BLYMYER
ENGINEERS, INC.

www.blymyer.com

September 27, 2007
BEI Proposal No. 207055

Mr. Steven Plunkett
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Subject: **Workplan for Additional Subsurface Investigation**
Good Chevrolet
1630 Park Street
Alameda, California
Fuel Leak Case No. RO0000008

Dear Mr. Plunkett:

On behalf of Good Chevrolet, Blymyer Engineers, Inc. is pleased to forward this workplan to conduct an additional subsurface investigation at the subject site (Figures 1 and 2). As Ms JoAnn Stewart discussed with you in May 2007, this work will consist of the following tasks, as ordered:

- Generate a workplan for an additional subsurface investigation,
- Redevelop four existing wells (excluding MW-4),
- Sample and perform laboratory analysis of groundwater samples from the four wells,
- Prepare a report and upload findings to GeoTracker and Alameda County databases,
- Define the extent of the plume with soil borings and collect soil and groundwater samples for analysis,
- Potentially install two additional monitoring wells, if required, and
- Prepare a report and upload findings to GeoTracker and Alameda County databases.

Scope of Work

Task 1 Generate workplan for additional subsurface investigation

This workplan has been written in conformance with San Francisco Bay Region Water Quality Control Board's (RWQCB) guidelines, and describes the proposed actions related to the subsurface investigation including well redevelopment, initiation of groundwater monitoring, generation and uploading of a quarterly groundwater monitoring report, proposed Geoprobe bore locations and work protocols, soil and groundwater analytical parameters to be used in each task, well installation protocols, and generation and uploading of a soil and groundwater investigation report. Upon approval of the workplan, or the passage of 60 days without technical comment from the Alameda County Environmental Health (ACEH), Blymyer Engineers will proceed with the work.

1829 CLEMENT AVENUE ALAMEDA, CA 94501•1395
PHONE 510•521•3773 FAX 510•865•2594

Task 2 Redevelop four existing wells

Blymyer Engineers will arrange for the redevelopment of four of the five existing wells (excluding well MW-4). The monitoring wells will be redeveloped by removal of a minimum of six well volumes of groundwater. The wells will be redeveloped until the groundwater appears to be clear of sediment, or until a maximum of 10 well volumes of groundwater has been removed. All development and purge water will be placed in DOT-approved, 55-gallon drums for future disposal by the owner.

Task 3 Initiate quarterly groundwater monitoring

Assuming free product is not encountered, a groundwater sample will be obtained from each monitoring well a minimum of 72 hours after well redevelopment to allow the aquifer to recover.

- **Collect groundwater samples from four monitoring wells**

  Groundwater samples will be collected by Blaine Tech Services (Blaine) from four monitoring wells using their standard groundwater sampling protocols (Appendix A). The monitoring wells will be purged a minimum of three well volumes prior to sampling. After each purge volume, the time, temperature, pH, conductivity, turbidity, and volume removed will be recorded. The groundwater samples will be placed in a chilled ice chest for delivery to the laboratory. Purge water will be stored in Department of Transportation (DOT)-approved 55-gallon drums pending analysis.

- **Submit groundwater samples for laboratory analysis**

  Groundwater samples from each monitoring well will be analyzed for Total Petroleum Hydrocarbons (TPH) as gasoline by modified EPA Method 8015; benzene, toluene, ethylbenzene, and total xylenes (BTEX), methyl *tert*-butyl ether (MTBE), all fuel oxygenates, lead scavengers, ethanol, and methanol by EPA Method 8260B, and total lead by EPA Method 6010. The groundwater sample for lead analysis will be filtered and unacidified in the field. The groundwater samples will be submitted to a California-certified laboratory on a standard 5-day turnaround.

Task 4 Generate and upload quarterly report to GeoTracker and ACHC Database

A report will be generated documenting the results of the quarterly sampling. The report will include a description of all field activities, including a tabulated summary of depth to groundwater and the groundwater analytical results, a scaled site plan depicting the groundwater flow direction and flow gradient, a copy of the laboratory analytical report, and conclusions and recommendations for additional work, if appropriate, based on the findings of the groundwater sampling event. The report will be uploaded to the GeoTracker and the ACEH web databases.

Task 5 Define extent of plume with soil bores and grab groundwater samples

Blymyer Engineers will conduct a Geoprobe investigation at the site and site vicinity in an attempt to determine the location of residual soil contamination, and to help determine the lateral extent of impacted groundwater. A Geoprobe drill rig will be retained for one day and approximately 8 to 9 bores will be installed. The actual number will be dependent on difficulties encountered during the work, and the actual number may be fewer than anticipated. This work will allow for the strategic placement of two potential wells (Task 5) should these be required by the ACEH.

- **Secure all required permits**

  Upon authorization to proceed, a drilling permit will be obtained from Alameda County Public Works Agency (ACPWA), and encroachment and excavation permits will be obtained from the City of Alameda, if warranted.

- **Generate a site-specific health and safety plan**

  A health and safety plan will be generated in order to outline potentially hazardous work conditions and contingencies for an emergency. All personnel assigned to this project will be required to demonstrate that they have completed the training requirements, according to Federal OSHA Standards under 29 CFR 1910.120. When appropriate, field personnel from Blymyer Engineers and their subcontractors will attend a project work task review before beginning work.

- **Locate utilities**

  Offsite utilities will be marked for location by Underground Service Alert (USA). Additionally, proposed bore locations will be marked for clearance by a private utility location service. Site utility laterals, as well as utility corridors that pass through the site will also be located at this time per the request of the ACEH.

- **Install Geoprobe soil bores**

  A Geoprobe rig will be scheduled to drill for one full day. Typically eight to nine bores can be installed during that time period. The Geoprobe bores will be installed as generally depicted in the Figure 2, or otherwise modified in consultation with Good Chevrolet, the ACEH, or the adjacent property owner. The Geoprobe soil bores will be hydraulically pushed to a depth of approximately 15 to 18 feet below grade surface (bgs). A continuous soil core will be collected from each bore.

- **Field screen and collect soil samples for laboratory analysis**

At a minimum of 4-foot intervals, selected soil samples will be collected from the soil cores for field screening using a photoionization detector (PID) and for lithologic description. All soil samples will be collected in accordance with *Standard Operating Procedure No. 4, Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment* (Appendix B). The soil bores will be converted to temporary wells and grab groundwater samples will be collected. The soil bores will be backfilled with cement grout upon removal of the temporary well casing.

The soil sample displaying the highest PID reading or the soil sample from the groundwater interface will be collected for laboratory analysis. One additional sample will be collected from selected bores (an estimated 12 samples will be submitted in total). The soil samples will be analyzed for TPH as gasoline by modified EPA Method 8015; for BTEX, and MTBE by EPA Method 8021B; all fuel oxygenates, ethanol, methanol, and lead scavengers by EPA Method 8260B; and for total lead by EPA Method 6010. The soil samples will be submitted to a California-certified laboratory on a standard 5-day turnaround. The laboratory report will also be requested to be delivered in EDF format for uploading to the state GeoTracker website.

- **Collect grab groundwater samples for laboratory analysis**

Grab groundwater samples will be collected from the temporary wells and will be submitted to a California-certified laboratory for analysis of TPH as gasoline by modified EPA Method 8015; BTEX and MTBE by EPA Method 8021B; all fuel oxygenates, ethanol, methanol, and lead scavengers by EPA Method 8260B; and total lead by EPA Method 6010. The laboratory report will also be requested to be delivered in EDF format for uploading to the state GeoTracker website.

- **Investigation derived waste handling**

Due to the volume of soil that is anticipated to be generated, all soil cuttings will be stored in a Department of Transportation (DOT)-approved 55-gallon drum for later disposal by the owner. All decontamination water will also be stored on-site in a DOT-approved 55-gallon drum for later disposal by the owner.

Task 6 Install two additional groundwater monitoring wells, if required

- **Locate and install two groundwater monitoring wells**

  In consultation with Good Chevrolet, ACEH, and potentially the adjacent property owner, Blymyer Engineers will identify two appropriate well locations. Additional permitting with ACPWA and City of Alameda will be undertaken if appropriate.

- **Install two groundwater monitoring wells and collect representative soil samples**

  A drill rig will be retained and scheduled to advance hollow-stem augers for the purpose of installing two permanent groundwater monitoring wells. The initial bores will be drilled to an assumed depth of approximately 18 feet bgs. Soil samples will be collected at maximum 5-foot intervals using a split-spoon sampler for field screening with a PID and lithological description. The soil sample exhibiting the highest PID reading will be submitted for the same analytical suite as outlined above. If no elevated PID readings are detected, the soil sample collected from the interval just above the depth that groundwater is first encountered will be submitted for laboratory analysis. It is assumed that one soil sample will be collected from each well borehole (for a total of 2). All soil samples will be collected in general conformance with *Standard Operating Procedure* (SOP) *No. 1, Soil and Grab Groundwater Sampling Using A Hollow-Stem Auger Drill Rig* (Appendix B).

  The soil bores will be converted to 2-inch-diameter groundwater monitoring wells using Schedule 40 PVC casing, with a 5- to 10-foot section of factory-slotted 0.010-inch screen.

- **Investigation derived waste handling**

  Investigation derived waste generated during well installation will be drummed with the waste generated during the prior Geoprobe bore phase of the investigation for future disposal by the owner.

Task 7 Prepare report and upload to GeoTracker and County databases

A report will be prepared to document the results of the soil and groundwater investigation. The report will include a description of all field activities, including a summary of the soil and groundwater analytical results, a scaled site plan showing the soil bore and monitoring well locations, groundwater gradient, selected contaminant isoconcentration maps for soil and groundwater, soil bore logs and monitoring well construction diagrams, a copy of the laboratory analytical reports, and conclusions and recommendations for additional investigatory work, if appropriate, based on the findings of the investigation. Hydrogeologic cross sections and rose diagrams may additionally be included based on appropriateness. As required, a copy of the final report and other appropriate GeoTracker data submittals will be uploaded to the GeoTracker and ACEH websites.

Should you have any questions about this workplan, please call Mark Detterman at (510) 521-3773.

Sincerely,

Blymyer Engineers, Inc.

By:____________________
Mark E. Detterman, C.E.G.
Senior Geologist

PROFESSIONAL GEOLOGIST
MARK E. DETTERMAN
No. 1788
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

By:____________________
Michael S. Lewis
Vice President, Technical Services

Attachments:

Table I:	Summary of Groundwater Elevation Measurements
Table II:	Summary of Groundwater Sample Hydrocarbon Analytical Results
Table III:	Summary of Groundwater Sample Fuel Oxygenate Analytical Results
Table IV:	Summary of Grab Groundwater Sample Hydrocarbon Analytical Results
Table V:	Summary of Soil Sample Hydrocarbon Analytical Results
Figure 1:	Site Location Map
Figure 2:	Site Plan
Appendix A:	*Standard Operating Procedures*, Blaine Tech Services, Inc.
Appendix B:	*Standard Operating Procedure No. 1, Soil and Grab Groundwater Sampling Using a Hollow-Stem Auger Drill Rig* and *Standard Operating Procedure No. 4, Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment*

Tables

Table I, Summary of Groundwater Elevation Measurements BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California				
Well ID	Date	TOC Elevation (feet)	Depth to Water (feet)	Water Surface Elevation (feet)
MW-1	Jul-89	104.76	8.93	95.83
	Apr-91		7.59	97.17
	Jul-92		8.72	96.04
	Aug-92		9.09	95.67
	Sep-92		9.25	95.51
	Oct-92		9.34	95.42
	Nov-92		9.21	95.55
	Dec-92		9.26	95.50
	Jan-93		7.81	96.95
	Feb-93		7.32	97.44
	Mar-93		7.20	97.56
	Apr-93		7.31	97.45
	May-93		8.29	96.47
	Jul-93		8.30	96.46
	Oct-93		9.38	95.38
	Jan-94		8.80	95.96
	Apr-94		8.15	96.61
	Jul-94		8.70	96.06
	Oct-94		9.37	95.39
	Jan-94		7.18	97.58
	Apr-95		6.76	98.00
	Jan-97		7.03	97.73
	Nov-98		8.10	96.66
	Jan-01		7.70	97.06
	Jun-02		7.30	97.46
	Nov-02		8.14	96.62
	Feb-03		6.87	97.89
	Jun-03		7.05	97.71

Table I, Summary of Groundwater Elevation Measurements BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California				
Well ID	Date	TOC Elevation (feet)	Depth to Water (feet)	Water Surface Elevation (feet)
MW-2	Jul-89	104.86	9.24	95.62
	Apr-91		8.01	96.85
	Jul-92		9.03	95.83
	Aug-92		9.34	95.52
	Sep-92		9.46	95.40
	Oct-92		9.52	95.34
	Nov-92		9.42	95.44
	Dec-92		9.47	95.39
	Jan-93		8.25	96.61
	Feb-93		7.85	97.01
	Mar-93		7.77	97.09
	Apr-93		7.86	97.00
	May-93		8.20	96.66
	Jul-93		8.72	96.14
	Oct-93		9.64	95.22
	Jan-94		9.12	95.74
	Apr-94		8.56	96.30
	Jul-94		9.02	95.84
	Oct-94		9.59	95.27
	Jan-94		7.71	97.15
	Apr-95		7.40	97.46
	Jan-97		7.55	97.31
	Nov-98		8.49	96.37
	Jan-01		8.08	96.78
	Jun-02		7.77	97.09
	Nov-02		8.50	96.36
	Feb-03		7.38	97.48
	Jun-03		7.57	97.29

Table I, Summary of Groundwater Elevation Measurements BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California				
Well ID	Date	TOC Elevation (feet)	Depth to Water (feet)	Water Surface Elevation (feet)
MW-3	Jul-89	104.52	9.00	95.52
	Apr-91		8.06	96.46
	Jul-92		8.82	95.70
	Aug-92		9.05	95.47
	Sep-92		9.09	95.43
	Oct-92		9.15	95.37
	Nov-92		9.05	95.47
	Dec-92		9.12	95.40
	Jan-93		8.18	96.34
	Feb-93		7.98	96.54
	Mar-93		7.94	96.58
	Apr-93		8.02	96.50
	May-93		7.69	96.83
	Jul-93		8.65	95.87
	Oct-93		9.32	??
	Jan-94		8.93	??
	Apr-94		8.52	96.00
	Jul-94		8.86	95.66
	Oct-94		9.25	95.27
	Jan-94		7.85	96.67
	Apr-95		7.64	96.88
	Jan-97		7.75	96.77
	Nov-98		8.38	96.14
	Jan-01		8.00	96.52
	Jun-02		7.81	96.71
	Nov-02		8.37	96.15
	Feb-03		7.48	97.04
	Jun-03		7.67	96.85

Table I, Summary of Groundwater Elevation Measurements BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California				
Well ID	Date	TOC Elevation (feet)	Depth to Water (feet)	Water Surface Elevation (feet)
MW-4	Apr-94	104.86	9.29	95.57
	Jul-94		9.55	95.31
	Oct-94		9.83	95.03
	Jan-94		8.88	95.98
	Apr-95		8.80	96.06
	Jan-97		NM	NM
	Nov-98		NM	NM
	Jan-01		NM	NM
	Jun-02		NM	NM
	Nov-02		NM	NM
	Feb-03		NM	NM
	Jun-03		NM	NM
MW-5	Apr-94	103.62	8.27	95.35
	Jul-94		8.50	95.12
	Oct-94		8.92	94.70
	Jan-94		7.61	96.01
	Apr-95		8.48	95.14
	Jan-97		6.79	96.83
	Nov-98		8.12	95.50
	Jan-01		7.67	95.95
	Jun-02		7.61	96.01
	Nov-02		8.01	95.61
	Feb-03		7.22	96.40
	Jun-03		7.43	96.19

Notes:
TOC = Top of Casing
* = Initial data set collected under direction of Blymyer Engineers, Inc.
NM = Not measured

Elevations in feet above mean sea level

Table II, Summary of Groundwater Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California								
Well ID	Sample Date	Modified EPA Method 8015 (µg/L)	EPA Method 8020, 8021B, or 8260B (µg/L)					
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE
MW-1	1/21/1987 [3]	**21,020**	**1,148**	**8,627**	**1,792**	**6,012**	NA
	1/11/1989	**1,400**	**74**	**10**	**13**	**5**	NA
	7/12/1989	**1,200**	**470**	**49**	**45**	**33**	NA
	4/9/1991 [4]	**850**	**260**	**10**	**15**	**12**	NA
	7/14/1992 [5]	**13,000**	**2,300**	**1,200**	**1,200**	**1,200**	NA
	10/7/1992	**3,600**	**1,600**	**80**	**120**	**120**	NA
	1/11/1993	**1,200**	**410**	**16**	**23**	**19**	NA
	4/23/1993	**2,200** [a]	**720**	**180**	**82**	**150**	NA
	7/8/1993	**3,200** [a]	**1,200**	**110**	**97**	**100**	NA
	10/15/1993	**3,700** [a]	**1,400**	**43**	**94**	**36**	NA
	1/25/1994	**1,600** [a]	**680**	**16**	**41**	**35**	NA
	4/28/1994	**6,100** [a]	**1,900**	**380**	**250**	**340**	NA
	7/27/1994	**6,000** [a]	**1,800**	**510**	**220**	**450**	NA
	10/27/1994	**3,000** [a]	**1,100**	**79**	**82**	**87**	NA
	1/26/1995	**1,600** [a]	**660**	**100**	**82**	**87**	NA
	4/13/1995	**3,800** [a]	**1,200**	**270**	**120**	**260**	NA
	7/21/1995	**5,200** [a]	**1,500**	**450**	**190**	**400**	NA
	10/25/1995	**5,900** [a]	**1,800**	**450**	**210**	**400**	NA
	1/21/1997	**3,100** [a]	**1,100**	**87**	**160**	**180**	<7.3
	11/12/1998	**1,000** [a]	**280**	**3.0**	**3.3**	**7.9**	<30
	1/16/2001	**4,700** [a]	**1,20**	**18**	**150**	**49**	<5 [e]
	6/27/2002	**5,900** [a]	**230**	**7.7**	<5	**1,500**	<5 [e]
	11/18/2002	**3,100** [a]	**890**	**12**	**310**	**28**	<2.5 [e]
	2/20/2003	**260** [d]	**100**	**0.72**	<0.5	<0.5	<0.5 [e]
	6/11/2003	**3,100** [a]	**480**	**6.7**	**220**	**420**	<2.5 [e]

Table II, Summary of Groundwater Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California							
Well ID	Sample Date	Modified EPA Method 8015 (µg/L)	EPA Method 8020, 8021B, or 8260B (µg/L)				
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE
MW-2	1/21/1987 [3]	**5,018**	**386**	**1,981**	**285**	**1,432**	NA
	1/11/1989	**10,000**	**3,000**	**410**	**240**	**190**	NA
	7/12/1989	**7,600**	**2,700**	**540**	**250**	**320**	NA
	4/9/1991 [4]	**4,900**	**910**	**210**	**130**	**200**	NA
	7/14/1992 [5]	**13,000**	**4,400**	**1,500**	**610**	**1,100**	NA
	10/7/1992	**11,000**	**5,200**	**1,500**	**500**	**1,200**	NA
	1/11/1993	**17,000**	**940**	**1,100**	**480**	**930**	NA
	4/23/1993	**52,000 [a]**	**13,000**	**8,400**	**1,700**	**5,300**	NA
	7/8/1993	**6,400 [a]**	**2,500**	**470**	**280**	**530**	NA
	10/15/1993	**17,000 [a]**	**3,900**	**870**	**500**	**940**	NA
	1/25/1994	**16,000 [a]**	**5,400**	**1,140**	**640**	**1,500**	NA
	4/28/1994	**15,000 [a]**	**4,00**	**910**	**480**	**1,200**	NA
	7/27/1994	**18,000 [a]**	**6,000**	**760**	**630**	**1,600**	NA
	10/27/1994	**9,500 [a]**	**2,700**	**230**	**320**	**640**	NA
	1/26/1995	**5,900 [a]**	**1,900**	**290**	**230**	**500**	NA
	4/13/1995	**10,000 [a]**	**3,300**	**620**	**360**	**930**	NA
	7/21/1995	**9,900 [a]**	**3,300**	**320**	**390**	**830**	NA
	10/25/1995	**13,000 [a]**	**4,900**	**400**	**580**	**990**	NA
	1/21/1997	**7,600 [a]**	**2,600**	**310**	**330**	**660**	<20
	11/12/1998	**31,000 [a]**	**11,000**	**750**	**1,500**	**2,300**	**<900**
	1/16/2001	**23,000 [a]**	**8,200**	**260**	**1,000**	**820**	<30
	6/27/2002	**39,000 [a]**	**7,000**	**1,800**	**690**	**4,000**	<5 [e]
	11/18/2002	**15,000 [a]**	**5,700**	**76**	**1,000**	**150**	<12 [e]
	2/20/2003	**26,000 [a]**	**6,300**	**1,100**	**1,300**	**1,900**	<5.0 [e]
	6/11/2003	**37,000 [a]**	**7,100**	**2,300**	**2,000**	**3,600**	<25 [e]

Table II, Summary of Groundwater Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California							
Well ID	Sample Date	Modified EPA Method 8015 (µg/L)	EPA Method 8020, 8021B, or 8260B (µg/L)				
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE
MW-3	1/21/1987 [3]	**10,287**	**1,428**	**3,281**	**610**	**2,761**	NA
	1/11/1989	**5,300**	**1,800**	**340**	**150**	**160**	NA
	7/12/1989	**7,800**	**3,100**	**900**	**300**	**480**	NA
	4/9/1991 [4]	**9,400**	**1,400**	**730**	**200**	**510**	NA
	7/14/1992 [5]	**17,000**	**3,500**	**390**	**390**	**260**	NA
	10/7/1992	**9,200**	**4,300**	**470**	**390**	**610**	NA
	1/11/1993	**2,000**	**740**	**29**	**58**	**28**	NA
	4/23/1993	**6,500** [a]	**2,600**	**280**	**260**	**190**	NA
	7/8/1993	**5,200** [a]	**2,100**	**260**	**250**	**180**	NA
	10/15/1993	**11,000** [a]	**3,500**	**580**	**430**	**370**	NA
	1/25/1994	**6,200** [a]	**2,500**	**270**	**160**	**28**	NA
	4/28/1994	**5,300** [a]	**1,700**	**190**	**210**	**180**	NA
	7/27/1994	**5,900** [a]	**2,000**	**360**	**260**	**330**	NA
	10/27/1994	**8,000** [a]	**2,200**	**580**	**260**	**170**	NA
	1/26/1995	**3,700** [a]	**1,200**	**150**	**150**	**190**	NA
	4/13/1995	**4,000** [a]	**1,400**	**200**	**180**	**210**	NA
	7/21/1995	**5,700** [a]	**2,000**	**280**	**270**	**280**	NA
	10/25/1995	**11,000** [a]	**3,500**	**1,100**	**460**	**680**	NA
	1/21/1997	**2,200** [a]	**860**	**63**	**71**	**80**	<5
	11/12/1998	**180** [d]	**44**	**0.51**	ND	**0.92**	<20
	1/16/2001	**64** [a]	**11**	**0.77**	<0.5	<0.5	<5 [e]
	6/27/2002	<50	<0.5	<0.5	<0.5	<0.5	<0.5 [e]
	11/18/2002	**110** [a]	**21**	**1.0**	<0.5	<0.5	<0.5 [e]
	2/20/2003	<50	**2.5**	<0.5	<0.5	<0.5	<0.5 [e]
	6/11/2003	<50	<0.5	<0.5	<0.5	<0.5	<0.5 [e]

Table II, Summary of Groundwater Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California							
Well ID	Sample Date	Modified EPA Method 8015 (µg/L)	EPA Method 8020, 8021B, or 8260B (µg/L)				
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE
MW-4	4/28/1994	**190** [b, c]	**3.8**	**2.9**	**2.1**	**3.1**	NA
	7/27/1994	**180** [a]	**15**	**9.2**	**7.6**	**28**	NA
	10/27/1994	**130** [a]	**8.6**	**6.6**	**4.5**	**17**	NA
	1/26/1995	**110**	**6.5**	**1.2**	**1.8**	**11**	NA
	4/13/1995	**82**	**3.9**	**ND**	**ND**	**2.5**	NA
	7/21/1995	**130**	**8.8**	**1.3**	**4.5**	**7.6**	NA
	10/25/1995	**95**	**6.6**	**1.7**	**4.3**	**7.0**	NA
	1/21/1997	NS	NS	NS	NS	NS	NS
	11/12/1998	NS	NS	NS	NS	NS	NS
	1/16/2001	NA	NA	NA	NA	NA	NA
	6/27/2002	NA	NA	NA	NA	NA	NA
	11/18/2002	NA	NA	NA	NA	NA	NA
	2/20/2003	NA	NA	NA	NA	NA	NA
	6/11/2003	NS	NS	NS	NS	NS	NS

Table II, Summary of Groundwater Sample Hydrocarbon Analytical Results
BEI Job No. 207055, Good Chevrolet
1630 Park Street, Alameda, California

Well ID	Sample Date	Modified EPA Method 8015 (µg/L)	EPA Method 8020, 8021B, or 8260B (µg/L)				
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE
MW-5	4/28/1994	**30,000** [a]	**4,000**	**3,000**	**810**	**3,500**	NA
	7/27/1994	**9,300** [a]	**2,000**	**800**	**290**	**940**	NA
	10/27/1994	**15,000** [a]	**2,700**	**1,300**	**420**	**1,100**	NA
	1/26/1995	**7,900** [a]	**2,100**	**680**	**240**	**860**	NA
	4/13/1995	**7,900** [a]	**2,400**	**580**	**340**	**630**	NA
	7/21/1995	**11,000** [a]	**3,400**	**760**	**610**	**1,200**	NA
	10/25/1995	**13,000** [a]	**2,900**	**830**	**570**	**1,100**	NA
	1/21/1997	**2,600** [a]	**750**	**65**	**1,860**	**280**	<5
	11/12/1998	<50	<0.5	<0.5	<0.5	<0.5	<5
	1/16/2001	<50	**11**	<0.5	<0.5	**0.82**	<5 [e]
	6/27/2002	<50	<0.5	<0.5	<0.5	<0.5	<0.5 [e]
	11/18/2002	**130** [a]	**17**	**3.8**	**2.1**	**16**	<0.5 [e]
	2/20/2003	<50	**5.6**	**0.51**	<0.5	**0.68**	<0.5 [e]
	6/11/2003	**170** [a]	**48**	<0.5	<0.5	**1.4**	<0.5 [e]

Table II, Summary of Groundwater Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California							
Well ID	Sample Date	Modified EPA Method 8015 (μg/L)	EPA Method 8020, 8021B, or 8260B (μg/L)				
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE

Notes: ug/L = micrograms per liter
TPH = Total Petroleum Hydrocarbons
EPA = Environmental Protection Agency
MTBE = Methyl *tert*-Butyl Ether
[3] = Initial sampling and reporting by Groundwater Technology, Inc.
[4] = Initial sampling and reporting by Environmental Science & Engineering, Inc.
[5] = Initial sampling and reporting by Geo Plexus, Inc.
[6] = Initial sampling and reporting by Blymyer Engineers, Inc.
N/A = Not applicable
NA = Not analyzed
NS = Not sampled
<*x* = Analyte not detected at reporting limit *x*
[a] = Laboratory note indicates the unmodified or weakly modified gasoline is significant.
[b] = Laboratory note indicates heavier gasoline range compounds are significant (aged gas?).
[c] = Laboratory note indicates gasoline range compounds are significant with no recognizable pattern.
[d] = Laboratory note indicates that lighter gasoline range coounds (the most mobile fraction) are significa
[e] = Analysis conducted by EPA Method 8260. See also Table III.

Bold results indicate detectable analyte concentrations.

Table III, Summary of Groundwater Sample Fuel Oxygenate Analytical Results
BEI Job No. 207055, Good Chevrolet
1630 Park Street, Alameda, California

Well ID	Sample Date	EPA Method 8260B (ug/L)								
		TAME	TBA	EBD	1,2-DCA	DIPE	Ethanol	ETBE	Methanol	MTBE
MW-1	1/16/2001	<5.0	<25	<5.0	<5.0	<5.0	NA	<5.0	NA	<5.0
	6/27/2002	<5.0	<50	<5.0	<5.0	<5.0	NA	<5.0	NA	<5.0
	11/18/2002	NA	NA	<2.5	<2.5	NA	NA	NA	NA	<2.5
	2/20/2003	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5
	6/11/2003	NA	NA	<2.5	<2.5	NA	NA	NA	NA	<2.5
MW-2	1/16/2001	<30	<150	<30	<30	<30	NA	<30	NA	<30
	6/27/2002	<5.0	<5.0	<5.0	**6.1**	<5.0	NA	<5.0	NA	<5.0
	11/18/2002	NA	NA	<12	<12	NA	NA	NA	NA	<2.5
	2/20/2003	NA	NA	<5.0	<5.0	NA	NA	NA	NA	<5.0
	6/11/2003	NA	NA	<25	<25	NA	NA	NA	NA	<25
MW-3	1/16/2001	<1.0	<5.0	<1.0	**1.4**	<1.0	NA	<1.0	NA	<1.0
	6/27/2002	<0.5	<5.0	<0.5	<0.5	<0.5	NA	<0.5	NA	<0.5
	11/18/2002	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5
	2/20/2003	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5
	6/11/2003	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5
MW-5	1/16/2001	<1.0	<5.0	<1.0	<1.0	<1.0	NA	<1.0	NA	<1.0
	6/27/2002	<0.5	<5.0	<0.5	<0.5	<0.5	NA	<0.5	NA	<0.5
	11/18/2002	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5
	2/20/2003	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5
	6/11/2003	NA	NA	<0.5	<0.5	NA	NA	NA	NA	<0.5

Table III, Summary of Groundwater Sample Fuel Oxygenate Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California										
Well ID	Sample Date	EPA Method 8260B (ug/L)								
		TAME	TBA	EBD	1,2-DCA	DIPE	Ethanol	ETBE	Methanol	MTBE

Notes: TAME = Methyl tert-Amyl Ether
TBA = tert-Butyl Alcohol
EDB = 1,2-Dibromoethane
1,2-DCA = 1,2-Dichloroethane
DIPE = Di-isopropyl ether
ETBE = Ethyl tert-butyl ether
MTBE = Methly tert-butyl ether
(µg/L) = Micrograms per liter
NV = No value
NA = Not analyzed

Bold results indicate detectable analyte concentrations.

Table IV, Summary of Grab Groundwater Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California							
Well ID	Sample Date	Modified EPA Method 8015 (µg/L)	EPA Method 8020 or 8021B (µg/L)				
		TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE
HP-1	4/23/1993	<50	<0.5	<0.5	<0.5	<0.5	NA
HP-2	4/23/1993	<50	<0.5	<0.5	<0.5	<0.5	NA
EB3-WSIA	10/15/1993	**120,000** [a]	**9,600**	**20,000**	**3,400**	**14,000**	NA
EB5-WSIA	10/15/1993	**83,000** [a]	**3,900**	**15,000**	**3,100**	**13,000**	NA
EB8-WS1	1/21/1997	**25,000** [a]	**2,600**	**3,200**	**780**	**3,600**	**<80**
EB10-WS1	1/21/1997	**81,000** [a, b]	**13,000**	**12,000**	**3,300**	**8,000**	**<370**
EB11-WS1	1/21/1997	**49,000** [a]	**6,900**	**6,000**	**2,100**	**4,600**	**<180**
EB12-WS1	1/21/1997	**38,000** [a, c]	**1,400**	**1,400**	**1,800**	**7,400**	**110**
P1-WS1	1/21/1997	**74,000** [a, c]	**1,100**	**5,800**	**3,800**	**18,000**	**<78**
P2-WS1	1/21/1997	**6,800** [a]	**2,200**	**290**	**310**	**560**	<10
P3-WS1	1/21/1997	**220** [a]	**1.9**	**17**	**10**	**49**	<5.0

Notes: (Table VI continued)

ug/L = micrograms per liter
TPH = Total Petroleum Hydrocarbons
EPA = Environmental Protection Agency
MTBE = Methyl *tert* -Butyl Ether
N/A = Not applicable
NA = Not analyzed
<*x* = Analyte not detected at reporting limit *x*
* = Pit water collected at a depth of 14 feet below grade surface.
[a] = Laboratory note indicates unmodified or weakly modified gasoline is significant.
[b] = Laboratory note indicates lighter than water immiscible sheen is present.
[c] = Laboratory note indicates liquid sample contains greater than ~5 vol. % sediment.

Bold results indicate detectable analyte concentrations.

Table V, Summary of Soil Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California									
Well ID	Depth (ft)	Sample Date	Modified EPA Method 8015	EPA Method 8020 or 8021B (mg/Kg)					
			TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	
MW-1-10	10	1/15/1987	**24**	**2.9**	**3.6**	NA	**1.8**	NA	
MW-1-15	15	1/15/1987	<1.0	<0.1	<0.1	NA	<0.1	NA	
MW-2-5	5	1/15/1987	<1.0	<0.1	<0.1	NA	<0.1	NA	
MW-2-10	10	1/15/1987	**350**	**14**	**22**	NA	**23**	NA	
MW-3-10	10	1/15/1987	**200**	**9.8**	**16**	NA	**16**	NA	
MW-3-15	15	1/15/1987	<1.0	<0.1	<0.1	NA	<0.1	NA	
SB-5-10	10	1/15/1987	**6.5**	<0.1	**0.22**	NA	<0.1	NA	
EB1-S2	8.5	10/15/1993	**510** [b]	**0.89**	**10**	**5.8**	**41**	NA	
EB1-S3	11	10/15/1993	**2,300** [b]	**22**	**190**	**57**	**280**	NA	
EB2-2S	10	10/15/1993	**15,000** [a]	**84**	**710**	**260**	**1,400**	NA	
EB2-S3	11.5	10/15/1993	**200** [a]	**4.3**	**15**	**3.9**	**20**	NA	
EB3-S2	10	10/15/1993	**2,200** [a]	**9.4**	**71**	**42**	**200**	NA	
EB3-S3	12.5	10/15/1993	**610** [b, c]	**1.2**	**3.2**	**4.5**	**2.9**	NA	
EB4-S2	8	10/15/1993	**4,900** [a]	**32**	**230**	**84**	**440**	NA	
EB4-S3	10.5	10/15/1993	**7,600** [a]	**60**	**390**	**130**	**630**	NA	
EB5-S2	9	10/15/1993	**1,800** [b]	<2.5	**22**	**27**	**140**	NA	
EB5-S3	11.5	10/15/1993	**14** [b]	**0.021**	**1.5**	**0.49**	**2.5**	NA	
EB6-S2	8.5	10/15/1993	**6,800** [a]	**20**	**230**	**100**	**590**	NA	
EB7-S2	6.5	10/15/1993	<50	<0.5	<0.5	<0.5	<0.5	NA	
EB7-S3	8.5	10/15/1993	**1,000** [b]	**3.8**	**45**	**21**	**110**	NA	
MW4-S1	4.5	4/20/1994	**<50** [b]	<0.5	<0.5	<0.5	**0.013**	NA	
MW4-S2	9	4/20/1994	**9.7** [a]	**1.1**	**0.82**	**0.42**	**1.3**	NA	
MW4-S3	14	4/20/1994	**<50** [b]	<0.5	**0.008**	<0.5	**0.022**	NA	
MW5-S1	4.5	4/20/1994	<50	<0.5	<0.5	<0.5	<0.5	NA	

Table V, Summary of Soil Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California									
Well ID	Depth (ft)	Sample Date	Modified EPA Method 8015	EPA Method 8020 or 8021B (mg/Kg)					
			TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	
MW5-S2	9	4/20/1994	**1,100** [b, c]	**12**	**43**	**20**	**93**	NA	
MW5-S3	14	4/20/1994	**1.1** [b, c]	**0.033**	**0.17**	**0.044**	**0.22**	NA	
EB8-S2	9.5	1/21/1997	**2,000** [a]	**8.4**	**83**	**44**	**210**	<4	
EB8-S3	13.5	1/21/1997	**18** [a]	**3.2**	**1.2**	**0.47**	**1.7**	**0.10**	
EB9-S1	6.5	1/21/1997	**1.8** [a]	**0.071**	**0.052**	**0.026**	**0.074**	<5	
EB9-S2	9.5	1/21/1997	**1,300** [a]	**7.1**	**54**	**29**	**130**	<4	
EB10-S1	8.5	1/21/1997	**2,300** [a]	**9.1**	**100**	**50**	**190**	**9.3**	
EB11-S1	9.5	1/21/1997	**3,800** [b, d]	**8.8**	**190**	**97**	**510**	<9	
EB11-S2	12	1/21/1997	**13** [a]	**1.1**	**1.6**	**0.47**	**1.4**	<0.1	
EB12-S1	9.5	1/21/1997	**300** [b, d]	**0.95**	**0.59**	**3.5**	**18**	<0.6	
EB12-S2	12	1/21/1997	**1,300** [a]	**9.4**	**23**	**35**	**130**	**6.2**	

Table V, Summary of Soil Sample Hydrocarbon Analytical Results BEI Job No. 207055, Good Chevrolet 1630 Park Street, Alameda, California								
Well ID	Depth (ft)	Sample Date	Modified EPA Method 8015	EPA Method 8020 or 8021B (mg/Kg)				
			TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE

Notes: ft = feet

mg/Kg = Milligrams per kilogram

TPH = Total Petroleum Hydrocarbons

MTBE = Methyl *tert* -Butyl Ether

NA = Not analyzed

<*x* = Analyte not detected at reporting limit *x*

[a] = Laboratory note indicates the unmodified or weakly modified gasoline is significant.

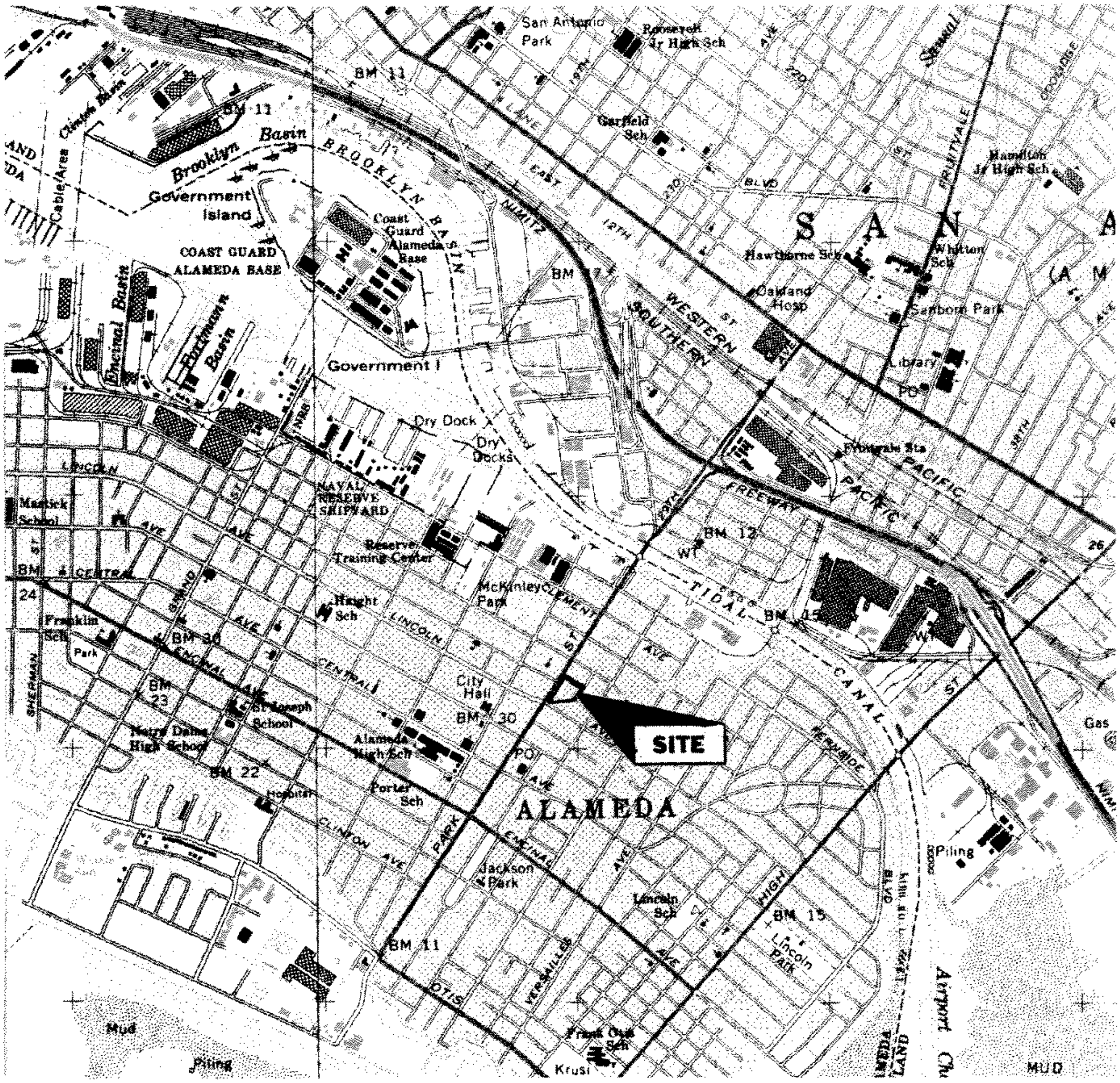
[b] = Laboratory note indicates heavier gasoline range compounds are significant (aged gas?).

[c] = Laboratory note indicates that lighter gasoline range compounds (the most mobile fraction) are significant.

[d] = Laboratory note indicates gasoline range compounds have broad chromatographic peaks are significant; biologically altered gasoline?

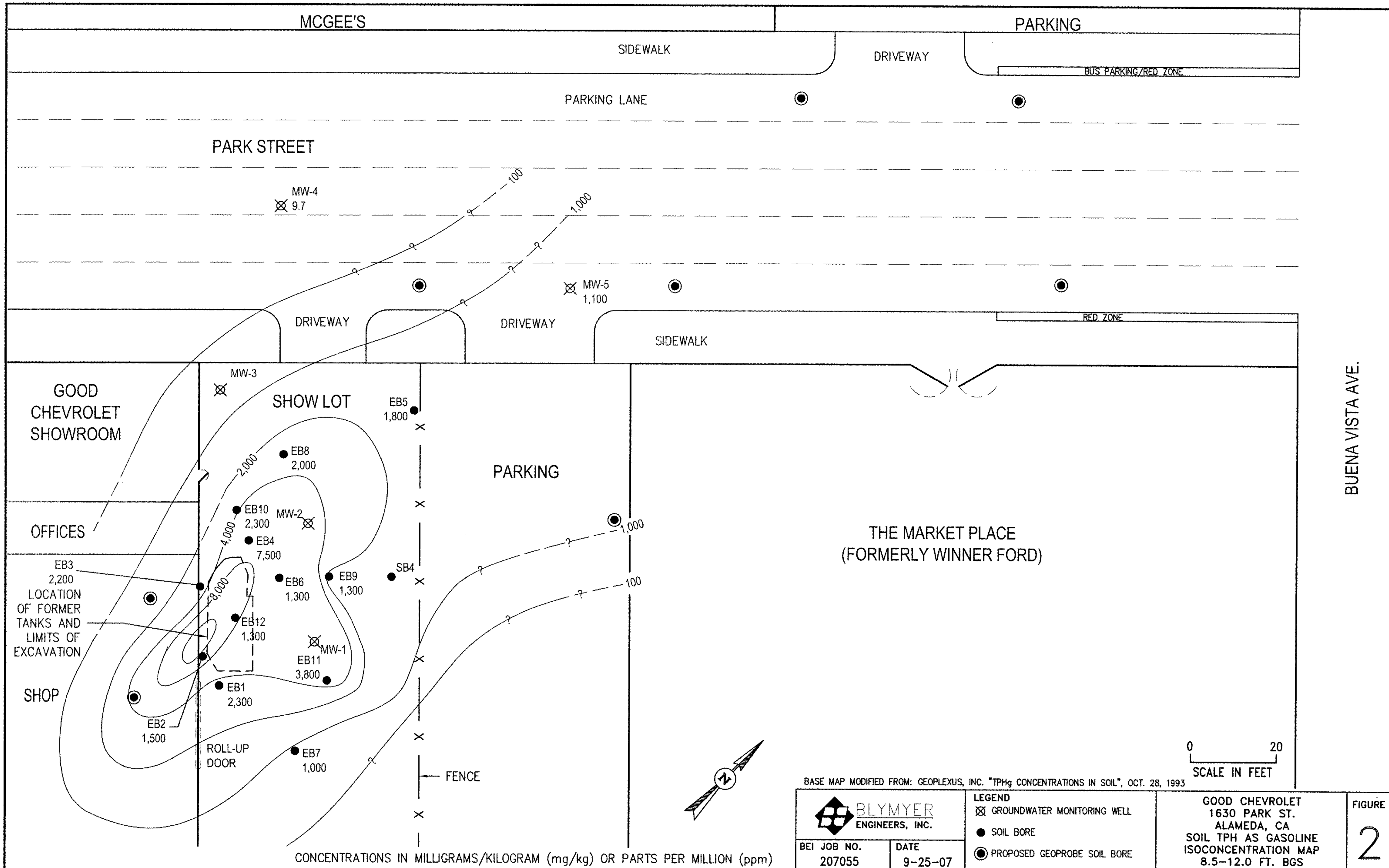
Bold results indicate detectable analyte concentrations.

Figures



UNITED STATES GEOLOGICAL SURVEY 7.5 QUADS "Oakland West, CA" Photorevised 1980 and "Oakland East, CA" Photorevised 1980

BLYMYER ENGINEERS, INC.		N 0 1000 2000 SCALE IN FEET	**SITE LOCATION MAP** Good Chevrolet 1630 Park Street Alameda, CA 94501	FIGURE **1**
BEI JOB NO. 201097	DATE 9/26/2007			



L: Acad 2007dwg 207055 Good Chev enviro alameda working 207055 FIG 2.dwg September 27, 2007 - 10:32AM lwittstock

Appendix A

Standard Operating Procedures

Blaine Tech Services, Inc.

Blaine Tech Services, Inc.
Standard Operating Procedure

WATER LEVEL, SEPARATE PHASE LEVEL AND TOTAL WELL DEPTH MEASUREMENTS (GAUGING)

Routine Water Level Measurements

1. Establish that water or debris will not enter the well box upon removal of the cover.
2. Remove the cover using the appropriate tools.
3. Inspect the wellhead (see Wellhead Inspections).
4. Establish that water or debris will not enter the well upon removal of the well cap.
5. Unlock and remove the well cap lock (if applicable). If lock is not functional cut it off.
6. Loosen and remove the well cap. CAUTION: DO NOT PLACE YOUR FACE OR HEAD DIRECTLY OVER WELLHEAD WHEN REMOVING THE WELL CAP. WELL CAP MAY BE UNDER PRESSURE AND/OR MAY RELEASE ACCUMULATED AND POTENTIALLY HARMFULL VAPORS.
7. Verify and identify survey point as written on S.O.W.
   TOC: If survey point is listed as Top of Casing (TOC), look for the exact survey point in the form of a notch or mark on the top of the casing. If no mark is present, use the north side of the casing as the measuring point.
   TOB: If survey point is listed as Top of Box (TOB), the measuring point will be established manually. Place the inverted wellbox lid halfway across the wellbox opening and directly over the casing. The lower edge of the inverted cover directly over the casing will be the measuring point.
8. Put new Latex or Nitrile gloves on your hands.
9. Slowly lower the Water Level Meter probe into the well until it signals contact with water with a tone and/or flashing a light.
10. Gently raise the probe tip slightly above the water and hold it there. Wait momentarily to see if the meter emits a tone, signaling rising water in the casing. Gently lower the probe tip slightly below the water. Wait momentarily to see if the meter stops emitting a tone, signaling dropping water in the casing. Continue process until water level stabilizes indicating that the well has equilibrated.
11. While holding the probe at first contact with water and the tape against the measuring point, note depth. Repeat twice to verify accuracy. Write down measurement on Well Gauging Sheet under Depth to Water column.
12. Recover probe, replace and tighten well cap, replace lock (if applicable), replace well box cover and tighten hardware (if applicable)

Water Level and Separate Phase Thickness Measurements in Wells Suspected of Containing Separate Phase

1. Establish that water or debris will not enter the well box upon removal of the cover.
2. Remove the cover using the appropriate tools.
3. Inspect the wellhead (see Wellhead Inspections).
4. Establish that water or debris will not enter the well upon removal of the well cap.

5. Unlock and remove the well cap lock (if applicable). If lock is not functional cut it off.
6. Loosen and remove the well cap. CAUTION: DO NOT PLACE YOUR FACE OR HEAD DIRECTLY OVER WELLHEAD WHEN REMOVING THE WELL CAP. WELL CAP MAY BE UNDER PRESSURE AND/OR MAY RELEASE ACCUMULATED AND POTENTIALLY HARMFULL VAPORS.
7. Verify and identify survey point as written on S.O.W.
   TOC: If survey point is listed as Top of Casing (TOC), look for the exact survey point in the form of a notch or mark on the top of the casing. If no mark is present, use the north side of the casing as the measuring point.
   TOB: If survey point is listed as Top of Box (TOB), the measuring point will be established manually. Place the inverted well box lid halfway across the well box opening and directly over the casing. The lower edge of the inverted cover directly over the casing will be the measuring point.
8. Put new Nitrile gloves on your hands.
9. Slowly lower the tip of the Interface Probe into the well until it emits either a solid or broken tone.
   BROKEN TONE: Separate phase layer is not present. Go to Step 8 of Routine Water Level Measurements shown above to complete gauging process using the Interface probe as you would a Water Level Meter.
   SOLID TONE: Separate phase layer is present. Go to the next step.
10. Gently raise the probe tip slightly above the separate phase layer and hold it there. Wait momentarily to see if the meter emits a tone, signaling rising water in the casing. Gently lower the probe tip slightly below the separate phase layer. Wait momentarily to see if the meter stops emitting a tone, signaling dropping water in the casing. Continue process until water level stabilizes indicating that the well has equilibrated.
11. While holding the probe at first contact with the separate phase layer and the tape against the measuring point, note depth. Repeat twice to verify accuracy. Write down measurement on Well Gauging Sheet under Depth to Product column.
12. Gently lower the probe tip until it emits a broken tone signifying contact with water. While holding the probe at first contact with water and the tape against the measuring point, note depth. Repeat twice to verify accuracy. Write down measurement on Well Gauging Sheet under Depth to Water column.
13. Recover probe, replace and tighten well cap, replace lock (if applicable), replace well box cover and tighten hardware (if applicable).

Routine Total Well Depth Measurements

1. Lower the Water Level Meter probe into the well until it lightens in your hands, indicating that the probe is resting at the bottom of well.
2. Gently raise the tape until the weight of the probe increases, indicating that the probe has lifted off the well bottom.
3. While holding the probe at first contact with the well bottom and the tape against the well measuring point, note depth. Repeat twice to verify accuracy. Write down measurement on Well Gauging Sheet under Total Well Depth column.

4. Recover probe, replace and tighten well cap, replace lock (if applicable), replace well box cover and tighten hardware (if applicable).

Blaine Tech Services, Inc.
Standard Operating Procedure

WELL WATER EVACUATION (PURGING)

Purpose
Evacuation of a predetermined minimum volume of water from a well (purging) while *simultaneously* measuring water quality parameters is typically required prior to sampling. Purging a minimum volume guarantees that actual formation water is drawn into the well. Measuring water quality parameters either verifies that the water is stable and suitable for sampling or shows that the water remains unstable, indicating the need for continued purging. Both the minimum volume and the stable parameter qualifications need to be met prior to sampling. This assures that the subsequent sample will be representative of the formation water surrounding the well screen and not of the water standing in the well.

Defining Casing Volumes
The predetermined minimum quantity of water to be purged is based on the wells' casing volume. A casing volume is the volume of water presently standing within the casing of the well. This is calculated as follows:

Casing Volume = (TD – DTW) VCF

1. Subtract the wells' depth to water (DTW) measurement from its total depth (TD) measurement. This is the height of the water column in feet.
2. Determine the well casings' volume conversion factor (VCF). The VCF is based on the diameter of the well casing and represents the volume, in gallons, that is contained in one (1) foot of a particular diameter of well casing. The common VCF's are listed on our Well Purge Data Sheets.
3. Multiply the VCF by the calculated height of the water column. This is the casing volume, the amount of water in gallons standing in the well.

Remove Three to Five Casing Volumes
Prior to sampling, an attempt will be made to purge all wells of a minimum of three casing volumes and a maximum of five casing volumes except where regulations mandate the minimum removal of four casing volumes.

Choose the Appropriate Evacuation Device Based on Efficiency
In the absence of instructions on the SOW to the contrary, selection of evacuation device will be based on efficiency.

Measure Water Quality Parameters at Each Casing Volume
At a minimum, water quality measurements include pH, temperature and electrical conductivity (EC). Measurements are made and recorded at least once every casing volume. They are considered stable when all parameters are within 10% of their previous measurement.

Note: The following instructions assume that well has already been properly located, accessed, inspected and gauged.

Prior to Purging a Well
1. Confirm that the well is to be purged and sampled per the SOW.
2. Confirm that the well is suitable based on the conditions set by the client relative to separate phase.
3. Calculate the wells' casing volume.
4. Put new Latex or Nitrile gloves on your hands.

Purging With a Bailer (Stainless Steel, Teflon or Disposable)
1. Attach bailer cord or string to bailer. Leave other end attached to spool.
2. Gently lower empty bailer into well until well bottom is reached.
3. Cut cord from spool. Tie end of cord to hand.
4. Gently raise full bailer out of well and clear of well head. Do not let the bailer or cord touch the ground.
5. Pour contents into graduated 5-gallon bucket or other graduated receptacle.
6. Repeat purging process.
7. Upon removal of first casing volume, fill clean parameter cup with purgewater, empty the remainder of the purgewater into the bucket, lower the bailer back into the well and secure the cord on the Sampling Vehicle.
8. Use the water in the cup to collect and record parameter measurements.
9. Continue purging until second casing volume is removed.
10. Collect parameter measurements.
11. Continue purging until third casing volume is removed.
12. Collect parameter measurements. If parameters are stable, stop purging. If parameters remain unstable, continue purging until stabilization occurs or the fifth casing volume is removed.

Purging With a Pneumatic Pump
1. Position Pneumatic pump hose reel over the top of the well.
2. Gently unreel and lower the pump into the well. Do not contact the well bottom.
3. Secure the hose reel.
4. Begin purging into graduated 5-gallon bucket or other graduated receptacle.
5. Adjust water recharge duration and air pulse duration for maximum efficiency.
6. Upon removal of first casing volume, fill clean parameter cup with water.
7. Use the water in the cup to collect and record parameter measurements.
8. Continue purging until second casing volume is removed.

9. Collect parameter measurements.
10. Continue purging until third casing volume is removed.
11. Collect parameter measurements. If parameters are stable, stop purging. If parameters remain unstable, continue purging until stabilization occurs or the fifth casing volume is removed.
12. Upon completion of purging, gently recover the pump and secure the reel.

Purging With a Fixed Speed Electric Submersible Pump

1. Position Electric Submersible hose reel over the top of the well.
2. Gently unreel and lower the pump to the well bottom.
3. Raise the pump 5 feet off the bottom.
4. Secure the hose reel.
5. Begin purging.
6. Verify pump rate with flow meter or graduated 5-gallon bucket
7. Upon removal of first casing volume, fill clean parameter cup with water.
8. Use the water in the cup to collect and record parameter measurements.
9. Continue purging until second casing volume is removed.
10. Collect parameter measurements.
11. Continue purging until third casing volume is removed.
12. Collect parameter measurements. If parameters are stable, stop purging. If parameters remain unstable, continue purging until stabilization occurs or the fifth casing volume is removed.
13. Upon completion of purging, gently recover the pump and secure the reel.

Blaine Tech Services, Inc.
Standard Operating Procedure

SAMPLE COLLECTION FROM GROUNDWATER WELLS USING BAILERS

Sampling with a Bailer (Stainless Steel, Teflon or Disposable)

1. Put new Latex or Nitrile gloves on your hands.
2. Determine required bottle set.
3. Fill out sample labels completely and attach to bottles.
4. Arrange bottles in filling order and loosen caps (see Determine Collection Order below).
5. Attach bailer cord or string to bailer. Leave other end attached to spool.
6. Gently lower empty bailer into well until water is reached.
7. As bailer fills, cut cord from spool and tie end of cord to hand.
8. Gently raise full bailer out of well and clear of well head. Do not let the bailer or cord touch the ground. If a set of parameter measurements is required, go to step 9. If no additional measurements are required, go to step 11.
9. Fill a clean parameter cup, empty the remainder contained in the bailer into the sink, lower the bailer back into the well and secure the cord on the Sampling Vehicle. Use the water in the cup to collect and record parameter measurements.
10. Fill bailer again and carefully remove it from the well.
11. Slowly fill and cap sample bottles. Fill and cap volatile compounds first, then semi-volatile, then inorganic. Return to the well as needed for additional sample material.

    Fill 40-milliliter vials for volatile compounds as follows: Slowly pour water down the inside on the vial. Carefully pour the last drops creating a convex or positive meniscus on the surface. Gently screw the cap on eliminating any air space in the vial. Turn the vial over, tap several times and check for trapped bubbles. If bubbles are present, repeat process.

    Fill 1 liter amber bottles for semi-volatile compounds as follows: Slowly pour water into the bottle. Leave approximately 1 inch of headspace in the bottle. Cap bottle.

    Field filtering of inorganic samples using a stainless steel bailer is performed as follows: Attach filter connector to top of full stainless steel bailer. Attach 0.45 micron filter to connector. Flip bailer over and let water gravity feed through the filter and into the sample bottle. If high turbidity level of water clogs filter, repeat process with new filter until bottle is filled. Leave headspace in the bottle. Cap bottle.

    Field filtering of inorganic samples using a disposable bailer is performed as follows: Attach 0.45 micron filter to connector plug. Attach connector plug to bottom of full disposable bailer. Water will gravity feed through the filter and into the sample bottle. If high turbidity level of water clogs filter, repeat process with new filter until bottle is filled. Leave headspace in the bottle. Cap bottle.

12. Bag samples and place in ice chest.
13. Note sample collection details on well data sheet and Chain of Custody.

Appendix B

Standard Operating Procedure No. 1, Soil and Grab Groundwater Sampling Using a Hollow-Stem Auger Drill Rig

Standard Operating Procedure No. 4, Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment

BLYMYER
ENGINEERS, INC.

Standard Operating Procedure No. 1

Soil and Grab Groundwater Sampling Using a Hollow-Stem Auger Drill Rig

Revision No. 1

Approved By:

Michael Lewis
Quality Assurance/Quality Control Officer
Blymyer Engineers, Inc.

5/31/94
Date

Table of Contents

1.0 Introduction and Summary

This Standard Operating Procedure (SOP) describes methods for drilling with the use of hollow-stem augers, soil sampling with the use of split-spoon samplers, and grab groundwater sampling through an open borehole. Drilling activities covered by this SOP may be conducted to obtain soil and grab groundwater samples or to create a borehole within which a well may be constructed. Soil samples may be obtained to log subsurface materials, to collect samples for chemical characterization, or to collect samples for physical parameter characterization.

The soil sampling techniques described in this SOP are generally suitable for chemical characterization and physical classification tests; because a driven split-spoon sampler is employed, the resulting soil samples should generally be considered "disturbed" with respect to physical structure and may not be suitable for measuring sensitive physical parameters, such as strength and compressibility. The augering techniques described in this SOP generally produce a borehole with a diameter corresponding to the outside diameter of the auger flights, a relatively small annulus of remolded soil surrounding the outside diameter of the auger flights, and limited capability for cross-contamination between subsurface strata as the leading flights of the augers pass from contaminated strata to uncontaminated underlying strata. However, should conditions require strict measures to help prevent cross-contamination or maintain the integrity of an aquitard, consideration should be given to augmenting the procedures of this SOP, for example, by using pre-drilled and grouted isolation casing.

The procedures for hollow-stem auger drilling and split-spoon soil sampling generally consist of initial decontamination, advancement of the augers, driving and recovery of the split-spoon sampler, logging and packaging of the soil samples, decontamination of the split-spoon and continued augering and sampling until the total depth of the borehole is reached. Withdrawal of the augers upon reaching the total depth requires completion of the borehole by grouting, by constructing a well, or other measures; well construction is not covered in this SOP.

2.0 Equipment and Materials

- Drill rig, drill rods, hollow-stem augers, and drive-weight assembly (for driving the split-spoon sampler) should conform to ASTM D 1586-Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) hollow-stem augers may exceed 6.5 inches inside diameter as may be necessary for installing 4-inch diameter well casing, (2) hollow-stem augers should have a center bit assembly (end plug), (3) alternative drive-weight assemblies or downhole hammers are acceptable as long as the type, weight, and equivalent free fall are noted on the boring log.

- Split-spoon sampler should conform to ASTM D 1586-Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) split-spoon should be fitted with liners for collection of chemical characterization samples, and (2) allowable split-spoon diameters include nominal 1.5-inch inside diameter by nominal 2-inch outside diameter (Standard Penetration Test split-spoon), nominal 2-inch inside diameter by nominal 2.5-inch outside diameter (California Modified split-spoon), or nominal 2-1/2-inch inside diameter by nominal 3-inch outside diameter (Dames & Moore split-spoon). The split-spoon type and length of the split barrel portion of the sampler should be noted on the boring log, as should the use of a sample catcher if employed.

- Liners should be 3- to 6-inch length, fitted with plastic end caps, brass or stainless steel, with a nominal diameter corresponding to that of the inside diameter of the split-spoon sampler. The boring log should note whether brass or stainless steel liners were used.

- Teflon® sheets, approximate 6-mil thickness, precut to a diameter or width of the liner diameter plus approximately 1 inch.

- Plastic end caps.

- Adhesiveless silicone tape.

- Disposable polyethylene bailer.

- Type I/Type II Portland cement.

- Groundwater sample containers (laboratory provided only).

- Kimwipes®, certified clean silica sand, or deionized water (for blank sample preparation).

- Sample labels, boring log forms, chain-of-custody forms, drum labels, Drum Inventory Sheet, and field notebook.

- Ziploc® plastic bags of size to accommodate a liner.

- Stainless steel spatula and knife.

- Cooler with ice or dry ice (do not use blue ice) and packing material.

- Field organic vapor monitor. The make, model, and calibration information for the field organic vapor monitor (including compound and concentration of calibration gas) should be noted on the boring log.

- Pressure washer or steam cleaner.

- Large trough (such as a water tank for cattle), plastic-lined pit, or equivalent for decontamination of hollow-stem augers, drill rod, and end plug.

- Buckets and bristle brushes for decontamination of liners, split-spoon sampler, and other small gear.

- Low-residue, organic-free soap such as Liquinox® or Alconox®.

- Distilled water.

- Heavy plastic sheeting such as Visqueen.

- Steel, 55-gallon, open-top drums conforming to the requirements of DOT 17H, if required.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 Typical Procedures

The following typical procedures are intended to cover the majority of drilling and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected subsurface conditions. Deviations from the following typical procedures may be expected and should be noted on the boring log.

1. Investigate location of the proposed boreholes for buried utilities and obstructions. At least 48 hours before drilling, contact known or suspected utility services individually or through collective services such as "Underground Service Alert."

2. Decontaminate drill rig, drill rods, hollow-stem augers, split-spoon sampler and other drilling equipment immediately prior to mobilization to the site.

3. Calibrate field organic vapor monitor equipment in accordance with the manufacturer's specifications. Note performance of the calibration in the geologist's field notebook.

4. Conduct "tail-gate" meeting and secure the work area in accordance with the Site Safety Plan.

5. Core concrete, if required.

6. Using hand-augering device, hand auger to a depth of 5 feet, if feasible, to clear underground utilities and structures not located by a utility service or on drawings. As appropriate, retain private buried utility location services or geophysical investigation services to search for buried utilities and obstructions. During initial advancement of each borehole, drill cautiously and have the driller pay particular attention to the "feel" of drilling conditions. The suspected presence of an obstruction, buried pipeline or cable, utility trench backfill, or similar may be cause for suspension of drilling, subject to further investigation.

7. Advance hollow-stem auger, fitted with end plug, to the desired sampling depth. Note depth interval, augering conditions, and driller's comments on boring log. Samples should be taken at intervals of 5 feet or less in homogeneous strata and at detectable changes of strata.

8. Remove drill rod and the end plug from the hollow-stem auger and note presence of water mark on drill rod, if any. If below the groundwater table in clean sand, allow water level in hollow-stem auger to equilibrate prior to removing end plug and remove plug slowly so as to minimize suction at the base of the plug. Also, monitor the top of the hollow-stem auger using field organic vapor monitor, as appropriate. In situations where heaving sand occurs, the use of a clean, inert knock-out plate may be employed, if necessary, to set wells. Also, clean water may be introduced into the hollow-stem auger to create a positive head pressure to exceed the hydrostatic pressure of the heaving sand formation.

9. Decontaminate split-spoon sampler, liners, spatulas and knives, and other equipment that may directly contact the chemical characterization sample. Fit the split-spoon sampler with liners and attach to drill rod.

10. Lower split-spoon sampler through hollow-stem of auger until sampler is resting on soil. Note in field notebook discrepancy between elevation of tip of sampler and leading edge of augers, if any. If more than 6 inches of slough exists inside the hollow-stem augers,

consider the conditions unsuitable and re-advance the hollow-stem augers and end plug to a new sampling depth.

11. Drive and recover split-spoon sampler according to the requirements of ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils. Record depth interval, hammer blows for each 6 inches, and sample recovery on boring log (copy attached). Monitor the recovered split-spoon sampler with the field organic vapor monitor, as appropriate.

12. Remove either bottom-most or second-from-bottom liner (or both) from split-spoon sampler for purposes of chemical characterization and physical parameter testing. Observe soil at each end of liner(s) for purposes of completing sample description. Place Teflon® sheet at each end of liner, cover with plastic caps, and tape plastic caps with adhesiveless silicone tape (do not use electrical or duct tape) to further minimize potential loss of moisture or volatile compounds. Label liner(s) and place in Ziploc® bag on ice or dry ice inside cooler.

13. Extrude soil from remaining liner(s) and subsample representative 1-inch cube (approximate dimensions). Place subsample in Ziploc® bag and seal. Allow bag to equilibrate at ambient conditions for approximately 5 minutes and screen for organic vapors by inserting the probe of the field organic vapor monitor into the bag. Record depth interval, observed sample reading, and ambient (background) reading on the boring log. Discard bag and sample after use in the solid waste stockpile.

14. Classify soil sample in approximate accordance with ASTM D 2488-Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and in accordance with the Unified Soil Classification System (USCS). Description should include moisture content, color, textural information, group symbol, group name, and odor. Optional descriptions, especially if classification is performed with protective gloves, include particle angularity and shape, clast composition, plasticity, dilatancy, dry strength, toughness, and reaction with HCl. Add notes on geologic structure of sample, as appropriate. Record depth interval, field organic vapor monitor reading, USCS classification, and other notes on the boring log.

15. Repeat steps 7 through 14 until total depth of borehole is reached.

16. If grab groundwater sample is to be collected, slowly lower bailer through the open borehole or partially retracted hollow-stem augers to minimize agitation and aeration of the sampled water. Transfer the grab groundwater sample into sample container(s).

Label sample container(s), place packing materials around containers, and place on ice or dry ice inside cooler.

17. After augers are removed, complete borehole according to the requirements specified elsewhere or by abandonment in accordance with section 8.0.

18. Decontaminate hollow-stem augers, drill rod, and end plug between boreholes and after finishing last borehole prior to drill rig leaving site.

19. Change decontamination solutions and clean decontamination trough, buckets, and brushes between boreholes.

20. Containerize decontamination liquids in 17H steel drums. Affix completed "Caution - Pending Analysis" labels to the drums.

21. Store bore cuttings on and cover with heavy plastic sheeting. If required by local regulations or due to site constraints, store bore cuttings in 17H steel drums. Affix completed "Caution - Analysis Pending" labels to drums.

22. Complete Drum Inventory Sheet (copy attached).

23. Complete pertinent portion of the chain-of-custody form and enter descriptions of field work performed in the field notebook.

4.0 Quality Assurance and Quality Control (QA/QC)

Optional quality control sampling consists of sequential replicates, collected at an approximate frequency of one sequential replicate for every 10 collected soil samples. Sequential replicates are collected by packaging two adjacent liners of soil from a selected split-spoon drive. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretations of data reproducibility should recognize the potential for significant changes in soil type, even over 6-inch intervals. Accordingly, sequential replicates do not supply the same information as normally encountered in duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) wipe sampling decontaminated liners and split-spoon with Kimwipes®, (2) pouring clean silica sand into a decontaminated split-spoon sampler that has been fitted with liners, or (3) pouring deionized water over the decontaminated liners and split-spoon sampler and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

The comparability of the field soil classification may be checked by conducting laboratory classification tests. Requests for laboratory testing verification of the field classification should be left to the discretion of the field staff.

Field decisions that may also affect the quality of collected data include the frequency of sampling and the thoroughness of documentation. Subject to reasonable limitations of budget and schedule, the completeness, comparability, and representativeness of data obtained using this SOP will be enhanced by decreasing the sampling interval (including collecting continuous samples with depth) and increasing the level of detail for sample classification and description of drilling conditions. More frequent sampling and more detailed documentation may be appropriate in zones of chemical concentration or in areas of critical geology (for example, zones of changing strata or cross-correlation of confining strata).

As required, rinse or wipe samples may be collected from the sampling equipment before the initial sampling is conducted to establish a baseline level of contamination present on the sampling equipment. Rinse or wipe samples may also be collected at intervals of decontamination wash and rinse events or after the final decontamination wash and rinse event.

5.0 Documentation

Observations, measurements, and other documentation of the drilling and soil sampling effort should be recorded on the following:

- Field notebook
- Boring log
- Sample label
- Chain-of-custody form

Documentation should include any deviations from this SOP, notations of unusual or unexpected conditions, and documentation of the containerization and disposal of investigation-derived waste. Information to be documented on the sample label and boring log is listed below.

5.1 Sample Label

- Project name and project number
- Borehole or well number
- Sample depth interval (feet below ground surface), record the depth interval using notation similar to "19.2-19.7;" generally do not record just one depth "19.2" because of uncertainty regarding the location such depth corresponds to (midpoint, top, etc.)
- Sample date and sample time
- Name of on-site geologist
- Optional designation of orientation of sample within the subsurface, for example, an arrow with "up" or "top" designated

5.2 Boring Log

- Project name, project number, and name of on-site geologist
- Borehole number
- Description of borehole location, including taped or paced measurements to noticeable topographic features (a location sketch should be considered)
- Date and time drilling started and completed
- Name of drilling company and name of drilling supervisor, optional names and responsibilities of driller's helpers
- Name of manufacturer and model number of drill rig

- Inside and outside diameter of the auger flights of the hollow-stem augers, type and size of sampler, optional description of type of bit on end plug and leading edge of auger, optional description of the size of drill rod

- USCS classification

- Number of blow counts, sampling interval, and total depth of borehole.

- Depth at which groundwater was first encountered with the notation "initial" and any other noted changes in groundwater movement or stabilized water level.

- Field organic vapor monitor readings

- Method of boring completion

- Other notations and recordings described previously in section 2.0, Equipment and Materials, and section 3.0, Typical Procedures

6.0 Decontamination

Prior to entering the site, the drill rig and appurtenant items (drill rod, hollow-stem augers, end plug, split-spoon sampler, shovels, troughs and buckets, driller's stand, etc.) should be decontaminated by steam cleaning or pressure washing. Between each borehole, appurtenant items that contacted downhole soil (essentially all appurtenant items including drill rod, hollow-stem augers, end plug, split-spoon sampler, shovels, troughs and buckets, etc.) should be decontaminated by steam cleaning or pressure washing. The drill rig should be steam cleaned or pressured washed as a final decontamination event. On-site decontamination should be conducted within the confines of a trough or lined pit to temporarily contain the wastewater. Between each borehole and prior to demobilization, the trough or lined pit should be decontaminated by steam cleaning or pressure washing. If a rack or other support is used to suspend appurtenant items over the trough or lined pit during decontamination, only the rack or other support needs to be decontaminated between boreholes.

Prior to collection of each sample, the split-spoon sampler, liners, sample catcher, spatulas and knives, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash (Alconox®, Liquinox®, or other organic-free, low-residue soap), followed by a clean water rinse. If testing for metals, a final rinse of deionized water should be conducted. Wastewater should be temporarily contained.

Between each borehole, buckets and brushes should be decontaminated by steam cleaning or pressure washing. Before installation of each borehole is begun, fresh decontamination solutions should be prepared. Decontaminated equipment should be kept off of the ground surface. Cleaned equipment should be placed on top of plastic sheeting, which is replaced after completion of each borehole or on storage racks.

More rigorous decontamination procedures may be employed if necessary to meet sampling or QA/QC requirements.

7.0 Investigation-Derived Waste

Wastes resulting from the activities of this SOP may include soil cuttings, excess soil samples, decontamination liquids, and miscellaneous waste (paper, plastic, gloves, bags, etc.).

Solid waste from each borehole should be placed on and covered with heavy plastic sheeting unless required to be containerized in 17H steel drums. Solids from multiple boreholes may be combined within a single stockpile if field observations (presence or absence of chemical staining and field organic vapor monitoring) indicate the solids are similarly uncontaminated or similarly contaminated. Given sufficient space and reasonable doubt, separate stockpiles should be used for solid waste from each borehole.

Decontamination liquids for each borehole should be placed in individual 17H steel drums with completed "Caution - Analysis Pending" labels affixed. Liquids from multiple boreholes may be combined, subject to the same limitations as solids.

8.0 Borehole Abandonment

Each borehole that is not to be completed as a monitoring well should be completely filled with a neat cement (5.5 gallons of water in proportion to one 94-pound bag of Type I/Type II Portland cement, ASTM C-150) from the bottom of the bore to grade surface. Water used to hydrate cement should be free of contaminants and organic material. Bentonite may be added to reduce shrinkage and improve fluidity. Add 3 to 5 pounds of bentonite with 6.5 gallons of water and one 94-pound bag of Type I/Type II Portland cement. The water and bentonite should be mixed first before adding the cement. The borehole should be filled from the bottom first to grade surface. A tremie pipe should be used in small diameter boreholes or in formations prone to bridging or collapse. The tremie pipe should be lifted as the cement grout is poured, but should never be lifted above the surface of the neat cement. In boreholes deeper than 50 feet, the neat cement may need to be applied with pressure.

9.0 References

Aller, L., Bennett T.W., Hackett G., Petty R.J., Lehr J.H., Sedoris H., and Nielson D.M., 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH, 1989.

American Society for Testing and Materials, 1992. ASTM Standards On Ground Water and Vadose Zone Investigations. ASTM, Philadelphia, PA, 1992.

Driscoll, F.G., 1986. Groundwater and Wells. Johnson Filtration Systems Inc., St Paul, MN, 1986.

Neilson, D.M., 1991. Practical Handbook of Ground-Water Monitoring. Lewis Publishers, Chelsea, MI, 1991.

United States Environmental Protection Agency, 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document. U.S. EPA, 1986.

BORING & WELL CONSTRUCTION LOG:

BLYMYER
ENGINEERS, INC.

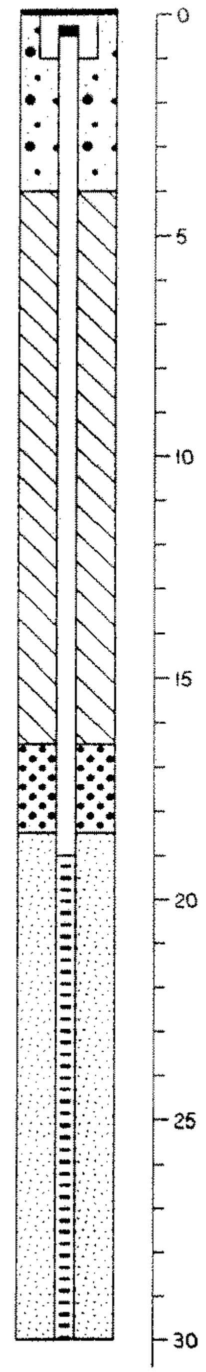
Job No.:	**Driller:**
Client:	**Drilling Contractor:**
Site:	**Logged By:**
	Drilling Equipment:
Date Drilled:	**Bore Diameter:**
Sample Container:	**Total Depth:** Ft.

Well Completion Depth: '

Component Size/Type	Depths in Feet From	To
Surface Completion:		
Blank Casing:		
Slotted Casing:		
Filter Pack:		
Seal:		
Annular Seal:		
Surface Seal:		
Bottom Seal:		

Initial Water Level: ▽
Stabilized water level: ▼

Depth (ft)	Blows/6 In.	P.I.D. (ppm)	Samples	DESCRIPTION	Unified Soil Classification	Graphic Log	Water Depth
0							
5							
10							
15							
20							
25							
30							



(continued on next page)

BLYMYER ENGINEERS DRUM INVENTORY FORM

Number of Drums	Date Generated	Person on-site when generated	Soil or Groundwater	Contents (Cuttings, Purge Water, Development Water, Decon Water, PPE)	% Full	Bore or Monitoring Well ID	Do Lab Results Exist for Contents?

Date Client Informed? ______________________

All drums labeled? ______________________

BLYMYER
ENGINEERS, INC.

Standard Operating Procedure No. 4

Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment

Revision No. 1

Approved By:

Michael Lewis
Quality Assurance/Quality Control Officer
Blymyer Engineers, Inc.

Date 9/1/94

Table of Contents

1.0 Introduction and Summary

This Standard Operating Procedure (SOP) describes methods for drilling with the use of hydraulically-driven equipment, soil sampling with the use of split-spoon samplers, and grab groundwater sampling through an open borehole. Drilling activities covered by this SOP are conducted to obtain soil and grab groundwater samples. Soil samples may be obtained to log subsurface materials, to collect samples for chemical characterization, or to collect samples for physical parameter characterization.

The soil sampling techniques described in this SOP are generally suitable for chemical characterization and physical classification tests; because a driven split-spoon sampler is employed, the resulting soil samples should generally be considered "disturbed" with respect to physical structure and may not be suitable for measuring sensitive physical parameters, such as strength and compressibility. The techniques described in this SOP generally produce a borehole with a diameter corresponding to the outside diameter of the drill rods, a relatively small annulus of remolded soil surrounding the outside diameter of the drill rods, and limited capability for cross-contamination between subsurface strata as the leading drill rods pass from contaminated strata to uncontaminated underlying strata. However, should conditions require strict measures to help prevent cross-contamination or maintain the integrity of an aquitard, consideration should be given to augmenting the procedures of this SOP, for example, by using pre-drilled and grouted isolation casing.

The procedures for hydraulically-driven soil sampling generally consist of initial decontamination, advancement of the drill rods, driving and recovery of the split-spoon sampler, logging and packaging of the soil samples, decontamination of the split-spoon and continued driving and sampling until the total depth of the borehole is reached. Withdrawal of the drill rods upon reaching the total depth requires completion of the borehole by grouting or other measures.

2.0 Equipment and Materials

- Drill rods and drive-weight assembly (hydraulic hammer or vibrator) for driving the drill rods and split-spoon sampler.

- Split-spoon sampler should conform to ASTM D 1586-Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) split-spoon should be fitted with liners for collection of chemical characterization samples, and (2) allowable split-spoon diameters include nominal 1.5-inch inside diameter by nominal 2-inch outside diameter (Standard Penetration Test split-spoon), nominal 2-inch inside diameter by nominal

2.5-inch outside diameter (California Modified split-spoon), or nominal 2-1/2-inch inside diameter by nominal 3-inch outside diameter (Dames & Moore split-spoon). The split-spoon type and length of the split barrel portion of the sampler should be noted on the Boring and Well Construction Log (copy attached), as should the use of a sample catcher if employed.

- Liners should be 3- to 6-inch length, fitted with plastic end caps, brass or stainless steel, with a nominal diameter corresponding to that of the inside diameter of the split-spoon sampler. The Boring and Well Construction Log should note whether brass or stainless steel liners were used.

- Teflon® sheets, approximate 6-mil thickness, precut to a diameter or width of the liner diameter plus approximately 1 inch.

- Plastic end caps.

- Adhesiveless silicone tape.

- Disposable polyethylene bailer.

- Type I/Type II Portland cement.

- Groundwater sample containers (laboratory provided only).

- Kimwipes®, certified clean silica sand, or deionized water (for blank sample preparation).

- Sample labels, Boring and Well Construction Logs, chain-of-custody forms, drum labels, Drum Inventory Sheet (copy attached), and field notebook.

- Ziploc® plastic bags of size to accommodate a liner.

- Stainless steel spatula and knife.

- Cooler with ice or dry ice (do not use blue ice) and packing material.

- Field organic vapor monitor. The make, model, and calibration information for the field organic vapor monitor (including compound and concentration of calibration gas) should be noted in the field notebook.

- Pressure washer or steam cleaner.

- Large trough (such as a water tank for cattle), plastic-lined pit, or equivalent for decontamination of drill rod and end plug.

- Buckets and bristle brushes for decontamination of liners, split-spoon sampler, and other small gear.

- Low-residue, organic-free soap such as Liquinox® or Alconox®.

- Distilled water.

- Heavy plastic sheeting such as Visqueen.

- 55-gallon, open-top, DOT-approved, 17H drums

- 5-gallon open-top DOT-approved pails, if required.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 Typical Procedures

The following typical procedures are intended to cover the majority of hydraulic drilling and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected subsurface conditions. Deviations from the following typical procedures may be expected and should be noted on the Boring and Well Construction Log.

1. Investigate location of the proposed boreholes for buried utilities and obstructions. At least 48 hours before drilling, contact known or suspected utility services individually or through collective services such as "Underground Service Alert."

2. Decontaminate drill rods, split-spoon sampler, and other drilling equipment immediately prior to mobilization to the site.

3. Calibrate field organic vapor monitor equipment in accordance with the manufacturer's specifications. Note performance of the calibration in the geologist's field notebook.

4. Conduct "tail-gate" meeting and secure the work area in accordance with the Site Safety Plan.

5. Core concrete, if required.

6. Using hand-augering device, hand auger to a depth of 5 feet, if feasible, to clear underground utilities and structures not located by a utility service or on drawings. As appropriate, retain private buried utility location services or geophysical investigation services to search for buried utilities and obstructions. During initial advancement of each borehole, drill cautiously and have the driller pay particular attention to the "feel" of drilling conditions. The suspected presence of an obstruction, buried pipeline or cable, utility trench backfill, or similar may be cause for suspension of drilling, subject to further investigation.

7. Advance drill rods, or nested drill rods, to the desired sampling depth using hydraulic hammer or vibrator. Note depth interval, augering conditions, and driller's comments on Boring and Well Construction Log. Samples should be collected at intervals of 5 feet or less in homogeneous strata and at detectable changes of strata.

The sampling procedure varies depending on whether the drill rods are nesting-type. With nesting-type drill rods, the inner and outer drill rods are driven simultaneously. As they are driven, soil is forced into the lined inner drill rod. The outer drill rod is left in place and the inner drill rod is relined with sample sleeves and replaced for the next sampling segment. Where nesting-type drill rods are not used, a split-spoon sampler is used. The following sampling procedures cover sampling with a split-spoon sampler:

8. Remove drill rod and note presence of water mark on drill rod, if any. Also, monitor the top of hollow drill rods using field organic vapor monitor, as appropriate.

9. Decontaminate split-spoon sampler, liners, spatulas and knives, and other equipment that may directly contact the chemical characterization sample. Fit the split-spoon sampler with liners and attach to drill rod.

10. Lower split-spoon sampler until sampler is resting on soil. If more than 6 inches of slough exists inside the borehole, consider the conditions unsuitable and re-advance the drill rods and sampler to a new sampling depth.

11. Drive and recover split-spoon sampler. Record depth interval and sample recovery on Boring and Well Construction Log. Monitor the recovered split-spoon sampler with the field organic vapor monitor, as appropriate.

12. Remove either bottom-most or second-from-bottom liner (or both) from split-spoon sampler for purposes of chemical characterization and physical parameter testing. Observe soil at each end of liner(s) for purposes of completing sample description. Place Teflon® sheet at each end of liner, cover with plastic caps, and tape plastic caps with adhesiveless silicone tape (do not use electrical or duct tape) to further minimize potential loss of moisture or volatile compounds. Label liner(s) and place in Ziploc® bag on ice or dry ice inside cooler.

13. Extrude soil from remaining liner(s) and subsample representative 1-inch cube (approximate dimensions). Place subsample in Ziploc® bag and seal. Allow bag to equilibrate at ambient conditions for approximately 5 minutes and screen for organic vapors by inserting the probe of the field organic vapor monitor into the bag. Record depth interval, observed sample reading, and ambient (background) reading on the Boring and Well Construction Log. Discard bag and sample after use in the solid waste stockpile.

14. Classify soil sample in approximate accordance with ASTM D 2488-Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and in accordance with the Unified Soil Classification System (USCS). Description should include moisture content, color, textural information, group symbol, group name, and odor. Optional descriptions, especially if classification is performed with protective gloves, include particle angularity and shape, clast composition, plasticity, dilatancy, dry strength, toughness, and reaction with HC1. Add notes on geologic structure of sample, as appropriate. Record depth interval, field organic vapor monitor reading, USCS classification, and other notes on the Boring and Well Construction Log.

15. Repeat steps 7 through 14 until total depth of borehole is reached.

16. If a grab groundwater sample is to be collected, slowly lower bailer through the open borehole to minimize agitation and aeration of the sampled water. Transfer the grab groundwater sample into sample container(s). Label sample container(s), place packing materials around containers, and place on ice inside cooler.

17. After drill rods are removed, complete borehole according to the requirements specified elsewhere or by abandonment in accordance with section 8.0.

18. Decontaminate drill rods between boreholes and after finishing last borehole prior to drill rig leaving site.

19. Change decontamination solutions and clean decontamination trough, buckets, and brushes between boreholes.

20. Containerize decontamination liquids in 17H steel drums. Affix completed "Caution - Analysis Pending" labels to the drums.

21. Store any excess soil sample on and cover with heavy plastic sheeting. If required by local regulations or due to site constraints, store excess soil sample in 5-gallon pails. Affix completed "Caution - Analysis Pending" labels to drums.

22. Complete Drum Inventory Sheet.

23. Complete pertinent portion of the chain-of-custody form and enter descriptions of field work performed in the field notebook.

4.0 Quality Assurance and Quality Control (QA/QC)

Optional quality control sampling consists of sequential replicates, collected at an approximate frequency of one sequential replicate for every 10 collected soil samples. Sequential replicates are collected by packaging two adjacent liners of soil from a selected split-spoon drive. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretations of data reproducibility should recognize the potential for significant changes in soil type, even over 6-inch intervals. Accordingly, sequential replicates do not supply the same information as normally encountered in duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) wipe sampling decontaminated liners and split-spoon with Kimwipes®, (2) pouring clean silica sand into a decontaminated split-spoon sampler that has been fitted with liners, or (3) pouring deionized water over the decontaminated liners and split-spoon sampler and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

The comparability of the field soil classification may be checked by conducting laboratory classification tests. Requests for laboratory testing verification of the field classification should be left to the discretion of the field staff.

Field decisions that may also affect the quality of collected data include the frequency of sampling and the thoroughness of documentation. Subject to reasonable limitations of budget and schedule, the completeness, comparability, and representativeness of data obtained using this SOP will be enhanced by decreasing the sampling interval (including collecting continuous samples with depth) and increasing the level of detail for sample classification and description of drilling conditions. More frequent sampling and more detailed documentation may be appropriate in zones of chemical concentration or in areas of critical geology (for example, zones of changing strata or cross-correlation of confining strata).

As required, rinse or wipe samples may be collected from the sampling equipment before the initial sampling is conducted to establish a baseline level of contamination present on the sampling equipment. Rinse or wipe samples may also be collected at intervals of decontamination wash and rinse events or after the final decontamination wash and rinse event.

5.0 Documentation

Observations, measurements, and other documentation of the drilling and soil sampling effort should be recorded on the following:

- Sample label
- Boring and Well Construction Log
- Field notebook
- Chain-of-custody form
- Drum Inventory Sheet

Documentation should include any deviations from this SOP, notations of unusual or unexpected conditions, and documentation of the containerization and disposal of investigation-derived waste. Information to be documented on the sample label and Boring and Well Construction Log is listed below.

5.1 Sample Label

- Project name and project number

- Borehole number

- Sample depth interval (feet below ground surface), record the depth interval using notation similar to "19.2-19.7;" generally do not record just one depth "19.2" because of uncertainty regarding the location such depth corresponds to (midpoint, top, etc.)

- Sample date and sample time

- Name of on-site geologist

- Optional designation of orientation of sample within the subsurface, for example, an arrow with "up" or "top" designated

5.2 Boring Log

- Project name, project number, and name of on-site geologist

- Borehole number

- Description of borehole location, including taped or paced measurements to noticeable topographic features (a location sketch should be considered)

- Date and time drilling started and completed

- Name of drilling company and name of drilling supervisor, optional names and responsibilities of driller's helpers

- Name of manufacturer and model number of sampling rig

- Type and size of sampler, optional description of the size of drill rod

- USCS classification

- Sampling interval and total depth of borehole

- Depth at which groundwater was first encountered with the notation "initial" and any other noted changes in groundwater movement or stabilized water level

- Field organic vapor monitor readings

- Method of boring completion

- Other notations and recordings described previously in section 2.0, Equipment and Materials, and section 3.0, Typical Procedures

6.0 Decontamination

Prior to entering the site, the sampling rig and appurtenant items (drill rods, split-spoon sampler, shovels, troughs and buckets, driller's stand, etc.) should be decontaminated by steam cleaning or pressure washing. Between each borehole, appurtenant items that contacted downhole soil (essentially all appurtenant items including drill rod, split-spoon sampler, shovels, troughs, and buckets, etc.) should be decontaminated by steam cleaning or pressure washing. The sampling rig should be steam cleaned or pressured washed as a final decontamination event. On-site decontamination should be conducted within the confines of a trough or lined pit to temporarily contain the wastewater. Between each borehole and prior to demobilization, the trough or lined pit should be decontaminated by steam cleaning or pressure washing. If a rack or other support is used to suspend appurtenant items over the trough or lined pit during decontamination, only the rack or other support needs to be decontaminated between boreholes.

Prior to collection of each sample, the split-spoon sampler, liners, sample catcher, spatulas and knives, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash (Alconox®, Liquinox®, or other organic-free, low-residue soap), followed by a clean water rinse. If testing for metals, a final rinse of deionized water should be conducted. Wastewater should be temporarily contained.

Between each borehole, buckets and brushes should be decontaminated by steam cleaning or pressure washing. Before installation of each borehole is begun, fresh decontamination solutions should be prepared. Decontaminated equipment should be kept off of the ground surface. Cleaned equipment should be placed on top of plastic sheeting, which is replaced after completion of each borehole, or on storage racks.

More rigorous decontamination procedures may be employed if necessary to meet sampling or QA/QC requirements.

7.0 Investigation-Derived Waste

Wastes resulting from the activities of this SOP may include excess soil samples, decontamination liquids, and miscellaneous waste (paper, plastic, gloves, bags, etc.).

Solid waste from each borehole should be placed on and covered with heavy plastic sheeting or containerized in DOT-approved 5-gallon pails. Solids from multiple boreholes may be combined within a single stockpile if field observations (presence or absence of chemical staining and field organic vapor monitoring) indicate the solids are similarly uncontaminated or similarly contaminated. Given sufficient space and reasonable doubt, separate stockpiles should be used for solid waste from each borehole.

Decontamination liquids for each borehole should be placed in individual 17H steel drums with completed "Caution - Analysis Pending" labels affixed. Liquids from multiple boreholes may be combined, subject to the same limitations as solids.

8.0 Borehole Abandonment

Each borehole should be completely filled with neat cement (5.5 gallons of water in proportion to one 94-pound bag of Type I/Type II Portland cement, ASTM C-150) from the bottom of the bore to grade surface. Water used to hydrate cement should be free of contaminants and organic material. Bentonite may be added to reduce shrinkage and improve fluidity. Add 3 to 5 pounds of bentonite with 6.5 gallons of water and one 94-pound bag of Type I/Type II Portland cement. The water and bentonite should be mixed first before adding the cement. The borehole should be filled from the bottom first to grade surface. A tremie pipe should be used in small diameter boreholes or in formations prone to bridging or collapse. The tremie pipe should be lifted as the cement grout is poured, but should never be lifted above the surface of the neat cement. In boreholes deeper than 50 feet, the neat cement may need to be applied with pressure.

9.0 References

Aller, L., Bennett T.W., Hackett G., Petty R.J., Lehr J.H., Sedoris H., and Nielson D.M., 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH, 1989.

American Society for Testing and Materials, 1992. ASTM Standards On Ground Water and Vadose Zone Investigations. ASTM, Philadelphia, PA, 1992.

Driscoll, F.G., 1986. Groundwater and Wells. Johnson Filtration Systems Inc., St. Paul, MN, 1986.

Neilson, D.M., 1991. Practical Handbook of Ground-Water Monitoring. Lewis Publishers, Chelsea, MI, 1991.

United States Environmental Protection Agency, 1992. RCRA Ground-Water Monitoring: Draft Guidance Document. U.S. EPA, 1992.

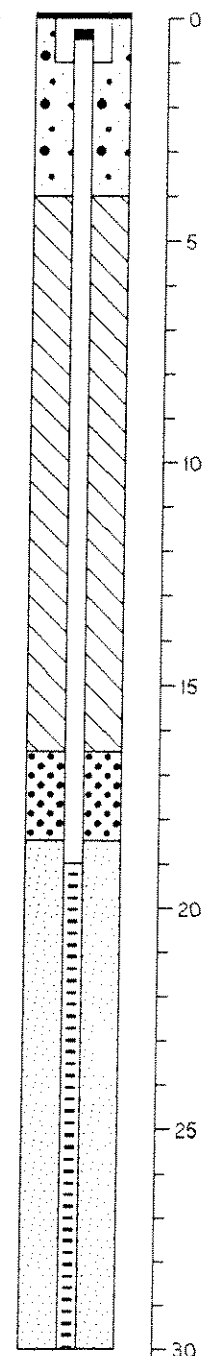
BLYMYER ENGINEERS, INC.	**BORING & WELL CONSTRUCTION LOG:**	*Page 1 of 0*
	Job No.: Client: Site: Date Drilled: Sample Container:	Driller: Drilling Contractor: Logged By: Drilling Equipment: Bore Diameter: Total Depth: Ft.

Well Completion Depth: '

Component Size/Type	Depths in Feet From	To
Surface Completion:		
Blank Casing:		
Slotted Casing:		
Filter Pack:		
Seal:		
Annular Seal:		
Surface Seal:		
Bottom Seal:		

Initial Water Level: ∇
Stabilized water level: ▼

Depth (ft)	Blows/6 In.	P.I.D. (ppm)	Samples	DESCRIPTION	Unified Soil Classification	Graphic Log	Water Depth
0							
5							
10							
15							
20							
25							
30							



(continued on next page)

BLYMYER ENGINEERS DRUM INVENTORY FORM

Number of Drums	Date Generated	Person on-site when generated	Soil or Groundwater	Contents (Cuttings, Purge Water, Development Water, Decon Water, PPE)	% Full	Bore or Monitoring Well ID	Do Lab Results Exist for Contents?

jmo\form\drums.inv

Date Client Informed? ______________________ All drums labeled? ______________________