January 16, 2020

Adam Harris, LHG
VCP Site Manager
Toxics Cleanup Program, Southwest Regional Office
Washington State Department of Ecology
P.O. Box 47775
Olympia, WA 98504-7775

Re: Request for Information Letter Dated December 20, 2019
Site Name: Morrells Dry Cleaners
Site Address: 608 N 1st Street, Tacoma, Pierce County, WA 98403
VCP Project No.: SW1039
Project No. 080190

Dear Mr. Harris:

Aspect Consulting, LLC (Aspect) is providing this letter in response to the referenced letter requesting information on the status of the cleanup at the Morrells Dry Cleaners site (Site). Site cleanup activities in 2018 and 2019 included the following:

- We continued to operate the soil vapor extraction (SVE) system (started up in October 2014) throughout 2018 and 2019.
- Six on-property cleanup alternatives were developed and evaluated. Our draft Supplemental Focused Feasibility Study (FFS) report dated August 10, 2018, is attached. Based on the results of a disproportionate cost analysis, an alternative consisting of expanded application of remedial technologies already implemented at the Site (i.e., SVE treatment of vadose zone soils and biostimulation of advanced outwash groundwater) was recommended.
- Seventeen well installations were completed on the Morrell's property between January 28 and July 11, 2019, including 13 vertical wells (MW-23 through MW-35) screened in the saturated interval of the advance outwash (approximately 45 to 60 feet below ground surface [bgs]) and four angled vapor extraction wells (VE-5 through VE-8) screened in the vadose zone (for expansion of SVE treatment). Boring and well construction logs for the new wells are attached. Figure 2 shows the locations of both the new and pre-existing Site wells.

  Soil samples collected during drilling were screened in the field for evidence of contamination using visual and olfactory methods, and by headspace screening using a photoionization detector (PID). Samples with elevated PID readings were preferentially selected for laboratory analysis of volatile organic compounds (VOCs). At least two samples from each boring were analyzed, and up to five samples were analyzed from borings with elevated PID readings.

  PID readings and laboratory analytical results are summarized in Table 2. Laboratory results exceeding MTCA soil cleanup levels are highlighted. Figure 3 shows locations and

depths of tetrachloroethene (PCE) detections in soil samples and the estimated on-property lateral extent of MTCA soil cleanup level exceedances.

- New and pre-existing monitoring wells were sampled in late 2018 and early 2019. Based on evaluation of advance outwash groundwater monitoring results, a biostimulant pilot test was determined to be necessary to evaluate radius-of-injection (ROI) influence.[1] The results of groundwater monitoring conducted prior to the test injection (in July 2019) are summarized in Tables 3 through 5. Figure 4 shows PCE detections in advance outwash groundwater and the estimated on-property extent of MTCA groundwater cleanup level exceedances.

- A total of approximately 5,000 gallons of 3DMe/CRS solution (biostimulants provided by Regenesis), anaerobic water, and microorganisms (Dhc culture provided by SiREM) was injected into well MW-20 over two nights in mid-July 2019. Post-injection groundwater samples were collected on two occasions (late August and mid-December 2019) from MW-20 and nearby wells MW-34, MW-24, MW-35, and MW-26 (located approximately 7, 10, 15, and 20 feet, respectively, from the injection well). Groundwater quality and natural attenuation parameter results for the MW-20 injection test are summarized in Tables 6 and 7, respectively.

- The results of all soil and groundwater sampling events conducted in 2018 and 2019 were submitted to Ecology's EIM system on January 7, 2020.

Aspect would like to continue conducting Site cleanup activities independently under the Voluntary Cleanup Program (VCP). We are currently evaluating injection test results. Our tentative plans for 2020 include:

- Installing additional wells screened in the saturated interval of the advance outwash and conducting a multi-well full-scale biostimulant injection, focusing on areas of the Morrell's Parking Lot Parcel where PCE concentrations in advance outwash groundwater exceed MTCA cleanup levels (see Figure 4); and

- Incorporating new wells VE-5 through VE-8 into the existing SVE system.

Please contact me if you have questions or need further information.

[1] Biostimulants were previously injected into Site wells in June 2014, and injection performance was evaluated in the attached Supplemental FFS report. However, ROI influence could not be evaluated because biostimulants were injected into all impacted groundwater wells screened in the advance outwash (with the exception of MW-5). ROI influence is a key factor in the design of full-scale injection spacing for effective distribution of the biostimulants and remediation of groundwater.

Sincerely,

Aspect **Consulting, LLC**

Dave Heffner, PE
Associate Engineer
dheffner@aspectconsulting.com

Attachments:
Table 2 – Summary of PID Screening and Sampling Results for Soil Borings
Table 3 – Advance Outwash Groundwater Quality Results Prior to Injection Test
Table 4 – Advance Outwash Groundwater Natural Attenuation Parameters Prior to Injection Test
Table 5 – Groundwater Quality Results, Deeper Water-Bearing Zone
Table 6 – Groundwater Quality Results, MW-20 Injection Test
Table 7 – Groundwater Natural Attenuation Parameters, MW-20 Injection Test
Figure 2 – Site Plan
Figure 3 – PCE Detections in Soil Samples
Figure 4 – PCE Detections in Advance Outwash Groundwater Prior to Injection Test
Boring Logs – MW-23 through MW-35 and VE-5 through VE-8
Report – Supplemental Focused Feasibility Study, Morrell's Dry Cleaners Site, 8/10/18 (Draft)

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TABLES

Table 2 - Summary of PID Screening and Sampling Results for Soil Borings, Current Investigation

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

DRAFT

				Chlorinated VOCs				Petroleum Hydrocarbons							
Well ID[2]	Sample Date	Sample Depth (feet bgs)	[PID][3]	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Methylene Chloride[4]	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Propylbenzene	Isopropylbenzene	sec-Butylbenzene	tert-Butylbenzene	p-Isopropyltoluene	Naphthalene
MW-22	Attempted on 2/4/19. Vac truck used to remove soil; unable to find sufficient drill clearance between subsurface utilities.														
MW-23	02/06/19	5.5	360	0.025 U	0.02 U	0.05 U	0.5 U	**0.14**	0.05 U	0.05 U	0.05 U	**0.059**	0.05 U	**0.058**	0.05 U
		10.5	31	**0.40**	**0.18**	**0.19**	**1.4**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		15.5	1.2												
		20.5	4.1	**0.045**	0.02 U	0.05 U	**0.51**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		25.5	704	**2.3**	0.02 U	0.05 U	0.5 U	0.05 U	**0.11**	0.05 U	0.05 U	**0.064**	0.05 U	**0.094**	0.05 U
		30.5	2.1												
		35.5	1.8												
		40.5	0.2												
		45.5	0.2												
		50.5	0.3												
		55.5	2.2	**0.095**	0.02 U	0.05 U	**0.83**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		60.5	0.4												
MW-24	1/30/19 & 1/31/19	5.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		10.5	0												
		15.5	0												
		20.5	--												
		25.5	0												
		30.5	0.5	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		35.5	0												
		40.5	0												
		45.5	0												
		50.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		55.5	0												
		60.5	0												
MW-25	1/28/19 & 1/29/19	5.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		10.5	0												
		15.5	0												
		20.5	0												
		25.5	0												
		30.5	0.2	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		35.5	0												
		40.5	0												
		45.5	0												
		50.5	0.5	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		55.5	0												
		60.5	0												
MW-26	1/29/19 & 1/30/19	5.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		10.5	0												
		15.5	0												
		20.5	0												
		25.5	0												
		30.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		35.5	0												
		40.5	0												
		45.5	0												
		50.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		55.5	0												
		60.5	0												
MW-27	1/31/19 & 2/1/19	5.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		10.5	0												
		15.5	0												
		20.5	0												
		25.5	0												
		30.5	1.5	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		35.5	0												
		40.5	0												
		45.5	0.5												
		50.5	0.5	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		55.5	0												
		60.5	0												
MW-28	03/14/19	5.5	0												
		10.5	0.3												
		15.5	0												
		20.5	0												
		25.5	0												
		30.5	3.5	**0.038**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		35.5	0												
		40.5	0												
		45.5	0												
		50.5	0												
		55.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		60.5	0												
MW-29	03/11/19	5.5	0												
		10.5	0												
		15	0	**0.043**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		20.5	0												
		25.5	0												
		30.5	0												
		35.5	0												
		40.5	0.5												
		45.5	0												
		50	0.9	**0.043**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		55.5	0												
		60.5	0												
MW-30	02/07/19	5.5	0												
		10.5	4	**0.084**	**0.021**	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		15.5	--												
		20.5	0.2												
		25.5	0.5												
		30.5	0.6												
		35.5	2.6	**0.10**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		40.5	0												
		45.5	0												
		50.5	0												

Table 2 - Summary of PID Screening and Sampling Results for Soil Borings, Current Investigation

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

				Chlorinated VOCs				Petroleum Hydrocarbons							
Well ID[2]	Sample Date	Sample Depth (feet bgs)	[PID][3]	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Methylene Chloride[4]	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Propylbenzene	Isopropylbenzene	sec-Butylbenzene	tert-Butylbenzene	p-Isopropyltoluene	Naphthalene
		55.5	0												
		60.5	0.4	**0.026**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
MW-31	02/05/19	5.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		10.5	0.1												
		15.5	0.1												
		20.5	0.1												
		25.5	0												
		30.5	0.1												
		35.5	0.3												
		40.5	1	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		45.5	0												
		50.5	0.3												
		55.5	1.5	**0.058**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		60.5	1.3	**0.058**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
MW-32	03/13/19	5.5													
		10.5													
		15.5	1	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		20.5	1												
		25.5	5												
		30.5	1.5												
		35.5	1.5												
		40.5	0												
		45.5													
		50.5	0												
		55.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		60.5	0												
MW-33	3/12/19 & 3/13/19	5.5	2												
		10	2	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		15.5	0												
		20.5	1												
		25.5	0												
		30.5	0												
		35.5	0.5												
		40.5	0												
		45.5	0												
		50.5	0												
		55.5	0	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		60.5	0												
MW-34	7/8/19 & 7/9/19	5.5	2												
		10.5													
		15.5	0.8												
		20.5													
		25.5	1.5												
		30.5	0.5												
		35.5	0.5												
		40.5	0.5												
		45.5	0												
		50.5	0.2												
		55.5	0.1												
		60.5	0.1												
B-35A[5]	7/9/19 & 7/10/19	5.5	0												
		10.5	0												
		15.5	0												
		20.5	0												
		25.5	0.3												
		30.5	1.1												
		35.5	0.3												
		40.5	0												
		45.5	0												
VE-5[6] (45 deg angle)	02/26/19	2.8	7												
		4.9	21												
		6.7	7												
		11.0	41												
		13.8	14												
		15.9	666	0.025 U	0.02 U	0.05 U	0.5 U	**0.069**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		19.4	109												
		22.6	126	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		25.5	7												
		27.9	21												
		30.4	16												
VE-6[6] (45 deg angle)	02/28/19	4.9	13												
		9.2	126	**0.47**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		14.8	99												
		20.9	22												
		26.9	71	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		29.0	33												
		35.7	8												
		40.3	42	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		44.2	27												
		46.0	55												
VE-7[6,7] (45 deg angle)	03/01/19	4.6	20												
		6.7	1,921	**1.4**	**0.16**	**0.16**	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		9.5	210												
		11.3	1641												
		13.1	30												
		15.6	2,489	**120**	**1.5**	0.05 U	0.5 U	**5.4**	**3.0**	**1.6**	**0.43**	**1.6**	**0.094**	**0.12**	**0.44**
		16.6	30												
		21.6	40												
		26.2	148	0.025 U	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		29.0	30												
		31.5	2												
		2.1	109												
		5.7	965												
		9.9	1,508	**0.089**	0.02 U	**0.34**	0.5 U	**0.91**	**1.0**	**0.27**	**0.084**	**0.35**	0.05 U	**0.57**	**0.1**
		13.4	343												

Table 2 - Summary of PID Screening and Sampling Results for Soil Borings, Current Investigation

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

				Chlorinated VOCs				Petroleum Hydrocarbons							
Well ID[2]	Sample Date	Sample Depth (feet bgs)	[PID][3]	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Methylene Chloride[4]	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Propylbenzene	Isopropylbenzene	sec-Butylbenzene	tert-Butylbenzene	p-Isopropyltoluene	Naphthalene
VE-8[6] (45 deg angle)	02/27/19	18.0	14												
		22.3	16												
		24.0	1,404	**7.3**	**0.15**	0.05 U	0.5 U	**0.88**	**0.76**	**0.40**	**0.12**	**1.2**	0.05 U	**0.55**	0.05 U
		27.2	69												
		30.1	26												
		33.2	68	**0.047**	0.02 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
		35.7	7												
		39.6	19												
		45.3	2												
Screening Level[8]				0.05	0.03	160	0.02		800	8,000		8,000	8,000		5

bgs below ground surface
PID photo-ionization detector
U not detected at the indicated detection limit
VOC volatile organic compound

Notes:

1) All concentrations are in milligrams per kilogram (mg/kg). Only analytes detected in at least one sample are included in this table. Detections are bolded. Screening level exceedances are shaded.
2) Borings and soil samples collected during drilling were designated "A-x" for angled borings and "B-xx" for vertical borings. When wells were installed, the letter designations were changed to "VE-x" for angled (soil vapor extraction) wells and "MW-xx" for vertical (advance outwash groundwater) wells.
3) PID readings were obtained by placing the soil sample in a zip-lock bag and, after waiting several minutes, inserting the tip of the PID into the bag to measure the total VOC concentration in the headspace.
4) In all cases where methylene chloride was detected, the laboratory noted that it was likely due to laboratory contamination.
5) In drilling B-35A, the auger got stuck at 46.5 ft bgs and the hole was abondoned. MW-35 was drilled (no soil sampling) and installed the following night.
6) For the angled borings, only a subset of the PID readings are included in this table. Refer to the boring logs for the full sets of PID readings.
7) Based on field screening of the A-7 cuttings, the presence of separate-phase liquid was suspected in the approximate depth ranges of 7 to 10 and 21 to 22.5 feet bgs.
8) The screening levels are Model Toxics Control Act (MTCA) Method A cleanup levels for PCE, TCE, methylene chloride, and naphthalene, and the Method B direct contact (CLARC table value) cleanup levels for all other compounds.

Table 3 - Advance Outwash Groundwater Quality Results Prior to Injection Test

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

DRAFT

Well ID	Sample Date	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Vinyl Chloride (VC)
MW-2	08/28/07	**2,900**	**1,800**	**7,100**	**19**
	01/30/08	**1,400**	**520**	**2,000**	0.2 U
	10/02/08	**1,900**	**880**	**2,300**	**3.1**
	05/12/09	**1,600**	**930**	**2,400**	**2.7**
	12/22/10	**2,100**	**1,100**	**2,100**	**2.7 J**
	02/07/12	**1,600**	**810**	**1,400**	0.2 U
	12/12/13	**1,600**	**830**	**1,200**	**0.84**
	*** Biostimulants injected in June 2014 ***				
	01/21/15	**19**	**25**	**150**	**0.77**
	07/30/15	**17**	**46**	**600**	**15**
	09/08/15	**18**	**77**	**610**	**17**
	02/02/16	**22**	**190**	**640**	**15**
	09/22/16	**16**	**110**	**480**	**7.8**
	01/04/17	**18**	**80**	**520**	**7.4**
	11/28/18	**28**	**14**	**490**	**5.9**
MW-5[3]	01/22/08	**67**	**3**	**13**	0.2 U
	01/30/08	**31**	**1.1**	**4.5**	0.2 U
	10/02/08	**75**	**3.2**	**17**	0.2 U
	05/11/09	**17**	**1.1**	**44**	0.2 U
	12/22/10	**190**	**14**	**41**	0.2 U
	02/07/12	**140**	**8.7**	**25**	0.2 U
	01/09/14	0.2 U	**0.46**	0.2 U	0.2 U
	04/28/15	**67**	**6.2**	**6.4**	0.2 U
	09/09/15	**31**	**3.6**	**3.6**	0.2 U
	02/02/16	**27**	**2.7**	**2.5**	0.2 U
	09/07/16	**12**	**1.4**	**1.4**	0.2 U
	01/04/17	**14**	**1.4**	**1.3**	0.2 U
	11/28/18	**13**	**1.4**	1 U	0.2 U
MW-7[3]	01/22/08	**6.6**	1 U	1 U	0.2 U
	01/30/08	**1.5**	1 U	1 U	0.2 U
	10/02/08	1 U	1 U	1 U	0.2 U
	05/11/09	**1.1**	1 U	1 U	0.2 U
	12/22/10	**1.4**	1 U	1 U	0.2 U
	02/06/12	1 U	1 U	1 U	0.2 U
	01/07/14	**1.4**	1 U	1 U	0.2 U
MW-8	04/22/08	**1,300**	**780**	**2,400**	0.2 U
	10/02/08	**680**	**390**	**3,600**	**6.9**
	05/12/09	**780**	**370**	**2,600**	**2**
	12/22/10	**470**	**150**	**1,800**	**1.4**
	02/07/12	**960**	**610**	**1,600**	20 U
	12/17/13	**940**	**560**	**1,300**	10 U
	*** Biostimulants injected in June 2014 ***				
	01/20/15	**14**	**8.5**	**1,200**	**9.4**
	07/30/15	**41**	**17**	**740**	**8.9**
	09/10/15	**18**	**13**	**1,000**	**12**
	02/01/16	**21**	**13**	**830**	**7.1**
	09/07/16	50 U	50 U	**560**	10 U
	09/22/16	**16**	**11**	**500**	**5.4**
	01/05/17	**19**	**12**	**480**	**5.6**
	11/28/18	**14**	**5.2**	**280**	**3.7**
MW-15	12/17/13	**460**	**110**	**380**	2 U
	*** Biostimulants injected in June 2014 ***				
	09/08/15	**86**	**53**	**220**	**4**
	02/01/16	**43**	**25**	**290**	**7.4**
	09/07/16	**15**	**8.4**	**330**	**4**
	01/04/17	**6.6**	**3.3**	**520**	**4.9**
	11/28/18	**3.3**	**1.6**	**65**	**0.78**
	12/13/13	**450**	**98**	**360**	**0.49**

Table 3 - Advance Outwash Groundwater Quality Results Prior to Injection Test

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Well ID	Sample Date	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Vinyl Chloride (VC)
MW-16	*** Biostimulants injected in June 2014 ***				
	01/21/15	**14**	**6.3**	**180**	**2.2**
	11/28/18	**11**	**2.8**	**230**	**2.6**
MW-17	12/13/13	**170**	**24**	**81**	0.2 U
	*** Biostimulants injected in June 2014 ***				
	11/28/18	**9.7**	**2.1**	**83**	**0.72**
MW-18	12/12/13	**460**	**57**	**360**	**0.53**
	*** Biostimulants injected in June 2014 ***				
MW-19	01/08/14	**62**	**4.8**	**20**	0.2 U
	*** Biostimulants injected in June 2014 ***				
	01/21/15	**9.7**	5 U	**45**	1 U
	09/09/15	**7.6**	**3.9**	**35**	**1.5**
	02/02/16	**8.5**	**5.1**	**43**	**1.5**
	09/07/16	20 U	20 U	20 U	4 U
	09/22/16	**8.5**	**4.1**	**16**	**0.43**
	01/04/17	**12**	**4.6**	**36**	**0.97**
	11/28/18	**2.5**	**1.6**	**53**	**0.56**
MW-20	01/08/14	**140**	**16**	**43**	0.2 U
	*** Biostimulants injected in June 2014 ***				
	01/20/15	**7.4**	**5.3**	**79**	**1.8**
	09/09/15	**11**	**5.8**	**150**	**1.5**
	02/02/16	1 U	1 U	**250**	**1.9**
	09/07/16	20 U	20 U	**250**	4 U
	09/22/16	**4.9**	**1.7**	**250**	**1.8**
	01/04/17	**6.2**	**2**	**240**	**2.5**
	11/28/18	**4.9**	1 U	**59**	**0.84**
MW-21	12/17/13	**500**	**130**	**460**	2 U
	*** Biostimulants injected in June 2014 ***				
	01/20/15	**15**	**12**	**270**	1 U
	09/08/15	**7.1**	**9.2**	**510**	**7.4**
	02/01/16	**18**	**17**	**650**	**9.7**
	09/22/16	**12**	**13**	**320**	**4.1**
	01/04/17	**15**	**14**	**340**	**4.2**
	11/28/18	**14**	**7.6**	**190**	**2.3**
MW-23	03/14/19	**100**	**25**	**18**	0.2 U
MW-24	02/13/19	**66**	**12**	**5.4**	0.2 U
MW-25	02/13/19	**37**	**3.6**	**3.0**	0.2 U
MW-26	02/13/19	**20**	**2.4**	**2.1**	0.2 U
MW-27	02/13/19	**9.4**	**1.6**	1 U	0.2 U
MW-28	03/26/19	**20**	**5.1**	**2.1**	0.2 U
MW-29	03/26/19	**12**	**1.1**	1 U	0.2 U
MW-30	02/25/19	**27**	**6.2**	**6.3**	0.2 U
MW-31	02/25/19	**150**	**45**	**28**	0.2 U
MW-32	03/26/19	**36**	**8.7**	**2.8**	0.2 U
MW-33	03/26/19	**28**	**3.9**	**1.6**	0.2 U
MW-34	07/15/19	**18**	**1.4**	1 U	0.2 U
Screening Level[2]		5	5	70	0.2

U not detected at the indicated detection limit

Notes:

1) All concentrations are in micrograms per liter (µg/L). Only analytes with concentrations exceeding their respective screening levels in at least one sample are included in this table. Detections are bolded. Screening level exceedances (see Note 2) are shaded.

2) Screening levels are Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for PCE, TCE, and vinyl chloride, and maximum contaminant level (MCL) for cDCE.

3) Potential impacts from Tully's Coffee water leak. An estimated 600,000 gallons of drinking water were released between May 2006 and Sept 2007 (per analysis of water bills).

Table 4 - Advance Outwash Groundwater Natural Attenuation Parameters Prior to Injection Test

Morrell's Dry Cleaners, Former Walker Chevrolet Property, Tacoma, Washington

Well ID	Date	DO (mg/L)	ORP (mV)	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Sulfate (mg/L)	Iron, total (mg/L)	Ferrous Iron (mg/L)	TOC (mg/L)	Methane (mg/L)	Ethene (mg/L)	Ethane (mg/L)	Dhc Assay[2]
MW-1	1/10/14	0.4	114		0.2	<0.1	8.8	4.07		<1.5				
MW-2	12/12/13	4.4	141		0.959	NA	9.26	6.17		<0.25				
	*** Biostimulants injected in June 2014 ***													
	1/21/15	1.6	33					294						
	2/27/19	0.5	58	50.6	<0.1	0.675	1.22	49.2	2.5	209				
MW-5	1/9/14	2.1	74		0.7	<0.1	20.6	11.5		<1.5				
MW-7	1/7/14	8.5	53		1.39	0.006	28.4	14.3		<0.25				
MW-8	12/17/13	0.4	23		0.33	0.004	20.9	77.3		<0.25				
	*** Biostimulants injected in June 2014 ***													
	1/20/15	0.4	36					89.1						
MW-15	12/17/13	4.1	75		2.08	<0.002	15.4	0.968		<0.25				
	*** Biostimulants injected in June 2014 ***													
MW-16	12/13/13	2.4	50		1.76	0.004	17	4.13		<0.25				
	*** Biostimulants injected in June 2014 ***													
	1/21/15	4.4	-3					62.5						
MW-17	12/13/13	1.7	63		1.51	0.004	14.9	32.8		<0.25				
	*** Biostimulants injected in June 2014 ***													
MW-18	12/12/13	3.8	122		0.681	NA	17.8	0.216		0.639				
	*** Biostimulants injected in June 2014 ***													
MW-19	1/8/14	2.4	97		2.66	0.006	22.7	113		0.254				
	*** Biostimulants injected in June 2014 ***													
	1/21/15	0.4	42					59.4						
MW-20	1/8/14	5.9	114		2.02	0.007	16.9	40.8		<0.25				
	*** Biostimulants injected in June 2014 ***													
	1/20/15	2.3	47					50.6						
	2/27/19	3.6	73	31.4	<0.1	0.128	<0.3	71	1.5	179				
	7/15/19	0.12	-11								10.2	<0.015	<0.016	$<1 \times 10^4$
MW-21	12/17/13	2.6	56		2.12	0.005	13.9	79.1		<0.25				
	*** Biostimulants injected in June 2014 ***													
	1/20/15	1.1	45					42.2						
MW-24	2/13/19	1.2	44	32.9	0.606	0.186	12.6	3.64	<0.5	0.751				
MW-25	2/13/19	0.5	55	48.5	0.624	0.308	16.1	1.67	<0.5	0.862				
MW-26	2/13/19	7.6	53	46.9	1.78	0.154	14.4	4.24	<0.5	<0.5				
MW-27	2/13/19	3.7	72	298	2.41	<1	18.9	3.22	<0.5	0.719				
MW-30	2/25/19	8.3	70	10.1	1.17	<0.2	24.2	4.53	<0.5	1.24				
MW-31	2/25/19	3.6	75	23.7	1.09	0.166	13.3	8.68	<0.5	0.723				
MW-34	7/15/19	0.96	9		0.484	0.125	15.1	3.65		3.9	0.031	<0.015	<0.016	$<1 \times 10^4$

bgs below ground surface mg/L milligrams per liter NA natural attenuation TOC total organic carbon

DO dissolved oxygen mV millivolts ORP oxidation-reduction potential

Notes:

1) Blank cell indicates sample was not analyzed for that parameter.

2) Gene-Trac® dehalococcoides (Dhc) assay based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the 1-liter sample.

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Table 5 - Groundwater Quality Results, Deeper Water-Bearing Zone

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Well ID	Sample Date	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Vinyl Chloride (VC)
MW-8D	05/11/09	< 1 U	< 1 U	**11**	< 0.2 U
	12/22/10	< 1 U	< 1 U	**21**	< 0.2 U
	02/06/12	< 1 U	< 1 U	**26**	< 0.2 U
	01/10/14	< 0.2 U	< 0.2 U	**42**	< 0.2 U
	04/28/15	< 1 U	< 1 U	**54**	< 0.2 U
	09/08/15	< 1 U	< 1 U	**65**	< 0.2 U
	02/02/16	< 1 U	< 1 U	**62**	< 0.2 U
	09/07/16	< 1 U	< 1 U	**69**	< 0.2 U
	01/12/17	< 1 U	< 1 U	**77**	< 0.2 U
	04/09/19	< 1 U	< 1 U	**97**	< 0.2 U
MW-12D	12/22/10	**6.1**	< 1 U	**22**	< 0.2 U
	02/06/12	< 1 U	< 1 U	**17**	< 0.2 U
	01/10/14	**0.7**	**0.34**	**22**	< 0.2 U
	04/29/15	< 1 U	< 1 U	**13**	< 0.2 U
	09/10/15	< 1 U	< 1 U	**9.1**	< 0.2 U
	02/02/16	< 1 U	< 1 U	**9.2**	< 0.2 U
	09/07/16	< 1 U	< 1 U	**3.4**	< 0.2 U
	01/12/17	< 1 U	< 1 U	**3.0**	< 0.2 U
MW-13D	12/22/10	**14**	**3.2**	**30**	< 0.2 U
	02/07/12	**4.2**	**2.4**	**28**	< 0.2 U
	12/16/13	**5.9**	**3.7**	**32**	< 0.2 U
	04/29/15	< 1 U	< 1 U	**14**	< 0.2 U
	09/09/15	**4.1**	**2.2**	**22**	< 0.2 U
	02/02/16	**2.2**	**2.1**	**23**	< 0.2 U
	09/07/16	**2.3**	**1.7**	**13**	< 0.2 U
	01/12/17	**11**	**3.2**	**16**	< 0.2 U
	04/09/19	**3.1**	**1.9**	**12**	< 0.2 U
MW-14D	02/06/12	**4.2**	**3.3**	**28**	< 0.2 U
	01/23/14	**2.4**	**1**	**4.5**	< 0.2 U
	04/29/15	**2.2**	< 1 U	**2.5**	< 0.2 U
	09/09/15	**9.2**	**3.9**	**15**	< 0.2 U
	02/02/16	**1.8**	< 1 U	**2.2**	< 0.2 U
	09/07/16	**3.2**	**1.1**	**3.6**	< 0.2 U
	01/12/17	**7.4**	**1.9**	**4.8**	< 0.2 U
	04/09/19[3]	< 1 U	< 1 U	< 1 U	< 0.2 U
	Screening Level[2]	5	5	70	0.2

U not detected at the indicated detection limit

Notes:

1) All concentrations are in micrograms per liter (µg/L). Detections are bolded. Screening level exceedances are shaded.

2) Screening levels are Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for PCE, TCE, and VC, and maximum contaminant level (MCL) for cDCE.

3) Extensive Sound Transit construction in North First St adjacent to MW-14D may have impacted concentrations at that well on 04/09/19.

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Table 6 - Groundwater Quality Results, MW-20 Injection Test

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Well ID	Distance from Injection Well (ft)	Sample Date	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	Vinyl Chloride (VC)
MW-20 (Injection Well)	--	01/08/14	**140**	**16**	**43**	0.2 U
		*** Biostimulants injected in June 2014 ***				
		01/20/15	**7.4**	**5.3**	**79**	**1.8**
		09/09/15	**11**	**5.8**	**150**	**1.5**
		02/02/16	1 U	1 U	**250**	**1.9**
		09/07/16	20 U	20 U	**250**	4 U
		09/22/16	**4.9**	**1.7**	**250**	**1.8**
		01/04/17	**6.2**	**2**	**240**	**2.5**
		11/28/18	**4.9**	1 U	**59**	**0.84**
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***				
		08/27/19	(Unable to collect water sample due to pump screen biofouling)			
		12/12/19	1 U	1 U	**14**	**1.5**
MW-34	7	07/15/19	**18**	**1.4**	1 U	0.2 U
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***				
		08/27/19	**25**	**2.2**	**1.3**	0.2 U
		12/13/19	**11**	**1.4**	**20**	0.2 U
MW-24	10	02/13/19	**66**	**12**	**5.4**	0.2 U
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***				
		08/27/19	**42**	**10**	**5.1**	0.2 U
		12/12/19	**50**	**11**	**4.2**	0.2 U
MW-35	15	*** Injection to MW-20, July 15, 16, & 17, 2019 ***				
		08/27/19	**39**	**4.9**	**2.8**	0.2 U
		12/13/19	**23**	**3.2**	**7.2**	0.2 U
MW-26	20	02/13/19	**20**	**2.4**	**2.1**	0.2 U
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***				
		08/27/19	**20**	**2.7**	**2.2**	0.2 U
		12/13/19	**19**	**2.3**	**2.0**	0.2 U
Screening Level[2]			5	5	70	0.2

U not detected at the indicated detection limit

Notes:

1) All concentrations are in micrograms per liter (µg/L). Detections are bolded. Screening level exceedances (see Note 2) are shaded.

2) Screening levels are Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for PCE, TCE, and vinyl chloride, and maximum contaminant level (MCL) for cDCE.

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Table 7 - Groundwater Natural Attenuation Parameters, MW-20 Injection Test

Morrell's Dry Cleaners, Former Walker Chevrolet Property, Tacoma, Washington

Well ID	Distance from Injection Well (ft)	Date	DO (mg/L)	ORP (mV)	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Sulfate (mg/L)	Iron, total (mg/L)	Ferrous Iron (mg/L)	TOC (mg/L)	Methane (mg/L)	Ethene (mg/L)	Ethane (mg/L)	Dhc Assay[2]
MW-20 (Injection Well)	--	1/8/14	5.9	114		2.02	0.007	16.9	40.8		<0.25				
		*** Biostimulants injected in June 2014 ***													
		1/20/15	2.3	47					50.6						
		2/27/19	3.6	73	31.4	<0.1	0.128	<0.3	71	1.5	179				
		7/15/19	0.12	-11								10.2	<0.015	<0.016	$<1 \times 10^4$
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***													
		8/27/19	(Unable to collect water sample due to pump screen biofouling)												
		12/12/19	1.05	-44		0.252	2.74	<0.3	114		809	3.73	<0.015	<0.016	$<1 \times 10^4$
MW-34	7	7/15/19	0.96	9		0.484	0.125	15.1	3.65		3.9	0.031	<0.015	<0.016	$<1 \times 10^4$
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***													
		8/27/19	0.94	13		0.285	<0.4	7.48	6.09		20.5	<0.0086	<0.015	<0.016	$<4 \times 10^3$
		12/13/19	0.52	53		<0.1	<0.1	4.26	7.32		6.76	0.065	<0.015	<0.016	$<3 \times 10^3$
MW-24	10	2/13/19	1.2	44	32.9	0.606	0.186	12.6	3.64	<0.5	0.751				
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***													
		8/27/19	7.0	26		0.566	<0.2	11.6	41.4		3.36	0.028	<0.015	<0.016	
		12/12/19	1.1	28		0.307	<0.1	9.69	4.07		2.43	2.3	<0.015	<0.016	
MW-35	15	*** Injection to MW-20, July 15, 16, & 17, 2019 ***													
		8/27/19	0.65	-28		0.268	1.17	7.27	6.17		132				
		12/13/19	1.5	-38		0.388	<0.1	13.2	4.66		3.66	<0.0086	<0.015	<0.016	$<6 \times 10^3$
MW-26	20	2/13/19	7.6	53	46.9	1.78	0.154	14.4	4.24	<0.5	<0.5				
		*** Injection to MW-20, July 15, 16, & 17, 2019 ***													
		8/27/19	7.7	75		1.92	<0.2	13.7	49.4		<0.5				
		12/13/19	7.0	17		1.85	<0.1	12.9	51.7		<1.0				

bgs below ground surface mg/L milligrams per liter NA natural attenuation TOC total organic carbon
DO dissolved oxygen mV millivolts ORP oxidation-reduction potential

Notes:

1) Blank cell indicates sample was not analyzed for that parameter.

2) Gene-Trac® dehalococcoides (Dhc) assay based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the 1-liter sample.

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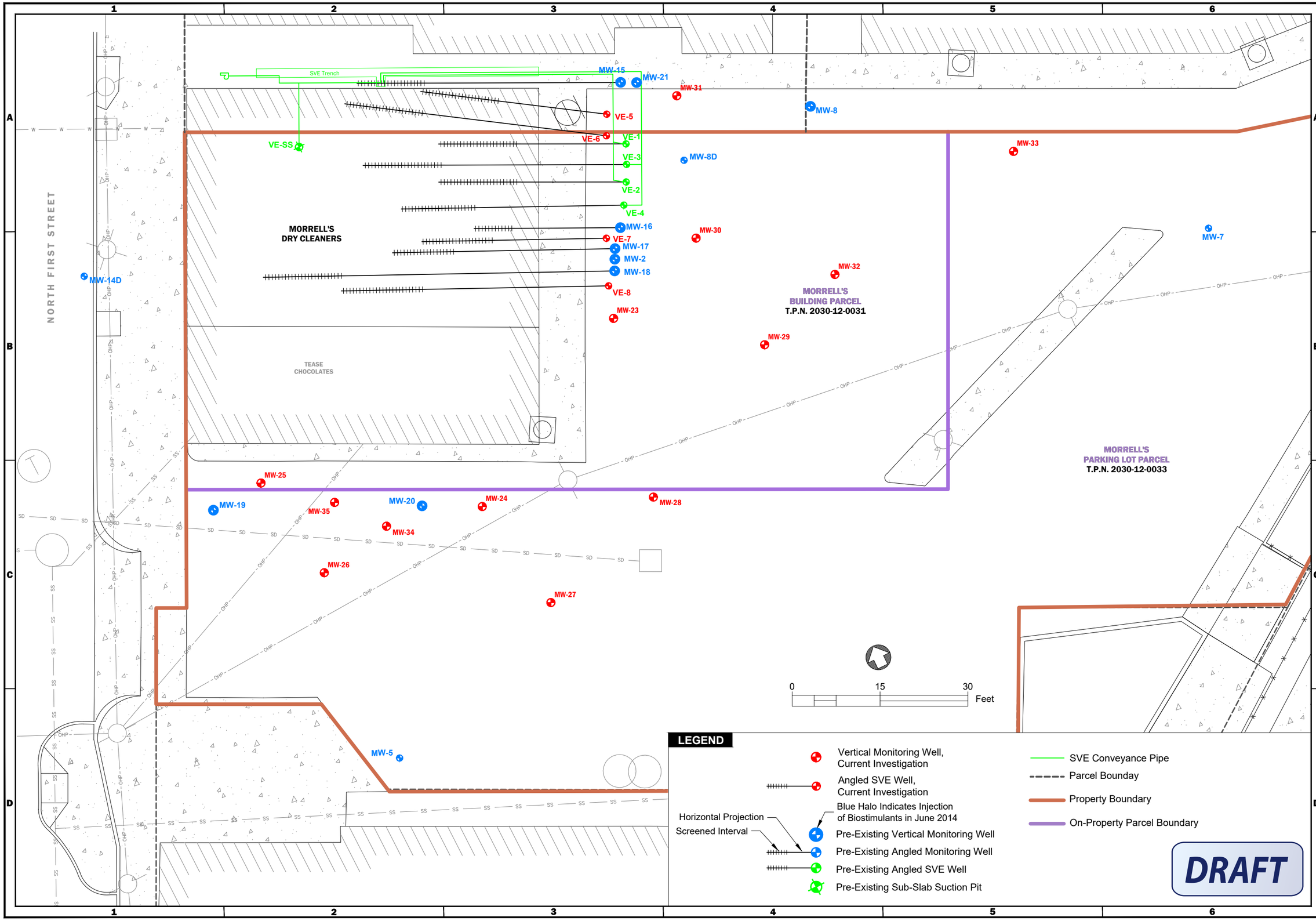
FIGURES



Site Plan

Construction and Design Report
for the 2019 Cleanup Expansion
Morrell's Dry Cleaner (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

FIGURE NO.

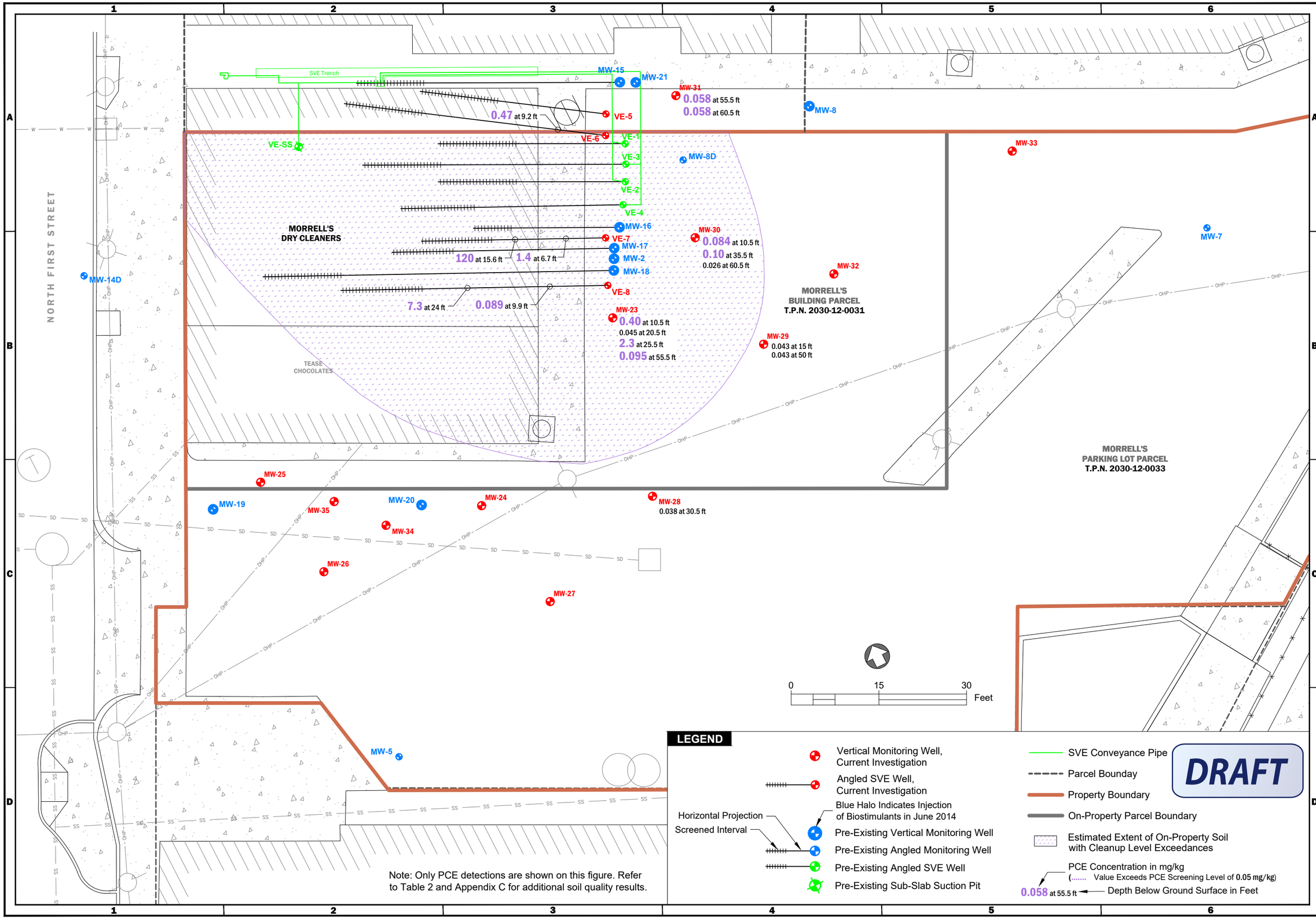
2

Aspect CONSULTING

DATE: Aug-2019 | REVISION: - | PROJECT NUMBER: 080190 | DESIGNED BY: DAH | DRAWN BY: SCC | REVISED BY: SCC

Coordinates System: NAD 1983 State Plane Washington North FIPS 4601 Feet | Date Saved: Aug 06, 2019 3:04pm | User: scudd

CAD Path: Q:_GeoTech\080190 Stadium Thriftway\2019-08 2019 Cleanup Expansion Construction and Design Report\080190-03 Site Plan.dwg 2-Site Plan



Note: Only PCE detections are shown on this figure. Refer to Table 2 and Appendix C for additional soil quality results.

REV.	DESCRIPTION	DATE	APPR.

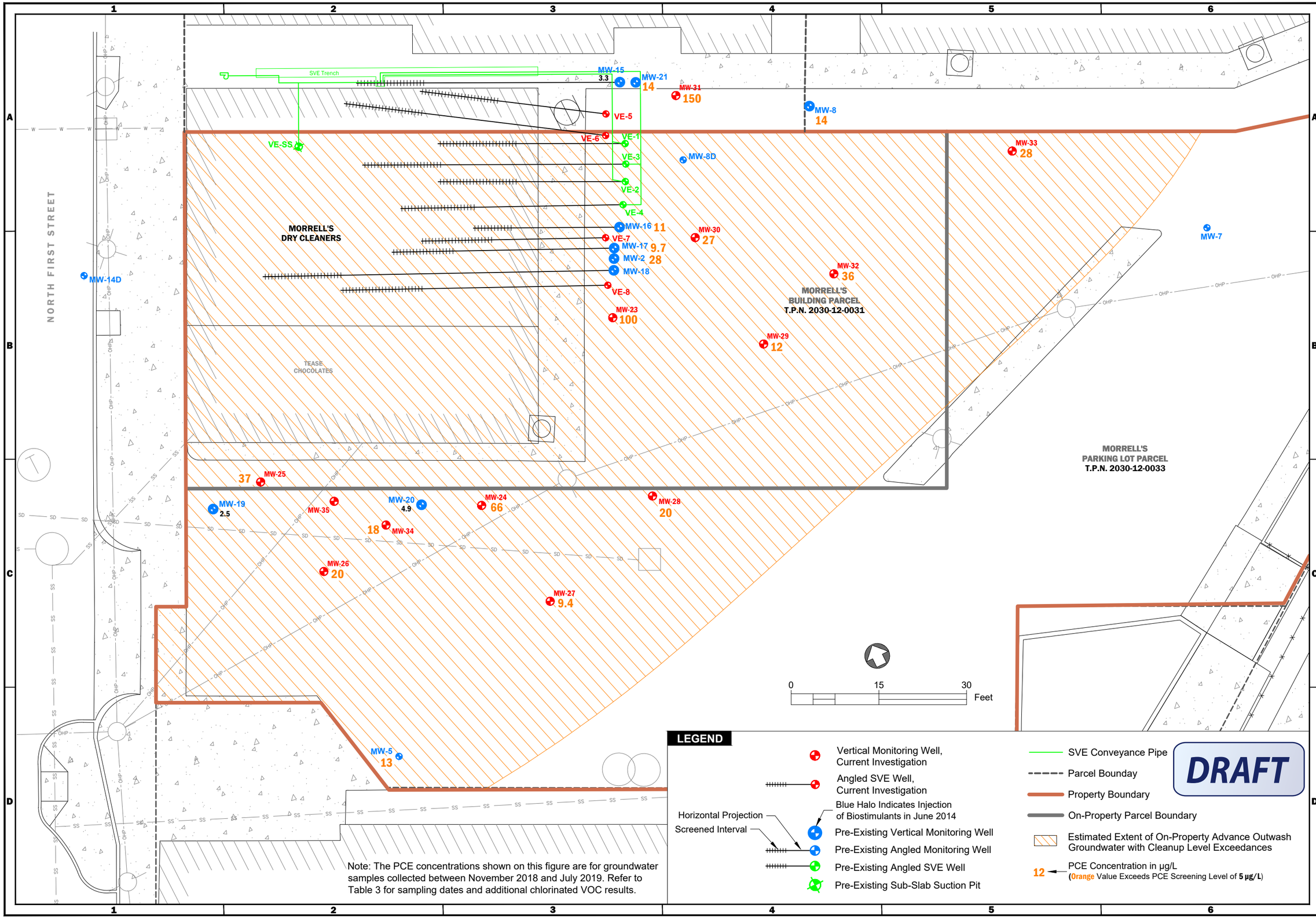
REVISED BY: SCC
DRAWN BY: SCC
DESIGNED BY: DAH
PROJECT NUMBER: 080190
REVISION: -
DATE: Aug-2019

Aspect CONSULTING

PCE Detections in Soil Samples, Current Investigation
Construction and Design Report
for the 2019 Cleanup Expansion
Morrell's Dry Cleaner (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

FIGURE NO.
3

CAD Path: Q:_GeoTech\080190 Stadium Thriftway\2019-08 2019 Cleanup Expansion Construction and Design Report\080190-03 Site Plan.dwg 3 PCE Soil || Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet || Date Saved: Aug 13, 2019 11:40am || User: scsoid



Note: The PCE concentrations shown on this figure are for groundwater samples collected between November 2018 and July 2019. Refer to Table 3 for sampling dates and additional chlorinated VOC results.

LEGEND

- Vertical Monitoring Well, Current Investigation
- Angled SVE Well, Current Investigation
- Blue Halo Indicates Injection of Biostimulants in June 2014
- Horizontal Projection
- Screened Interval
- Pre-Existing Vertical Monitoring Well
- Pre-Existing Angled Monitoring Well
- Pre-Existing Angled SVE Well
- Pre-Existing Sub-Slab Suction Pit
- SVE Conveyance Pipe
- Parcel Bounday
- Property Boundary
- On-Property Parcel Boundary
- Estimated Extent of On-Property Advance Outwash Groundwater with Cleanup Level Exceedances
- 12 — PCE Concentration in µg/L (Orange Value Exceeds PCE Screening Level of **5 µg/L**)

DRAFT

PCE Detections in Advance Outwash Groundwater Prior to Injection Test
Construction and Design Report
for the 2019 Cleanup Expansion
Morrell's Dry Cleaner (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

FIGURE NO.

4

Aspect CONSULTING

DATE: Aug-2019 | REVISION: - | PROJECT NUMBER: 080190 | DESIGNED BY: DAH | DRAWN BY: SCC | REVISED BY: SCC

CAD Path: Q:_GeoTech\080190 Stadium Thriftway\2019 CB 2019 Cleanup Expansion Construction and Design Report\080190-03 Site Plan.dwg 4-PCE GW | Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet | Date Saved: Aug 13, 2019 11:39am | User: kcobb

Boring Logs

Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines	GW	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
			GP	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
		≥15% Fines	GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines	SW	Well-graded SAND Well-graded SAND WITH GRAVEL
			SP	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
		≥15% Fines	SM	SILTY SAND SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%		ML	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
			CL	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
			OL	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More		MH	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
			CH	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
			OH	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
Highly Organic Soils			PT	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

GEOTECHNICAL LAB TESTS

MC	=	Natural Moisture Content
GS	=	Grain Size Distribution
FC	=	Fines Content (% < 0.075 mm)
GH	=	Hydrometer Test
AL	=	Atterberg Limits
C	=	Consolidation Test
Str	=	Strength Test
OC	=	Organic Content (% Loss by Ignition)
Comp	=	Proctor Test
K	=	Hydraulic Conductivity Test
SG	=	Specific Gravity Test

CHEMICAL LAB TESTS

Organic Chemicals

BTEX	=	Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx	=	Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G	=	Gasoline-Range Petroleum Hydrocarbons
VOCs	=	Volatile Organic Compounds
SVOCs	=	Semi-Volatile Organic Compounds
PAHs	=	Polycyclic Aromatic Hydrocarbon Compounds
PCBs	=	Polychlorinated Biphenyls

Metals

RCRA8	=	As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5	=	As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13	=	Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

FIELD TESTS

PID	=	Photoionization Detector
Sheen	=	Oil Sheen Test
SPT[2]	=	Standard Penetration Test
NSPT	=	Non-Standard Penetration Test
DCPT	=	Dynamic Cone Penetration Test

COMPONENT DEFINITIONS

Descriptive Term		*Size Range and Sieve Number*
Boulders	=	Larger than 12 inches
Cobbles	=	3 inches to 12 inches
Coarse Gravel	=	3 inches to 3/4 inches
Fine Gravel	=	3/4 inches to No. 4 (4.75 mm)
Coarse Sand	=	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	=	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	=	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	=	Smaller than No. 200 (0.075 mm)

ESTIMATED[1] PERCENTAGE

% by Weight		*Modifier*	*% by Weight*		*Modifier*
<1	=	Subtrace	15 to 25	=	Little
1 to <5	=	Trace	30 to 45	=	Some
5 to 10	=	Few	>50	=	Mostly

MOISTURE CONTENT

Dry	=	Absence of moisture, dusty, dry to the touch
Slightly Moist	=	Perceptible moisture
Moist	=	Damp but no visible water
Very Moist	=	Water visible but not free draining
Wet	=	Visible free water, usually from below water table

RELATIVE DENSITY

Non-Cohesive or Coarse-Grained Soils

Density[3]		*SPT*[2] *Blows/Foot*	*Penetration with 1/2" Diameter Rod*
Very Loose	=	0 to 4	≥ 2'
Loose	=	5 to 10	1' to 2'
Medium Dense	=	11 to 30	3" to 1'
Dense	=	31 to 50	1" to 3"
Very Dense	=	> 50	< 1"

CONSISTENCY

Cohesive or Fine-Grained Soils

Consistency[3]		*SPT*[2] *Blows/Foot*	*Manual Test*
Very Soft	=	0 to 1	Penetrated >1" easily by thumb. Extrudes between thumb & fingers.
Soft	=	2 to 4	Penetrated 1/4" to 1" easily by thumb. Easily molded.
Medium Stiff	=	5 to 8	Penetrated >1/4" with effort by thumb. Molded with strong pressure.
Stiff	=	9 to 15	Indented ~1/4" with effort by thumb.
Very Stiff	=	16 to 30	Indented easily by thumbnail.
Hard	=	> 30	Indented with difficulty by thumbnail.

GEOLOGIC CONTACTS

Observed and Distinct — Observed and Gradual — Inferred

Aspect CONSULTING

Exploration Log Key

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's entrance, south of MW-17		*Coordinates* NA	*Exploration Number* **MW-23**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 160
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/6/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 52.7' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; with base course.	0
						TILL	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					SILTY SAND (SM); very dense, moist, gray brown; fine to medium sand; trace fine subround gravel; chemical odor.	1
2							2
3							3
4	2" diameter, schedule 40 PVC, threaded connections, 0'-45' bgs						4
5			B-23-5.5 VOCs by 8260C	PID=360 SPT=50/5			5
6							6
7							7
8							8
9							9
10			B-23-10.5 VOCs by 8260C	PID=31 SPT=29, 50/5			10
11							11
12							12
13							13
14							14
15				PID=1.2 SPT=50/6		GRAVEL (GP); very dense; gray; moist; fine subround gravel.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-8' bgs		B-23-20.5 VOCs by 8260C	PID=4.1 SPT=29, 50/4		SAND WITH SILT AND GRAVEL (SW-SM); very dense, moist, gray brown; fine to coarse sand; fine to coarse subround gravel.	20
21							21
22							22
23							23
24							24

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MVA
Approved by: DAH

Exploration Log MW-23

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's entrance, south of MW-17		*Coordinates* NA	*Exploration Number* **MW-23**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 160
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/6/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 52.7' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26			B-23-25.5 VOCs by 8260C	SPT=22, 50/6 PID=704		SILTY SAND WITH GRAVEL (SM); very dense, moist, gray to gray brown; fine to medium sand (trace coarse); fine gravel.	26
27						SAND WITH SILT (SP-SM); very dense, moist, gray brown; fine to medium sand; trace fine subround gravel.	27
28							28
29							29
30				PID=2.1 SPT=16, 50/5		SILTY SAND (SM); very dense, slightly moist, brown; fine to medium sand; trace fine subround gravel; slight chemical odor.	30
31							31
32							32
33							33
34							34
35				PID=1.8 SPT=24, 30, 50/6		SAND WITH SILT (SP-SM); very dense, moist, brown; fine to medium sand (trace coarse sand); trace fine subround gravel.	35
36							36
37							37
38							38
39							39
40				PID=0.2 SPT=33, 50/5		**OUTWASH** SAND (SP); dense to very dense, moist, red brown; fine to medium sand (with trace coarse sand); trace silt.	40
41							41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0.2			45
46				SPT=30, 32, 42			46
47							47
48							48
49							49

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MVA
Approved by: DAH

Exploration Log MW-23

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's entrance, south of MW-17		*Coordinates* NA	*Exploration Number* **MW-23**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 160
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/6/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 52.7' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51				SPT=18, 22, 32 PID=0.3		**OUTWASH** SAND (SP); dense to very dense, moist, red brown; fine to medium sand (with trace coarse sand); trace silt. (continued)	51
52	2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs ▽ 2/6/2019						52
53							53
54							54
55			B-23-55.5 VOCs by 8260C	PID=2.2			55
56				SPT=17, 21, 33			56
57							57
58							58
59						SILTY SAND (SM); very dense, very moist, brown; fine sand.	59
60	Threaded PVC endcap			PID=0.4			60
61				SPT=27, 35, 50/5			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type: ◧ Continuous core 1.125" ID

Water Level: ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MVA
Approved by: DAH

Exploration Log MW-23

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's southeast corner		*Coordinates* NA	*Exploration Number* **MW-24**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 186
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/30/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.6' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; with base course.	0
						TILL	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					SAND WITH GRAVEL (SP); dense, moist, dark brown; fine to medium sand; fine subround gravel.	1
2							2
3							3
4	2" diameter, schedule 40 PVC, threaded connections, 0'-10' bgs						4
5				PID=0			5
6	Bentonite chips, 2'-8' bgs		B-24-5.5 VOCs by 8260C	SPT=13, 22, 50/5		SANDY SILT WITH GRAVEL (ML); hard, slightly moist, brown; low plasticity silt; fine to coarse sand; fine to coarse subround gravel.	6
7							7
8							8
9	12/20 sand filter pack, 8'-22' bgs						9
10				PID=0		SILTY SAND WITH GRAVEL (SM); very dense, slightly moist, gray brown; fine to coarse sand; fine to coarse subround gravel.	10
11				SPT=15, 47, 50/5			11
12							12
13							13
14							14
15	2" diameter 0.020", schedule 40 PVC screen, 10'-20' bgs			PID=0		SAND WITH SILT AND GRAVEL (SP-SM); very dense, slightly moist, brown; fine to medium sand; fine to course subround gravel.	15
16				SPT=14, 37, 50/5			16
17							17
18							18
19							19
20				SPT=50/5		SAND WITH SILT AND GRAVEL (SW-SM); very dense, moist, gray brown; fine to coarse sand; coarse subround gravel; on rock, blow counts overstated	20
21							21
22							22
23							23
24							24

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-24

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's southeast corner		*Coordinates* NA	*Exploration Number* **MW-24**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 186
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/30/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.6' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26	2" diameter, schedule 40 PVC, threaded connections, 20'-45' bgs			SPT=24, 40, 50/5 PID=0		SILTY SAND (SM); very dense, moist, gray brown; fine to coarse sand; trace fine to coarse subround gravel.	26
27							27
28							28
29							29
30	Bentonite chips, 22'-42' bgs		B-24-30.5 VOCs by 8260C	PID=0.5 SPT=32, 50/5			30
31							31
32							32
33							33
34							34
35				PID=0 SPT=36, 50/5			35
36							36
37							37
38							38
39							39
40				PID=0		**OUTWASH**	40
41				SPT=38, 41, 24		SAND (SP); very dense, moist, brown; fine to medium sand; trace silt.	41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0 SPT=18, 50/6			45
46							46
47							47
48							48
49							49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-24

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's southeast corner		*Coordinates* NA	*Exploration Number* **MW-24**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 186
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/30/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.6' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	▽ 1/31/2019		B-24-50.5 VOCs by 8260C	SPT=24, 32, 34 PID=0		SAND WITH SILT (SP-SM); very dense, wet, red brown; fine sand.	51
52	2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs						52
53							53
54							54
55				PID=0			55
56				SPT=27, 40, 34		SAND (SP); very dense, wet, red brown; fine to medium sand (trace coarse); few fine to coarse subround gravel; trace silt.	56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=0			60
61				SPT=23, 50/6			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-24

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of southwest Morell's building corner		*Coordinates* NA	*Exploration Number* **MW-25**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 184
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/28/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.9' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt	0
						Till	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					SILTY SAND WITH GRAVEL (SM); very dense, very moist, gray brown; fine to coarse sand, fine subround gravel	1
2							2
3							3
4							4
5			B-25-5.5 VOCs by 8260	PID=0 SPT=24, 50/5			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45' bgs			PID=0		SAND (SP); dense. slightly moist gray brown; fine sand, 5% silt	10
11				SPT=14, 38, 50/4			11
12							12
13							13
14							14
15				PID=0 SPT=70/5		SAND WITH SILT (SW-SM); very dense, slightly moist, gray brown; fine to coarse sand, fine subround gravel	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=0 SPT=50/5		SILTY SAND (SM); very dense, moist, gray brown; fine to coarse sand, fine to coarse subround gravel	20
21							21
22							22
23							23
24							24

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-25

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of southwest Morell's building corner		*Coordinates* NA	*Exploration Number* **MW-25**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 184
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/28/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.9' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=70/6 PID=0		SAND (SP); very dense, moist, gray brown; fine to coarse sand, coarse subround gravel	26
27							27
28							28
29							29
30			B-25-30.5 VOCs by 8260	PID=0.2		SAND WITH SILT (SP-SM); very dense, moist, gray brown; 85% fine sand, 5% medium to coarse sand	30
31				SPT=22, 37, 50/6			31
32							32
33							33
34						SILT (ML); very stiff, moist, light brown; 10% fine sand	34
35				PID=0			35
36				SPT=14, 29, 38		SAND WITH SILT (SP-SM); very dense, moist, red brown; fine to medium sand	36
37							37
38							38
39							39
40				PID=0		**Outwash**	40
41				SPT=23, 38, 46		SAND (SP); very dense, moist, red brown; 5% silt, 5% coarse subround gravel	41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0			45
46				SPT=24, 32, 36			46
47							47
48							48
49							49

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-25

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of southwest Morell's building corner		*Coordinates* NA	*Exploration Number* **MW-25**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 184
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/28/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.9' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51			B-25-50.5 VOCs by 8260	SPT=33, 32, 50/5 PID=0.5		SILTY SAND (SM); very dense, moist, brown; fine sand	51
52	▽ 1/29/2019 2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs						52
53							53
54							54
55				PID=0			55
56				SPT=26, 32, 50/6		SAND (SP); very dense, wet, red brown; fine to medium sand (<5% coarse), 5% silt, up to 10% fine subround gravel	56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=0			60
61				SPT=25, 50/6			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type: ◧ Continuous core 1.125" ID

Water Level: ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-25

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's, south of MW-25		*Coordinates* NA	*Exploration Number* **MW-26**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 185
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/29/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 52' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt	0
0						CONCRETE; Concrete	0
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**TILL** SILTY SAND (SM); dense to very dense, slightly moist, gray brown; fine to coarse sand, few fine to coarse subround gravel.	1
2							2
3							3
4							4
5			B-26-5.5 VOCs by 8260	PID=0 SPT=29, 50/5			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-44' bgs			PID=0 SPT=27, 50/6			10
11							11
12							12
13							13
14							14
15				PID=0 SPT=19, 42, 50/5		SANDY SILT (ML); hard, slightly moist, light brown; low plasticity silt; fine to coarse sand; few fine to coarse subround gravel.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=0 SPT=19, 50/6		SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown; fine to coarse sand (mostly fine); fine subround gravel.	20
21							21
22							22
23							23
24							24

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-26

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's, south of MW-25		*Coordinates* NA	*Exploration Number* **MW-26**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 185
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/29/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 52' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=18, 50/6 PID=0		SILTY SAND WITH GRAVEL (SM); very dense, moist, gray brown; fine to coarse sand (mostly fine); fine subround gravel. (continued)	26
27							27
28							28
29							29
30			B-26-30.5 VOCs by 8260	PID=0 SPT=19, 34, 38		SAND WITH SILT (SP-SM); very dense, moist, red brown; fine to medium sand; up to trace course gravel; broken rock found in sampler.	30
31							31
32							32
33							33
34							34
35				PID=0 SPT=20, 25, 49		Becomes wet	35
36							36
37							37
38							38
39							39
40				PID=0 SPT=39, 50/5		**OUTWASH** SAND (SP); very dense, moist, red brown; fine to medium sand; trace silt; trace fine subround gravel.	40
41							41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0 SPT=46, 39, 36			45
46							46
47							47
48							48
49							49

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-26

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's, south of MW-25		*Coordinates* NA	*Exploration Number* **MW-26**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 185
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/29/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 52' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51			B-26-50.5 VOCs by 8260	SPT=14, 40, 50/5 PID=0		**OUTWASH** SAND (SP); very dense, moist, red brown; fine to medium sand; trace silt; trace fine subround gravel. (continued) Becomes wet	51
52	▽ 1/30/2019 2" diameter 0.020", schedule 40 PVC screen, 44'-59' bgs						52
53							53
54							54
55				PID=0 SPT=21, 50/6			55
56							56
57							57
58							58
59	Threaded PVC endcap						59
60				PID=0			60
61				SPT=14, 23, 50/6			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type: ◧ Continuous core 1.125" ID

Water Level: ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-26
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's, southeast of B-24		*Coordinates* NA	*Exploration Number* **MW-27**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 158
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/31/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 46.3' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; with base course.	0
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**TILL** SAND (SP); dense, moist, gray; with bentonite; 2" long piece of concrete in sampler.	1
2							2
3							3
4							4
5			B-27-5.5 VOCs by 8260	PID=0 SPT=24, 50/4			5
6						SILTY SAND (SM); very dense, slightly moist, gray brown; fine to medium sand (trace coarse); few fine subround gravel.	6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-44' bgs			PID=0			10
11				SPT=10, 42, 50/3			11
12							12
13							13
14							14
15				PID=0 SPT=37, 50/5		SAND WITH SILT (SP-SM); very dense, slightly moist, gray brown; fine to medium sand; few fine subround gravel.	15
16							16
17							17
18							18
19						SAND (SP); very dense, slightly moist, gray brown; fine to medium sand; few fine to coarse subround gravel.	19
20	Bentonite chips, 2'-42' bgs			PID=0 SPT=30, 50/5.5			20
21						SILTY SAND (SM); very dense, slightly moist, gray brown; fine to medium sand (trace coarse sand); few fine to coarse subround gravel.	21
22							22
23							23
24							24

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-27
Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's, southeast of B-24		*Coordinates* NA	*Exploration Number* **MW-27**
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 158
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/31/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 46.3' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=23, 13, 23 PID=0		SILT (ML); very stiff, moist, light brown; non plastic, rapid dilatency.	26
27						SAND WITH SILT (SP-SM); dense, moist, brown; fine sand.	27
28							28
29							29
30				PID=1.5			30
31			B-27-30.5 VOCs by 8260	SPT=19, 29, 39		SILTY SAND (SM); very dense, moist, gray brown; fine to medium sand; trace fine round gravel.	31
32							32
33							33
34							34
35				PID=0			35
36				SPT=33, 50/6		SAND WITH SILT (SP-SM); very dense, wet, brown; fine to medium sand; trace coarse subround gravel.	36
37							37
38							38
39							39
40				PID=0			40
41				SPT=26, 50/6		**OUTWASH** SAND (SP); very dense, moist, red brown; fine to medium sand (trace coarse), few fine to coarse subround gravel; trace silt.	41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0.5			45
46	▽ 2/1/2019			SPT=20, 29, 32			46
47							47
48							48
49							49

Legend

Sample Type: Continuous core 1.125" ID

Water Level: ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-27

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's, southeast of B-24		*Coordinates* NA	*Exploration Number* **MW-27** Ecology Well Tag No. BLI 158
Contractor Holt	*Equipment* CME - 75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 1/31/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 46.3' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51			B-27-50.5 VOCs by 8260	SPT=18, 24, 36 PID=0.5		SAND WITH SILT (SP-SM); very dense, wet, red brown; fine sand.	51
52	2" diameter 0.020", schedule 40 PVC screen, 44'-59' bgs					SAND (SP); very dense, wet, red brown; fine to medium sand; trace silt.	52
53							53
54							54
55				PID=0			55
56				SPT=24, 35, 50/5			56
57							57
58							58
59	Threaded PVC endcap						59
60				PID=0			60
61				SPT=23, 48, 50/5			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-27
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Southeast of Morell's southeast corner		*Coordinates* NA	*Exploration Number* **MW-28**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 935
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/14/2019 to 3/15/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 49' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt	0
0.5						CONCRETE; Concrete	0.5
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**TILL** SANDY SILT (ML); Very dense, slightly moist, light brown; fine to medium sand; few fine subround gravel.	1
2							2
3							3
4							4
5				PID=0 SPT=17, 50/5			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-44' bgs			PID=0.3 SPT=22, 50/4		SAND WITH SILT AND GRAVEL (SP-SM); Very dense, moist, light brown; fine to medium sand; fine subround gravel.	10
11							11
12							12
13							13
14							14
15				PID=0 SPT=22, 50/5		SILTY SAND WITH GRAVEL (SM); Very dense, slightly moist, light brown; fine to coarse sand; fine to coarse subround gravel.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=0 SPT=17, 39, 50/5		Gravel content decreases to trace.	20
21							21
22							22
23							23
24							24

Legend

Sample Type
- No Soil Sample Recovery
- Continuous core 1.125" ID

Water Level
- Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-28

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Southeast of Morell's southeast corner		*Coordinates* NA	*Exploration Number* **MW-28**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 935
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/14/2019 to 3/15/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 49' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=12, 34, 36 PID=0		SILTY SAND WITH GRAVEL (SM); Very dense, slightly moist, light brown; fine to coarse sand; fine to coarse subround gravel. (continued)	26
27							27
28							28
29							29
30				PID=3.5			30
31			B-28-30.5 VOCs by 8260	SPT=17, 39, 50/5		SANDY SILT (ML); Hard, moist, light brown; low plasticity silt; fine to medium sand; trace fine to coarse subround gravel.	31
32							32
33							33
34							34
35				PID=0			35
36				SPT=21, 34, 42		SAND (SP); Very dense, wet, red brown; find to medium sand; trace silt; trace fine to course subround gravel.	36
37							37
38							38
39							39
40				PID=0			40
41				SPT=24, 29, 32		SANDY SILT (ML); Hard, moist, tan; low plasticity silt; fine sand. SAND (SP); Very dense, moist, light brown; fine sand; trace silt.	41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0		**OUTWASH**	45
46				SPT=19, 29, 34		SAND (SP); Very dense, wet, red brown; find to medium sand; trace silt; trace fine to course subround gravel.	46
47							47
48							48
49	▼ 3/15/2019						49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-28

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Southeast of Morell's southeast corner		*Coordinates* NA	*Exploration Number* **MW-28**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 935
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/14/2019 to 3/15/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 49' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51				SPT=17, 22, 34 PID=0		**OUTWASH** SAND (SP); Very dense, wet, red brown; find to medium sand; trace silt; trace fine to course subround gravel. (continued)	51
52	2" diameter 0.020", schedule 40 PVC screen, 44'-59' bgs						52
53							53
54							54
55				PID=0			55
56			B-28-55.5 VOCs by 8260	SPT=40, 33, 29			56
57							57
58							58
59	Threaded PVC endcap						59
60				PID=0			60
61				SPT=43, 50/5			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-28
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Parking lot east of Morell's and MW-23		*Coordinates* NA	*Exploration Number* **MW-29**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 932
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/11/2019 to 3/12/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.18' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt	0
						CONCRETE; Concrete	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**TLL** SILTY SAND (SM); Very dense, moist, grayfine to medium sand; trace fine to coarse subround gravel; trace cobble (broken cobble found in sampler). Blow counts possibly overstated.	1
2							2
3							3
4							4
5				PID=0 SPT=50, 50/5			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45' bgs			PID=0 SPT=50/6			10
11							11
12							12
13							13
14							14
15			B-29-15.0 VOCs by 8260	PID=0 SPT=26, 50/5		No cobbles found in sample.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=0 SPT=12, 26, 42		SAND WITH SILT (SP-SM); Very dense, slightly moist; light brown; fine to medium sand.	20
21							21
22							22
23							23
24							24

Legend

Sample Type
- No Soil Sample Recovery
- Continuous core 1.125" ID

Water Level
- Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-29
Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Parking lot east of Morell's and MW-23		*Coordinates* NA	*Exploration Number* **MW-29**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 932
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/11/2019 to 3/12/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.18' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=26, 50/5 PID=0		SAND WITH SILT (SP-SM); Very dense, slightly moist; light brown; fine to medium sand. (continued)	26
27							27
28							28
29							29
30				PID=0 SPT=50/6		SILTY SAND (SM); Very dense, slightly moist, light brown; fine to coarse sand; few cobbles (broken cobble found in sampler. Blow counts may be overstated.	30
31							31
32							32
33							33
34							34
35				PID=0		SAND (SP); Very dense, slightly moist, gray; fine to medium sand, trace silt. Heave?	35
36				SPT=11, 22, 33			36
37							37
38							38
39							39
40				PID=0.5		**OUTWASH** SAND (SP); Very dense, slightly moist, red brown; fine to medium sand, trace silt.	40
41				SPT=18, 30, 37			41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0			45
46				SPT=17, 30, 40			46
47							47
48							48
49							49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-29

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Parking lot east of Morell's and MW-23		*Coordinates* NA	*Exploration Number* **MW-29**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 932
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/11/2019 to 3/12/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.18' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	3/12/2019		B-29-50.0 VOCs by 8260	SPT=30, 33, 35 PID=0.9		**OUTWASH** SAND (SP); Very dense, slightly moist, red brown; fine to medium sand, trace silt. (continued) Trace fine subangular gravel.	51
52	2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs						52
53							53
54							54
55				PID=0			55
56				SPT=8, 22, 33			56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=0			60
61				SPT=18, 27, 38			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-29
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's entrance, east of MW-2		*Coordinates* NA	*Exploration Number* **MW-30**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 161
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/7/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.15' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt.	0
						CONCRETE; Concrete.	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**TILL**	1
2						SANDY SILT (ML); hard, slightly moist, gray brown; low plasticity, medium high dilatency silt; fine to medium sand; trace fine subround gravel.	2
3							3
4							4
5				PID=0 SPT=8, 50/3			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45' bgs		B-30-10.5 VOCs by 8260	PID=4 SPT=23, 37, 50/3		SILTY SAND (SM); very dense, slightly moist, gray brown; fine to coarse sand; fine subround gravel.	10
11							11
12							12
13							13
14							14
15				SPT=50/1 PID=N/A			15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=0.2		SAND WITH SILT AND GRAVEL (SW-SM); very dense, slightly moist, gray brown; fine to coarse sand; fine to coarse subround gravel.	20
21				SPT=23, 43, 50/3			21
22							22
23							23
24							24

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-30
Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's entrance, east of MW-2		*Coordinates* NA	*Exploration Number* **MW-30**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 161
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/7/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.15' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=35, 50/3 PID=0.5		SANDY SILT (ML); hard, slightly moist, light brown; fine to coarse sand; trace fine to coarse subround gravel.	26
27							27
28							28
29							29
30				PID=0.6 SPT=12, 50/6			30
31							31
32							32
33							33
34							34
35				PID=2.6			35
36			B-30-35.5 VOCs by 8260	SPT=33, 50/5		**OUTWASH** SAND (SP); very dense, slightly moist, red brown; fine to medium sand; trace silt; trace fine to coarse subround gravel.	36
37							37
38							38
39							39
40				PID=0			40
41				SPT=25, 34, 35			41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0			45
46				SPT=11, 30, 36			46
47							47
48							48
49							49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-30
Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's entrance, east of MW-2		*Coordinates* NA	*Exploration Number* **MW-30**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 161
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/7/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.15' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	▼ 2/7/2019			SPT=16, 25, 31 PID=0		**OUTWASH** SAND (SP); very dense, slightly moist, red brown; fine to medium sand; trace silt; trace fine to coarse subround gravel. (continued)	51
52	2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs						52
53							53
54							54
55				PID=0		Becomes wet.	55
56				SPT=15, 24, 31			56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=0.4			60
61			B-30-60.5 VOCs by 8260	SPT=16, 36, 42			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ▮▮ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-30
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, MW corner of Morell's parking area		*Coordinates* NA	*Exploration Number* **MW-31**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 159
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/5/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.36' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt.	0
						CONCRETE; Concrete.	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**Till** GRAVELLY SILT WITH SAND (ML); very dense, wet, brown; low plasticity silt; fine to coarse sand; fine to coarse subround gravel.	1
2							2
3							3
4	2" diameter, schedule 40 PVC, threaded connections, 0'-9.5' bgs						4
5				PID=0 SPT=50/5			5
6	Bentonite chips, 2'-7.5' bgs						6
7							7
8							8
9	12/20 sand filter pack, 7.5'-21.5' bgs						9
10				PID=0.1		SAND WITH SILT (SP-SM); very dense, slightly moist, gray brown; fine to medium sand (trace coarse); trace coarse subround gravel.	10
11				SPT=15, 38, 50/5			11
12							12
13							13
14							14
15	2" diameter 0.020", schedule 40 PVC screen, 9.5'-19.5' bgs		B-31-15.5 VOCs by 8260	PID=0.1 SPT=20, 50/5		Gravel content increases to SAND WITH SILT AND GRAVEL.	15
16							16
17							17
18							18
19							19
20				PID=0.1 SPT=24, 50/6		SANDY SILT WITH GRAVEL (ML); hard, slightly moist, gray brown; low plasticity silt; fine to coarse sand, fine to coarse subround gravel.	20
21							21
22							22
23							23
24							24

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-31
Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, MW corner of Morell's parking area		*Coordinates* NA	*Exploration Number* **MW-31**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 159
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/5/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.36' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26	2" diameter, schedule 40 PVC, threaded connections, 19.5'-44.5' bgs			SPT=18, 50/4 PID=0		SANDY SILT WITH GRAVEL (ML); hard, slightly moist, gray brown; low plasticity silt; fine to coarse sand, fine to coarse subround gravel. (continued)	26
27							27
28							28
29							29
30	Bentonite chips, 21.5'-41.5' bgs			PID=0.1 SPT=31, 50/3		SILTY SAND (SM); very dense, slightly moist, brown; fine to medium sand (trace coarse); trace coarse subround gravel.	30
31							31
32							32
33							33
34							34
35				PID=0.3 SPT=37, 50/6			35
36							36
37							37
38							38
39							39
40				PID=1.0		**OUTWASH**	40
41			B-31-40.5 VOCs by 8260	SPT=28, 42, 37		SAND (SP); very dense, moist, brown; fine to medium sand; trace silt; trace fine gravel.	41
42							42
43							43
44							44
45	12/20 sand filter pack, 41.5'-60' bgs			PID=0			45
46				SPT=17, 39, 46			46
47							47
48							48
49							49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-31
Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, MW corner of Morell's parking area		*Coordinates* NA	*Exploration Number* **MW-31**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 159
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 2/5/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.36' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	▼ 2/5/2019 2" diameter 0.020", schedule 40 PVC screen, 44.5'-59.5' bgs			SPT=11, 39, 49 PID=0.3		**OUTWASH** SAND (SP); very dense, moist, brown; fine to medium sand; trace silt; trace fine gravel. (continued)	51
52							52
53							53
54							54
55				PID=1.5			55
56			B-31-55.5 VOCs by 8260	SPT=22, 31, 50/6			56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=1.3			60
61			B-31-60.5 VOCs by 8260	SPT=20, 33, 50/5			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-31
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Parking Lot east of Morell's and B-30		*Coordinates* NA	*Exploration Number* **MW-32**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 934
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/13/2019 to 3/14/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.09' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt.	0
						CONCRETE; Concrete.	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs						1
2							2
3							3
4							4
5				SPT=50/3			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45' bgs			SPT=50/4			10
11							11
12							12
13							13
14							14
15			B-32-15.5 VOCs by 8260	PID=1 SPT=24, 50/5		SILTY SAND (SM); Very dense, slightly moist, light brown; fine to medium sand, trace fine subround gravel.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=1 SPT=30, 50/5		SAND WITH SILT (SP-SM); Very dense, slightly moist, light brown; fine to medium sand; trace fine subround gravel.	20
21							21
22							22
23							23
24							24

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-32

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Parking Lot east of Morell's and B-30		*Coordinates* NA	*Exploration Number* **MW-32**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 934
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/13/2019 to 3/14/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.09' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=24, 50/4 PID=5		SANDY SILT (ML); Hard, slightly moist, light gray; low plasticity silt; trace fine sand.	26
27							27
28							28
29							29
30				PID=1.5 SPT=23, 50/6		SILTY SAND (SM); Very dense, moist, light brown; fine to medium sand; trace fine subround gravel.	30
31							31
32							32
33							33
34							34
35				PID=1.5 SPT=15, 50/6		No gravel.	35
36							36
37							37
38							38
39							39
40				PID=0 SPT=17, 28, 30		SAND (SP); Very dense, moist, red brown; fine to medium sand; trace silt.	40
41							41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs						45
46				SPT=44, 30/4			46
47							47
48							48
49							49

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-32

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, Parking Lot east of Morell's and B-30		*Coordinates* NA	*Exploration Number* **MW-32** Ecology Well Tag No. BLR 934
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/13/2019 to 3/14/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.09' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	3/14/2019			SPT=17, 24, 28 PID=0		SAND (SP); Very dense, moist, red brown; fine to medium sand; trace silt. (continued) Becomes wet.	51
52	2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs						52
53							53
54							54
55				PID=0			55
56			B-32-55.5 VOCs by 8260	SPT=21, 33, 40			56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=0			60
61				SPT=34, 50/5			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type: Continuous core 1.125" ID

Water Level: Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-32

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Copper Door in parking lot		*Coordinates* NA	*Exploration Number* **MW-33**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 933
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/12/2019 to 3/13/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.8' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt.	0
						CONCRETE; Concrete	
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					**TILL**	1
2						SANDY SILT (ML); Hard, very moist, gray; low plasticity silt; fine to coarse sand; few fine, subround to subangular gravel.	2
3							3
4							4
5							5
6				PID=2 SPT=18, 27, 50/3			6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45' bgs		B-33-10.0 VOCs by 8260	SPT=8, 50/6 PID=2		SANDY SILT WITH GRAVEL (ML); Hard, moist, gray; low plasticity silt; fine to coarse sand; fine, subround to subangular gravel.	10
11							11
12							12
13							13
14							14
15				PID=0 SPT=27, 50/6		SILTY SAND WITH GRAVEL (SM); Very dense, slightly moist, light brown; fine to coarse sand; fine to coarse subround gravel.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=1 SPT=40, 50/6			20
21							21
22							22
23							23
24							24

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-33
Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Copper Door in parking lot		*Coordinates* NA	*Exploration Number* **MW-33**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 933
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/12/2019 to 3/13/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.8' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=26, 50/6 PID=0		SAND WITH SILT (SP-SM); Very dense, moist, light brown; fine to medium sand; few fine to coarse subround gravel.	26
27							27
28							28
29							29
30				PID=0 SPT=50/6		SAND WITH SILT (SW-SM); Very dense, slightly moist, light brown; fine to coarse sand; trace fine subround gravel.	30
31							31
32							32
33							33
34							34
35				PID=0.5		SAND (SP); Very dense, slightly moist, light brown; fine to medium sand; trace silt.	35
36				SPT=28, 30, 36			36
37							37
38							38
39							39
40				PID=0		**OUTWASH**	40
41				SPT=15, 24, 37		Becomes red brown.	41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs						45
46				PID=0 SPT=22, 31, 35			46
47							47
48							48
49							49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-33
Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Copper Door in parking lot		*Coordinates* NA	*Exploration Number* **MW-33**
Contractor Holt	*Equipment* CME - 85	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLR 933
Operator John B	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 3/12/2019 to 3/13/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 51.8' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51				SPT=24, 35, 35 PID=0		SAND (SP); Very dense, slightly moist, light brown; fine to medium sand; trace silt. (continued) Becomes wet.	51
52	▼ 3/13/2019 2" diameter 0.020", schedule 40 PVC screen, 45'-60' bgs						52
53							53
54							54
55				PID=0		Trace fine subround gravel.	55
56			B-33-55.5 VOCs by 8260	SPT=24, 30, 37			56
57							57
58							58
59							59
60	Threaded PVC endcap			PID=0		SAND WITH SILT (SP-SM); Very dense, wet, light brown,; fine sand.	60
61				SPT=9, 24, 38			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-33
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's 5' SW of MW-20		*Coordinates* NA	*Exploration Number* **MW-34**
Contractor Holt	*Equipment* CME-75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BMF673
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 7/8/2019 to 7/9/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 47.7' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					ASPHALT; Asphalt SAND WITH SILT AND GRAVEL (SP-SM); Very dense, slightly moist, brown; fine to medium sand; low plasticity silt; fine to coarse subround gravel.	1
2							2
3							3
4							4
5				PID=2 SPT=42, 42, 50/3			5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-44' bgs			SPT=50/4 PID=N/A			10
11							11
12							12
13							13
14							14
15				PID=0.8 SPT=37, 50/4		SAND (SP); Very dense, slightly moist, brown; fine to medium sand; trace silt; trace fine subround gravel.	15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs			PID=N/A SPT=50/5			20
21							21
22							22
23							23
24							24

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-34

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's 5' SW of MW-20		*Coordinates* NA	*Exploration Number* **MW-34**
Contractor Holt	*Equipment* CME-75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BMF673
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 7/8/2019 to 7/9/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 47.7' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26				SPT=29, 50/5 PID=1.5		SILTY SAND (SM); Very dense, moist, gray brown; fine to medium sand; low plasticity silt; trace fine to coarse subangular gravel; broken rock in sampler, blow counts may be biased high.	26
27							27
28							28
29							29
30				PID=0.5			30
31				SPT=28, 45, 50/4			31
32							32
33							33
34							34
35				PID=0.5		SAND (SP); Very dense, moist, red brown; fine to medium sand; trace silt.	35
36				SPT=11, 40, 40			36
37							37
38							38
39							39
40				PID=0.5			40
41				SPT=42, 50/5			41
42							42
43							43
44							44
45	12/20 sand filter pack, 42'-61.5' bgs			PID=0			45
46				SPT=33, 35, 43			46
47	▽ 7/9/2019						47
48							48
49							49

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-34

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's 5' SW of MW-20		*Coordinates* NA	*Exploration Number* **MW-34**
Contractor Holt	*Equipment* CME-75	*Sampling Method* Autohammer; lb hammer; " drop	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BMF673
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 7/8/2019 to 7/9/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 47.7' (ATD)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51				SPT=24, 35, 42 PID=0.2		SAND (SP); Very dense, moist, red brown; fine to medium sand; trace silt. (continued) Becomes wet	51
52	2" diameter 0.020", schedule 40 PVC screen, 44'-59' bgs						52
53							53
54							54
55				PID=0.1 SPT=50/5			55
56							56
57							57
58							58
59	Threaded PVC endcap						59
60				PID=0.1		Becomes dense	60
61				SPT=12, 17, 30			61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type
- ◯ No Soil Sample Recovery
- ◧ Continuous core 1.125" ID

Water Level
- ▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-34
Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's 15' W of MW-20		*Coordinates* NA	*Exploration Number* **MW-35**
Contractor Holt	*Equipment* CME-75	*Sampling Method* No Sampling	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BMF672
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 7/10/2019 to 7/11/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.8' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
0						ASPHALT; Asphalt.	0
1	Flushmount monument, lockable thermos cap, concrete seal, 0'-2' bgs					No logging or sampling	1
2							2
3							3
4							4
5							5
6							6
7							7
8							8
9							9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-43' bgs						10
11							11
12							12
13							13
14							14
15							15
16							16
17							17
18							18
19							19
20	Bentonite chips, 2'-42' bgs						20
21							21
22							22
23							23
24							24

Legend

Sample Type

Water Level ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-35

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's 15' W of MW-20		*Coordinates* NA	*Exploration Number* **MW-35**
Contractor Holt	*Equipment* CME-75	*Sampling Method* No Sampling	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BMF672
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 7/10/2019 to 7/11/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.8' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
26–49	12/20 sand filter pack, 42'-61.5' bgs						26–49

Legend

Sample Type

Water Level — Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-35

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, South of Morell's 15' W of MW-20		*Coordinates* NA	*Exploration Number* **MW-35**
Contractor Holt	*Equipment* CME-75	*Sampling Method* No Sampling	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BMF672
Operator Kyle	*Exploration Method(s)* 8.5" OD X 4.25" ID Hollow-Stem Auger	*Work Start/Completion Dates* 7/10/2019 to 7/11/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* 50.8' (Static)

Depth (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
51	▼ 7/11/2019						51
52	2" diameter 0.020", schedule 40 PVC screen, 43'-58' bgs						52
53							53
54							54
55							55
56							56
57							57
58							58
59	Threaded PVC endcap						59
60							60
61							61
62						Bottom of exploration at 61.5 ft. bgs.	62
63							63
64							64
65							65
66							66
67							67
68							68
69							69
70							70
71							71
72							72
73							73
74							74

Legend

Sample Type

Water Level ▼ Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log MW-35

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403. Off of Morell's northeast corner, south of MW-21		*Coordinates* NA	*Exploration Number* **VE-5** Ecology Well Tag No. BLI 188
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/26/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
1	1						ASPHALT; Asphalt	1
							TILL	
2		No Monument, well completed sub surface for future SVE connection, lockable thermos cap					SILTY SAND WITH GRAVEL (SM); Slightly moist, gray brown; fine to medium and trace course sand; fine subround gravel.	2
3	2							3
4					PID=7			4
5	3	Well installed at 45 degree angle			PID=12			5
6	4				PID=3		SANDY SILT WITH GRAVEL (ML); Slightly moist, light brown; low plasticity silt ; fine to medium sand; fine subround gravel.	6
7	5				PID=21			7
8		2" diameter, schedule 40 PVC, threaded connections, 1'-25' bgs			PID=15			8
9	6				PID=7			9
10	7						SILTY SAND WITH GRAVEL (SM); Very moist, gray; fine to medium sand; fine to course subround gravel; singular cobble.	10
11	8							11
12					PID=39			12
13	9				PID=30			13
14	10	Bentonite chips, 1'-22' bgs						14
15					PID=41			15
16	11							16
17	12						SAND WITH SILT AND GRAVEL (SP-SM); Very moist, gray brown; fine to medium sand; fine to course, subround gravel.	17
18					PID=24			18
19	13							19
20	14				PID=14		SILTY SAND WITH GRAVEL (SM); Moist, gray; fine to course sand; fine to course subround gravel.	20
21	15							21
22					PID=508			22
23	16			A-5-22.5 VOCs by 8260C	PID=666			23
24		12/20 sand filter pack, 22'-45' bgs						24

Legend

Sample Type: Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-5

Sheet 1 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403. Off of Morell's northeast corner, south of MW-21		*Coordinates* NA	*Exploration Number* **VE-5**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 188
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/26/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
26	18				PID=100		SILTY SAND WITH GRAVEL (SM); Moist, gray; fine to course sand; fine to course subround gravel. (continued)	26
27	19							27
28	20				PID=109			28
29					PID=18			29
30	21	2" diameter 0.020", schedule 40 PVC screen, 25'-45' bgs					SAND WITH SILT AND GRAVEL (SP-SM); Very moist, light brown; fine to medium SAND; fine to course subround gravel.	30
31	22							31
32				A-5-32.0 VOCs by 8260C	PID=126			32
33	23				PID=24			33
34	24							34
35					PID=13		SILTY SAND (SM); Moist, light brown; fien to course sand; few fine subround gravel.	35
36	25				PID=7			36
37	26							37
38	27				PID=9			38
39								39
40	28				PID=21			40
41	29				PID=10			41
42								42
43	30				PID=16			43
44	31							44
45		Threaded PVC endcap			PID=14		Bottom of exploration at 45 ft. bgs. Note: A-5 was advanced at a 45 degree angle	45
46	32							46
47	33							47
48	34							48
49								49

Legend

Sample Type: ◧ Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-5

Sheet 2 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, south of A-5		*Coordinates* NA	*Exploration Number* **VE-6**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 190
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/27/2019 to 2/28/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
0	0						ASPHALT; Asphalt	0
1	1	No Monument, well completed sub surface for future SVE connection, lockable thermos cap					SILTY SAND (SM); Slightly moist, light brown; fine to course sand; trace fine subround gravel.	1
2	2							2
3	2							3
4	3				PID=10			4
5	3	Well installed at 45 degree angle						5
6	4				PID=3			6
7	5				PID=13			7
8	6	2" diameter, schedule 40 PVC, threaded connections, 1'-45' bgs					SAND WITH SILT (SP-SM); Very moist, light brown; fine to medium sand; fine subround gravel.	8
9	6				PID=19			9
10	7							10
11	8							11
12	8				PID=57			12
13	9			A-6-13.0 VOCs by 8260C	PID=126			13
14	10							14
15	10				PID=87			15
16	11						SAND WITH SILT AND GRAVEL (SP-SM); Moist, gray brown; fine to medium sand; fine to course, subround gravel.	16
17	12				PID=15			17
18	12				PID=12			18
19	13				PID=17			19
20	14							20
21	15				PID=99			21
22	15							22
23	16				PID=82			23
24	16						SAND (SP); Very moist, gray; fine to medium sand; trace silt.	24

Legend

Sample Type: Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-6

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, south of A-5		*Coordinates* NA	*Exploration Number* **VE-6**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 190
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/27/2019 to 2/28/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
26	18				PID=86		SILTY SAND WITH GRAVEL (SM); Moist, light brown; fine to medium sand; fine subround gravel.	26
27	19				PID=38			27
28	20				PID=25			28
29	21				PID=22			29
30		Bentonite chips, 1'-42' bgs						30
31	22				PID=25			31
32	23						Silt content dereases; gravel content decreases and is only fine.	32
33								33
34	24				PID=50			34
35	25						Becomes very moist, gravel content increases and is fine to course.	35
36								36
37	26							37
38	27			A-6-36.0 VOCs by 8260C	PID=57 PID=71			38
39					PID=43			39
40	28							40
41	29				PID=33		SAND WITH SILT (SP-SM); Moist, brown; fine to medium sand; trace fine subround gravel.	41
42					PID=28			42
43	30				PID=41			43
44	31							44
45		12/20 sand filter pack, 42'-65' bgs						45
46	32				PID=10		SAND (SP); Moist, brown; fine to medium sand; trace silt.	46
47	33							47
48	34				PID=35			48
49					PID=12		GRAVEL WITH SILT AND SAND (GW-GM); Moist, light brown; fine to course sand; fine to course subround gravel.	49

Legend

Sample Type: ◧ Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-6

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, south of A-5		*Coordinates* NA	*Exploration Number* **VE-6**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 190
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/27/2019 to 2/28/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
51	36	2" diameter 0.020", schedule 40 PVC screen, 45'-65' bgs			PID=8		SAND (SP); Very moist, light brown; fine to medium sand; trace silt.	51
52	37				PID=13		SILT WITH SAND (ML); Moist, light brown;low-plasticity silt, ; fine to medium sand.	52
53								53
54	38				PID=23		SAND (SP); Moist, red brown; fine to medium sand; few fine subround gravel.	54
55	39							55
56								56
57	40			A-6-57.5 VOCs by 8260C	PID=42			57
58	41							58
59								59
60	42				PID=33			60
61	43				PID=37		Gravel deminishes, trace silt.	61
62	44							62
63					PID=27			63
64	45							64
65	46	Threaded PVC endcap			PID=55		Bottom of exploration at 65 ft. bgs. Note: A-6 was advanced at a 45 degree angle	65
66	47							66
67								67
68	48							68
69	49							69
70								70
71	50							71
72	51							72
73								73
74	52							74

Legend

Sample Type: Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-6

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, between MW-16 and MW-17		*Coordinates* NA	*Exploration Number* **VE-7**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 191
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/28/2019 to 3/1/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
1							ASPHALT; Asphalt	
							CONCRETE; Concrete	
							TILL	
2	1						SILTY GRAVEL WITH SAND (GM); Slightly moist, gray; fine to medium sand; fine to course subround gravel.	2
3		No Monument, well completed sub surface for future SVE connection, lockable thermos cap			PID=4			3
4	2						SILTY SAND WITH GRAVEL (SM); Slightly moist, light brown; fine to medium sand; fine subround gravel.	4
5					PID=9			5
	3	Well installed at 45 degree angle						
6							SANDY SILT WITH GRAVEL (MH); Slightly moist, light brown; low plasticity silt; fine to medium sand; fine subround gravel.	6
7	4				PID=20			7
8							SILTY SAND WITH GRAVEL (SM); Wet, dark gray; fine to medium sand; fine subround gravel. Strong solvent odor.	8
	5	2" diameter, schedule 40 PVC, threaded connections, 1'-25' bgs						
9					PID=48			9
	6				PID=1921			
10							Suspect separate-phase liquid 7'-10' bgs.	10
11	7							11
					PID=762			
12	8							12
13					PID=210			13
	9							
14		Bentonite chips, 1'-22' bgs			PID=256		SILTY SAND (SM); Moist, light brown; fine to course sand; few fine subround gravel. Strong solvent odor.	14
15	10							15
	11							
16					PID=1641			16
17	12				PID=700		SAND WITH SILT AND GRAVEL (SW-SM); Slightly moist, gray; fine to medium sand; fine to course subround gravel; few cobbles.	17
18					PID=30			18
19	13							19
20	14						GRAVEL WITH SILT AND SAND (GP-GM); Wet, gray; fine to course subround gravel, fine to course sand. Strong solvent odor.	20
21	15						SAND (SP); Slightly moist, gray; fine to medium sand; trace silt. Strong solvent odor. Separate-phase liquid suspected.	21
22				A-7-22.0 VOCs by 8260C	PID=2489			22
23	16				PID=30		SILTY SAND (SM); Slightly moist, gray; fine to medium sand; few fine subround gravel.	23
24		12/20 sand filter pack, 22'-45' bgs			PID=30			24

Legend

Sample Type: ◧ Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-7

Sheet 1 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, between MW-16 and MW-17		*Coordinates* NA	*Exploration Number* **VE-7**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 191
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/28/2019 to 3/1/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
26	18				PID=20		SILTY SAND (SM); Slightly moist, gray; fine to medium sand; few fine subround gravel. (continued)	26
27	19							27
28	20				PID=26		SILTY SAND WITH GRAVEL (SM); Slightly moist, gray; fine to medium sand; fine to course subround gravel.	28
29	21				PID=40			29
30	22	2" diameter 0.020", schedule 40 PVC screen, 25'-45' bgs			PID=75		Gravel content decreases, silt content increases.	30
31	23				PID=59			31
32	24							32
33	25						SANDY SILT WITH GRAVEL (ML); Moist, light brown; low palsticity silt, fine to medium sand; fine to course subround gravel.	33
34	26			A-7- 37.0 VOCs by 8260C	PID=148			34
35	27				PID=14			35
36	28							36
37	29				PID=30		SAND WITH SILT AND GRAVEL (SP-SM); Very moist, brown; fine to medium sand; fine to course subround gravel.	37
38	30				PID=8			38
39	31				PID=2			39
40	32	Threaded PVC endcap					Bottom of exploration at 45 ft. bgs. Note: A-7 was advanced at a 45 degree angle	40
41	33							41
42	34							42
43								43
44								44
45								45
46								46
47								47
48								48
49								49

Legend

Sample Type: ◫ Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-7

Sheet 2 of 2

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, South of MW-18		*Coordinates* NA	*Exploration Number* **VE-8**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 189
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/26/2019 to 2/27/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
							ASPHALT; Asphalt	
							CONCRETE; Concrete	
1	1	No Monument, well completed sub surface for future SVE connection, lockable thermos cap			PID=18		SILTY SAND (SM); Moist, light brown; fine to course sand; few fine to course subround gravel.	1
2								2
3	2				PID=109			3
4					PID=683			4
5	3	Well installed at 45 degree angle						5
6	4				PID=192			6
7	5				PID=402		SILTY SAND WITH GRAVEL (SM); Slightly moist, light brown; fine to medium sand; fine to course subround gravel.	7
8		2" diameter, schedule 40 PVC, threaded connections, 1'-45' bgs			PID=965			8
9	6							9
10	7				PID=651			10
11								11
12	8				PID=440			12
13	9				PID=893		SAND WITH SILT (SP-SM); Moist, light brown; fine to course sand; few fine to course subround gravel.	13
14	10			A-8-14.0 VOCs by 8260C	PID=1508			14
15								15
16	11				PID=414		SAND WITH SILT AND GRAVEL (SW-SM); Moist, gray; fine to course sand; fine to course subround gravel, few cobbles.	16
17	12				PID=228			17
					PID=1277			
18	13							18
19					PID=343		Gravel content increases, no cobbles	19
20	14							20
21	15						SAND (SP); Slightly moist, light gray; fine to medium sand; with silt; few fine subround gravel, and few cobbles.	21
22					PID=25			22
23	16						SAND WITH SILT AND GRAVEL (SP-SM); Slightly moist, gray; fine to medium sand, fine to course subround gravel.	23
24					PID=7			24

Legend

Sample Type: ◫ Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-8

Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, South of MW-18		*Coordinates* NA	*Exploration Number* **VE-8**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 189
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/26/2019 to 2/27/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
26	18				PID=14			26
27	19						Few cobbles.	27
28	20				PID=6		SAND (SP); Moist, gray; fine to medium sand; trace silt; few fine subround gravel.	28
29	21							29
30	22	Bentonite chips, 1'-42' bgs					SILTY SAND (SM); Moist, light brown; fine to medium sand; few fine subround gravel.	30
31	22							31
32	23				PID=16			32
33	23				PID=341			33
34	24			A-8-34.0 VOCs by 8260C	PID=1404			34
35	25						SAND WITH SILT (SP-SM); Moist, light brown; fine to medium sand; trace fine subround gravel.	35
36	26							36
37	26				PID=820			37
38	27				PID=69		SILTY SAND (SM); Moist, light brown; fine to course sand, fine to course subround gravel.	38
39	28							39
40	28							40
41	29							41
42	30				PID=26			42
43	30				PID=36			43
44	31				PID=39			44
45	32	12/20 sand filter pack, 42'-65' bgs					SAND WITH SILT (SP-SM); Slightly moist, light brown; fine to medium sand; few fine subround gravel.	45
46	33						SILTY SAND (SM); Moist, light brown; fine to medium sand.	46
47	33			A-8-47.0 VOCs by 8260C	PID=68			47
48	34				PID=47		SAND WITH SILT (SP-SM); Slightly moist, gray; fine to medium sand; few fine subround gravel.	48
49								49

Legend

Sample Type: ◧ Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-8

Aspect CONSULTING	Morell's Dry Cleaners - 080190		Environmental Exploration Log	
	Project Address & Site Specific Location 608 N 1st Street, Tacoma WA 98403, East of Morell's, South of MW-18		*Coordinates* NA	*Exploration Number* **VE-8**
Contractor Holt	*Equipment* TerraSonic 150 cc	*Sampling Method* Rotary core	*Ground Surface (GS) Elev.* 0' (est)	Ecology Well Tag No. BLI 189
Operator Ben	*Exploration Method(s)* Sonic	*Work Start/Completion Dates* 2/26/2019 to 2/27/2019	*Top of Casing Elev.* NA	*Depth to Water (Below GS)* No Water Encountered

Dist. Along (feet)	Depth (feet bgs)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Dist. Along (ft)
51	36	2" diameter 0.020", schedule 40 PVC screen, 45'-65' bgs			PID=7		SAND (SP); Very moist, red brown; fine to medium sand, trace silt.	51
52	37				PID=12.5			52
53								53
54	38				PID=14			54
55	39							55
56				A-8-56.0 VOCs by 8260C	PID=19			56
57	40							57
58	41				PID=7			58
59								59
60	42							60
61	43							61
62	44				PID=4.5			62
63					PID=3.5			63
64	45				PID=2			64
65	46	Threaded PVC endcap					Bottom of exploration at 65 ft. bgs. Note: A-8 was advanced at a 45 degree angle	65
66	47							66
67								67
68	48							68
69	49							69
70								70
71	50							71
72	51							72
73	52							73
74								74

Legend

Sample Type: Continuous core 7" ID

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: BMG
Approved by: DAH

Exploration Log VE-8

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE \\BISERVER1.ASPECT.LOCAL\PROJECTS\GINTW\PROJECTS\MORELL'S 080190 2019.GPJ July 31, 2019

SUPPLEMENTAL FOCUSED FEASIBILITY STUDY

Morrell's Dry Cleaners Site
608 North First Street, Tacoma, Washington
FS No. 18489568, VCP No. SW1039

Prepared for: Walker Chevrolet

Project No. 080190-004-17 • August 10, 2018 Draft

Aspect CONSULTING

earth + water

SUPPLEMENTAL FOCUSED FEASIBILITY STUDY

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608 North First Street, Tacoma, Washington
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Project No. 080190-004-17 • August 10, 2018 Draft

Aspect Consulting, LLC

PRELIMINARY

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V:\080190 Stadium Thriftway LLC\Deliverables\Morrells Supplemental FFS\August 2018 Draft\Supplemental FFS_Aug 2018 DRAFT.docx

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1 Introduction and Background

This Supplemental Focused Feasibility Study[1] (SFFS) develops and evaluates remedial alternatives for addressing subsurface contamination at the Morrell's Dry Cleaners site (Site). The Site location is shown on Figure 1-1. Site contamination is primarily the result of chlorinated solvent releases from historical dry cleaner operations[2] at 608 North First Street in Tacoma, Washington (Property). The Site includes the Property and any off-Property soil or groundwater confirmed or suspected of being impacted by chlorinated solvent releases at the Property. The Site is enrolled in the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP) and assigned VCP No. SW1039.

This SFFS is intended as a decision-making tool for achieving compliance with environmental cleanup requirements under the Washington State Model Toxics Control Act (MTCA), 70.105D Revised Code of Washington (RCW), and its implementing regulations. While remediation efforts have been ongoing at the Site since 2014, significant contamination remains both on and off the Property. Cleanup of residual on-Property contamination is the focus of this SFFS. Practicable on-Property cleanup alternatives are developed and evaluated with respect to the MTCA criteria for selecting cleanup actions (Washington Administrative Code [WAC] 173-340-360). The cleanup alternatives are intended to address the soil vapor intrusion, soil direct contact, and soil-to-groundwater leaching exposure pathways.

The Property consists of two parcels, referred to in this SFFS as the Building Parcel and the Parking Lot Parcel (Figure 1-2). The chlorinated solvent releases occurred on the Building Parcel. Results of investigation and remediation efforts to date suggest that the magnitude and extent of contamination on the Building Parcel are such that cleanup of the Property will take many years unless the building is first demolished to improve access to underlying contamination and very aggressive (and costly) remedial technologies are applied[3]. Cleanup of the upgradient Parking Lot Parcel is expected to be much more straightforward because soil and groundwater in that parcel are both less contaminated and more accessible for cleanup activities. A cleanup scenario that focusses on the Parking Lot Parcel is considered at the end of this SFFS, separate from the on-Property cleanup alternative evaluation[4].

---

[1] As discussed in this report, a Focused Feasibility Study was conducted for the Morrell's Dry Cleaners site in March 2013 (Aspect, 2013), followed by an interim cleanup action in 2014. The current "supplemental" study considers additional actions needed to address residual contamination.

[2] As discussed in this report, petroleum hydrocarbons are also present in the subsurface, and represent a significant fraction of the total contaminant mass. The source of the petroleum hydrocarbons is unknown. Historical dry-cleaning operations, which may have used petroleum hydrocarbons (e.g., Stoddard solvent) before chlorinated solvents came into use, is a possible source.

[3] The owners of the Property are not in favor of building demolition.

[4] The owners of the Property are interested in selling the Parking Lot Parcel and have requested that this scenario be considered in the SFFS evaluation.

1.1 Recommended On-Property Cleanup Alternative

Six on-Property cleanup alternatives are developed in Section 6, and a disproportionate cost analysis (DCA) is performed in Section 7.3 to quantify each alternative's environmental benefits versus costs. Alternative 2 is recommended for implementation. This alternative would expand the application of soil vapor extraction (SVE) and groundwater biostimulation, remedial technologies already being applied at the Site in an interim cleanup action. Alternative 2 is expected to achieve groundwater cleanup levels in roughly a 10-year time frame. Cleanup levels are likely to be difficult to achieve in shallow soils beneath the Morrell's building. However, with an environmental covenant in place to protect against direct contact and vapor intrusion exposures, the Property would likely be eligible for a Property-Specific No Further Action (NFA) opinion from Ecology.

1.2 Site Description and History

Figure 1-2 is a Site Plan and Table 1-1 provides general Site and parcel information.

Table 1-1. General Site and Parcel Information

Site Name	Morrell's Dry Cleaners
Facility/Site No.	18489568
VCP No.	SW1039
VCP Site Manager	Nick Acklam
Consultant and VCP Customer	Aspect Consulting, LLC Dave Heffner, P.E. 401 2nd Avenue South, Suite 201 Seattle, WA 98104
Site Address	608 North First Street, Tacoma, Washington 98403
Site Coordinates	47.264174ºN, 122.448441ºW
Public Land System Location	T21N, R3E, S32, SW¼ of NE¼
City of Tacoma Zoning	Community Commercial Mixed-Use (CCX)
On-Property Parcels	
Building Parcel Pierce County Parcel No. Address Property Owner Tenant/Business Names	 2030-12-0031 608 North First Street, Tacoma, Washington 98403 Thriftway Properties, LLC Morrell's Dry Cleaners, Tease Chocolates
Parking Lot Parcel Pierce County Parcel No. Address Property Owner Tenant/Business Names	 2030-12-0033 618 North First Street, Tacoma, Washington 98403 Thriftway Properties, LLC Stadium Thriftway parking lot
Off-Property Parcels with Confirmed Impacts from Chlorinated Solvent Releases at the Property	
Pierce County Parcel No. Address Property Owner Tenant/Business Names	2030-12-0012 16 North Tacoma Avenue, Tacoma, Washington 98403 4 the Boys Company, LLC Franco the Tailor (owner), Tully's Coffee, offices

Pierce County Parcel No.	2030-12-0013
Address	2 North Tacoma Avenue, Tacoma, Washington 98403
Property Owner	Stadium, LLC
Tenant/Business Names	Stadium Dental Health Center, retail

The Building Parcel (Parcel No. 2030-12-0031) is approximately 7,930 square feet and contains a single-story, approximately 3,700-square-foot building[5], which is currently occupied by Morrell's Dry Cleaners and Tease Chocolates. The Parking Lot Parcel (Parcel No. 2030-12-0033) is approximately 13,450 square feet and is used primarily by patrons of the south-adjacent grocery store (see next paragraph). The entire Property outside the Morrell's building footprint is paved with asphalt and concrete.

The adjoining property to the south contains an auto body shop and a Thriftway grocery store and was formerly the Walker Chevrolet automobile dealership. The adjoining properties to the northeast contain commercial and office space. The adjacent building is separated from the Morrell's building by an approximately 5-foot-wide paved, gated alley.

According to reverse city directories, dry cleaning operations have been performed continuously on the Property since 1929. Tetrachloroethene (PCE) was used in successive dry-cleaning machines from the beginning of the Morrell's tenancy in 1972[6] until early 2009, when Morrell's purchased the existing dry-cleaning machine, which does not use PCE.

The Property is zoned by the City of Tacoma as Neighborhood Commercial Mixed-Use District (NCX), allowing for a mix of residential, office, retail, and commercial service uses. There are currently no firm plans for redeveloping the Property. For the purposes of this SFFS, it is assumed that future land use will conform to the existing zoning.

1.3 Summary of Site Characterization and Remedy Selection Reports

This section briefly summarizes the Site characterization and remedy selection reports that have been submitted to Ecology under the VCP. Site characterization information is summarized in tables, figures, and appendices as follows:

- Figure 1-2 shows pre-2013 soil and groundwater sampling locations.
- Table 1-2 shows soil sample results for the volatile organic compounds (VOCs) PCE, trichloroethene (TCE), and naphthalene. These analytes were detected in at least one soil sample at concentrations exceeding their respective screening levels[7]. These data were collected prior to the 2014 cleanup action (as described in Section 4).

[5] As shown on Figure 1-2, the extreme northern portion of the building extends onto off-property Parcel 2030-12-0012.
[6] PCE was likely used for dry cleaning at the Site prior to 1972 as well, but records are not available.
[7] Refer to Section 3.2.3 for discussion of soil screening levels and other analytes detected in soil.

- Tables 1-3 through 1-5 show the following groundwater sample results:
    - Table 1-3 – bromodichloromethane, PCE, TCE, and vinyl chloride in reconnaissance groundwater samples;
    - Table 1-4 – carbon tetrachloride, PCE, TCE, cis-1,2-dichloroethene (cDCE), 1,1- dichloroethene, and vinyl chloride in groundwater samples from monitoring wells screened in advance outwash; and
    - Table 1-5 – PCE and cDCE in groundwater samples from monitoring wells screened in Olympia bed interglacial deposits.

  Similar to the soil results in Table 1-2, the analytes listed in these three tables exhibit one or more screening level exceedances[8].
- Table 1-6 shows sub-slab vapor sampling results prior to and during soil vapor extraction (SVE) operations[9], and compares them with the most stringent MTCA Method B sub-slab soil gas cleanup levels. All analytes detected in at least one sample are included in this table.
- Table 1-7 shows indoor air sampling results prior to SVE operations and compares them with the most stringent MTCA Method B indoor air cleanup levels. All analytes detected in at least one sample are included in this table.
- Figure 1-3 shows PCE results for a GORE® survey conducted beneath the dry cleaner building and building perimeter in 2010.
- Figure 2-1 provides two Site cross sections (A-A' and B-B'). The cross-section locations are shown on Figure 1-2.
- Figure 2-2 shows groundwater elevations measured on December 22, 2010, in monitoring wells screened in the advance outwash, along with estimated elevation contours.
- Boring and monitoring well construction logs are provided in Appendix A.
- Time-series graphs for PCE, TCE, cDCE, and vinyl chloride in monitoring wells are provided in Appendix B.

1.3.1 2009 Site Conditions Summary

The "Site Conditions Summary" (Aspect, 2009) documents due-diligence investigation results performed by Stemen Environmental, Inc. (Stemen) between 2006 and 2008, and follow-up investigations by Aspect in 2009, at the Morrell's Dry Cleaners and adjacent Walker Chevrolet sites. Investigation activities included: construction of 11 monitoring wells (MW-2 through MW-11 and deep well MW-8D); sampling of soil, groundwater, soil gas, and indoor air; and a camera survey of the sewer lines beneath and adjacent to the Morrell's building. Water was encountered beneath the building foundation, and an analysis of the water bill of Tully's Coffee (located across the alley to the north)

[8] Refer to Section 3.1.3 for discussion of groundwater screening levels and other analytes detected in groundwater.
[9] SVE operations are discussed in Section 4.

indicated that an estimated 600,000 gallons of drinking water had been released between May 2006 and September 2007.

The Site Conditions Summary describes the geologic and hydrogeologic setting, develops a preliminary conceptual site model, and provides baseline groundwater sampling for the Morrell's Dry Cleaners and Walker Chevrolet sites.

1.3.2 2011 Remedial Investigation Report

The "Remedial Investigation Report" (Aspect, 2011; referred to herein as the RI Report) describes the historical uses, environmental setting, and environmental investigations for the Morrell's Dry Cleaners and Walker Chevrolet sites. The remedial investigations (RI) documents the following investigation activities:

- A Gore-Sorber survey in January and February 2010 to evaluate the extent of volatile organic compounds (VOCs) beneath and in the immediate vicinity of the Morrell's building.
- Sampling in October 2010 of seven direct-push soil borings at locations inside the Morrell's building, in the alley north of the building, and on the sidewalk east of the building.
- Construction and sampling in October 2010 of deep monitoring wells MW-12D and MW-13D within the interglacial deposits along Tacoma Avenue north of the Morrell's building.

The RI described the preliminary conceptual site model and provided sufficient investigative data to proceed with a feasibility study (FS).

1.3.3 2011 Ecology Review Comments on the Remedial Investigation

Ecology's review comments on the RI (Ecology, 2011) stated that the perched groundwater in the advance outwash was adequately delineated but requested additional delineation of the deeper groundwater within the interglacial deposits. Ecology also recommended performing a Tier II indoor air sampling assessment in and adjacent to the Morrell's building.

1.3.4 2012 Data Gaps Investigation

The "Data Gaps Investigation Report" (Aspect, 2012) was prepared to address Ecology's RI review comments. The data gaps investigation included:

- Construction of deep monitoring well MW-14D in the right-of-way (ROW) adjacent to the west side of the Morrell's building.
- Sampling of eight direct-push soil borings on the south and east sides of the Morrell's building and in the parking lot.
- Sampling of groundwater, indoor air, and soil gas in the alley along the north side of the building.

1.3.5 2013 Focused Feasibility Study

Separate FFS reports were prepared for the Morrell's Dry Cleaners and Walker Chevrolet sites. The Morrell's Dry Cleaners FFS (Aspect, 2013) developed cleanup action objectives, and developed and evaluated cleanup alternatives in accordance with MTCA criteria in WAC 173-340-360. The FFS identified sub-slab depressurization, SVE, and biostimulation as viable cleanup technologies that could be implemented under the current Site use. SVE was recommended to remove chlorinated VOC from beneath the foundation and the glacial till and advance outwash sand beneath the building, using perimeter SVE trenches and peripheral SVE wells that extend beneath the building. Biostimulation was recommended to enhance the natural reductive dechlorination of PCE in groundwater. The preferred remedy identified by the FFS was implemented as an interim action in 2014; refer to Section 4.

2 Environmental Setting

2.1 Topography and Surface Cover

The Site is located in the Stadium District of Tacoma between Wright Park and Commencement Bay. The Stadium District is located above an escarpment that descends to Commencement Bay. The Morrell's Dry Cleaners parking lot is about Elevation 278 feet (NAVD88) and the top of the escarpment is about Elevation 240 feet. The top of the escarpment is about 500 feet northwest and northeast from the Site boundary. The bottom of the escarpment is about Elevation 20 feet at Schuster Parkway, which extends along Commencement Bay. The lateral distance from the top to the bottom of the escarpment is about 400 feet, thus the escarpment has an approximate 55 percent grade.

Wright Park is a 32-acre park with pervious cover that is located south of the Site (Figure 1-1). A surface water pond in Wright Park is located about 900 feet from the Site boundary, and the pond is elevated above the Site. Commencement Bay, which is 1,200 feet from the Site boundary, is the closest surface water body downslope and hydraulically downgradient from the Site.

Stadium District is predominantly covered with impervious surfaces and the Site and surrounding properties (except Wright Park) are entirely covered with impervious surfaces.

2.2 Hydrogeologic Conditions

Figure 2-1 provides hydrogeologic cross sections beneath the Site (see Figure 1-2 for cross-section locations). Site soils consist of approximately 35 feet of silty sand and gravel, interpreted as ice-contact deposits (Qvi) and glacial till (Qvt), overlying approximately 30 feet of sand, interpreted as advance outwash (Qva). Underlying the outwash sand is a sequence consisting primarily of silt and silty sand, with a limited thickness of interbedded slightly silty sand, which is interpreted as Olympia bed interglacial deposits (Qob). This sequence of silt, silty sand, and sand extends to at least 146 feet below ground surface (bgs), the maximum depth drilled on the Site. This same sequence was recorded on the Tacoma General Hospital well logs, which extend to 275 feet bgs. The Tacoma General Hospital wells intersect a water bearing sandy gravel interval between 255 and 275 feet bgs (Elevation 25 to 45 feet).

The advance outwash is the uppermost groundwater-bearing unit at the Site, and the base of the outwash ranged from about 63 to 74 feet bgs in the Site boring logs. The depth to groundwater is about 52 feet bgs beneath the Morrell's Dry Cleaners parking lot. Monitoring wells MW-1 to MW-11 and biostimulation wells MW-15 to MW-21 are completed in the advance outwash. The five advance outwash wells constructed along Tacoma Avenue North and North First Street (i.e., MW-3, MW-4, MW-6, MW-9, and MW-10) did not yield water over multiple years of monitoring, and these dry wells were subsequently decommissioned. On this basis, the upper water bearing unit is estimated to terminate along the approximate boundary shown on Figure 2-2.

Borings for MW-3, MW-5, MW-8D, MW-10, MW-11, and MW-12D to MW-14D penetrated through the advance outwash into the Olympia bed interglacial deposits, which are characterized as a leaky lower-confining unit with discontinuous, low-yield sandy intervals. Deeper water-bearing zones were encountered within thin sandy intervals of the Olympia bed interglacial deposits. Wells MW-8D and MW-12D to MW-14D, completed in the interglacial deposits, yield limited quantities of groundwater during sample collection, and would not be capable of providing a sustainable yield of 0.5 gallons per minute. The intersected water bearing units are under unconfined conditions, and water column heights in the 20-foot screened intervals ranged from 2 to 9.5 feet of water. The discontinuous, low-yield, water-bearing units in the Olympia bed interglacial deposits likely contain nonpotable groundwater based on low yield (WAC 173-340-720(2)(b)(i)), and unlikely interconnection with potential future sources of drinking water (WAC 173-340-720(2)(c)). Impacted groundwater within the interglacial deposits would be unlikely to reach surface water, which is about 140 feet beneath and 1,200 feet lateral from the Site boundary.

Figure 2-2 shows contoured groundwater elevations in the advance outwash in December 2010. Groundwater elevations observed in the advance outwash combined with the understanding of hydrogeologic conditions are consistent with a conceptual model of:

- Recharge is derived primarily from precipitation and irrigation at Wright Park.
- Recharge infiltrates downward to the advance outwash where it perches on the underlying leaky confining unit formed by the Olympia beds.
- The perched groundwater in the advance outwash migrates laterally from Wright Park across the Site to the north and west.
- Perched groundwater concurrently leaks downward through the Olympia beds, fully infiltrating and leaving the advance outwash dry to the northwest and northeast of the Site.

3 Cleanup Requirements

This SFFS is developed to evaluate cleanup alternatives to address the release of contamination from the soil and upper water bearing unit, and to mitigate and/or control on-Property exposure pathways.

3.1 Groundwater Cleanup

3.1.1 Groundwater Exposure Pathways

Potential groundwater exposure pathways and receptors include:

- Humans who drink contaminated groundwater in the future, if groundwater is brought to the surface for this purpose.
- Humans in buildings inhaling indoor air contaminated—via vapor intrusion—by volatilization from impacted groundwater.
- Direct exposure for aquatic ecological receptors in Commencement Bay, if contaminants in groundwater discharge to surface water.
- Humans consuming aquatic ecological receptors contaminated by discharges to surface water.

Based on the perched nature and limited lateral extent of the upper water-bearing unit; the more than two orders of magnitude decrease in PCE concentrations between the upper water-bearing unit and the deeper, downgradient water-bearing unit; the 1,200-foot distance from the Property to surface water of Commencement Bay; and the apparent biodegradation of chlorinated VOCs, it is unlikely that contaminants in groundwater from the upper water-bearing unit are discharging to surface water. As a result, the human consumption and direct exposure for aquatic ecological receptor pathways are not complete at this Site.

Volatile contaminants that have been detected in indoor air (Table 1-7) are assumed to originate from contaminated soils and/or from the building itself, not from contaminated groundwater. Since the depth to groundwater is relatively large (greater than 50 feet bgs), dissolved petroleum hydrocarbons such as benzene are not a vapor intrusion concern per Ecology guidance[10]. However, the potential for vapor intrusion impacts by chlorinated VOCs that may volatilize from groundwater cannot be ruled out based on Ecology guidance[11].

Advance outwash groundwater is not currently used as a drinking water source. Based on the limited saturated thickness and lateral extent of this unit, it is unlikely to be used for drinking water purposes in the future. However, potential migration of contaminated

[10] *Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion* (Ecology, 2016b) discusses vertical screening distances for buildings in determining whether the initial VI assessment process is complete.

[11] Chapter 2 of *Guidance for Evaluating Soil Vapor Intrusion in Washington State* (Ecology, 2016a) discusses the "100-foot rule" as a guideline for determining whether the vapor intrusion pathway must be considered for contaminants other than petroleum hydrocarbons.

water from the advance outwash to deeper units that could support future drinking water use cannot be ruled out and the human drinking water pathway could potentially be complete in the future.

3.1.2 Groundwater Points of Compliance

The groundwater point of compliance is established throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest depth that could potentially be affected by the Site.

3.1.3 Groundwater Constituents of Concern and Proposed Cleanup Levels

The constituents of concern (COCs) in groundwater include the chlorinated VOCs carbon tetrachloride, PCE, TCE, cDCE, 1,1-dichloroethene, and vinyl chloride. The proposed cleanup levels are the more stringent of the MTCA Method A groundwater cleanup levels and the maximum contaminant levels (MCLs). The proposed cleanup levels are defined in Table 3-1.

Table 3-1. Proposed Groundwater Cleanup Levels

	MTCA Method A (µg/L)	MCL (µg/L)	Proposed Cleanup Level (µg/L)
Carbon Tetrachloride	-	5	5
PCE	5	5	5
TCE	5	5	5
cDCE	-	70	70
1-1-Dichloroethene	-	7	7
Vinyl Chloride	0.2	2	0.2

As shown in Table 1-3, bromodichloromethane was detected above its screening level in three reconnaissance groundwater samples collected in 2006/2007 during the Tully's drinking water leak. Bromodichloromethane is a byproduct of drinking water disinfection, and its presence in these samples is attributable to the water leak. Therefore, bromodichloromethane is not identified as a COC.

Other analytes detected in groundwater samples at concentrations below screening levels include the following:

- Chloroform (detected below 80 µg/L screening level)
- Trans-1,2-dichloroethene (tDCE; detected below 100 µg/L screening level)
- Benzene (detected below 5 µg/L screening level)
- Naphthalene (detected below 160 µg/L screening level)
- Lead (detected below 15 µg/L screening level)

3.2 Soil Cleanup

3.2.1 Soil Exposure Pathways

Potential exposure pathways and receptors include:

- Workers contacting contaminated soils in the future (skin contact or incidental ingestion) during excavation or other construction-related activities, if no worker protection controls are in place.
- Humans in buildings inhaling indoor air contaminated—via vapor intrusion—by volatilization from impacted soils.
- Leaching of soil contamination to the upper water-bearing unit from surface infiltration, condensate, and plumbing leaks.
- Terrestrial ecological receptors contacting contaminated soils in the future, if no controls are in place.

Areas of the Property with COCs in soil are paved with asphalt or covered with buildings, limiting the potential for the human or ecological receptor direct contact pathways under current conditions. Any future construction activities in these areas that disturb the overlying pavement could result in completion of the human direct contact pathway, but this could be effectively managed with appropriate soil-handling protocols. Soil vapor and indoor air monitoring results indicate that the vapor intrusion pathway may currently be complete at the Morrell's building, although the measured concentrations of chlorinated solvents in indoor air may be attributed to an operating dry cleaner with a long history of chlorinated solvent usage.

3.2.2 Soil Points of Compliance

The point of compliance for the direct contact and ingestion exposure pathways extends from the ground surface to a depth of 15 feet bgs. The point of compliance for the leaching exposure pathway extends from the ground surface to the groundwater table (at approximately 53 feet bgs). The point of compliance for the indoor air exposure pathway is all occupied spaces within the building.

3.2.3 Soil Constituents of Concern and Proposed Cleanup Levels

The COCs in soil include the chlorinated VOCs PCE, TCE, and vinyl chloride, and the petroleum hydrocarbons benzene, total xylenes, and naphthalene. PCE and TCE were detected above screening levels in soil, sub-slab vapor, and indoor air samples. Naphthalene was detected above its screening level in soil and sub-slab vapor. Benzene and total xylenes were detected above screening levels in sub-slab vapor and indoor air. Vinyl chloride was detected above its screening level in sub-slab vapor.

The proposed cleanup levels for soil are the same as the screening levels: MTCA Method A cleanup levels for unrestricted land use. The proposed cleanup levels for indoor air are the MTCA Method B indoor air cleanup levels (most stringent of cancer and noncancer

values) adjusted for commercial use[12]. Table 3-2 provides the proposed soil and indoor air cleanup levels.

Table 3-2. Proposed Soil and Indoor Air Cleanup Levels

	Proposed Soil Cleanup Level (mg/kg)	Proposed Indoor Air Cleanup Level (µg/m^3)
PCE	0.05	40.4
TCE	0.03	1.6
Vinyl Chloride	-	1.2
Benzene	0.03	1.35
Total Xylenes	9	192
Naphthalene	5	0.309

Although cDCE and tDCE were detected in soil gas, and cDCE was detected in soil and indoor air, these bioattenuation daughter products of PCE are not indicator hazardous substances in soil (WAC 173-340-703) and are not retained as COCs in soil or indoor air. In all samples with cDCE and tDCE detections, PCE is also detected, typically at a much higher concentration. Their overall threat to human health and the environment is much lower than that of PCE, and remedial actions that address PCE-contaminated soil would also address cDCE and tDCE. Furthermore, Ecology has not established indoor air cleanup levels for cDCE and tDCE.

Chloroform and acrolein were detected above their sub-slab soil gas screening levels in a single sample collected beneath the Morrell's building (the sample collected from VP-4 on 9/7/16; refer to Table 1-6). Chloroform is sometimes found at low concentrations in drinking water as a byproduct of the chlorination process. Acrolein is a simple unsaturated aldehyde that is used as a contact herbicide to control submersed and floating weeds and algae in irrigation canals. Since these compounds are not associated with dry cleaning operations and are not commonly encountered as soil contaminants in urban settings, they are not considered COCs.

Toluene and ethylbenzene were detected in soil gas and indoor air, but only at concentrations below their respective screening levels. Other petroleum hydrocarbons were also detected soil and soil gas, and other VOCs were detected in soil gas (Table 1-6), but in all cases either concentrations were below screening levels or soil and indoor air cleanup levels have not been established for those compounds.

[12] Section 6.6.2 of Ecology's draft *Guidance for Evaluating Soil Vapor Intrusion* (Ecology, 2016a) provides for adjustment of Method B values where the building of concern is being used commercially. Based on a commercial exposure of 40 hours per week rather than continuous exposure (168 hours per week), the table values were increased by a factor of 4.2.

4 2014 Interim Cleanup Action

A cleanup interim action (IA) was performed in 2014 to implement the preferred remedy identified by the FFS (Aspect, 2013). Remedial objectives included reducing risks for the indoor air, soil, and groundwater exposure pathways. It was not anticipated that the 2014 IA would achieve MTCA Method A soil and groundwater cleanup levels. It was assumed that Site closure would not be approved by Ecology until contaminant concentrations meet cleanup levels throughout the Site, or if conditional points of compliance are approved at the Property boundary.

4.1 Design and Construction of Biostimulation and SVE Facilities

The Construction and Design Report (Aspect, 2014a) documents design and construction of biostimulation and SVE facilities for the IA. The SVE system is designed to remove VOC contaminant mass from beneath the Morrell's building and to control the migration of soil vapor. A 48-foot-long SVE trench (VE-H) was constructed in the alley on the north side of the Morrell's building, and a sub-slab suction pit (VE-SS) was constructed inside the building. Four angled SVE wells were constructed beneath the building (VE-1 through VE-4). VE-1 and VE-2 are completed in the glacial till, with screen intervals of 18 to 32 feet bgs. VE-3 and VE-4 are completed in the advance outwash, with screen intervals of 30 to 45 feet bgs. The above-ground portion of the SVE system includes a 2-horsepower single-phase regenerative blower, a 55-gallon moisture separator with automatic water transfer pump, and two 55-gallon vapor-phase granular activated carbon (GAC) drums connected in series.

Seven new biostimulation wells were constructed: four angled wells beneath the alley and Morrell's building (MW-15 to MW-18); two vertical wells on the south side of the building (MW-19 and MW-20); and one vertical well at the northeast corner of the building (MW-21). Refer to Figure 4-1 for SVE and biostimulation component locations. Boring and well construction logs are provided in Appendix A.

4.2 Biostimulant Injection and SVE System Startup

The Construction Completion Report (Aspect, 2014b) documents implementation of biostimulation and SVE as components of the IA. In June 2014, biostimulants were pumped into impacted wells in the advance outwash to optimize *in situ* treatment, including angled wells MW-15 through MW-18 and vertical wells MW-2, MW-8, MW-19, MW-20, and MW-21. Approximately 550 gallons of a dilute mixture of 3D-Microemulsion (3DMe® Factory Emulsified) and Hydrogen Release Compound (HRC Primer®) were pumped into each of the nine wells. 3DMe® is a blend of lactate, polylactate esters, and free fatty acids and fatty acid esters that were diluted at the Site and injected as a high-volume emulsion. According to manufacturer literature, 3DMe® provides variable release rates of electron donors to biostimulate groundwater for periods of up to 3 years. HRC Primer® was added to the 3DMe® emulsion to quickly improve the reducing conditions for the reductive dechlorination of chlorinated VOCs.

Continuous SVE operations were initiated in October 2014. An additional VE-SS was constructed and connected to the SVE system in November 2014 to enhance sub-slab depressurization coverage beneath the Morrell's building[13].

4.3 Biostimulation Performance Summary

Six rounds of post-injection groundwater monitoring were conducted between January 2015 and January 2017. Tables 1-4 and 1-5 show groundwater sampling results for monitoring wells screened in the advance outwash and the Olympia bed interglacial deposits, respectively, and time-series graphs are provided in Appendix B. Biostimulation successfully reduced the concentrations of PCE in groundwater by up to two orders of magnitude, but PCE remained at concentrations up to four times the cleanup level in January 2017. TCE concentrations also decreased significantly but remained above the cleanup level. Biostimulation significantly reduced the total molar concentrations of COCs. Biodegradation products, including cDCE and vinyl chloride, were generated through PCE and TCE degradation. The concentrations of cDCE and vinyl chloride remain above cleanup levels but are expected to decline once biostimulant activity runs its course and PCE and TCE biodegradation diminishes.

4.4 SVE Performance Summary

The SVE system has continued to operate since startup in October 2014. During O&M site visits, a photo-ionization detector (PID) is used to measure total VOC concentration and an anemometer is used to measure gas flow rate at various points in the SVE system. Based on these measurements, contaminant mass is primarily removed from the four SVE wells; mass removal from the SVE trench and sub-slab suction pit is negligible. However, continued operation of the sub-slab suction pit is necessary to maintain a negative differential pressure across the floor slab, which ensures that soil vapor intrusion into the Morrell's building is not a concern.

Summa canister samples were also collected periodically and submitted for laboratory analysis. All samples were analyzed for individual VOCs by EPA Method TO-15. Selected samples were also analyzed for aliphatic and aromatic petroleum hydrocarbons in three carbon ranges (by Method MA-APH). Sampling results from the following SVE system locations are summarized in Table 4-1[14]:

- The "VE-1/2 Leg" of the system, which includes soil gas extracted from SVE wells VE-1 and VE-2 completed in the glacial till;
- The "VE-3/4 Leg" of the system, which includes soil gas extracted from SVE wells VE-3 and VE-4 completed in the advance outwash;
- The sub-slab suction pit (VE-SS); and
- The combined flow prior to treatment in the GAC vessels.

[13] Refer to Appendix C for sub-slab depressurization performance monitoring.
[14] Refer to Appendix C for more comprehensive gas sampling results.

Mass removal of petroleum hydrocarbons by the SVE system is comparable to mass removal of chlorinated VOCs. This is evident from analysis of the combined flow (GAC influent) sample collected on July 5, 2018, in which the sum of [PCE], [TCE], and [DCE] is about 11,000 µg/m^3 and the sum of aliphatic hydrocarbons in the C5 to C12 range is 12,000 µg/m^3. Chlorinated VOCs are primarily coming from the mid-depth soils beneath the building (via angled wells VE-1 and VE-2 screened at 18 to 32 feet bgs), whereas petroleum hydrocarbons are primarily coming from deeper soils (via angled wells VE-3 and VE-4 screened at 30 to 45 feet bgs). The source of the deep petroleum hydrocarbon contamination is not known. One possible source is historical dry-cleaning operations, which may have used petroleum hydrocarbons (e.g., Stoddard solvent) before chlorinated solvents came into use.

PCE concentration is correlated to the total VOC concentration measured by PID using the average of the [PCE]/[VOC] ratios measured on the seven occasions when GAC influent samples were collected for laboratory analysis (refer to Table 4-1). The resulting correlation factor of 0.29 is used to estimate PCE mass removal based on PID readings. On this basis, the SVE system has removed an estimated 271 pounds (lbs) of PCE from the subsurface through June 2018. An average PCE removal rate of 0.633 lbs/day is estimated for the first 3 months of SVE system operation (mid-October through mid-December 2014), versus 0.103 lbs/day estimated for the second quarter of 2018.

5 On-Property Cleanup Level Exceedances

On-Property media with COC concentrations in excess of proposed cleanup levels include vadose zone soils (i.e., soils above the advance outwash groundwater), groundwater in the advance outwash, and deeper groundwater. (Refer to the Figure 2-1 cross sections.) As noted above, PCE is the primary COC, and PCE concentrations define the extent of cleanup level exceedances in both soil and groundwater[15].

5.1 Vadose Zone Soils

Vadose zone soils extend from ground surface to the advance outwash water table at approximately 53 feet bgs. Soil sample depths and sampling results are provided in Table 1-2, sample locations are shown on Figures 1-2 and 5-1, and boring logs are provided in Appendix A. Most of the soil samples have been collected from depths of less than 9 feet bgs. The highest PCE detection among these relatively shallow samples was 36 mg/kg (2.5 feet bgs at DP-7), but most PCE detections were less than 3 mg/kg.

MW-21 is the only on-Property location where deeper soil contamination has been investigated. Five depth-discrete samples collected from the MW-21 boring were submitted for laboratory analysis. As shown in Table 1-2, PCE concentrations varied widely with depth, from below the detection limit at 25 and 40 feet bgs to 44 mg/kg (the highest site-wide detection in soil to date) at 15.5 feet bgs.

Other evidence of deeper on-Property vadose zone soil contamination includes the following:

- **SVE system gas sampling results (Table 4-1).** After nearly four years of SVE system operation, elevated concentrations of PCE and other chlorinated VOCs are detected in soil gas extracted from 18 to 32 feet bgs, and elevated concentrations of both chlorinated VOCs and petroleum hydrocarbons are detected in soil gas extracted from 30 to 45 feet bgs. The SVE system continues to remove contaminant mass (both chlorinated VOCs and petroleum hydrocarbons) at significant rates, in spite of the fact that the tight soils are not particularly well-suited to SVE.
- **Boring logs.** The boring logs for SVE wells VE-1 through VE-4 all contain the description "strong solvent-like odor in cuttings." The boring log for well MW-15 contains the description "strong solvent-like odor in cuttings" at about the 19-foot depth, and a PID reading of 37 parts per million (ppm) at about the 24-foot depth[16]. The boring log for well MW-19 has three separate description entries of "solvent odor" in the 0- to 35-foot depth range, and a description entry of "slight solvent odor" below the 35-foot depth.

Figure 5-1 shows the estimated areal extent of on-Property cleanup level exceedances in vadose zone soils based on soil sampling results and the other evidence described above. Based on depth-discrete sampling at MW-21 it is clear that cleanup level exceedances do not extend from ground surface to the advance outwash water table at all locations within

[15] Except for deeper groundwater; refer to the Section 5.3 discussion below.
[16] Note that, since MW-15 is an angled well, the "depth" column on the left side of the boring log in Appendix A is actually "distance down the hole."

this area. However, there is currently insufficient soil data to attempt to interpret lateral migration of contaminants in vadose zone soils from the source area beneath the Morrell's building.

5.2 Advance Outwash Groundwater

Table 1-4 provides groundwater sampling results for monitoring wells screened in the advance outwash, and Figure 5-1 shows well locations. As indicated in the table, biostimulants were injected into all of the wells except MW-5 and MW-7 in June 2014. The most recent groundwater sampling round was conducted in January 2017, 2.6 years after the injection event. Interpretation of current "ambient" concentrations in advance outwash groundwater is difficult, since: a) the manufacturer claims that the biostimulant remains active for "up to 3 years" after injection; and b) we do not know how far the effects of the biostimulant injection extended radially outward from the injection wells (i.e., the biostimulant radius of influence). However, current PCE concentrations in the bulk aquifer (i.e., away from the biostimulated wells) are likely higher than PCE concentrations detected in samples collected from the biostimulated wells in January 2017.

Figure 5-1 shows the estimated areal extent of on-Property cleanup level exceedances in advance outwash groundwater. Its northern and western boundaries correspond to the Property boundaries. The estimated curved boundary to the south and east is based primarily on PCE concentrations detected in wells MW-5[17], MW-7, and MW-8[18].

5.3 Deeper Groundwater

Borings for MW-3, MW-5, MW-8D, MW-10, MW-11, MW-12D, MW-13D, and MW-14D penetrated through the advance outwash into the underlying interglacial deposits. Figure 1-2 shows the boring locations, and boring logs are provided in Appendix A. The base of the advance outwash ranges from approximately 63 to 74 feet bgs in these borings, and was dry in MW-10, MW-12D, and MW-13D along Tacoma Avenue.

The underlying Olympia bed interglacial deposits are characterized as a leaky confining unit with discontinuous, low-yield sandy intervals. Water-bearing zones were encountered in on-Property boring MW-8D and off-Property borings MW-12D, MW-13D, and MW-14D, which were completed as deeper groundwater monitoring wells. Table 1-5 summarizes sampling results for these wells, and Figure 2-1 shows wells MW-8D, MW-12D, and MW-14D in cross section.

On-Property well MW-8D is screened at 96 to 106 feet bgs. PCE, TCE, and vinyl chloride have never been detected in this well in the nine sampling events conducted between May 2009 and January 2017. The cDCE concentration has steadily increased

[17] PCE concentrations in MW-5 appear to be naturally attenuating over time, such that the current concentration may be very close to the groundwater cleanup level.

[18] As noted in Table 1-3, an estimated 600,000 gallons of drinking water was released between May 2006 and September 2007 (per analysis of water bills) by Tully's Coffee, which occupied the retail space at the southeast corner of Tacoma Avenue and North First Street. This release likely contributed to the apparent upgradient migration of advance outwash groundwater contamination.

over this period, and it slightly exceeded the cDCE cleanup level for the first time in the most recent sample. The presence of cDCE is likely the result of reductive dichlorination of PCE. It is notable that there was already a clear trend of increasing cDCE concentration at MW-8D before the June 2014 biostimulant injection event.

cDCE has also been detected in the three off-Property wells screened in the Olympia bed interglacial deposits, but only at concentrations below the cDCE cleanup level. Low concentrations of PCE and TCE have also been detected in those wells, with PCE concentrations exceeding the PCE cleanup level on several occasions (once in MW-12D, three times in MW-13D, and twice in MW-14D).

Due to insufficient data, the areal extent of on-Property cleanup level exceedances in deeper groundwater cannot be estimated.

6 Development of On-Property Remedial Alternatives

Several practical on-Property remedial alternatives are selected and described in this section. The remedial alternatives are then evaluated (in Section 7) and a "preferred" alternative is identified.

6.1 Remedial Action Goals

The goals of on-Property remediation include goals associated with contamination reduction and protection of human health, as well as a property reuse goal. Remedial action goals associated with contamination reduction and protection of human health include the following:

- Reduce contaminant concentrations in on-Property soil and groundwater to achieve cleanup levels.
- Prevent human exposure to contaminated on-property soil and groundwater.
- While near-surface soil concentrations remain elevated, prevent soil vapor intrusion into the building.
- Minimize off-Property migration of contaminated groundwater.

The Property reuse goal is to obtain an unencumbered[19] Property-Specific No Further Action (NFA) opinion letter from Ecology. The NFA opinion letter would preferably encompass the two tax parcels included in the Property. However, as is evident on Figure 5-1, the extent of contamination is much greater on the Building Parcel than it is on the Parking Lot Parcel. Therefore, an alternate goal with respect to property reuse is to obtain an unencumbered NFA opinion letter for the Parking Lot Parcel only. The remedial alternatives described in this section address the entire Property. A cleanup action that focuses on the Parking Lot Parcel is discussed in Section 8.

6.2 Assumptions in Developing Remedial Alternatives

The following assumptions were made in developing on-Property remedial alternatives:

- Figure 5-1 provides a reasonably accurate depiction of the areal extent of on-Property cleanup level exceedances in advance outwash groundwater and vadose zone soils.
- Alternatives will not include active remediation of deeper groundwater (i.e., it is assumed that cleanup of shallower contamination will result in natural attenuation of deeper groundwater contamination).

[19] An "unencumbered" NFA opinion letter is one that does not encumber the Property with restrictions, prohibitions, or institutional control requirements addressing residual contamination.

6.3 Selection and Description of Remedial Alternatives

The following remedial alternatives were selected for evaluation in this SFFS:

- **Alternative 1** – Long-Term Controls and Environmental Covenant
- **Alternative 2** – Expanded SVE of Accessible On-Property Soil Contamination, and Biostimulation of Advance Outwash Groundwater
- **Alternative 3** – Electrical resistance heating (ERH) and SVE of Accessible On-Property Soil Contamination, and Biostimulation/HEPA of Advance Outwash Groundwater
- **Alternative 4** – ERH of Accessible On-Property Contaminated Soil and Advance Outwash Groundwater
- **Alternative 5** – Comprehensive ERH of On-Property Contaminated Soil and Advance Outwash Groundwater Following Building Demolition
- **Alternative 6** – Removal of On-Property Contaminated Soil to 15-Foot Depth Following Building Demolition, and ERH of Deeper On-Property Contaminated Soil and Advance Outwash Groundwater

An important distinction among the alternatives is that Alternatives 5 and 6 assume that the Morrell's building will be demolished to improve access to underlying contaminated media, whereas the earlier alternatives assume that the building will remain in place. The Property owners are not in favor of building demolition.

Each alternative is described, and conceptual design criteria and assumptions are briefly discussed. This provides the basis for estimating the cost of each alternative. The estimates are present value costs using a discount factor of 0.7 percent[20]. They have an intended accuracy in the range of -30 to +50 percent.

The elements that make up the remedial alternatives and the estimated cost of each alternative are summarized in Table 6-1. Itemized cost estimates for each alternative are provided in Appendix D.

6.3.1 Alternative 1 – Long-Term Controls and Environmental Covenant

Alternative 1 includes the following:

- Designating existing building and pavement as a cap that prevents direct contact exposure to underlying contaminated soil. A plan would be developed addressing periodic inspection and maintenance of the cap and specifying requirements to ensure worker protection during intrusive activities, such as utility installation and repair.

- Long-term operation of radon fans and/or the existing SVE system to prevent soil vapor intrusion into the building. A plan would be developed addressing periodic

[20] Discount factor based on real interest rate on US Treasury 30-year notes and bonds, Circular A-94 Appendix C, Office of Management and Budget (Revised November 2016).

monitoring and maintenance of the vapor intrusion measures, and termination after it is demonstrated that they are no longer necessary. The plan would also specify contingency measures to be considered in the event that monitoring indicates potential vapor intrusion concerns.

- Designating conditional points of compliance (CPOCs) in deep groundwater wells for the vertically discharging chlorinated-VOC-contaminated groundwater plume. The CPOCs would be permitted wells in the City of Tacoma ROW. A groundwater monitoring plan would be developed that includes contingency actions to be considered in the event that periodic monitoring indicates a potential cleanup level exceedance at a CPOC. On-property wells would also be included in the monitoring program, to track contaminant attenuation over time.

- Developing and recording an environmental covenant that incorporates the above requirements. The adjacent property owners would be requested to sign a subordination agreement, which would allow the covenant to encompass the Site properties. The City of Tacoma would abide by a memorandum of agreement or memorandum of understanding.

For cost-estimating purposes it is assumed that the existing SVE system operates for one more year, after which it is decommissioned, and radon fans are installed to provide continued vapor intrusion mitigation via sub-slab depressurization. Other than vapor intrusion protection measures that coincidentally remove contaminant mass from the subsurface, as well as any contingency actions that may become necessary, Alternative 1 does not include any active remediation after the existing SVE system is shut down. Contaminant concentrations in soil and groundwater would be expected to decrease over time via natural attenuation, but only at a very slow rate.

Cap inspection and maintenance, vapor intrusion mitigation and monitoring, and groundwater monitoring would be required indefinitely (30 years assumed for cost estimating purposes, in accordance with U.S. Environmental Protection Agency [EPA] guidance [EPA, 1988]).

The estimated present value cost of Alternative 1 is $600,000.

6.3.2 Alternative 2 – Expanded SVE of Accessible On-Property Soil Contamination, and Biostimulation of Advance Outwash Groundwater

As discussed in Section 4.4, the interim action SVE wells (VE-1 through VE-4) have removed a significant amount of contaminant mass from vadose zone soils beneath the northeast portion of the Morrell's building. However, those wells only target contamination beneath the northeast portion of the building. Similarly, injection of biostimulants into contaminated advance outwash groundwater in June 2014 showed promise, based on the results of post-injection groundwater monitoring through January 2017. However, the existing injection wellfield covers only a portion of the estimated groundwater exceedance area, and it is unclear how far the effects of the biostimulant injection extended radially outward from the injection wells. In Alternative 2, these

remedial technologies would be applied on an expanded scale. SVE would be expanded to address all on-property contaminated vadose zone soils, and biostimulation would be expanded to address all on-property contaminated groundwater in the advance outwash.

As discussed in Section 5.1, the estimated lateral extents of contaminated vadose zone soils and advance outwash groundwater shown on Figure 5-1 are based on limited data. In addition, the vertical distribution of contaminants in vadose zone soil is not known. In this alternative, vertical soil borings would be advanced outside the building footprint to better define the extent of on-property cleanup level exceedances. Borings that encounter contamination would be completed as SVE wells, biostimulation wells, and/or groundwater monitoring wells. SVE would require some wells screened in glacial till soils and some screened in advance outwash soils[21]. Selected borings that do not encounter contamination would also be completed as groundwater monitoring wells to define the perimeter of the contaminant plume. For the purpose of evaluating Alternative 2 in this SFFS, it is assumed that 12 additional vertical borings are completed as injection/groundwater monitoring wells, and 14 as SVE wells (9 screened in glacial till soils and 5 in advance outwash soils).

As in the 2014 interim action, angled wells would be used to expand coverage of the remedial technologies beneath the Morrell's building. For the purpose of evaluating Alternative 2 in this SFFS, it is assumed that additional subsurface completions beneath the building would include 10 SVE wells screened in the glacial till, 6 SVE wells screened in the advance outwash, and 6 injection/groundwater monitoring wells. Wells would need to be drilled from both sides of the building (i.e., the parking lot and North First Street) to maximize coverage beneath the building footprint.

For cost-estimating purposes, it is assumed that the expanded SVE system operates for six years, at which point contaminant removal rates have decreased such that the cost of further operation cannot be justified. Individual SVE well lines would be periodically monitored for soil gas flow rate and contaminant concentrations, and the system would be operated in alternating patterns to maximize contaminant mass removal. However, due to the relatively low permeability of glacial till soils and the difficulty of accessing those soils with SVE wells while the building remains in place, it is assumed that near-surface soil contamination would remain after SVE removal reaches its asymptotic limit. Therefore, periodic cap inspection and maintenance, and vapor intrusion mitigation and monitoring are assumed to be required indefinitely.

With respect to groundwater remediation, it is assumed that a round of biostimulant injection is conducted once the new wellfield is installed, and a second round four years later. As in Alternative 1, a groundwater monitoring plan would be developed and CPOC wells would be installed in the City of Tacoma ROW. Demonstration that cleanup levels have been achieved is assumed after 10 years of groundwater monitoring.

[21] Both the wells screened in the glacial till (VE-1 and VE-2) and those screened in the advance outwash (VE-3 and VE-4) have been productive with respect to contaminant mass removal. The advance outwash soils are more permeable and, therefore, more amenable to SVE than the glacial till soils. Closer spacing of SVE wells is likely required to remediate glacial till soils.

As in Alternative 1, an environmental covenant would be developed and recorded. The estimated present value cost of Alternative 2 is $1,500,000.

6.3.3 Alternative 3 – ERH and SVE of Accessible On-Property Soil Contamination, and Biostimulation/HEPA of Advance Outwash Groundwater

Alternative 3 would rely on *in situ* thermal technologies, SVE, and biostimulation to remediate on-property vadose zone soil and advance outwash groundwater. The technologies would target depth-discrete contaminated media as follows:

- **Glacial Till Soils**. Electrical resistance heating (ERH) would be used to treat contaminated glacial till soils. The assumed treatment area corresponds to the vadose zone soil exceedance area depicted on Figure 5-1. Electrodes would be installed to heat the soils to near the water boiling point to volatilize contaminants. Angled electrodes would be installed beneath the building, and vertical electrodes elsewhere. ERH would be coupled with an enhanced SVE system to capture and treat volatilized contamination. SVE wells would be collocated with the ERH electrodes. For the purpose of evaluating Alternative 3 in this SFFS, it is assumed that a total of 30 electrodes would be installed, and heating would occur over a 3-month period of operation. As with the existing SVE system, vapor-phase contaminants in the extracted soil gas would be adsorbed onto granular activated carbon (GAC).
- **Advance Outwash Vadose Zone Soils**. Similar to Alternative 2, SVE would be used to remediate advance outwash vadose zone soils. Compared to the glacial till soil, these deeper, higher-permeability soils are more amenable to SVE treatment and would be more expensive to treat by ERH. As in Alternative 2, it is assumed that six new angled wells beneath the building and five new vertical wells outside the building footprint would be installed, all screened in the advance outwash vadose zone. It is assumed that the SVE system would run for 3 years before reaching its asymptotic removal limit.
- **Advance Outwash Groundwater.** Heat-enhanced plume attenuation (HEPA) would be used along with biostimulant injection to treat contaminants in the advanced outwash groundwater. An array of wells screened in the groundwater would be installed in the groundwater exceedance area depicted on Figure 5-1. Following biostimulant injection, electrodes would be installed in the wells and the groundwater would be heated from 10–15 degrees Celsius to a target temperature of 50 degrees Celsius. This temperature would be maintained for an extended period to enhance biodegradation of dissolved contaminants. For the purpose of evaluating Alternative 3 in this SFFS, it is assumed that a total of 20 injection/HEPA treatment wells would be installed, and that the elevated groundwater temperature would be maintained for 1 year longer than the ERH heating period.

The application of ERH to glacial till soils is expected to be more effective than the SVE employed in Alternative 2. However, difficulties associated with installing electrodes beneath the building may still result in pockets of residual near-surface soil

contamination. SVE treatment is likely to remove considerable contaminant mass from the advance outwash vadose zone soils. For the purposes of evaluation in this SFFS, the following assumptions are made with respect to soil remediation in Alternative 3:

- Near-surface soil contamination remains beneath the building, such that capping and vapor intrusion mitigation are still required to address direct contact and vapor inhalation exposure concerns.
- Leaching of residual soil contaminants no longer causes cleanup level exceedances in advance outwash groundwater.

With respect to groundwater remediation, it is assumed that biostimulant injection in combination with HEPA is effective at reducing contaminant concentrations to below cleanup levels in advanced outwash groundwater. As in Alternatives 1 and 2, a groundwater monitoring plan would be developed and CPOC wells would be installed in the City of Tacoma right-of-way. Demonstration that cleanup levels have been achieved is assumed after 4 years of groundwater monitoring.

As in Alternatives 1 and 2, an environmental covenant would be developed and recorded. The estimated present value cost of Alternative 3 is $3,100,000.

6.3.4 Alternative 4 – ERH of Accessible On-Property Contaminated Soil and Advance Outwash Groundwater

In Alternative 4, the scope of ERH treatment described for Alternative 3 would be expanded to include treatment of advance outwash vadose zone soils (in lieu of SVE alone) and advance outwash groundwater (in lieu of biostimulant injection and HEPA treatment). In the soil exceedance area depicted on Figure 5-1, electrodes would be installed to heat the entire soil column down to the base of the advance outwash groundwater zone. Angled electrodes would be installed beneath the building, and vertical electrodes elsewhere. In the groundwater exceedance area depicted on that figure, vertical electrodes would be installed to heat the advance outwash groundwater zone only. ERH would be coupled with an enhanced SVE system to capture and treat volatilized contamination. SVE wells would be collocated with the ERH electrodes. For the purpose of evaluating Alternative 4 in this SFFS, it is assumed that a total of 60 electrodes would be installed, and heating would occur over a 6-month period of operation. Electrical energy usage in this alternative is anticipated to be roughly twice that of Alternative 3. Vapor-phase contaminants in the extracted soil gas would be adsorbed onto GAC.

Since glacial till soils would be treated by the same technology as in Alternative 3, the same treatment effectiveness would be achieved. However, advance outwash soils would be more effectively treated compared to Alternative 3, which relies on SVE alone to treat those soils. As in Alternative 3, it is assumed that treated vadose zone soils would still represent a concern with respect to direct contact and soil vapor exposures, and that leaching would no longer result in cleanup level exceedances in advance outwash groundwater.

A groundwater monitoring plan would be developed and CPOC wells would be installed in the City of Tacoma right-of-way. Demonstration that cleanup levels have been achieved is assumed in this alternative after 3 years of groundwater monitoring.

As with the previous alternatives, an environmental covenant encompassing the Site properties would be required. The estimated present value cost of Alternative 4 is $3,600,000.

6.3.5 Alternative 5 – Comprehensive ERH of On-Property Contaminated Soil and Advance Outwash Groundwater Following Building Demolition

As in Alternative 4, Alternative 5 would employ ERH treatment to remediate impacted vadose zone soils and advance outwash groundwater. However, the Morrell's building would first be demolished, which would both improve access to underlying contamination and reduce ERH construction costs. Vertical electrodes could be used exclusively in Alternative 5, which would allow for a much more efficient ERH design. It is assumed that a total of 40 electrodes would be required (reduced from 60 in Alternative 4). As in Alternative 4, and heating would occur over a 6-month period of operation. Due to the more efficient system design, electrical energy usage in this alternative would be somewhat lower than in Alternative 4, even though ERH performance would by improved. Unlike Alternative 4, it is assumed that ERH treatment in Alternative 5 would be successful in achieving cleanup levels in all on-property vadose zone soils. Therefore, post-construction cap inspection and maintenance, and vapor intrusion mitigation and monitoring, would not be required.

As in Alternative 4, a groundwater monitoring plan would be developed, CPOC wells would be installed in the City of Tacoma right-of-way, and demonstration that cleanup levels have been achieved is assumed after 3 years of groundwater monitoring.

The estimated present value cost of Alternative 5 is $2,800,000. This estimate does not include loss of income generated by the existing building or the cost of constructing a new building.

6.3.6 Alternative 6 – Removal of On-Property Contaminated Soil to 15-Foot Depth Following Building Demolition, and ERH of Deeper On-Property Contaminated Soil and Advance Outwash Groundwater

Alternative 6 is similar to Alternative 5 except that the upper 15 feet of on-property contaminated soils would be removed prior to ERH treatment. Approximately 200 lineal feet of temporary shoring would be installed along the north and west property boundaries, and an estimated 5,100 tons of contaminated soils would be excavated and disposed of at a hazardous waste landfill as F-listed waste. Clean fill would be imported to restore grades prior to implementation of ERH treatment. The cost of ERH treatment would be significantly lower than in Alternative 5 since less impacted soil would need to be treated. However, the time frame for ERH treatment would be similar. Since soil excavation would occur prior to ERH treatment, the overall cleanup time frame would be somewhat longer than in Alternative 5.

Alternative 6 is more certain than Alternative 5 to achieve cleanup levels in shallow soils, since contaminated soil removal is more reliable than ERH treatment. However, because

the excavated soil would likely classify as hazardous waste, disposal costs would be very high. The estimated present value cost of Alternative 6 is $4,400,000. This estimate does not include loss of income generated by the existing building or the cost of constructing a new building.

7 Evaluation of On-Property Remedial Alternatives

7.1 Evaluation Criteria

This section discusses the minimum requirements and procedures for selecting cleanup actions under MTCA (WAC 173-340-360).

7.1.1 MTCA Threshold Requirements

Cleanup actions selected under MTCA must meet four "threshold" requirements identified in WAC 173-340-360(2)(a) to be accepted by Ecology. All cleanup actions must:

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

7.1.2 MTCA Selection Criteria

When selecting from remedial alternatives that meet the threshold requirements, the following three criteria, identified in WAC 173-340-360(2)(b), must be evaluated:

- **Use permanent solutions to the maximum extent practicable.** A disproportionate cost analysis (DCA) is conducted to assess the extent to which the remedial alternatives address this criterion. The general procedure for conducting a DCA is described in Section 7.1.3.
- **Provide a reasonable restoration time frame.** MTCA places a preference on remedial alternatives that can be implemented in a shorter period of time.
- **Consider public concerns.** Consideration of public concerns is an inherent part of the Site cleanup process under MTCA. This SFFS considers public concerns as a component of the DCA.

7.1.3 MTCA Disproportionate Cost Analysis

A DCA is conducted to determine whether a cleanup action uses permanent solutions to the maximum extent practicable. This is done by evaluating the relative benefits and costs of remedial alternatives. Seven criteria are considered in the evaluation as specified in WAC173-340-360(3)(f):

- **Protectiveness** – The overall protectiveness of human health and the environment, including the degree to which existing site risks are reduced, time required to reduce the risks and attain cleanup standards, on-site and off-site risks during implementation, and improvement in overall environmental quality.
- **Permanence** – The degree to which the alternative reduces the toxicity, mobility, or volume of hazardous substances, including the adequacy of destroying hazardous substances, the reduction or elimination of hazardous substance releases and sources

of releases, the degree of irreversibility of treatment, and the characteristics and quantity of the treatment residuals.

- **Cost** – The remedy design, construction, and long-term O&M costs to implement the alternative.
- **Long-term effectiveness** – The degree of certainty that the alternative will successfully and reliably address contamination that exceeds applicable cleanup levels until cleanup levels are attained, the magnitude of the residual risk with the alternative in place, and the effectiveness of controls to manage treatment residue and remaining wastes.
- **Short-term risk management** – The risks to human health and the environment during construction and implementation of the alternative, and the effectiveness of measures that will be taken to manage such risks.
- **Implementability** – Includes consideration of whether the alternative is technically possible; the availability of necessary off-Site facilities, services, and materials; administrative and regulatory requirements; scheduling, size, and complexity of the alternative; monitoring requirements; access for construction, operations, and monitoring; and integration with existing facility operations and other current or potential remedial actions.
- **Consideration of public concerns** – Includes concerns from individuals, community groups, local governments, state agencies, and other interested organizations.

The DCA is based on a comparative evaluation of an alternative's cost against the other six criteria (environmental benefits). Per WAC 173-340-360(3)(e)(i), cost is disproportionate to benefits if the incremental cost of an alternative over that of a lower-cost alternative exceeds the incremental degree of benefits achieved by the alternative over that of the lower-cost alternative.

7.2 Evaluation with Respect to MTCA Threshold Requirements

The remedial alternatives are evaluated for compliance with the MTCA threshold criteria in Table 7-1. All six alternatives provide for compliance monitoring and are expected to be protective of human health and the environment. They vary significantly in contaminant mass removal achieved, and only Alternatives 5 and 6 are expected to fully comply with cleanup standards. Alternatives 3 and 4 are expected to do better than Alternatives 1 and 2 in this regard. However, it is assumed that pockets of soil with cleanup level exceedances will remain beneath the Morrell's building following ERH treatment of glacial till soils in Alternatives 3 and 4. ERH would be much more likely to achieve soil cleanup levels if the building is first removed (Alternative 5), since that would allow for effective placement of an electrode array[22].

[22] Since we are not aware of a more aggressive *in situ* technology than ERH for treatment of glacial till soils, we believe that the building will need to be demolished in order to effectively clean up on-Property soil contamination.

Alternatives that do not fully comply with the MTCA threshold criteria are typically not carried forward in the evaluation process. In this case, however, where only two relatively high-cost alternatives fully comply, all six are carried forward to the next stage of evaluation[23].

7.3 Disproportionate Cost Analysis

As described in Section 7.1.3, a DCA is performed to evaluate whether a cleanup action uses permanent solutions to the maximum extent practicable. The DCA quantifies the environmental benefits of each remedial alternative, and then compares alternative benefits versus costs. Costs are disproportionate to benefits if the incremental cost of a more permanent alternative over that of a lower-cost alternative exceeds the incremental benefits achieved by the alternative over that of the lower-cost alternative. Alternatives that exhibit disproportionate costs are considered "impracticable" under MTCA.

The DCA is performed in Table 7-2. Environmental benefit is quantified by first rating the alternatives with respect to each of the criteria (except cost[24]) discussed in Section 7.1.3. Rating values are assigned on a scale of 1 to 5, where 1 indicates the criterion is satisfied to a very low degree, and 5 indicates the criterion is satisfied to a very high degree. Since Ecology does not consider the criteria to be of equal importance, each criterion is assigned a "weighting factor." Based on Ecology input for feasibility studies conducted at other sites, weighting factors are assigned as follows:

- Overall protectiveness: 30 percent
- Permanence: 20 percent
- Long-term effectiveness: 20 percent
- Short-term effectiveness: 10 percent
- Implementability: 10 percent
- Consideration of public concerns: 10 percent

A MTCA benefits ranking is then obtained for each alternative by multiplying the six rating values by their corresponding weighting factors and summing the weighted values. Finally, the benefits ranking of each alternative is divided by the alternative's estimated cost (in $million) to obtain a benefit/cost ratio, which is a relative measure of the cost effectiveness of the alternative.

7.3.1 Benefits Rankings, Estimated Costs, and Benefit/Cost Ratios

The MTCA benefits rankings, estimated costs, and benefit/cost ratios for Alternatives 1 through 6 are presented at the bottom of Table 7-2. The benefit rankings range from a low of 2.3 for Alternative 1 to a high of 4.3 for Alternative 5. Estimated costs range from $600,000 (Alternative 1) to $4,400,000 (Alternative 6). Benefit/cost ratios range from a high of 3.8 for Alternative 1 to a low of 0.9 for Alternative 6.

[23] The threshold requirement that the alternative provide for a reasonable restoration time frame is considered moot in this case and is not evaluated.
[24] The cost criterion factors into the DCA after the environmental benefit is quantified.

7.3.2 Disproportionate Cost Analysis Recommendation

Among the alternatives evaluated in this FFS, Alternative 1 achieved the highest benefit/cost ratio. However, while Alternative 1 is expected to be protective of human health, it will not achieve soil and groundwater cleanup levels in a reasonable time frame. Therefore, while it may be acceptable as an interim measure (e.g., until the existing building is demolished), it is not expected to result in the Property being eligible for a Property-Specific NFA opinion from Ecology.

Alternative 2, which would expand the application of remedial technologies already implemented at the Site, achieved the second-highest benefit/cost ratio. This alternative is expected to achieve groundwater cleanup levels in roughly a 10-year time frame. However, cleanup levels are expected to be difficult to achieve in shallow soils beneath the Morrell's building. With an environmental covenant in place to protect against direct contact and vapor intrusion exposures, the Property would likely be eligible for a Property-Specific NFA opinion from Ecology.

Alternative 5, which includes demolition of the Morrell's building followed by application of a very aggressive (and costly) remedial technology, achieved the third-highest benefit/cost ratio. Alternative 5 has a relatively short cleanup time frame, and the Property would likely be eligible for an unencumbered Property-Specific NFA opinion. However, the Property owners are not in favor of building demolition.

Based on the above considerations, Alternative 2 is recommended for implementation. Among the alternatives that are likely to result in the Property being eligible for a Property-Specific NFA opinion from Ecology (all except Alternative 1), the DCA identified Alternative 2 as the most cost-effective.

8 Remediation of the Parking Lot Parcel

This section focuses on remediation of the Parking Lot Parcel, with the goal of obtaining an unencumbered NFA opinion letter from Ecology for that parcel only[25]. Cleanup of the Parking Lot Parcel is more straightforward than cleanup of the Building Parcel for the following reasons:

- The extent of vadose zone soil contamination is expected to be limited to the extreme northwest corner of the parcel[26], and concentrations are expected to be much lower there than beneath the northern portion of the Morrell's building.
- Because the Parking Lot Parcel is upgradient of the former source area beneath the Morrell's building, it is expected to have much lower contaminant concentrations in advance outwash groundwater compared to the Building Parcel.

[25] The owners of the Property are interested in selling the Parking Lot Parcel and have requested that this scenario be considered in the SFFS evaluation.

[26] Although there are no soil sampling results confirming vadose zone contamination at this location, solvent odors were noted from near ground surface to at least 40 feet bgs during the drilling of MW-19.

- Since there are no large structures on the Parking Lot Parcel, access to the subsurface is much more straightforward.

Another benefit of being upgradient of the former source area is that once groundwater in the Parking Lot Parcel is remediated, it is unlikely to be recontaminated by residual contamination in the Building Parcel[27].

The assumed areal extent of vadose zone soil and advance outwash groundwater contamination in the Parking Lot Parcel shown on Figure 5-1 is based on very limited data. Additional subsurface investigation is needed and would likely be performed by advancing an array of vertical borings, beginning along the on-property parcel boundary (shaded purple on Figure 5-1) and expanding outward to the south and east. Borings that encounter vadose zone contamination could potentially be completed as dual-purpose wells, appropriately screened for both SVE[28] and groundwater biostimulation. Borings that do not encounter vadose zone contamination would be completed as groundwater monitoring wells and, if subsequent monitoring indicates cleanup level exceedances, as potential biostimulant injection wells. Wells that do not encounter groundwater contamination would define the upgradient extent of contamination.

Figure 8-1 provides a conceptual well layout for investigation and remediation of the Parking Lot Parcel, based on the assumed areal extent of vadose zone soil and advance outwash groundwater contamination. It is assumed that 13 new vertical wells are installed to supplement existing wells MW-5, MW-7, MW-19, and MW-20. The 3 new wells along the south side of the Morrell's building are assumed to encounter vadose zone soil contamination and would be screened for both SVE and groundwater monitoring/biostimulation. These wells, along with MW-19, and MW-20, would be connected to the existing SVE system via subsurface piping installed around the south and east sides of the building. The other 10 wells would be screened at the water table for the purpose of groundwater monitoring and potential biostimulant injection.

Table D-7 in Appendix D provides a preliminary cost estimate of $520,000 for cleanup of the Parking Lot Parcel under this scenario. The cost estimate assumes the following:

- The SVE system operates for 3 years[29], after which a soil investigation confirms that cleanup levels have been achieved in the northwest corner of the parcel.
- A single biostimulant injection event is conducted and, after 4 years of post-injection groundwater monitoring, it is confirmed that cleanup levels have been achieved in the advance outwash groundwater throughout the parcel.

[27] As noted in Section 5.2, the Tully's drinking water release between May 2006 and September 2007 is likely responsible for the apparent migration of groundwater contamination upgradient of the source area.

[28] SVE is assumed to be an appropriate cleanup technology for vadose zone soils based on the expectation of only low contaminant concentrations in the Parking Lot Parcel.

[29] Most of the existing SVE system's capacity would be devoted to Parking Lot Parcel remediation during this period. However, soil gas extraction from beneath the building (particularly via VE-SS) would continue to the extent necessary to maintain mitigation of vapor intrusion.

- After soil and groundwater cleanup levels are achieved, most of the wells are decommissioned[30] and the cleanup action is reported to Ecology under the Voluntary Cleanup Program (VCP) along with a request for a parcel-specific NFA opinion letter.

It must be stressed that many assumptions have been made in developing this scenario. The actual cost and time frame for cleanup of the Parking Lot Parcel will be highly dependent on the magnitude and extent of contamination, which is currently not well delineated.

[30] Several wells would likely be needed for subsequent monitoring associated with cleanup of the Building Parcel.

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Limitations

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting are intended solely for Walker Chevrolet (the Client) and apply only to the services described in the Agreement with Client. Any use or reuse by Client for purposes outside of the scope of Client's Agreement is at the sole risk of Client and without liability to Aspect Consulting. Aspect Consulting shall not be liable for any third parties' use of the deliverables provided by Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix E titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report.

TABLES

Table 1-2. Soil Sampling Results

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Sample Location	Sample Date	Sample Depth (feet bgs)	Tetrachloroethene (PCE)	Trichloroethene (TCE)	Naphthalene
B-1	06/29/07	0-2	**0.04**	< 0.02 U	--
B-1	06/29/07	2-3	**0.04**	< 0.02 U	--
DC1	08/31/06	8	< 0.02 U	< 0.02 U	< 0.05 U
DC-PLAS-2	09/18/06	18.5-20	--	--	--
DP-1	10/21/10	1	**2.1**	< 0.03 U	< 0.05 U
DP-1	10/21/10	2	**1**	< 0.03 U	< 0.05 U
DP-2	10/21/10	1	**0.8**	< 0.03 U	< 0.05 U
DP-4	10/20/10	2	**1.8**	< 0.03 U	< 0.05 U
DP-5	10/20/10	3	**1.4**	< 0.03 U	< 0.05 U
DP-5	10/20/10	6	**0.54**	< 0.03 U	< 0.05 U
DP-7	10/21/10	2	**2.7**	< 0.03 U	< 0.05 U
DP-7	10/21/10	2.5	**36**	**0.14**	< 0.05 U
DP-8	10/20/10	3	< 0.025 U	< 0.03 U	**28**
DP-8	10/20/10	4.5	< 0.025 U	< 0.03 U	**0.22**
DP-9	10/20/10	3	< 0.025 U	< 0.03 U	< 0.05 U
DP-9	10/20/10	6	**0.13**	< 0.03 U	< 0.05 U
DP-10	02/08/12	8.5	**0.24**	< 0.03 U	< 0.05 U
DP-11	02/08/12	4	--	--	--
DP-12	02/08/12	5.5	< 0.025 U	< 0.03 U	< 0.05 U
DP-13	02/08/12	7	< 0.025 U	< 0.03 U	< 0.05 U
DP-14	02/08/12	7	< 0.025 U	< 0.03 U	< 0.05 U
DP-15	02/08/12	4	--	--	--
DP-16	02/08/12	4	--	--	--
DP-17	02/08/12	4	--	--	--
F-12	07/31/07	1	**1.5**	< 0.02 U	--
F-20	07/31/07	1.7	**2.1**	< 0.02 U	--
MW-21	10/11/13	11	**0.63**	< 0.03 U	< 0.05 U
MW-21	10/11/13	15.5	**44**	**0.57**	< 0.05 U
MW-21	10/11/13	25	< 0.025 U	< 0.03 U	< 0.05 U
MW-21	10/11/13	40	< 0.025 U	< 0.03 U	< 0.05 U
MW-21	10/11/13	55	**0.095**	**0.032**	< 0.05 U
R-12	07/31/07	1	**1.9**	**0.28**	--
R-18	07/31/07	1.5	**18**	**0.85**	--
T-1	06/29/07	0-1.75	**0.04**	< 0.02 U	--
TRENCH-BT-C	12/09/13	4.5	**0.26**	< 0.03 U	< 0.05 U
TRENCH-BT-E	12/09/13	4.5	**0.16**	< 0.03 U	< 0.05 U
TRENCH-BT-W	12/09/13	4.5	**0.25**	< 0.03 U	< 0.05 U
Screening Level[3]			0.05	0.03	5

bgs below ground surface U not detected at the indicated detection limit

Notes:

1) All concentrations are in milligrams per kilogram (mg/kg). Only analytes with concentrations exceeding their respective screening levels in at least one sample are included in this table. Detections are bolded. Screening level exceedances are shaded. Refer to Section 3.2.3 for discussion of other analyte detections.

2) Soil sampling was also conducted for the purpose of profiling soil for off-site disposal. Those sampling results are not included in this table.

3) The screening levels are Model Toxics Control Act (MTCA) Method A soil cleanup levels.

Table 1-3. Reconnaissance Groundwater Sampling Results from Soil Borings

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Chemical Name[1]	Screening Level[2]	DC-PLAS-2-W Beneath parking lot east of Morrell's during Tully's drinking water leak[3] 09/18/06	B-1 Beneath adjoining lease space foundation south of Morrell's during Tully's drinking water leak[3] 06/29/07	PW-1 Beneath Morrell's foundation during Tully's drinking water leak[3] 07/11/07	GW-7 Beneath Morrell's foundation after repair of Tully's drinking water leak[3] 05/08/08	GW-8 Beneath Morrell's foundation after repair of Tully's drinking water leak[3] 05/08/08
Bromodichloromethane[4]	0.08	1.5	1.5	2.3	< 1 U	< 1 U
Tetrachloroethylene (PCE)	5		**52**	**1,700**	**13,000**	**1,300**
Trichloroethylene (TCE)	5		**6**	**17**	**33**	**21**
Vinyl chloride	0.2		**19**	**0.51**	< 0.2 U	< 0.2 U

bgs below ground surface

U not detected at the indicated detection limit

Notes:

1) All concentrations are in micrograms per liter (µg/L). Only analytes with concentrations exceeding their respective screening levels in at least one sample are included in this table. Detections are bolded. Screening level exceedances are shaded. Refer to Section 3.1.3 for discussion of other analyte detections.

2) Screening levels are maximum contaminant level (MCL) for bromodichloromethane and Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for the other analytes.

3) An estimated 600,000 gallons of drinking water was released between May 2006 and September 2007 (per analysis of water bills) by Tully's Coffee, which occupied the retail space at the southeast corner of Tacoma Avenue and North First Street.

4) Bromodichloromethane is a byproduct of drinking water disinfection. Its presence is attributable to the Tully's drinking water leak.

Table 1-4. Groundwater Sampling Results in Advance Outwash Monitoring Wells

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Well ID	Sample Date	Carbon Tetrachloride	Tetrachloroethene (PCE)	Trichloroethene (TCE)	cis-1,2-Dichloroethene (cDCE)	1,1-Dichloroethene	Vinyl chloride
MW-2[3]	08/28/07	1	2,900	1,800	7,100		19
	01/30/08	< 1 U	1,400	520	2,000		< 0.2 U
	10/02/08	1	1,900	880	2,300	< 1 U	3.1
	05/12/09	< 1 U	1,600	930	2,400	< 1 U	2.7
	12/22/10	< 1 U	2,100	1,100	2,100	< 1 U	2.7 J
	02/07/12	< 100 U	1,600	810	1,400	< 100 U	< 20 U
	12/12/13	< 1 U	1,600	830	1,200	< 1 U	0.84
	01/21/15	< 1 U	19	25	150	< 1 U	0.77
	07/30/15		17	46	600	< 1 U	15
	09/08/15		18	77	610	1.6	17
	02/02/16		22	190	640	4.2	15
	09/22/16		16	110	480	3.8	7.8
	01/04/17		18	80	520	3.8	7.4
MW-5[4,5]	01/22/08	3.3	67	3	13		< 0.2 U
	01/30/08	2	31	1.1	4.5		< 0.2 U
	10/02/08	1.2	75	3.2	17	< 1 U	< 0.2 U
	05/11/09	< 1 U	17	1.1	44	< 1 U	< 0.2 U
	12/22/10	3.2	190	14	41	< 1 U	< 0.2 U
	02/07/12	4.6	140	8.7	25	< 1 U	< 0.2 U
	01/09/14	< 0.2 U	< 0.2 U	0.46	< 0.2 U	< 0.2 U	< 0.2 U
	04/28/15	2.1	67	6.2	6.4	< 1 U	< 0.2 U
	09/09/15		31	3.6	3.6	< 1 U	< 0.2 U
	02/02/16		27	2.7	2.5	< 1 U	< 0.2 U
	09/07/16		12	1.4	1.4	< 1 U	< 0.2 U
	01/04/17		14	1.4	1.3	< 1 U	< 0.2 U
MW-7[4]	01/22/08	< 1 U	6.6	< 1 U	< 1 U		< 0.2 U
	01/30/08	1.5	1.5	< 1 U	< 1 U		< 0.2 U
	10/02/08	1.5	< 1 U	< 1 U	< 1 U	< 1 U	< 0.2 U
	05/11/09	2	1.1	< 1 U	< 1 U	< 1 U	< 0.2 U
	12/22/10	3.3	1.4	< 1 U	< 1 U	< 1 U	< 0.2 U
	02/06/12	2.2	< 1 U	< 1 U	< 1 U	< 1 U	< 0.2 U
	01/07/14	1.6	1.4	< 1 U	< 1 U	< 1 U	< 0.2 U
MW-8[3]	04/22/08	< 1 U	1,300	780	2,400		< 0.2 U
	10/02/08	< 1 U	680	390	3,600	10	6.9
	05/12/09	< 1 U	780	370	2,600	4.3	2
	12/22/10	< 1 U	470	150	1,800	3.7	1.4
	02/07/12	< 100 U	960	610	1,600	< 100 U	< 20 U
	12/17/13	< 50 U	940	560	1,300	< 50 U	< 10 U
	01/20/15	< 5 U	14	8.5	1,200	6.4	9.4
	07/30/15		41	17	740	1.5	8.9
	09/10/15		18	13	1,000	4.2	12
	02/01/16		21	13	830	2.5	7.1
	09/07/16		< 50 U	< 50 U	560	< 50 U	< 10 U
	09/22/16		16	11	500	2.2	5.4
	01/05/17		19	12	480	1.8	5.6
MW-15[3]	12/17/13	< 10 U	460	110	380	< 10 U	< 2 U
	09/08/15		86	53	220	< 1 U	4
	02/01/16		43	25	290	< 1 U	7.4
	09/07/16		15	8.4	330	< 5 U	4
	01/04/17		6.6	3.3	520	< 1 U	4.9
MW-16[3]	12/13/13	2.2	450	98	360	< 1 U	0.49
	01/21/15	< 5 U	14	6.3	180	< 5 U	2.2
MW-17[3]	12/13/13	3	170	24	81	< 1 U	< 0.2 U
MW-18[3]	12/12/13	< 1 U	460	57	360	< 1 U	0.53
MW-19[3]	01/08/14	7	62	4.8	20	< 1 U	< 0.2 U
	01/21/15	< 5 U	9.7	< 5 U	45	< 5 U	< 1 U
	09/09/15		7.6	3.9	35	< 1 U	1.5
	02/02/16		8.5	5.1	43	< 1 U	1.5
	09/07/16		< 20 U	< 20 U	< 20 U	< 20 U	< 4 U
	09/22/16		8.5	4.1	16	< 1 U	0.43
	01/04/17		12	4.6	36	< 1 U	0.97
MW-20[3]	01/08/14	3.6	140	16	43	< 1 U	< 0.2 U
	01/20/15	< 1 U	7.4	5.3	79	< 1 U	1.8
	09/09/15		11	5.8	150	< 1 U	1.5
	02/02/16		< 1 U	< 1 U	250	< 1 U	1.9
	09/07/16		< 20 U	< 20 U	250	< 20 U	< 4 U
	09/22/16		4.9	1.7	250	1.1	1.8
	01/04/17		6.2	2	240	1.1	2.5
MW-21[3]	12/17/13	< 10 U	500	130	460	< 10 U	< 2 U
	01/20/15	< 5 U	15	12	270	< 5 U	< 1 U
	09/08/15		7.1	9.2	510	< 1 U	7.4
	02/01/16		18	17	650	< 1 U	9.7
	09/22/16		12	13	320	< 1 U	4.1
	01/04/17		15	14	340	< 1 U	4.2
Screening Level[2]		5	5	5	70	7	0.2

U not detected at the indicated detection limit

Notes:

1) All concentrations are in micrograms per liter (µg/L). Only analytes with concentrations exceeding their respective screening levels in at least one sample are included in this table. Detections are bolded. Screening level exceedances are shaded. Refer to Section 3.1.3 for discussion of other analyte detections.

2) Screening levels are Model Toxics Control Act (MTCA) Method A groundwater cleanup levels for PCE, TCE, and vinyl chloride, and maximum contaminant levels (MCLs) for the other analytes.

3) Biostimulated in June 2014.

4) Potential impacts from Tully's Coffee water leak. An estimated 600,000 gallons of drinking water were released between May 2006 and September 2007 (per analysis of water bills).

5) Potential impacts from MW-20 biostimulation (June 2014).

Table 1-5 - Groundwater Sampling Results in Olympia Bed Interglacial Deposit Monitoring Wells

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Well ID	Sample Date	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene (cDCE)
MW-8D	05/11/09	< 1 U	**11**
	12/22/10	< 1 U	**21**
	02/06/12	< 1 U	**26**
	01/10/14	< 0.2 U	**42**
	04/28/15	< 1 U	**54**
	09/08/15	< 1 U	**65**
	02/02/16	< 1 U	**62**
	09/07/16	< 1 U	**69**
	01/12/17	< 1 U	**77**
MW-12D	12/22/10	**6.1**	**22**
	02/06/12	< 1 U	**17**
	01/10/14	**0.7**	**22**
	04/29/15	< 1 U	**13**
	09/10/15	< 1 U	**9.1**
	02/02/16	< 1 U	**9.2**
	09/07/16	< 1 U	**3.4**
	01/12/17	< 1 U	**3.0**
MW-13D	12/22/10	**14**	**30**
	02/07/12	**4.2**	**28**
	12/16/13	**5.9**	**32**
	04/29/15	< 1 U	**14**
	09/09/15	**4.1**	**22**
	02/02/16	**2.2**	**23**
	09/07/16	**2.3**	**13**
	01/12/17	**11**	**16**
MW-14D	02/06/12	**4.2**	**28**
	01/23/14	**2.4**	**4.5**
	04/29/15	**2.2**	**2.5**
	09/09/15	**9.2**	**15**
	02/02/16	**1.8**	**2.2**
	09/07/16	**3.2**	**3.6**
	01/12/17	**7.4**	**4.8**
Screening Level[2]		5	70

U not detected at the indicated detection limit

Notes:

1) All concentrations are in micrograms per liter (µg/L). Only analytes with concentrations exceeding their respective screening levels in at least one sample are included in this table. Detections are bolded. Screening level exceedances are shaded. Refer to Section 3.1.3 for discussion of other analyte detections.

2) Screening levels are Model Toxics Control Act (MTCA) Method A groundwater cleanup level for PCE and maximum contaminant level (MCL) for cDCE.

Table 1-6. Sub-slab Vapor Sampling Results prior to and during Soil Vapor Extraction Operations

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039), 608 North First Street, Tacoma, Washington

	Sample Location	GV-4	GV-5	GV-6	SV-1	SV-2	SV-3	SV-4	VP-1	VP-2	VP-3	VP-4	VP-4	VP-4	VP-4	VP-5	VP-5	VP-5	VP-7
	Sample Date	5/8/08	5/8/08	5/8/08	1/21/09	1/21/09	1/21/09	1/21/09	2/9/12	2/9/12	2/9/12	10/15/14	4/21/15	9/7/16	12/28/16	4/21/15	9/7/16	12/28/16	10/15/14
												Morrell's Dry Cleaners lease space, middle of lease space				Morrell's Dry Cleaners lease space, adjacent to south interior wall			Tenant space south of Morrell's Dry Cleaners
Chemical	Sub-Slab Soil Gas Method B Screening Level (most stringent)[1]	East of Morrell's Dry Cleaners entry in parking lot	South of Morrell's Dry Cleaners in parking lot	South of Morrell's Dry Cleaners building	Southwest of Morrell's building near sewer main	Alley north of Morrell's Dry Cleaners, west of middle	Sewer main, 125 feet west of Property	Southwest of dry cleaner building near sewer connection and GV-6	Alley north of Morrell's Dry Cleaners, west side	Alley north of Morrell's Dry Cleaners, middle	Alley north of Morrell's Dry Cleaners, east side	Prior to SVE Startup	After 35 days of VE-SS shutdown	After 39-days of VE-SS shutdown	VE-SS shutdown for sampling only	After 35 days of VE-SS shutdown	After 39-days of VE-SS shutdown	VE-SS shutdown for sampling only	Prior to SVE Startup
Chlorinated Volatile Organic Compounds																			
Tetrachloroethylene (PCE)	321	**12,000**	**1,600**	**70,000**	< 200 U	**6,500**	**400**	**200**	**270**	**150,000**	**380**	**680,000**	**400**	**1,000**	**16**	**2,800**	**900**	**26**	**3,200**
Trichloroethylene (TCE)	12.3	< 20 U	**2,700**	**7,800**	< 200 U	< 200 U	< 200 U	< 200 U	**1.1**	< 230 U	**1.9**	**5,100**	**29**	**27**	**8.8**	**110**	**54**	**7.3**	**140**
cis-1,2-Dichloroethylene (cDCE)		**16,000**	**320**	**2,500**	< 200 U	< 200 U	< 200 U	< 200 U	< 0.72 U	< 170 U	< 1.2 U	< 880 U	**0.81**	< 2 U	< 0.4 U	**8.2**	**2.5**	**0.74**	**8.6**
trans-1,2-Dichloroethylene		< 50 U	< 50 U	< 50 U	< 200 U	< 200 U	< 200 U	< 200 U	< 0.72 U	< 170 U	< 1.2 U	< 880 U	**2.7**	< 2 U	**0.45**	< 7.2 U	< 2 U	< 0.4 U	< 6.9 U
Vinyl Chloride	9.33	**540**	< 200 U	< 200 U	< 200 U	< 200 U	< 200 U	< 200 U	< 0.47 U	< 110 U	< 0.78 U	< 560 U	< 0.48 U	< 1.3 U	< 0.26 U	< 4.6 U	< 1.3 U	< 0.26 U	< 4.5 U
Methylene Chloride	8,330	< 1,000 U	< 1,000 U	< 1,000 U	< 500 U	< 500 U	< 500 U	< 500 U					**60**	< 430 U	**150**	**23**	< 430 U	< 87 U	
Chloromethane	1,370	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U				< 1800 U	< 1.9 U	< 1 U	**0.36**	< 19 U	< 1 U	< 0.21 U	< 36 U
Trihalomethanes (Disinfection By-Products in Chlorinated Potable Water)																			
Chlorodifluoromethane	762,000													< 1.8 U	**1.5**		< 1.8 U	**0.89**	
Chloroform	3.62	< 50 U	< 50 U	< 50 U	< 200 U	< 200 U	< 200 U	< 200 U				< 1100 U	< 0.91 U	**18**	**0.83**	< 8.8 U	< 2.4 U	< 0.49 U	< 8.5 U
Dichlorodifluoromethane	1,520	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U				< 1100 U	**1.2**	< 13 U	**2.3**	< 9.0 U	< 13 U	**2.2**	< 8.6 U
Trichlorofluoromethane	1,070	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U					**1.2**	< 2.8 U	**1.2**	< 10 U	< 2.8 U	**1.2**	
Petroleum Hydrocarbons																			
APH EC5-8 aliphatics[2]	90,000													**1,700**	**5,600**		**1,700**	**3,500**	
APH EC9-12 aliphatics[2]	4,700													**1,100**	**3,600**		**2,400**	**460**	
APH EC9-10 aromatics[2]	6,000													< 250 U	< 250 U		< 250 U	< 250 U	
Benzene	10.7	**140**	**390**	**230**	< 200 U	< 200 U	< 200 U	< 200 U	< 0.58 U	< 140 U	< 0.97 U	**1,300**	< 0.60 U	< 1.6 U	**1**	< 5.8 U	< 1.6 U	**0.94**	< 5.6 U
Toluene	76,200	**100**	**270**	**200**	< 200 U	< 200 U	< 200 U	< 200 U	**1.9**	< 160 U	**6**	**2,600**	**5.4**	**3.1**	**3.7**	**7.5**	**4**	**5.5**	< 6.6 U
Ethylbenzene	15,200	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U	< 0.79 U	< 180 U	**1.8**	**1,700**	**3.4**	< 2.2 U	**7.7**	< 7.8 U	< 2.2 U	**3.3**	< 7.6 U
m,p-Xylenes	1,520				**500**	< 400 U	< 400 U	< 400 U	**3.2**	< 180 U	**7.2**	**3,400**	**10**	**6.5**	**6.6**	**13**	**7.1**	**6**	< 7.6 U
o-Xylene	1,520				**200**	< 200 U	< 200 U	< 200 U	**0.92**	< 180 U	**2.1**	**1,200**	**3.9**	**2.7**	**2.1**	< 7.8 U	**3**	**1.9**	< 7.6 U
Total Xylenes	1,520	< 100 U	< 100 U	< 100 U	**700**	< 600 U	< 600 U	< 600 U	**4.12**	< 180 U	**9.3**	**4,600**	**13.9**	**9.2**	**8.7**	**13**	**10.1**	**7.9**	< 7.6 U
Naphthalene	2.45	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U	< 4.8 U	< 900 U	< 8.0 U			**2.8**	**1.8**		**3**	**2**	
1,2,4-Trimethylbenzene	107	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U					**2.8**	< 12 U	**3.8**	< 8.9 U	< 12 U	**3**	
1-Propene														**4.8**	**8.3**		< 3.4 U	**10**	
4-Ethyltoluene													**2.6**			< 8.9 U			
Cyclohexane													< 0.64 U	< 34 U	**150**	< 6.2 U	< 34 U	**150**	
Cyclopentane														< 1.4 U	**3.5**		< 1.4 U	**5.3**	
Hexane													< 0.66 U	< 18 U	**64**	< 6.4 U	< 18 U	**89**	
Isobutylene														**6.3**	**1.3**		< 4.6 U	< 0.92 U	
Isopropylbenzene	6,100	< 1,000 U	< 1,000 U	< 1,000 U	< 200 U	< 200 U	< 200 U	< 200 U					< 0.92 U			**9.4**			
Pentane														< 15 U	**5.9**		< 15 U	**6.7**	
Styrene	15,200	< 100 U	< 100 U	< 100 U	< 200 U	< 200 U	< 200 U	< 200 U					**3.5**	< 4.3 U	**1.3**	< 7.7 U	< 4.3 U	**1.2**	
Other Volatile Organic Compounds																			
1-Butanol														< 30 U	**12**		< 30 U	< 6.1 U	
2-Butanone (MEK)	76,200												< 2.8 U	< 15 U	< 2.9 U	< 27 U	< 15 U	**5.3**	
4-Methyl-2-pentanone	45,700	< 100 U	< 100 U	< 100 U	< 1,000 U	< 1,000 U	< 1,000 U	< 1,000 U					**1**	< 20 U	< 4.1 U	**17**	< 20 U	< 4.1 U	
Acetaldehyde														< 45 U	**16**		< 45 U	< 9 U	
Acetone		< 1,000 U	< 1,000 U	< 1,000 U	**1,000**	< 1,000 U	< 1,000 U	< 1,000 U					**7.2**	< 24 U	**3.8**	**170**	< 24 U	**8.4**	
Acrolein	0.305													**5.9**	< 0.92 U		< 4.6 U	< 0.92 U	
Ethanol													**7.9**	< 38 U	**19**		< 38 U	**31**	
Isopropyl Alcohol													< 2.3 U	< 43 U	< 8.6 U	**22**	**63**	< 8.6 U	
Vinyl acetate	3,050													< 35 U	< 7 U		< 35 U	**52**	

U not detected at the indicated reporting limit

Notes:

1) All concentrations are in micrograms per cubic meter. Analytes detected in at least one sample are included in this table. Detections are bolded. Concentrations that exceed the screening level are shaded.

2) All samples were analyzed by EPA Method TO-15 for volatile organic compounds (VOCs). Samples collected on 9/7/16 and 12/28/16 were also analyzed by Method MA-APH for aliphatic and aromatic hydrocarbons in the indicated carbon ranges. Non-petroleum compounds were subtracted from the EC5-8 aliphatic range prior to quantitation.

Table 1-7. Indoor Air Sampling Results prior to Soil Vapor Extraction Operations

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Sample Location		Office Can #1	Office Can #2	Bakery Can #3	Bakery Can #4	Back Bakery	Front Bakery	Back Office	Thriftway Office	Morrell's
Sample Date		5/22/07	5/22/07	5/22/07	5/22/07	2/8/08	2/8/08	2/8/08	2/9/12	2/9/12
Chemical[1]	Indoor Air Method B Cleanup Level (most stringent)[1]	Collected within adjoining lease space south of Morrell's Dry Cleaners								Collected from Dry Cleaners
Tetrachloroethylene (PCE)	9.62	**1,040**	**1,470**	**2,050**	**2,710**	**650**	**6,700**	**2,500**	**15**	**22**
Trichloroethylene (TCE)	0.37	**12**	**19**	**13**	< 9 U	< 1,000 U	< 1,000 U	< 1,000 U	**5.7**	**9.0**
cis-1,2-Dichloroethylene (cDCE)		**10**	**18**	< 6 U	< 6 U	< 1,000 U	< 1,000 U	< 1,000 U	< 0.14 U	< 0.14 U
Benzene	0.321	< 5 U	< 5 U	< 5 U	< 5 U	**380**	< 1,000 U	< 1,000 U	**2.2**	**2.2**
Toluene	2,290	**7.5**	**6.0**	< 6 U	< 6 U	**190**	< 1,000 U	< 1,000 U	**9.0**	**7.3**
Ethylbenzene	457	< 7 U	< 7 U	< 7 U	< 7 U	< 1,000 U	< 1,000 U	< 1,000 U	**2.2**	**2.0**
m,p-Xylenes	45.7	< 13 U	< 13 U	< 13 U	< 14 U				**8.1**	**7.2**
o-Xylene	45.7	< 7 U	< 7 U	< 7 U	< 7 U				**3.1**	**2.8**
Total Xylenes	45.7	< 20 U	< 20 U	< 20 U	< 21 U	**190**	< 1,000 U	< 1,000 U	**11.2**	**10.0**

U not detected at the indicated reporting limit

Notes:

1) All concentrations are in micrograms per cubic meter. Analytes detected in at least one sample are included in this table. Detections are bolded. Concentrations that exceed the screening level are shaded.

2) Continuous soil vapor extraction operations were initiated on October 15, 2014.

Table 4-1. Soil Vapor Extraction System Gas Sampling Results (Pretreatment[1])

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1040), 608 North First Street, Tacoma, Washington

Location	VE-1/2	VE-3/4	VE-SS	GAC Influent						
Date	7/5/18	7/5/18	7/5/18	10/15/14	3/13/15	6/30/15	2/26/16	8/30/16	10/26/17	7/5/18
Chemical	Well Screen Intervals 18 to 32 feet bgs	Well Screen Intervals 30 to 45 feet bgs	Sub-slab	Combined Flow Prior to Treatment[1]						
Chlorinated Volatile Organic Compounds										
Tetrachloroethene (PCE)	**96,000**	**26,000**	**1,200 ve**	**800,000**	**31,000**	**38,000**	**7,500**	**21,000**	**21,000 ve**	**9,900 ve**
Trichloroethene (TCE)	**450**	**1,300**	**29**	**2,000**	**2,400**	**2,100**	**580**	**1,100**	**1,300**	**440**
cis-1,2-Dichloroethene (cDCE)	**5,300**	**1,300**	<1.3 U	**1,500**	**2,200**	**1,400**	**550**	**790**	**740**	**390**
trans-1,2-Dichloroethene (tDCE)	<200 U	<99 U	<1.3 U	< 1300 U	< 73 U	< 66 U	< 20 U	< 40 U	< 9.9 U	<9.9 U
1,1-Dichloroethene	<200 U	<99 U	**4.6**	< 1300 U	< 73 U	< 66 U	< 20 U	< 40 U	< 9.9 U	<9.9 U
1,1,1-Trichloroethane	<270 U	<140 U	**4.8**	< 1800 U	< 100 U	< 91 U	< 27 U	< 55 U		<14 U
Vinyl chloride	**440**	<64 U	<0.84 U	< 820 U	< 47 U	< 43 U	< 13 U	< 26 U	< 6.4 U	<6.4 U
Carbon tetrachloride	<310 U	<310 U	**6.5**	< 2000 U	**160**	< 100 U	< 31 U	< 63 U		**22**
Chloroform	<24 U	**46**	**1.5**	< 1600 U	< 90 U	< 82 U	< 24 U	< 49 U		**15**
Methylene chloride	<43,000 U	<22,000 U	<290 U	< 1100 U	< 640 U	< 580 U	< 870 UJ	**10,000**		<2,200 U
1,4-Dichlorobenzene	<120 U	<60 U	**1.0**	< 1900 U	< 110 U	< 100 U	< 30 U	< 60 U		<6 U
Petroleum Hydrocarbons										
APH EC5-8 aliphatics[(3)]	<23,000 U	**40,000**	<150 U							**10,000**
APH EC9-12 aliphatics[(3)]	<17,000 U	<8,700 U	**1,200**							**2,000**
APH EC9-10 aromatics[(3)]	<12,000 U	<6,200 U	<82 U							<620 U
Benzene	<160 U	**190**	<1.1 U	< 1000 U	< 59 U	< 53 U	< 16 U	**160**	**130**	**58**
Toluene	<190 U	**280**	**4.5**	< 1200 U	< 69 U	< 63 U	< 19 U	**280**	**200**	**93**
Ethylbenzene	<220 U	<110 U	<1.4 U	< 1400 U	< 80 U	< 72 U	< 22 U	< 43 U	**13**	<11 U
Total Xylenes	<650 U	**650**	<4.3 U	< 1400 U	< 80 U	< 72 U	< 43 U	**211**	**335**	**210**
Naphthalene	<52 U	<26 U	**3.0 fb**				< 26 U	< 52 U	< 13 U	**3.5 fb**
1,2-Dibromoethane (EDB)	<38 U	<19 U	<0.56 U	< 2500 U	< 140 U	< 130 U	< 38 U	< 77 U		<1.9 U
1,2-Dichloroethane (EDC)	<20 U	<10 U	<0.24 U	< 1300 U	< 74 U	< 68 U	< 20 U	< 40 U	< 10 U	<1 U
Methyl tert-butyl ether (MTBE)	<900 U	<450 U	<5.9 U	< 1200 U	< 66 U	< 60 U	< 18 U	< 36 U		<45 U
Propene	<340 U	<170 U	<2.3 U				< 34 U	< 69 U		<17 U
Isobutene	<460 U	<230 U	<3 U				< 46 U	< 92 U		<23 U
Pentane	<1,500 U	<740 U	<9.7 U				**170**	**320**		**170**
Cyclopentane	<140 U	<72 U	<0.95 U				< 14 U	**48**		<7.2 U
n-Hexane	<1,800 U	<880 U	<12 U	< 1100 U	**640**	**260**	**230**	**550**		**150**
Cyclohexane	<3,400 U	<1,700 U	<23 U	< 1100 U	**370**	**160**	< 340 U	< 690 U		<170 U
Heptane				< 1300 U	**630**	**150**				
2,2,4-Trimethylpentane				< 1500 U	**2,700**	**1,500**				
Other Detected Volatile Organic Compounds										
Acetone	<2,400 U	<1,200 U	<16 U	< 3000 U	< 440 U	< 400 U	< 240 U	< 480 U		<120 U
Acrolein	<460 U	<230 U	<3 U				< 46 U	< 92 U		<23 U
CFC-113	<380 U	<190 U	**23**				< 38 U	< 77 U		**23**
Chlorodifluoromethane	<180 U	<88 U	**1.3**				< 18 U	< 35 U		<8.8 U
Dichlorodifluoromethane	<250 U	<120 U	**3.1**	< 1600 U	< 91 U	< 82 U	**29**	**55**		**38**
Ethanol	<3,800 U	<1,900 U	<25 U	< 2400 U	< 140 U	< 120 U	< 380 U	< 750 U		<190 U
2-Propanol	<4,300 U	<2,200 U	<28 U	< 3200 U	< 180 U	< 160 U	< 430 UJ	< 860 U		<220 U
Tetrahydrofuran				**1,600**	< 54 U	< 49 U				
Trichlorofluoromethane	<280 U	<140 U	**5.8**	< 1800 U	< 100 U	< 94 U	< 28 U	< 56 U		<14 U

APH air-phase hydrocarbons
bgs below ground surface
fb the analyte was detected in the method blank

J the value reported is an estimate (concentration is below lowest calibration standard)
U not detected at the indicated reporting limit
ve the value reported is an estimate (response exceeded the valid instrument calibration range)

Notes:
1) SVE gas samples were also collected from between and after the carbon vessels. Sampling results are provided in Appendix C, Table C-4.
2) All concentrations are in micrograms per cubic meter. Only analytes detected in at least one sample are included in this table. Detections are bolded.
3) All samples were analyzed by EPA Method TO-15 for volatile organic compounds (VOCs). Samples collected on 7/5/18 were also analyzed by Method MA-APH for aliphatic and aromatic hydrocarbons in the indicated carbon ranges. Non-petroleum compounds were subtracted from the EC5-8 aliphatic range prior to quantitation.

Table 6-1. Summary of Remedial Alternatives and Estimated Costs

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039), 608 North First Street, Tacoma, Washington

	Alternative 1 Long-Term Controls and Environmental Covenant[2]	Alternative 2 Expanded SVE of Accessible On-Property Soil Contamination, and Biostimulation of Advance Outwash Groundwater[2]	Alternative 3 ERH and SVE of Accessible On-Property Soil Contamination, and Biostimulation/HEPA of Advance Outwash Groundwater[2]	Alternative 4 ERH of Accessible On-Property Contaminated Soil and Advance Outwash Groundwater[2]	Alternative 5 Comprehensive ERH of On-Property Contaminated Soil and Advance Outwash Groundwater Following Building Demolition	Alternative 6 Removal of On-Property Contaminated Soil to 15-Foot Depth Following Building Demolition, and ERH of Deeper On-Property Contaminated Soil and Advance Outwash Groundwater
Elements of Remedial Alternative[1]	• Operate existing SVE system for 1 more year • Develop plans for cap I&M, vapor intrusion mitigation M&M, and groundwater monitoring • Install deep groundwater CPOC wells • Install radon fans for vapor intrusion mitigation • Implement cap I&M, vapor intrusion mitigation M&M, and groundwater monitoring • Develop and record environmental covenant	• Operate existing SVE system for 1 more year • Install and operate expanded SVE system to remediate contaminated on-property glacial till and advance outwash soils • Install additional groundwater monitoring/ biostimulation wells and conduct two more biostimulant injections • Develop plans for cap I&M, vapor intrusion mitigation M&M, and groundwater monitoring • Install deep groundwater CPOC wells • Install radon fans for vapor intrusion mitigation • Implement cap I&M, vapor intrusion mitigation M&M, and groundwater monitoring • Develop and record environmental covenant	• Operate existing SVE system for 1 more year • Install and operate expanded SVE system to remediate contaminated on-property advance outwash soils • Implement ERH to remediate contaminated on-property glacial till soils • Install additional groundwater monitoring/ biostimulation wells • Conduct biostimulant injection with HEPA to remediate contaminated on-property advance outwash groundwater • Develop plans for cap I&M, vapor intrusion mitigation M&M, and groundwater monitoring • Install deep groundwater CPOC wells • Install radon fans for vapor intrusion mitigation • Conduct groundwater monitoring to demonstrate compliance with cleanup levels • Implement cap I&M and vapor intrusion mitigation M&M • Develop and record environmental covenant	• Implement ERH to remediate contaminated on-property glacial till soils and advance outwash soils and groundwater • Develop plans for cap I&M, vapor intrusion mitigation M&M, and groundwater monitoring • Install deep groundwater CPOC wells • Install radon fans for vapor intrusion mitigation • Conduct groundwater monitoring to demonstrate compliance with cleanup levels • Implement cap I&M and vapor intrusion mitigation M&M • Develop and record environmental covenant	• Demolish Morrell's building to access underlying contaminated soils • Implement ERH to remediate on-property contaminated soils and advance outwash groundwater • Develop plans for groundwater monitoring and install deep groundwater CPOC wells • Conduct groundwater monitoring to demonstrate compliance with cleanup levels • Develop and record environmental covenant	• Demolish Morrell's building to access underlying contaminated soils • Remove contaminated soils to 15-foot depth and backfill with clean imported soil • Implement ERH to remediate deeper on-property contaminated soils and advance groundwater • Develop plans for groundwater monitoring and install deep groundwater CPOC wells • Conduct groundwater monitoring to demonstrate compliance with cleanup levels • Develop and record environmental covenant
Estimated Present Value Cost[3,4]	$600,000	$1,500,000	$3,100,000	$3,600,000	$2,800,000	$4,400,000

CPOC conditional point of compliance
ERH electrical resistance heating
HEPA heat-enhanced plume attenuation
I&M inspection and maintenance
M&M monitoring and maintenance
SVE soil vapor extraction

Notes:
1) Refer to Section 4.2 for descriptions of each remedial alternative.
2) It is assumed that the Morrell's building remains in place in Alternatives 1 through 4.
3) Present value costs are based on 2018 dollars, are calculated using a discount factor of 0.7 percent, and have an intended accuracy of -30/+50 percent. Costs are shown to two significant figures. Refer to Appendix D for itemized estimates.
4) The estimated costs of Alternatives 5 and 6 do not include loss of income generated by the existing building or the cost of constructing a new building.

Table 7-1. Evaluation of Remedial Alternatives for Threshold Criteria

Project No. 080190, Morrell's Dry Cleaners (VCP No. SW1039), 608 North First Street, Tacoma, Washington

Remedial Alternative[1]	Protection of Human Health and the Environment	Compliance with Cleanup Standards and Applicable Laws	Provision for Compliance Monitoring	Conclusions
Alternative 1 Long-Term Controls and Environmental Covenant[2]	Provides engineering controls to mitigate indoor air exposure pathway and provides environmental covenant to restrict access to and use of impacted media. Controls and restrictions would remain in place *in perpetuity* .	Leaves soil and groundwater contamination above cleanup levels.	Environmental covenant would require compliance monitoring. Compliance monitoring points could be defined in downgradient wells in lower water bearing unit.	Retained
Alternative 2 Expanded SVE of Accessible On-Property Soil Contamination, and Biostimulation of Advance Outwash Groundwater[2]	Active remedial technologies would reduce contaminant concentrations in soil and groundwater, but with limited effectiveness. Provides engineering controls to mitigate indoor air exposure pathway and provides environmental covenant to restrict access to and use of impacted media. Controls and restrictions would remain in place to protect human health and the environment for as long as necessary.	Significant further reductions in contaminant concentrations in soil and groundwater, but cleanup levels are unlikely to be achieved in either media due to limitations in SVE technology to fully treat soil, and the likelihood that residual impacted soil will continue to serve as a source of groundwater contamination.	Environmental covenant would require compliance monitoring. Compliance monitoring points could be defined in downgradient wells in lower water bearing unit.	Retained
Alternative 3 ERH and SVE of Accessible On-Property Soil Contamination, and Biostimulation/HEPA of Advance Outwash Groundwater[2]	Soil treatment is likely to have limited effectiveness. Provides environmental covenant to restrict access to and use of impacted media and vapor intrusion mitigation if necessary. Controls and restrictions would remain in place to protect human health and the environment for as long as necessary.	Extensive further reductions in contaminant concentrations in soil and groundwater, but soil cleanup levels are unlikely to be achieved due to: a) limitations in SVE technology to fully treat soil; and b) Morrell's building will limit access to underlying soil contamination.	Environmental covenant would require compliance monitoring. Compliance monitoring points could be defined in downgradient wells in lower water bearing unit.	Retained
Alternative 4 ERH of Accessible On-Property Contaminated Soil and Advance Outwash Groundwater[2]	Soil treatment is likely to have limited effectiveness. Provides environmental covenant to restrict access to and use of impacted media and vapor intrusion mitigation if necessary. Controls and restrictions would remain in place to protect human health and the environment for as long as necessary.	Extensive further reductions in contaminant concentrations in soil and groundwater, but soil cleanup levels are unlikely to be achieved because Morrell's building will limit access of ERH to underlying soil contamination.	Environmental covenant would require compliance monitoring. Compliance monitoring points could be defined in downgradient wells in lower water bearing unit.	Retained
Alternative 5 Comprehensive ERH of On-Property Contaminated Soil and Advance Outwash Groundwater Following Building Demolition	ERH will likely eliminate the need for on-property vapor intrusion mitigation and effectively reduce contaminant concentrations in all media. Provides environmental covenant to restrict access to and use of any residual impacted media and vapor intrusion mitigation if necessary. Controls and restrictions would remain in place to protect human health and the environment for as long as necessary.	Cleanup levels are expected to be achieved provided that ERH technology is well-designed and aggressively executed.	Environmental covenant would require compliance monitoring. Compliance monitoring points could be defined in downgradient wells in lower water bearing unit.	Retained
Alternative 6 Removal of On-Property Contaminated Soil to 15-Foot Depth Following Building Demolition, and ERH of Deeper On-Property Contaminated Soil and Advance Outwash Groundwater	Soil removal and ERH will likely eliminate the need for on-property vapor intrusion mitigation and effectively reduce contaminant concentrations in all media. Provides environmental covenant to restrict access to and use of any residual impacted media and vapor intrusion mitigation if necessary. Controls and restrictions would remain in place to protect human health and the environment for as long as necessary.	Cleanup levels are expected to be achieved provided that ERH technology is well-designed and aggressively executed.	Environmental covenant would require compliance monitoring. Compliance monitoring points could be defined in downgradient wells in lower water bearing unit.	Retained

Notes:

1) Refer to Section 4.2 for descriptions of each remedial alternative.

2) It is assumed that the Morrell's building remains in place in Alternatives 1 through 4.

Table 7-2 - Disproportionate Cost Analysis

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039), 608 North First Street, Tacoma, Washington

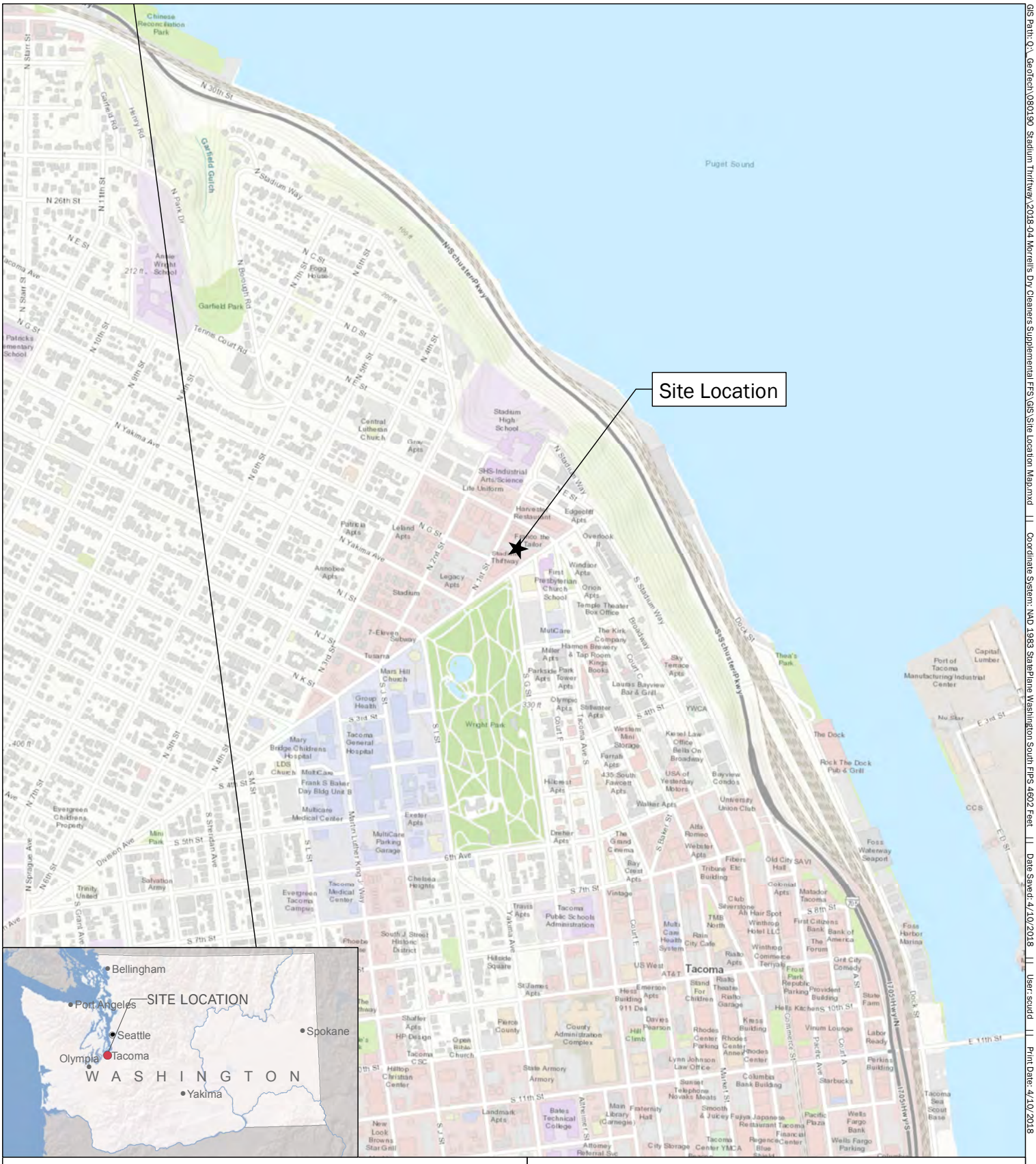
		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
		Long-Term Controls and Environmental Covenant	**Expanded SVE of Accessible On-Property Soil Contamination, and Biostimulation of Advance Outwash Groundwater**	**ERH and SVE of Accessible On-Property Soil Contamination, and Biostimulation/HEPA of Advance Outwash Groundwater**	**ERH of Accessible On-Property Contaminated Soil and Advance Outwash Groundwater**	**Comprehensive ERH of On-Property Contaminated Soil and Advance Outwash Groundwater Following Building Demolition**	**Removal of On-Property Contaminated Soil to 15-Foot Depth Following Building Demolition, and ERH of Deeper On-Property Contaminated Soil and Advance Outwash Groundwater**
Criteria to Evaluate Use of Permanent Solutions to the Maximum Extent Practicable	Protectiveness (30% weighting factor)	Site risks are low, but long-term protectiveness relies on institutional controls and environmental covenant. (2)	Expanded SVE and biostimulation is expected to reduce reliance on institutional controls and environmental covenant for protectiveness. (3)	Groundwater cleanup levels may be achieved in this alternative, but an environmental covenant and institutional controls addressing soil contamination would likely still be required. (4)	Groundwater cleanup levels may be achieved in this alternative, but an environmental covenant and institutional controls addressing soil contamination would likely still be required. (4)	Alternatives 5 and 6 are expected to have the least reliance on institutional controls and environmental covenant for long-term protectiveness. (5)	Alternatives 5 and 6 are expected to have the least reliance on institutional controls and environmental covenant for long-term protectiveness. (5)
	Permanence (20% weighting factor)	Only a relatively minor amount of additional mass would be removed in this alternative (1).	Expanded SVE and biostimulation would remove significant additional contaminant mass relative to Alternative 1. (3)	Contaminant mass removal is expected to be more complete than in Alternative 2, but residual near-surface soil contamination is expected beneath building. (4)	Permanence is expected to be similar to Alternative 3. (4)	ERH is expected to be highly effective at removing contaminant mass. (5)	Soil removal and ERH are expected to be highly effective at removing contaminant mass. (5)
	Long-Term Effectiveness (20% weighting factor)	Exposure to residual contamination is addressed through institutional controls and an environmental covenant, which are considered to have relatively low long-term effectiveness. (1)	The additional contaminant mass removal achieved in this alternative may result in greater long-term effectiveness relative to Alternative 1. (2)	The additional contaminant mass removal achieved in this alternative may result in greater long-term effectiveness relative to Alternative 2. (4)	Long-term effectiveness is expected to be similar to Alternative 3. (4)	The additional contaminant mass removal achieved in this alternative may result in greater long-term effectiveness relative to Alternatives 3 and 4. (5)	Long-term effectiveness is expected to be similar to Alternative 5. (5)
	Short-Term Risk Management (10% weighting factor)	Short-term risks can be effectively managed in this alternative. (5)	Increased short-term risks relative to Alternative 1, due primarily to the large drilling component of this alternative (48 new wells assumed). (4)	Drilling component is larger than in Alternative 2, plus additional short-term risks associated with thermal remediation. (3)	Short-term risks are expected to be similar to Alternative 3. (3)	Short-term risks are expected to be similar to Alternatives 3 and 4. (3)	The soil removal component of this alternative may increase exposure risks to construction workers and the public relative to Alternative 5. (2)
	Implementability (10% weighting factor)	The siting and installation of CPOC wells in the City of Tacoma right-of-way and development/recording of an environmental covenant are likely to have implementation challenges. (4)	In addition to the challenges noted for Alternative 1, installing angled wells beneath the Morrell's building (22 angled wells assumed) would be technically and administratively challenging. (3)	Implementation of *in situ* technologies beneath the Morrell's building in this alternative would have major technical challenges. (2)	Implementation of ERH beneath the Morrell's building in this alternative would have major technical challenges. (2)	Implementation of ERH would be more straightforward than in Alternative 4 since the Morrell's building would be removed first. (3)	Implementability is expected to be similar to Alternative 5. (3)
	Public Concerns (10% weighting factor)	Based on public response to investigation and cleanup activities completed to date, this alternative is unlikely to generate significant public concerns. (4)	Construction would likely require temporary closure of North First St. and the grocery store parking lot, which would generate short-term public concerns. (3)	The larger scope of construction in this alternative would likely generate more public concerns than Alternative 2. (2)	Since the scope of construction in this alternative is similar to that of Alternative 3, public concerns would likely also be similar. (2)	Since the scope of construction in this alternative is similar to that of Alternative 4, public concerns would likely also be similar. (2)	The soil removal component of this alternative may generate increased public concerns (truck traffic; vapor emissions) relative to Alternative 5. (1)
MTCA Benefits Ranking[2]		2.3	2.9	3.5	3.5	4.3	4.1
Estimated Cost[3,4]		$600,000	$1,500,000	$3,100,000	$3,600,000	$2,800,000	$4,400,000
Benefit/Cost Ratio[5]		**3.8**	**1.9**	**1.1**	**1.0**	**1.5**	**0.9**

Notes:

CPOC conditional point of compliance ERH electrical resistance heating MTCA Model Toxics Control Act SVE soil vapor extraction

1) A numeric scale of 1 to 5 is used to rate the alternatives with respect to the criteria to evaluate use of permanent solutions to the maximum extent practicable, as follows:
   1 - meets criterion to a very low degree
   2 - meets criterion to a low degree
   3 - meets criterion to a moderate degree
   4 - meets criterion to a high degree
   5 - meets criterion to a very high degree
2) The MTCA benefits ranking is obtained by multiplying the rating for each criterion by its weighting factor, and summing the results for the six criteria.
3) Costs are estimated in 2018 dollars. The costs shown are rounded to two significant figures. Itemized estimates are provided in Appendix D.
4) The estimated costs of Alternatives 5 and 6 do not include loss of income generated by the existing building or the cost of constructing a new building.
5) The benefit/cost ratio is obtained by dividing the alternative's MTCA benefits ranking by its estimated cost (in $million).

FIGURES



Site Location Map

Supplemental Focused Feasibility Study
Morrell's Dry Cleaners (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

Aspect CONSULTING	APR-2018	BY: DAH/SCC	FIGURE NO. 1-1
	PROJECT NO. 080190	REV BY: SCC	

GIS Path: Q:_GeoTech\080190 Stadium Thriftway\2018-04 Morrell's Dry Cleaners Supplemental FFS\GIS\Site Location Map.mxd || Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet || Date Saved: 4/10/2018 || User: scudd || Print Date: 4/10/2018

TACOMA AVENUE

4 THE BOYS COMPANY, LLC
T.P.N. 2030-12-0012

STADIUM, LLC
T.P.N. 2030-12-0013

MORRELL'S
DRY CLEANERS

MORRELL'S
BUILDING PARCEL
T.P.N. 2030-12-0031

TEASE
CHOCOLATES

MORRELL'S
PARKING LOT PARCEL
T.P.N. 2030-12-0033

NORTH FIRST STREET

DIVISION AVENUE

MW-13D MW-4 MW-12D MW-9 MW-10 MW-6 MW-14D MW-3 MW-5 MW-21 MW-8D MW-7

TRENCH-BT-W TRENCH-BT-C TRENCH-BT-E

DP-04 DP-05 GW-8 PW-3/GW-7 F-12/ F-20 R-12/ R-18 DP-01 DP-02 DP-07 DP-09 DP-13 DP-14 DC-1 DC-PLAS-2 DP-12 DP-08 DP-10 DP-11 T-1 B-1 DP-17 DP-16 DP-15

A A' B B'

LEGEND

- Soil Sample Location
- Monitoring Well Location
- Decommissioned Monitoring Well Location
- Reconnaissance Groundwater Sample Location
- Parcel Boundaries
- Property Boundary
- A A' Cross Section Location

0 30 60 Feet

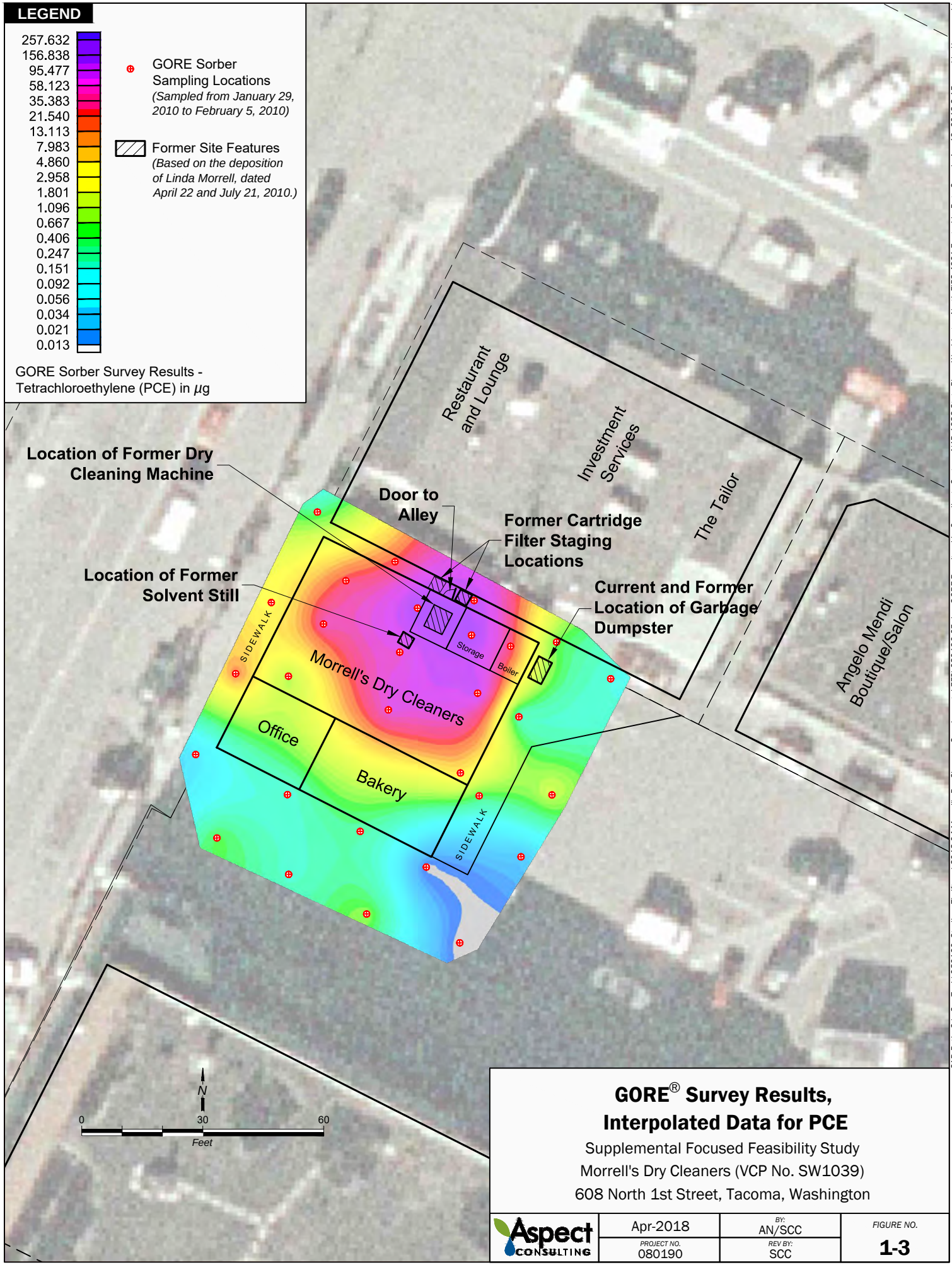
Site Plan Showing
Pre-2013 Explorations
Supplemental Focused Feasibility Study
Morrell's Dry Cleaner (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

FIGURE NO.
1-2

Aspect CONSULTING

DATE: May-2018 | REVISION: - | PROJECT NUMBER: 080190 | DESIGNED BY: DAH | DRAWN BY: SCC | REVISED BY: SCC | Date Saved: May 08, 2018 2:59pm | User: scott

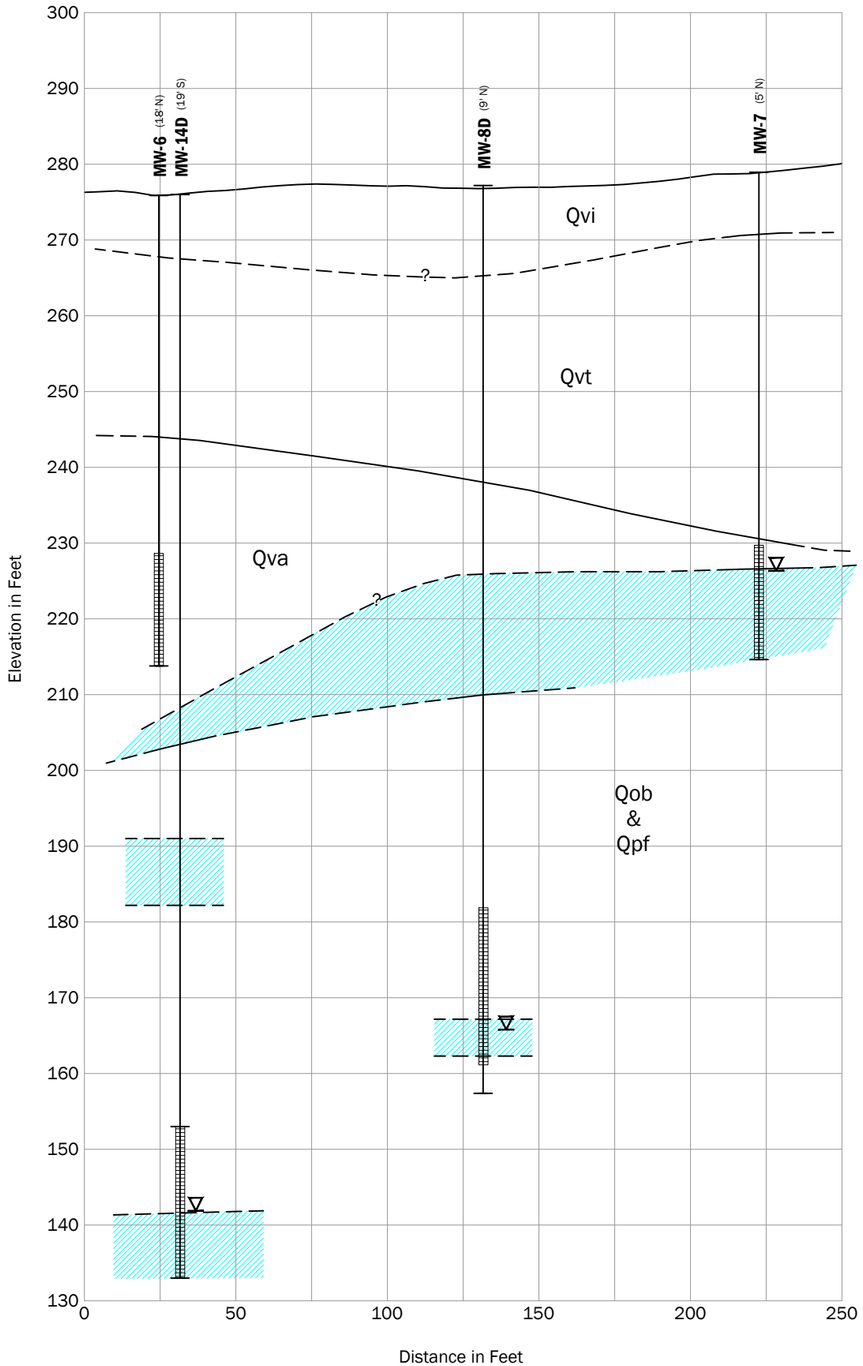
CAD Path: Q:_Dec\Tech\080190 Stadium Trim\Rev_2018-04 Morrells Dry Cleaners Supplemental FFS\080190-03 Site Plan and GW.dwg 1:2 Site Plan Pre-2013 Explorations | Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet

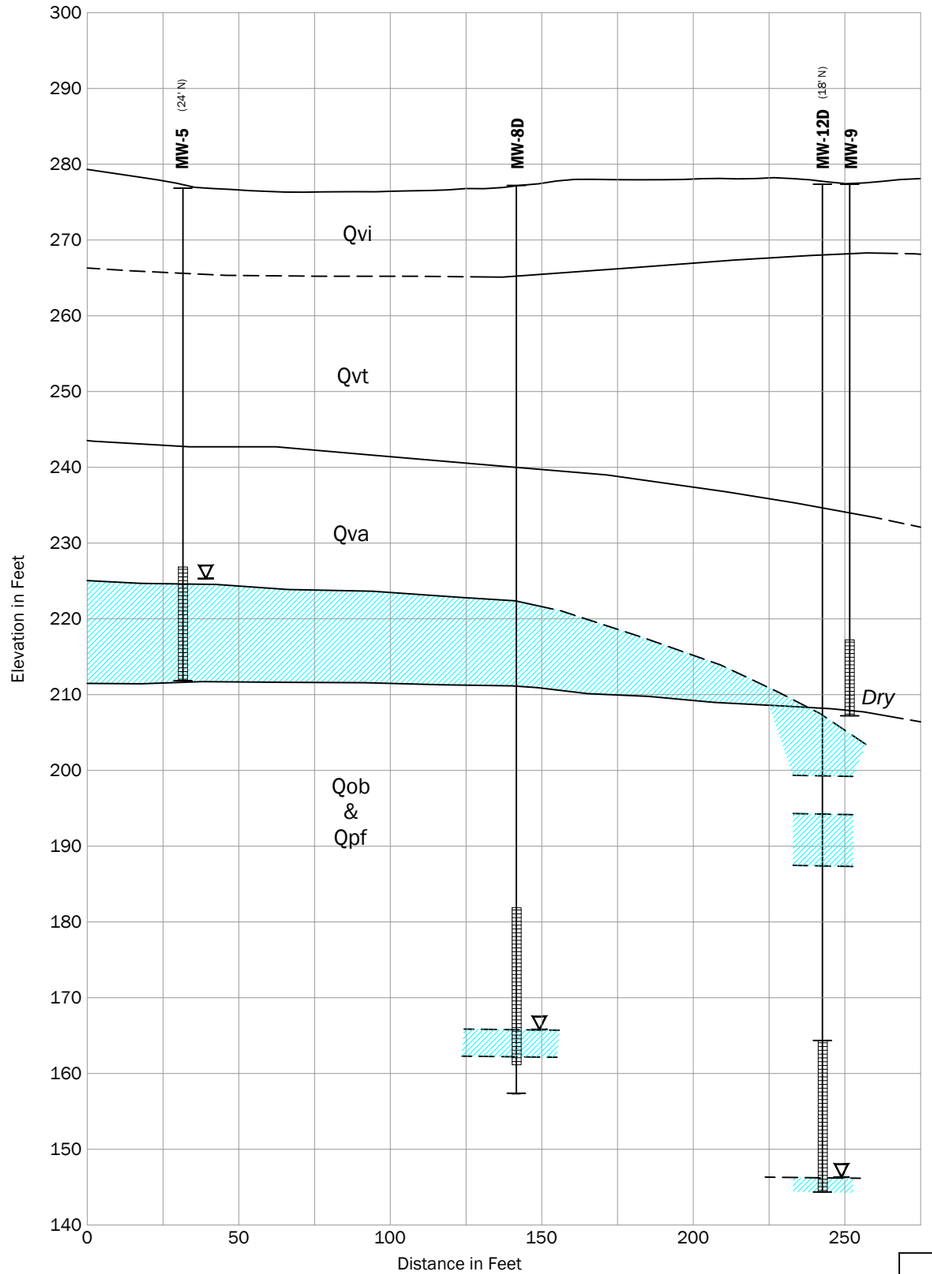


GORE® Survey Results, Interpolated Data for PCE

Supplemental Focused Feasibility Study
Morrell's Dry Cleaners (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

Aspect Consulting	Apr-2018	BY: AN/SCC	FIGURE NO. 1-3
	PROJECT NO. 080190	REV BY: SCC	





LEGEND

MW-8 (45' NW) — Monitoring Well Location and Designation

Water Level (Dec 2010)

Screened Interval

Saturated Interval

Qvi - Vashon Stade Ice-Contact Deposits

Qvt - Vashon Stade Glacial-Till Deposits

Qva - Advance Outwash Deposits

Qob - Olympia Bed Interglacial Deposits

Qpf - Pre-Fraser Glacial and Interglacial Deposits

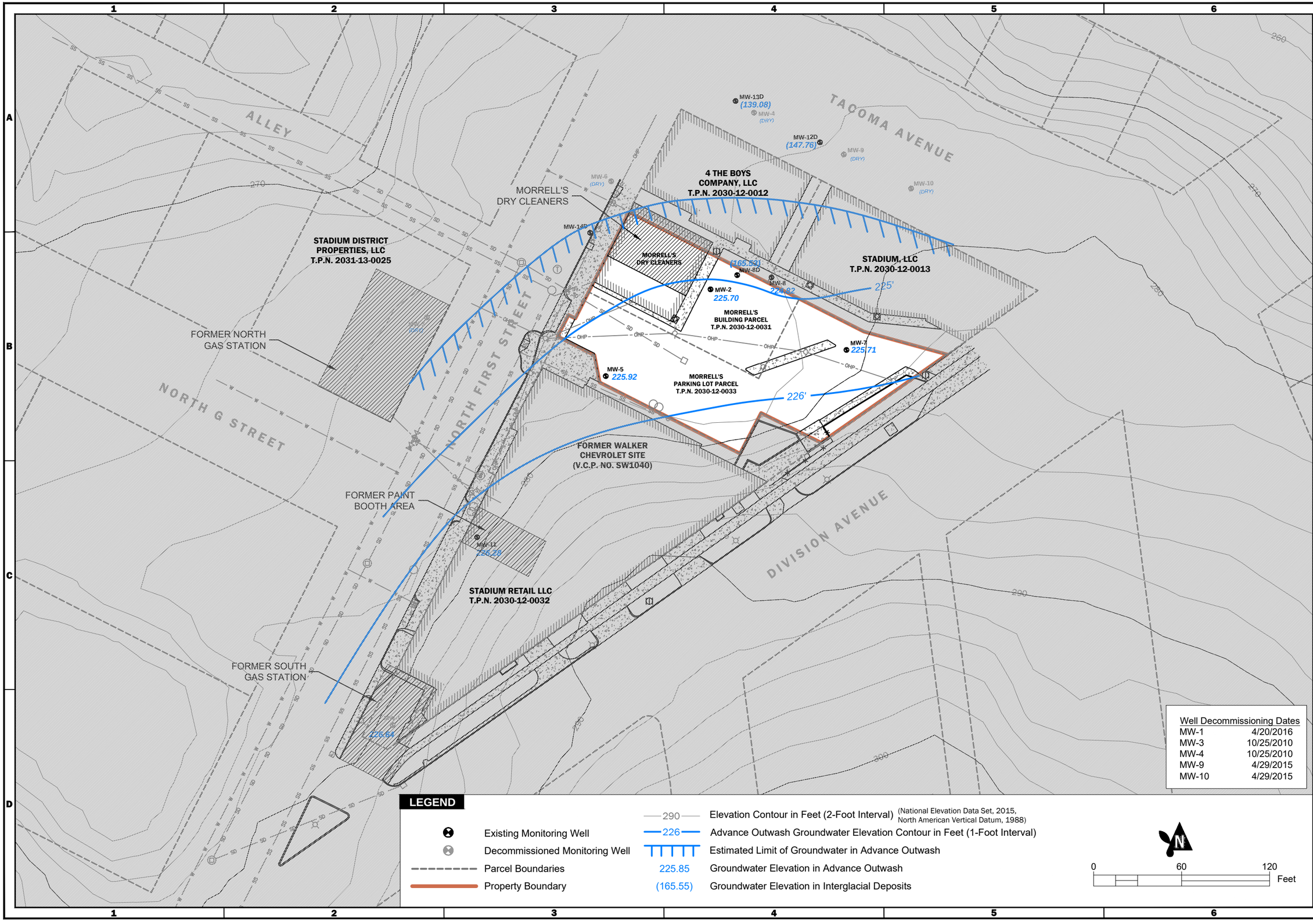
Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 20'
Vertical Exaggeration 2.5x

0 50 100 Feet

Cross Sections A-A' and B-B'

Supplemental Focused Feasibility Study
Morrell's Dry Cleaners (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

Aspect Consulting	Apr-2018	BY: DAH/SCC	FIGURE NO. 2-1
	PROJECT NO. 080190	REVISED BY: SCC	



Well Decommissioning Dates	
MW-1	4/20/2016
MW-3	10/25/2010
MW-4	10/25/2010
MW-9	4/29/2015
MW-10	4/29/2015

LEGEND

- Existing Monitoring Well
- Decommissioned Monitoring Well
- Parcel Boundaries
- Property Boundary
- 290 — Elevation Contour in Feet (2-Foot Interval) (National Elevation Data Set, 2015, North American Vertical Datum, 1988)
- 226 — Advance Outwash Groundwater Elevation Contour in Feet (1-Foot Interval)
- Estimated Limit of Groundwater in Advance Outwash
- 225.85 — Groundwater Elevation in Advance Outwash
- (165.55) — Groundwater Elevation in Interglacial Deposits

0 60 120 Feet

Groundwater Elevations & Gradient Map in Advance Outwash-December 22, 2010
Supplemental Focused Feasibility Study
Morrell's Dry Cleaners (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

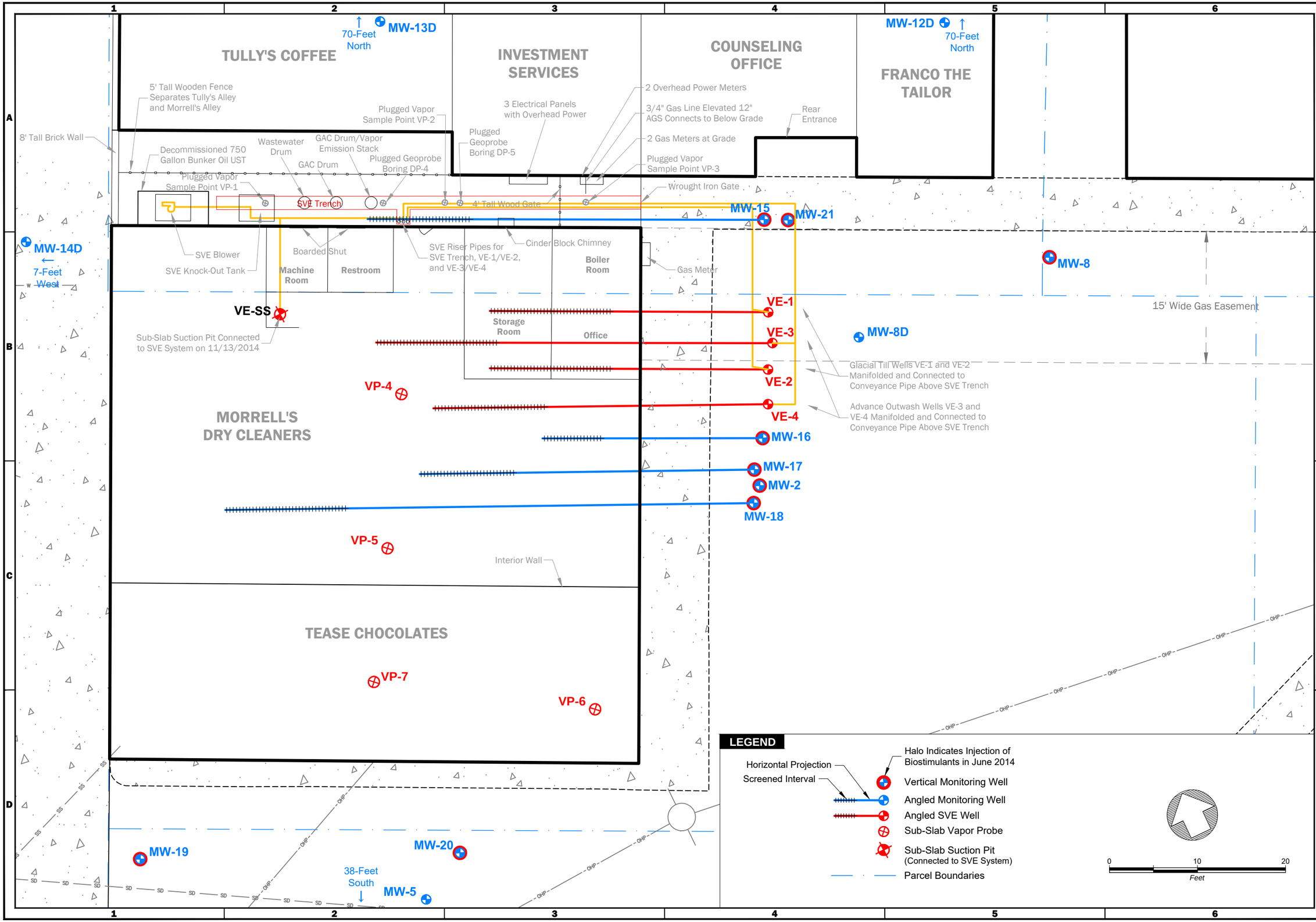
FIGURE NO.
2-2

Aspect CONSULTING

DESIGNED BY: AN | DRAWN BY: SCC | REVISED BY: SCC
PROJECT NUMBER: 080190 | REVISION: - | DATE: May-2018

REV.	DESCRIPTION	DATE	APPR
-	-	-	-

CAD Path: Q:_DevTech\080190 Stadium Thriftway\2018-04 Morrell's Dry Cleaners Supplemental FFS\080190-02 Site Map and GW.dwg 2-2 GW Gradient Map 12-10 | Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet | Date Saved: May 08, 2018 2:54pm | User: scudd



Aspect CONSULTING

2014 Interim Action

Supplemental Focused Feasibility Study
Morrell's Dry Cleaners (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

FIGURE NO.

4-1

DESIGNED BY: AN
DRAWN BY: SCC
REVISED BY:
REVISION: -
PROJECT NUMBER: 080190
DATE: Apr-2018

APPR. | DATE | DESCRIPTION | REV.

CAD Path: Q:_Geo Rech\080190 Stadium Thriftway 2018\04 Morrells Dry Cleaners Supplemental FFS\080190-04 Remediation Area.dwg 4-1-2014 Interim Action || Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet || Date Saved: Apr 11, 2018 12:07pm || User: scudd

LEGEND

- Vertical Monitoring Well
- Angled Monitoring Well
- Angled SVE Well
- Sub-Slab Vapor Probe
- Sub-Slab Suction Pit (Connected to SVE System)
- Parcel Boundary
- Property Boundary
- Estimated Extent of On-Property Advance Outwash Groundwater with Cleanup Level Exceedances
- Estimated Extent of On-Property Vadose Zone Soil with Cleanup Level Exceedances

(Note 1)
Only two on-property wells (MW-8D and MW-14D) are screened deeper than the advance outwash, and cleanup level exceedances have been observed in both. The extents of cleanup level exceedances in deeper groundwater is unknown.

0 30 60 Feet

TACOMA AVENUE

4 THE BOYS COMPANY, LLC
T.P.N. 2030-12-0012

STADIUM, LLC
T.P.N. 2030-12-0013

MORRELL'S
DRY CLEANERS

MORRELL'S
BUILDING PARCEL
T.P.N. 2030-12-0031

MORRELL'S
PARKING LOT PARCEL
T.P.N. 2030-12-0033

TEASE CHOCOLATES

NORTH FIRST STREET

DIVISION AVENUE

MW-13D, MW-12D, MW-25, MW-21, MW-8, MW-8D (Note 1), MW-14D (Note 1), MW-7, MW-16, MW-17, MW-2, MW-18, MW-19, MW-20, MW-5

VE-SS, VE-1, VE-3, VE-2, VE-4

VP-4, VP-5, VP-7, VP-6

OHP, SD, SS, W

Aspect CONSULTING

Assumed Areal Extent of On-Property Cleanup Level Exceedances
Supplemental Focused Feasibility Study
Morrell's Dry Cleaner (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

FIGURE NO.
5-1

REV:	DESCRIPTION	DATE	APPR

DESIGNED BY: DAH
DRAWN BY: SCC
REVISED BY: SCC
PROJECT NUMBER: 080190
REVISION: -
DATE: May-2018

CAD Path: Q:_Geo\fcm\080190 Stadium Thriftway\2018-04 Moments Dry Cleaners Supplemental FFS\080190-03 Site Plan and GW.dwg,5-1 Areal Extent Exceedances | Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet | Date Saved: May 11, 2018 3:58pm | User: scudd

LEGEND

- New Monitoring/Remediation Well, Conceptual Layout
- Existing Vertical Well
- Existing Angled Well
- Existing Sub-Slab Vapor Probe
- Existing Sub-Slab Suction Pit (Connected to SVE System)
- Parcel Bounday
- Property Boundary
- On-Property Parcel Boundary
- Estimated Extent of On-Property Advance Outwash Groundwater with Cleanup Level Exceedances
- Estimated Extent of On-Property Vadose Zone Soil with Cleanup Level Exceedances

0 30 60 Feet

TACOMA AVENUE

4 THE BOYS COMPANY, LLC
T.P.N. 2030-12-0012

STADIUM, LLC
T.P.N. 2030-12-0013

MORRELL'S DRY CLEANERS

MORRELL'S BUILDING PARCEL
T.P.N. 2030-12-0031

MORRELL'S PARKING LOT PARCEL
T.P.N. 2030-12-0033

TEASE CHOCOLATES

NORTH FIRST STREET

DIVISION AVENUE

MW-13D, MW-12D, MW-15, MW-21, MW-8, MW-9D, VE-SS, VE-1, VE-3, VE-2, VE-4, MW-16, MW-17, MW-2, MW-18, VP-4, VP-5, VP-7, VP-6, MW-14D, MW-7, MW-19, MW-20, MW-5

OHP, SD, SS, W

Aspect CONSULTING

Conceptual Well Layout for Parking Lot Parcel Investigation/Remediation
Supplemental Focused Feasibility Study
Morrell's Dry Cleaner (VCP No. SW1039)
608 North 1st Street, Tacoma, Washington

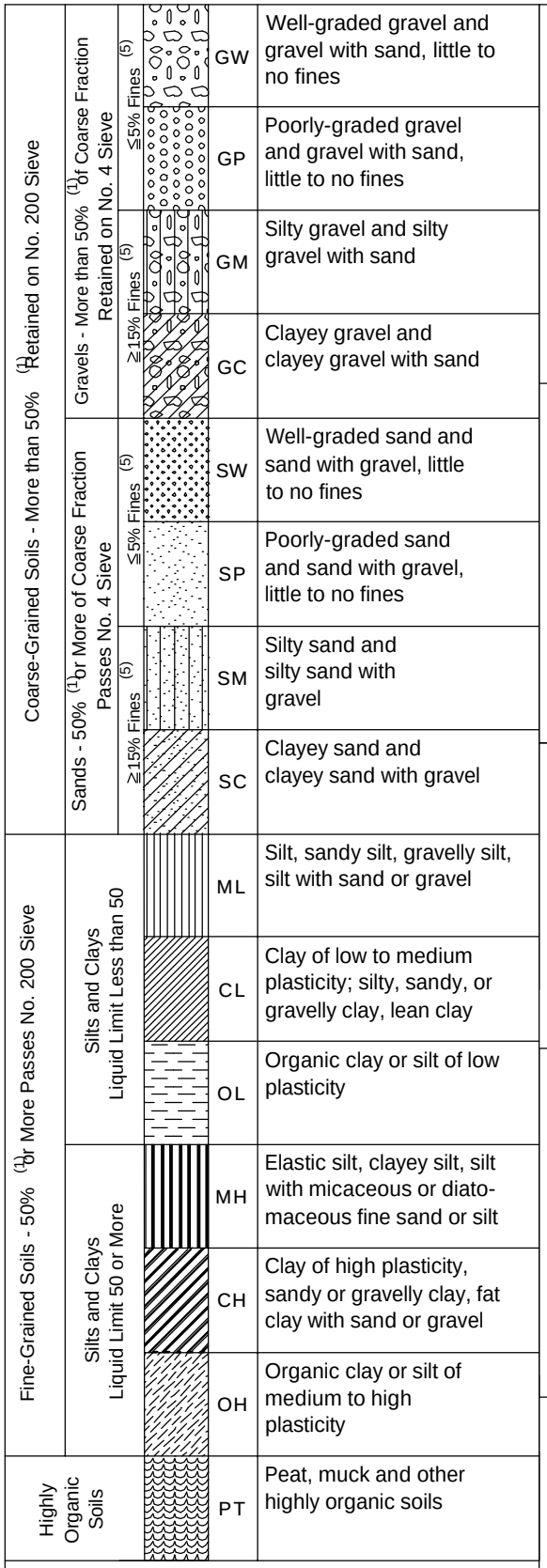
FIGURE NO.
8-1

DESIGNED BY: DAH | DRAWN BY: SCC | REVISED BY: SCC
PROJECT NUMBER: 080190 | REVISION: - | DATE: May-2018
APPR. | DATE | DESCRIPTION | REV.

CAD Path: Q:_Geofech\080190 Stadium Thriftway-2018-04 Morrell's Dry Cleaners Supplemental FFS\080190-03 Site Plans and GW.dwg & 1 Conceptual Well Layout | | Coordinate System: NAD 1983 State Plane Washington North FIPS 4601 Feet | | Date Saved: May 18, 2018 4:39pm | | User: scudd

APPENDIX A

Boring and Well Construction Logs



Terms Describing Relative Density and Consistency

	Density	SPT (2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT (2) blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

FC = Fines Content
G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Consolidation
DD = Dry Density
K = Permeability
Str = Shear Strength
Env = Environmental
PiD = Photoionization Detector

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

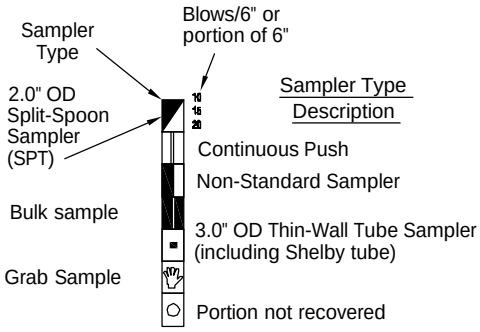
(3) Estimated Percentage

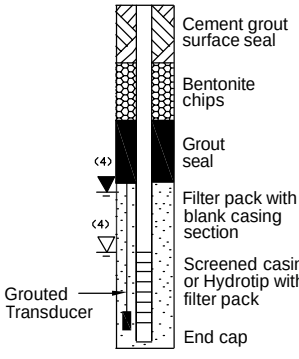
Percentage by Weight	Modifier
<5	Trace
5 to 15	Slightly (sandy, silty, clayey, gravelly)
15 to 30	Sandy, silty, clayey, gravelly)
30 to 49	Very (sandy, silty, clayey, gravelly)

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of groundwater — ATD = At time of drilling; Static water level (date); BGS = below ground surface
(5) Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Aspect CONSULTING

Exploration Log Key

DATE:
DESIGNED BY:
DRAWN BY:
REVISED BY:

PROJECT NO.

FIGURE NO.
B-1

Q:_ACAD Standards\Standard Details\Exploration Log Key B1.dwg

Holt Drilling A Division of Boart Longyear Company

MW-1

Resource Protection Well Report

Project Name BRUCE TITUS CHEV

Date 1-22-07

Well Identification # ALM-064

County PIERCE SE 1/4 SE 1/4

Drilling Method SONIC 6"

Section 32 T 21N R 3E

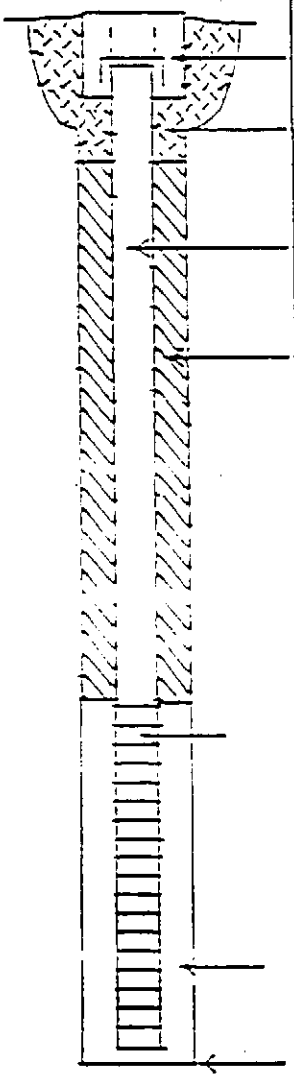
Driller Ken Phillips

Street Address 630 STADIUM WY

License # 2652

Start Card R-70639

Consulting Firm STEMEN ENV.



AS-BUILT

WELL DATA

ALM-

MONUMENT: 8" FLUSH

CONCRETE SURFACE SEAL: 2 FT

RISER: 2" x 60'

BACKFILL: FT

TYPE: 3/8 CHIPS

SCREEN: 2" x 15'

TYPE: PVC

SLOT SIZE: .020

SAND PACK: 17'

MATERIAL: 10x20 SILICA

WELL DEPTH: 65'

FORMATION DESCRPITION

0-15' FT
BROWN SILTY SAND + GRAVEL FILL 20-30% ~~SAND~~ FINES
FT

15-50' FT
GREY SILTY SAND TO SANDY SILT WITH OCCASSIONAL LARGE GRAVELS VERY DENSE DRY (TILL)
FT

50-65 FT
ORANGE/BROWN SAND MEDIUM DENSE TO DENSE WET @ 54' TURNING GREY IN COLOR @ 60' FT

REMARKS

Signature

Holt Drilling A Division of Boart Longyear Company

MW-2

Resource Protection Well Report

Project Name BRUCE TITUS CHEV

Well Identification # ALM-#69

Drilling Method SONIC 6"

Driller Ken Phillips

License # 2652

Date 1-22-07

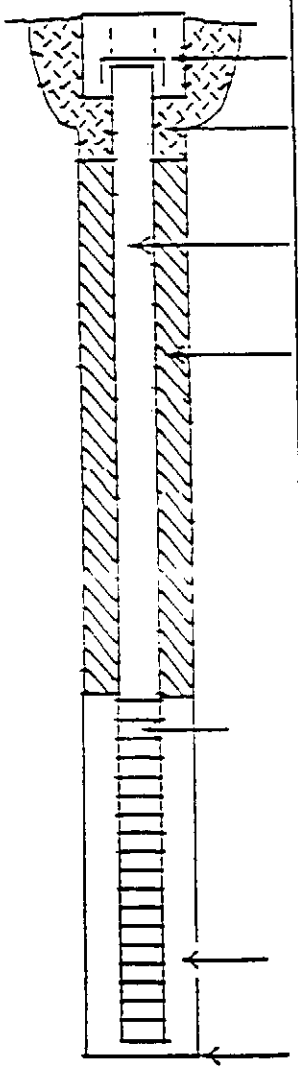
County PIERCE SE 1/4 SE 1/4

Section 32 T 21N R 3E

Street Address 630 STADIUM WY

Start Card R-70639

Consulting Firm STEMEN ENV.



AS-BUILT	WELL DATA	FORMATION DESCRPITION
	ALM-169	
	MONUMENT: 8" FLUSH	0-15' FT BROWN SILTY SAND + GRAVEL FILL 20-30% ~~SAND~~ FINES FT
	CONCRETE SURFACE SEAL: 2 FT	
	RISER: 2 "x 50'	
	BACKFILL: FT TYPE: 3/8 CHIPS	15-50' FT GREY SILTY SAND TO SANDY SILT WITH OCCASSIONAL LARGE GRAVELS VERY DENSE DRY (TILL) FT
		50-65 FT ORANGE/BROWN SAND MEDIUM DENSE TO DENSE WET @ 54' TURNING GREY IN COLOR @ 60' FT
	SCREEN: 2"x 15'	
	TYPE: PVC	
	SLOT SIZE: .020	
	SAND PACK: 17'	
	MATERIAL: 10x20 SILICA	REMARKS
	WELL DEPTH: 65'	

Signature K L Phillips

Holt Drilling A Division of Boart Longyear Company

Resource Protection Well Report

MW-3

Project Name BRUCE TITUS CHEV

Well Identification # ALM-068

Drilling Method SONIC 6"

Driller Ken Phillips

License # 2652

Date 2-1-07

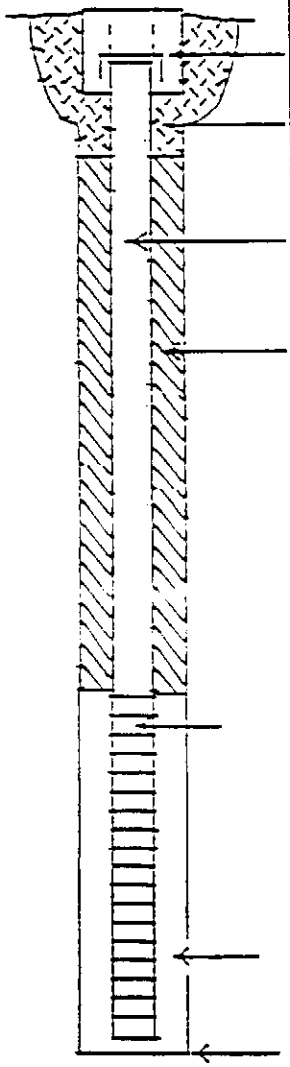
County PIERCE SE 1/4 SE 1/4

Section 32 T 21N R 3E

Street Address 633 DIVISION

Start Card R70639

Consulting Firm STEMEN ENVIORMENTAL



AS-BUILT	WELL DATA	FORMATION DESCRPITION
	MONUMENT: 8" FLUSH	0-3 FT 2" ASPHALT BROWN COARSE SAND T GRAVEL 20-30% FINES (FILL) FT
	CONCRETE SURFACE SEAL: 2 FT	
	RISER: 2 "x 52'	
	BACKFILL: 48 FT TYPE: 3/8" CHIPS	3-54 FT GREY TO BROWN SILTY FINE SAND VERY DENSE DRY OCCASIONAL 20-30% FINES (TILL) 54-65 FT MOIST BROWN SAND MEDIUM DENSE 10-15% FINES
	SCREEN: 2 "x 15'	65-67 FT GREY VERY DENSE GREY SILTY FINE SAND WITH GRAVELS (TILL) FT
	TYPE: FACTORY FLUSH	
	SLOT SIZE: .020	
	SAND PACK: 17'	
	MATERIAL: 10x20 SILICA	REMARKS
	WELL DEPTH: 67'	

Signature

BOART LONGYEAR E & I

MW-4

Resource Protection Well Report

Project Name Stadium Thriftway

Well Identification # BAM 164

Drilling Method Sonic

Driller Thomas W. Croney

License # 2409

Date 1/9/08

County Pierce, NW¼ SE ¼

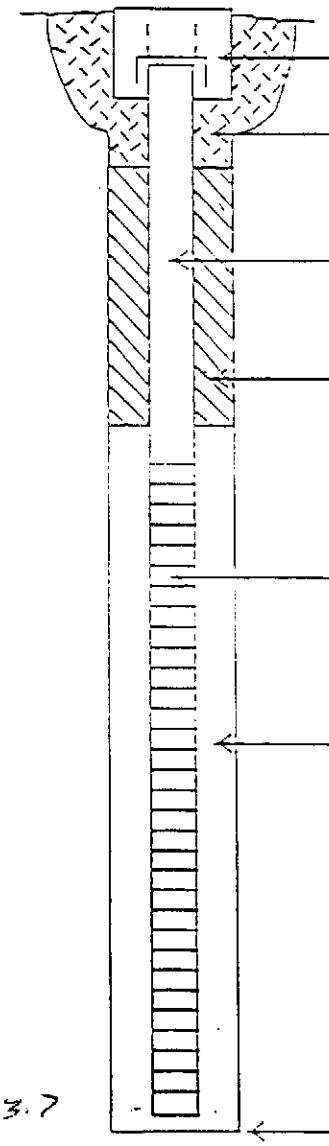
Section 32 T. 21N R. 3E

Street Address N 1st N Tacoma Ave

Start Card # 70843

Consulting Firm Stemen ENV

AS-BUILT | WELL DATA | FORMATION DESCRIPTION



MONUMENT TYPE: flush

CONCRETE SURFACE SEAL: 1-5 ±

PVC BLANK: 2 "40

39 - neat cement

BACKFILL: 4 feet

TYPE: Bentonite

PVC SCREEN: 2 inch 15 feet

SLOT SIZE: 10

TYPE: flush thread

GRAVEL PACK: 18 ±

MATERIAL: 10 20 silica

WELL DEPTH: 63.7 ft

0 - .52 ± Med Brn till U- Dense

.52 - 61 ± Compact Sand. Lt Brn gravel

61 - 65 ± compact grey till

REMARKS

Signature Thomas W. Croney

BOART LONGYEAR E & I

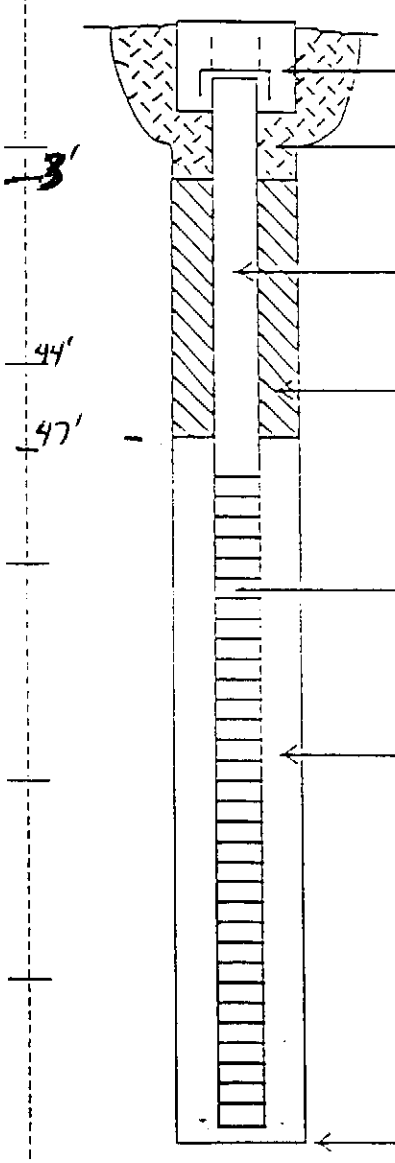
MW-5

Resource Protection Well Report

Project Name Stadium Thriftway
Well Identification # BAM 168
Drilling Method Sonic
Driller Thomas Craney
License # 2409

Date 1-11-08
County Pierce NW ¼ SE ¼
Section 32 T. 21 N R. 3E
Street Address N. 1st ST & N. Tacoma AVE
Start Card R 70822
Consulting Firm Stemen Env.

AS-BUILT | WELL DATA | FORMATION DESCRIPTION



MONUMENT TYPE: Flush
CONCRETE SURFACE SEAL: 3 ±
PVC BLANK: 2 x 50'
BACKFILL: 44 ±
TYPE: Bentonite
PVC SCREEN: 2 x 15'
SLOT SIZE: 10
TYPE: Flush Thread
GRAVEL PACK: 18 ±
MATERIAL: 10x20 Silica
WELL DEPTH: 65'

0 - 30 ±
med Brn consolidated sand med. gravel

30 - 42 ±
med - dk Brn course sand wet

42 - 57 ±
med Brn Till

57 - 63 ±
med Brn course sand - wet

63 - 65 ±
med Brn Till

REMARKS

Signature Thomas W. Craney

BOART LONGYEAR E & I

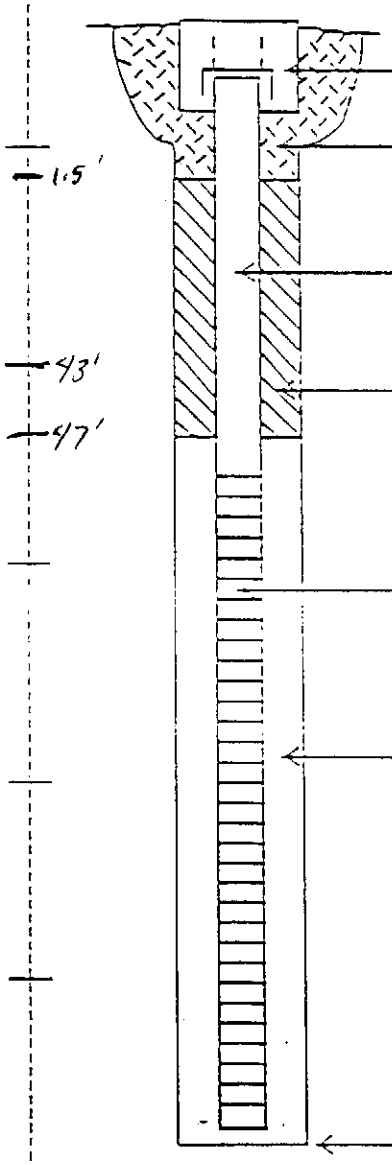
Resource Protection Well Report

MW-6

Project Name Stadium Thriftway
Well Identification # BAM 167
Drilling Method Sonic
Driller Thomas Cooney
License # 2409

Date 1-16-08
County Pierce NW ¼ SE ¼
Section 32 T. 21 N R. 3E
Street Address N 12th & N Tacoma Ave
Start Card R70822
Consulting Firm Stemen Env.

AS-BUILT | WELL DATA | FORMATION DESCRIPTION



MONUMENT TYPE: flush
CONCRETE SURFACE SEAL: 1 ft.
PVC BLANK 2 " x 49'
neat cement 41'
BACKFILL 4 ft.
TYPE: Bentonite
PVC SCREEN: 2 " x 15'
SLOT SIZE: 20
TYPE: Flush Thread
GRAVEL PACK: 17 ft.
MATERIAL: 10x20 Silica
WELL DEPTH: 64.2 ft.

0 - 1 ft.
Asphalt - Road Base

1 - 60 ft.
Compact sand grvl med Brn V. Dense

60 - 65 ft.
Med - DK Brn sand

REMARKS

Signature Thomas W. Cooney

Holt Drilling A Division of Boart Longyear Company

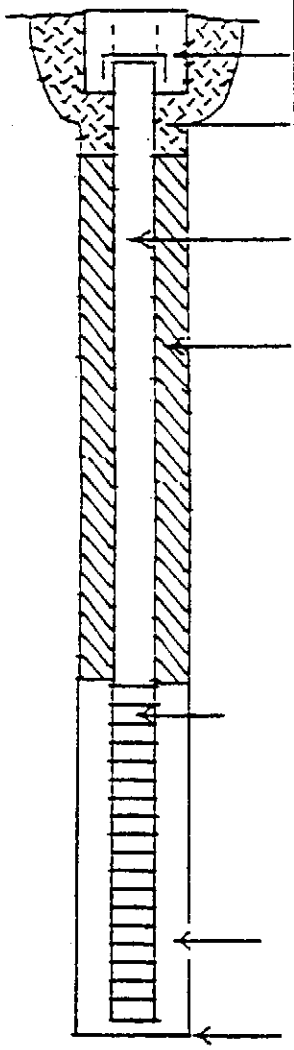
Resource Protection Well Report

MW-7

Project Name STADIUM THRIFTWAY
Well Identification # BAM-111
Drilling Method SONIC 4x6"
Driller Ken Phillips
License # 2652

Date 1.18.08
County PIERCE NW 1/4 SE 1/4
Section 32 T 21N R 3E
Street Address N. 1st St + Tacoma Ave
Start Card R70822
Consulting Firm STEMEN ENVIRONMENTAL

AS-BUILT



WELL DATA

BAM-111

MONUMENT: 8" FLUSH
CONCRETE SURFACE SEAL: 2 FT
RISER: 2 "x 50'
BACKFILL: FT
TYPE: 3/4 CHIPS
SCREEN: 2 "x 15'
TYPE: FACTORY FLUSH
SLOT SIZE: .020
SAND PACK: 18'
MATERIAL: 10x20 SILICA
WELL DEPTH: 65'

FORMATION DESCRPITION

0-1' FT
ASPHALT + BROWN SAND AND GRAVEL ROADBASE

1-50' FT
BROWN SILTY SAND WITH LARGE GRAVELS VERY DENSE ~~WET~~ MOIST SAND @ 25'
(TILL) FT

50-65 FT
BROWN OXIDIZED SAND MEDIUM WET @ 55'

FT

FT

REMARKS

Signature

MW-8

BOART LONGYEAR

Resource Protection Well Report

Project Name Titus

Well Identification # BA5078

Drilling Method Sonic

Driller Brian Owens

License # 2997

Date 4/17/08

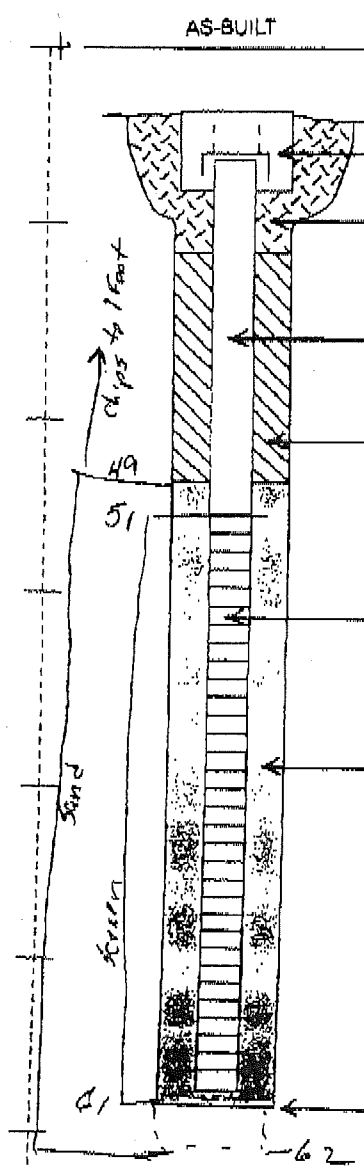
County Pierce NW ¼ SE ¼

Section 32 T. 21N R. 3E

Street Address N 1st N Tacoma Ave

Start Card R 70843

Consulting Firm Stemen



0 - 15 ft.
BROWN SILTY SAND & GRAVELLY FILL

ft.

15 - 50 ft.
GREY SILTY SANDS INTERMIXED WITH MEDIUM/LARGE GRAVELS

50 - 60 ft.
RUST/BROWN COLORED SAND MEDIUM DENSE/DENSE, WET AT 54 FT.

60 - 65 ft.
GREY COLORED SAND, MEDIUM DENSE.

REMARKS

Signature Brian Owens

VAV03a.CDR

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-8D	1 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278.5
Location:	Tacoma, WA	Top of Casing Elev.	278.11
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/4/2009 - 5/6/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 – 278	Flushmount monument, lockable thermos cap, concrete seal 0'-1'						Blacktop and concrete.	1
2 – 277							Vacuumed to 3'.	2
3 – 276								3
4 – 275							**Qvi**	4
5 – 274							Very hard, slightly moist, light brown, slightly sandy, gravelly SILT (ML); fine sand; coarse to fine gravel, subrounded.	5
6 – 273								6
7 – 272								7
8 – 271								8
9 – 270							Grades to sandy.	9
10 – 269								10
11 – 268	2" diameter, schedule 40 PVC, threaded connections, 0'-96'							11
12 – 267							**Qvt**	12
13 – 266							Very hard, brown, slightly gravelly, silty SAND (SM); fine gravel, rounded.	13
14 – 265								14
15 – 264								15
16 – 263								16
17 – 262								17
18 – 261								18
19 – 260								19
20 – 259								20
21 – 258	Hydrated bentonite chips, 1'-92'							21
22 – 257							Gravelly.	22
23 – 256								23
24 – 255								24
25 – 254							Slightly gravelly.	25
26 – 253								26
27 – 252								27
28 – 251								28
29 – 250								29
30 – 249							Hard, brown, slightly gravelly, very sandy SILT (ML); fine gravel, rounded.	30
31 – 248								31
32 – 247								32
33 – 246								33
34 – 245							Hard, brown, slightly gravelly, very silty SAND (SM); fine gravel, rounded.	34
35 – 244								35
36 – 243								36
37 – 242								37
38 – 241							**Qva**	38
39 – 240							Moist, red-brown, slightly silty SAND (SP); medium sand.	39
40 – 239							Trace gravel.	40
41 – 238								41
42 – 237								42
43 – 236								43
44 – 235								44
45 – 234								45
46 – 233								46
47 – 232								47
48 – 231								48
49 – 230								49
229								

Sampler Type:
- ○ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: DFR

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-8D	2 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278.5
Location:	Tacoma, WA	Top of Casing Elev.	278.11
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/4/2009 - 5/6/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51 – 228								51
52 – 227								52
53 – 226								53
54 – 225								54
55 – 224	▽ 5/4/2009						Wet.	55
56 – 223								56
57 – 222								57
58 – 221								58
59 – 220								59
60 – 219								60
61 – 218								61
62 – 217								62
63 – 216		○						63
64 – 215								64
65 – 214								65
66 – 213	10/20 sand filter pack, 92'-120'						Brown.	66
67 – 212							**Qob** Very hard, moist, brown, sandy, silty GRAVEL (GM); non-plastic.	67
68 – 211								68
69 – 210								69
70 – 209								70
71 – 208								71
72 – 207								72
73 – 206								73
74 – 205							Brown, slightly gravelly, very silty SAND (SM); non-plastic.	74
75 – 204								75
76 – 203								76
77 – 202								77
78 – 201							Dark blue, slightly sandy SILT (ML); trace gravel.	78
79 – 200								79
80 – 199								80
81 – 198								81
82 – 197								82
83 – 196							Dry, gray, silty, very gravelly SAND (SM); fine sand.	83
84 – 195								84
85 – 194								85
86 – 193								86
87 – 192							Trace cobbles, subrounded.	87
88 – 191								88
89 – 190								89
90 – 189								90
91 – 188								91
92 – 187								92
93 – 186	2" diameter, 10-slot, schedule 40 PVC screen, 96'-106'						Very hard, dry, blue gray, sandy, very silty GRAVEL (GM).	93
94 – 185								94
95 – 184								95
96 – 183								96
97 – 182								97
98 – 181							Loose, slightly moist, brown, gravelly, very silty SAND (SM).	98
99 – 180								99
179								

Sampler Type:
○ No Recovery
▮ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: DFR

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-8D	3 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278.5
Location:	Tacoma, WA	Top of Casing Elev.	278.11
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/4/2009 - 5/6/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
101 (178)								101
102 (177)							Hard, dry, dark blue gray, gravelly, sandy SILT (ML).	102
103 (176)								103
104 (175)								104
105 (174)								105
106 (173)							Hard, dry, light gray, silty, very gravelly SAND (SM); fine sand; fine to coarse gravel.	106
107 (172)								107
108 (171)								108
109 (170)								109
110 (169)	▽							110
111 (168)								111
112 (167)	▼ 5/11/2009						Loose, wet, brown, slightly silty SAND (SP); fine sand.	112
113 (166)								113
114 (165)								114
115 (164)								115
116 (163)	Threaded PVC endcap						Hard, dry, light gray, silty, very gravelly SAND (SM); fine sand.	116
117 (162)								117
118 (161)								118
119 (160)								119
120 (159)								120
121 (158)							Boring terminated 120 ft BGS. Depth to perched water was 55 ft BGS ATD. Depth to water table at 112.56 ft BGS on 5/11/2009.	121
122 (157)								122
123 (156)								123
124 (155)								124
125 (154)								125
126 (153)								126
127 (152)								127
128 (151)								128
129 (150)								129
130 (149)								130
131 (148)								131
132 (147)								132
133 (146)								133
134 (145)								134
135 (144)								135
136 (143)								136
137 (142)								137
138 (141)								138
139 (140)								139
140 (139)								140
141 (138)								141
142 (137)								142
143 (136)								143
144 (135)								144
145 (134)								145
146 (133)								146
147 (132)								147
148 (131)								148
149 (130)								149
(129)								

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: DFR

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-9	1 of 2

Project Name:	Walker Chevrolet	Ground Surface Elev.	279.5
Location:	Tacoma, WA	Top of Casing Elev.	278.78
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/5/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 – 279	Flushmount monument, lockable thermos cap						Blacktop and concrete.	1
2 – 278							Vacuumed to 5'.	2
3 – 277								3
4 – 276								4
5 – 275								5
6 – 274							**Qvi**	6
7 – 273							Slightly moist, gray blue, gravelly, sandy SILT (ML).	7
8 – 272								8
9 – 271								9
10 – 270	Quickrite portland cement, 0'-30'						**Qvt**	10
11 – 269							Dry, light brown, very gravelly, sandy SILT (ML)	11
12 – 268							Brown, slightly moist, gravelly, silty SAND (SM).	12
13 – 267								13
14 – 266								14
15 – 265								15
16 – 264								16
17 – 263							Dry, light gray.	17
18 – 262								18
19 – 261								19
20 – 260	2" diameter, schedule 40 PVC, threaded connections, 0'-60'							20
21 – 259								21
22 – 258								22
23 – 257							Very dense, slightly moist, gray blue.	23
24 – 256								24
25 – 255								25
26 – 254								26
27 – 253							Dry, dark gray blue, sandy SILT (ML), trace gravel.	27
28 – 252								28
29 – 251							Slightly moist, brown, gravelly, very silty SAND (SM); fine to medium sand, predominantly fine.	29
30 – 250								30
31 – 249								31
32 – 248							Grades to trace gravel.	32
33 – 247								33
34 – 246							Moist.	34
35 – 245	Hydrated bentonite chips, 30'-57'							35
36 – 244								36
37 – 243								37
38 – 242							Very gravelly.	38
39 – 241								39
40 – 240							Trace gravel.	40
41 – 239								41
42 – 238								42
43 – 237							**Qva**	43
44 – 236							Loose, moist, dark brown-red SAND (SP), trace gravel; fine to medium sand, predominantly fine; fine gravel, subrounded.	44
45 – 235								45
46 – 234								46
47 – 233							Grades to slightly silty.	47
48 – 232								48
49 – 231								49
230								

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: DFR

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-9	2 of 2

Project Name:	Walker Chevrolet	Ground Surface Elev.	279.5
Location:	Tacoma, WA	Top of Casing Elev.	278.78
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/5/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51 – 229	Hydrated bentonite chips, 30'-57'						Grades to gravelly.	51
52 – 228								52
53 – 227								53
54 – 226	▽ 5/5/2009						Wet.	54
55 – 225								55
56 – 224								56
57 – 223							No gravel.	57
58 – 222	10/20 sand filter pack, 57'-70'							58
59 – 221								59
60 – 220								60
61 – 219								61
62 – 218								62
63 – 217								63
64 – 216	2" diameter, 10-slot, schedule 40 PVC screen, 60'-70'							64
65 – 215								65
66 – 214								66
67 – 213								67
68 – 212								68
69 – 211								69
70 – 210	Threaded PVC endcap						Boring terminted 70' BGS. Depth to water was 54 ft BGS ATD. Well was dry on 5/11/2009.	70
71 – 209								71
72 – 208								72
73 – 207								73
74 – 206								74
75 – 205								75
76 – 204								76
77 – 203								77
78 – 202								78
79 – 201								79
80 – 200								80
81 – 199								81
82 – 198								82
83 – 197								83
84 – 196								84
85 – 195								85
86 – 194								86
87 – 193								87
88 – 192								88
89 – 191								89
90 – 190								90
91 – 189								91
92 – 188								92
93 – 187								93
94 – 186								94
95 – 185								95
96 – 184								96
97 – 183								97
98 – 182								98
99 – 181								99
180								

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: DFR

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-10	1 of 2

Project Name:	Walker Chevrolet	Ground Surface Elev.	280
Location:	Tacoma, WA	Top of Casing Elev.	279.45
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/7/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 279	Flushmount monument, lockable thermos cap						Blacktop and concrete.	1
							Qvi	
2 278							Medium dense, wet, dark brown, slightly silty, very gravelly SAND (SP); fine to coarse sand; fine to coarse gravel, rounded.	2
3 277								3
4 276								4
5 275							Medium dense, mosit, gray purple, silty, very gravelly SAND (SM); fine to coarse sand; fine to coarse gravel, subrounded.	5
6 274								6
7 273							Dry to slightly moist, brown to dark brown.	7
8 272							Loose, moist, dark brown, slightly silty, gravelly SAND (SP); predominantly medium to coarse sand; fine gravel, subrounded.	8
9 271								9
10 270							Medium dense, dry to slightly moist, fine to coarse gravel.	10
11 269								11
12 268							Very dense, dry, gray purple boulder.	12
13 267							Medium dense, slightly moist, yellow-red to dark brown, gravelly, very silty SAND (SM); fine to coarse sand; fine to coarse gravel, subrounded.	13
14 266								14
15 265	Quickrite portland cement, 0'-41'						Very stiff, dry to slightly moist, brown, gravelly, very sandy SILT (ML); fine to coarse sand; fine to coarse gravel, subrounded.	15
16 264								16
17 263								17
18 262							Medium dense, slightly moist, dark brown, silty, very gravelly SAND (SP); fine to coarse sand; fine to coarse gravel, subrounded.	18
19 261								19
20 260							Medium dense, slightly moist, dark brown, slightly silty, very gravelly SAND (SP); predominantly medium to coarse sand; fine to coarse gravel, subrounded.	20
21 259								21
22 258							**Qvt**	22
23 257							Dense, dry to slightly moist, yellow-red to dark brown, silty, sandy GRAVEL (GM); fine to coarse sand; fine to coarse gravel, subrounded.	23
24 256								24
25 255	2" diameter, schedule 40 PVC, threaded connections, 0'-60'						Medium dense, dry to slightly moist, yellow-red to dark brown, slightly silty, gravelly to very gravelly SAND (SP); predominantly medium to coarse sand; fine to coarse gravel, subrounded, increasing gravel with depth.	25
26 254								26
27 253								27
28 252								28
29 251							Medium dense, dry to slightly moist, yellow-red to dark brown, silty, very gravelly SAND (SM); fine to coarse sand; fine gravel, subangular to subrounded.	29
30 250								30
31 249							Gradational decrease in silt. Becomes slightly silty, very gravelly SAND (SP).	31
32 248								32
33 247							Loose to medium dense, gravelly.	33
34 246							Medium dense, slightly moist, yellow-red, silty, very gravelly SAND (SM); fine to coarse sand; fine to coarse gravel, subrounded.	34
35 245								35
36 244							Loose, very silty, no gravel.	36
37 243							Medium dense, red-brown, gravelly.	37
38 242								38
39 241							**Qva**	39
40 240							Loose, slightly moist, yellow-red, slightly silty SAND (SP), trace gravel; perdominantly medium sand.	40
41 239							Medium dense to dense, gravelly; fine to coarse gravel, subrounded.	41
42 238								42
43 237								43
44 236								44
45 235	Hydrated bentonite chips, 41'-56'11"						Slightly gravelly; fine gravel.	45
46 234								46
47 233							Gravelly lense.	47
48 232								48
49 231							Gravelly lense.	49

Sampler Type:
- ○ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 8, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-10	2 of 2

Project Name:	Walker Chevrolet	Ground Surface Elev.	280
Location:	Tacoma, WA	Top of Casing Elev.	279.45
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/11/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/7/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–229	Hydrated bentonite chips, 41'-56'11"						Loose, moist. perdominantly medium to coarse sand.	51
52–228								52
53–227								53
54–226								54
55–225	▽ 5/7/2009						Medium dense, wet, trace gravel; predominantly medium sand; fine gravel.	55
56–224								56
57–223							Red-brown with black staining, slightly gravelly.	57
58–222	10/20 sand filter pack, 56'11"-70'							58
59–221								59
60–220							Black, fine to medium sand.	60
61–219							Loose to medium dense, very moist to wet, brown SAND (SP); no silt, no gravel.	61
62–218								62
63–217								63
64–216	2" diameter, 10-slot, schedule 40 PVC screen, 60'-70'							64
65–215								65
66–214								66
67–213								67
68–212								68
69–211							**Qob**	69
70–210	Threaded PVC endcap						Medium dense, wet, red-brown, slightly clayey; fine to medium sand.	70
71–209							Medium dense, wet, red-brown, slightly gravelly, clayey SAND (SC); predominantly fine to medium sand; fine gravel.	71
72–208	Natural backfill, 70'-75'							72
73–207							Medium dense, wet, dark brown, silty, gravelly SAND (SM); fine to coarse sand; fine gravel to cobbles, subrounded.	73
74–206								74
75–205							Medium dense, wet, dark brown to gray, slightly silty, very sandy GRAVEL (GP); fine to coarse sand; fine to coarse gravel, subrounded.	75
76–204							Boring terminated 75 ft BGS. Depth to water was 55 ft BGS ATD. Well was dry on 5/11/2009.	76
77–203								77
78–202								78
79–201								79
80–200								80
81–199								81
82–198								82
83–197								83
84–196								84
85–195								85
86–194								86
87–193								87
88–192								88
89–191								89
90–190								90
91–189								91
92–188								92
93–187								93
94–186								94
95–185								95
96–184								96
97–183								97
98–182								98
99–181								99

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 8, 2016

Monitoring Well Construction Log

Aspect Consulting

Project Number	Well Number	Sheet
080190	MW-11	1 of 2

Project Name:	Walker Chevrolet	Ground Surface Elev.	279
Location:	Tacoma, WA	Top of Casing Elev.	278.52
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/12/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/8/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 278	Flushmount monument, lockable thermos cap, concrete seal 0'-1'						Concrete.	1
2 277							**Qvi** Wet, light brown, silty, very gravelly SAND (SM); fine to coarse gravel, subround to subangular.	2
3 276								3
4 275							Slightly moist, very silty.	4
5 274								5
6 273							Wet, grades to gravelly, very silty SAND (SM); fine to coarse sand.	6
7 272							**Qvt**	7
8 271							Very dense, very silty, very sandy GRAVEL (GM); cobbles.	8
9 270								9
10 269	2" diameter, schedule 40 PVC, threaded connections, 0'-53'						Slightly moist, brown, silty, sandy GRAVEL (GM); fine to coarse sand; fine to coarse gravel.	10
11 268								11
12 267							Grades to brown-gray.	12
13 266								13
14 265							Gray, very silty.	14
15 264							Very moist, brown, silty, very sandy GRAVEL (GM).	15
16 263							Very hard, very moist, dark gray, gravelly, very silty SAND (SM) with sandy silt interbeds	16
17 262								17
18 261								18
19 260								19
20 259	Hydrated bentonite chips, 1'-49'11"						Dry, gray, silty, very sandy GRAVELLY (GM); fine to coarse sand; fine to coarse gravel.	20
21 258								21
22 257								22
23 256							Brown.	23
24 255							Dry, brown, trace to slightly silty, very sandy GRAVEL (GP).	24
25 254							Gray, sandy.	25
26 253								26
27 252								27
28 251							Moist, gray, sandy, very silty GRAVEL (GM).	28
29 250							Brown, silty, very sandy.	29
30 249							Very moist, red-brown to dark brown, slightly gravelly, very silty SAND (SM).	30
31 248								31
32 247								32
33 246							Trace gravel.	33
34 245								34
35 244								35
36 243							**Qva**	36
37 242							Very moist, red-brown to dark brown, slightly gravelly, slightly silty SAND (SM).	37
38 241								38
39 240							Interbedded red-brown, very silty SAND and gray, very sandy SILT (SM/ML)	39
40 239							Very moist, red-brown, slightly silty to silty SAND (SM), trace gravel; fine to medium sand, fine gravel.	40
41 238								41
42 237								42
43 236							Very moist, red-brown, slightly silty, gravelly SAND with interbeds of silty to very silty SAND (SP-SM). Sand is fine to medium.	43
44 235								44
45 234								45
46 233								46
47 232								47
48 231							Brown gray, silty SAND interbedded with sandy SILT (SM-ML).	48
49 230	▽ 5/8/2009						Dark brown, predominately medium sand.	49

Sampler Type:
- ○ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JTL

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-11	2 of 2

Project Name:	Walker Chevrolet	Ground Surface Elev.	279
Location:	Tacoma, WA	Top of Casing Elev.	278.52
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water	- 5/12/2009
Sampling Method:	Continuous Core	Start/Finish Date	5/8/2009

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–228							Wet.	51
52–227	5/12/2009							52
53–226	10/20 sand filter pack, 49'11"-63'						Gravelly.	53
54–225							Trace gravel to slightly gravelly.	54
55–224							Wet, red-brown, interbedded silty SAND and slightly silty SAND (SM).	55
56–223								56
57–222	2" diameter, 10-slot, schedule 40 PVC screen, 53'-63'							57
58–221								58
59–220								59
60–219							Wet, brown, silty SAND (SM); fine sand.	60
61–218								61
62–217							Wet, brown, slightly silty, gravelly SAND (SP); fine to coarse sand.	62
63–216	Threaded PVC endcap						**Qob**	63
64–215							Slightly moist, gray, very sandy, very silty GRAVEL (GM).	64
65–214							Moist, brown.	65
66–213							Slightly moist, light brown, sandy.	66
67–212								67
68–211								68
69–210	Natural backfill, 63'-70'						Grades to slightly moist, gray, slightly sandy, gravelly SILT (ML); with wood.	69
70–209							Boring terminated 70 ft BGS. Depth to water was 52.20 ft BGS on 5/12/2009.	70
71–208								71
72–207								72
73–206								73
74–205								74
75–204								75
76–203								76
77–202								77
78–201								78
79–200								79
80–199								80
81–198								81
82–197								82
83–196								83
84–195								84
85–194								85
86–193								86
87–192								87
88–191								88
89–190								89
90–189								90
91–188								91
92–187								92
93–186								93
94–185								94
95–184								95
96–183								96
97–182								97
98–181								98
99–180								99

Sampler Type:
- ⃝ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JTL

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-12D	1 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278
Location:	Tacoma, WA	Top of Casing Elev.	277.72
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water (ft BGS)	- 10/29/2010
Sampling Method:	Continuous Core	Start/Finish Date	10/25/2010 - 10/27/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 277	Flushmount monument, thermos cap						Air Vacuum - No Recovery	1
2 276								2
3 275							**Qvi**	3
4 274	Concrete seal, 0'-5.5'						Dry, gray-blue, slighlty gravelly, sandy SILT (ML); fine gravel; fine to medium sand	4
5 273							Dark brown, gravelly, very sandy SILT (ML); fine to coarse gravel (2")	5
6 272	Hydrated bentonite chips, 5.5'-110'						Gray-blue/dark brown, slightly gravelly, sandy SILT (ML)	6
7 271							Dry, brown, slightly silty, gravelly, SAND (SP-SM); fine to coarse gravel (2.5"), rounded to subrounded	7
8 270							Dry, dark brown, gravelly, silty SAND (SM); fine to coarse gravel (2"), rounded to subrounded; fine to coarse sand	8
9 269							Dry, dark brown, very sandy GRAVEL (GW); fine to coarse gravel (2"), rounded to subrounded; fine to coarse sand	9
10 268	2" diameter, Sch 40 PVC, 0.4'-113'						Dry, brown, slightly silty, gravelly SAND (SP-SM); fine to coarse gravel (2"), rounded to subrounded; fine to medium sand; with dark gray, slightly clayey, slightly gravelly, very sandy SILT (ML) lense (6")	10
11 267							**Qvt**	11
12 266							Dry, brown/light gray, silty, very gravelly SAND (SM); fine to coarse gravel (2"); fine to coarse sand	12
13 265							Red-brown/light gray, slightly gravelly, very silty SAND (SM)	13
14 264							Light gray with red-brown mottling, slightly gravelly, silty SAND (SM); fine gravel; predominantly fine to medium sand	14
15 263							Dark brown, gravelly, very silty SAND (SM)	15
16 262								16
17 261								17
18 260								18
19 259								19
20 258								20
21 257								21
22 256								22
23 255								23
24 254								24
25 253								25
26 252								26
27 251								27
28 250								28
29 249								29
30 248							Slightly gravelly, very silty SAND (SM)	30
31 247							**Qva**	31
32 246							Dry, dark brown SAND (SP); trace gravel and silt; fine gravel, rounded, predominantly medium sand	32
33 245							Dry, dark brown, slightly silty SAND (SP-SM); medium sand	33
34 244							Dry, dark brown, slightly gravelly, silty SAND (SM); fine gravel, subrounded; fine to medium sand	34
35 243							Dry, dark brown, slightly gravelly SAND (SP); trace silt; fine gravel, subrounded; fine to medium sand	35
36 242							Dark brown/yellow-red, gravelly SAND (SP); fine to coarse gravel (1"); predominantly medium sand	36
37 241							Red-brown, slightly gravelly SAND (SP); trace silt; fine to medium sand	37
38 240							Fine to coarse gravel (3"); medium sand	38
39 239								39
40 238								40
41 237								41
42 236								42
43 235								43
44 234								44
45 233							Dark brown, gravelly SAND (SP)	45
46 232							Dark brown/yellow-red, slightly gravelly SAND (SP); trace silt; fine gravel; fine to medium sand	46
47 231							Slightly gravelly SAND (SP); medium sand	47
48 230								48
49 229								49

Sampler Type:
- ○ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-12D	2 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278
Location:	Tacoma, WA	Top of Casing Elev.	277.72
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water (ft BGS)	- 10/29/2010
Sampling Method:	Continuous Core	Start/Finish Date	10/25/2010 - 10/27/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51 227							Medium to coarse sand	51
52 226							Slightly gravelly SAND (SP); fine to coarse gravel (1.5"); predominantly medium sand	52
53 225								53
54 224								54
55 223							Trace silt; fine gravel	55
56 222								56
57 221								57
58 220							Dry, dark brown, silty SAND (SM); trace fine gravel; fine to medium sand	58
59 219								59
60 218							Dry, dark brown SAND (SP); medium sand	60
61 217								61
62 216								62
63 215								63
64 214								64
65 213								65
66 212								66
67 211							Gravelly SAND (SP); trace silt; fine to coarse gravel (3"), subrounded; medium to coarse sand	67
68 210								68
69 209								69
70 208							**Qob**	70
71 207							Slightly moist, dark brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse gravel (2"); fine to coarse sand	71
72 206								72
73 205								73
74 204							Wet, dark brown/dark gray, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (2"); medium to coarse sand	74
75 203								75
76 202							Wet, red-brown, silty, very sandy GRAVEL (GM); fine to coarse gravel (2"); fine to coarse sand	76
77 201								77
78 200	▽						Wet, yellow-red, silty, gravelly SAND (SM); fine to coarse gravel (2"); fine to coarse sand	78
79 199								79
80 198							Moist/very moist, dark brown, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (1.5"); fine to coarse sand	80
81 197								81
82 196							Moist/very moist, yellow-red, silty, very gravelly SAND (SM); fine to coarse gravel (2"); fine to coarse sand	82
83 195								83
84 194							Moist/very moist, yellow-red, silty, very sandy GRAVEL (GM); fine to coarse gravel (3.5"); fine to coarse sand	84
85 193							Wet, red-brown/dark brown, slightly gravelly SAND (SP); fine gravel; predominantly medium sand	85
86 192								86
87 191							Wet, dark brown, slightly silty, gravelly SAND (SP-SM); fine to coarse gravel (2"); predominantly medium sand	87
88 190								88
89 189							Wet, brown, silty, very sandy GRAVEL (GM); fine to coarse gravel (2"); fine to coarse sand; with slightly silty, SAND (SP-SM) lense (6")	89
90 188								90
91 187							Wet, dark brown, silty, very gravelly SAND (SM); fine to coarse gravel (1"); predominantly coarse sand	91
92 186								92
93 185							Dry, gray SILT (ML)	93
94 184							Red-brown slightly gravelly, slightly sandy SILT (ML); fine gravel; fine to medium sand	94
95 183							Dry, brown, gravelly, very silty SAND (SM); fine gravel; fine to coarse sand	95
96 182								96
97 181							Dry, dark brown, gravelly, very sandy SILT (ML); fine to coarse gravel; fine to coarse sand	97
98 180								98
99 179							Yellow-red, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (2.5"); fine to coarse sand	99

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-12D	3 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278
Location:	Tacoma, WA	Top of Casing Elev.	277.72
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water (ft BGS)	- 10/29/2010
Sampling Method:	Continuous Core	Start/Finish Date	10/25/2010 - 10/27/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
101–177							Slightly moist, dark brown, sandy, silty GRAVEL (GM); fine to coarse gravel (3"); fine to coarse sand	101
102–176								102
103–175								103
104–174							Slightly moist/moist, dark brown, silty, very gravelly SAND (SM); fine to coarse gravel (1.5"); fine to coarse sand	104
105–173								105
106–172							Moist, dark brown, silty, gravelly SAND (SM); fine to coarse gravel (3"); fine to coarse sand	106
107–171								107
108–170								108
109–169							Moist, dark brown, slightly silty, gravelly SAND (SP-SM); fine to coarse gravel (1.5"); fine to coarse sand	109
110–168	10/20 filter pack, 110'-134.5'							110
111–167							Moist, dark brown SAND (SP); trace fine gravel; medium sand	111
112–166								112
113–165	2" diameter, 10-slot, Sch 40 PVC screen, 113'-133'						Slightly moist, dark brown, silty, very sandy GRAVEL (GM); fine to coarse gravel (3"); fine to coarse sand	113
114–164								114
115–163								115
116–162							Slightly moist, gray, sandy, very silty GRAVEL (GM); fine to coarse gravel (3"); fine to coarse sand	116
117–161								117
118–160								118
119–159								119
120–158							Slightly moist, gray, gravelly, sandy SILT (ML); fine gravel; fine to coarse sand	120
121–157								121
122–156							Dry, dark brown/gray, sandy, silty GRAVEL (GM); fine gravel to cobbles, rounded to subrounded; fine to coarse sand	122
123–155								123
124–154							Moist, yellow-red/gray, slightly silty, sandy GRAVEL (GW-GM), fine to coarse gravel (3"); fine to coarse sand	124
125–153								125
126–152								126
127–151	▽ 10/26/2010							127
128–150								128
129–149	▼ 10/29/2010							129
130–148							Moist, gray, slightly sandy, gravelly SILT (ML); fine gravel; fine to coarse sand	130
131–147							Dry, dark brown/gray, sandy, gravelly SILT (ML); fine to coarse gravel (2"); fine to coarse sand	131
132–146								132
133–145	PVC endcap							133
134–144								134
135–143	Hydrated bentonite chips, 134.5'-140'						Very moist, gray, slightly sandy, gravelly SILT (ML); fine to coarse gravel (2"); fine to coarse sand	135
136–142							Very moist, brown, silty, sandy GRAVEL (GM); fine to coarse gravel (3"), rounded to subrounded; fine to coarse sand	136
137–141								137
138–140								138
139–139								139
140–138							Wet, brown, silty, sandy GRAVEL (GM); fine to coarse gravel (2"); fine to coarse sand	140
141–137								141
142–136								142
143–135								143
144–134								144
145–133								145
146–132								146
147–131								147
148–130								148
149–129								149

Sampler Type:
- ○ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-13D	1 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	277
Location:	Tacoma, WA	Top of Casing Elev.	276.96
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water (ft BGS)	- 10/29/2010
Sampling Method:	Continuous Core	Start/Finish Date	10/27/2010 - 10/29/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 276	Flushmount monument, thermos cap						Air Vacuum - No Recovery	1
2 275		○						2
3 274								3
4 273	Concrete seal, 0'-6'							4
5 272							**Qvi** Dry, brown, gravelly SAND (SP); trace silt; fine to coarse gravel (1.5"); predominantly fine sand	5
6 271								6
7 270	Hydrated bentonite chips, 6'-121'						Dry, brown, slightly gravelly, silty SAND (SM); fine gravel; fine sand	7
8 269								8
9 268							Dry, dark brown, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (1.5"); fine to coarse sand	9
10 267	2" diameter, Sch 40 PVC, 0.4'-125'							10
11 266							Gray, slightly silty, very gravelly SAND (SP-SM) lense (2")	11
12 265								12
13 264							**Qvt** Dry/slightly moist, gray, gravelly, silty SAND (SM); fine to coarse gravel (1.5"); fine to coarse sand	13
14 263								14
15 262							Dry, yellow-red/gray, sandy, very gravelly SILT (ML); fine to coarse gravel (1.5"); fine to coarse sand	15
16 261								16
17 260							Dry, gray, silty, very gravelly SAND (SM); fine to coarse gravel (1"), rounded to subrounded; fine to coarse sand	17
18 259							Yellow-red/gray mottling, slightly gravelly, silty SAND (SM)	18
19 258								19
20 257							Dry, yellow-red/brown, silty SAND (SM); trace gravel; fine gravel; predominantly fine sand	20
21 256								21
22 255							Gray, silty, very gravelly SAND (SM); fine to coarse gravel (2.5"); fine to coarse sand	22
23 254								23
24 253								24
25 252								25
26 251								26
27 250								27
28 249							Dry, yellow-red, slightly silty, gravelly SAND (SP-SM); fine to coarse gravel (3"); predominantly fine to medium sand	28
29 248		○						29
30 247							Slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (1.5"); fine to coarse sand	30
31 246								31
32 245							**Qva**	32
33 244							Dry, yellow-red, slightly gravelly SAND (SP); trace silt; fine gravel, rounded; predominantly medium-fine sand	33
34 243								34
35 242								35
36 241							Fine to coarse gravel (1.5"); predominantly medium sand	36
37 240								37
38 239								38
39 238								39
40 237							Slightly moist, dark brown, gravelly SAND (SP); fine to coarse gravel (2"); predominantly medium sand	40
41 236								41
42 235							SAND (SP); medium sand	42
43 234								43
44 233								44
45 232							Silty, gravelly SAND (SM) lense (6")	45
46 231							Yellow-red, slightly gravelly SAND (SP); fine gravel	46
47 230								47
48 229							Dark brown, slightly gravelly SAND (SP); trace silt; fine to coarse gravel (2"); predominantly fine to medium sand	48
49 228								49

Sampler Type:
○ No Recovery
▮ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-13D	2 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	277
Location:	Tacoma, WA	Top of Casing Elev.	276.96
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water (ft BGS)	- 10/29/2010
Sampling Method:	Continuous Core	Start/Finish Date	10/27/2010 - 10/29/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51 226							Trace gravel	51
52 225								52
53 224								53
54 223								54
55 222							Fine gravel	55
56 221								56
57 220								57
58 219								58
59 218							Slightly moist, gray, silty SAND (SM); fine sand	59
60 217							Dry, dark brown/yellow-red SAND (SP); medium-fine sand	60
61 216								61
62 215								62
63 214							Slightly moist, dark brown, silty SAND (SM); fine to medium sand	63
64 213								64
65 212							Dry, yellow-red/dark brown SAND (SP); medium sand	65
66 211							Very gravelly SAND (SP) lense (6")	66
67 210								67
68 209								68
69 208								69
70 207							Dark brown silty SAND (SM) lense (6")	70
71 206							Slightly moist/moist, dark brown, gravelly SAND (SP); fine to coarse gravel (2"), rounded to subangular; medium-fine sand	71
72 205								72
73 204							Moist/very moist, dark brown SAND (SP); trace gravel	73
74 203							**Qob**	74
75 202							Wet, yellow-red/dark brown, silty, sandy GRAVEL (GM); fine to coarse gravel (2"); fine to coarse sand	75
76 201								76
77 200								77
78 199								78
79 198							Moist, gray, slightly gravelly, very silty SAND (SM); fine gravel; fine to coarse sand	79
80 197								80
81 196	▽						Wet, red-brown, silty, gravelly SAND (SM); fine to coarse gravel (1.5"); fine to coarse sand, predominantly coarse	81
82 195								82
83 194							Wet, red-brown, slightly silty, gravelly SAND (SP-SM); fine to coarse gravel (3"); predominantly medium sand	83
84 193								84
85 192							Moist, red-brown, sandy, silty GRAVEL (GM); fine to coarse gravel (3"), rounded to subrounded; fine to coarse sand	85
86 191								86
87 190							Wet, red-brown, slightly silty, gravelly SAND (SP-SM); fine gravel; fine to coarse sand, predominantly coarse	87
88 189								88
89 188							Moist/very moist, yellow-red/red-brown, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (2"), rounded to subangular; fine to coarse sand	89
90 187		○						90
91 186							Dry, dark brown, sandy, very gravelly SILT (ML); fine to coarse gravel (2.5"), rounded to subangular; fine to coarse sand	91
92 185								92
93 184							Wet, dark brown, sandy, very silty GRAVEL (GM); fine to coarse gravel (2"), rounded to subrounded; fine to coarse sand	93
94 183								94
95 182							No recovery	95
96 181								96
97 180		○						97
98 179								98
99 178								99

Sampler Type:
○ No Recovery
▮ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-13D	3 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	277
Location:	Tacoma, WA	Top of Casing Elev.	276.96
Driller/Method:	Boart Longyear / Spider Sonic	Depth to Water (ft BGS)	- 10/29/2010
Sampling Method:	Continuous Core	Start/Finish Date	10/27/2010 - 10/29/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
101–176							Moist, brown, silty, sandy GRAVEL (GM); fine gravel to cobbles (4"), rounded to angular; fine to coarse sand; with silty, gravelly SAND (SM) lense (6")	101
102–175								102
103–174							Moist, dark brown/gray, silty, gravelly SAND (SM); fine to coarse gravel (3"), rounded to subrounded; fine to coarse sand	103
104–173								104
105–172								105
106–171							Moist, brown/dark brown, sandy, silty GRAVEL (GM); fine to coarse gravel, rounded to subrounded; fine to coarse sand	106
107–170								107
108–169							Very moist, dark brown/yellow-red, silty, gravelly SAND (SM); fine to coarse gravel (1"); predominantly coarse sand	108
109–168								109
110–167							Very moist, brown/dark brown, sandy, very silty GRAVEL (GM); fine to coarse gravel (2.5"); fine to coarse sand	110
111–166								111
112–165							Slightly moist, red-brown/brown, slightly silty, gravelly SAND (SP-SM); fine to coarse gravel (2"); predominanlty fine sand	112
113–164								113
114–163							Dry, light brown, sandy, silty GRAVEL (GM); fine gravel to cobbles (3.5"), rounded to subrounded; fine to coarse sand	114
115–162								115
116–161							Moist, brown, silty, gravelly SAND (SM) lense (6")	116
117–160							Wet, dark brown, slightly silty, gravelly SAND (SP-SM) lense	117
118–159							Very moist, brown, sandy, very silty GRAVEL (GM); fine gravel to cobbles (4"); fine to coarse sand	118
119–158								119
120–157							Wet, yellow-red, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (3"); predominantly medium sand	120
121–156								121
122–155	10/20 filter pack, 121'-146'							122
123–154							Moist, brown, silty, very sandy GRAVEL (GM); fine to coarse gravel (2"); predominantly medium sand	123
124–153							Slightly moist, brown, sandy, silty GRAVEL (GM); fine to coarse gravel (2.5"); fine to coarse sand	124
125–152	2" diameter, 10-slot, Sch 40 PVC screen, 125'-145'						Very moist/wet, brown, silty, sandy GRAVEL (GM); fine gravel to cobbles (4"); predominantly coarse sand	125
126–151							Moist, gray, sandy, very silty GRAVEL (GM); fine to coarse gravel (2"); fine to coarse sand	126
127–150							Dry, dark brown/gray, silty, sandy GRAVEL (GM); fine to coarse gravel (3"), rounded to subangular; fine to coarse sand	127
128–149								128
129–148								129
130–147								130
131–146								131
132–145								132
133–144								133
134–143								134
135–142								135
136–141	▽ 10/28/2010						Wet, brown, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (2"); predominantly medium to coarse sand	136
137–140	▼ 10/29/2010							137
138–139							Moist, yellow-red, silty, very gravelly SAND (SM); fine to coarse gravel (3"); predominantly medium to coarse sand	138
139–138								139
140–137							Dry, gray-purple, slightly gravelly, sandy SILT (ML); fine gravel; fine to coarse sand	140
141–136								141
142–135							Wet, brown, slightly silty, very gravelly SAND (SP-SM); fine to coarse gravel (3"), predominantly coarse sand	142
143–134								143
144–133							Wet, brown, slightly silty, sandy GRAVEL (GW-GM); fine to coarse gravel (3"), rounded to angular; fine to coarse sand	144
145–132	PVC endcap							145
146–131								146
147–130								147
148–129								148
149–128								149

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-14D	1 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278
Location:	Tacoma, WA	Top of Casing Elev.	277.46 ft
Driller/Method:	Major Drilling - Jeffrey / Sonic Geoprobe 8140LS - track mounted	Depth to Water (ft BGS)	- 2/3/2012
Sampling Method:	Continuous Core	Start/Finish Date	1/30/2012 - 2/2/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1 277	Flush mounted steel well monument; thermos cap						Cleared for utilities using an air vacuum - No Recovery.	1
2 276	Cement surface seal from 0-2' bgs							2
3 275								3
4 274		○						4
5 273								5
6 272								6
7 271								7
8 270								8
9 269							**Qvt**	9
10 268	2" ID schedule 40 PVC casing, threaded connection, 0'-123'						Moist, brown, very gravelly, very silty SAND (SM); cobbles up to 5"; fine to medium sand, diamict fabric.	10
11 267								11
12 266								12
13 265								13
14 264							Slightly moist, sandy, very gravelly, SILT (ML); fine to medium sand; cobbles up to 4".	14
15 263	Bentonite chip seal (NSF/ANSI 60), 2'-121' bgs							15
16 262								16
17 261								17
18 260								18
19 259								19
20 258								20
21 257							Diamict fabric.	21
22 256								22
23 255								23
24 254							Moist, brown, gravelly, very silty SAND (SM); fine to medium sand; subangular gravel; diamict fabric; cobbles up to 4".	24
25 253							Orange-brown.	25
26 252							Brown.	26
27 251								27
28 250							Moist, brown, slightly silty, gravelly SAND (SP-SM); fine to medium sand; subrounded gravel.	28
29 249								29
30 248								30
31 247							Moist, gray, gravelly, silty SAND (SM); fine to medium sand; subangular gravel.	31
32 246							Brown.	32
33 245								33
34 244							**Qva**	34
35 243							Moist, brown, slightly gravelly SAND (SP); fine to medium sand.	35
36 242							1" pockets of pink, slightly silty SAND.	36
37 241								37
38 240								38
39 239								39
40 238								40
41 237								41
42 236							Moist, gray with iron stain mottling, gravelly, very sandy SILT (ML); fine to medium sand; subrounded gravel; diamict fabric.	42
43 235								43
44 234							Moist, gray, slightly silty, gravelly SAND (SP-SM); fine to medium sand.	44
45 233								45
46 232							Moist, orange-brown, slightly gravelly SAND (SP); trace silt.	46
47 231								47
48 230							Moist, brown with iron stain mottling, slightly gravelly, silty SAND (SM); 1" pockets of silt, fine to medium sand, subangular fine gravel with cobbles.	48
49 229								49

Sampler Type:
○ No Recovery
▮ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-14D	2 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278
Location:	Tacoma, WA	Top of Casing Elev.	277.46 ft
Driller/Method:	Major Drilling - Jeffrey / Sonic Geoprobe 8140LS - track mounted	Depth to Water (ft BGS)	- 2/3/2012
Sampling Method:	Continuous Core	Start/Finish Date	1/30/2012 - 2/2/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51 227							Moist, dark gray brown, slightly gravelly SAND (SP); medium to coarse sand, fine subrounded gravel.	51
52 226							Moist, red-brown, slightly silty SAND (SP-SM); medium sand; trace gravel.	52
53 225								53
54 224							Gravelly.	54
55 223							Moist, yellow-brown SAND (SP); medium to coarse sand.	55
56 222								56
57 221								57
58 220								58
59 219							Moist, gray, slightly silty SAND (SP-SM); fine to medium sand, trace fine gravel; faint stratification	59
60 218								60
61 217							Moist, brown to dark brown SAND (SP); medium sand.	61
62 216							Red-orange, slightly gravelly.	62
63 215								63
64 214								64
65 213							Very moist to wet, brown, very silty SAND (SM); fine sand.	65
66 212								66
67 211							Grades to fine to medium sand.	67
68 210							Wet, dark red-brown, very gravelly SAND (SP); coarse sand; trace silt, with cobbles up to 3".	68
69 209								69
70 208								70
71 207							Wet, brown-gray SAND (SP); trace gravel; medium sand.	71
72 206								72
73 205							**Qob**	73
74 204							Wet, red-brown GRAVEL (GW); fine to coarse gravel; trace silt; trace coarse sand.	74
75 203								75
76 202							Moist, red-brown with iron staining, very gravelly SAND (SP); medium sand, fine to coarse rounded gravel with cobbles up to 3"; trace silt; diamict fabric.	76
77 201							Brown.	77
78 200								78
79 199							Dry, gray, gravelly, very sandy SILT (ML); fine to medium sand; subrounded to subangular gravel; cobbles up to 4".	79
80 198								80
81 197							Moist, brown-red, slightly gravelly SAND (SP); medium sand; subrounded gravel; trace silt.	81
82 196								82
83 195							Slightly moist, gray, gravelly, silty SAND (SM); fine to medium sand; fine to coarse subrounded to rounded gravel.	83
84 194								84
85 193								85
86 192							Wet, brown SAND (SP); fine to medium sand, trace gravel.	86
87 191							Wet, red-brown GRAVEL (GP); coarse gravel and cobbles.	87
88 190								88
89 189							Very moist to wet, brown, gravelly, sandy SILT (ML); diamict fabric, cobbles up to 4".	89
90 188							Gray.	90
91 187								91
92 186								92
93 185							Moist, gray-brown, slightly gravelly, silty SAND (SM); fine to medium sand.	93
94 184								94
95 183								95
96 182								96
97 181								97
98 180							Moist to wet, brown-gray SAND (SP); fine to medium sand.	98
99 179							Moist, gray-brown, slightly silty, gravelly SAND	99

Sampler Type:
- No Recovery
- Continuous Core

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: AET

Approved by: ALN

Figure No.

MONITORING WELL_STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-14D	3 of 3

Project Name:	Walker Chevrolet	Ground Surface Elev.	278
Location:	Tacoma, WA	Top of Casing Elev.	277.46 ft
Driller/Method:	Major Drilling - Jeffrey / Sonic Geoprobe 8140LS - track mounted	Depth to Water (ft BGS)	- 2/3/2012
Sampling Method:	Continuous Core	Start/Finish Date	1/30/2012 - 2/2/2012

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
101–177							(SP-SM).	101
102–176							Moist to wet, brown, very sandy GRAVEL (GP); tr. silt, fine to coarse sand; fine subrounded to subangular gravel.	102
103–175								103
104–174								104
105–173							Slightly moist, gray and brown mottled, gravelly, sandy SILT (ML); fine to medium sand; fine to coarse gravel; diamict fabric.	105
106–172								106
107–171								107
108–170								108
109–169								109
110–168								110
111–167							Moist, brown and gray mottled, gravelly, silty SAND (SM); fine to medium sand; subrounded gravel up to 2".	111
112–166								112
113–165								113
114–164							Dry to slightly moist, gray with iron stain mottling, gravelly, sandy SILT (ML); diamict fabric.	114
115–163								115
116–162								116
117–161							Moist, brown-gray, slightly silty, very gravelly SAND (SP-SM); medium to coarse sand.	117
118–160							Moist, brown-gray, gravelly, silty SAND (SM); cobbles up to 3".	118
119–159								119
120–158								120
121–157							Slightly moist, gray, gravelly, sandy SILT (ML); fine to medium sand; cobbles up to 3".	121
122–156								122
123–155							Moist, brown, very silty, sandy GRAVEL (GM); cobbles up to 4", angular gravel, fine to coarse sand.	123
124–154								124
125–153	10x20 colorado silica sand filter pack, 121'-143.5' bgs						Dry to slightly moist, gray, gravelly, sandy SILT (ML); fine to medium sand, cobbles up to 4".	125
126–152								126
127–151								127
128–150								128
129–149							Moist, brown-gray with orange mottling, silty, very gravelly SAND (SM); fine to coarse sand; fine to coarse angular gravel with cobbles up to 3".	129
130–148	▽ 2/1/2012							130
131–147								131
132–146								132
133–145								133
134–144	▼ 2/3/2012						Moist to wet, gray-brown, gravelly, sandy SILT (ML); fine to coarse sand, fine to coarse subangular gravel; diamict fabric.	134
135–143	2" ID schedule 40 PVC 20-slot screen, 123.5'-143.5' bgs							135
136–142							Very gravelly.	136
137–141								137
138–140							Moist.	138
139–139								139
140–138							Wet.	140
141–137								141
142–136								142
143–135								143
144–134	Threaded PVC end cap							144
145–133							Bottom of boring at 145' BGS.	145
146–132								146
147–131								147
148–130								148
149–129								149

Sampler Type:
- ◯ No Recovery
- ▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: AET

Approved by: ALN

Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Aspect CONSULTING

Monitoring Well Construction Log

Project Number	Well Number	Sheet
080190	MW-15	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 278.84 ft
Depth to Water
Start/Finish Date 10/14/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-4'						Concrete.	1
2							No logging or sampling.	2
3								3
4								4
5							Boring drilled 37 degrees from vertical to intercept saturated soil under alley.	5
6								6
7								7
8								8
9								9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-55'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20	Hydrated bentonite chips, 4'-52'							20
21								21
22								22
23								23
24							Strong solvent-like odor in cuttings. (24 ft bgs)	24
25								25
26								26
27								27
28								28
29								29
30				36.7				30
31								31
32								32
33								33
34								34
35								35
36								36
37								37
38								38
39								39
40								40
41								41
42								42
43								43
44								44
45								45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

_MONITORING WELL_STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-15	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 278.84 ft
Depth to Water
Start/Finish Date 10/14/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–74	10/20 sand filter pack, 52'-75' 2" diameter, 0.020-inch, schedule 40 PVC screen, 55'-75'						Well screen is completed in advance outwash beneath alley, 33 to 45 ft west-northwest of monument, and 44 to 60 ft below ground surface	51–74
75	Threaded PVC endcap						Bottom of boring is 60 feet below ground surface.	75
76–99								76–99

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-16	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 277.88 ft
Depth to Water
Start/Finish Date 10/15/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-4'						Asphalt over concrete.	1
2							No logging or sampling.	2
3								3
4								4
5							Boring drilled 23 degrees from vertical, perpendicular to the building.	5
6								6
7								7
8								8
9								9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20	Hydrated bentonite chips, 4'-42'							20
21								21
22								22
23								23
24								24
25								25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35								35
36								36
37								37
38								38
39								39
40								40
41								41
42							Well screen is completed in advance outwash beneath Morrell's Dry Cleaners building, 18 to 25 feet west-northwest of monument, and 41 to 60 feet below ground surface	42
43	10/20 sand filter pack, 42'-65'							43
44								44
45								45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-16	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 277.88 ft
Depth to Water
Start/Finish Date 10/15/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–64	2" diameter, 0.020-inch, schedule 40 PVC screen, 45'-65'							51–64
65	Threaded PVC endcap						Bottom of boring is 60 feet below ground surface.	65
66–99								66–99

Sampler Type:
No Recovery

PID - Photoionization Detector
Static Water Level
Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-17	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 277.97 ft
Depth to Water
Start/Finish Date 10/15/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-4'						Asphalt over concrete.	1
2							No logging or sampling.	2
3								3
4								4
5							Boring drilled 32 degrees from vertical, perpendicular to the building.	5
6								6
7								7
8								8
9								9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-51'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20	Hydrated bentonite chips, 4'-48'							20
21								21
22								22
23								23
24								24
25								25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35								35
36								36
37								37
38								38
39								39
40								40
41								41
42								42
43							Well screen is completed in advance outwash beneath Morrell's Dry Cleaners, 27 to 38 feet west-northwest of monument, and 43 to 60 feet below ground surface.	43
44								44
45								45
46								46
47								47
48								48
49	10/20 sand filter pack, 48'-71'							49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-17	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 277.97 ft
Depth to Water
Start/Finish Date 10/15/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–70	2" diameter, 0.020-inch, schedule 40 PVC screen, 51'-71'							51–70
71	Threaded PVC endcap						Bottom of boring is 60 feet below ground surface.	71
72–99								72–99

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Aspect CONSULTING

Monitoring Well Construction Log

Project Number	Well Number	Sheet
080190	MW-18	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 277.80 ft
Depth to Water
Start/Finish Date 10/16/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1–49	Flushmount monument, lockable thermos cap, concrete seal 0'-4' 2" diameter, schedule 40 PVC, threaded connections, 0'-65' Hydrated bentonite chips, 4'-62'						Asphalt over concrete. No logging or sampling, strong solvent-like odor in cuttings. Boring drilled 45 degrees from vertical, perpendicular to the building.	1–49

Sampler Type:
No Recovery

PID - Photoionization Detector
Static Water Level
Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL_STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-18	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 277.80 ft
Depth to Water
Start/Finish Date 10/16/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–99	10/20 sand filter pack, 62'-85' 2" diameter, 0.020-inch schedule 40 PVC screen, 65'-85' Threaded PVC endcap						Well screen is completed in advance outwash beneath Morrell's Dry Cleaners, 46 to 60 feet west-northwest of monument, and 46 to 60 feet below ground surface Bottom of boring is 60 feet below ground surface.	51–99

Sampler Type:
No Recovery

PID - Photoionization Detector
Static Water Level
Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-19	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: Dames & Moore

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 278.15 ft
Depth to Water
Start/Finish Date 10/17/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1–49	Flushmount monument, lockable thermos cap, concrete seal 0'-2'						Asphalt.	1
							Qvt Very dense, moist, brown, slightly silty, gravelly SAND (SP-SM); diamict fabric, fine to medium sand, solvent-like odor.	2–19
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45'				50/6			10–19
20	Hydrated bentonite chips, 2'-42'				50/6		Very dense, moist, brown gray, silty, gravelly SAND (SM); diamict fabric, solvent-like odor, predominantly fine sand, fine to coarse gravel.	20–24
25					50/6		Trace gravel.	25–29
30					50/6		**Qva** Very dense, moist, orange brown, slightly gravelly SAND (SP); fine to medium sand, solvent-like odor.	30–34
35					21 21 30		Trace silt.	35–39
40					36 50/6		Trace fine gravel, slight solvent-like odor.	40–49
42	10/20 sand filter pack, 42'-60.5'							
45					50/6			

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-19	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: Dames & Moore

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 278.15 ft
Depth to Water
Start/Finish Date 10/17/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–99					50/6		Wet, red brown.	51–99
55–56	2" diameter, 0.020-inch, schedule 40 PVC screen, 45'-60'							
60	Threaded PVC endcap				50/6		Very dense, wet, dark red brown SAND (SP); fine to coarse sand, trace fine gravel.	60
61							Bottom of boring is 60.5 feet below ground surface.	61

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL_STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-20	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 278.03 ft
Depth to Water
Start/Finish Date 10/11/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-2'						Asphalt.	1
2							No logging or sampling.	2
3								3
4								4
5								5
6								6
7								7
8								8
9								9
10	2" diameter, schedule 40 PVC, threaded connections, 0'-45'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20	Hydrated bentonite chips, 2'-42'							20
21								21
22								22
23								23
24								24
25								25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35								35
36								36
37								37
38								38
39								39
40								40
41								41
42								42
43	10/20 sand filter pack, 42'-60'							43
44								44
45								45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-20	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 278.03 ft
Depth to Water
Start/Finish Date 10/11/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–59	2" diameter, 0.020-inch, schedule 40 PVC screen, 45'-60'							51–59
60	Threaded PVC endcap						Bottom of boring is 60 feet below ground surface.	60
61–99								61–99

Sampler Type:
No Recovery

PID - Photoionization Detector
Static Water Level
Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-21	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: Dames & Moore

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 279.03 ft
Depth to Water
Start/Finish Date 10/17/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1–2	Flushmount monument, lockable thermos cap, concrete seal 0'-2'						Asphalt.	1–2
							Qvt Very dense, moist, brown, silty, gravelly SAND (SM); diamict fabric, fine to medium sand.	
5				0.0	50/6			5
10–11	2" diameter, schedule 40 PVC, threaded connections, 0'-45'		VOC/FOC	10.5	26 50/6			10–11
15			VOC/FOC	165	50/6			15
20	Hydrated bentonite chips, 2'-42'			0.0	50/6			20
25			VOC/FOC	0.0	50/6			25
30				0.0	50/6			30
35				0.0	50/5		**Qva** Very dense, moist, red brown, slightly gravelly SAND (SP); fine to medium sand.	35
40			VOC/FOC	0.0	50/6		Brown.	40
42–43	10/20 sand filter pack, 42'-60.5'							42–43
45				0.0	50/6		Red brown, trace fine gravel.	45
49								49

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	MW-21	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: Dames & Moore

Ground Surface Elev. (site datum)
Top of Casing Elev. (site datum) 279.03 ft
Depth to Water
Start/Finish Date 10/17/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51				0.0	50/6		Very dense, moist, brown, slightly silty SAND (SP-SM); fine sand.	51
52								52
53								53
54								54
55	2" diameter, 0.020-inch, schedule 40 PVC screen, 45'-60'		VOC/FOC	0.0	50/6		Very dense, wet, brown, SAND (SP); fine to medium sand.	55
56								56
57								57
58								58
59								59
60	Threaded PVC endcap			0.0	50/6		Bottom of boring is 60.5 feet below ground surface.	60
61								61
62								62
63								63
64								64
65								65
66								66
67								67
68								68
69								69
70								70
71								71
72								72
73								73
74								74
75								75
76								76
77								77
78								78
79								79
80								80
81								81
82								82
83								83
84								84
85								85
86								86
87								87
88								88
89								89
90								90
91								91
92								92
93								93
94								94
95								95
96								96
97								97
98								98
99								99

Sampler Type:
- ○ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	VE-1	1 of 1

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum) 273.99 ft
Top of Casing Elev. (site datum)
Depth to Water
Start/Finish Date 10/21/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-2'						Concrete.	1
2							No logging or sampling, strong solvent-like odor in cuttings.	2
3								3
4								4
5	4" diameter, schedule 40 PVC, threaded connections, 0'-25'						Boring drilled 45 degrees from vertical, perpendicular to the building.	5
6								6
7								7
8								8
9								9
10	Hydrated bentonite chips, 2'-22'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20								20
21								21
22								22
23	10/20 sand filter pack, 22'-45'							23
24								24
25							Well screen is completed in glacial till beneath Morrell's Dry Cleaners building, 18 to 32 feet west-northwest of near-surface manifold, and 18 to 32 feet below ground surface	25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35	4" diameter, 0.020-inch, schedule 40 PVC screen, 25'-45'							35
36								36
37								37
38								38
39								39
40								40
41								41
42								42
43								43
44								44
45	Threaded PVC endcap						Bottom of boring is 32 feet below ground surface.	45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	VE-2	1 of 1

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum) 273.81 ft
Top of Casing Elev. (site datum)
Depth to Water
Start/Finish Date 10/21/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-2'						Concrete.	1
2							No logging or sampling, strong solvent-like odor in cuttings.	2
3								3
4								4
5	4" diameter, schedule 40 PVC, threaded connections, 0'-25'						Boring drilled 45 degrees from vertical, perpendicular to the building.	5
6								6
7								7
8								8
9								9
10	Hydrated bentonite chips, 2'-22'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20								20
21								21
22								22
23	10/20 sand filter pack, 22'-45'							23
24								24
25							Well screen is completed in glacial till beneath Morrell's Dry Cleaners building, 18 to 32 feet west-northwest of near-surface manifold, and 18 to 32 feet below ground surface.	25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35	4" diameter, 0.020-inch, schedule 40 PVC screen, 25'-45'							35
36								36
37								37
38								38
39								39
40								40
41								41
42								42
43								43
44								44
45	Threaded PVC endcap						Bottom of boring is 32 feet below ground surface.	45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	VE-3	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum) 273.92 ft
Top of Casing Elev. (site datum)
Depth to Water
Start/Finish Date 10/22/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-2'					Concrete.	Concrete.	1
2							No logging or sampling, strong solvent-like odor in cuttings.	2
3								3
4								4
5	4" diameter, schedule 40 PVC, threaded connections, 0'-44'						Boring drilled 45 degrees from vertical, perpendicular to the building.	5
6								6
7								7
8								8
9								9
10	Hydrated bentonite chips, 2'-41'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20								20
21								21
22								22
23								23
24								24
25								25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35								35
36								36
37								37
38								38
39								39
40								40
41								41
42	10/20 sand filter pack, 41'-64'						Well screen is completed in advance outwash beneath Morrell's Dry Cleaners building, 31 to 45 feet west-northwest of near-surface manifold, and 31 to 45 feet below ground surface.	42
43								43
44								44
45								45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	VE-3	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum) 273.92 ft
Top of Casing Elev. (site datum)
Depth to Water
Start/Finish Date 10/22/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–63	4" diameter, 0.020-inch, schedule 40 PVC screen, 44'-64'							51–63
64	Threaded PVC endcap						Bottom of boring is 45 feet below ground surface.	64
65–99								65–99

Sampler Type:
No Recovery

PID - Photoionization Detector
Static Water Level
Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	VE-4	1 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum) 273.53 ft
Top of Casing Elev. (site datum)
Depth to Water
Start/Finish Date 10/18/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
1	Flushmount monument, lockable thermos cap, concrete seal 0'-2'					Concrete.	Concrete.	1
2							No logging or sampling, strong solvent-like odor in cuttings.	2
3								3
4								4
5	4" diameter, schedule 40 PVC, threaded connections, 0'-39'						Boring drilled 40 degrees from vertical, perpendicular to the building.	5
6								6
7								7
8								8
9								9
10	Hydrated bentonite chips, 2'-37'							10
11								11
12								12
13								13
14								14
15								15
16								16
17								17
18								18
19								19
20								20
21								21
22								22
23								23
24								24
25								25
26								26
27								27
28								28
29								29
30								30
31								31
32								32
33								33
34								34
35								35
36								36
37								37
38	10/20 sand filter pack, 37'-59'						Well screen is completed in advance outwash beneath Morrell's Dry Cleaners building, 25 to 38 feet west-northwest of near-surface manifold, and 30 to 45 feet below ground surface.	38
39								39
40								40
41								41
42								42
43								43
44								44
45								45
46								46
47								47
48								48
49								49

Sampler Type:
○ No Recovery

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

Monitoring Well Construction Log

Aspect CONSULTING

Project Number	Well Number	Sheet
080190	VE-4	2 of 2

Project Name: Walker Chevrolet
Location: Tacoma, WA
Driller/Method: Cascade Drilling / Hollow Stem Auger - Angle
Sampling Method: No samples

Ground Surface Elev. (site datum) 273.53 ft
Top of Casing Elev. (site datum)
Depth to Water
Start/Finish Date 10/18/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
51–58	4" diameter, 0.020-inch, schedule 40 PVC screen, 39'-59'							51–58
59	Threaded PVC endcap							59
60							Bottom of boring is 45 feet below ground surface.	60
61–99								61–99

Sampler Type:
No Recovery

PID - Photoionization Detector
Static Water Level
Water Level (ATD)

Logged by: AET
Approved by: ALN
Figure No.

MONITORING WELL STADIUM THRIFTWAY.GPJ July 7, 2016

DEPARTMENT OF ECOLOGY State of Washington

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☒ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method :* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 275 ft. Depth of completed well 275 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 8" Diam. from +5 ft. to 265 ft.
☐ Liner installed _____" Diam. from _____ ft. to _____ ft.
☐ Threaded _____" Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☒ K-Pac Location 264

Manufacturer's Name Alloy Machine Works

Type Telescopic SS Model No. _____

Diam. 7" Slot size 50 from 275 ft. to 265 ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 32 ft.

Material used in seal bentonite 3/8 chips

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 300 ft.

Static level 215 ft. below top of well Date 8-16-2012

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? TP&D

Yield: 54 gal./min. with 23 ft. drawdown after 3 hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
750 min	216'				

Date of test 8-21-2012

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 40 gal./min. with stem set at 264 ft. for 3 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☐ No

CURRENT

Notice of Intent No. WE14640

Unique Ecology Well ID Tag No. BCN-811

Water Right Permit No. _____

Property Owner Name Tacoma General Hospital

Well Street Address 315 MLK Way

City Tacoma County Pierce

Location SW1/4-1/4 SE1/4 Sec 32 Twn 21 R 3E EWM ☐ Or WWM ☐

(s, t, r Still REQUIRED) 466500

Lat/Long Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 200318001

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown silty sand & gravel	0	30
Brown silt more sand	30	55
Gray silty clay with wood,occ		
gravels	55	62
Brown siltbound sand gravel	62	70
Gray claybound sand gravel	70	78
Brown clay silty sand gravel	78	86
Brn sand gravel-silty -loose	86	93
Gray claybound sand gravel	93	104
Black brown sand-med to fine	104	125
Silty sand gravel w blk sand		
with occ cobbles and silt lay	125	205
Gray clay and silt	205	220
Brown peat	220	225
Sand gravel layers some silt	225	252
Gray sandy clay and gravel	252	254
wb sand gravel some silt	254	275

Start Date 8-13-2012 Completed Date 8-16-2012

RECEIVED
SEP 25 2012
WA State Department of Ecology (SWRO)

RECEIVED AUG 27 2012 DEPT OF ECOLOGY NWRO WR

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) John Arfman

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2673

IF TRAINEE: Driller's License No: _____

Driller's Signature: _____

Drilling Company Tacoma Pump & Drilling

Address 30316 Mountain Highway

City, State, Zip Graham, WA 98338

Contractor's Registration No. TACOMPD203PF Date 8-20-2012

REVISED COPY

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☑ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 353552

CURRENT
Notice of Intent No. WE09787

Unique Ecology Well ID Tag No. BAK 935

Water Right Permit No.

Property Owner Name Tacoma General Hospital

Well Street Address 315 Martin Luther King Jr. Way

City Tacoma County Pierce

Location SW 1/4-1/4 SE 1/4 Sec 32 Twn 21 R 3 EWM or WWM ☐ circle one

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg Lat Min/Sec Long Deg Long Min/Sec

Tax Parcel No 2003180011

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other

TYPE OF WORK: Owner's number of well (if more than one)
☑ New well ☐ Reconditioned ☐ Deepened
Method: ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 276.5 ft.
Depth of completed well 278.5 ft.

CONSTRUCTION DETAILS
Casing Installed: ☑ Welded 8 " Diam. from +2 ft. to 268.5 ft.
☐ Liner installed " Diam. from ft. to ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☑ No
Type of perforator used
SIZE of perfs in. by in. and no. of perfs from ft. to ft.

Screens: ☑ Yes ☐ No ☑ K-Pac Location 269.5
Manufacturer's Name Alloy Machine Works
Type 8" S.S. Telesope Model No.
Diam. 7" Slot size .05 from 268.5 ft. to 278.5 ft.
Diam. Slot size from ft. to ft.

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand
Materials placed from ft. to ft.

Surface Seal: ☑ Yes ☐ No To what depth? 20' ft.
Material used in seal Bentonite Chips
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? Depth of strata
Method of sealing strata off

PUMP: Manufacturer's Name
Type: H.P.

WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 213 ft. below top of well Date 4/22/09
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☑ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Yield: gal./min. with ft. drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 55 gal./min. with stem set at 268 ft. for 1.5 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Asphalt	0	.5
Gray clayey medium gravel	.5	11
Brown silty medium sand & gravel	11	43
Brown medium to coarse silty sand	43	60
Brown silty coarse sand & gravel	60	65
Dense brown clayey coarse sand, gravel, cobbles (till)	65	75
Wet brown & gray medium to coarse sand & gravel	75	203
(till)		
Gray clayey silt	203	217
Gray clayey medium gravel	217	225
Brownish-gray clayey medium sand & gravel; wet and	225	252
looser		
Water bearing gtrayish-brown silty medium sand	252	260
& gravel		
Coarse gray silty sand & gravel - water bearing	260	276.5

RECEIVED
OCT 16 2009
DEPARTMENT OF ECOLOGY

RECEIVED
MAY 05 2009
Washington State Department of Ecology

Job #09-1568-02

Start Date 04/15/2009 Completed Date 04/22/2009

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Matt Call

Driller/Engineer/Trainee Signature

Driller or trainee License No. 25871

If TRAINEE,
Driller's Licensed No.
Driller's Signature Matthew R Call

Drilling Company Tacoma Pump & Drilling Co. Inc.

Address 30316 Mountain Highway

City, State, Zip Graham, WA 98338

Contractor's Registration No. TACOMPD203PF Date 05/01/2009

Ecology is an Equal Opportunity Employer.

REVISED COPY

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

☉ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice*

353552 *of Intent Number* _____

CURRENT

Notice of Intent No. WE09787

Unique Ecology Well ID Tag No. BAK 935

Water Right Permit No. _____

Property Owner Name Tacoma General Hospital

Well Street Address 315 Martin Luther King Jr. Way

City Tacoma County Pierce

Location SW 1/4-1/4 SE 1/4 Sec 32 Twn 21 R 3 EWM or WWM ☐ circle one

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg 47 Lat Min/Sec 15/40 Long Deg -122 Long Min/Sec 27/40

Tax Parcel No. na 2003180011

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☑ Other Emergency

TYPE OF WORK: Owner's number of well (if more than one) _____

☑ New well ☐ Reconditioned ☐ Deepened *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 276.5 ft.

Depth of completed well 278.5 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 8 " Diam. from +2 ft. to 266.5 ft.

☐ Liner installed _____ " Diam. from _____ ft. to _____ ft.

☐ Threaded _____ " Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☐ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☑ Yes ☐ No ☑ K-Pac Location 267.5

Manufacturer's Name Alloy Machine Works

Type 8" S.S. Telesope Model No. _____

Diam. 7" Slot size .050 from 268.5 ft. to 278.5 ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☐ No ☐ Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☑ Yes ☐ No To what depth? 20' ft.

Material used in seal Bentonite Chips

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level 300 ft.

Static level 213 ft. below top of well Date 4/22/09

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☑ Yes ☐ No If yes, by whom? Tacoma Pump

Yield: 100 gal./min. with 32 ft. drawdown after 0.5 hrs.

Yield: 100 gal./min. with 35 ft. drawdown after 1.0 hrs.

Yield: 100 gal./min. with 38 ft. drawdown after 2.0 hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 5/5/09

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 55 gal./min. with stem set at 268 ft. for 1.5 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☑ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Asphalt	0	.5
Gray clayey medium gravel	.5	11
Brown silty medium sand & gravel	11	43
Brown medium to coarse silty sand	43	60
Brown silty coarse sand & gravel	60	65
Dense brown clayey coarse sand, gravel, cobbles (till)	65	75
Wet brown & gray medium to coarse sand & gravel	75	203
(till)		
Gray clayey silt	203	217
Gray clayey medium gravel	217	225
Brownish-gray clayey medium sand & gravel; wet and	225	252
looser		
Water bearing gtrayish-brown silty medium sand	252	260
& gravel		
Coarse gray silty sand & gravel - water bearing	260	276.5

RECEIVED
OCT 16 2009
DEPARTMENT OF ECOLOGY

RECEIVED
MAY 15 2009
Washington State Department of Ecology

Job #09-1568-02

Start Date 04/15/2009 Completed Date 05/6/09

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☉ Driller ☐ Engineer ☐ Trainee Name (Print) Matt Call

Driller/Engineer/Trainee Signature Matt Call

Driller or trainee License No. 2571

If TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Drilling Company Tacoma Pump & Drilling Co. Inc.

Address 30316 Mountain Highway

City, State, Zip Graham, WA 98338

Contractor's Registration No. TACOMPD203PF Date 05/13/2009

Ecology is an Equal Opportunity Employer.

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE11563

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 399019

Consulting Firm Aspect

Unique Ecology Well ID

Tag No. NA #1

Type of Well *(select one)*

☒ Resource Protection

☐ Geotech Soil Boring

Property Owner Aspect

Site Address 1008 N. 1st St.

City Tacoma County Pierce

Location SW 1/4-1/4 NE 1/4 Sec 32 Twn 21 R 3 Select One ☒ E/W ☐ W/M

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter _____ Static Level _____

Work/Decommission Start Date 10-25-10

Work/Decommission Completed Date 10-25-10

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

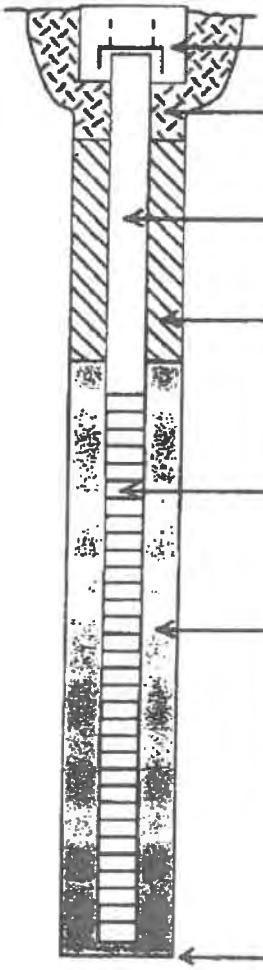
☒ Driller ☐ Engineer ☐ Trainee Name (Print) Joshua Roberts

Driller/Engineer/Trainee Signature [signature]

Driller or Trainee License No. 2924

If trainee, licensed driller's Signature and License No. _____

Construction/Design



MONUMENT TYPE: _____

CONCRETE SURFACE SEAL 0-2 ft.

PVC BLANK _____ "x _____ '

BACKFILL 2-65 ft.

TYPE: Bentonite chips

PVC SCREEN _____ "x _____ '

SLOT SIZE: _____

TYPE: _____

GRAVEL PACK _____ ft.

MATERIAL: _____

WELL DEPTH _____ ' _____ "

Well Data

Formation Description

0 - 2 ft. Concrete

2 - 65 ft. Bentonite chips

_____ - _____ ft.

_____ - _____ ft.

_____ - _____ ft.

RECEIVED

JAN 04 2011

WA State Department of Ecology (SWRO)

REMARKS chip in place 2' concrete patch

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE11563

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 399017

Consulting Firm Aspect

Unique Ecology Well ID

Tag No. NA #2

Type of Well *(select one)*

☒ Resource Protection

☐ Geotech Soil Boring

Property Owner Aspect

Site Address 1008 N. 1st St.

City Tacoma County Pierce

Location SW 1/4-1/4 NE 1/4 Sec 32 Twn 21 R 3 *Select One* ☒ EWM ☐ WWM

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter _____ Static Level _____

Work/Decommission Start Date 10-25-10

Work/Decommission Completed Date 10-25-10

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

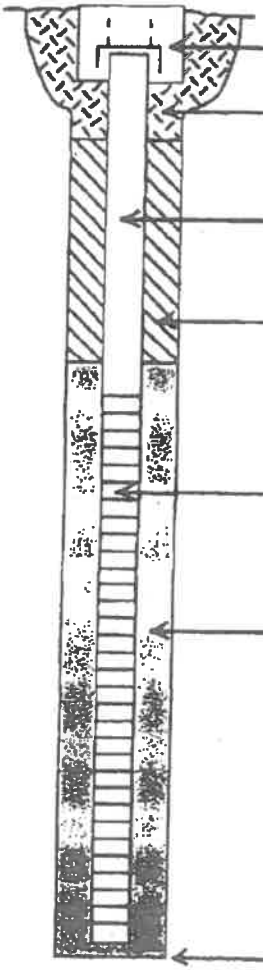
☒ Driller ☐ Engineer ☐ Trainee Name (Print): Joshua Roberts

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. 2924

If trainee, licensed driller's Signature and License No. _____

Construction/Design



MONUMENT TYPE: _____

CONCRETE SURFACE SEAL 0-2 ft.

PVC BLANK _____ "x _____ '

BACKFILL 2-65 ft.

TYPE: Bentonite chips

PVC SCREEN _____ "x _____ '

SLOT SIZE: _____

TYPE: _____

GRAVEL PACK _____ ft.

MATERIAL: _____

WELL DEPTH _____ ' "

Well Data

Formation Description

0 - 2 ft. Concrete

2 - 65 ft. Bentonite chips

_____ - _____ ft.

_____ - _____ ft.

_____ - _____ ft.

REMARKS chip in place 2' concrete patch

RECEIVED

JAN 04 2011

Well Construction

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE 11563

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 399018

Consulting Firm Aspect

Unique Ecology Well ID

Tag No. NA #3

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print): Joshua Roberts

Driller/Engineer /Trainee Signature

Driller or Trainee License No. 2924

If trainee, licensed driller's Signature and License No.

Type of Well *(select one)*

☒ Resource Protection

☐ Geotech Soil Boring

Property Owner Aspect

Site Address 1008 N. 1st St.

City Tacoma County Pierce

Location SW 1/4-1/4 NE 1/4 Sec 32 Twn 21 R 3 *Select One* ☒ BWAS ☐ WWM

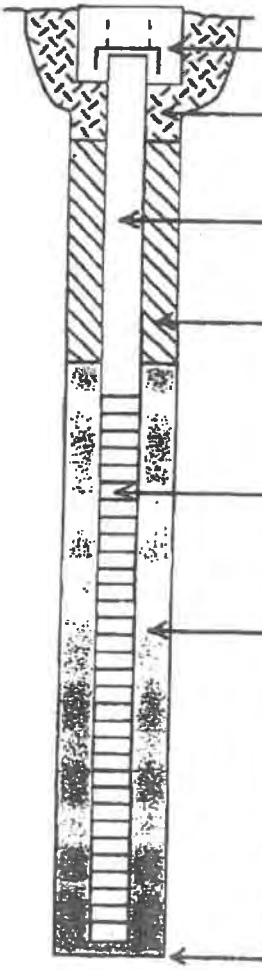
Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No.

Cased or Uncased Diameter 10" Static Level

Work/Decommission Start Date 10-25-10

Work/Decommission Completed Date 10-25-10



Construction/Design

Well Data

MONUMENT TYPE:

CONCRETE SURFACE SEAL 0-2 ft.

PVC BLANK "x '

BACKFILL 2-65 ft.

TYPE: Bentonite chips

PVC SCREEN "x '

SLOT SIZE:

TYPE:

GRAVEL PACK ft.

MATERIAL:

WELL DEPTH ' "

Formation Description

0 - 2 ft. Concrete

2 - 65 ft. Bentonite chips

- ft.

- ft.

- ft.

RECEIVED
JAN 04 2011
WA State Department of Ecology (SWRO)

REMARKS chip in place 2' concrete patch

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE31579

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☑ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Consulting Firm Aspect Consulting

Unique Ecology Well ID Tag No. BRE 895 (MW-9)

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) _____

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. 3021

If trainee, licensed driller's Signature and License No. _____

Type of Well *(select one)*

☑ Resource Protection

☐ Geotech Soil Boring

Property Owner Morrell's Dry Cleaners

Site Address 608 North 1st St

City Tacoma County Pierce

Location SE 1/4-1/4 NW 1/4 Sec 32 Twn 21N R 3 Select One ☒ BWM ☐ WWM

Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

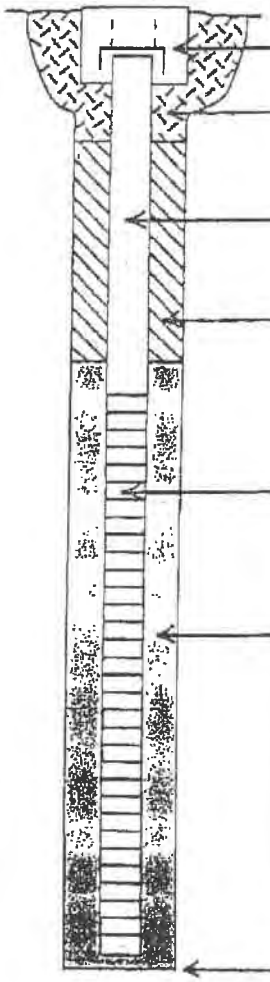
Tax Parcel No. _____

Cased or Uncased Diameter 2" Static Level N/A

Work/Decommission Start Date 4-29-15

Work/Decommission Completed Date 4-29-15

Construction/Design



Well Data

MONUMENT TYPE: Removed Flush

CONCRETE SURFACE SEAL 1 ft.

PVC BLANK 2" " x ,

BACKFILL 70' ft.

TYPE: Bentonite chips

PVC SCREEN 2" " x ,

SLOT SIZE: _____

TYPE: _____

GRAVEL PACK _____ ft.

MATERIAL: _____

WELL DEPTH 70.0 "

Formation Description

0 - ft.

- ft.

- ft.

- ft.

- ft.

REMARKS

Backfilled well with Bentonite. Removed flush monument and patched with concrete.

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. AE31579

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☐ Construction

☑ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Consulting Firm Aspect Consulting

Unique Ecology Well ID Tag No. BBE 920 (MW-10)

Type of Well *(select one)*

☑ Resource Protection

☐ Geotech Soil Boring

Property Owner Morrell's Dry Cleaners

Site Address 608 North 1st St.

City Tacoma County Pierce

Location SE 1/4-1/4 NW 1/4 Sec 32 Twn 21N R 3 Select One ☒ SWM ☐ WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) _____

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. 3021

If trainee, licensed driller's Signature and License No. _____

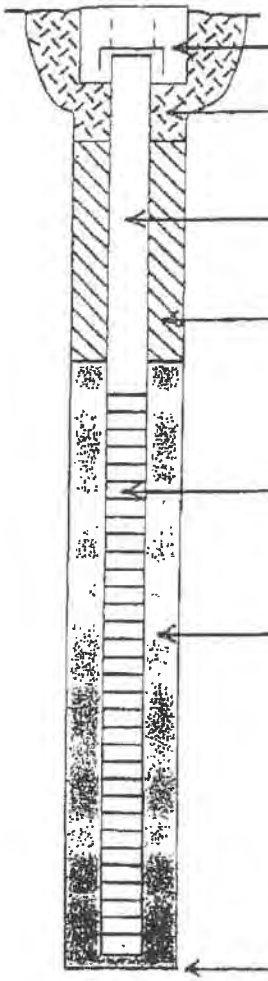
Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No. _____

Cased or Uncased Diameter 2" Static Level NA

Work/Decommission Start Date 4-29-15

Work/Decommission Completed Date 4-29-15

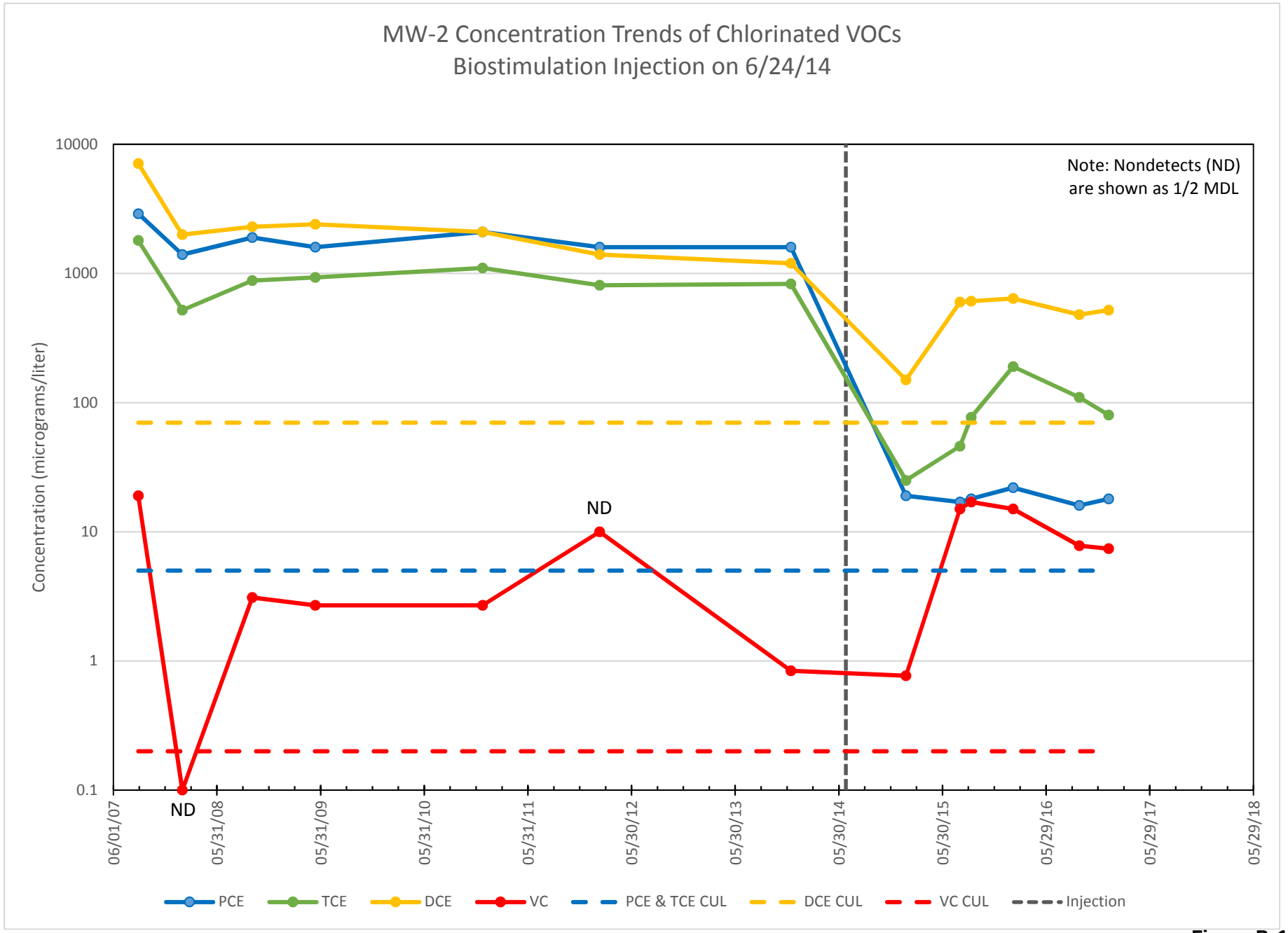
Construction/Design	Well Data	Formation Description
	MONUMENT TYPE: Removed Flush CONCRETE SURFACE SEAL ft. PVC BLANK 2" "x BACKFILL 75' ft. TYPE: Bentonite chips PVC SCREEN 2" "x SLOT SIZE: TYPE: GRAVEL PACK ft. MATERIAL: WELL DEPTH 75 0 "	0 . ft. . ft. - ft. - ft. - ft.

REMARKS

Backfilled well with Bentonite. Removed flush monument. and patched w/ concrete.

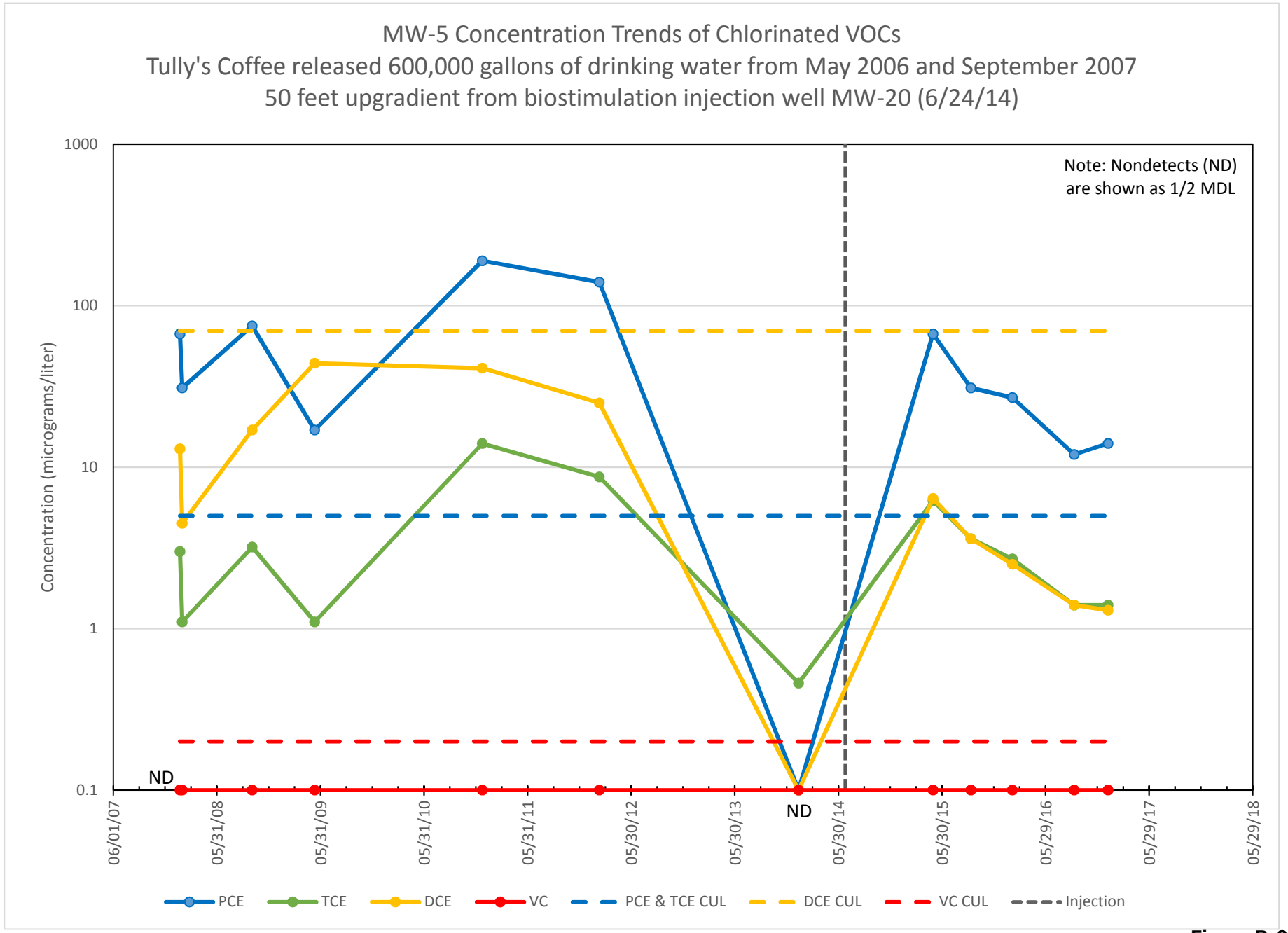
APPENDIX B

Time-Series Graphs for Groundwater COCs in Monitoring Wells



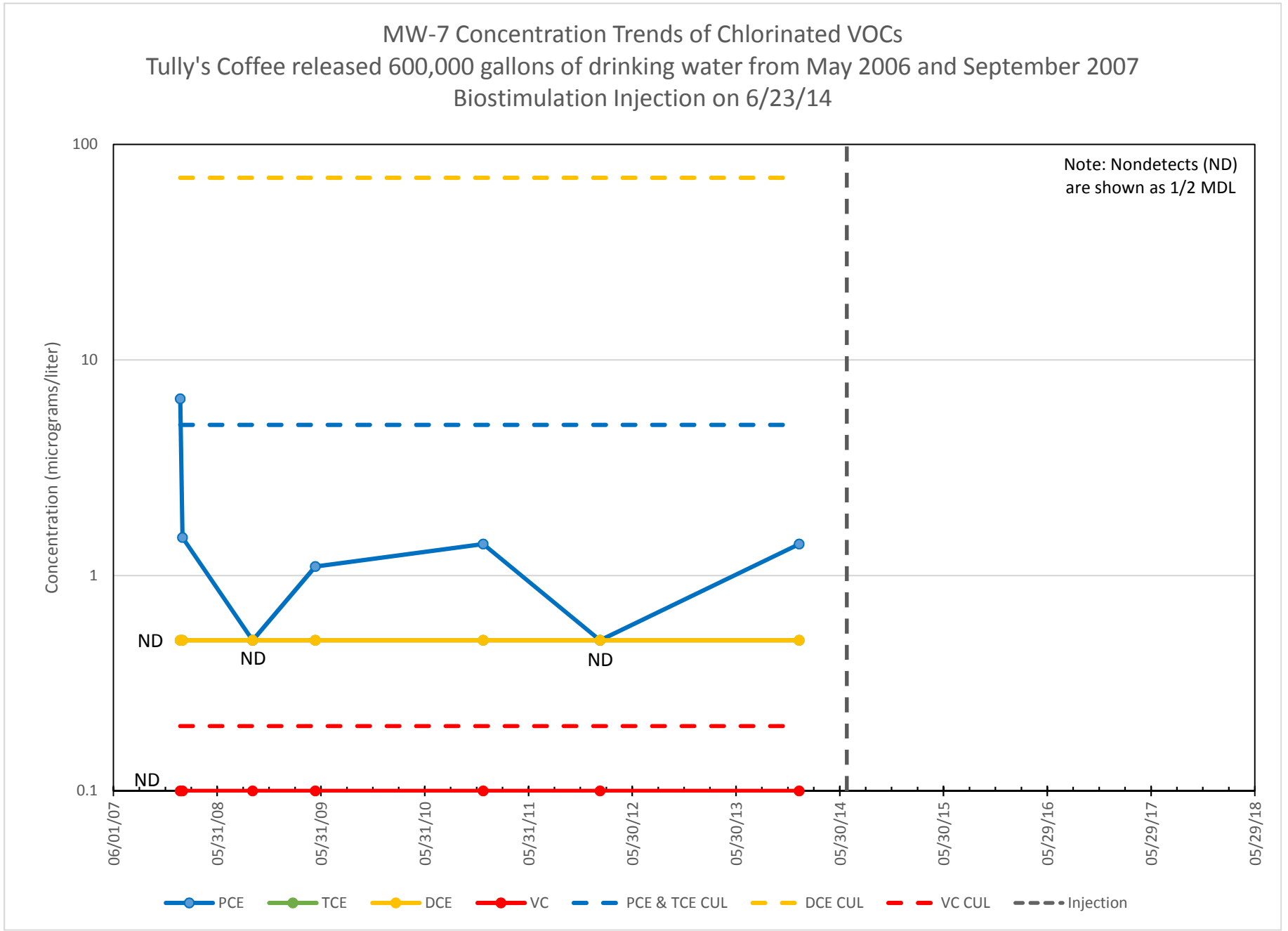
Aspect Consulting
August 2018
App B-GW plotsMW2 Gr

Figure B-1
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



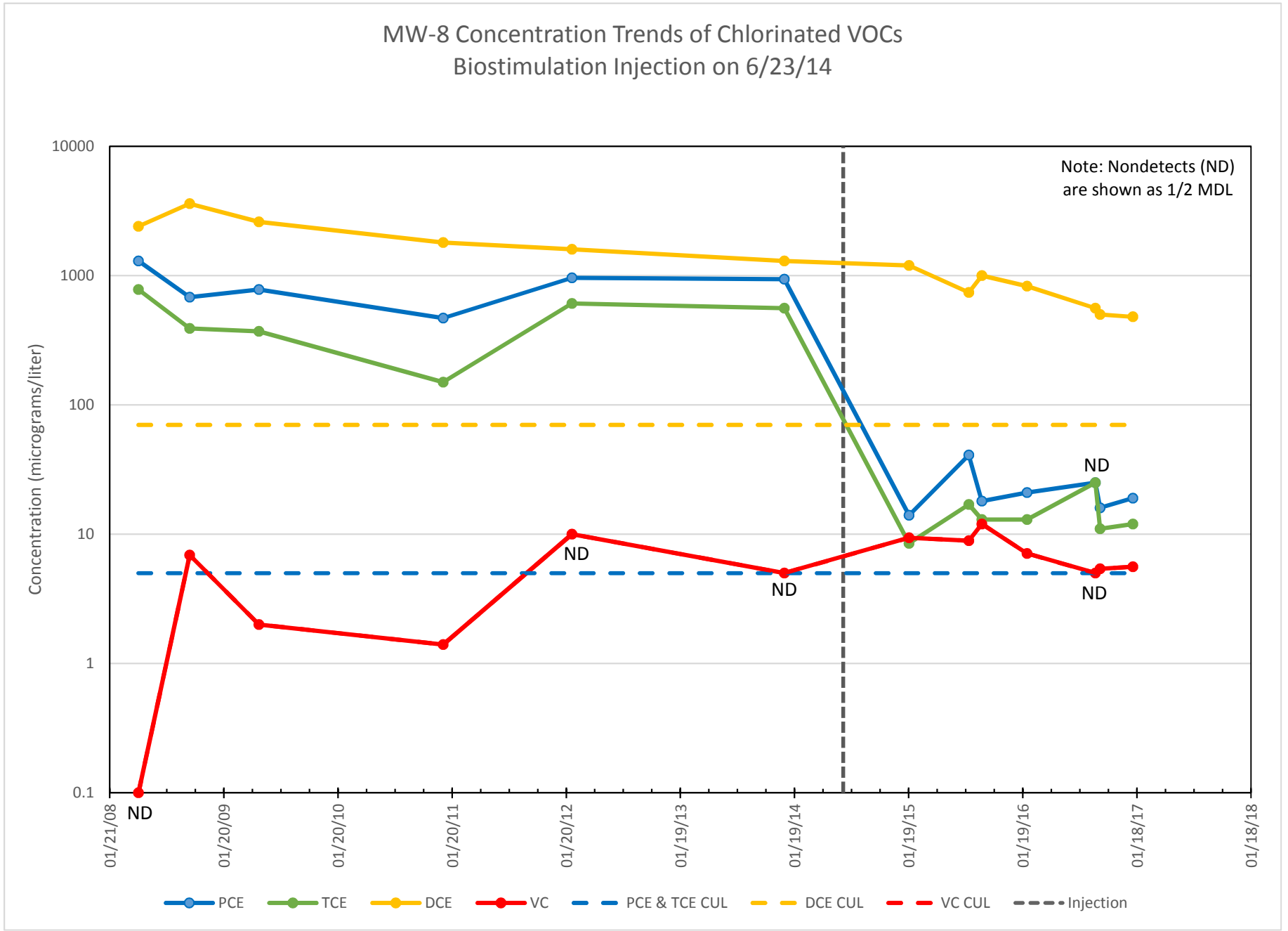
Aspect Consulting
August 2018
App B-GW plotsMW5 Gr

Figure B-2
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



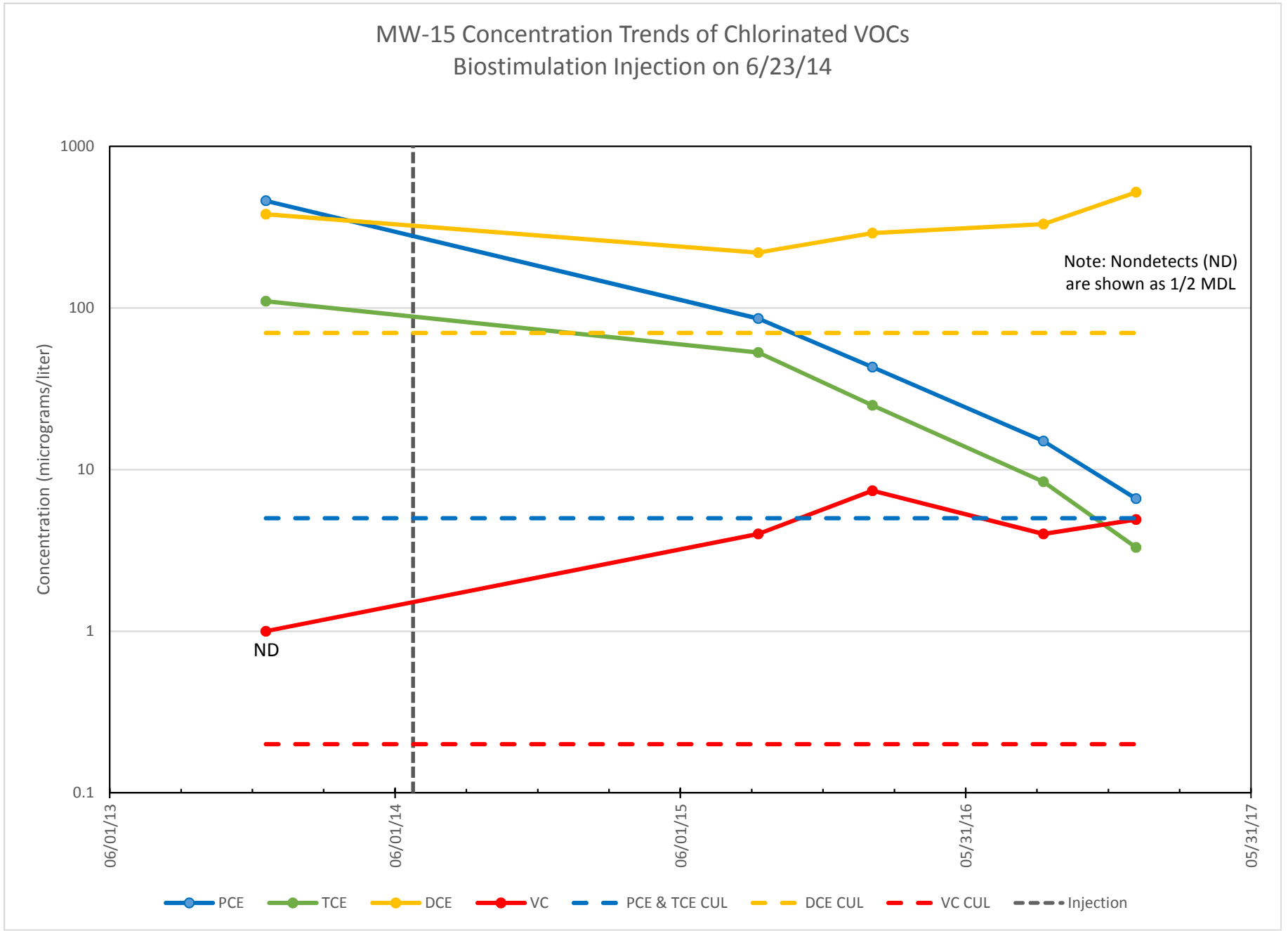
Aspect Consulting
August 2018
App B-GW plotsMW7 Gr

Figure B-3
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



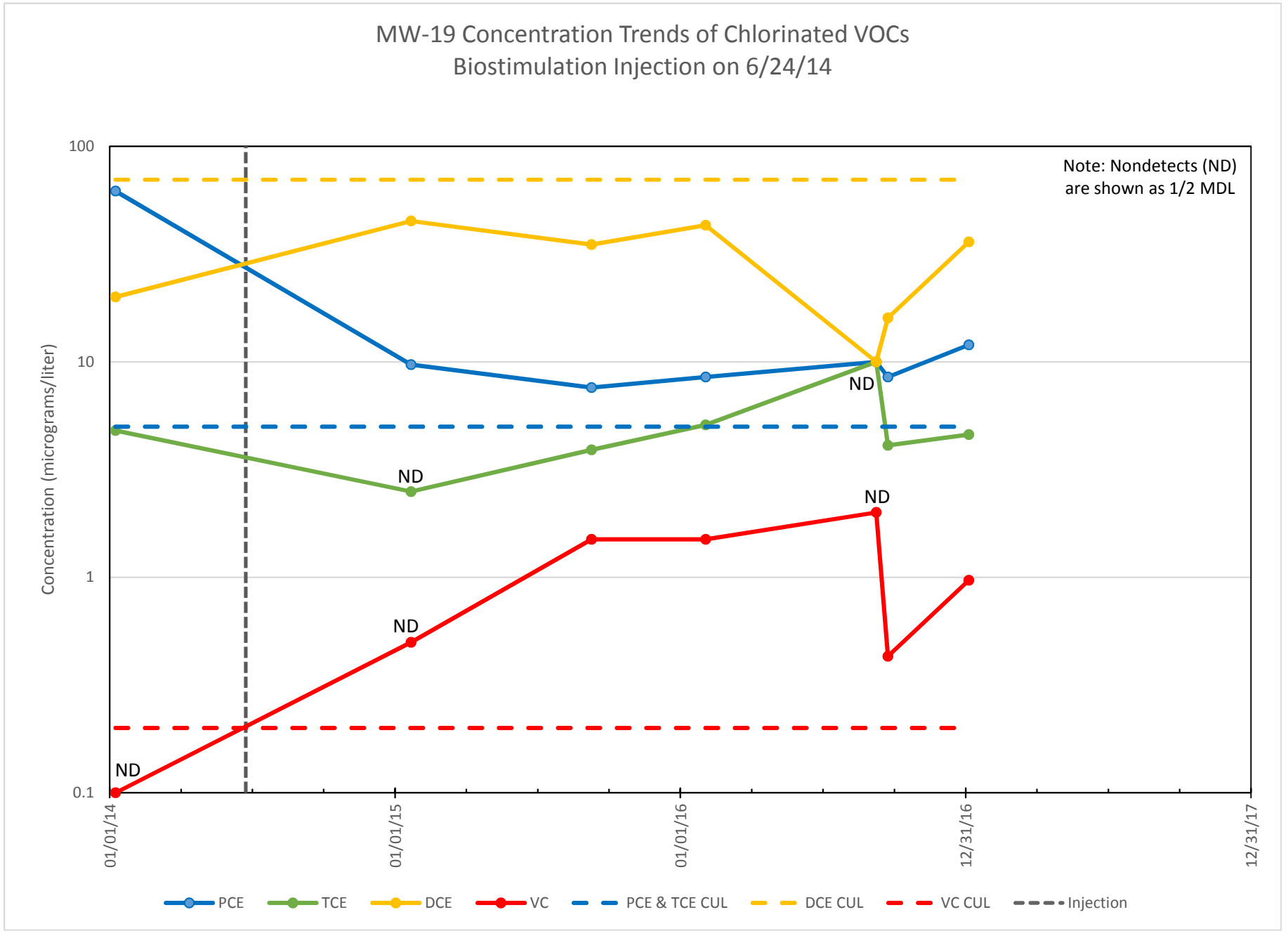
Aspect Consulting
August 2018
App B-GW plotsMW8 Gr

Figure B-4
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



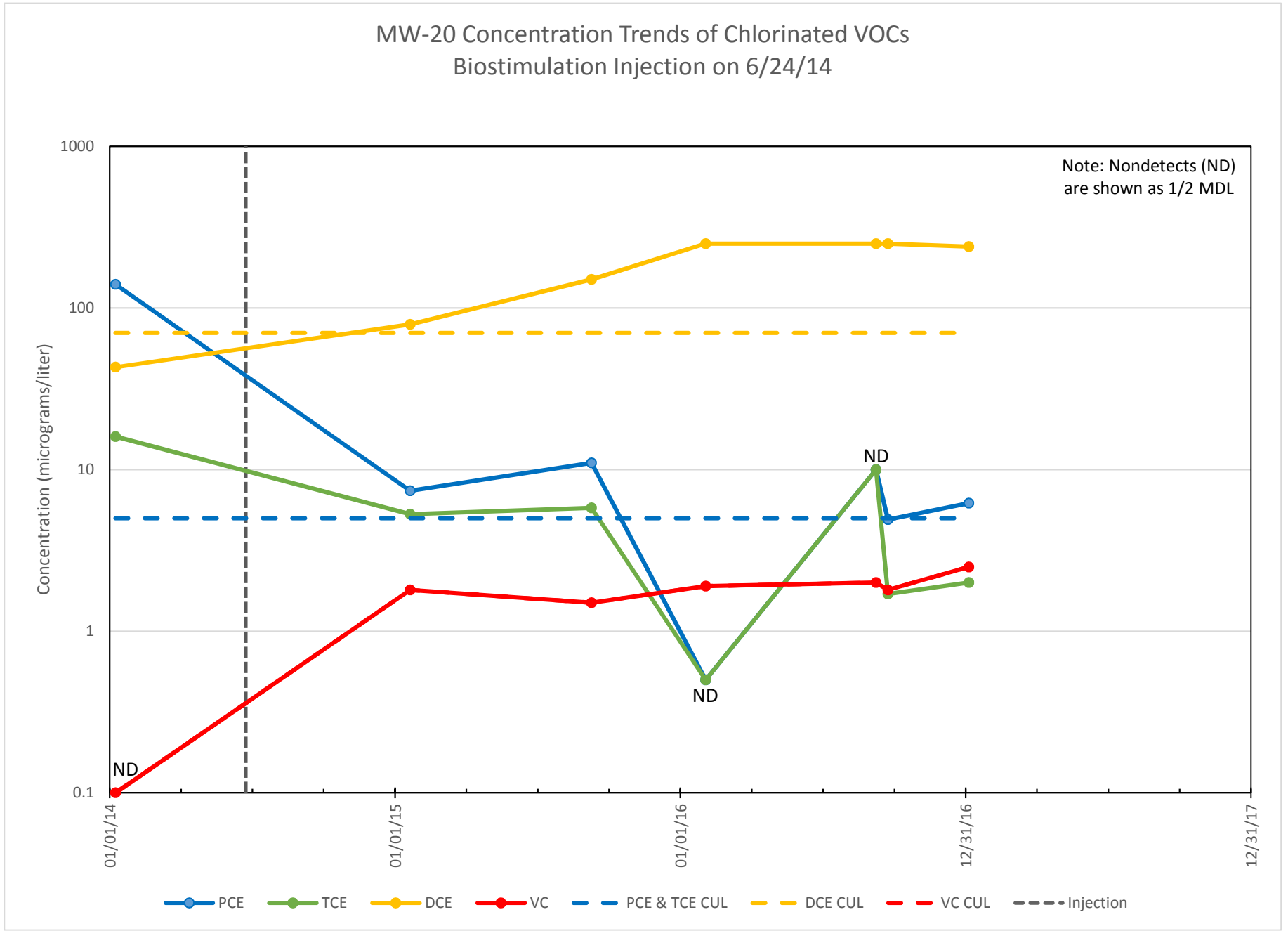
Aspect Consulting
August 2018
App B-GW plotsMW15 Gr

Figure B-5
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



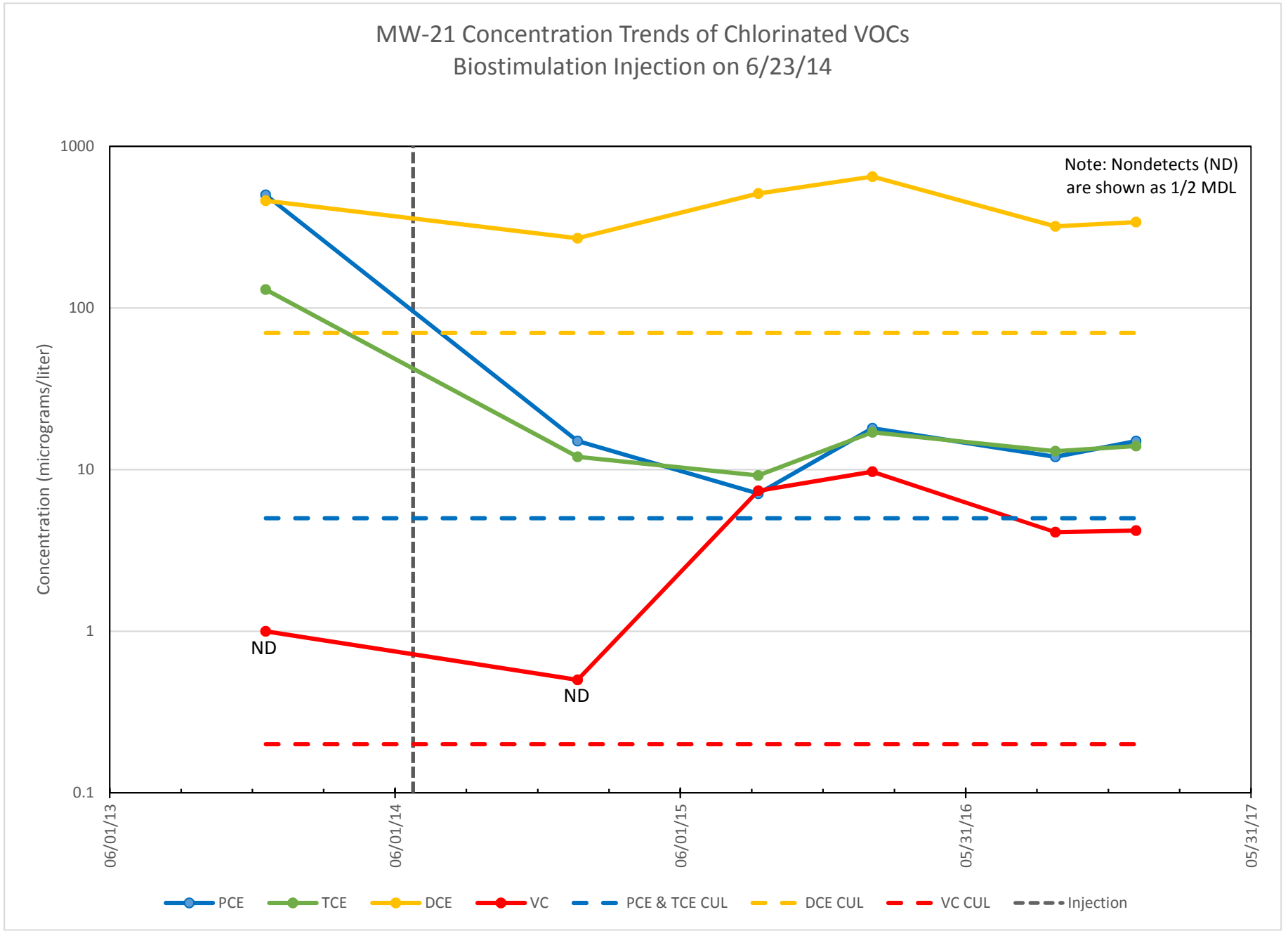
Aspect Consulting
August 2018
App B-GW plotsMW19 Gr

Figure B-6
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



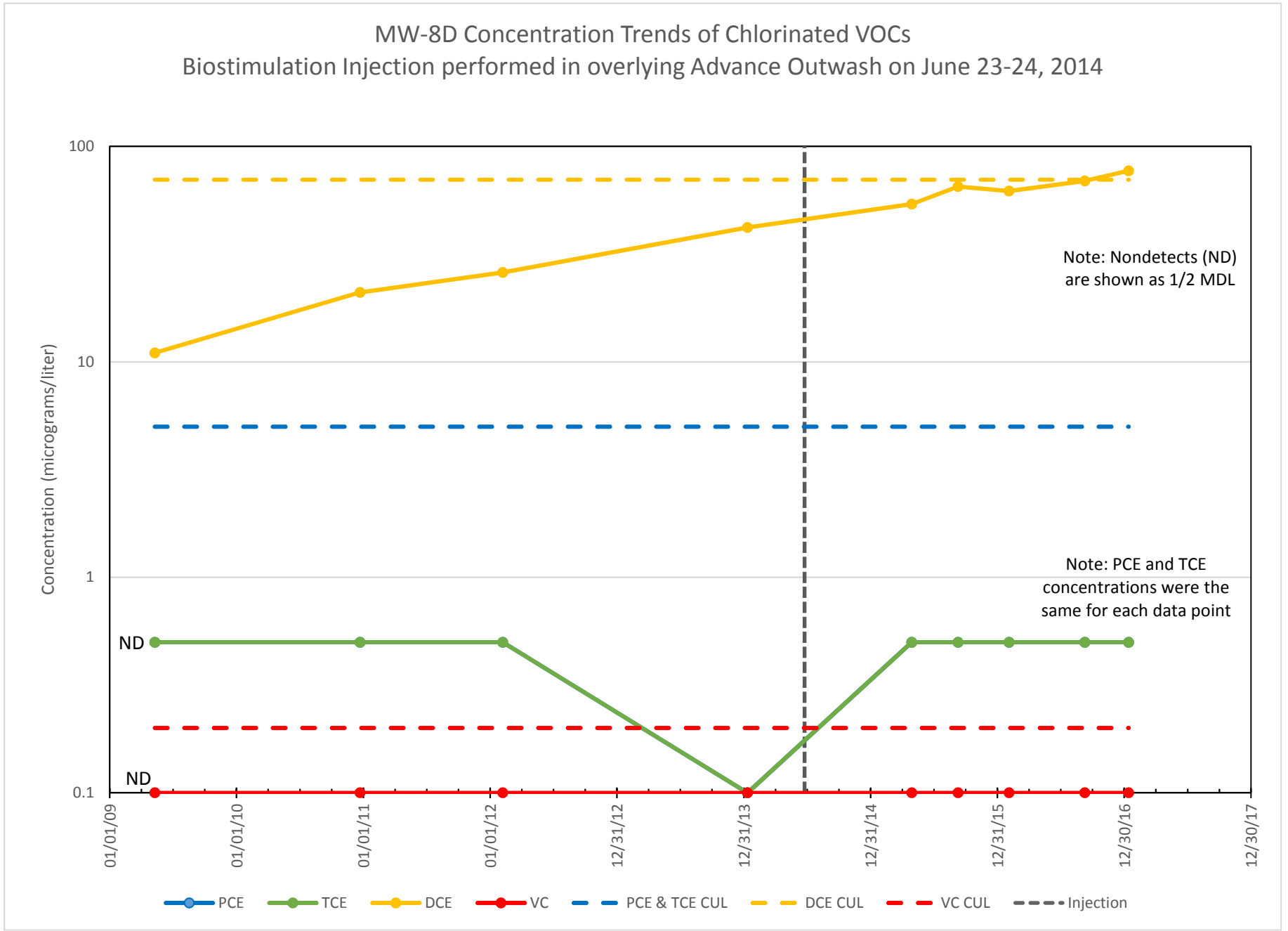
Aspect Consulting
August 2018
App B-GW plotsMW20 Gr

Figure B-8
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



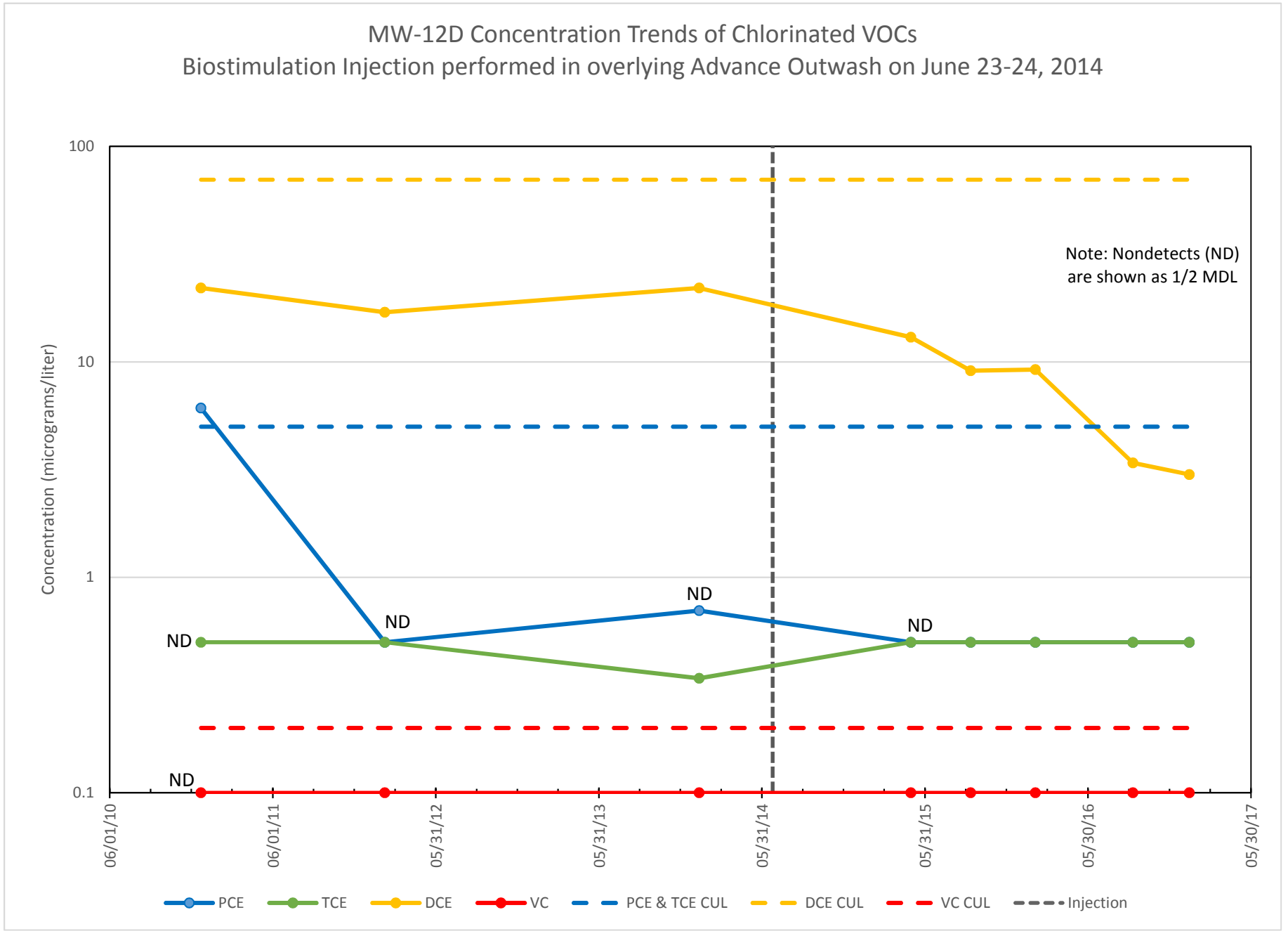
Aspect Consulting
August 2018
App B-GW plotsMW21 Gr

Figure B-8
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



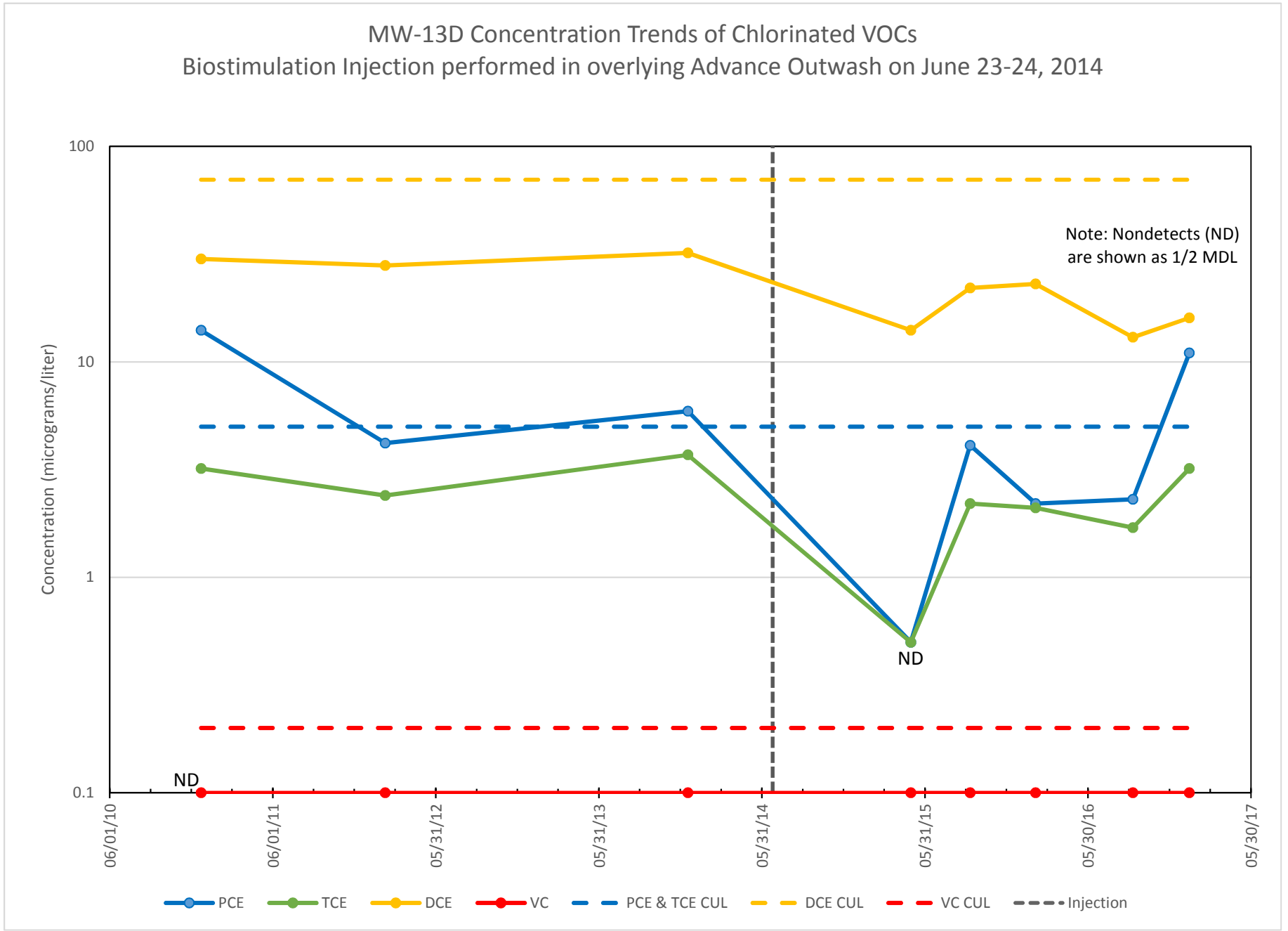
Aspect Consulting
August 2018
App B-GW plotsMW8D Gr

Figure B-9
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



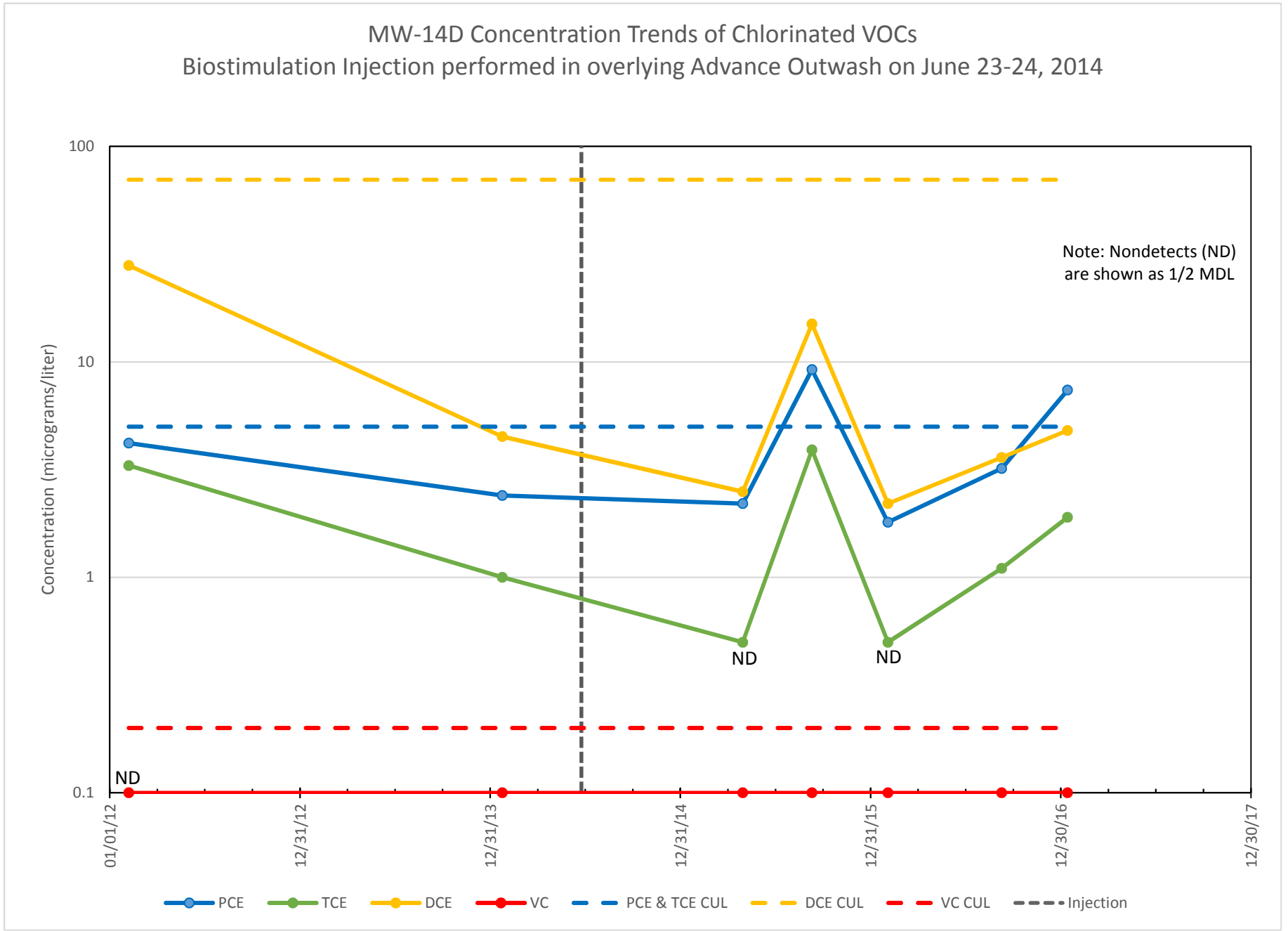
Aspect Consulting
August 2018
App B-GW plotsMW12D Gr

Figure B-10
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



Aspect Consulting
August 2018
App B-GW plotsMW13D Gr

Figure B-11
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)



Aspect Consulting
August 2018
App B-GW plotsMW14D Gr

Figure B-12
Supplemental FFS
Morrell's Dry Cleaners Site (VCP No. SW1039)

APPENDIX C

Soil Vapor Extraction System Performance Monitoring

C. Soil Vapor Extraction System Performance Monitoring

The Morrell's Dry Cleaners Soil Vapor Extraction (SVE) system has operated continuously since October 15, 2014. Figure 4-1 of the main report shows the SVE system components, the dry cleaners and adjacent building details, and the sub-slab vapor probe locations beneath the 60-foot by 60-foot dry cleaners building. Morrell's Dry Cleaners occupies the northern 40 feet of the building. The southern 20 feet of the building was used by Stadium Thriftway as an office and bakery during the due diligence and RI phases of Site characterization, and then as an unoccupied storage space until March 2015, when Tease Chocolates began operating in this lease space.

The construction, testing, and start-up of the SVE system are described in the Construction and Design Report (Aspect, 2014a) and Construction Completion Report (Aspect, 2014b). The system was monitored initially on a biweekly, and later on a monthly, basis. During operation and maintenance (O&M) site visits, system parameters were recorded, vapor concentrations were measured using a photoionization detector (PID), and sub-slab vapor pressures were measured. This appendix evaluates SVE system performance with respect to sub-slab depressurization and contaminant mass removal.

C.1. Sub-Slab Depressurization Performance

The 3,600-square-foot dry cleaners building has a concrete slab on top of 6 to 12 inches of gravel bedding and is underlain by about 30 feet of glacial till and about 15 feet of dry advance outwash. Volatile organic compounds (VOCs) diffuse from the glacial till and accumulate in the gravel bedding beneath the building. Figure 1-3 of the main report shows the areas where tetrachloroethene (PCE) accumulated beneath the building; which is an interpolation of Gore-Sorber® survey results obtained in early 2010. The SVE trench (VE-H) constructed along the north side of the building intersects more-permeable soil near the middle of the trench, where PCE contamination appears to accumulate in the alley.

Sub-slab vapor samples were collected from beneath the alley on February 9, 2012, and from beneath the building on October 15, 2014, prior to SVE start-up. Table 1-6 of the main report summarizes the sampling results. The concentration of PCE was 680,000 micrograms per cubic meter ($\mu g/m^3$) in VP-4 in the middle of dry cleaners and 3,200 $\mu g/m^3$ in VP-7 on the south side of the dry cleaners, which exceeds the 321 $\mu g/m^3$ Model Toxics Control Act (MTCA) Method B sub-slab soil gas screening level. The concentration of PCE was 150,000 $\mu g/m^3$ beneath the middle of the alley, which is consistent with the Gore-Sorber survey and permeable soil observed during trench construction. PCE concentrations were 270 and 380 $\mu g/m^3$ beneath the west and east sides of the alley, which is consistent with the Gore-Sorber survey and the hard till encountered during construction.

The SVE system is operated to maintain a minimum of 0.005 inches of water column (IWC) of vapor pressure beneath the entire slab foundation of the dry cleaner building. The extent of sub-slab depressurization from the SVE trench was initially evaluated using a 1-horse-power (HP), regenerative blower (Rotron Model EN404) during the January 2014 SVE pilot test.

The blower provided less than 3 IWC for the SVE trench (i.e., below the minimum 3-IWC gauge limit). Table C-1 shows the sub-slab pressure measurements collected during the 4-hour SVE pilot test and Figure C-1 shows the sub-slab vacuum pressures as a function of distance from the SVE trench along the centerline of the building. The 1-HP blower provided 0.005 IWC of depressurization beneath the entire Morrell's Dry Cleaners lease space, but not beneath the adjoining lease space.

After start-up of the SVE system on October 15, 2014, the extent of sub-slab depressurization from the SVE trench was evaluated using a 2-HP, regenerative blower (Rotron Model EN505). Sub-slab sample locations were completed with a Cox-Colvin vapor pin in the middle of Morrell's Dry Cleaners (VP-4) and the adjoining lease space (VP-7). The SVE system was operated with SVE trench (VE-H) and the four SVE wells (VE-1 to VE-4) fully open, which provided about 5 IWC of vacuum pressure in VE-H. Table C-2 shows the sub-slab pressure measurements collected during SVE O&M site visits. The 2-HP blower provided similar vacuum responses in VP-4 and VP-7, compared with the pilot test. The vacuum pressures ranged from 0.015 to 0.028 IWC in VP-4 in Morrell's Dry Cleaners, which exceeds the 0.005 IWC standard; however, the vacuum pressures ranged from 0.000 to 0.005 IWC in VP-7 in the storage space, which did not meet the 0.005 IWC standard.

The sub-slab suction pit (VE-SS) was constructed on November 12 and 13, 2014. A temporary blower was used to perform a pilot test for the suction pit. This pilot test measured the air flow rates and vacuum pressures beneath the building in VP-4 (Morrell's Dry Cleaners) and VP-7 (former Stadium Thriftway storage space) and a temporary vapor probe (VP-6) in the southeast corner of the Stadium Thriftway storage space. This pilot test showed that a single radon mitigation fan could depressurize beneath the building and that the SVE blower did not have the capacity to extract soil vapor from more than one suction pit. VE-SS was connected to the SVE system to allow the removal and treatment of the contaminated soil vapors.

The SVE system was initially operated with VE-SS and the SVE wells fully open to maximize sub-slab depressurization. This resulting vacuum pressure was 0.025 IWC in VP-7, which is 36 feet from VE-SS. This configuration limits SVE effectiveness because air is disproportionately extracted from the sub-slab, and the mass removal rate is relatively low because indoor air leaks through the concrete slab.

Subsequently, the valve to VE-SS was partially closed to decrease the intrusion of surface air while maintaining 0.005 IWC in VP-7. As shown in Table C-2, the vacuum pressure in VE-SS ranged from 0.6 to 0.8 IWC, while the vacuum pressure in VE-7 ranged from 0.007 to 0.013 IWC. VP-7 was destroyed when the lease space was redeveloped for Tease Chocolates, and an alternate probe VP-5 was completed inside Morrell's Dry Cleaners and adjacent to the interior wall between the two lease spaces. The vacuum pressure ranged from 0.188 to 0.321 IWC in VP-5 when VE-SS operated.

As shown in Table C-2, VE-H was periodically operated to remove accumulated contamination. The SVE system does not provide 0.005 IWC of depressurization beneath Tease Chocolates when VE-SS is shut off.

Sub-slab vapor samples were collected from VP-4 and VP-5 to evaluate the effectiveness of the SVE system and the rebound of contamination in the absence of SVE. VE-SS was shut down for 39 days prior to sample collection on April 21, 2015, and for 35 days prior to

sample collection on September 7, 2015, while vapor was alternately extracted from VE-H. When sub-slab vapors were allowed to recover for a month, the concentrations of PCE and TCE exceeded the Method B sub-slab soil gas screening levels. In contrast, VE-SS was only shut down during sample collection on December 28, 2016. The extraction of vapors from VE-SS maintained the concentrations of PCE and TCE below the Method B sub-slab soil gas screening levels when the concentrations were not allowed to rebound.

C.2. Contaminant Mass Removal

Selected SVE system operational data are summarized in Table C-3. Summa canister samples were collected from the following SVE system locations and submitted for laboratory analysis:

- the "VE-1/2 Leg" of the system, which includes soil gas extracted from SVE wells VE-1 and VE-2 completed in the glacial till (screen intervals of 18 to 32 feet bgs);
- the "VE-3/4 Leg" of the system, which includes soil gas extracted from SVE wells VE-3 and VE-4 completed in the advance outwash (screen intervals of 30 to 45 feet bgs);
- the sub-slab suction pit (VE-SS);
- the combined flow prior to the GAC vessels (INF);
- the combined flow between the GAC vessels (MID); and
- effluent from the GAC vessels (EFF);

All samples were analyzed for individual VOCs by Method TO-15. Samples collected on July 5, 2018 were also analyzed for aliphatic and aromatic petroleum hydrocarbons in three carbon ranges (by Method MA-APH). Sample results are summarized in Table C-4. PCE initially accounted for 98.7 percent by weight of detected VOCs. The percentage decreased to the 77 to 87 percent range as the PCE concentrations and detection limits decreased, and to 60 percent on August 30, 2016, because of detections of methylene chloride and petroleum hydrocarbons—including benzene, toluene, xylenes, pentane, and hexane—that were previously not detected or were present at lower concentrations.

Samples collected during the SVE pilot test (Aspect, 2014a) indicate that the relative concentrations of PCE biodegradation products increase with depth, as summarized in Table C-5 below:

Table C-5. Percentage of Chlorinated VOC Compounds with Depth during SVE Pilot Test

Pilot Test Well Depth (feet bgs)	VE-H 1.5 - 4	VE-1 18 - 32	VE-3 31-45
Formation	Glacial till	Glacial till	Advance outwash
PCE	100%	96%	77%
TCE	ND	2%	8%
cis-1,2-DCE	ND	2%	15%

Table C-5. Percentage of Chlorinated VOC Compounds with Depth during SVE Pilot Test

Vinyl chloride	ND	ND	0.08%

ND – not detected

During O&M site visits, a photo-ionization detector (PID) was used to measure VOC concentrations and an anemometer was used to measure gas flow rates at various points in the SVE system. Based on measured concentrations and gas flow rates, contaminant mass is primarily removed from the four SVE wells. Mass removal from the SVE trench and sub-slab suction pit, which is limited by diffusion of PCE from the underlying glacial till, attenuated to negligible amounts within a couple of months. The trench and sub-slab suction pit were primarily used for sub-slab depressurization and to reduce the vacuum pressures in the SVE wells.

PCE concentration is correlated to the VOC concentration measured by PID using the average of the [PCE]/[VOC] ratios measured on the seven occasions when GAC influent samples were collected for laboratory analysis (refer to Table C-4). The resulting correlation factor of 0.29 is used to estimate PCE mass removal based on PID readings. PCE mass removal estimates are provided in Table C-3 and plotted on Figure C-2. The SVE system has removed an estimated 271 pounds (lbs) of PCE from the subsurface through June 2018. An average PCE removal rate of 0.633 lbs/day is estimated for the first 3 months of SVE system operation (mid-October through mid-December 2015), versus 0.103 lbs/day estimated for the second quarter of 2018.

Mass removal of petroleum hydrocarbons by the SVE system is comparable to mass removal of chlorinated VOCs. This is evident from analysis of the combined flow (INF) sample collected on July 5, 2018, in which the sum of [PCE], [TCE], and [DCE] is about 11,000 $\mu g/m^3$ and the sum of aliphatic hydrocarbons in the C5 to C12 range is 12,000 $\mu g/m^3$. Chlorinated VOCs are primarily coming from the mid-depth soils beneath the dry cleaner building (via angled wells VE-1 and VE-2 screened at 18 to 32 feet bgs), whereas petroleum hydrocarbons are primarily coming from deeper soils (via angled wells VE-3 and VE-4 screened at 30 to 45 feet bgs). The source of the deep petroleum hydrocarbon contamination is not known. One possible source is historical dry-cleaning operations, which may have used petroleum hydrocarbons (e.g., Stoddard solvent) before chlorinated solvents came into use.

C.3. References

Aspect Consulting, LLC (Aspect), 2014a, Interim Cleanup Action Construction and Design Report, Morrell's Dry Cleaners, Prepared for David Shaw, Successor to Walker Chevrolet, May 16, 2014.

Aspect Consulting, LLC (Aspect), 2014b, Interim Cleanup Action Construction Completion Report, Morrell's Dry Cleaners, Prepared for David Shaw, Successor to Walker Chevrolet, December 23, 2014.

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Table C-1 - Sub-Slab Depressurization Measurements during Pilot Test using Soil Vapor Extraction Trench

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039)
608 North First Street, Tacoma, Washington

Elapsed Time (minutes)	VP-1 (IWC)	VP-3 (IWC)	VP-4 (IWC)	VP-5 (IWC)	VP-7 (IWC)	VP-6 (IWC)	VP-2 (IWC)	VP-8 (IWC)
Distance from SVE Trench (ft)	1.75	9	22.5	35	57.4	57.4	12.5	57.9
Pilot Test (0 min)	0	0	0	0	0	0	0.002	0
Pilot Test (15 min)	-0.058	-0.024	-0.014	-0.01	-0.001	-0.003	-0.003	-0.003
Pilot Test (45 min)	-0.058	-0.025	-0.015	-0.011	0	0	-0.004	-0.001
Pilot Test (75 min)	-0.056	-0.024	-0.014	-0.01	0	0	-0.002	0.001
Pilot Test (105 min)	-0.05	-0.02	-0.011	-0.008	0	-0.002	-0.001	-0.003
Pilot Test (135 min)	-0.054	-0.023	-0.014	-0.01	0	0.002	-0.002	0.001
Pilot Test (165 min)	-0.056	-0.024	-0.014	-0.01	0	-0.001	-0.004	-0.001
Pilot Test (195 min)	-0.055	-0.024	-0.014	-0.01	0	-0.001	-0.003	-0.001
Pilot Test (225 min)	-0.053	-0.024	-0.013	-0.01	0	0	-0.004	-0.003

Notes:
Pilot test performed on January 21, 2014 using a 1-horsepower Rotron blower for the SVE Trench (VE-H)
Recommended minimum vacuum for sub-slab depressurization = 0.005 IWC
IWC = inches of water column
SVE = soil vapor extraction

Table C-2 - Sub-Slab Depressurization Measurements during Continuous Soil Vapor Extraction Operations

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039)
608 North First Street, Tacoma, Washington

Date	VE-H (IWC)	VE-SS (IWC)	VP-4 (IWC)	VP-5 (IWC)	VP-7 (IWC)	
Location	Alley	Morrell's Dry Cleaners	Morrell's Dry Cleaners	Morrell's Dry Cleaners	Stadium Thriftway Storage/ Teese Chocolates	
Distance from VE-H (ft)	0		22.5	38	57.4	
Distance from VE-SS (ft)		0	12	28	36	**Comments**
10/15/2014	-4	NA	-0.03		-0.005	VE-H, VE-1/2, and VE-3/4 were fully open
10/16/2014	-4	NA	-0.024		0	VE-H, VE-1/2, and VE-3/4 were fully open
10/22/2014	-5	NA	-0.028		-0.001	VE-H, VE-1/2, and VE-3/4 were fully open
10/29/2014	-5	NA	-0.022		0	VE-H, VE-1/2, and VE-3/4 were fully open
11/6/2014	-5	NA	-0.015		0	VE-H, VE-1/2, and VE-3/4 were fully open
11/13/2014	-5	NA	-0.015		-0.001	VE-H, VE-1/2, and VE-3/4 were fully open
11/13/2014	-5	NA	-0.441		-0.021	VE-SS, VE-1/2, and VE-3/4 fully open, VE-H turned off
11/20/2014	-	-1.5	-0.5		-0.025	VE-SS, VE-1/2, and VE-3/4 fully open, VE-H turned off
12/4/2014	-	-0.7	-0.247		-0.009	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
12/18/2014	-	-0.6	-0.182		-0.007	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
1/2/2015	-	-0.6	-0.183		-0.007	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
1/15/2015	-	-0.6	-0.211		-0.008	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
1/28/2015	-	-1.7	-		-	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
2/11/2015	-	-0.7	-0.233		-	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
2/26/2015	-	-0.7	-0.237		-0.013	VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
3/13/2015	-	-0.7	-0.25			VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
4/21/2015	-5	-	-0.015	-0.012		VE-H barely open, VE-1/2, and VE-3/4 fully open, VE-SS turned off
5/27/2015	-	-0.8	-0.31	-0.257		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
6/30/2015	-	-0.8	-0.383	-0.321		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
7/29/2015	-3	-	-0.016	-0.013		VE-H barely open, VE-1/2, and VE-3/4 fully open, VE-SS turned off
8/27/2015	-	-0.8	-0.339	-0.286		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
9/28/2015	-3	-	-0.001	-0.008		VE-H barely open, VE-1/2, and VE-3/4 fully open, VE-SS turned off
10/29/2015	-	-0.6	-0.227	-0.188		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
12/1/2015	-2	-0.5	-0.191	-0.155		VE-SS and VE-H barely open, VE-1/2 and VE-3/4 fully open
12/28/2015	-	-0.6	-0.202	-0.164		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
1/29/2016	-	-0.6	-0.279	-0.236		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
2/26/2016	-	-0.6	-0.255	-0.214		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
3/29/2016	-	-0.6	-0.203	-0.197		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
4/26/2016	-	-0.6				VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
6/3/2016	-	-0.7	-0.338	-0.281		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
6/29/2016	-3	-	-0.015	-0.011		VE-H barely open, VE-1/2 and VE-3/4 fully open, VE-SS turned off
8/3/2016	-	-0.6	-0.324	-0.272		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
8/30/2016	-3	-	-	-		VE-H barely open, VE-1/2 and VE-3/4 fully open, VE-SS turned off
10/5/2016	-3	-	-0.011	-0.007		VE-H barely open, VE-1/2 and VE-3/4 fully open, VE-SS turned off
11/2/2016	-	-0.9	-0.357	-0.298		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
12/6/2016	-	-0.7	-0.297	-0.251		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
12/28/2016	-	-0.6	-0.298	-0.238		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
2/3/2017	-	-0.9				VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
3/2/2017	-	-0.8		-0.446		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
4/4/2017	-	-0.8		-0.446		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
5/4/2017	-	-0.9		-0.463		VE-SS barely open, VE-1/2 and VE-3/4 fully open, VE-H turned off
6/2/2017	-3	-		-0.014		VE-H barely open, VE-1/2 and VE-3/4 fully open, VE-SS turned off

Notes:

Recommended minimum vacuum for sub-slab depressurization = 0.005 IWC

VE-SS was installed on 11/13/2014 to reduce contamination beneath the dry cleaners and to provide sub-slab depressurization beneath the entire building.

The 2-hp regenerative blower does not have flow capacity to simultaneously operate VE-H and VE-SS effectively.

VP-7 was sampled in the former Stadium Thriftway storage space. After Teese Chocolates began occupying the tenant space, VP-5 was installed near the adjoining wall in Morrell's Dry Cleaners in April 21, 2015.

IWC = inches of water column
SVE = soil vapor extraction
VE-1/2 - Manifolded angled SVE wells completed in the glacial till.
VE-3/4 - Manifolded angled SVE wells completed in the advance outwash.
VE-H - SVE trench
VE-SS - Sub-slab suction pit within the dry cleaners building. VE-SS is connected to the SVE system.

Table C-3 - Soil Vapor Extraction System Operational Data

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1039)
608 North First Street, Tacoma, Washington

																VE-1/2 Leg		VE-3/4 Leg	
Date	SVE Blower Clock (hours)	Elapsed Run Time (days)	Cumulative Percent Operating Time	Effluent Pitot Tube Differential Pressure (IWC)	Air Density (kg/m^3)	Blower Flow Rate[1] (SCFM)	Pressure at Blower (IWC)	Pressure at Wellhead/ Sample Point (IWC)	Inlet/ Outlet Temp (F)	Inlet/ Outlet Temp (K)	[VOC] (ppmV, PID) (Measured)	[VOC] (ppmV, PID) (Standard)	PCE Mass Removal Rate[3] (lbs/day)	Mass of PCE Removed[3] (lbs)	Cumulative Mass of PCE Removed[3] (lbs)	Flow Rate[2] (SCFM)	[VOC] (ppmV, PID)	Flow Rate[2] (SCFM)	[VOC] (ppmV, PID)
10/15/14	5	0.0																	
10/15/14	7	0.1	100%	2.1	1.18	117.2	-18.5	16	103	313	267	279	5.732	0.6	0.6	20.1	280	22.4	191
10/16/14	26	0.9	100%	2.1	1.19	116.7	-19	16	98	310	139	144	2.971	2.4	2.9	19.5	205	19.6	221
10/22/14	173	7.0	100%	2.1	1.18	116.9	-19	15	99	310	34	35	0.727	4.5	7.4	19.5	193	21.0	98
10/29/14	345	14.2	100%	2.1	1.18	116.8	-19	15	98	310	32	33	0.683	4.9	12.3	20.3	400	21.1	130
11/6/14	534	22.1	100%	2.1	1.18	116.8	-20	15	98	310	40	41	0.854	6.7	19.0	24.8	400	21.8	394
11/13/14	699	28.9	99.8%	2.1	1.19	116.4	-20	15	94	308	23	24	0.489	3.4	22.4	19.7	460	22.0	168
11/13/14	700	29.0	99.9%	2.1	1.19	116.4	-20	15	94	308	23	24	0.489	0.0	22.4	3.0	363	3.0	168
11/20/14	868	36.0	99.9%	2.1	1.19	116.7	-17	16	98	310	24	25	0.513	3.6	26.0	2.3	265	4.5	167
12/4/14	1,204	50.0	100.0%	1.7	1.16	105.9	-31	13	104	313	34	36	0.655	9.2	35.2	68.3	98	73.5	71
12/18/14	1,539	63.9	99.9%	1.6	1.16	103.2	-37	11	106	314	48	51	0.897	12.5	47.7	75.3	75	80.5	92
1/2/15	1,899	78.9	99.9%	1.6	1.16	103.0	-38	11	104	313	22	23	0.411	6.2	53.9	74.9	47	80.1	84
1/15/15	2,209	91.9	99.8%	1.6	1.16	103.2	-38	11	106	314	18	19	0.337	4.3	58.2	94.5	360	83.4	134
1/28/15	2,521	104.9	99.9%	1.6	1.16	103.0	-38	11	104	313	31	32	0.579	7.5	65.7	86.7	302	84.5	138
2/11/15	2,858	118.9	99.9%	1.6	1.17	102.7	-35	13	103	313	8	8	0.149	2.1	67.8	83.2	65	89.9	33
2/26/15	3,214	133.7	99.8%	1.5	1.17	99.4	-35	14	104	313	11	12	0.199	3.0	70.8	60.8	101	43.0	37
3/13/15	3,576	148.8	99.9%	1.5	1.15	100.1	-35	14	112	318	13	14	0.237	3.6	74.4	78.2	136	81.1	41
4/21/15	4,401	183.2	97.4%	1.9	1.17	111.8	-19	16	106	314	1	1	0.020	0.7	75.1	21.5	91	23.0	32
5/27/15	5,060	210.6	94.0%	1.6	1.16	102.9	-31	15	108	315	28	30	0.527	14.5	89.5	75.9	946	88.4	63
6/30/15	5,827	242.6	94.0%	1.6	1.14	103.8	-32	15	118	321	23	25	0.436	13.9	103.5	76.0	173	65.1	20
7/29/15	6,516	271.3	94.5%	1.7	1.15	106.5	-31	15	113	318	19	20	0.370	10.6	114.1	37.2	162	34.3	20
8/27/15	7,156	298.0	94.3%	1.6	1.14	103.9	-33	14	118	321	12	13	0.227	6.1	120.1	75.3	312	92.6	19
9/28/15	7,925	330.0	94.8%	1.6	1.16	102.8	-34	14	106	314	12	13	0.225	7.2	127.4	78.3	36	58.4	38
10/29/15	8,669	361.0	95.3%	1.3	1.16	92.9	-39	12	106	314	12	13	0.202	6.3	133.6	76.0	78	91.5	14
12/1/15	9,339	388.9	94.4%	1.5	1.20	98.0	-22	16	91	306	3	3	0.054	1.5	135.1	41.8	57	42.6	12
12/28/15	9,988	416.0	94.8%	1.4	1.18	95.3	-37	11	92	306	7	7	0.121	3.3	138.4	74.2	11	58.3	12
1/29/16	10,757	448.0	95.1%	1.4	1.19	95.3	-32	12	93	307	9	9	0.156	5.0	143.4	109.7	38	105.9	13
2/26/16	11,425	475.9	95.4%	1.4	1.18	95.4	-36	12	94	308	15	15	0.260	7.2	150.6	108.6	110	111.7	27
3/29/16	12,197	508.0	95.7%	1.4	1.16	96.5	-35	12	107	315	12	13	0.210	6.8	157.4	45.7	115	47.2	18
4/26/16	12,847	535.1	95.7%	1.4	1.15	96.7	-36	12	109	316	16	17	0.281	7.6	165.0	64.6	154	39.7	27
6/3/16	13,753	572.9	96.0%	1.5	1.13	100.9	-36	12	118	321	9	10	0.165	6.2	171.2	109.9	51	118.6	23
6/29/16	14,360	598.1	96.0%	1.5	1.14	100.6	-35	11	114	319	8	9	0.146	3.7	174.9	95.4	167	120.2	21
8/3/16	15,079	628.1	95.5%	1.5	1.13	101.0	-37	11	118	321	7	8	0.128	3.8	178.7	73.0	41	88.9	9
8/30/16	15,614	650.4	94.9%	1.5	1.13	101.2	-36	11	120	322	7	8	0.128	2.9	181.6	43.9	28	45.4	9
10/5/16	16,446	685.1	95.0%	1.5	1.15	100.1	-37	11	108	315	6	6	0.109	3.8	185.4	85.3	14	101.5	9
11/2/16	17,114	712.9	95.2%	1.5	1.16	99.7	-37	11	104	313	11	12	0.199	5.5	190.9	47.4	3	44.5	20
12/6/16	17,936	747.1	95.4%	1.5	1.19	98.5	-36	11	90	305	5	5	0.089	3.1	194.0	55.5	16	43.3	9
12/28/16	18,459	768.9	95.5%	1.5	1.18	98.9	-38	11	94	308	5	5	0.090	2.0	195.9	58.8	31	48.3	10
2/3/17	19,345	805.9	95.7%	1.5	1.17	99.1	-36	8	93	307	5	5	0.089	3.3	199.2	56.0	28	59.7	9
3/2/17	19,995	832.9	95.9%	1.5	1.16	99.8	-36	7	99	310	6	6	0.107	2.9	202.1	66.5	39	70.3	11
4/4/17	20,781	865.7	96.0%	1.5	1.14	100.4	-35	7	106	314	5	5	0.090	3.0	205.1	57.6	37	51.0	10
5/5/17	21,530	896.9	96.1%	1.5	1.14	100.5	-36	7	107	315	4	4	0.072	2.3	207.3	25.8	5	29.5	8
6/2/17	22,142	922.4	96.0%	1.5	1.11	101.8	-36	6	120	322	6	6	0.109	2.8	210.1	44.0	9	45.4	14
6/29/17	22,747	947.6	95.9%	1.5	1.14	100.5	-37	6	106	314	7	7	0.126	3.2	213.3	31.0	44	34.0	11
8/1/17	23,507	979.3	95.9%	1.5	1.13	101.2	-36	6	114	319	13	14	0.236	7.5	220.7	35.0	27	34.0	18
9/5/17	24,171	1,006.9	95.4%	1.6	1.12	104.8	-31	8	119	321	10	11	0.188	5.2	226.0	40.0	8	37.0	13
9/29/17	24,713	1,029.5	95.3%	1.3	1.13	94.0	-41	4	108	315	37	39	0.620	14.0	240.0	29.0	12	32.0	30
10/26/17	25,362	1,056.6	95.4%	1.4	1.14	97.3	-37	6	108	315	18	19	0.314	8.5	248.4	27.0	9	30.0	23
12/4/17	26,297	1,095.5	95.6%	1.7	1.17	105.8	-39	4	90	305	4	4	0.075	2.9	251.4	42.0	5	41.0	12
1/5/18	27,063	1,127.4	95.7%	1.7	1.16	106.3	-35	4	96	309	4	4	0.076	2.4	253.8	24.0	8	26.0	7
2/1/18	27,365	1,140.0	94.6%	1.8	1.15	109.7	-35	4	99	310	5	5	0.098	1.2	255.0	30.0	51	30.0	11
3/5/18	28,031	1,167.8	94.4%	1.7	1.16	106.3	-37	3.5	95	308	6	6	0.114	3.2	258.2	27.0	25	51.0	19
4/2/18	28,806	1,200.1	94.9%	1.7	1.15	106.7	-36	4	100	311	6	6	0.114	3.7	261.9	54.0	60	88.0	22
5/1/18	29,502	1,229.1	95.0%	1.8	1.13	101.0	-34	4	108	315	10	11	0.180	5.2	267.1	29.0	102	25.0	32
6/8/18	30,372	1,265.3	95.0%	1.7	1.13	98.0	-33	4	110	316	5	5	0.087	3.2	270.3	83.0	16	74.0	14
7/5/18	30,928	1,288.5	94.8%	1.6	1.12	95.0	-33	4	115	319	3.5	3.7	0.059	1.4	271.6	66.0	11	77.0	9

IWC = inches of water column
PCE = tetrachloroethene
PID = photoionization detector
ppmV = parts per million by volume
SCFM = standard cubic feet per minute
SVE = soil vapor extraction
VOC = volatile organic compound

Notes:

1) Rotron EN505 blower curve indicates that the blower should extract 97.5 SCFM at 37.5 IWC and 120 SCFM at 20 IWC. Flow rate for the blower is measured using a pitot tube, and the flow measurements reconcile with the two Rotron EN505 blower curve match points, indicating the accuracy of the blower flow measurements.
2) Flow rates are measured with an anemometer for the VE-1/2 and VE-3/4 legs of the SVE system. These are highly variable and combined measurements often greatly exceed blower capacity, indicating limitations for the anemometer flow measurements.
3) PCE concentration was correlated to the VOC concentration measured by PID using the average of the [PCE]/[VOC] ratios measured on the seven occasions on which SVE influent samples were analyze by EPA Method TO-15 (refer to Table C-4). The resulting correlation factor of 0.290 is used to estimate PCE mass removal based on PID readings.

Table C-4 - Soil Vapor Extraction System Gas Sampling Results

Project No. 080190, Morrell's Dry Cleaners Site (VCP No. SW1040)
608 North First Street, Tacoma, Washington

Location	VE-1/2	VE-3/4	VE-SS	GAC Influent							Between GAC		GAC Effluent					
Date	7/5/18	7/5/18	7/5/18	10/15/14	3/13/15	6/30/15	2/26/16	8/30/16	10/26/17	7/5/18	2/26/16	8/30/16	10/15/14	3/13/15	6/30/15	2/26/16	8/30/16	10/26/17
Chemical	Well Screen Intervals 18 to 32 feet bgs	Well Screen Intervals 30 to 45 feet bgs	Sub-slab	Combined Flow Prior to Treatment							Between Serial Carbon Vessels		Emissions to Atmosphere					
Chlorinated Volatile Organic Compounds																		
Tetrachloroethene (PCE)	**96,000**	**26,000**	**1,200 ve**	**800,000**	**31,000**	**38,000**	**7,500**	**21,000**	**21,000 ve**	**9,900 ve**	**11,000**	**2,500**	< 8.2 U	< 8.1 U	< 8.0 U	< 6.8 U	< 3.4 U	**25**
Trichloroethene (TCE)	**450**	**1,300**	**29**	**2,000**	**2,400**	**2,100**	**580**	**1,100**	**1,300**	**440**	**1,200**	**1,500**	< 6.5 U	< 6.4 U	< 6.4 U	< 5.4 U	< 2.7 U	**1,900**
cis-1,2-Dichloroethene (cDCE)	**5,300**	**1,300**	<1.3 U	**1,500**	**2,200**	**1,400**	**550**	**790**	**740**	**390**	**540**	**1,500**	< 4.8 U	< 4.7 U	**1,100**	**1,500**	**12**	**12**
trans-1,2-Dichloroethene (tDCE)	<200 U	<99 U	<1.3 U	< 1300 U	< 73 U	< 66 U	< 20 U	< 40 U	< 9.9 U	<9.9 U	**7.1**	< 40 U	< 4.8 U	< 4.7 U	**16**	**24**	< 2 U	**950**
1,1-Dichloroethene	<200 U	<99 U	**4.6**	< 1300 U	< 73 U	< 66 U	< 20 U	< 40 U	< 9.9 U	<9.9 U	< 4 U	< 40 U	< 4.8 U	< 4.7 U	< 4.7 U	< 4 U	< 2 U	**5.6**
1,1,1-Trichloroethane	<270 U	<140 U	**4.8**	< 1800 U	< 100 U	< 91 U	< 27 U	< 55 U		<14 U	< 5.5 U	< 55 U	< 6.6 U	< 6.5 U	< 6.5 U	< 5.5 U	< 2.7 U	
Vinyl chloride	**440**	<64 U	<0.84 U	< 820 U	< 47 U	< 43 U	< 13 U	< 26 U	< 6.4 U	<6.4 U	< 2.6 U	< 26 U	< 3.1 U	< 3.0 U	< 3.0 U	< 2.6 U	< 1.3 U	< 2.6 U
Carbon tetrachloride	<310 U	<310 U	**6.5**	< 2000 U	**160**	< 100 U	< 31 U	< 63 U		**22**	**70**	< 63 U	< 7.6 U	< 7.5 U	< 7.4 U	< 6.3 U	< 3.1 U	
Chloroform	<24 U	**46**	**1.5**	< 1600 U	< 90 U	< 82 U	< 24 U	< 49 U		**15**	**22**	< 49 U	< 5.9 U	< 5.8 U	< 5.8 U	**45**	< 2.4 U	
Methylene chloride	<43,000 U	<22,000 U	<290 U	< 1100 U	< 640 U	< 580 U	< 870 UJ	**10,000**		<2,200 U	**430 J**	< 8700 U	< 42 U	< 41 U	**48**	**250 J**	**850**	
1,4-Dichlorobenzene	<120 U	<60 U	**1.0**	< 1900 U	< 110 U	< 100 U	< 30 U	< 60 U		<6 U	< 6 U	< 60 U	< 7.3 U	< 7.2 U	< 7.1 U	< 6 U	< 3 U	
Petroleum Hydrocarbons																		
APH EC5-8 aliphatics[2]	<23,000 U	**40,000**	<150 U							**10,000**								
APH EC9-12 aliphatics[2]	<17,000 U	<8,700 U	**1,200**							**2,000**								
APH EC9-10 aromatics[2]	<12,000 U	<6,200 U	<82 U							<620 U								
Benzene	<160 U	**190**	<1.1 U	< 1000 U	< 59 U	< 53 U	< 16 U	**160**	**130**	**58**	**34**	**280**	< 3.9 U	< 3.8 U	< 3.8 U	< 3.2 U	< 1.6 U	**130**
Toluene	<190 U	**280**	**4.5**	< 1200 U	< 69 U	< 63 U	< 19 U	**280**	**200**	**93**	< 3.8 U	< 38 U	< 4.6 U	< 4.5 U	< 4.5 U	< 3.8 U	**2.7**	**28**
Ethylbenzene	<220 U	<110 U	<1.4 U	< 1400 U	< 80 U	< 72 U	< 22 U	< 43 U	**13**	<11 U	< 4.3 U	< 43 U	< 5.3 U	< 5.2 U	< 5.1 U	< 4.3 U	< 2.2 U	< 4.3 U
Total Xylenes	<650 U	**650**	<4.3 U	< 1400 U	< 80 U	< 72 U	< 43 U	**211**	**335**	**210**	< 8.7 U	< 87 U	< 5.3 U	< 5.2 U	< 5.1 U	< 8.7 U	< 4.3 U	**47**
Naphthalene	<52 U	<26 U	**3.0 fb**				< 26 U	< 52 U	< 13 U	**3.5 fb**	< 5.2 U	< 52 U				< 5.2 U	< 2.6 U	< 5.2 U
1,2-Dibromoethane (EDB)	<38 U	<19 U	<0.56 U	< 2500 U	< 140 U	< 130 U	< 38 U	< 77 U		<1.9 U	< 7.7 U	< 77 U	< 9.3 U	< 9.1 U	< 9.1 U	< 7.7 U	< 3.8 U	
1,2-Dichloroethane (EDC)	<20 U	<10 U	<0.24 U	< 1300 U	< 74 U	< 68 U	< 20 U	< 40 U	< 10 U	<1 U	**4.5**	< 40 U	< 4.9 U	< 4.8 U	< 4.8 U	< 4 U	< 2 U	< 4 U
Methyl tert-butyl ether (MTBE)	<900 U	<450 U	<5.9 U	< 1200 U	< 66 U	< 60 U	< 18 U	< 36 U		<45 U	< 3.6 U	< 36 U	< 4.4 U	< 4.3 U	< 4.3 U	< 3.6 U	< 1.8 U	
Propene	<340 U	<170 U	<2.3 U				< 34 U	< 69 U		<17 U	< 6.9 U	< 69 U				< 6.9 U	**4.1**	
Isobutene	<460 U	<230 U	<3 U				< 46 U	< 92 U		<23 U	< 9.2 U	< 92 U				< 9.2 U	**9.5**	
Pentane	<1,500 U	<740 U	<9.7 U				**170**	**320**		**170**	**430**	**420**				< 30 U	< 15 U	
Cyclopentane	<140 U	<72 U	<0.95 U				< 14 U	**48**		<7.2 U	< 2.9 U	**81**				**160**	**4**	
n-Hexane	<1,800 U	<880 U	<12 U	< 1100 U	**640**	**260**	**230**	**550**		**150**	**760**	**930**	< 4.3 U	< 4.2 U	< 4.2 U	< 35 U	< 18 U	
Cyclohexane	<3,400 U	<1,700 U	<23 U	< 1100 U	**370**	**160**	< 340 U	< 690 U		<170 U	**380**	< 690 U	< 4.2 U	< 4.1 U	< 4.1 U	< 69 U	< 34 U	
Heptane				< 1300 U	**630**	**150**							< 5.0 U	< 4.9 U	< 4.8 U			
2,2,4-Trimethylpentane				< 1500 U	**2,700**	**1,500**							< 5.7 U	< 5.6 U	< 5.5 U			
Other Detected Volatile Organic Compounds																		
Acetone	<2,400 U	<1,200 U	<16 U	< 3000 U	< 440 U	< 400 U	< 240 U	< 480 U		<120 U	< 48 U	< 480 U	**36**	< 28 U	**37**	< 48 U	**30**	
Acrolein	<460 U	<230 U	<3 U				< 46 U	< 92 U		<23 U	< 9.2 U	< 92 U				< 9.2 U	**9.4**	
CFC-113	<380 U	<190 U	**23**				< 38 U	< 77 U		**23**	< 7.7 U	< 77 U				< 7.7 U	< 3.8 U	
Chlorodifluoromethane	<180 U	<88 U	**1.3**				< 18 U	< 35 U		<8.8 U	< 3.5 U	< 35 U				< 3.5 U	< 1.8 U	
Dichlorodifluoromethane	<250 U	<120 U	**3.1**	< 1600 U	< 91 U	< 82 U	**29**	**55**		**38**	**48**	**49**	< 6.0 U	**68**	**60**	**60**	**42**	
Ethanol	<3,800 U	<1,900 U	<25 U	< 2400 U	< 140 U	< 120 U	< 380 U	< 750 U		<190 U	< 75 U	< 750 U	< 9.2 UJ	**28**	**130**	< 75 U	< 38 U	
2-Propanol	<4,300 U	<2,200 U	<28 U	< 3200 U	< 180 U	< 160 U	< 430 UJ	< 860 U		<220 U	< 86 UJ	< 860 U	< 12 U	< 12 U	**35**	< 86 UJ	**85**	
Tetrahydrofuran				**1,600**	< 54 U	< 49 U							< 3.6 U	< 3.5 U	< 3.5 U			
Trichlorofluoromethane	<280 U	<140 U	**5.8**	< 1800 U	< 100 U	< 94 U	< 28 U	< 56 U		<14 U	< 5.6 U	< 56 U	< 6.8 U	< 6.7 U	**16**	**5.6**	**6.2**	

APH air-phase hydrocarbons
bgs below ground surface
fb the analyte was detected in the method blank

J the value reported is an estimate (concentration is below lowest calibration standard)
U not detected at the indicated reporting limit
ve the value reported is an estimate (response exceeded the valid instrument calibration range)

Notes:

1) All concentrations are in micrograms per cubic meter. Only analytes detected in at least one sample are included in this table. Detections are bolded.

2) All samples were analyzed by EPA Method TO-15 for volatile organic compounds (VOCs). Samples collected on 7/5/18 were also analyzed by Method MA-APH for aliphatic and aromatic hydrocarbons in the indicated carbon ranges. Non-petroleum compounds were subtracted from the EC5-8 aliphatic range prior to quantitation.

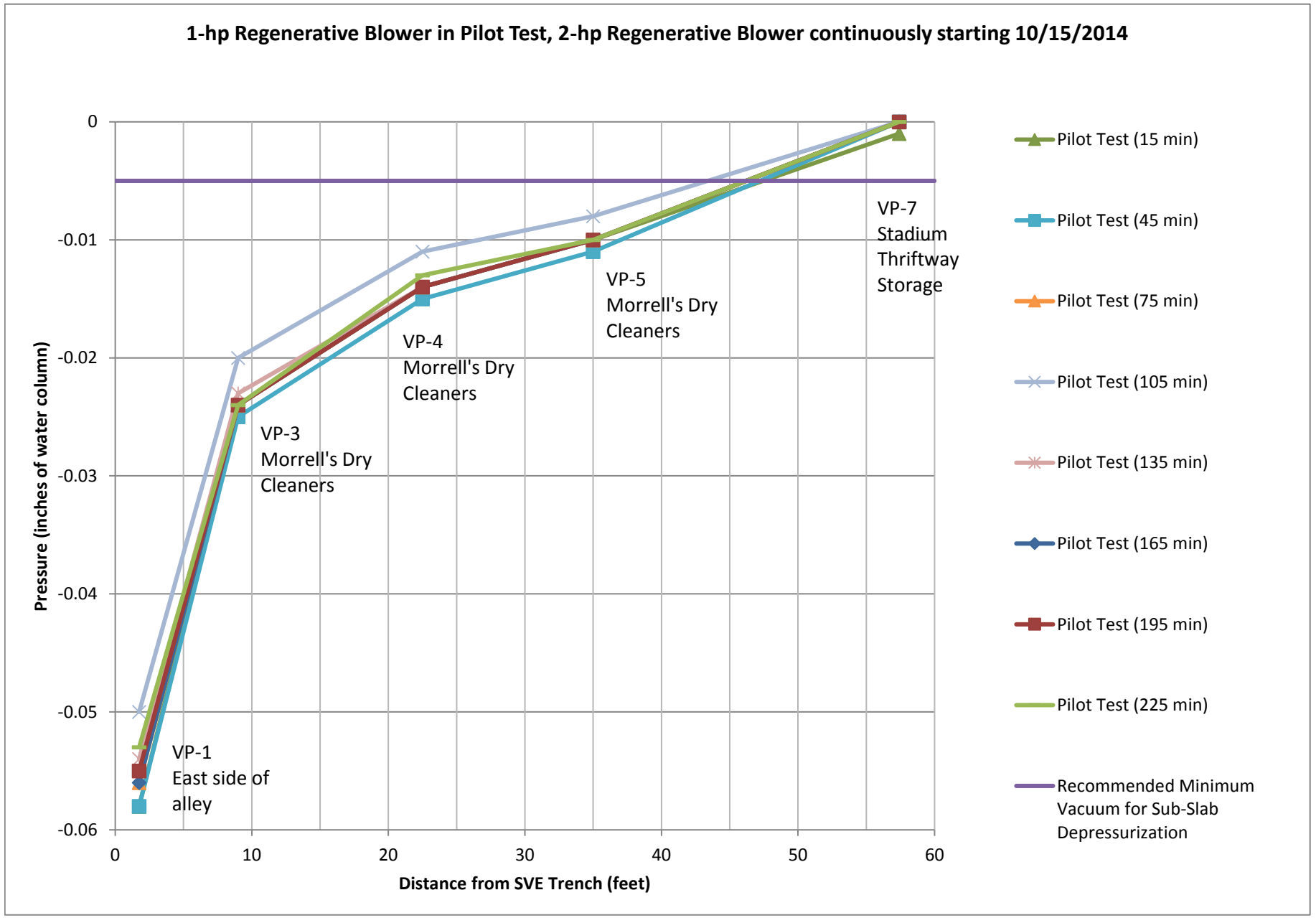

Figure C-1

SVE Trench Extent of Influence during Pilot Test

Morrell's Dry Cleaners (VCP No. SW1039)

Aspect Consulting

August 2018

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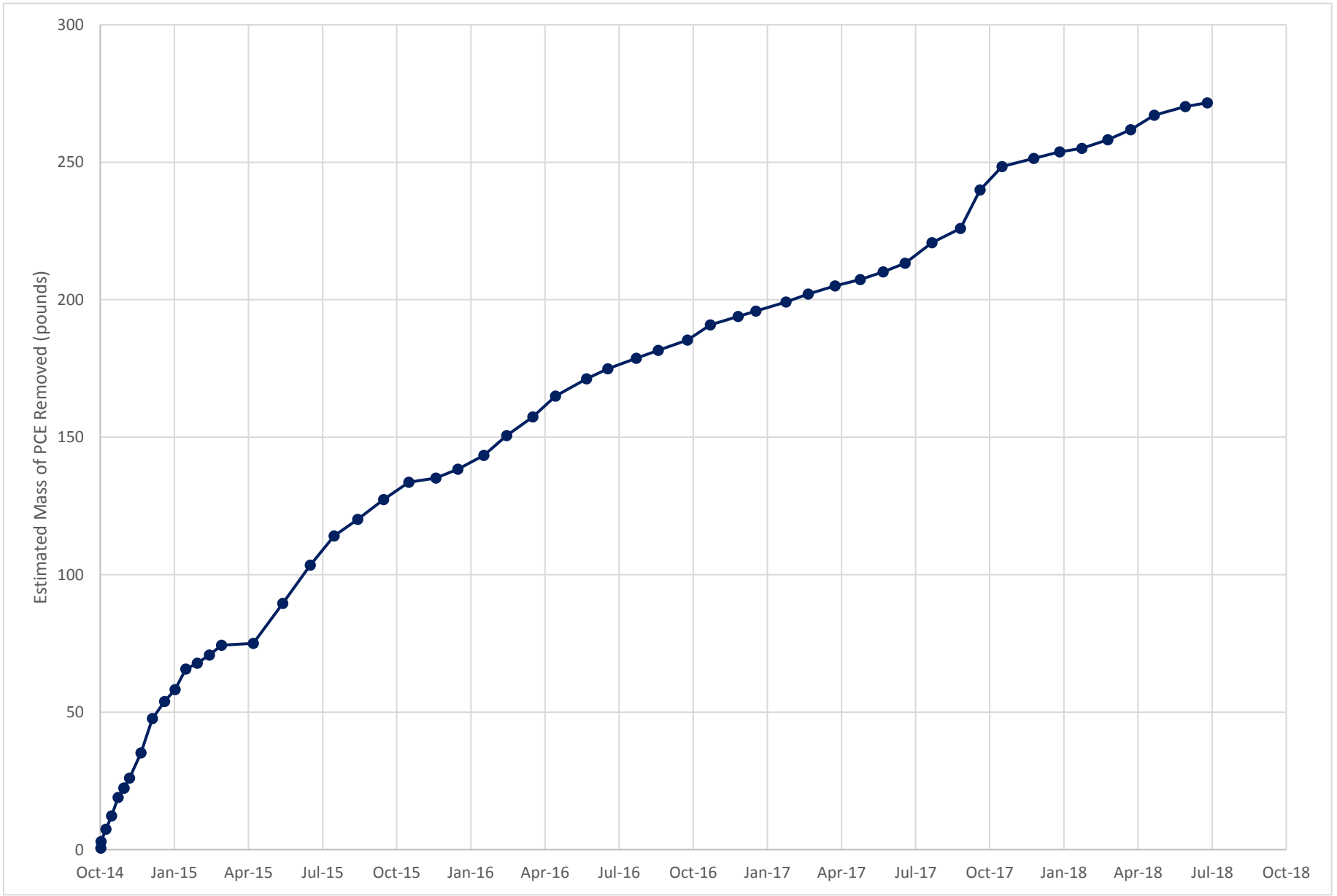

Aspect Consulting
August 2018

Figure C-2
Estimated Mass of PCE Removed by the SVE System through June 2018
Morrell's Dry Cleaners, Tacoma, WA

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APPENDIX D

Remedial Cost Estimates

Table D-1. Cost Estimate for Alternative 1 Long-Term Controls and Environmental Covenant

Project No 080190, Morrell's Dry Cleaners (VCP Site SW1039)
609 N. First Street, Tacoma, WA

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[(2)]
Develop Plans and Environmental Covenant					
Cap I&M plan	1	LS	$8,000	2018	$8,000
VI mitigation plan	1	LS	$10,000	2018	$10,000
Groundwater monitoring & contingency plan	1	LS	$15,000	2018	$15,000
Environmental covenant	1	LS	$40,000	2018	$40,000
Vapor Intrusion Mitigation					
Existing SVE system O&M and reporting	1	YR	$35,000	2018	$35,000
Install radon fans & decommission SVE system	1	LS	$40,000	2019	$39,722
VI mitigation IM&M and reporting	29	YR	$4,000	2019 - 2047	$100,654
Groundwater Monitoring					
Install deep groundwater CPOC wells (2 wells assumed)	1	LS	$60,000	2019	$59,583
Groundwater monitoring and reporting (8 wells assumed)	30	YR	$9,000	2018 - 2047	$242,772
Cap I&M					
Cap I&M and reporting	30	YR	$2,000	2018 - 2047	$53,949
				PRESENT VALUE COST	**$604,680**

Notes:

1) These FS-level cost estimates have an intended accuracy of -30/+50 percent.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

Table D-2. Cost Estimate for Alternative 2

Expanded SVE of Accessible On-Property Soil Contamination, and Biostimulation of Advance Outwash Groundwater

Morrell's Dry Cleaners (VCP Site SW1039) Supplemental Focused Feasibility Study

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[(2)]
Develop Plans and Environmental Covenant					
Cap I&M plan	1	LS	$8,000	2018	$8,000
VI mitigation plan	1	LS	$10,000	2018	$10,000
Groundwater monitoring & contingency plan	1	LS	$15,000	2018	$15,000
Environmental covenant	1	LS	$40,000	2018	$40,000
Remediation design/work plans/permits	1	LS	$60,000	2018	$60,000
SVE					
Additional angled SVE wells	16	EA	$8,000	2018	$128,000
Additional vertical SVE wells	14	EA	$6,500	2018	$91,000
Construction/startup of expanded system	1	LS	$140,000	2018	$140,000
Construction completion report	1	LS	$20,000	2019	$19,861
Expanded system O&M and reporting	6	YR	$55,000	2019 - 2024	$319,442
Biostimulation					
Additional angled biostimulation/monitoring wells	6	EA	$9,000	2018	$54,000
Additional vertical biostimulation/monitoring wells	12	EA	$7,000	2018	$84,000
First expanded biostimulation injection event	1	LS	$80,000	2019	$79,444
Second expanded biostimulation injection event	1	LS	$60,000	2023	$57,943
Vapor Intrusion Mitigation					
Existing SVE system O&M and reporting	1	YR	$35,000	2018	$35,000
Install radon fans & decommission SVE system	1	LS	$50,000	2024	$47,951
VI mitigation IM&M and reporting	24	YR	$4,000	2024 - 2047	$84,476
Groundwater Monitoring					
Install deep groundwater CPOC wells (2 wells assumed)	1	LS	$60,000	2019	$59,583
Groundwater monitoring and reporting (12 wells assumed)	10	YR	$12,000	2018 - 2027	$115,506
Cap I&M					
Cap I&M and reporting	30	YR	$2,000	2018 - 2047	$53,949
				PRESENT VALUE COST	**$1,503,156**

Notes:

1) These FS-level cost estimates have an intended accuracy of -30/+50 percent.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

Table D-3. Cost Estimate for Alternative 3
ERH and SVE of Accessible On-Property Soil Contamination, and Biostimulation/HEPA of Advance Outwash Groundwater

Morrell's Dry Cleaners (VCP Site SW1039) Supplemental Focused Feasibility Study

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[(2)]
Develop Plans and Environmental Covenant					
Cap I&M plan	1	LS	$8,000	2018	$8,000
VI mitigation plan	1	LS	$10,000	2018	$10,000
Groundwater monitoring & contingency plan	1	LS	$15,000	2018	$15,000
Environmental covenant	1	LS	$40,000	2018	$40,000
Remediation design/work plans/permits	1	LS	$160,000	2018	$160,000
Thermal Remediation (includes ERH and HEPA)					
Electrode materials mobilization	1	LS	$340,000	2018	$340,000
Subsurface installation	1	LS	$680,000	2018	$680,000
Drill cuttings and waste disposal	1	LS	$60,000	2018	$60,000
Electrical permit and utility connection to PCU	1	LS	$80,000	2018	$80,000
Surface installation and start-up	1	LS	$310,000	2018	$310,000
ERH operation (includes HEPA heatup phase)	1	LS	$370,000	2019	$367,428
HEPA operation for one additional year	1	YR	$80,000	2019	$79,444
Electrical energy usage	1	LS	$140,000	2019	$139,027
Demobilization and final report	1	LS	$180,000	2020	$177,506
SVE					
Existing SVE system O&M and reporting	1	YR	$35,000	2018	$35,000
Additional angled SVE wells in Advance Outwash	6	EA	$8,000	2018	$48,000
Additional vertical SVE wells in Advance Outwash	6	EA	$6,500	2018	$39,000
Construction/startup of modified system	1	LS	$70,000	2018	$70,000
Construction completion report	1	LS	$16,000	2019	$15,889
Modified system O&M and reporting	3	YR	$40,000	2019 - 2021	$117,239
Biostimulation					
Biostimulation injection event	1	LS	$100,000	2019	$99,305
Groundwater Monitoring					
Install deep groundwater CPOC wells (2 wells assumed)	1	LS	$60,000	2019	$59,583
Groundwater monitoring and reporting (14 wells assumed)	4	YR	$13,000	2018 - 2021	$51,103
Cap I&M					
Cap I&M and reporting	30	YR	$2,000	2018 - 2047	$53,949
				PRESENT VALUE COST	**$3,055,472**

Notes:

1) These FS-level cost estimates have an intended accuracy of -30/+50 percent.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

Table D-4. Cost Estimate for Alternative 4

ERH of Accessible On-Property Contaminated Soil and Advance Outwash Groundwate

Morrell's Dry Cleaners (VCP Site SW1039) Supplemental Focused Feasibility Study

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[(2)]
Develop Plans and Environmental Covenant					
Cap I&M plan	1	LS	$8,000	2018	$8,000
VI mitigation plan	1	LS	$10,000	2018	$10,000
Groundwater monitoring & contingency plan	1	LS	$15,000	2018	$15,000
Environmental covenant	1	LS	$40,000	2018	$40,000
Remediation design/work plans/permits	1	LS	$130,000	2018	$130,000
ERH					
Electrode materials mobilization	1	LS	$450,000	2018	$450,000
Subsurface installation	1	LS	$950,000	2018	$950,000
Drill cuttings and waste disposal	1	LS	$120,000	2018	$120,000
Electrical permit and utility connection to PCU	1	LS	$80,000	2018	$80,000
Surface installation and start-up	1	LS	$380,000	2018	$380,000
ERH operation	1	LS	$760,000	2019	$754,717
Electrical energy usage	1	LS	$290,000	2019	$287,984
Demobilization and final report	1	LS	$240,000	2019	$238,332
Groundwater Monitoring					
Install deep groundwater CPOC wells (2 wells assumed)	1	LS	$60,000	2019	$59,583
Groundwater monitoring and reporting (14 wells assumed)	3	YR	$13,000	2018 - 2020	$38,460
Cap I&M					
Cap I&M and reporting	30	YR	$2,000	2018 - 2047	$53,949
				PRESENT VALUE COST	**$3,616,025**

Notes:

1) These FS-level cost estimates have an intended accuracy of -30/+50 percent.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

Table D-5. Cost Estimate for Alternative 5
Comprehensive ERH of On-Property Contaminated Soil and Advance Outwash Groundwater Following Building Demolition

Morrell's Dry Cleaners (VCP Site SW1039) Supplemental Focused Feasibility Study

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[2]
Demolish Building, Develop Plans and Environmental Covenant					
Building demolition[3]	1	LS	$30,000	2018	$30,000
Groundwater monitoring & contingency plan	1	LS	$15,000	2018	$15,000
Environmental covenant	1	LS	$40,000	2018	$40,000
Remediation design/work plans/permits	1	LS	$110,000	2018	$110,000
ERH					
Electrode materials mobilization	1	LS	$400,000	2018	$400,000
Subsurface installation	1	LS	$550,000	2018	$550,000
Drill cuttings and waste disposal	1	LS	$90,000	2018	$90,000
Electrical permit and utility connection to PCU	1	LS	$80,000	2018	$80,000
Surface installation and start-up	1	LS	$350,000	2018	$350,000
ERH operation	1	LS	$600,000	2019	$595,829
Electrical energy usage	1	LS	$260,000	2019	$258,193
Demobilization and final report	1	LS	$200,000	2019	$198,610
Groundwater Monitoring					
Install deep groundwater CPOC wells (2 wells assumed)	1	LS	$60,000	2019	$59,583
Groundwater monitoring and reporting (14 wells assumed)	3	YR	$13,000	2018 - 2020	$38,460
				PRESENT VALUE COST	**$2,815,675**

Notes:

1) These FS-level cost estimates have an intended accuracy of -30/+50 percent.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

3) The building demolition cost estimate includes demolition permitting and planning. Loss of income generated by the building and the cost of constructing a new building are not included in the estimate.

Table D-6. Cost Estimate for Alternative 6

Removal of On-Property Contaminated Soil to 15-Foot Depth Following Building Demolition and ERH of Deeper On-Property Contaminated Soil and Advance Outwash Groundwater

Morrell's Dry Cleaners (VCP Site SW1039) Supplemental Focused Feasibility Study

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[2]
Demolish Building, Develop Plans and Environmental Covenant					
Building demolition[3]	1	LS	$30,000	2018	$30,000
Groundwater monitoring & contingency plan	1	LS	$15,000	2018	$15,000
Environmental covenant	1	LS	$40,000	2018	$40,000
Remediation design/work plans/permits	1	LS	$170,000	2018	$170,000
Soil Removal to 15-Foot Depth					
Temporary shoring[4]	2,940	sq ft	$60	2018	$176,400
Soil excavation, transport, and disposal[5]	5,100	ton	$300	2018	$1,530,000
Clean fill import and compaction	5,100	ton	$30	2018	$153,000
Excavation monitoring and construction completion report	1	LS	$70,000	2018	$70,000
ERH					
Electrode materials mobilization	1	LS	$290,000	2019	$287,984
Subsurface installation	1	LS	$370,000	2019	$367,428
Drill cuttings and waste disposal	1	LS	$60,000	2019	$59,583
Electrical permit and utility connection to PCU	1	LS	$80,000	2019	$79,444
Surface installation and start-up	1	LS	$300,000	2019	$297,915
ERH operation	1	LS	$590,000	2019	$585,899
Electrical energy usage	1	LS	$200,000	2019	$198,610
Demobilization and final report	1	LS	$190,000	2020	$187,368
Groundwater Monitoring					
Install deep groundwater CPOC wells (2 wells assumed)	1	LS	$60,000	2019	$59,583
Groundwater monitoring and reporting (14 wells assumed)	4	YR	$13,000	2018 - 2021	$51,103
				PRESENT VALUE COST	**$4,359,315**

Notes:

1) These FS-level cost estimates have an intended accuracy of -30/+50 percent.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

3) The building demolition cost estimate includes demolition permitting and planning. Loss of income generated by the building and the cost of constructing a new building are not included in the estimate.

4) A total length of 196 feet of temporary shoring wall is assumed along the north and west property boundaries. The unit cost for temporary shoring is per square foot of exposed shoring wall.

5) The weight of soil requiring offsite disposal is estimated based on an area of 5,700 square feet, a depth of 15 feet, and a soil density of 1.6 ton/CY. The unit cost for excavation, transport, and disposal assumes disposal in a RCRA Subtitle C hazardous waste landfill.

Table D-7. Preliminary Cost Estimate for Cleanup of Parking Lot Parcel

Morrell's Dry Cleaners (VCP Site SW1039) Supplemental Focused Feasibility Study

	No. of Units	Units	Unit Cost	Year of Expenditure	Present Value Cost[(2)]
Plans and Construction Preparation					
Design/work plans/permits	1	LS	$40,000	2018	$40,000
Groundwater monitoring & contingency plan	1	LS	$10,000	2018	$10,000
Investigation/Construction and SVE					
Additional vertical wells	13	EA	$7,000	2018	$91,000
Construction monitoring and SVE system modifications	1	LS	$80,000	2018	$80,000
Investigation/construction completion report	1	LS	$20,000	2019	$19,861
SVE system O&M and reporting	3	YR	$35,000	2019 - 2021	$102,584
Biostimulation and Groundwater Monitoring					
Biostimulation injection event	1	LS	$70,000	2019	$69,513
Groundwater monitoring and reporting (10 wells assumed)	4	YR	$10,000	2019 - 2022	$38,967
Post-Cleanup					
Soil investigation to confirm cleanup levels are achieved	1	LS	$25,000	2022	$24,312
Obtain parcel-specific NFA opinion letter	1	LS	$25,000	2023	$24,143
Well decommissioning	13	EA	$1,200	2023	$15,065
PRESENT VALUE OF FUTURE COSTS					**$515,446**

Notes:

1) This preliminary cost estimate is based on the conceptual design discussed in Section 8 of the main report. The actual cost will be highly dependent on the magnitude and extent of soil and groundwater contamination in the Parking Lot Parcel, which is currently not well delineated.

2) Present value costs are based on 2018 dollars and are calculated using a discount factor of 0.7 percent.

APPENDIX E

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND USE GUIDELINES

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on this report or the product of our services without the express written consent of Aspect Consulting, LLC (Aspect). This limitation is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual conditions or limitations and guidelines governing their use of the report. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and recognized standards of professionals in the same locality and involving similar conditions.

Services for Specific Purposes, Persons and Projects

Aspect has performed the services in general accordance with the scope and limitations of our Agreement. This report has been prepared for the exclusive use of the Client and their authorized third parties, approved in writing by Aspect. This report is not intended for use by others, and the information contained herein is not applicable to other properties.

This report is not, and should not, be construed as a warranty or guarantee regarding the presence or absence of hazardous substances or petroleum products that may affect the subject property. The report is not intended to make any representation concerning title or ownership to the subject property. If real property records were reviewed, they were reviewed for the sole purpose of determining the subject property's historical uses. All findings, conclusions, and recommendations stated in this report are based on the data and information provided to Aspect, current use of the subject property, and observations and conditions that existed on the date and time of the report.

Aspect structures its services to meet the specific needs of our clients. Because each environmental study is unique, each environmental report is unique, prepared solely for the specific client and subject property. This report should not be applied for any purpose or project except the purpose described in the Agreement.

This Report Is Project-Specific

Aspect considered a number of unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you
- Not prepared for the specific purpose identified in the Agreement
- Not prepared for the specific real property assessed
- Completed before important changes occurred concerning the subject property, project or governmental regulatory actions

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Geoscience Interpretations

The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

Discipline-Specific Reports Are Not Interchangeable

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

Environmental Regulations Are Not Static

Some hazardous substances or petroleum products may be present near the subject property in quantities or under conditions that may have led, or may lead, to contamination of the subject property, but are not included in current local, state or federal regulatory definitions of hazardous substances or petroleum products or do not otherwise present potential liability. Changes may occur in the standards for appropriate inquiry or regulatory definitions of hazardous substance and petroleum products; therefore, this report has a limited useful life.

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time (for example, Phase I ESA reports are applicable for 180 days), by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope failure or groundwater fluctuations. If more than six months have passed since issuance of our report, or if any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Phase I ESAs – Uncertainty Remains After Completion

Aspect has performed the services in general accordance with the scope and limitations of our Agreement and the current version of the “Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process”, ASTM E1527, and U.S. Environmental Protection Agency (EPA)'s Federal Standard 40 CFR Part 312 "Innocent Landowners, Standards for Conducting All Appropriate Inquiries".

No ESA can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in connection with subject property. Performance of an ESA study is intended to reduce, but not eliminate, uncertainty regarding the potential for environmental conditions affecting the subject property. There is always a potential that areas with contamination that were not identified during this ESA exist at the subject property or in the study area. Further evaluation of such potential would require additional research, subsurface exploration, sampling and/or testing.

Historical Information Provided by Others

Aspect has relied upon information provided by others in our description of historical conditions and in our review of regulatory databases and files. The available data does not provide definitive information with regard to all past uses, operations or incidents affecting the subject property or adjacent properties. Aspect makes no warranties or guarantees regarding the accuracy or completeness of information provided or compiled by others.

Exclusion of Mold, Fungus, Radon, Lead, and HBM

Aspect’s services do not include the investigation, detection, prevention or assessment of the presence of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detection, assessment, prevention or abatement of molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts. Aspect’s services also do not include the investigation or assessment of hazardous building materials (HBM) such as asbestos, polychlorinated biphenyls (PCBs) in light ballasts, lead based paint, asbestos-containing building materials, urea-formaldehyde insulation in on-site structures or debris or any other HBMs. Aspect’s services do not include an evaluation of radon or lead in drinking water, unless specifically requested.