7.7	4.5	5.1	8.4
G17.5-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	3.9	6.3	3.1	3.3	4.3	4.1	10.2	7.5	9.5	10.9	35.3
MW-10-24-26	0.0	0.0	0.0	0.0	0.0	0.5	0.7	1.4	0.8	1.0	1.2	2.2	17.2	27.3	10.2	10.2	5.4	2.7	5.4	13.6
MW-08-24-26	0.0	0.0	0.0	0.0	0.0	0.0	3.0	6.3	6.9	4.7	3.2	2.0	3.9	7.8	10.9	12.8	4.5	7.7	9.6	16.7
ST-02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	0.9	0.6	0.5	0.8	13.4	9.3	17.9	10.7	7.2	13.6	23.6
ST-01	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.3	0.2	0.8	8.1	12.2	17.1	8.2	6.5	18.8	26.9


Grain Size Distribution by Hydrometer
Gravel
Sand
Silt
Clay
100
90
80
70
60
50
40
30
20
10
0
Percent Finer Than
100000
10000
1000
100
10
1
Particle Diameter
G15-15
G16-10
G20-12
G18-18

QR16:00017


Grain Size Distribution by Hydrometer
Gravel
Sand
Silt
Clay
100
90
80
70
60
50
40
30
20
10
0
Percent Finer Than
100000
10000
1000
100
10
1
Particle Diameter
G16-7
G24-16
G17.5-7
MW-10-24-26


Grain Size Distribution by Hydrometer
Gravel
Sand
Silt
Clay
100
90
80
70
60
50
40
30
20
10
0
Percent Finer Than
100000
10000
1000
100
10
1
Particle Diameter
MW-08-24-26
ST-02
ST-01

QR16:00019

Amec Geomatrix
March Point (Whitmarsh Landfill)

Test Results for Flexible Wall Hydraulic Conductivity Testing

Sample Identification	Depth (ft)	As Received Sample Parameters				After Test Sample Parameters				Gradient (h/l)	Hydraulic Conductivity (cm/s)
		Wet Density (lbs/ft^3)	Total Porosity	Saturation	Moisture Content (%)	Wet Density (lbs/ft^3)	Total Porosity	Saturation	Moisture Content (%)		
G17.5-7	6	101.1	0.641	1.042	70.1	102.0	0.637	1.055	69.9	1.76	4.43E-06
MW-10-24-26	25	90.4	0.614	0.692	41.5	125.3	0.433	1.165	33.6	1.66	8.91E-08

Notes:

1. The samples were tested in accordance with ASTM D-5084.
2. The tests were performed using tap water for the permeant.
3. The porosity and the saturation were calculated using an assumed specific gravity value of 2.65.

Sample Description and Dimensions

Sample ID	Depth (ft)	Visual Description	Confining Pressure (psi)	Initial Average Length (cm)	Initial Average Diameter (cm)	Final Average Length (cm)	Final Average Diameter (cm)
G17.5-7	6	Dark Brown Organic Silt	4.2	9.06	7.18	9.04	7.16
MW-10-24-26	25	Sandy Clayey Silt, Shells, Wood	15.7	12.77	7.66	9.47	7.34

Amec Geomatrix
March Point (Whitmarsh Landfill)

Test Results for Flexible Wall Hydraulic Conductivity Testing

Sample Identification	Depth (ft)	As Received Sample Parameters				After Test Sample Parameters				Gradient (h/l)	Hydraulic Conductivity (cm/s)
		Wet Density (lbs/ft^3)	Total Porosity	Saturation	Moisture Content (%)	Wet Density (lbs/ft^3)	Total Porosity	Saturation	Moisture Content (%)		
MW-08-24-26	24	76.2	0.678	0.541	42.9	116.7	0.472	0.994	33.5	1.54	7.91E-08
ST-02	1	83.2	0.775	0.951	123.6	90.4	0.744	1.035	113.6	0.59	3.43E-06

Notes:

1. The samples were tested in accordance with ASTM D-5084.
2. The tests were performed using tap water for the permeant.
3. The porosity and the saturation were calculated using an assumed specific gravity value of 2.65.

Sample Description and Dimensions

Sample ID	Depth (ft)	Visual Description	Confining Pressure (psi)	Initial Average Length (cm)	Initial Average Diameter (cm)	Final Average Length (cm)	Final Average Diameter (cm)
MW-08-24-26	24	Soft Sandy Clayey Silt, Glass	13.2	10.94	9.00	9.90	7.39
ST-02	1	Grey Clayey Silt	0.6	9.26	7.15	8.39	7.05

Amec Geomatrix
March Point (Whitmarsh Lanfill)

Test Results for Flexible Wall Hydraulic Conductivity Testing

Sample Identification	Depth (ft)	As Received Sample Parameters				After Test Sample Parameters				Gradient (h/l)	Hydraulic Conductivity (cm/s)
		Wet Density (lbs/ft^3)	Total Porosity	Saturation	Moisture Content (%)	Wet Density (lbs/ft^3)	Total Porosity	Saturation	Moisture Content (%)		
ST-01	1	100.7	0.661	1.081	79.5	92.4	0.679	0.927	74.0	1.66	4.06E-06

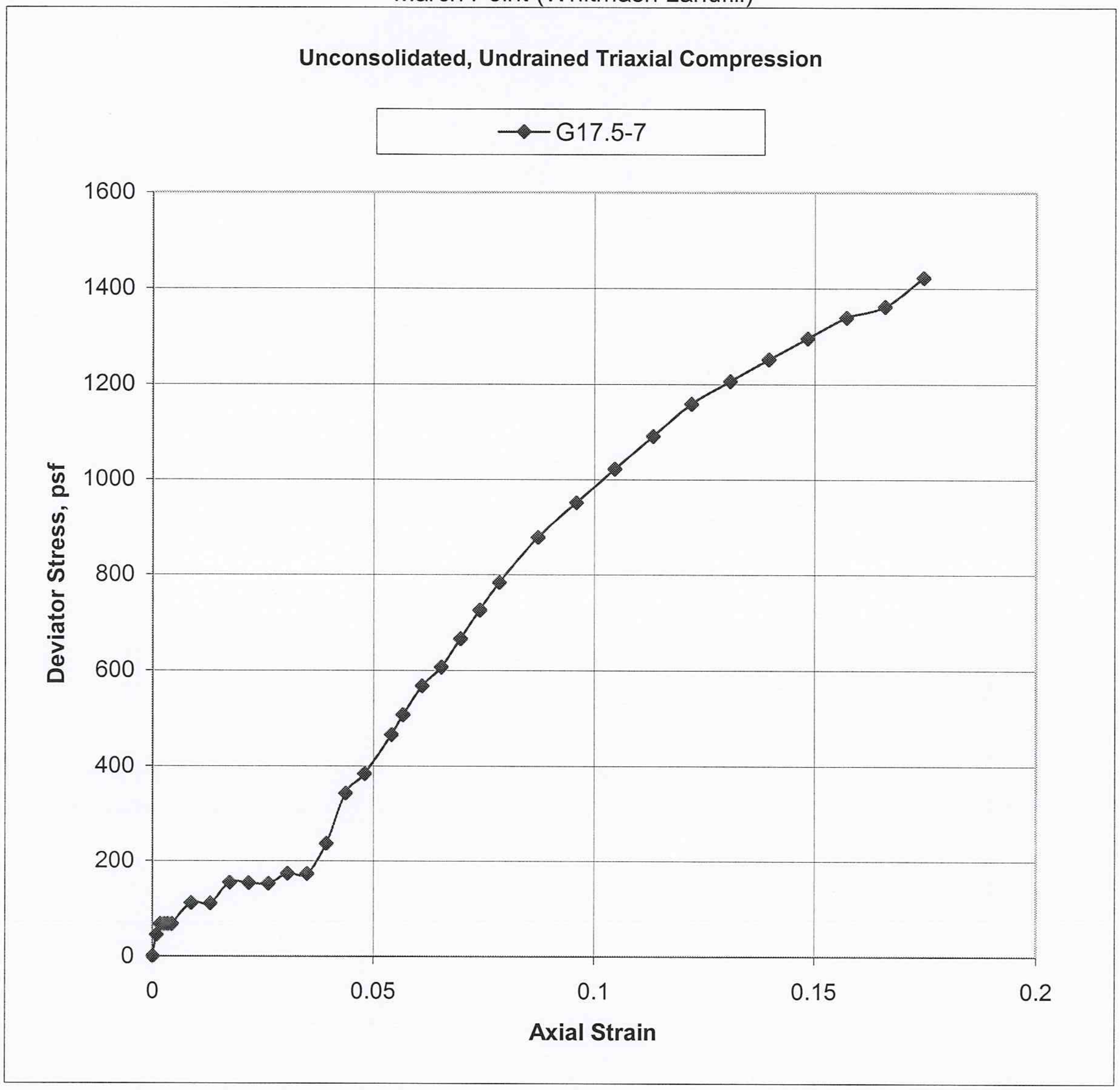
Notes:

1. The samples were tested in accordance with ASTM D-5084.
2. The tests were performed using tap water for the permeant.
3. The porosity and the saturation were calculated using an assumed specific gravity value of 2.65.

Sample Description and Dimensions

Sample ID	Depth (ft)	Visual Description	Confining Pressure (psi)	Initial Average Length (cm)	Initial Average Diameter (cm)	Final Average Length (cm)	Final Average Diameter (cm)
ST-01	1	Grey Clayey Silt	0.5	4.16	3.46	4.11	3.58

Amec Geomatrix
March Point (Whitmash Landfill)

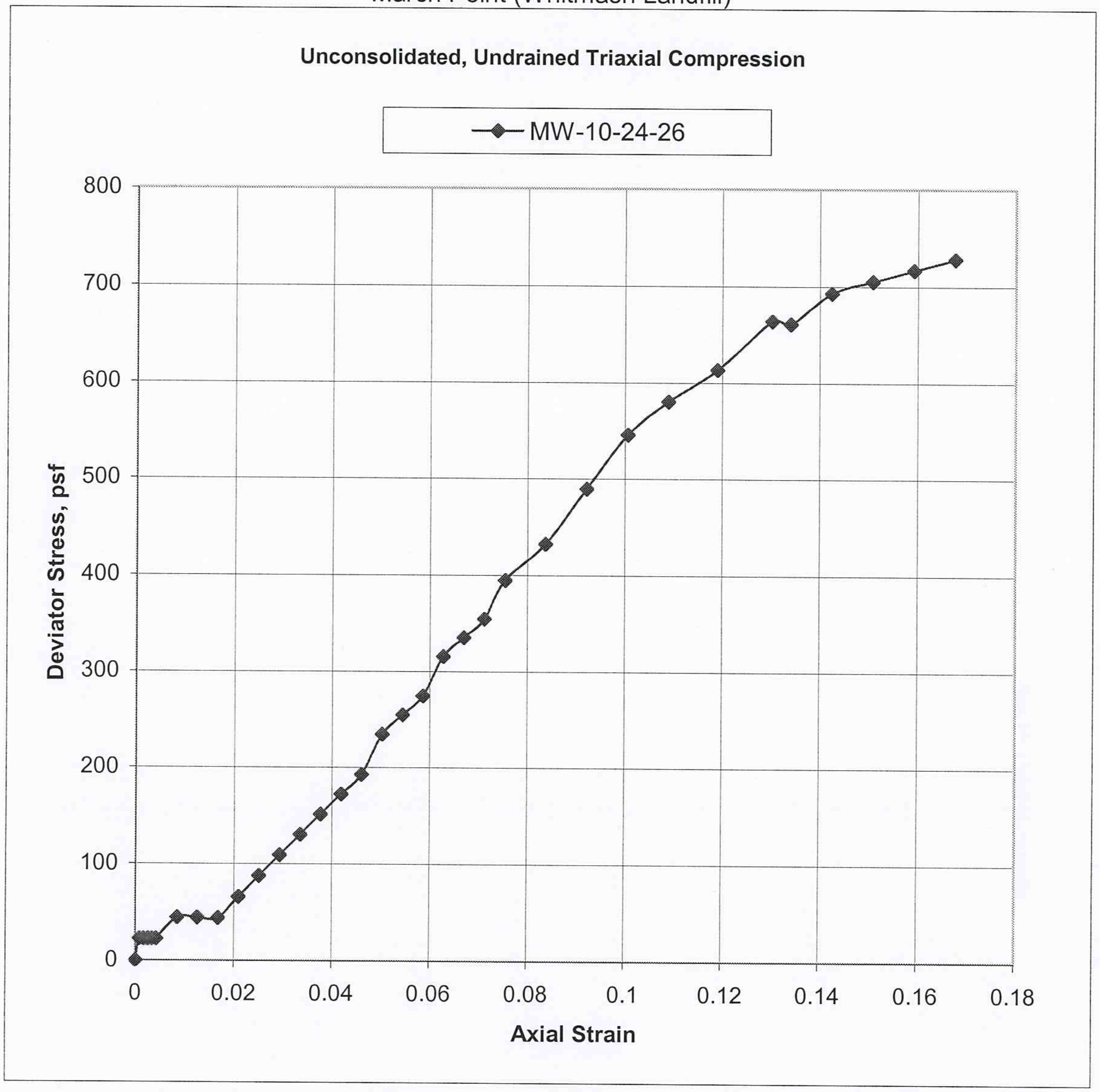


Sample ID	Depth (ft)	Confining Pressure (psi)	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)
G17.5-7	5.5	2.7	71.5	218.1	22.5

Notes to the testing:
1. The testing was performed according to ASTM D-2850.
2. The sample had a shear failure.

QR16

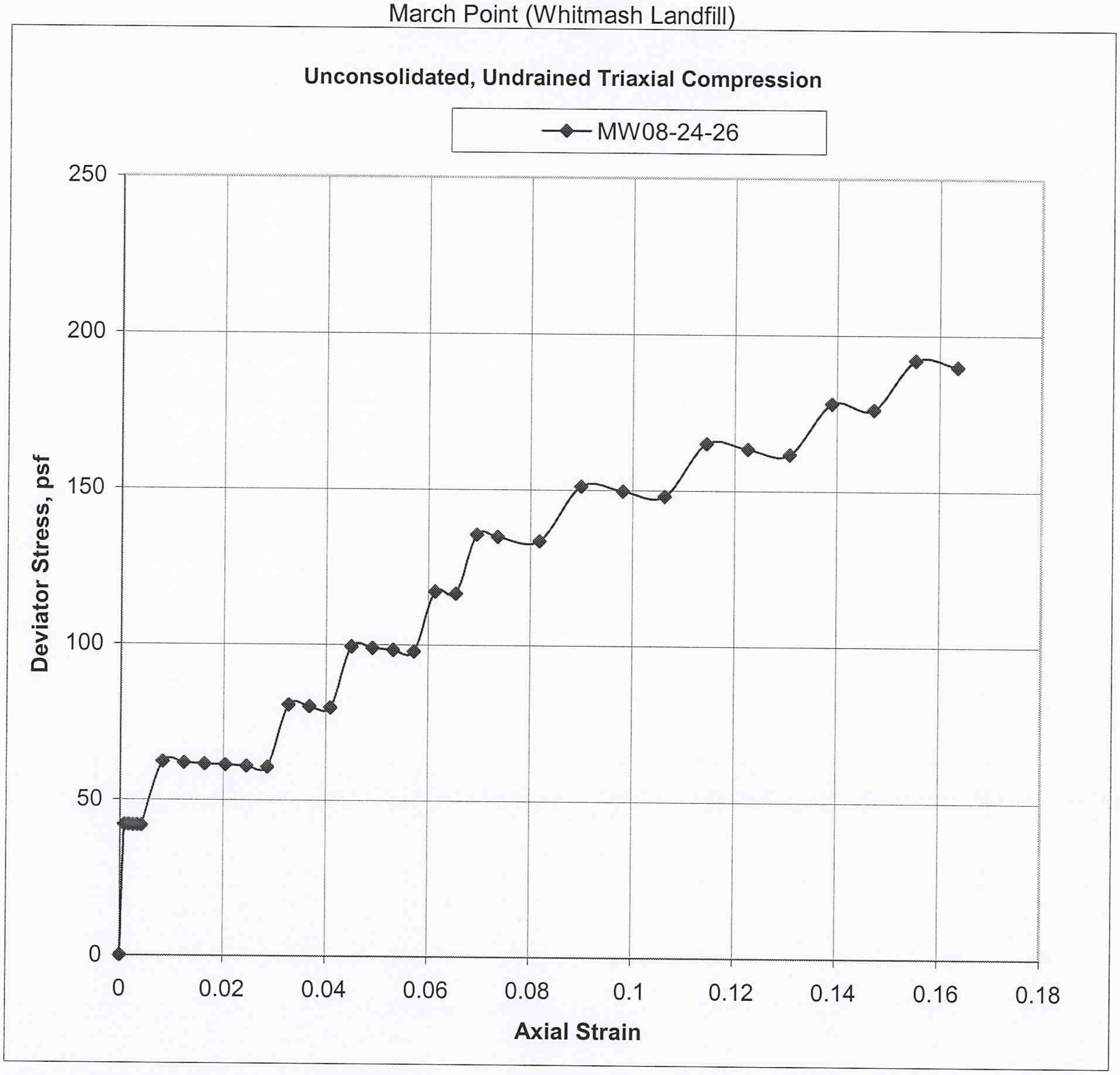
Amec Geomatrix
March Point (Whitmash Landfill)



Sample ID	Depth (ft)	Confining Pressure (psi)	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)
MW-10-24-26	26	20.0	110.8	41.5	78.3

Notes to the testing:
1. The testing was performed according to ASTM D-2850.
2. The sample had a shear failure.

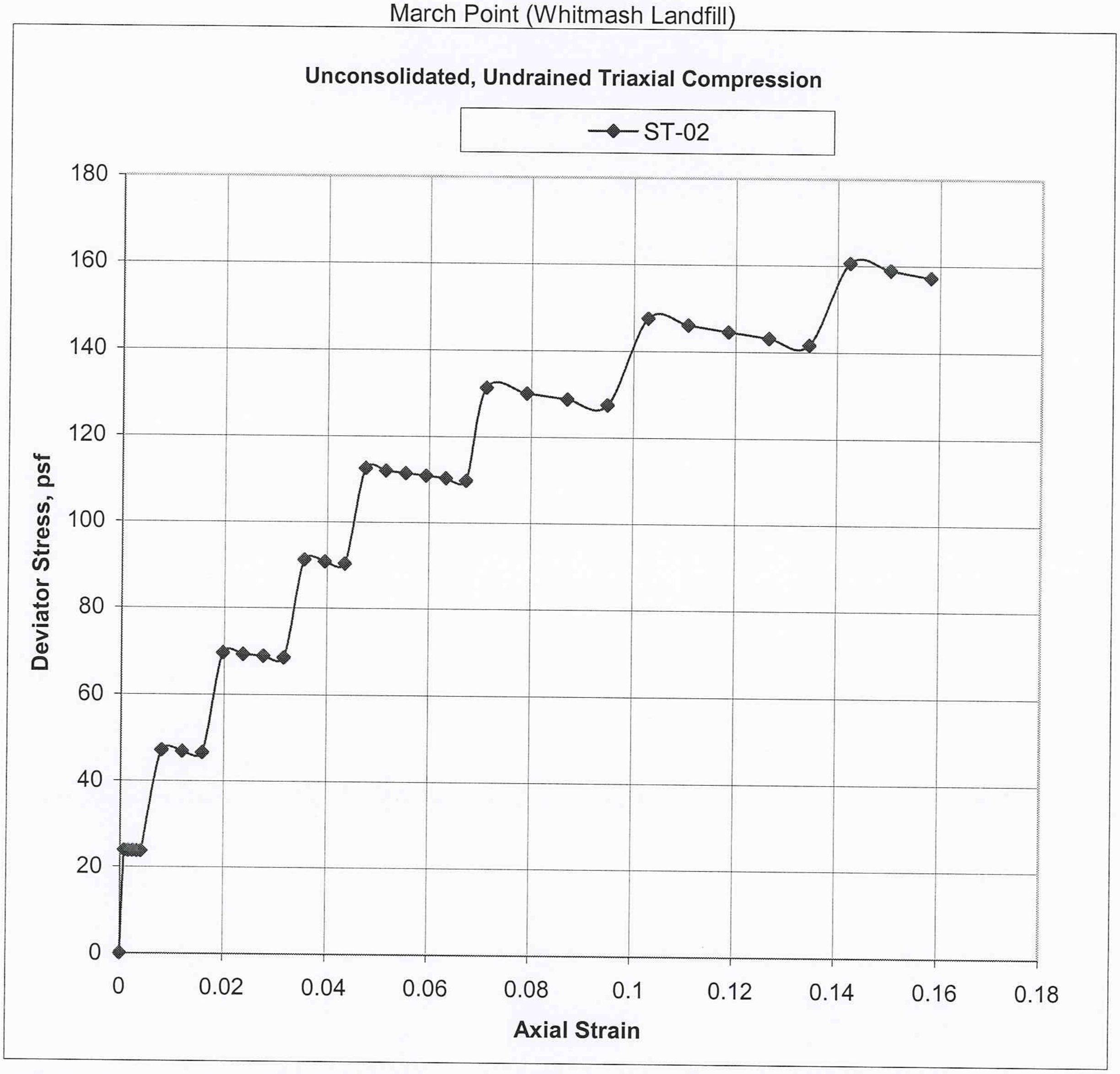
Amec Geomatrix
March Point (Whitmash Landfill)



Sample ID	Depth (ft)	Confining Pressure (psi)	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)
MW08-24-26	25	17.7	102.2	41.3	72.3

Notes to the testing:
1. The testing was performed according to ASTM D-2850.
2. The sample had a bulging failure.

Amec Geomatrix
March Point (Whitmash Landfill)

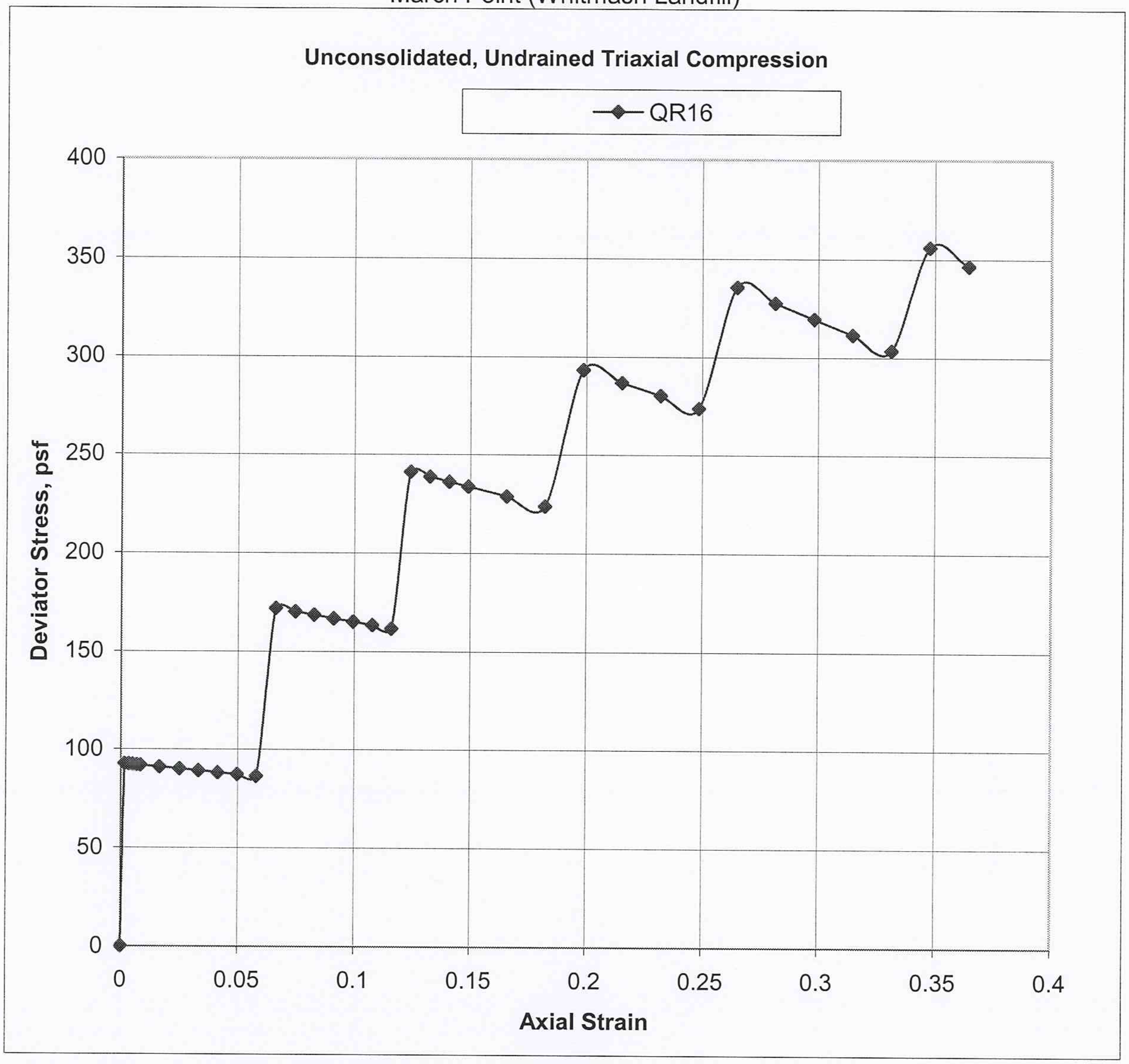


Sample ID	Depth (ft)	Confining Pressure (psi)	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)
ST-02	1	0.6	86.9	114.2	40.6

Notes to the testing:
1. The testing was performed according to ASTM D-2850.
2. The sample had a shear failure.

QR16

Amec Geomatrix
March Point (Whitmash Landfill)



Sample ID	Depth (ft)	Confining Pressure (psi)	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)
QR16	1	0.6	90.5	86.0	48.7

Notes to the testing:
1. The testing was performed according to ASTM D-2850.
2. The sample had a shear failure, with 2 distinct shear planes.

QR16

One-Dimensional Consolidation ASTM D 2435

Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
G17.5-7

Step No.	Vertical Stress (psf)	H_0 (in) / S_{100} (in.)	0.900 / H_{100} (in.)	Vertical Strain (%)	H_{50} (in.)	t_{50} (min.)	c_v (ft^2/day)
1	100						
2	250	0.0199	0.8801	2.21	0.8730	0.25	1.50
3	500	0.0249	0.8552	4.97	0.8486	0.36	0.99
4	1000	0.0410	0.8142	9.53	0.8048	0.16	1.99
5	2000	0.0635	0.7507	16.59	0.7364	0.36	0.74
6	4000	0.1045	0.6462	28.20	0.6300	0.25	0.78
7	8000	0.1020	0.5442	39.53	0.5132	2.56	0.05
8	2000	-0.0337	0.5780	35.78	0.5611	3.99	0.04
9	500	-0.0399	0.6179	31.34	0.6385	33.64	0.01
10	125	-0.0535	0.6714	25.40	0.6870	23.04	0.01
11	250	0.0029	0.6684	25.54	0.6699	2.80	0.08
12	500	0.0062	0.6639	26.37	0.6670	1.35	0.16
13	1000	0.0173	0.6454	28.29	0.6412	0.64	0.32
14	2000	0.0291	0.6163	31.52	0.6098	0.81	0.23
15	4000	0.0393	0.5770	35.89	0.5703	0.36	0.44
16	8000	0.0377	0.5393	40.07	0.5283	0.81	0.17
17	16000	0.0824	0.4569	49.23	0.4285	3.61	0.03
18	4000	-0.0346	0.4916	45.86	0.4743	4.49	0.02
19	1000	-0.0402	0.5275	41.39	0.5452	33.64	0.00
20	250	-0.0473	0.5747	36.14			
21	100	-0.0233	0.5980	33.55			

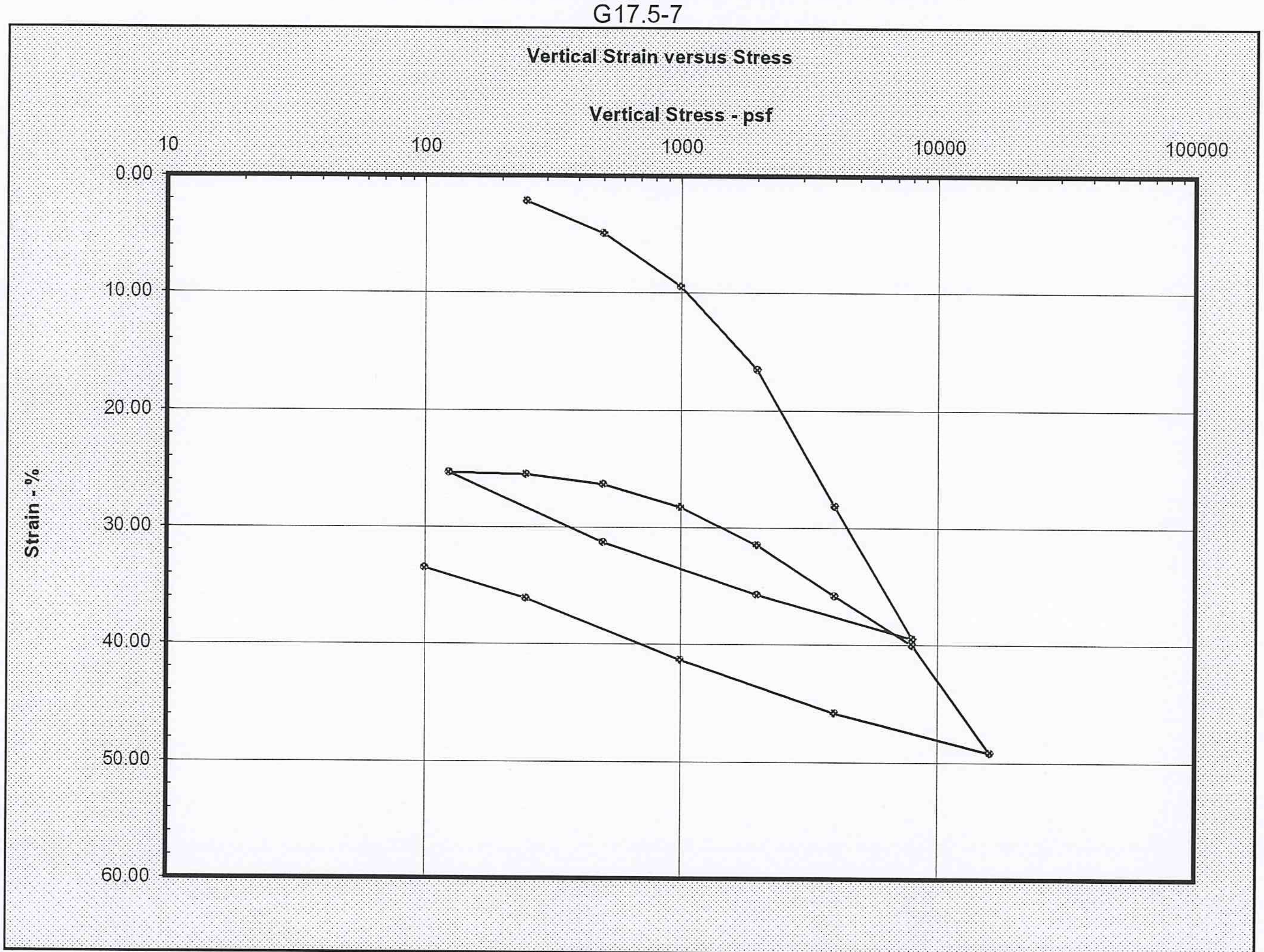
Time (min.)	Sq. Root Time (min.)	Inc. Disp. (in.)	Total Disp. (in.)	Load (lbs)
0.00	0.0000	0.0000	0.3725	34.6519
0.10	0.3162	-0.0018	0.3707	9.6934
0.20	0.4472	-0.0021	0.3704	9.9393
0.45	0.6708	-0.0025	0.3700	8.7598
0.95	0.9747	-0.0032	0.3693	9.1993
1.95	1.3964	-0.0040	0.3686	8.7717
3.95	1.9875	-0.0050	0.3676	8.5329
7.97	2.8225	-0.0065	0.3660	8.6280
15.97	3.9958	-0.0089	0.3636	8.6517
29.98	5.4757	-0.0119	0.3606	9.0188
59.00	7.6811	-0.0184	0.3541	8.2479
117.95	10.8605	-0.0272	0.3454	8.6624
236.97	15.3937	-0.0379	0.3346	9.2504
475.97	21.8167	-0.0471	0.3254	8.3013
480.32	21.9161	-0.0473	0.3253	8.4866

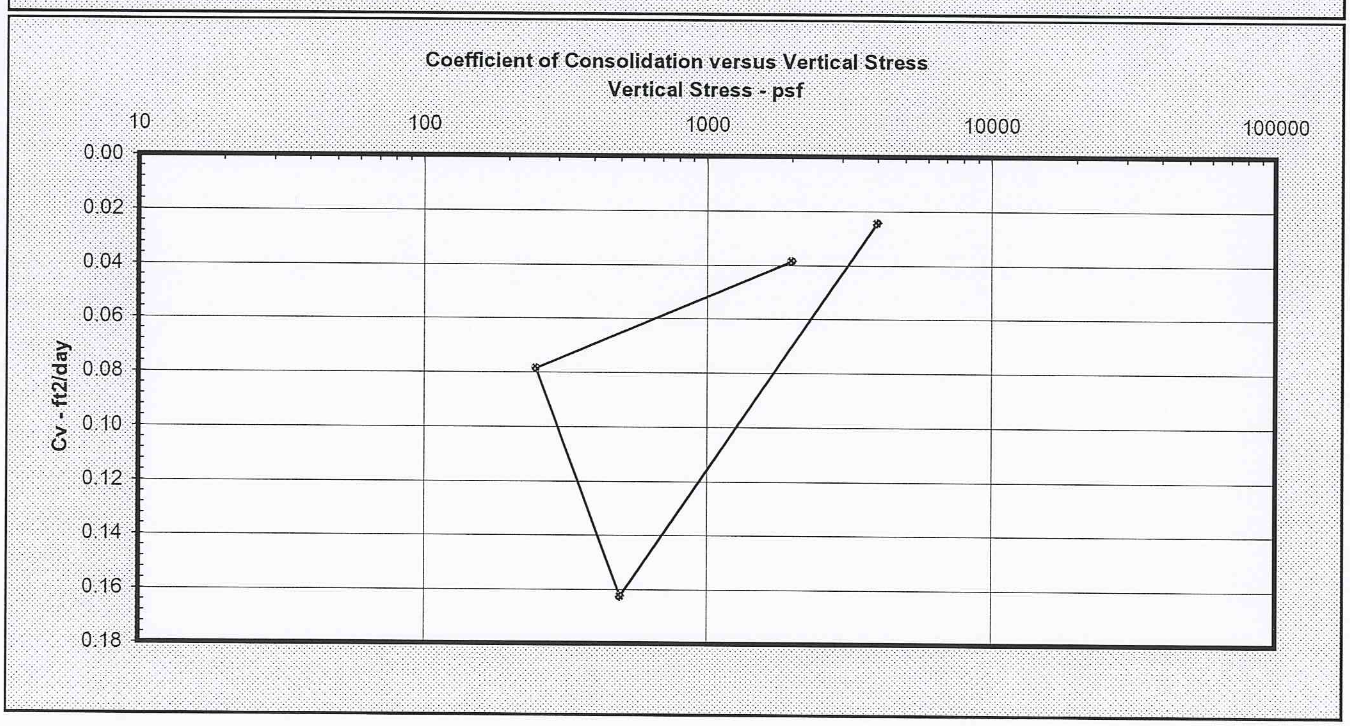
Water Content		Dry Unit Weight		Void Ratio		Saturation Degree	
Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
174.7468	124.9746	4.085617	6.012963	5.356444	3.319002	86.45268	99.78377

QR16G

QR16:00028

One-Dimensional Consolidation ASTM D 2435
Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
G17.5-7





One-Dimensional Consolidation ASTM D 2435

Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
MW-10-24-26

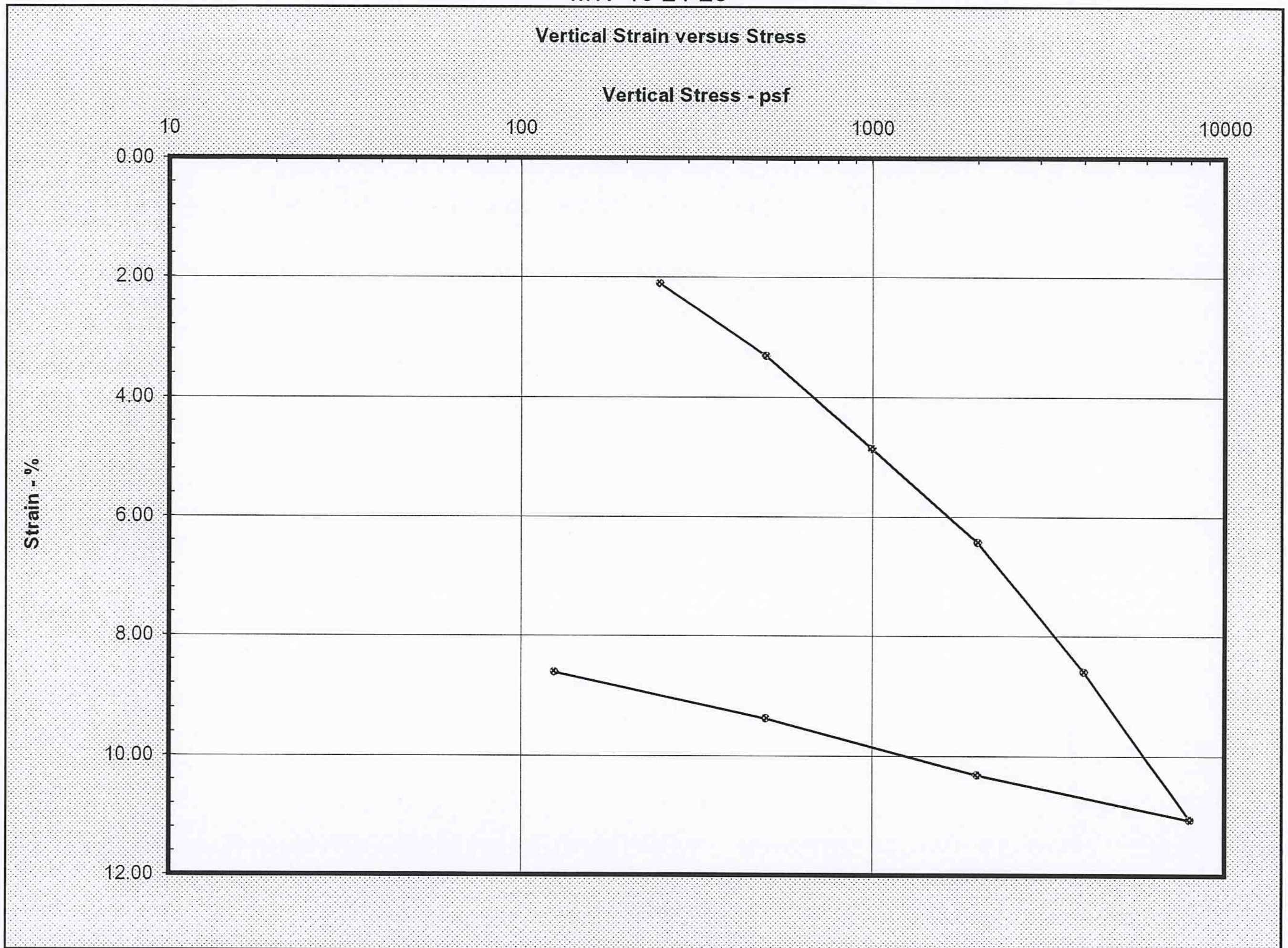
Step No.	Vertical Stress (psf)	H_0 (in) / S_{100} (in.)	0.900 / H_{100} (in.)	Vertical Strain (%)	H_{50} (in.)	t_{50} (min.)	c_v (ft^2/day)
1	100						
2	250	0.0192	0.8809	2.12	0.8691	4.00	0.09
3	500	0.0090	0.8719	3.33	0.8764	2.31	0.16
4	1000	0.0138	0.8562	4.87	0.8502	2.89	0.12
5	2000	0.0141	0.8420	6.44	0.8361	1.21	0.28
6	4000	0.0195	0.8225	8.61	0.8148	0.56	0.58
7	8000	0.0223	0.8002	11.08	0.7915	0.36	0.86
8	2000	-0.0068	0.8070	10.33	0.8114	0.25	1.30
9	500	-0.0084	0.8155	9.39	0.8195	1.00	0.33
10	125	-0.0070	0.8224	8.62	0.8259	7.84	0.04
2	250	0.0036	0.8964	0.40	0.8948	0.64	0.62
3	500	0.0028	0.8937	0.70	0.8950	1.78	0.22
4	1000	0.0042	0.8895	1.17	0.8876	1.21	0.32
5	2000	0.0058	0.8837	1.81	0.8811	0.49	0.78
6	4000	0.0071	0.8767	2.59	0.8722	1.00	0.37
7	8000	0.0107	0.8659	3.78	0.8603	0.64	0.57
8	16000	0.0221	0.8438	6.24	0.8337	0.64	0.53
9	4000	-0.0095	0.8533	5.19	0.8610	0.64	0.57
10	1000	-0.0078	0.8610	4.33	0.8648	0.36	1.02
11	250	-0.0084	0.8694	3.40	0.8714	0.36	1.04

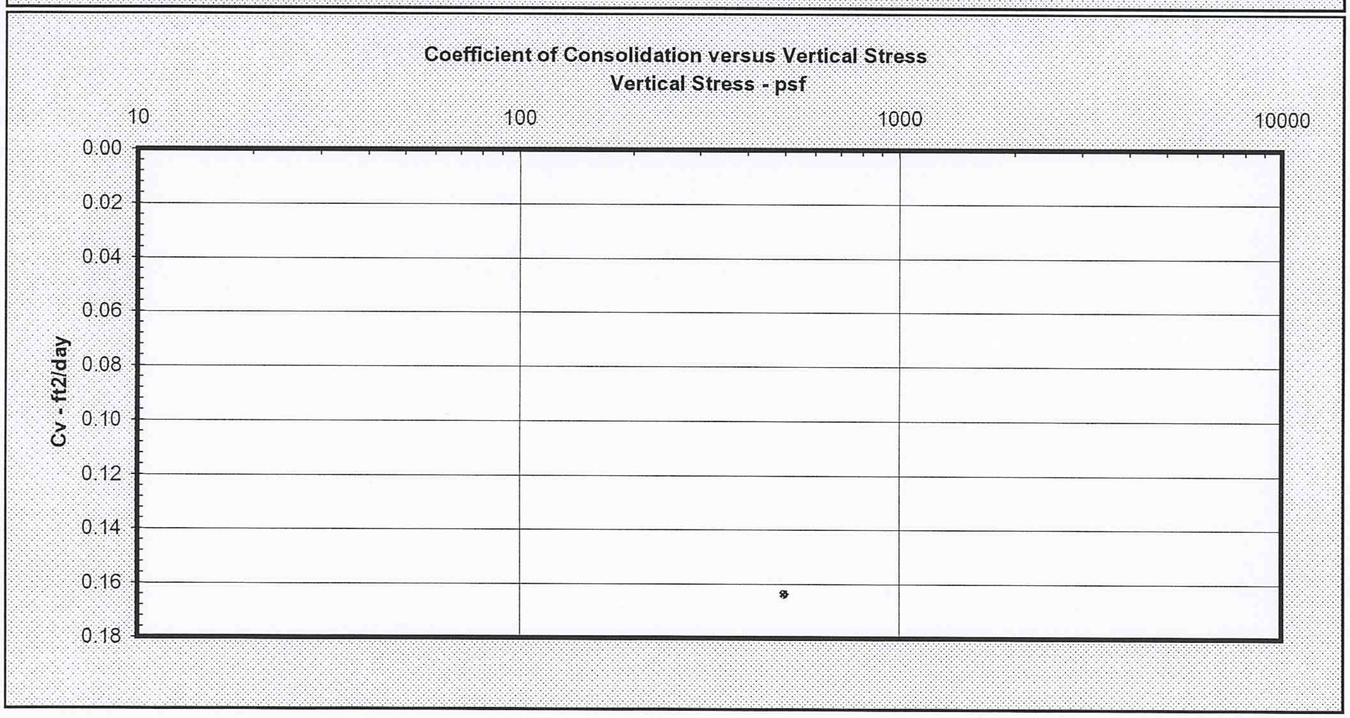
Time (min.)	Sq. Root Time (min.)	Inc. Disp. (in.)	Total Disp. (in.)	Load (lbs)
0.00	0.0000	0.0000	0.0930	67.6789
0.10	0.3162	-0.0027	0.0902	17.7061
0.20	0.4472	-0.0029	0.0900	17.8190
0.45	0.6708	-0.0033	0.0897	17.5933
0.95	0.9747	-0.0039	0.0891	17.3023
1.95	1.3964	-0.0049	0.0881	17.0326
3.95	1.9875	-0.0054	0.0876	17.0600
7.95	2.8196	-0.0061	0.0869	16.7190
15.95	3.9937	-0.0069	0.0861	16.6882
29.93	5.4711	-0.0071	0.0859	17.5161
58.92	7.6757	-0.0076	0.0854	16.9043
117.98	10.8620	-0.0078	0.0852	17.3260
236.98	15.3943	-0.0083	0.0847	17.0552
476.00	21.8174	-0.0084	0.0845	17.0695
480.40	21.9180	-0.0084	0.0845	17.6159

Time (min.)	Sq. Root Time (min.)	Inc. Disp. (in.)	Total Disp. (in.)	Load (lbs)
0.00	0.0000	0.0000	0.0390	33.9157
0.10	0.3162	-0.0012	0.0378	9.1045
0.20	0.4472	-0.0017	0.0373	9.0618
0.45	0.6708	-0.0024	0.0366	9.8980
0.95	0.9747	-0.0028	0.0361	8.6401
1.95	1.3964	-0.0033	0.0357	8.7589
3.95	1.9875	-0.0041	0.0348	8.4025
7.95	2.8196	-0.0048	0.0342	8.5023
15.97	3.9958	-0.0055	0.0335	8.6294
29.98	5.4757	-0.0062	0.0327	8.5284
58.98	7.6801	-0.0071	0.0318	8.4405
117.95	10.8605	-0.0078	0.0312	8.0937
236.93	15.3926	-0.0084	0.0306	8.6532
237.10	15.3981	-0.0084	0.0306	8.6733

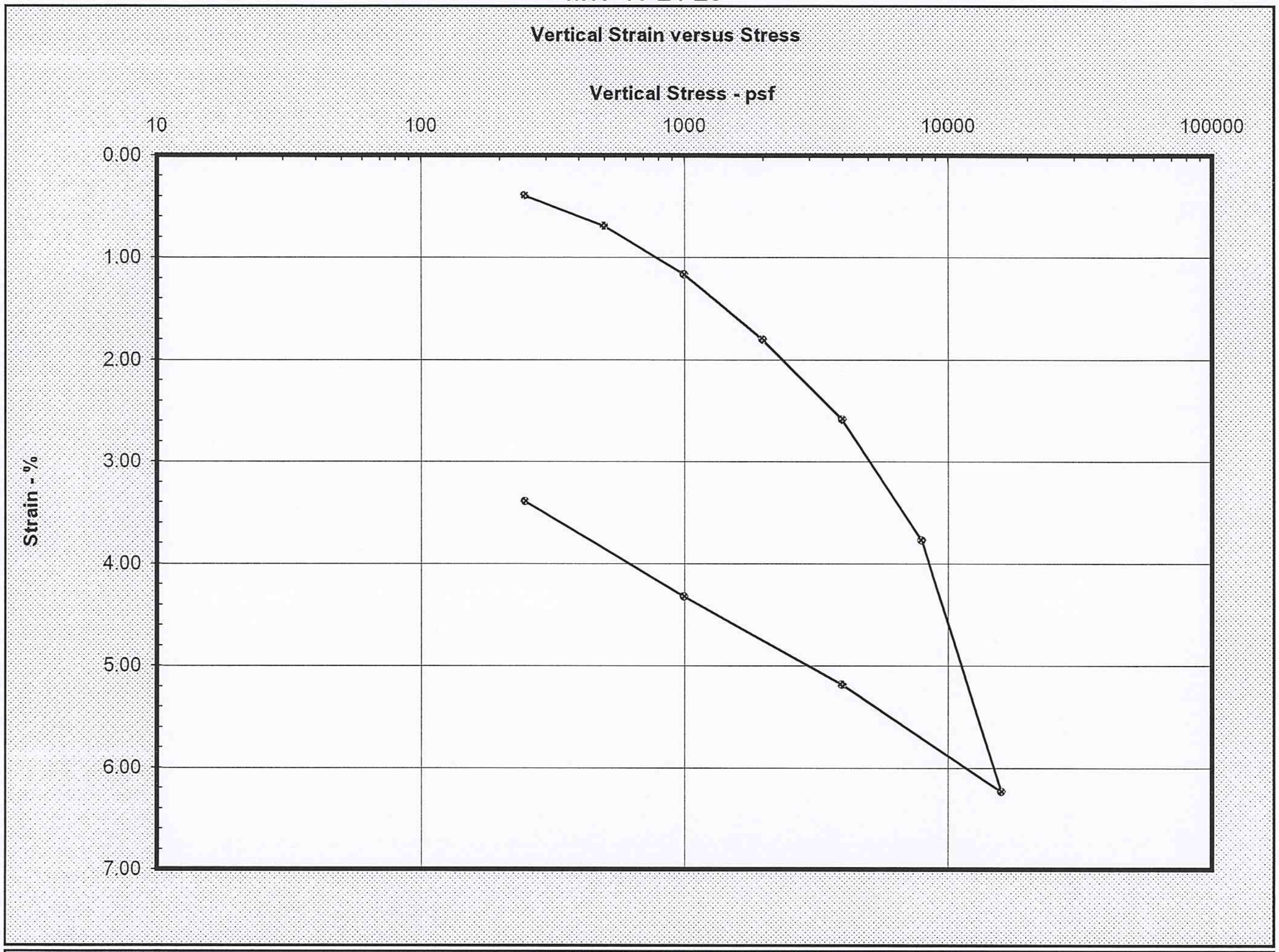
Water Content		Dry Unit Weight		Void Ratio		Saturation Degree	
Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
39.62087	30.28707	12.89107	14.27677	1.014573	0.819039	103.4872	97.99375

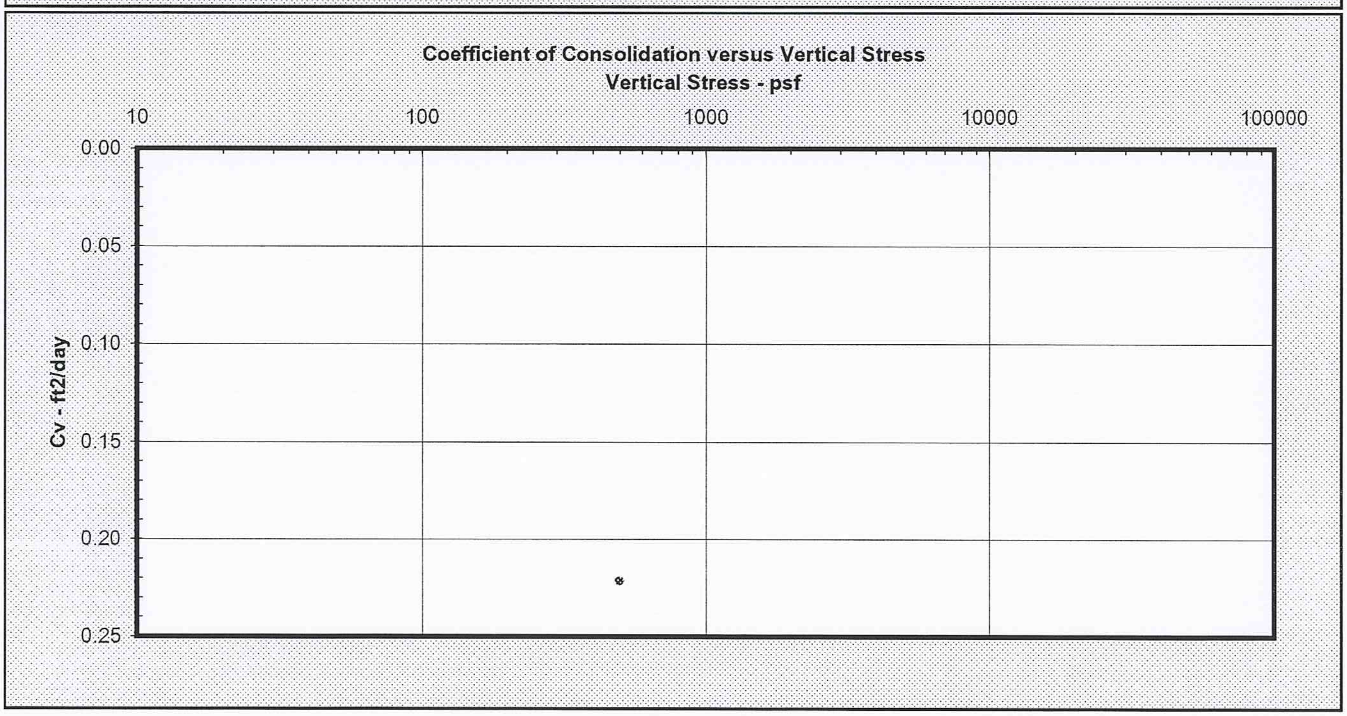
ASTM D 2435
Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
MW-10-24-26





ASTM D 2435
Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
MW-10-24-26





One-Dimensional Consolidation ASTM D 2435

Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
ST-02

Step No.	Vertical Stress (psf)	H_0 (in) / S_{100} (in.)	0.900 / H_{100} (in.)	Vertical Strain (%)	H_{50} (in.)	t_{50} (min.)	c_v (ft^2/day)
1	100						
2	250	0.0657	0.8344	7.29	0.8141	0.64	0.51
3	500	0.0509	0.7835	12.95	0.7718	0.49	0.60
4	1000	0.0574	0.7261	19.32	0.7133	0.36	0.70
5	2000	0.0642	0.6619	26.45	0.6485	0.25	0.83
6	4000	0.0653	0.5967	33.70	0.5761	0.49	0.33
7	8000	0.0593	0.5374	40.29	0.5215	0.25	0.54
8	2000	-0.0118	0.5492	38.98	0.5566	0.36	0.42
9	500	-0.0136	0.5628	37.46	0.5671	0.64	0.25
10	125	-0.0121	0.5749	36.13	0.5774	5.29	0.03
2	250	0.0148	0.8851	1.65	0.8783	0.81	0.47
3	500	0.0096	0.8755	2.72	0.8732	0.49	0.77
4	1000	0.0105	0.8650	3.88	0.8609	0.64	0.57
5	2000	0.0116	0.8534	5.17	0.8480	1.21	0.29
6	4000	0.0148	0.8386	6.83	0.8329	0.25	1.37
7	8000	0.0227	0.8158	9.35	0.8071	0.64	0.50
8	16000	0.0461	0.7698	14.47	0.7547	0.49	0.57
9	4000	-0.0114	0.7811	13.21	0.7886	0.49	0.63
10	1000	-0.0123	0.7934	11.84	0.7979	0.16	1.96
11	250	-0.0189	0.8124	9.74	0.8165	1.21	0.27
12	100	-0.0123	0.8247	8.37	0.8261	0.81	0.41

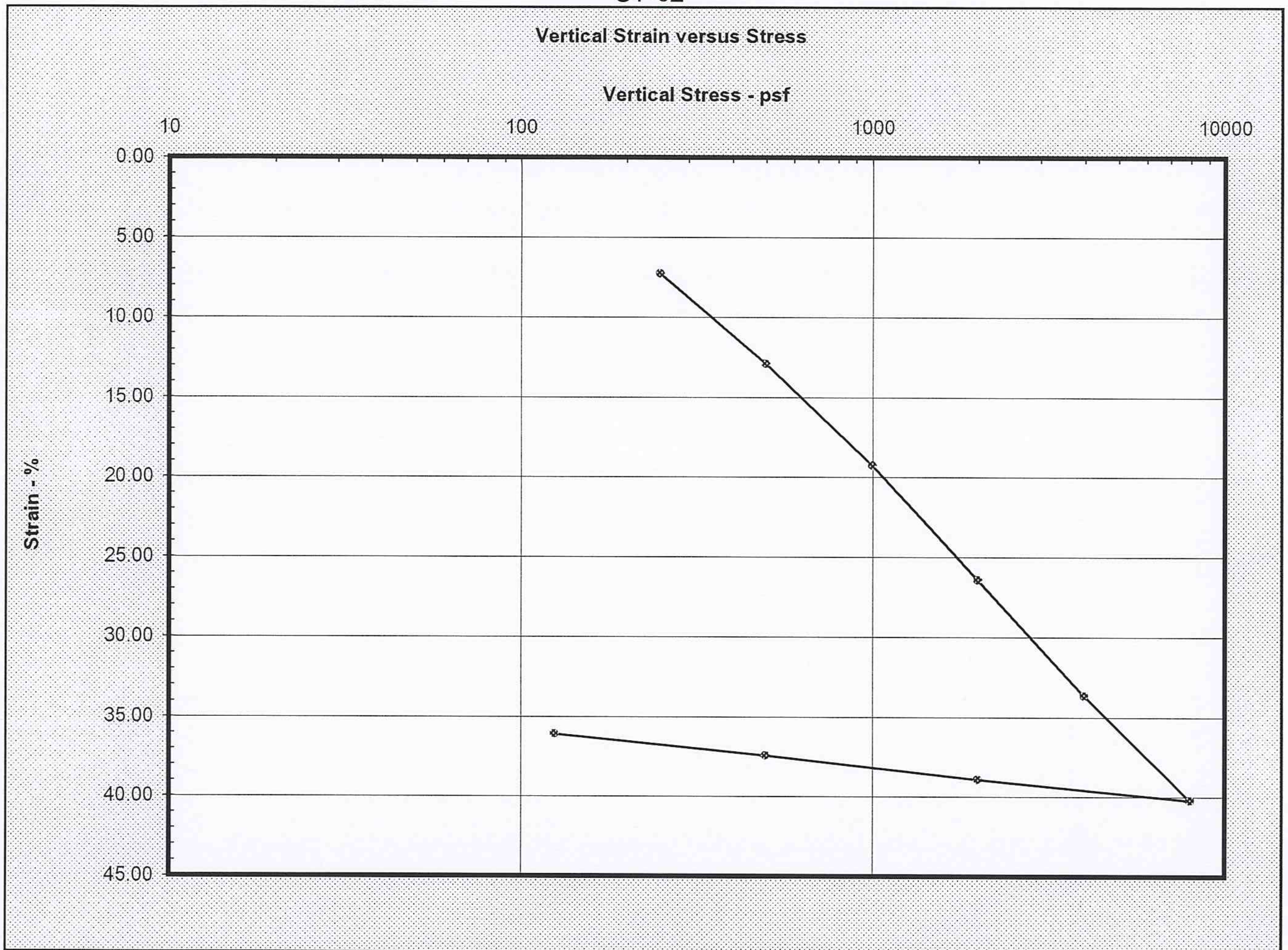
Time (min.)	Sq. Root Time (min.)	Inc. Disp. (in.)	Total Disp. (in.)	Load (lbs)
0.00	0.0000	0.0000	0.3626	272.8111
0.10	0.3162	-0.0065	0.3561	71.5943
0.20	0.4472	-0.0074	0.3552	69.2424
0.45	0.6708	-0.0076	0.3550	69.6083
0.95	0.9747	-0.0083	0.3543	67.9774
1.95	1.3964	-0.0088	0.3538	67.9929
3.95	1.9875	-0.0093	0.3533	68.4335
7.97	2.8225	-0.0100	0.3526	67.6555
15.97	3.9958	-0.0105	0.3521	68.1449
29.97	5.4742	-0.0107	0.3519	68.1105
58.97	7.6790	-0.0113	0.3513	67.9869
117.92	10.8589	-0.0115	0.3511	68.1877
236.92	15.3921	-0.0118	0.3508	68.3872
475.95	21.8163	-0.0119	0.3507	68.1592
480.25	21.9146	-0.0118	0.3508	68.2197

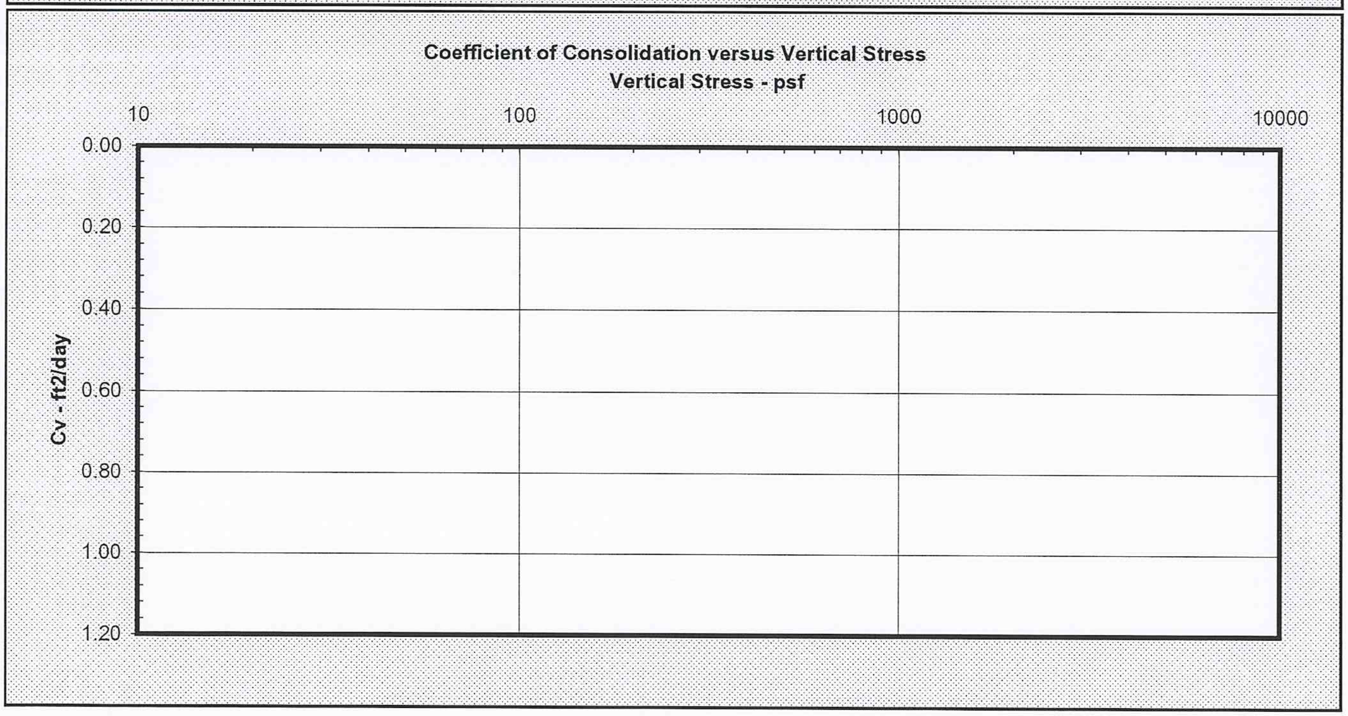
Time (min.)	Sq. Root Time (min.)	Inc. Disp. (in.)	Total Disp. (in.)	Load (lbs)
0.00	0.0000	0.0000	0.0876	8.7216
0.10	0.3162	-0.0005	0.0871	4.6687
0.20	0.4472	-0.0010	0.0867	3.5474
0.45	0.6708	-0.0012	0.0864	3.4762
0.97	0.9832	-0.0015	0.0861	3.5961
1.97	1.4024	-0.0021	0.0856	3.3443
3.97	1.9916	-0.0026	0.0850	3.5807
7.97	2.8225	-0.0032	0.0845	3.2968
15.97	3.9958	-0.0039	0.0838	3.3716
29.97	5.4742	-0.0048	0.0828	3.4536
58.98	7.6801	-0.0061	0.0815	3.5629
117.97	10.8612	-0.0080	0.0796	3.6282
236.97	15.3937	-0.0098	0.0779	3.3206
475.97	21.8167	-0.0123	0.0754	3.0200
480.35	21.9169	-0.0123	0.0753	3.6389

Water Content		Dry Unit Weight		Void Ratio		Saturation Degree	
Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
117.0886	55.58358	6.374038	10.33722	3.07434	1.512282	100.9273	97.40015

QR16J

ASTM D 2435
Amec Geomatrix 14159 March Point (Whitmarsh Landfill)
ST-02

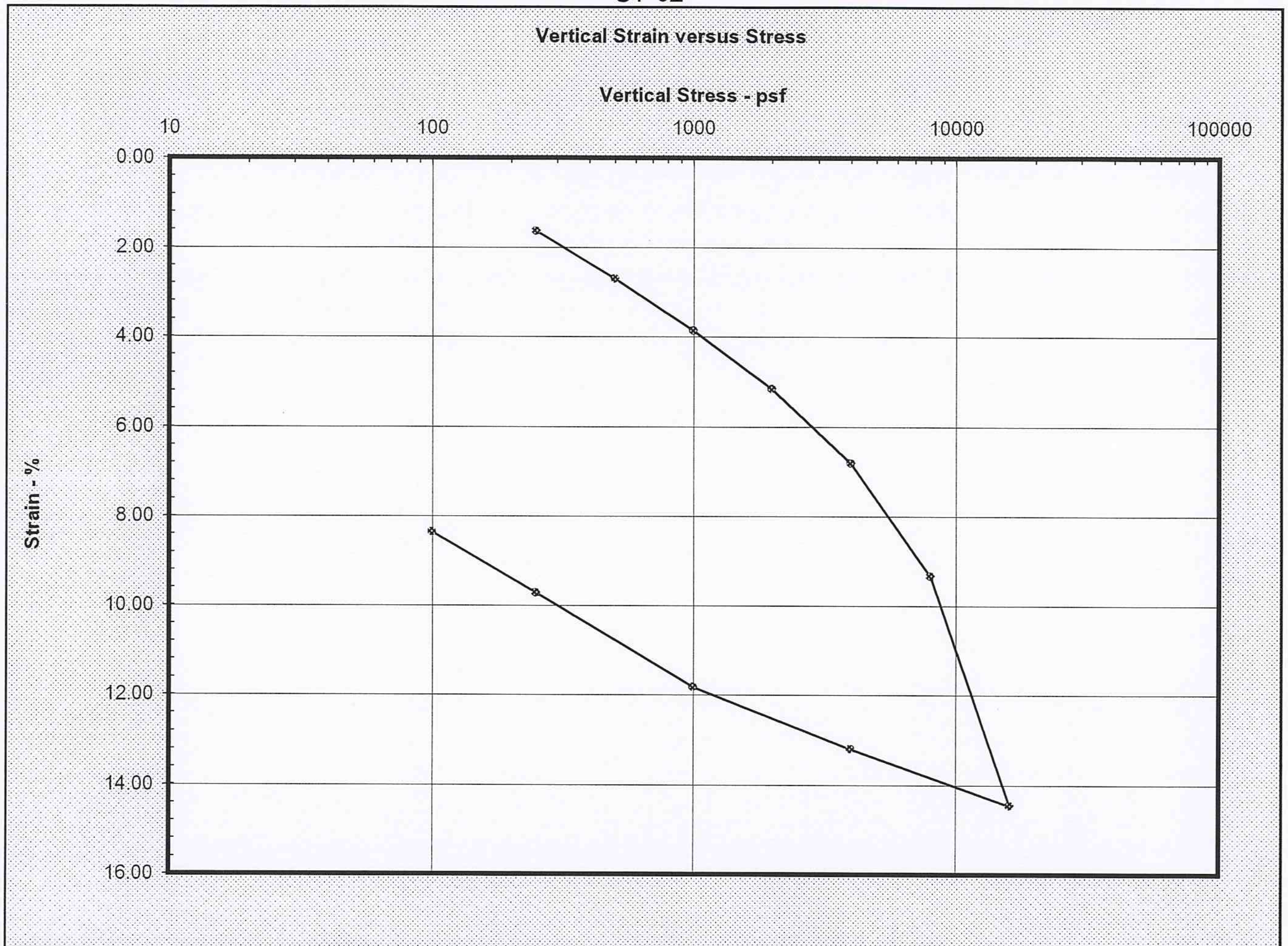


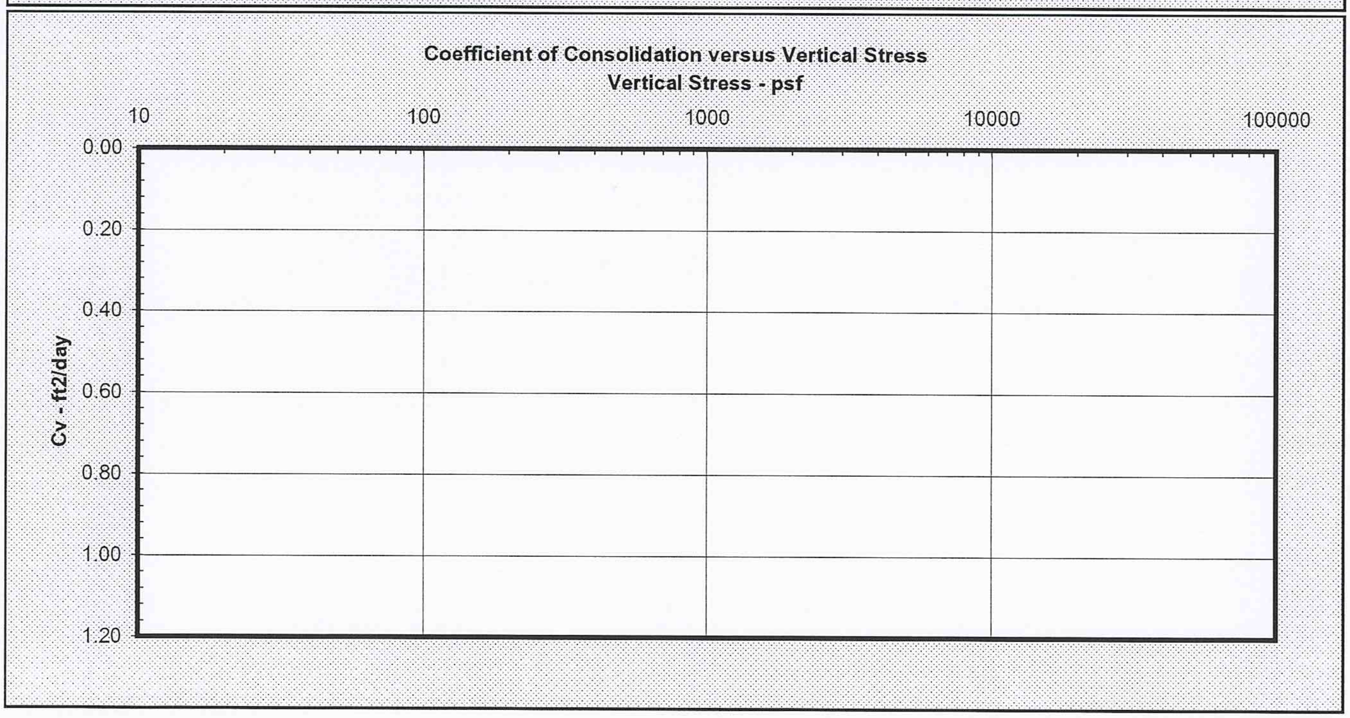


ASTM D 2435

Amec Geomatrix 14159 March Point (Whitmarsh Landfill)

ST-02





APPENDIX N

GCLL Technical References

CETCO

Date: May 22, 2015

To: Koorus Tahghighi, John Long, Dave Haddock

Subject: GCL Compatibility Testing with Site-Specific Permeant from March Point Landfill, Anacortes, WA

This memo discusses the expected hydraulic performance of a polymer enhanced Geosynthetic Clay Liner (GCL), trade name Resistex Plus, with site-specific permeant fluid present at the subject project.

The test method being used to determine hydraulic conductivity of the GCL is ASTM D6766. The permeant fluid is a site-specific sample sent by Amec Foster Wheeler to CETCO's GAI-LAP accredited laboratory in Hoffman Estates, IL having the following properties:

Conductivity	45,600 μS/cm
pH	7.558
I*	.4379
RMD**	1.43

*Ionic Strength

**Ratio of monovalent to divalent cations

Element	ppm
Silver	≈0.0
Aluminum	0.9767
Arsenic*	≈0.0
Boron	≈0.0
Barium	≈0.0
Calcium	315.5
Cadmium	≈0.0
Chloride	11,500
Chromium	2.463
Copper	≈0.0
Iron*	≈0.0
Mercury*	≈0.0
Potassium	≈0.0
Magnesium	959.7
Manganese	≈0.0
Molybdenum	≈0.0
Sodium	7202
Nickel	≈0.0
Phosphorus	≈0.0
Lead*	≈0.0
Sulfur	383.2
Antimony	0.6024
Selenium*	≈0.0
Titanium	≈0.0
Zinc	≈0.0
Zircon	0.3337

Notes
1) Accuracy is ±0.005 ppm except for arsenic, iron, mercury, lead and selenium which have accuracy limits of 0.02 ppm.
2) The sample was diluted 1:99 prior to testing and the results scaled up by 100x.

Test conditions are per scenario 2 (no fresh water pre-hydration, indicative of worst case), method C (falling head, rising tailwater), and standard confining pressure of 5 psi as described in ASTM D6766.

Testing indicates a **hydraulic conductivity of Resistex Plus of 9.54 x 10^{-9} cm/s**. Recently, chemical equilibrium termination criteria as defined in ASTM D6766 was reached. Equilibrium is established when the ratio of the outflow-to-inflow electrical conductivity is 1.0 ± .01. This termination criteria is the most conservative of termination criteria noted in ASTM D6766, and is generally indicative of steady state flow.

Subsequent to hydraulic conductivity testing of the GCL, we've taken the liberty of preparing estimated leakage rates for a geofilm-laminated GCL as compared to the prescriptive liner system of at least two feet of 10^{-6} cm/s or lower permeability soil. Leakage calculations for the prescriptive liner system can be estimated using Darcy's Law:

$$q = k \cdot i = k \cdot \frac{(h + L)}{L}$$

Where:
q is the flow rate per unit area ($m^3/m^2/s$)

k is the hydraulic conductivity (m/s)

i is the hydraulic gradient

L is the liner thickness (m)

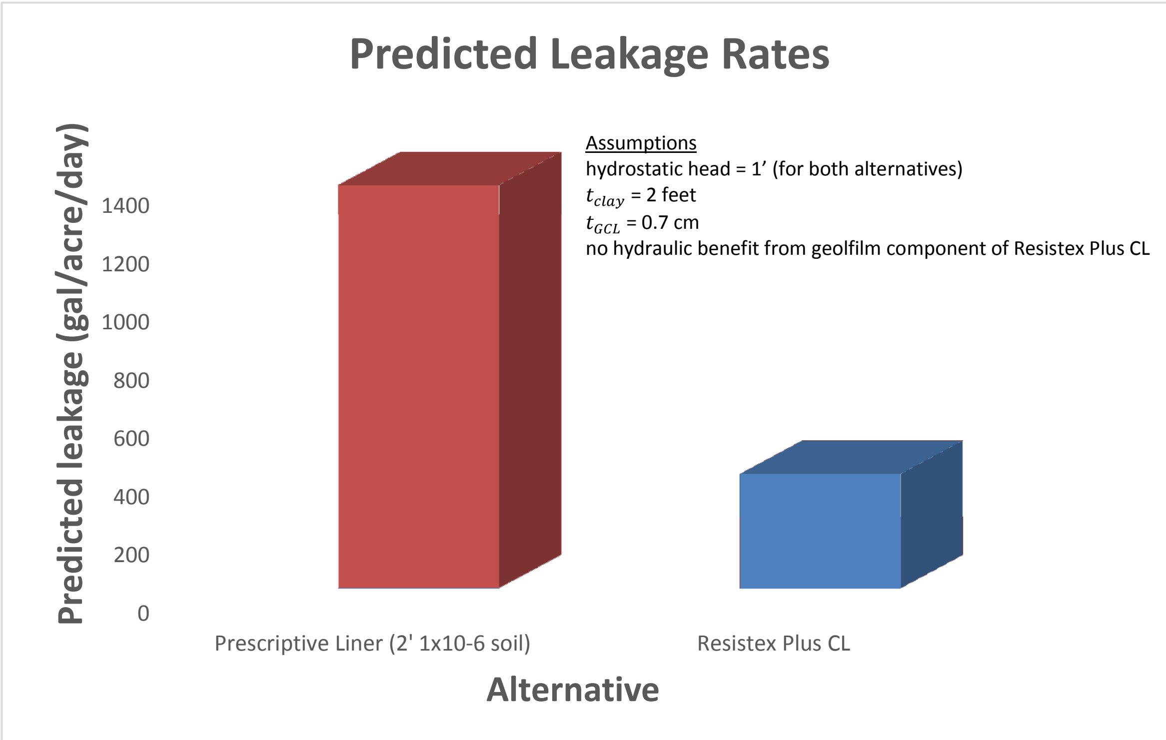
h is the hydraulic head (m)

Assuming the prescribed hydraulic conductivity of 10^{-6} cm/s and thickness of .6096m (2'), and a hydraulic head of .3048m (1'), it is predicated that the prescriptive liner system would allow leakage of **1,384 gallons/acre/day**.

A potentially better performing, lower-cost composite liner option is a geofilm-backed GCL, such as Resistex Plus CL. Resistex Plus CL consists of Resistex Plus with a 0.127-mm HDPE geofilm laminated to one side for improved hydraulic performance, as well as mitigation of the deleterious effects of wet/dry cycling and ion exchange in a capping application such as this. For simplicity of comparison purposes, we've calculated the predicted leakage rates of the Resistex Plus CL material ignoring any hydraulic performance benefits of the geofilm.

Using Darcy's Law, assuming the measured hydraulic conductivity of 9.54 x 10^{-9} cm/s and thickness of .7 cm, and a hydraulic head of .3048m (1'), it is predicted that Resistex Plus CL would allow leakage of **392 gallons/acre/day.** When we factor in the benefits of the overlying geofilm component, the expected leakage would be even lower.

Those predicted leakage rates are summarized in the chart below:



CETCO appreciates the opportunity to work on this project and welcomes any questions or comments you may have.

Andy Jung
Technical Sales Manager, Environmental Products Group
CETCO
Phone: 303-551-5529
andrew.jung@cetco.com www.cetco.com

Exhibit 1: GCL test report provided under separate cover

Summary of Liner Leakage Calculations

Former Whitmarsh Landfill

July 2015

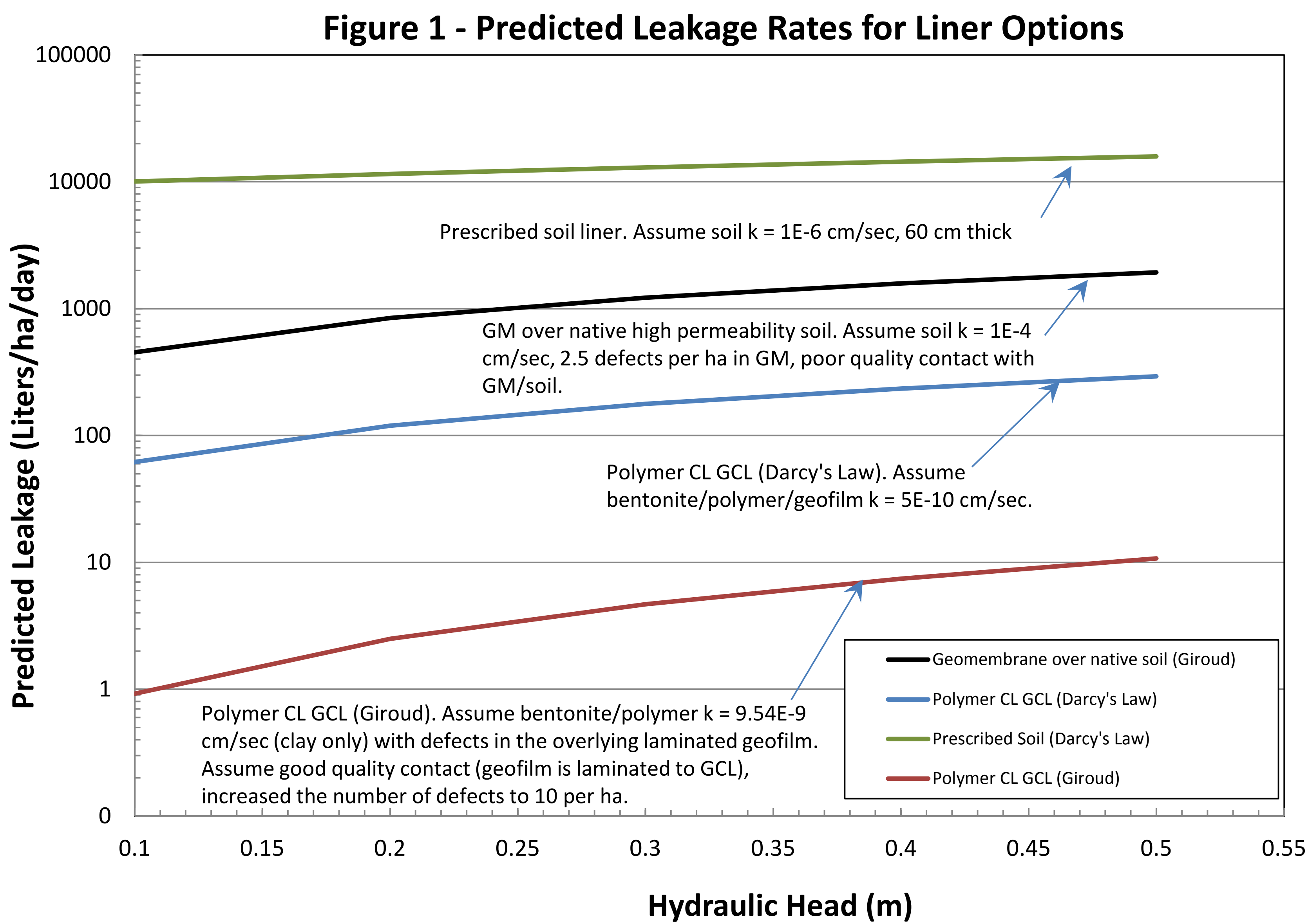


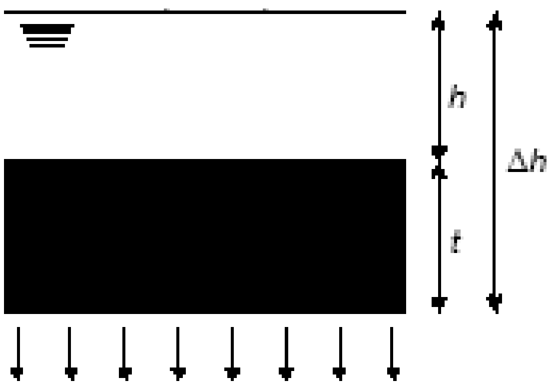
Figure 1 - Predicted Leakage Rates for Liner Options
Predicted Leakage (Liters/ha/day)
100000
10000
1000
100
10
1
0
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
Hydraulic Head (m)
Prescribed soil liner. Assume soil k = 1E-6 cm/sec, 60 cm thick
GM over native high permeability soil. Assume soil k = 1E-4 cm/sec, 2.5 defects per ha in GM, poor quality contact with GM/soil.
Polymer CL GCL (Darcy's Law). Assume bentonite/polymer/geofilm k = 5E-10 cm/sec.
Polymer CL GCL (Giroud). Assume bentonite/polymer k = 9.54E-9 cm/sec (clay only) with defects in the overlying laminated geofilm. Assume good quality contact (geofilm is laminated to GCL), increased the number of defects to 10 per ha.
Geomembrane over native soil (Giroud)
Polymer CL GCL (Darcy's Law)
Prescribed Soil (Darcy's Law)
Polymer CL GCL (Giroud)

Assumptions - Soil

- Darcy's Law was used for calculating the prescribed soil leakage rates, using the following equation:

$$q = \frac{Q}{A} = ki$$

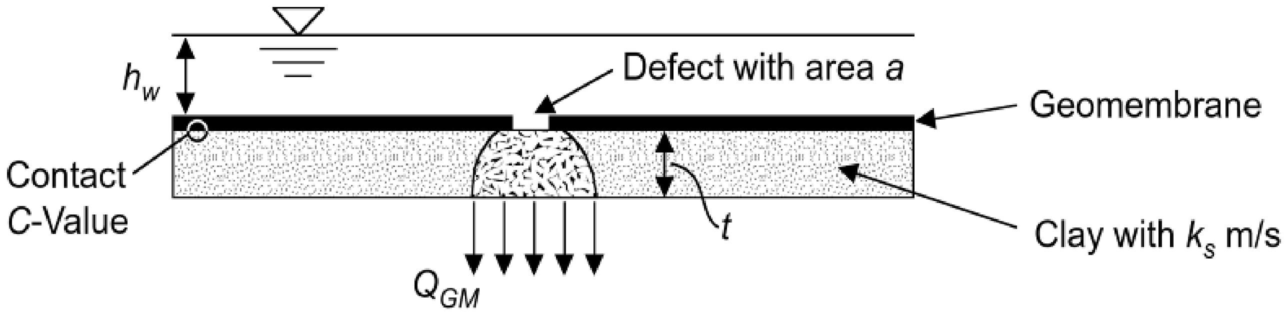
- k = hydraulic conductivity (1E-6 cm/sec)
- i = hydraulic gradient = (H+T)/T
- Where, H = hydraulic head (0 - 0.5 m) and T = Liner thickness (0.6 m)



Assumptions – GCLL (Darcy's Law)

- Same formula as previous slide, with the following values:
- k = 5E-10 cm/sec (this k value includes the laminate)
- T = 0.007 m
- H = same as before, 0 – 0.5 m
- Much of the leakage measured using ASTM D5887 with a laminate GCLL, such as Bentomat CL, is sidewall leakage and not leakage through the actual GCLL.
- Hence this k value may be conservative (i.e., a lower overall leakage rate is likely).
- For this reason, we also used Giroud's equation to evaluate leakage through the GCLL.

Assumptions – GCLL (Giroud)



$$Q = C_{qo}\left(1 + 0.1\cdot\left(h/t_s\right)^{0.95}\right)a^{0.1}\cdot h^{0.9}\cdot k^{0.74}$$

where:

Q = flow through hole in geomembrane

$\boldsymbol{C_{qo}}$ = quality of intimate contact between GM/soil

(C_{qo} = 1.15 for poor contact and 0.21 for good contact)

h = liquid head on liner system (< 3 m)

$\boldsymbol{t_s}$ = thickness of soil beneath geomembrane

a = area of hole in geomembrane (circular, max diam 25 mm)

k = permeability of soil under geomembrane (constant)

See attached TR-258 for additional information on Giroud's equation.

Assumptions – GCLL (Giroud), Cont.

- Laminate is glued to the GCL, hence the contact coefficient (C_{qo}) will be good (0.21).
- h = similar to previous calculations, 0 – 0.5 m
- t_s = 0.007 m (thickness of low permeability bentonite/polymer clay)
- a = 1 cm^2, based on assumed defect diameter of 11 mm.

Typical for liner performance evaluation one defect per acre (4,000 m^2) is considered with a defect area of 0.1 cm^2 (equivalent to defect diameter of 3.5 mm), for a conservative design a defect area of 1 cm^2 (equivalent defect diameter of 11 mm) can be considered (Giroud et al., 1994).

Assumptions – GCLL (Giroud), Cont.

- k = 9.54E-9 cm/sec, based on measured k value of only the clay component with the site sea water.
- Assumed 10 installation defects per ha to be more conservative due to the thinner laminate thickness.
- Despite the increased number of assumed defects, the low permeability clay would help minimize leakage despite the increased defects.

Installation quality	Defect density (number acre)	Frequency (percent)
Excellent	Up to 1	10
Good	1 to 4	40
Fair	4 to 10	40
Poor	10 to 20*	10

Based on Help model (Schroeder et al., 1994).

Assumptions – HDPE GM (Giroud)

Same equation as previous slide, with the following variable modifications:

- C_{qo} will not be as good as that of the GCLL. The HDPE will not conform as well to the subgrade surface (wrinkles, non-uniform subgrade, etc). Assumed value is 1.15.
- h = similar to previous calculations, 0 – 0.5 m
- t_s = 10 m (assumed thickness of existing soil)
- a = 1 cm^2, based on assumed defect diameter of 11 mm.
- k = 1E-4 cm/sec, assuming a higher permeability soil on site.
- Assumed 2.5 installation defects per ha (1 defect per acre), which assumes good to excellent installation quality (from table on slide 7, based on Help model).

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April 26th, 2015

Title: Expected Service Life of Polymer Modified Geosynthetic Clay Liners

Introduction:

Synthetic water-soluble polymers have proven successful for various commercial applications such as rheological modifiers, flocculation aids, sealants for undersea cables, waterproofing, grouts, coatings, absorbents and lubricants, to name a few. CETCO employs such polymers as functional additives in geosynthetic clay liners such as Resistex, InterLoK and Continuum. It has been well studied that the geosynthetic materials (membranes, textiles, etc.) used in civil engineering applications must be formulated with proper levels and types of antioxidant/stabilizer/plasticizer packages. For example, a study on the degradation of high density polyethylene (HDPE) geomembranes indicated that, at ambient temperatures and steady oxygen supply, the service life of the HDPE geomembrane might be over 300 years.[1] The information included in this report, however, focuses on the anticipated longevity of the polymers used to modify CETCO geosynthetic clay liners (GCLs). Despite the fact that the polymers used to modify CETCO's GCL products are designed to be more stable than the polymers referenced in the cited literature, the cited literate can be used as an estimate of lifespan by analogy.

Background:

Since the early '90s there has been interest in determining the environmental fate of water swellable/soluble polymers due to their perceived recalcitrance (when deposited in landfills). Several studies have been done to understand the rate at which high molecular weight polymers breakdown on exposure to microbes. This report provides a review of major academic research findings that have been published to date. Several studies have investigated the breakdown of hydrophilic polymers in various disposal settings. These studies sought to determine the rate of mineralization of the polymer (conversion to CO_2 gas) or breakdown of the polymer crosslinks/chains producing smaller polymer chains or low molecular weight organic acids. Due to the relatively slow degradation rates of hydrophilic polymers and the presence of other degradable refuse (intentionally mixed-in to simulate real-world conditions), it was necessary to employ ultra-sensitive detection methods. The use of ^{14}C radiolabeled polymers allowed for accurate kinetic models in both aerobic and anaerobic conditions.

Anaerobic Degradation of High Molecular Weight Polymers:

The studies referenced herein set out to mimic the effects of various phases of biological activity in a landfill such as adjustment, transition, acid formation, methane fermentation and final maturation. These studies involved intentional inoculation of the polymer with microbes. It should be mentioned that other scenarios (such as mining applications for example) would be less aggressive, since the level of microbe activity would be less and the construction depth generally would be greater than the generally accepted anaerobic conditions that occur at a soil depth of 3 meters or less. The first comprehensive anaerobic degradation study was by Pohland et al., where a radiolabeled polymer was mixed with shredded municipal refuse.[2] In this study, the radiolabeled ^{14}C contents in the gas phase and leachates were monitored throughout the various stages of the simulated landfill life. Pohland found minimal amounts of degradation after the simulation reached final maturation. It

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was estimated that <3% of the total ^{14}C appeared in either the leachate or gas phases in the time up to 1250 days. After 1250 days, very little $^{14}CO_2$ evolution was observed over the next 250 days (the study was ended at 1500 days). A similar investigation was published by Stegmann et al. in which the degradation was studied in both anaerobic and aerobic conditions on diaper absorbent polymers.[3] These authors found that, in anaerobic conditions, >90% of the hydrophilic polymer remained localized in the waste, and only 2-4% of the polymer, most likely lower molecular weight components, appeared in the leachate. These tests showed that only 0.5% of the polymer degraded once the simulated landfill reached the methanogenic phase after which biodegradation was "essentially nil". The Stegmann and Pohland findings in anaerobic conditions were further supported in a study by Ress et al., where they found only 2.5% of the polymer was mineralized. In this study, the rate of degradation slowed considerably after 50 days and was negligible after 200 days.[3]

Aerobic Degradation of High Molecular Weight Polymers:
A separate study on aerobic degradation was done by Cook et al.[5] The Cook study concluded that after a 100 day composting period, only 8% degradation had occurred. Cook predicted the ensuing degradation rate would be approximately 0.007% per day (127 years to complete degradation). Since most waterproofing applications would be oxygen starved, any degradation occurring through bacterial or oxidation pathways would therefore occur at a much slower rate.

Conclusions:
The research indicates that high molecular weight water soluble polymers are slow to completely degrade in the environment. Anaerobic conditions (example: >3 meters of soil coverage) would result in much slower degradation rates, with an initial polymer degradation of 3-6% and negligible degradation thereafter. Based on this data, it is theorized that the longevity of the hydrophilic polymers in CETCO GCL products will be greater than 120 years. CETCO is currently planning more in-depth studies to understand the impact of various field conditions on the longevity of the products.

Sincerely,

Michael S Donovan, Ph.D.
Global R&D Director – Construction Technologies
CETCO / Minerals Technologies Corporation

References:

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4) Ress, B.; Calvert, P.; Barlaz, M. *Environ. Sci. Technol*. 1998, 32, 821-827.
5) Cook, B.; Bloom, P.; Halbach, T. *Journal of Environmental Quality* 1997, 26(3), 618-625.

Hydrologic performance of final covers containing GCLs

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ABSTRACT: Field performance data are examined for landfill final covers employing a barrier layer consisting of a conventional GCL, a laminated GCL (GCL with geofilm affixed), or a GCL composite (geomembrane over GCL). Data from covers relying solely on a conventional GCL indicate that the hydraulic conductivity of the GCL tends to increase over time, resulting in higher percolation rates than originally intended (covers with sodic soils are an exception). Percolation rates of 200-300 mm/yr are typical of covers relying on a conventional GCL in humid climates. Covers employing laminated GCLs and composite GCL-geomembrane barriers have low percolation rates (< 5 mm/yr). However, field performance data for covers with a composite GCL barrier are only available for arid regions. Samples of exhumed GCLs indicate that substantial increases in the hydraulic conductivity of conventional GCLs can occur if the native sodium in the bentonite is replaced by calcium or magnesium and the bentonite dehydrates. Use of a GCL as the sole hydraulic barrier layer in a cover is not recommended unless the overlying cover soils are sufficiently sodic. In contrast, covers employing a GCL overlain by a geomembrane or a GCL laminated with geofilm can be effective in limiting percolation to very small quantities regardless of the sodicity of the cover soil.

1 INTRODUCTION

Geosynthetic clay liners (GCLs) are used frequently as a hydraulic barrier layer in landfill final covers due to their thinness, ease of installation, and perceived resistance to environmental distress relative to barriers constructed with compacted clay. A variety of field studies have been conducted over the last decade in Europe and the USA to assess percolation rates characteristic of covers employing GCLs. Studies that have been published in the open literature are reviewed in this chapter. Recommendations regarding the use of GCLs in final covers are also provided. Characteristics of the field sites are summarized in Table 1.

Table 1. Characteristics of sites where field performance of covers containing GCLs have been evaluated. NP = needle punched, SB = stitch bonded, CA = Ca bentonite, LNP = laminated needle punched.

Study	Location	Climate	Barrier Layer	Annual Precipitation (mm/yr)	GCL Type	Long Term Percolation Rate (mm/yr)
Melchior (2002)	Hamburg, Germany	Oceanic	Conventional GCL	620-750	NP SB	188 222
Wagner et al. (2002)	Esch-Belval, Luxembourg	Oceanic	Conventional GCL	713-1037		6.2
Henken-Mellis (2002)	Aurach, Germany	Continental	Conventional GCL	750	CA	14
Benson et al. (2007)	Wisconsin USA	Continental Humid	Conventional GCL	892	NP	299-450
			Laminated GCL		LNP	<5
Albright et al. (2004)	California, USA	Arid	GCL-geom. composite	112	NP	<0.1
	Boardman, USA	Semi-Arid	GCL-geom. composite	215	NP	0

2 COVERS RELYING SOLELY ON A GCL

2.1 *Georgswerder Study in Germany*

Melchior (2002) constructed two triangular lysimeters near Hamburg, Germany to evaluate percolation rates for covers employing a GCL as the barrier layer. Hamburg has a humid and seasonal climate with 600-750 mm of precipitation annually. Each lysimeter had an area of 100 m^2 and 8% slope. One lysimeter was used to test a needle-punched GCL (NP) containing natural sodium (Na) bentonite, and the other tested a stitch-bonded (SB) GCL containing Na-activated bentonite. The cover profile consisted of (top to bottom) 300 mm of loamy sand topsoil, the GCL, and 150 mm of sandy gravel, as depicted in Figure 1.

Annual percolation rates reported by Melchior (2002) are shown as a function of time in Figure 2. During the first year of operation, the percolation rate was less than 6 mm/yr for both lysimeters (< 1% of precipitation). After the first year, however, the percolation rate increased substantially, and ultimately reached 220 mm/yr for the NP GCL and 190 mm/yr for the SB GCL. The peak daily percolation rate was 15 mm/d for both lysimeters.

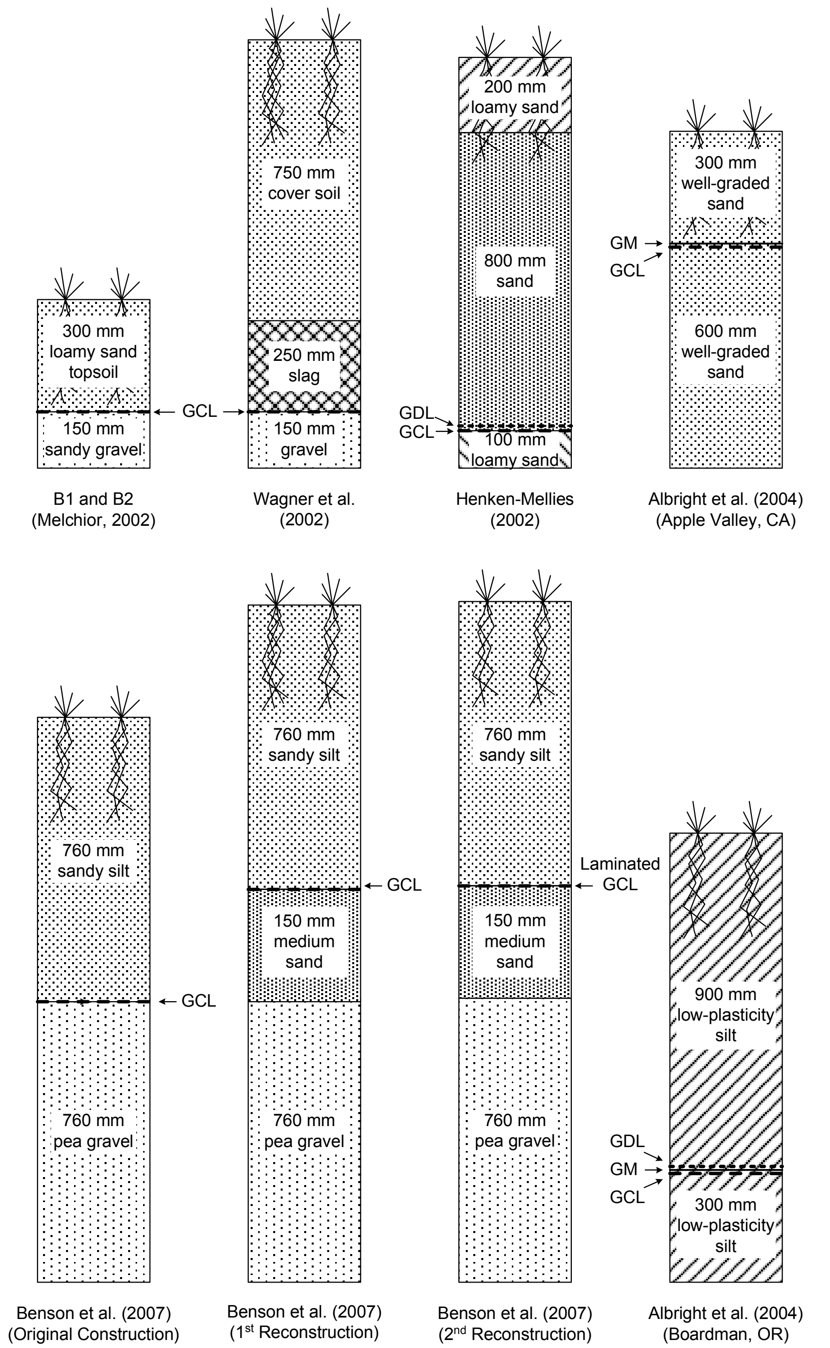

Figure 1. Profiles of final covers with GCLs evaluated in Europe and the USA. GCL = geosynthetic clay liner, GDL = geosynthetic drainage layer, GM = geomembrane.

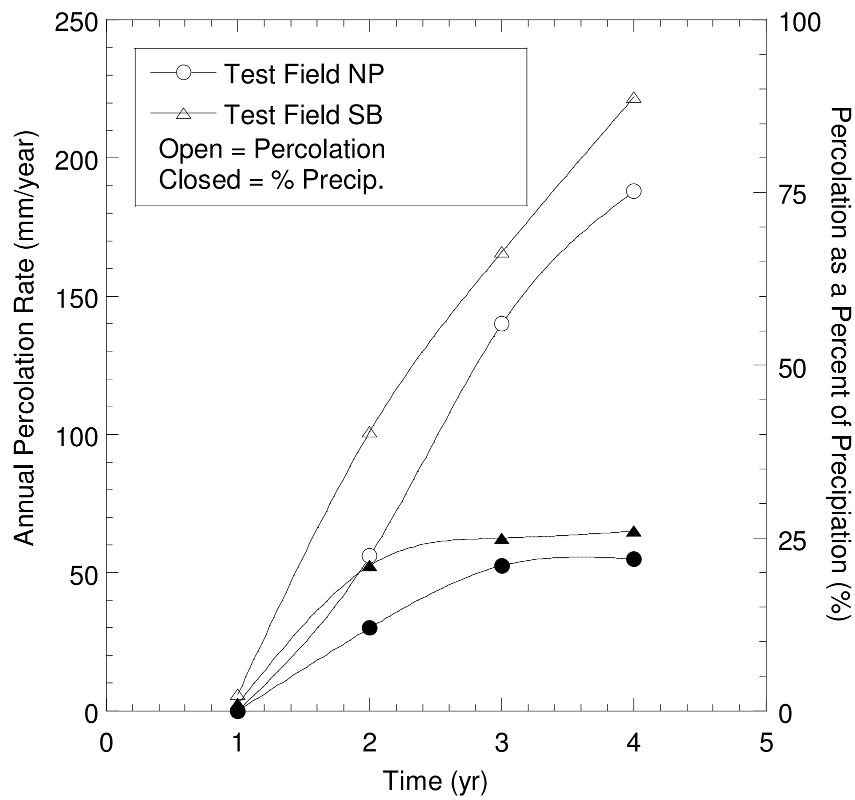

Figure. 2. Annual percolation rate and percolation as a percentage of precipitation from final covers with GCLs evaluated by Melchior (2002) in Hamburg, Germany.

For a GCL with a typical hydraulic conductivity of $2x10^{-9}$ cm/s, a percolation rate < 1 mm/yr is expected under saturated steady-state unit-gradient conditions. In contrast, a percolation rate of 15 mm/d corresponds to $1.7x10^{-5}$ cm/s under saturated steady-state unit-gradient conditions. Thus, the GCLs in both lysimeters had higher hydraulic conductivity than originally anticipated.

Exhumations were conducted periodically to determine if changes in the GCL were occurring. Within the first year, root penetrations and cracks in the bentonite were visible in both GCLs. By the end of the monitoring period, nearly all of the Na originally in the exchange complex of the bentonite was replaced by calcium (Ca) and magnesium (Mg), and the free swell of the bentonite was comparable to that of Ca bentonite rather than Na bentonite. Cation exchange was attributed to cations in water percolating downward through the cover soils and into the GCL. Hydraulic conductivity of GCLs exhumed at the end of the study ranged from 1.1×10^{-5} to 3.0×10^{-4} cm/s. This range is consistent with the hydraulic conductivity corresponding to the peak percolation rate measured in the field.

2.2 *Esch-Belval Study in Luxembourg*

Wagner et al. (2002) evaluated a needle-punched GCL containing Na bentonite as the barrier layer in a final cover profile at a blast furnace dust dump in Luxembourg, where the annual precipitation is 700-1100 mm/yr. The test section was located on a 5% slope and consisted of (top to bottom) a 750-mm-thick layer of cover soil, the GCL, and 250 mm of electric furnace slag (Fig. 1). A 3 m x 5 m pan lysimeter was used to collect percolation from the cover. Data were collected for 2 yr.

The annual percolation rate was 1.4 mm/yr in the first year and 6.2 mm/yr in the second year. These annual percolation rates correspond to hydraulic conductivities of 4 x 10^{-9} cm/s and 2 x 10^{-8} cm/s under steady-state unit-gradient conditions. Thus, the hydraulic conductivity of the GCL apparently increased during the first two years of study. However, samples of the GCL were not exhumed and thus the hydraulic conductivity of the GCL cannot be confirmed.

2.3 *Aurach Study in Germany*

Henken-Mellies et al. (2002) evaluated percolation rates from a test cover installed at a landfill in Aurach, Germany, where the average annual precipitation rate is 750 mm/yr. The cover employed a GCL containing Ca bentonite as the barrier layer and was composed of (top to bottom) 200 mm of loamy sand topsoil, 800 mm of sand, a geocomposite drainage layer, the GCL, and 300 mm of loamy sand (Fig. 1). The GCL had higher dry mass per unit area (9.5 kg/m^2) than is typical of GCLs containing Na bentonite (3.5-5.5 kg/m^2). Percolation from the test section was monitored for 3 yr, during which 14 mm of percolation (0.5% of precipitation) was recorded. No temporal pattern in percolation rate was observed, and the highest percolation rates occurred within the first 6 months after installation.

2.4 *Wisconsin Study in USA*

Benson et al. (2007) report percolation rates recorded in two pan lysimeters (4.3 x 4.9 m) installed beneath a cover containing a GCL used for closure of a coal ash landfill in Wisconsin, USA. The cover profile consisted of (top to bottom) 760 mm of sandy silt, the GCL, and 760 mm of pea gravel (Fig. 1). A non-reinforced GCL containing granular natural Na bentonite was employed. Percolation rates recorded in both lysimeters are shown in Figure 3.

Percolation rates in both lysimeters remained low (< 13 mm/year) for the first few months, but increased to as much as 299 mm/yr within the next 4-7 months. Consequently, the GCLs over both lysimeters were replaced. A 150-mm-thick layer of quartz sand was also installed as a buffer between the GCL and the underlying pea gravel to eliminate stress concentrations that might affect the GCL (Fig. 1). Percolation rates remained low for 9-15 months after reconstruction, but then increased again to rates similar to those measured prior to replacing the GCL (Fig. 3).

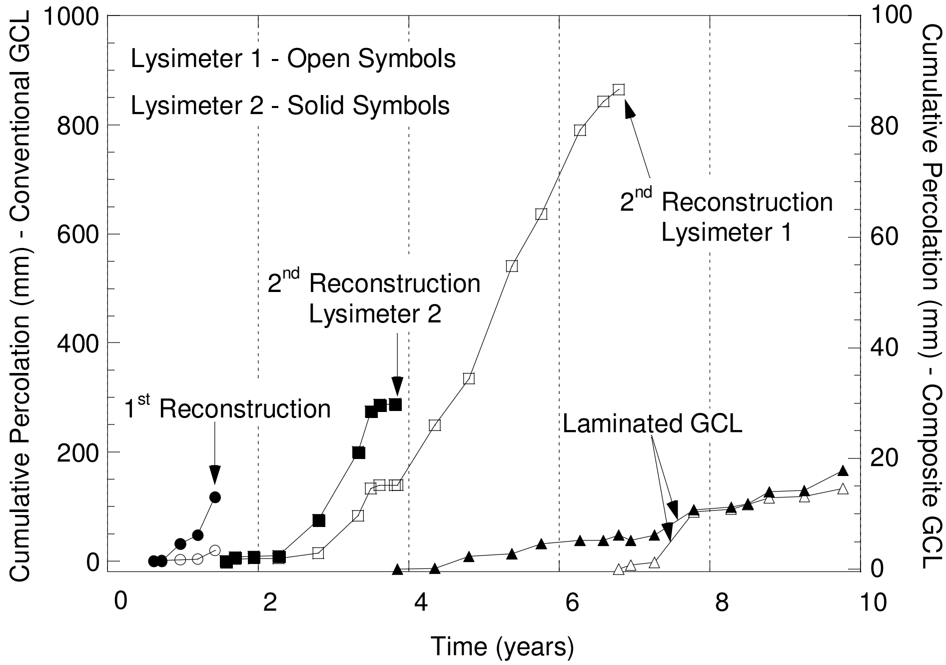

Figure. 3. Percolation rates recorded in lysimeters beneath a final cover employing a GCL in Wisconsin, USA. Left vertical ordinate is cumulative percolation through a conventional GCL system; right vertical ordinate is cumulative percolation through a laminated GCL system (adapted from Benson et. al. 2007).

GCL samples were collected from the field site during reconstruction activities to evaluate how the GCL had changed since installation. Hydraulic conductivity tests conducted on the exhumed GCLs confirmed that the hydraulic conductivity of the GCL had increased. The exhumed GCLs had hydraulic conductivities ranging between 1.4×10^{-6} and 9.1×10^{-5} cm/s, whereas tests on samples of new GCL had hydraulic conductivities ranging between 2.7×10^{-9} and 7.8×10^{-9} cm/s. The new GCL that was tested was the same type used in the original installation and the reconstruction.

Examination of the bentonite showed that nearly all of the Na originally in the exchange complex was replaced by Ca and Mg, and that the swell index of the bentonite was comparable to that of Ca bentonite. Benson et al. (2007) attributed the high percolation rates observed in the field (and the high hydraulic conductivity of the GCL) to the loss of swelling capacity incurred by replacement of Na by Ca and Mg coupled with dehydration of the bentonite. Shrinkage cracks that formed when the bentonite dried did not swell shut when the bentonite rehydrated, resulting in the high hydraulic conductivities. Cation exchange was attributed to cations in water that percolated downward through the cover soils and into the GCL.

3 COVERS WITH A GCL-COMPOSITE BARRRIER

3.1 *Wisconsin Study in USA*

The GCLs in the field tests described by Benson et al. (2007) were replaced a second time after the percolation rates were found to be much higher than expected. The second reconstruction employed a GCL containing natural Na bentonite laminated with a 0.1-mm-thick polyethylene geofilm. The reconstruction was conducted in two phases. In the first phase, the laminated GCL was installed with the geofilm downward. The geofilm was oriented upward in the second phase. Otherwise the cover profiles were identical to those employed with the original GCL (Fig. 1).

Percolation rates for both orientations of the GCL are shown in Figure 4. Percolation rates remained low in both lysimeters after the laminated GCL was installed. The peak percolation rate was less than 18 mm/yr, and the average percolation rates were 2.6 and 4.1 mm/yr for the two lysimeters.

3.2 *California Study in USA*

A cover with a composite barrier layer consisting of a GCL overlain by a geomembrane was evaluated at a field site in Apple Valley, California, USA as part of the Alternative Cover Assessment Program (Albright et al. 2004). Apple Valley, California is an arid location, and receives 112 mm of precipitation annually (on average). Percolation from the cover was collected using a 10 m x 20 m pan lysimeter (Benson et al. 2001).

The cover profile consisted of (top to bottom) 300 mm of well-graded sand, a textured high-density polyethylene (HDPE) geomembrane, a needle-punched GCL containing Na bentonite, and 600 mm of well-graded sand (Fig. 1). An 11-mm-diameter hole was placed in the geomembrane near the center of the test area to simulate a construction defect. No percolation was transmitted by the cover during the first 1.5 yr of operation. After 5 yr, only 0.2 mm of cumulative percolation had been transmitted (Fig. 4).

The GCL was uncovered and samples were collected 5 yr after installation. No roots or desiccation cracks were present, indicating that the geomembrane was protecting the GCL. The geomembrane was covered with 300 mm of cover soil, which provided sufficient surcharge to maintain good contact between the geomembrane and the GCL. Hydraulic conductivity of the GCL samples ranged between 1.0×10^{-9} and 3.0×10^{-9} cm/s, which is typical of a new GCL (i.e., no change in hydraulic conductivity was observed). However, only 23% of the Na originally in exchange complex remained when the GCLs were sampled, having been replaced by Ca and Mg. The replacement of Na by Ca and Mg was evident in the swell index of the bentonite (13.0-16.5 ml/2g), which fell between swell indices typical of Ca (6-10 mL/2 g) and Na bentonites (34-36 mL/2 g). Thus, the GCL was not immune to cation exchange, even though the GCL was overlain by a geomembrane. Melchior (2002) and Meer and Benson (2007) have reported similar observations for sites where a GCL was covered by a geomembrane. They suggest that upward migration of Ca and Mg from the underlying subgrade is responsible for cation exchange.

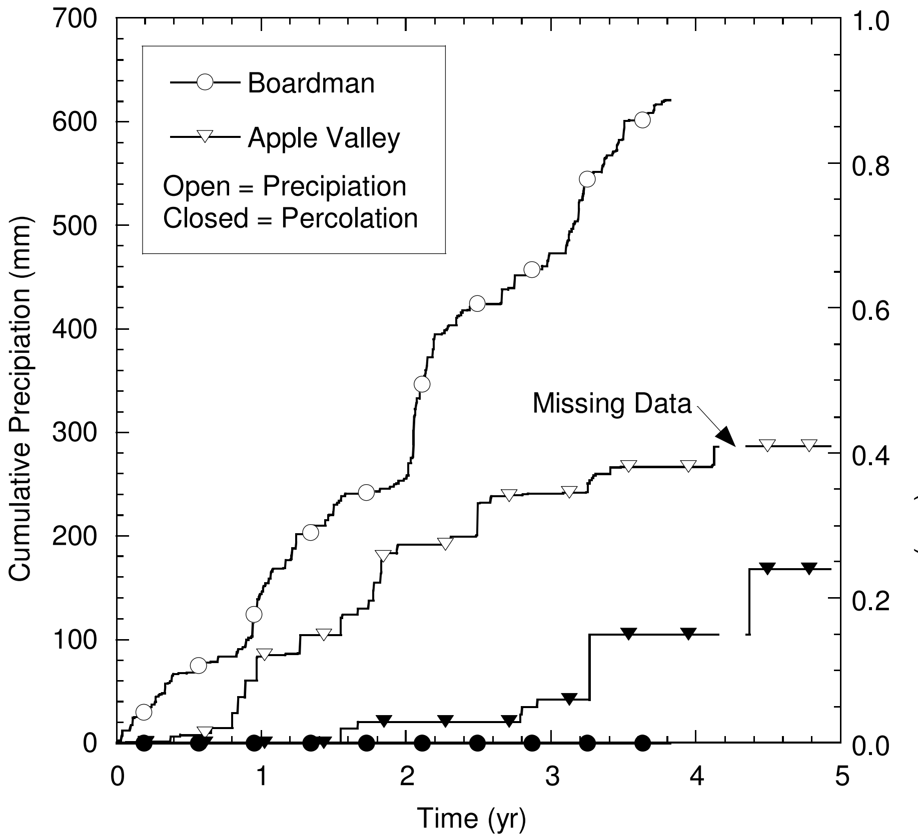

Figure. 4. Cumulative precipitation and percolation for final cover test sections with GCLS in Boardman, OR and Apple Valley, CA USA. Test sections at both sites had a composite GCL-geomembrane barrier layer.

3.3 *Oregon Study in USA*

A cover with a composite barrier layer consisting of a needle-punched GCL containing Na bentonite overlain by a textured HDPE geomembrane was evaluated at a field site in Boardman, Oregon, USA as part of the Alternative Cover Assessment Program (Albright et al. 2004). Boardman, Oregon is semi-arid, with 215 mm of precipitation annually (on average).

The cover profile consisted of (top to bottom) a 900-mm-thick layer of low-plasticity silt, a geocomposite drainage layer, a textured HDPE geomembrane, the GCL, and 300 mm of low-plasticity silt (Fig. 1). An 11-mm-diameter hole was placed in the geomembrane near the center of the test area to simulate a construction defect. No percolation was transmitted from the cover over a 4-yr monitoring period (Fig. 4).

The GCL was uncovered and samples were collected 6.7 yr after installation. No roots were present in the GCL and hydration of the bentonite was modest. The bentonite still appeared granular and had relatively low water content (16-20%). The subgrade was also very dry at the time of the exhumation, which probably precluded significant hydration of the bentonite. Despite the lack of hydration and a dry subgrade, approximately % of Na originally in the exchange complex of the bentonite had been replaced by Ca and Mg, and the swell index of the bentonite (16.0-17.0 mL/2 g) was between swell indices typical of Ca and Na bentonites. As with the site in Apple Valley, CA, cation exchange at the Boardman site apparently was due to upward migration of divalent cations from the underlying subgrade.

Hydraulic conductivity of the exhumed GCLs was measured using two different permeant liquids: 0.01 M $CaCl_2$ solution (i.e., so called "standard water" that is stipulated in ASTM D 5084) and deionized (DI) water. When the Ca solution was used as the permeant liquid, the hydraulic conductivity of the exhumed GCLs ranged from 8.5×10^{-8} to 1.9×10^{-6} cm/s. In contrast, when DI water was used, the hydraulic conductivity was between 1.3×10^{-9} to 2.3×10^{-9} cm/s (i.e., in the range for a new GCL). This contrast in hydraulic conductivities suggests that a transition was occurring in the bentonite in response to cation exchange, with significantly higher hydraulic conductivities being realized when additional exchange occurred during permeation with the Ca solution. Similar behavior might have occurred in the field if additional Ca-for-Na exchange from the subgrade had continued.

4 PRACTICAL IMPLICATIONS

4.1 *Cation Exchange and Hydraulic Conductivity*

The evidence presented herein and by others has shown that cation exchange is common in GCLs used in covers regardless of whether they are covered with a geomembrane. The source of cations involved in exchange most likely is different for GCLs used without and with a geomembrane (i.e., cations eluted from overlying cover soils or cations migrating upward from the subgrade). However, the end result is the same: Na naturally in the bentonite is replaced by Ca (primarily) and Mg. This Ca-for-Na exchange can (but does not always) result in a large increase in hydraulic conductivity. GCLs that hydrate and then undergo exchange, but do not dehydrate, appear to maintain low hydraulic conductivity (e.g., Apple Valley, CA site). In contrast, GCLs that hydrate and undergo exchange and then dehydrate (e.g., Georgswerder Germany study, Wisconsin USA study) or GCLs that undergo exchange without significant hydration (Oregon USA study) can become very permeable. This suggests that GCLs should be installed under conditions that promote rapid hydration and prevent dehydration. Conditions that preclude or minimize cation exchange should also be selected if practical.

4.2 *Promoting Hydration and Preventing Dehydration*

The most practical means to promote hydration is to place the GCL on a moist compacted subgrade. In general, GCLs placed on a subgrade prepared at optimum water content (or wetter) will be fully hydrated within 60-90 d (USEPA 1996, Bradshaw 2008), with greater hydration occurring when the water content of the subgrade is wet of optimum water content (EPA 1996). Hydration can also be achieved by direct wetting of the GCL after placement, but this practice can result in construction difficulties and displacement of bentonite within the GCL when overlying geosynthetics and cover soils are placed. GCLs that are prehydrated in the factory are also available (e.g., Kolstad et al. 2004a), but they tend to be more costly than conventional GCLs.

The only effective means currently available to prevent dehydration of GCLs is to cover the GCL with a geomembrane or to use a laminated GCL with the geofilm oriented upward. For GCLs covered with a geomembrane, placing cover soil over the geomembrane is particularly important. Surcharge provided by the cover soil ensures good contact between the geomembrane and GCL. Without good contact, dehydration of the bentonite can occur as moisture migrates upward and evaporates into the space between the geomembrane and GCL. For this reason, cover soil should be placed on the geomembrane as soon as practical.

This strategy to prevent dehydration effectively implies that GCLs used in final covers should be part of a composite barrier (geomembrane over GCL or GCL laminated with a geofilm). As illustrated earlier, the field performance of final covers with GCL composite barriers is excellent. Percolation rates less than 1 mm/yr are typical in arid regions, and percolation rates less than 5 mm/yr have been recorded for laminated GCLs in humid climates. Even lower percolation rates are anticipated in humid regions for GCLs overlain by geomembranes, but field data for such covers are not available.

4.3 *Conditions Precluding Cation Exchange and Increases in Hydraulic Conductivity*

Cation exchange can be precluded or limited to acceptable levels if the cover soils are sufficiently sodic. For example, Mansour (2001) describes a case history at a semi-arid site in California where a GCL was deployed in a final cover with sodic cover soils. After 5 yr of service, the GCL was exhumed and evaluated. The average hydraulic conductivity of the exhumed GCL was 1.9×10^{-9} cm/s and the swell index was characteristic of Na bentonite.

Benson and Meer (2008) describe a series of experiments that were conducted to determine how the relative abundance of monovalent and divalent cations in water contacting a GCL affects cation exchange, bentonite swell, and the hydraulic conductivity. The intent was to identify pore water conditions conducive to maintaining low hydraulic conductivity in the presence of wetting and drying. GCL specimens were subjected to cyclic wetting and drying, with wetting accomplished via permeation with salt solutions prepared using various proportions of NaCl and $CaCl_2$. Relative abundance of monovalent and divalent cations in water permeating the GCL was quantified using RMD (Kolstad et al. 2004b):

$$\mathrm{RMD} = \frac{M_m}{\sqrt{M_d}} \tag{1}$$

where M_m is the total molarity of monovalent cations in the pore water and M_d is the total molarity of divalent cations in the pore water.

Results of hydraulic conductivity tests by Meer and Benson (2007) are shown in Figure 5. The hydraulic conductivity after wet-dry cycling was strongly related to the RMD of the permeant solution, with lower hydraulic conductivity obtained as the sodicity of the solution increased (i.e., higher RMD). Moreover, when RMD of the permeant solution was at least 0.15 $M^{0.5}$, only a small increase in hydraulic conductivity was observed. Low hydraulic conductivity was maintained at high RMD because less Na was replaced by Ca (Fig. 6). As a result, the swelling capacity of the bentonite was retained, which permitted desiccation cracks in the bentonite to swell shut during rehydration.

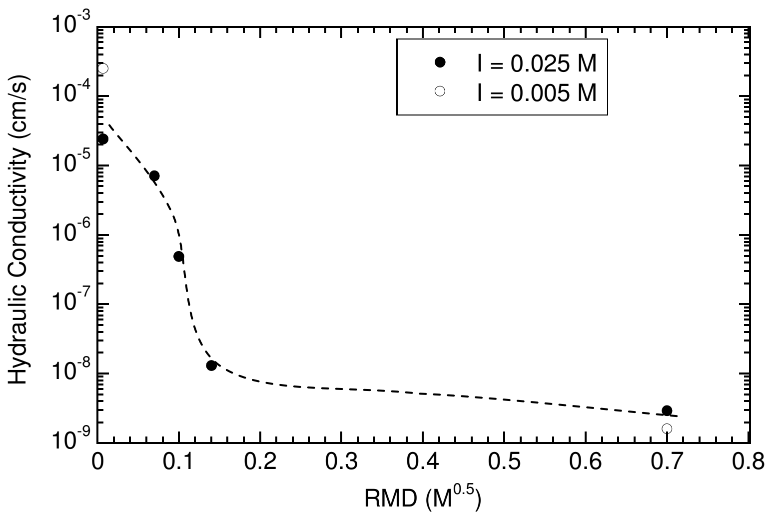

Figure. 5. Equilibrium hydraulic conductivity of GCLs subjected to cyclic wetting and drying using permeant solutions with different RMD and two ionic strengths (I) (adapted from Benson and Meer 2008).

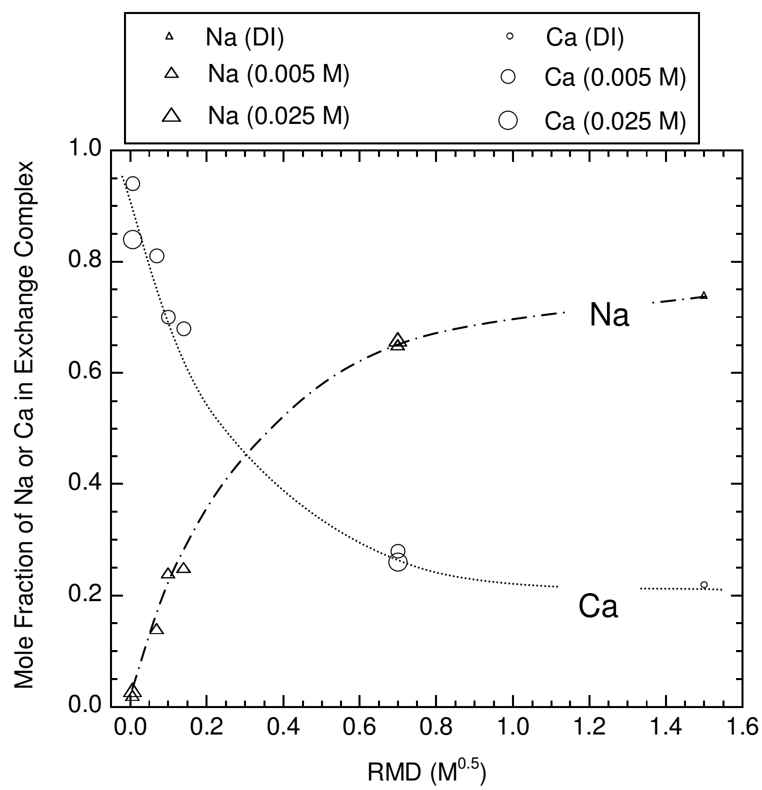

Figure. 6. Mole fractions of Na and Ca in the exchange complex of GCLs subjected to cyclic wetting and drying using permeant solutions with different RMD and two ionic strengths (I). Control tests conducted with DI water. Graph adapted from Benson and Meer (2008).

4.4 *Recommended Usage of GCLs in Final Covers*

Based on the observations that have been reported, the following recommendations are made regarding the use of GCLs in final covers:

- GCLs should not be used in final covers without an overlying geomembrane or geofilm unless the RMD of the pore water in the cover soil is at least 0.15 $M^{0.5}$. RMD of the pore water can be assessed using ASTM D 6141.

- When covering a GCL with a geomembrane, the overlying cover soil should be placed as soon as possible after deployment of the geomembrane. The cover soil provides a surcharge that ensures good contact between the geomembrane and GCL, thereby limiting the potential for dehydration of the bentonite.

- GCLs should be placed on a moist subgrade to promote rapid hydration of the bentonite. More rapid hydration occurs when the water content of the subgrade is at optimum water content or higher.

5 ACKNOWLEDGEMENT

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A Review of Key Factors on Geosynthetic Clay Liners' Performance as Liner System

Mochamad Arief Budihardjo, Amin Chegenizadeh, Hamid Nikraz

Abstract— Geosynthetic clay liners (GCLs) as a substitute material to compacted clay liner (CCLs) can be employed as landfill leachate barriers, waste water impoundments and any other liquid impediments. They have some advantages in their shape, availability, easy in installation and mainly hydraulic performance. However, the hydraulic performance of GCLs as liquid barricade depends on some factors. In this paper, a review of some key factors that affected the GCLs performance as leachate and liquid barrier will be presented and discussed in order to provide a critical view of GCLs behavior.

Keywords — GCLs, hydration, internal-erosion, self-healing.

I. Introduction

MORE than decades, geosynthetic clay liners (GCLs) have extensively been accepted to substitute compacted clay liners (CCLs) since they have more benefits over CCLs specifically their hydraulic ability, availability, transport and construction cost. GCLs can be in form of a composite liner that consist of a thin layer of bentonite and two geosynthetic layers. The geosynthetic layers used are generally geotextiles [1], [2]. The bentonite which can be in powder or granular form is laid over carrier geotextiles and beneath cover geotextile. The type carrier and cover geotextile can be all woven, non woven and combination of woven and nonwoven which depend on the purposes. Some of GCLs may be reinforced by needle-punching, adhesive bonding and combined with thermal bonding in their production. The thin layers of bentonite in GCLs are more impermeable toward water compared to the CCLs [1], [2] and the GCLs have been used layering them with geomembrane to form a composite liner system at the base of sanitary landfills, and many other liquid containment purposes in some developed countries [3]-[6].

In order to perform as leachate or liquid barriers, some key factors such as hydration, internal erosion and self healing are significantly affecting the hydraulic conductivity performance of GCLs. Thus, to get a clear picture, some researches on those entire factors that have been conducted in the previous years will be discussed in this paper.

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II. Hydration of GCLs

The ability of the GCLs to reach their maximum hydraulic performance depends on their degree of saturation. GCLs must be sufficiently hydrated typically using water to function as a liner system for an impediment for any liquid contaminant [4]. After being hydrated, the bentonite particles will swell and attach to each other. The hydration process of the GCLs can take place immediately after the GCLs are being placed on underlying subgrade which contains water such as soil. Watering the GCLs is not required as long as the subgrade has adequate moisture content. During the hydration process, the GCL will absorb the water from the subgrade, swell and make the GCLs water impermeable.

The hydration process of GCLs has been investigated extensively by placing the GCL on some different subgrade such as sand which contains different level of moisture content. It was reported by Daniel *et al.* [7] that the GCLs could absorb more than 80% of the water from their subgrade after being laid for less than 2 months. Unfortunately, the moisture content of the subgrade during and after hydration process was not reported. Additionally, the precipitation and humidity factors which were suspected to have significant influence on the hydration rate also have not been mentioned on the report.

Anderson, Rayhani, and Rowe [8] investigated the GCLs hydration phase by placing the GCLs on the sand subgrade which has about 8-10% moisture content. The result showed that the rate of hydration process was relatively fast. The GCLs took up 100% of moisture content in less than 24 hours and absorbed 140% after being placed for 60 days. In addition, Rayhani *et al*. [9] also believed that the method of GCLs' bonding during production which are needle-punching, adhesive bonding and or combined with thermal bonding also have an influence on the hydration process of GCLs. The type of bentonite also has been reported to contribute toward hydration process of the GCls [10]. Regrettably, the moisture content of the subgrade, precipitation and humidity level during the experiment was not conveyed in all reports.

Rayhani *et al*. [9] suggested that the subsoil grain size distribution and initial moisture content also contributed to the degree and rate of hydration. They also investigated the GCls' hydration under isothermal condition at room temperature and it was found that the rate of GCL hydration was slightly lower when silty sand was used as a subsoil compared to sand. Meanwhile, Anderson, Rayhani, and Rowe [8] stated that when the GCLs were placed on a sand subgrade and confining pressure was applied on the sample, the water content balance of the GCL decreased corresponding to the increasing of the confining pressure.

During construction, the GCLs are potentially exposed to the open air or direct sunlight which causes the GCLs encounter daily thermal cycle. Since the previous studies did not mention any daily thermal cycle, nevertheless, Rowe, Bostwick, and Take [11] found that daily sun exposure also considerably contributes to the hydration of the GCLs while resting on silty sand and sand subsoil. In order to minimize the effect of daily thermal cycle, it was recommended to shield the GCL using a protection layer or soil cover after installation. However, all previous studies on GCLs' hydration have not considered yet the impact of protection layer or soil cover that can be significantly affect the internal temperature of GCLs, moisture content and hydration process during daily thermal cycles.

III. Internal Erosion of GCLs

GCLs have the potential to exhibit internal erosion when confronted with large hydraulic gradient that is caused by leachate or liquid that collects above the liner during their application as composite liner system for a landfill or the sole liner for a pond and lagoon. The loss of bentonite particles that separate from each other and are moved away by the flowing water may reduce the GCLs performance and augment their hydraulic conductivity. According to Stark [12], bentonite migration could also occur in a non-uniform normal stress zone. This zone is generally developed by GCL's wrinkles and resulting to a space under the GCLs. This would lead the bentonite migrating into the unsupported space under the wrinkles. Moreover, Fox [13] found that dynamic loading caused by movement by heavy equipment like a bulldozer on a lesser soil cover depth could also significantly damage the GCLs after installation. Fox, De Battista, and Mast [14] also believed that increasing cover soil particle size and rate of loading will increase the amount of bentonite migration in GCLs. However, all those previous research did not consider the effect of subgrade on the performance of GCLs toward internal erosion.

Rowe and Orsini [15] conducted research on internal erosion occurrence of some types of GCL that were laid on three different subgrades (gravel, geonet and sand) and posed by high hydraulic gradient. They reported that high hydraulic gradient could trigger an internal erosion of GCLs when placed over gravel or geonet. Meanwhile, there was no indication of internal erosion of the GCLs placed on sand subgrade even when an extreme gradient was applied during the experiment. It has also been reported that a scrim-reinforced nonwoven geotextile carrier layer has a better hydraulic performance than a single light-weight (woven or nonwoven) geotextile carrier [15]. However, it has not yet been considered if an additional protection layer such as soil or gravel spread on the GCLs could have any effects on the GCLs.

Dickinson and Brachman [17] believed that the GCL was much more susceptible to failure from internal erosion when a geotextile protection layer was installed above the GCL. This would allow the large head to act on the thinnest part of the GCL as a result of the increased transmissivity between the gravel and GCLs. On the other hand, Stark, Choi, and Akhtarshad [16] suggested using compacted clay liner sandwiching the bentonite between two geomembrane to diminish the occurrence of internal erosion. This is because the clay liner will reduce the amount of hydration, stress concentration and make the geometry of the site smoother.

However, all the suggestions made above can be implemented but the previous experiments have been conducted under the specific conditions and materials; consequently, an experimental verification should be carried out for specific design purposes in different conditions that could be vary in each site.

IV. Self Healing of GCLs

During its application as landfill liner, GCLs may deal with some situations which possibly trigger the damage of the GCLs and reduce their sealing performance. The thickness of GCLs is subjected toward static pressures that causes GCLs thinning non-uniformly. Sharp materials might puncture the GCLs and reduce the capability of the GCLs as liquid barriers. Anderson *et al.* [18] investigated the self-healing properties of bentonite during rehydration by creating some artificial holes and reported that the bentonite could seal up a hole up to 25 mm but failed to fill the 75 mm hole. According to Sivakumar Babu et al. [19], it only needs 15 days to seal up a hole measuring 30 mm in diameter but the durability of the recovered area was limited. It could only hold up water of no more than 1 m of the hydraulic head. Shan and Lai [18] did not mention in detail of any physical changes during the rehydration process, but the previous researchers indicated that the self healing process happened during rehydrated period of GCL.

Sivakumar Babu *et al*. [19] conducted another experiment to investigate the self-healing capacity with desiccation cracks or punctures of the GCLs for the case. The test also considered the influence of temperature, swell percentage, swell pressure and also void ratio. This experiment was undertaken since Shan and Lai [18] stated that swell percentage tests or direct measurements of hydraulic conductivity or permittivity were helpful to assess the self healing capacity of GCLs. The results showed that the tested GCLs have good self-healing properties. It was also claimed that the method of binding the GCL components, i.e., stitch-bonding or needle-punching, had a significant influence on the self healing of the GCLs. Again, Sivakumar Babu *et al*. [19] also did not discuss any changes in the appearance of the crack or puncture areas during the self healing process. The permittivity test was also conducted after the swelling phase and self healing of the GCLs. GCLs have also been able to seal a gap when a solid object is inserted into the GCLs without having any effect on its hydraulic performance.

It is quite clear that the GCLs have an ability of self healing once they are punctured or get any cracks. In addition, needle-punched and stitch-bonded GCLs had a better self healing performance than other binding method of GCLs such as adhesive bonding. Whereas, the previous research did not try to look at any possibilities of the GCL's self healing performance when the water or liquid still passed the holes.

V. SUMMARY

It can be summarized that the performance of GCLs relies on some factors which are hydration, internal erosion occurrence and self healing. The hydration of GCLs can begin immediately after the GCLs are being laid on the subgrade with certain moisture content. It has also been recommended that a protection layer such as soil should be applied to minimize the effect of daily thermal cycle that might be influence the hydration process. Regarding the internal erosion, some researchers believed that the type of subgrade contributed significantly toward occurrence of internal erosion. It has been investigated that the sand subgrade can perform better in preventing the GCLs from bentonite migration even when under an excessive hydraulic gradient. Lastly, the previous researches have proven the ability of the GCL to conduct self recovery when a number of holes of different diameters up to 30 mm in diameter were created in the sample although the durability of the recovered area was limited. Additionally, the GCLs could seal up a gap completely when a solid objected was punched into the sample without any rise in hydraulic conductivity. Nevertheless, the self healing performance of GCLs towards any puncture or defects during continuous the flow is still being questioned since all the previous experiments have only shown that the recovery process were took placed during the rehydration phase.

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EQUATIONS FOR CALCULATING THE LEAKAGE THROUGH COMPOSITE LINERS

The attached paper presents empirical equations for calculating the expected rate of liquid flow through composite liners due to geomembrane defects. Equations are provided that are applicable to composite liners containing either compacted clay liners (CCLs) or geosynthetic clay liners (GCLs). Note in the equations that a key parameter to leakage through geomembrane defects in composite liners is the hydraulic conductivity of the underlying clay liner. Thus, if the hydraulic conductivity of a GCL is less than that of a CCL, then the leakage through the composite liner will be less using a GCL instead of a CCL.

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Technical Paper by J.P. Giroud

EQUATIONS FOR CALCULATING THE RATE OF LIQUID MIGRATION THROUGH COMPOSITE LINERS DUE TO GEOMEMBRANE DEFECTS

ABSTRACT: Equations available to date for calculating the rate of liquid migration through a composite liner due to geomembrane defects require the use of graphs to obtain the value of one of the terms of the equations for the case where the liquid head is larger than the thickness of the low-permeability soil component of the composite liner. In this paper, it is shown that the terms that require graphs can be expressed analytically, which leads to a new set of equations that provides an entirely analytical means of calculating the rate of liquid migration through composite liners. This new set of equations is particularly useful when the liquid head is large compared to the thickness of the low-permeability soil component of the composite liner, which is often the case when the low-permeability soil associated with the geomembrane to form a composite liner is a geosynthetic clay liner. A numerical example is given.

KEYWORDS: Liquid migration, Leachate migration, Leakage, Composite liner, Equations.

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1 INTRODUCTION

1.1 Purpose of this Paper

Equations are available to calculate the rate of liquid migration through a composite liner, due to geomembrane defects, when the liquid head on top of the liner is small compared to the thickness of the low-permeability soil component of the composite liner, whether the defect is small (Giroud et al. 1989) or large (Giroud et al. 1992). Equations are also available for the case where the head of liquid on top of the liner is large compared to the thickness of the low-permeability soil component of the composite liner (Giroud et al. 1992,1994); however, in such a case, graphs are necessary to obtain the value of one of the terms of the equations, which is cumbersome.

In this paper, it is shown that the graphs can be replaced by equations, which leads to an entirely analytical method for the evaluation of the rate of leachate migration through a composite liner, regardless of the head of liquid on top of the liner.

1.2 Composite Liner

A composite liner is a liner that consists of two or more components. In the context of this paper, the term composite liner will be used for liners that consist of two components, a geomembrane and a low-permeability soil, the geomembrane being on top of the low-permeability soil.

The low-permeability soil component of a composite liner is generally either a compacted clay liner (CCL) or a geosynthetic clay liner (GCL). The thickness of a CCL is typically between 0.3 and 1.5 m whereas the thickness of a hydrated GCL depends on the compressive stress applied during hydration and is typically between 5 and 10 mm, i.e. on the order of 100 times less than the thickness of a CCL. The hydraulic conductivity of both CCLs and GCLs depends on the nature of the material, the nature of the liquid, and the applied compressive stress; when the liquid is water or a leachate that does not affect the hydraulic conductivity of clay, including bentonite, the hydraulic conductivity of a CCL is typically between 1×10^{-10} and 1×10^{-9} m/s whereas the hydraulic conductivity of a GCL is typically between 5×10^{-12} and 5×10^{-11} m/s, i.e. on the order of 10 to 100 times less than the hydraulic conductivity of a CCL.

1.3 Liquid Migration Through a Composite Liner

Since an intact geomembrane has an extremely low permeability, most of the liquid migration through a composite liner occurs through geomembrane defects. In this paper, the only mechanism of liquid migration that is considered is flow through geomembrane defects. The liquid considered herein is water or any aqueous solution such as leachate from municipal or hazardous solid waste landfills.

If there is a defect in the geomembrane component of a composite liner, the liquid passes first through the geomembrane defect, then it flows laterally some distance between the geomembrane and the low-permeability soil, and, finally it infiltrates into and through the low-permeability soil layer which is the second component of the composite liner (Figure 1). Flow in the space between the geomembrane and the low-perme-

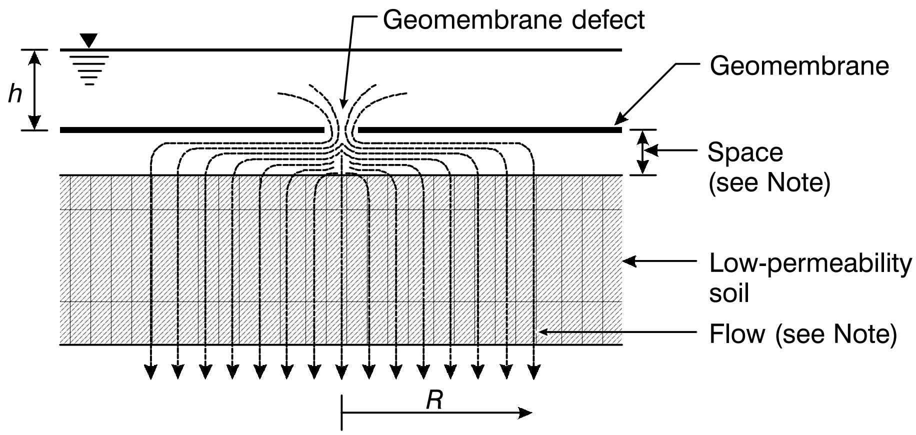

Figure 1. Liquid migration through a composite liner.

Note: The space between the geomembrane and the low-permeability soil is exaggerated to show interface flow. The flow in the soil is assumed to be vertical and *R* is the radius of the wetted area.

ability soil is called interface flow, and the area covered by the interface flow is called the wetted area.

The quality of the contact between the two components of a composite liner (i.e. the geomembrane and the low-permeability soil) is one of the key factors governing the rate of flow through the composite liner, because it governs the radius of the wetted area (Figure 1). *Good* and *poor* contact conditions have been defined by Bonaparte et al. (1989) as follows:

- *Good* contact conditions correspond to a geomembrane installed, with as few wrinkles as possible, on top of a low-permeability soil layer that has been adequately compacted and has a smooth surface.
- *Poor* contact conditions correspond to a geomembrane that has been installed with a certain number of wrinkles, and/or placed on a low-permeability soil that has not been well compacted and does not appear smooth.

For good contact conditions, it is assumed that there is sufficient compressive stress to maintain the geomembrane in contact with the low-permeability soil layer. In the case of a GCL, good contact conditions may be assumed because GCLs are usually installed flat, and because the bentonite slurry that may exude from a hydrated GCL contributes to establishing a close contact between the geomembrane and the GCL, provided sufficient compressive stress is applied.

Other factors affecting the rate of flow through a composite liner are the size of the defect, the hydraulic conductivity of the low-permeability soil underlying the geomembrane, and the head of liquid on top of the geomembrane. If hydrostatic conditions prevail, the head of liquid on top of the geomembrane is equal to the depth of liquid (Figure 2a) and, if the liquid is unconfined and flowing along a slope (Figure 2b), the head of liquid on top of the geomembrane, *h*, is given by the following equation:

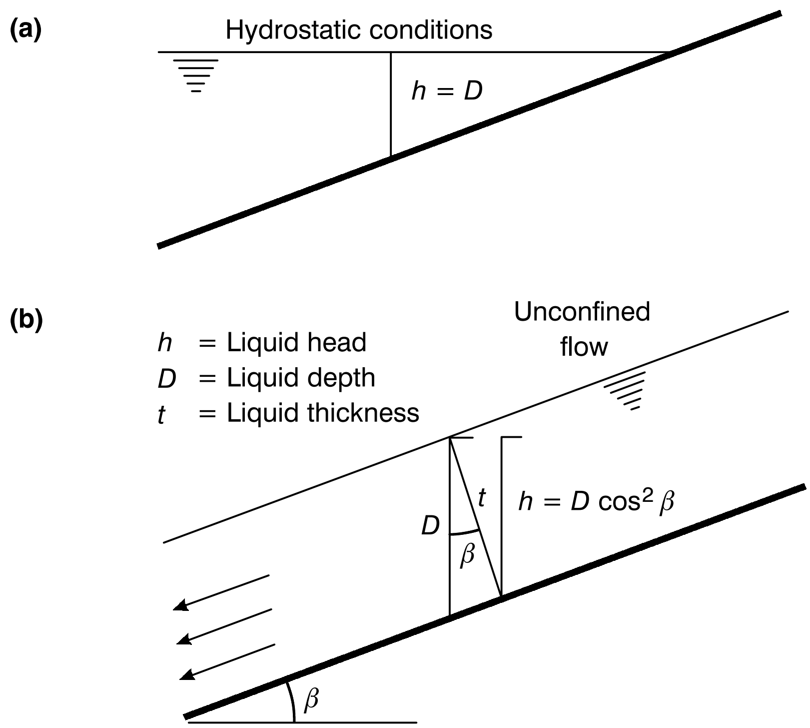

Figure 2. Head of liquid on top of the liner in the case of a liner on a slope: (a) hydrostatic conditions; (b) unconfined flow along the slope.

$$h = t \cos \beta = D \cos^2 \beta \qquad (1)$$

where: t = thickness of liquid; D = depth of liquid; and β = slope angle.

1.4 Geomembrane Defects

The following defect shapes are considered in this paper (Figure 3a):

- circular, with a surface area, a, and a diameter, d;
- square, with a side length, b;
- rectangular, with a length, B, and a width, b; and
- infinitely long ($B = \infty$) with a width, b.

1.5 Parameters and Units

The parameters that appear in the liquid migration rate equations are defined in Figure 3b. In the case of a liner on a slope, the liquid head, h, is defined in Figure 2 and by Equation 1.

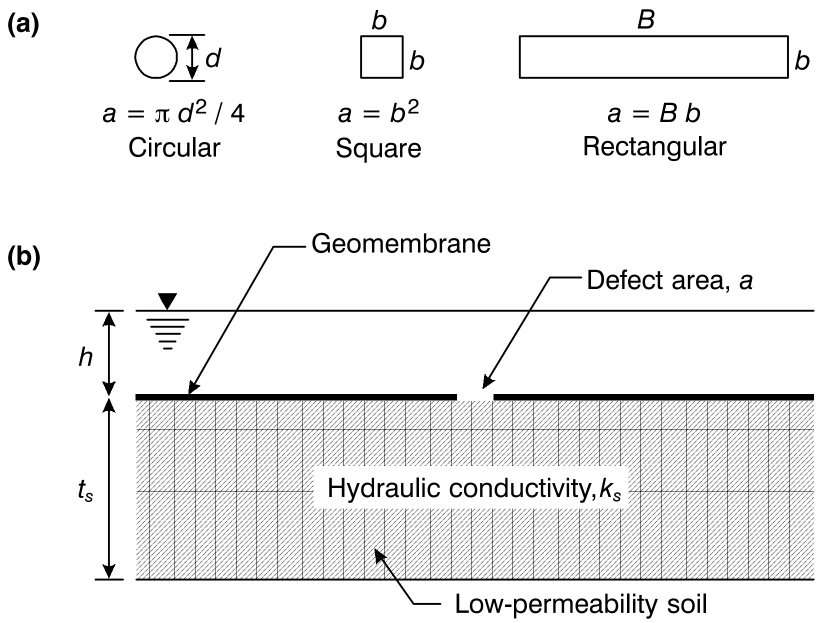

Figure 3. Definition of parameters used in the equations: (a) plan view showing shapes of geomembrane defects; (b) cross section.

Note: If the composite liner is on a slope, the liquid head on top of the liner is defined in Figure 2.

In the equations that follow, Q is the rate of liquid migration through the geomembrane defect. When the defect has an infinite length, the equation gives Q^*, which is the liquid migration rate per unit length of geomembrane defect.

It is important to note that the equations for liquid migration rate that follow are semi-empirical and can only be used with the following basic SI units: h (m), t_s (m), B (m), b (m), a (m^2), k_s (m/s), Q (m^3/s), and Q^* (m^2/s). (Note: t_s = thickness of the low-permeability soil component of the composite liner; k_s = hydraulic conductivity of the low-permeability soil component of the composite liner; and all other symbols were defined above.)

2 EXISTING EQUATIONS TO CALCULATE THE RATE OF LIQUID MIGRATION THROUGH COMPOSITE LINERS

2.1 Equations for Small Head

The following equations have been proposed for the case where the head of liquid on top of the liner is less than the thickness of the low-permeability soil component of the composite liner.

Case of a Circular Defect. In the case of a circular defect, the following equation has been established by Giroud et al. (1989):

$$Q = C_{qo} \; a^{0.1} \; h^{0.9} \; k_s^{0.74} \tag{2}$$

hence:

$$Q = 0.976 \, C_{qo} \; d^{\,0.2} \, h^{0.9} \, k_s^{0.74} \tag{3}$$

where C_{qo} is the contact quality factor (dimensionless) for a circular or square hole, with:

$$C_{qogood} \le C_{qo} \le C_{qopoor} \tag{4}$$

where: C_{qogood} = value of C_{qo} in the case of good contact conditions; and C_{qopoor} = value of C_{qo} in the case of poor contact conditions. (The good and poor contact conditions were defined in Section 1.3.) The following values were established by Giroud et al. (1989):

$$C_{qogood} = 0.21 \tag{5}$$

$$C_{qopoor} = 1.15 \tag{6}$$

Case of a Square Defect. In the case of a square defect, the following equation has been established by Giroud et al. (1992):

$$Q = C_{qo} \; b^{0.2} \; h^{0.9} \; k_s^{0.74} \tag{7}$$

In this case, the value of C_{qo} is the same as in the case of a circular defect discussed above.

Case of a Defect of Infinite Length. In the case of a defect of infinite length ($B = \infty$ in Figure 3a), the following equation has been established by Giroud et al. (1992):

$$Q^* = C_{q\infty} \; b^{0.1} \; h^{0.45} \; k_s^{0.87} \tag{8}$$

where $C_{q\infty}$ is the contact quality factor (dimensionless) for a defect of infinite length, with:

$$C_{q\infty\,good} \le C_{q\infty} \le C_{q\infty\,poor} \tag{9}$$

where: $C_{q\infty good}$ = value of $C_{q\infty}$ in the case of good contact conditions; and $C_{q\infty poor}$ = value of $C_{q\infty}$ in the case of poor contact conditions. The following values were established by Giroud et al. (1992):

$$C_{q\infty\ good} = 0.52 \tag{10}$$

$$C_{q\infty\ poor} = 1.22 \tag{11}$$

Case of a Rectangular Defect. In the case of a rectangular defect, the following equation has been established by Giroud et al. (1992):

$$Q = C_{qo}\ b^{0.2}\ h^{0.9}\ k_s^{0.74} + C_{q\infty}(B-b)\ b^{0.1}\ h^{0.45}\ k_s^{0.87} \tag{12}$$

where C_{qo} and $C_{q\infty}$ have the values defined above.

2.2 Equations for Large Head

When the head of liquid on top of the liner is greater than the thickness of the low-permeability soil component of the composite liner, Equations 2, 3, 7, 8 and 12 are not valid. Instead, the following equations should be used, as shown by Giroud et al. (1992):

- Circular defect:

$$Q = C_{qo}\ i_{avgo}\ a^{0.1}\ h^{0.9}\ k_s^{0.74} \tag{13}$$

- Square defect:

$$Q = C_{qo}\ i_{avgo}\ a^{0.2}\ h^{0.9}\ k_s^{0.74} \tag{14}$$

- Infinitely long defect:

$$Q^* = C_{q\infty}\ i_{avg\infty}\ b^{0.1}\ h^{0.45}\ k_s^{0.87} \tag{15}$$

- Rectangular defect:

$$Q = C_{qo}\ i_{avgo}\ b^{0.2}\ h^{0.9}\ k_s^{0.74} + C_{q\infty}\ i_{avg\infty}\ (B-b)\ b^{0.1}\ h^{0.45}\ k_s^{0.87} \tag{16}$$

where: i_{avgo} = average hydraulic gradient in the low-permeability soil in the case of a circular or square defect; and $i_{avg\infty}$ = average hydraulic gradient in the low-permeability soil in the case of a defect of infinite length. The values of i_{avgo} and $i_{avg\infty}$ are given in the graphs presented in Figure 4.

It appears that, when the head of liquid is greater than the thickness of the low-permeability soil component of the composite liner, the calculation of the rate of liquid migra-

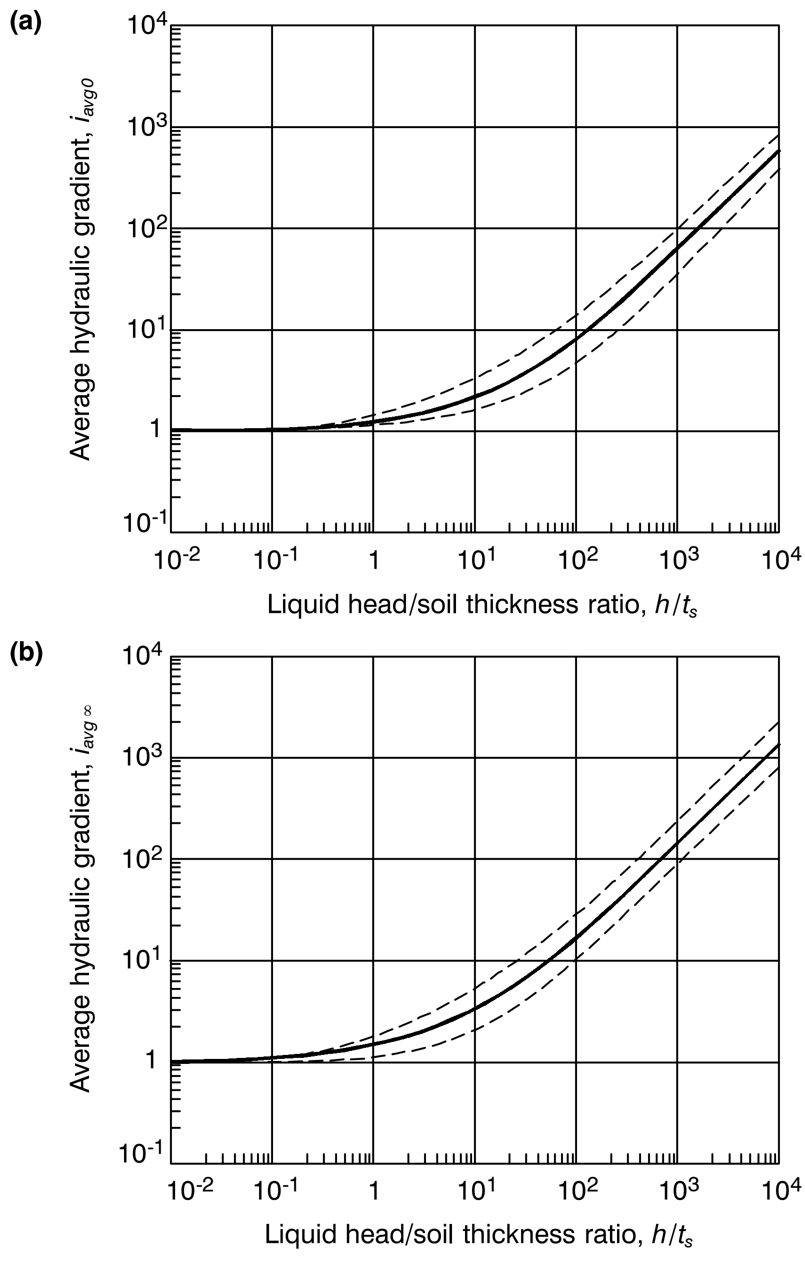

Figure 4. Values of the average hydraulic gradient to be used in equations for liquid migration rate calculations: (a) case of a circular or square defect; (b) case of an infinitely long defect (from Giroud et al. 1992).

Note: The dashed lines represent the upper and lower limit of the range of values for i_{avgo} and $i_{avg\infty}$, since for a given value of h/t_s there is not a unique value of i_{avgo} and $i_{avg\infty}$ (Giroud et al. 1992). The solid lines represent the curves given by Equation 17 (Figure 4a) and Equation 18 (Figure 4b).

tion is not entirely analytical since graphs must be used. This is not convenient, especially when calculations for a large number of cases have to be performed.

3 NEW EQUATIONS TO CALCULATE THE RATE OF LIQUID MIGRATION THROUGH COMPOSITE LINERS

3.1 Analytical Expression of the Average Hydraulic Gradient

After numerous attempts, it was found that a good approximation of the values of i_{avgo} and $i_{avg\infty}$ presented in Figure 4 is given by the following equations:

$$i_{avgo} = 1 + 0.1\,(h / t_s)^{0.95} \quad (17)$$

$$i_{avg\,\infty} = 1 + 0.2\,(h / t_s)^{0.95} \quad (18)$$

3.2 New Equations for Liquid Migration Rate

Combining Equations 13 to 16 with Equations 17 and 18 gives the following equations that can be used to calculate the rate of liquid migration through composite liners:

- Circular defect:

$$Q = C_{qo}\ [1 + 0.1\ (h / t_s)^{0.95}]\ a^{0.1}\ h^{0.9}\ k_s^{0.74} \quad (19)$$

hence:

$$Q = 0.976\ C_{qo}\left[1 + 0.1\left(h / t_s\right)^{0.95}\right] d^{0.2}\ h^{0.9}\ k_s^{0.74} \quad (20)$$

- Square defect:

$$Q = C_{qo}\ [1 + 0.1\ (h / t_s)^{0.95}]\ b^{0.2}\ h^{0.9}\ k_s^{0.74} \quad (21)$$

- Infinitely long defect:

$$Q^* = C_{q\infty}\ [1 + 0.2\ (h / t_s)^{0.95}]\ b^{0.1}\ h^{0.45}\ k_s^{0.87} \quad (22)$$

- Rectangular defect:

$$Q = C_{qo}\ [1 + 0.1\ (h / t_s)^{0.95}]\ b^{0.2}\ h^{0.9}\ k_s^{0.74} + C_{q\infty}\,[1 + 0.2\ (h / t_s)^{0.95}]\ (B - b)\ b^{0.1}\ h^{0.45}\ k_s^{0.87} \quad (23)$$

Values of C_{qo} are given by Equations 4, 5 and 6. Values of $C_{q\infty}$ are given by Equations 9, 10 and 11. The other parameters are defined in Section 1.5. Equations 19 to 23 are semi-empirical and they must be used with the units defined in Section 1.5.

It should be noted that, when the head of liquid on top of the liner is smaller than the thickness of the low-permeability soil component of the composite liner, the value of i_{avgo} and $i_{avg\infty}$ given by Equations 17 and 18, respectively, is approximately equal to 1, and Equations 19, 20, 21, 22 and 23 become identical to Equations 2, 3, 7, 8 and 12, respectively.

3.3 Limitations

The limits of validity of the above equations are discussed in detail by Giroud et al. (1997). These limits can be summarized as follows:

- If the defect is circular, the defect diameter should be no less than 0.5 mm and not greater than 25 mm. In the case of defects that are not circular, it is proposed to use these limitations for the defect width.
- The liquid head on top of the geomembrane should be equal to or less than 3 m.
- The hydraulic conductivity of the low-permeability soil underlying the geomembrane should be equal to or less than a certain value k_G , which is less than the value k_{GB} for which the relevant equation for the considered defect type (i.e. an equation selected from Equations 19 to 23) and Bernoulli's equation for free flow through an orifice give the same value of the rate of liquid migration through the geomembrane defect.

To ensure a smooth transition between liquid migration rates calculated using Equations 19 to 23 and those calculated using Bernoulli's equation, Giroud et al. (1997) propose the following value for k_G :

$$k_G = k_{GB}/10 \tag{24}$$

In the case where the geomembrane defect is circular, k_G is given by the following equation (Giroud et al. 1997):

$$k_G = \left\{ \frac{0.3891\, d^{1.8}}{C_{qo}\left[1 + 0.1\left(\dfrac{h}{t_s}\right)^{0.95}\right] h^{0.4}} \right\}^{1/0.74} \tag{25}$$

Equation 25 must be used with the units defined in Section 1.5. Values of k_G calculated using Equation 25 with C_{qo} = 0.21 (i.e. good contact conditions, as indicated by Equation 5) and t_s = 0.6 m are given in Table 1.

Table 1. Hydraulic conductivity, k_G , of the low-permeability soil underlying the geomembrane that gives the upper limit of validity of the equation for liquid migration through a circular defect in a geomembrane underlain by a low-permeability soil (Equation 20).

Head of liquid on top of the geomembrane, *h* (m)	Geomembrane defect diameter, *d* (mm)						
	0.5	1	2	3	5	10	11.284
0.01	2.6×10^{-7}	1.4×10^{-6}	7.5×10^{-6}	2.0×10^{-5}	7.0×10^{-5}	3.8×10^{-4}	5.1×10^{-4}
0.03	1.4×10^{-7}	7.7×10^{-7}	4.1×10^{-6}	1.1×10^{-5}	3.8×10^{-5}	2.1×10^{-4}	2.8×10^{-4}
0.1	7.3×10^{-8}	3.9×10^{-7}	2.1×10^{-6}	5.7×10^{-6}	2.0×10^{-5}	1.1×10^{-4}	1.4×10^{-4}
0.3	3.8×10^{-8}	2.1×10^{-7}	1.1×10^{-6}	3.0×10^{-6}	1.0×10^{-5}	5.6×10^{-5}	7.5×10^{-5}
1	1.8×10^{-8}	9.5×10^{-8}	5.1×10^{-7}	1.4×10^{-6}	4.7×10^{-6}	2.6×10^{-5}	3.4×10^{-5}
3	7.1×10^{-9}	3.8×10^{-8}	2.1×10^{-7}	5.6×10^{-7}	1.9×10^{-6}	1.0×10^{-5}	1.4×10^{-5}

Notes: The tabulated values of k_G were calculated using Equation 25 with C_{qo} = 0.21 (good contact) and t_s = 0.6 m. The defect diameter of 11.284 mm corresponds to a defect surface area of 1 cm^2.

3.4 Example

A composite liner consists of a geomembrane placed on a GCL having a thickness of 6 mm and a hydraulic conductivity of 2×10^{-11} m/s. The geomembrane has a rectangular defect with a width of 1 mm and a length of 15 mm. The head of liquid on top of the composite liner is 25 mm. Calculate the rate of liquid migration through this defect.

The rate of liquid migration through the composite liner is calculated as follows using Equation 23:

$$Q = C_{qo}[1 + 0.1(25/6)^{0.95}](1\times10^{-3})^{0.2}(25\times10^{-3})^{0.9}(2\times10^{-11})^{0.74} +$$
$$C_{q\infty}[1 + 0.2(25/6)^{0.95}](15-1)\times10^{-3}(1\times10^{-3})^{0.1}(25\times10^{-3})^{0.45}(2\times10^{-11})^{0.87}$$

hence:

$$Q(\text{m}^3/\text{s}) = C_{qo}(1.53\times10^{-10}) + C_{q\infty}(1.17\times10^{-12})$$

Assuming good contact between the geomembrane and the GCL, Equations 5 and 10 give:

$$C_{qo} = 0.21 \qquad C_{q\infty} = 0.52$$

hence:

$$Q(\text{m/s}^3) = 0.21 \times 1.53 \times 10^{-10} + 0.52 \times 1.17 \times 10^{-12} = 3.21 \times 10^{-11} + 6.08 \times 10^{-13}$$

hence:

$$Q = 3.27 \times 10^{-11} \text{ m/s}^3 = 2.8 \times 10^{-3} \text{ liters/day} = 1.0 \text{ liter/year}$$

It is interesting to note that, if the defect had been square with a side length of 1 mm, the rate of liquid migration through the defect would have been expressed by the first term of the above equation (3.21×10^{-11} m^3/s), which is much greater than the second term. In other words, the calculated rate of liquid migration is only slightly greater through the 15 mm × 1 mm defect than through the 1 mm × 1 mm defect. This is because, in this particular example, the radius of the wetted area, calculated as indicated by Giroud et al. (1992), is very large compared to the defect size and is far more dependent on defect width than on defect length. (The calculation gives a wetted area radius of approximately 0.6 m.)

4 CONCLUSIONS

The equations presented in this paper provide design engineers with an entirely analytical method to calculate the rate of liquid migration through a composite liner, due to geomembrane defects, for liquid heads on top of the liner up to 3 m. The new equations are equivalent to the existing method (Giroud et al. 1992, 1994) which requires both equations and graphs when the head of liquid on top of the liner is greater than the thickness of the low-permeability soil component of the composite liner. However, the new equations are more convenient because the values that had to be obtained from graphs are now incorporated into the equations (Equations 19 to 23).

The new equations are particularly useful in cases where the low-permeability soil component of the composite liner is a GCL because the head of liquid on top of the liner is often greater than the thickness of the GCL.

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NOTATIONS

Basic SI units are given in parentheses.

a = defect area (m^2)

B = length of rectangular defect (m)

b = width of rectangular defect (m)

b = side length of square defect (m)

C_q = contact quality factor (dimensionless)

C_{qo} = contact quality factor for a circular or square defect (dimensionless)

C_{qogood} = value of C_{qo} in the case of good contact conditions (dimensionless)

C_{qopoor} = value of C_{qo} in the case of poor contact conditions (dimensionless)

$C_{q\infty}$ = contact quality factor for a defect of infinite length (dimensionless)

$C_{q\infty\ good}$ = value of $C_{q\infty}$ in the case of good contact conditions (dimensionless)

$C_{q\infty\ poor}$ = value of $C_{q\infty}$ in the case of poor contact conditions (dimensionless)

D depth of liquid on top of the geomembrane (m)

d = diameter of circular defect (m)

h = head of liquid on top of the geomembrane (m)

i_{avgo} = average hydraulic gradient in the low-permeability soil in the case of a circular or square defect (dimensionless)

$i_{avg\infty}$ = average hydraulic gradient in the low-permeability soil in the case of an infinitely long defect (dimensionless)

k_G = value of k_s above which Equations 19 to 23 are not valid (m/s)

k_{GB} = value of k_s for which Equation 19 to 23 and Bernoulli's equation for free flow through an orifice give the same value of the rate of liquid migration through a geomembrane defect (m/s)

k_s	=	hydraulic conductivity of the low-permeability soil component of the composite liner (m/s)
Q	=	liquid migration rate through the considered geomembrane defect (m^3/s)
Q^*	=	liquid migration rate per unit length of geomembrane defect in the case of an infinitely long defect (m^2/s)
R	=	radius of wetted area (m)
t	=	thickness of liquid on top of the geomembrane (m)
t_s	=	thickness of the low-permeability soil component of the composite liner (m)
β	=	slope angle (°)