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GROUNDWATER MONITORING REPORT SECOND SEMI-ANNUAL THIRD YEAR JANUARY
2011 AT BP WELLS SITE NAS CECIL FIELD FL
03/30/2011
TETRA TECH NUS



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PITT-03-11-079

March 30, 2011

Project Number 112G02267

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Reference: CLEAN Contract Number N62470-08-D-1001
Contract Task Order JM09

Subject: Groundwater Monitoring Report, 2nd Semi-Annual, 3rd Year - January 2011
BP Wells Site
Naval Air Station Cecil Field
Jacksonville, Florida

Dear Mr. Grabka:

On behalf of the Navy, Tetra Tech NUS, Inc. (Tetra Tech) is pleased to submit this 2nd Semi-Annual, Year 3 Groundwater Monitoring Report for the referenced Contract Task Order for the BP Wells Site. This Groundwater Monitoring Report was prepared for Naval Facilities Engineering Command Southeast (NAVFAC SE) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62470-08-D-1001.

The primary objective of current activities at this site is to conduct semi-annual monitoring of groundwater associated with the shallow zone of the surficial aquifer to track contamination and ensure it is not migrating. The sampling program is being conducted in general accordance with the April 2010 Final Uniform Federal Policy-Sampling and Analysis Plan (UFP-SAP) for Petroleum Sites: North-South Apron, Building 82, Tank G82, BP Wells, and 815 Wash Rack and subsequent Field Task Modification Requests (FTMR) No. 01 (submitted in May 2010) and No. 02 (submitted in December 2010), all provided in Attachment A.

This 2nd Semi-Annual, 3rd Year Groundwater Monitoring Report summarizes the field operations and analytical results for the sampling event conducted during the week of January 18, 2011, and the groundwater elevation measurements collected February 15, 2011 for the subject site. The work was conducted in general accordance with Florida Department of Environmental Protection (FDEP) Standard Operating Procedures (SOPs) under DEP-SOP-001/01, as detailed in the UFP-SAP.

BACKGROUND

The BP Wells Site is located on the north-south flightline, southeast of Building 880. During assessment activities in 1999 and 2000, five shallow wells (CEF-BP-1S through CEF-BP-4S and CEF-BP-6S) and one intermediate well (CEF-BP-5I) were installed at the site and subsequently sampled. The groundwater was determined to be contaminated with petroleum-related hydrocarbons. After this initial assessment, Tetra

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Tetra Tech conducted a Site Assessment to identify the extent of groundwater contamination and the groundwater flow direction.

Based on the results of the Site Assessment, a Natural Attenuation Monitoring Plan (NAMP) was prepared and submitted in 2000 to FDEP, which issued a NAMP Approval Order (NAMP AO) on August 31, 2000. In accordance with this NAMP AO, Tetra Tech performed the first two semi-annual monitoring events in April and October 2001. Hydrocarbon concentrations [1,2,4-trimethylbenzene (TMB); 1,3,5-TMB; ethylbenzene; toluene; and total xylenes] in groundwater exceeded FDEP Natural Attenuation Default Concentrations (NADCs) during both sampling events. The second monitoring report recommended that a Remedial Action Plan (RAP) be prepared for this site because contaminant concentrations at the source well (CEF-BP-1S) were greater than NADCs, and because there was a significant increase in contaminant concentrations from April 2001 to October 2001. On February 20, 2002, FDEP concurred that a RAP was warranted. A treatability study was recommended and approved to evaluate the effectiveness of in-situ enhanced bioremediation as a possible remedy to be included in the RAP, and a work plan was prepared and approved. The treatability study was conducted between October 2002 and November 2003. Injection wells CEF-BP-7S through CEF-BP-9S were installed during the treatability study. Three in-situ oxygen curtain (iSOC) diffusers were installed in wells CEF-BP-7S through CEF-BP-9S, which were located about 10 to 15 feet from CEF-BP-5I, CEF-BP-1S, and CEF-BP-6S, respectively. The results of these oxygen injections were evaluated by Tetra Tech in the April 2004 Enhanced Natural Attenuation Treatability Study Evaluation Report for the BP Wells Site, and it was determined that remediation efforts were not completely successful. Further groundwater monitoring at the BP Wells Site was not completed until the November 2006 event conducted in conjunction with the adjacent Tank G82 Site groundwater sampling. Groundwater analytical results confirmed that natural attenuation was occurring at the BP Wells Site and that concentrations of contaminants of concern (COCs) were decreasing over time.

In May 2008, CH2MHill Constructors, Inc. (CH2MHill) submitted an updated NAMP for Building 82 (Tank G82) and BP Wells that recommended long-term semi-annual groundwater sampling for the following COCs based on the results of the November 2006 groundwater sampling event:

- Benzene, toluene, ethylbenzene, and xylenes (BTEX) and naphthalene via United States Environmental Protection Agency (U.S. EPA) Method 8260B.
- Polycyclic Aromatic Hydrocarbons (PAHs) including 1-methylnaphthalene and 2-methylnaphthalene via U.S. EPA Method 8270 Selected Ion Monitoring (SIM).
- Total recoverable petroleum hydrocarbons (TRPH) via the Florida Petroleum-Range Organics (FL-PRO) Method.
- Natural attenuation parameters including dissolved methane (Method RSK 175), nitrate/nitrite and sulfate (U.S. EPA Method 300.0).

Semi-annual sampling in accordance with the updated NAMP began in July 2008. FDEP Groundwater Cleanup Target Levels (GCTLs) for ethylbenzene, total xylenes, naphthalene, 1,2,4-TMB, 1,3,5-TMB, and isopropylbenzene were exceeded in the source well (CEF-BP-1S) during the July 2008 sampling event. The July 2008 concentration of isopropylbenzene in downgradient well CEF-BP-6S also slightly exceeded its GCTL.

During the January 2009 sampling event, GCTLs and NADCs for ethylbenzene, xylenes, isopropylbenzene, 1,2,4-TMB, and 1,3,5-TMB were exceeded at CEF-BP-1S. GCTLs for naphthalene, 2-methylnaphthalene, and benzene were also exceeded at CEF-BP-1S, but these concentrations were less than NADCs. The January 2009 concentrations of isopropylbenzene and 1,2,4-TMB also exceeded GCTLs in downgradient well CEF-BP-6S.

During the July 2009 sampling event, GCTLs and NADCs for 1,2,4-TMB, 1,3,5-TMB, isopropylbenzene, and xylenes were exceeded at CEF-BP-1S. The GCTLs for ethylbenzene and benzene were also exceeded at the source well (CEF-BP-1S). Concentrations of 1,2,4-TMB, isopropylbenzene, and xylenes



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exceeded GCTLs at CEF-BP-6S; concentrations of benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded GCTLs at upgradient well CEF-BP-7S; and concentrations of benzo(a)anthracene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded GCTLs at downgradient well CEF-BP-9S.

During the January 2010 sampling event, GCTLs and NADCs for total xylenes, 1,2,4-TMB, 1,3,5-TMB, and isopropylbenzene were exceeded in source well CEF-BP-1S, and concentrations of naphthalene and ethylbenzene exceeded GCTLs only. GCTLs for 1,2,4-TMB, isopropylbenzene, 1,3,5-TMB, ethylbenzene, total xylenes, and naphthalene were exceeded in CEF-BP-6S; and concentrations of 1,2,4-TMB and isopropylbenzene also exceeded NADCs.

In April 2010, Tetra Tech submitted the UFP-SAP (approved by FDEP in May 2010), which recommended long-term semi-annual monitoring of the following COCs based on discussions at the August 2009 Data Quality Objective (DQO) Meeting:

- VOCs - ethylbenzene, isopropylbenzene, 1,2,4-TMB, 1,3,5-TMB, and total xylenes via U.S. EPA Method 8260B).
- PAHs - 2-methylnaphthalene and naphthalene via U.S. EPA Method 8270 SIM.
- TRPH via the FL-PRO Method.

Based on discussions at the February 2010 Base Realignment and Closure (BRAC) Cleanup Team (BCT) meeting (Decision No. 777, Minute 2603) regarding exceedances at downgradient well CEF-BP-6S, additional wells were proposed. The UFP-SAP was not yet submitted as final, but had already been approved by the Navy Chemist; therefore, an FTMR was prepared. FTMR No. 01 submitted by Tetra Tech in May 2010 recommended the installation of two shallow groundwater monitoring wells downgradient of CEF-BP-6S, and the collection of four soil samples in the vicinity of CEF-BP-1S (with analysis for the same COCs listed in the UFP-SAP, with the addition of 1-methylnaphthalene) to establish a new downgradient groundwater monitoring point for the shallow zone of the surficial aquifer, and to ensure that a soil continuing source was not contributing to groundwater contamination. The groundwater monitoring well and soil sample locations were confirmed at the May 2010 BCT meeting (Minute 2621).

On July 19, 2010, in accordance with FTMR No. 01, four soil samples were collected from four borings: CEF-BP-SS01 located adjacent to CEF-BP-1S; and CEF-BP-SS02, CEF-BP-SS03, and CEF-BP-SS04 located approximately 10 feet west, northwest, and north, respectively, from CEF-BP-1S. No borings were installed south or east of CEF-BP-1S because of Building 838 and the flightline. Soil samples were collected at 1-foot intervals until the water table was encountered [approximately 4.5 feet below ground surface (bgs)] and tested with an organic vapor analyzer-flame ionization detector (OVA-FID).

Concentrations reported by the laboratory for soil samples collected during this sampling event were compared to FDEP Soil Cleanup Target Levels (SCTLs). Concentrations of benzo(a) pyrene equivalents (BaPEqs) exceeded the residential SCTL of 0.1 mg/kg in soil sample CEF-BP-SS01. TRPH concentrations exceeded residential and leachability SCTLs in both CEF-BP-SS01 and CEF-BP-SS04. No other analytes were detected in excess of SCTLs in any of the other soil samples, as reported in the Groundwater Monitoring and Supplemental Soil Sampling Report, 1st Semi-Annual, 3rd Year – July 2010 report.

During the November 2010 BCT meeting, it was decided that wells CEF-BP-7S and CEF-BP-8S no longer required monitoring, but that water levels would continue to be collected from these wells, and also that no further action with regards to soils was required at this time (Meeting Minute No. 2651, Decisions 794 and 795). An FTMR was prepared to reflect this change to the monitoring program, and the FTMR No. 02 is included in Attachment A.



FIELD OPERATIONS

Based on the UFP-SAP and BCT decisions, groundwater samples were collected from wells CEF-BP-1S, CEF-BP-4S, CEF-BP-5I, CEF-BP-6S, CEF-BP-9S, CEF-BP-10S, and CEF-BP-11S on January 18, 2011, during the routine semi-annual sampling event. The analyses for these samples were conducted in accordance with the approved UFP-SAP and FTMRs. Monitoring well locations of all site wells are provided on Figure 1.

All groundwater samples collected were placed on ice and subsequently delivered via FedEx under chain of custody to Empirical Laboratories, Inc., in Nashville, Tennessee, for analysis. The laboratory analyzed the groundwater samples from CEF-BP-1S, CEF-BP-4S, CEF-BP-5I, CEF-BP-6S, CEF-BP-9S, CEF-BP-10S, and CEF-BP-11S for VOCs using U.S. EPA Method SW-846 8260B; for PAHs including 1-methylnaphthalene and 2-methylnaphthalene using U.S. EPA Method 8270 SIM; and for TRPH using the FL-PRO method.

Synoptic water levels and total well depths were measured and recorded on a site-specific groundwater measurement sheet for all wells sampled at the BP Wells Site. Water levels were collected in January 2011, but water levels were only collected from wells that were recently surveyed. On February 15, 2011, water levels were collected from all site wells, and depths to water at the BP Wells Site ranged from 6.14 feet below top of casing (btoc) (CEF-BP-1S) to 7.41 feet btoc (CEF-BP-3S). Depth to water measurements, top of casing elevations, and groundwater elevations are presented in Table 1, and the estimated groundwater flow direction is illustrated on Figure 2. General sampling protocols were in accordance with FDEP SOPs and Tetra Tech SOP SA-1.1.

RESULTS

Selected groundwater elevation data for the shallow zone across the BP Wells Site are shown on Figure 2. Based on these data, the inferred direction of groundwater flow in the shallow zone of the surficial aquifer is predominantly toward the east, which is slightly different from previous events where the flow direction has typically been east-southeast.

Concentrations reported by the laboratory for groundwater samples collected during this sampling event were compared to FDEP GCTLs and NADCs. The data and standards are presented in Table 2. At monitoring well CEF-BP-1S, parameters detected in exceedance of GCTLs included: total xylenes (120 µg/L), isopropylbenzene (6.37 µg/L), ethylbenzene (47.5 µg/L), 1,2,4-TMB (77.5 µg/L), 1,3,5-TMB (49.7 µg/L) and naphthalene (17.1 µg/L). No COCs exceeded NADCs in CEF-BP-1S during this round of sampling. Concentrations in groundwater from well CEF-BP-6S exceeded NADCs for the following constituents: isopropylbenzene (13.9 µg/L), 1,2,4-TMB (162 µg/L), and total xylenes (247 µg/L). 1,3,5-TMB (41.8 µg/L), ethylbenzene (113 µg/L), and naphthalene (18.1 µg/L) were also detected in CEF-BP-6S at concentrations exceeding GCTLs. A duplicate sample was collected from CEF-BP-1S, and the results confirmed these exceedances. In all of the other wells sampled, all of the COCs were either not detected or were detected at estimated concentrations less than GCTLs. The results for 1-methylnaphthalene, 2-methylnaphthalene, and TRPH were less than NADCs and GCTLs, and have been for four or more consecutive events in all wells sampled.

Laboratory data are presented in Attachment B. Figure 3 summarizes VOC analytical results in groundwater and depicts the estimated extent of the VOC plume between CEF-BP-1S and CEF-BP-6S. Figure 4 summarizes PAH analytical results and depicts the estimated extent of the naphthalene plume between CEF-BP-1S and CEF-BP-6S.



CONCLUSIONS AND RECOMMENDATIONS

The shallow groundwater flow direction in the area of the BP Wells site is to the east, which is a slight change from previous sampling events, when the flow direction has typically been to the east-southeast.

In source well CEF-BP-1S, concentrations of total xylenes, 1,2,4-TMB, 1,3,5-TMB, isopropylbenzene, naphthalene, and ethylbenzene exceeded GCTLs. No concentrations exceeded NADCs in this well, after concentrations of these COCs were greater than their respective NADC for the past four semi-annual events. In downgradient well CEF-BP-6S, concentrations of 1,2,4-TMB, total xylenes, isopropylbenzene, 1,3,5-TMB, ethylbenzene, and naphthalene exceeded GCTLs; and concentrations of 1,2,4-TMB, total xylenes, and isopropylbenzene exceeded NADCs.

The following observations for source well CEF-BP-1S and downgradient well CEF-BP-6S are based on the data collected in January 2011:

CEF-BP-1S

- The total xylenes concentration decreased greatly from July 2010 to January 2011, no longer exceeding the NADC at CEF-BP-1S for the first time since semi-annual monitoring began.
- The isopropylbenzene concentration decreased to less than the NADC (8 µg/L), but remained greater than the GCTL (0.8 µg/L).
- 1,2,4-TMB concentration decreased greatly from July 2010 to January 2011 to less than the NADC. This concentration continues to exceed the GCTL.
- 1,3,5-TMB concentration decreased from July 2010 to January 2011. This concentration exceeds the GCTL, but no longer exceeds the NADC.
- Ethylbenzene exceeded its GCTL (30 µg/L), but decreased greatly from July 2010 to January 2011.
- Naphthalene continued to exceed its GCTL (14 µg/L), but decreased greatly from July 2010 to January 2011.

CEF-BP-6S

- 1,2,4-TMB remained at a concentration greater than the NADC (100 µg/L), but decreased when compared to the July 2010 concentration.
- Isopropylbenzene concentration remained relatively the same compared to the July 2010 concentration, and continues to exceed its GCTL (0.8 µg/L) and NADC (8 µg/L).
- The total xylenes concentration remained relatively the same since July 2010, and continues to exceed its NADC (200 µg/L).
- 1,3,5-TMB, ethylbenzene, and naphthalene concentrations continued to exceed GCTLs.

No other analytes were detected in exceedance of GCTLs in any of the other wells sampled. The trend in concentrations of ethylbenzene, 1,2,4-TMB, 1,3,5-TMB, total xylenes, and naphthalene in CEF-BP-6S appeared to be increasing leading up to this event, but most concentrations decreased from July 2010 to January 2011.

The next semi-annual groundwater sampling event is currently scheduled to be conducted in July 2011. It is recommended that 1-methylnaphthalene and 2-methylnaphthalene be eliminated from the groundwater monitoring program. These constituents have not been detected greater than their respective GCTLs at any wells for at least four consecutive events. TRPH concentrations have also not exceeded GCTLs at any wells during the six events conducted under the current monitoring program, but because TRPH



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concentrations in soil collected during the July 2010 supplemental sampling event exceeded leachability criteria in two samples, TRPH will continue to be analyzed in the groundwater monitoring program.

If this recommendation is accepted, the July 2011, 1st Semi-Annual, Year 4 sampling event will consist of sampling seven wells (CEF-BP-1S, CEF-BP-4S, CEF-BP-5I, CEF-BP-6S, CEF-BP-9S, CEF-BP-10S, and CEF-BP-11S) and analyzing groundwater samples for VOCs, naphthalene, and TRPH; and measuring groundwater elevations at all wells sampled and also at CEF-BP-2S, CEF-BP-3S, CEF-BP-7S, and CEF-BP-8S.

Based on the results of the January 2011 sampling event, it is recommended that a pilot study be conducted or Remedial Action Plan (RAP) be prepared to address the NADC exceedances at the site. Options to address these exceedances will be discussed at the May 2011 BCT meeting.

If you have any questions regarding this submittal, please feel free to contact me at (412) 921-8163 or via e-mail at Robert.Simcik@tetratech.com.

Sincerely,

Robert F. Simcik, P.E.
Task Order Manager
P.E. Number 61263

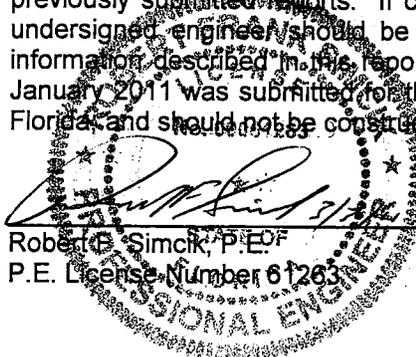
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Attachments (4)

- c: A. Sanford, BRAC PMO SE (electronic copy)
- M. Davidson, BRAC PMO SE (electronic copy)
- S. Martin, NAVFAC Atlantic (electronic copy)
- D. Vaughn-Wright, U.S, EPA (electronic copy)
- M. Halil, CH2M Hill (electronic copy)
- S. Currie, Tetra Tech CTO JM09 project file (1 copy, unbound)
- J. Trepanowski, Tetra Tech
- M. Jonnet, Tetra Tech (electronic copy)
- M. Boerio, Tetra Tech (electronic copy)
- J. Johnson, Tetra Tech (1 copy for Information Repository)

CERTIFICATION

The information contained herein is based on the investigation data and information obtained from previously submitted reports. If conditions are determined to exist that differ from those described, the undersigned engineer should be notified to evaluate the effects of any additional information on the information described in the report. This Groundwater Monitoring Report, 2nd Semi-Annual, 3rd Year – January 2011 was submitted for the BP Wells Site at Former Naval Air Station Cecil Field, Jacksonville, Florida, and should not be considered to apply to any other site.


Robert F. Simcik, P.E.
P.E. License Number 61263

TABLES

Table 1
Groundwater Elevation and Monitoring Well Construction Data

2nd Semi-Annual, 3rd Year - January 2011 Groundwater Sampling Event
 BP Wells Site
 Naval Air Station Cecil Field
 Jacksonville, Florida
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Well Number	Total Depth of Well (feet btoc)	Top of Casing Elevation (feet above msl)	9/23/2002		1/6/2003		4/17/2003		7/17/2003	
			Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)
CEF-BP-1S	14.72	71.28	5.10	66.18	6.00	65.28	5.75	65.53	4.63	66.65
CEF-BP-2S	14.48	71.78	5.42	66.36	6.41	65.37	6.14	65.64	5.02	66.76
CEF-BP-3S	14.57	72.38	6.32	66.06	NA	NA	6.98	65.40	5.90	66.48
CEF-BP-4S	14.75	72.28	6.30	65.98	NA	NA	6.96	65.32	5.86	66.42
CEF-BP-5I	34.39	71.63	5.45	66.18	NA	NA	6.11	65.52	5.01	66.62
CEF-BP-6S	14.20	71.87	5.79	66.08	6.72	65.15	6.44	65.43	5.35	66.52

Well Number	Total Depth of Well (feet btoc)	Top of Casing Elevation (feet above msl)	7/24/2008		1/26/2009		7/15/2009		1/18/2010	
			Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)
CEF-BP-1S	14.72	71.28	NM	NM	7.82	63.46	4.98	66.30	7.08	64.20
CEF-BP-2S	14.48	71.78	5.80	65.98	8.24	63.54	5.37	66.41	7.51	64.27
CEF-BP-3S	14.57	72.38	6.62	65.76	9.03	63.35	6.19	66.19	8.31	64.07
CEF-BP-4S	14.75	72.28	6.55	65.73	8.96	63.32	6.13	66.15	8.23	64.05
CEF-BP-5I	34.39	71.63	5.78	65.85	8.19	63.44	5.31	66.32	7.43	64.20
CEF-BP-6S	14.20	71.87	6.09	65.78	8.48	63.39	5.64	66.23	7.73	64.14

msl = Mean sea level.
 btoc = Below top of casing.
 NA = Not available.
 NM = Not measured.

Table 1
Groundwater Elevation and Monitoring Well Construction Data

2nd Semi-Annual, 3rd Year - January 2011 Groundwater Sampling Event
 BP Wells Site
 Naval Air Station Cecil Field
 Jacksonville, Florida
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Well Number	Total Depth of Well (feet btoc)	Top of Casing Elevation (feet above msl)	7/21/2010		1/27/2011		2/15/2011	
			Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)	Depth to Water (feet btoc)	Groundwater Elevation (feet above msl)
CEF-BP-1S	14.72	71.28	6.61	64.67	7.74	63.54	6.14	65.14
CEF-BP-2S	14.48	71.78	7.04	64.74	8.16	63.62	6.60	65.18
CEF-BP-3S	14.57	72.38	7.80	64.58	9.07	63.31	7.41	64.97
CEF-BP-4S	14.75	72.36	7.78	64.58	8.99	63.37	7.31	65.05
CEF-BP-5I	34.39	71.63	6.88	64.75	NM	NM	6.50	65.13
CEF-BP-6S	14.20	71.94	7.28	64.66	8.45	63.49	6.83	65.11
CEF-BP-7S	15.00	71.69	6.82	64.87	NM	NM	6.37	65.32
CEF-BP-8S	15.00	71.90	7.04	64.86	NM	NM	6.58	65.32
CEF-BP-9S	15.00	71.91	7.03	64.88	NM	NM	6.55	65.36
CEF-BP-10S	15.00	72.04	7.43	64.61	NM	NM	7.01	65.03
CEF-BP-11S	15.00	71.81	7.15	64.66	NM	NM	6.71	65.10

msl = Mean sea level.
 btoc = Below top of casing.
 NA = Not available.
 NM = Not measured.

Table 2: Summary of Detections in Groundwater

2nd Semi-Annual, 3rd Year - January 2011 Groundwater Sampling Event
 BP Wells Site
 Naval Air Station Cecil Field
 Jacksonville, Florida
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Constituent	FDEP GCTL	FDEP NADC	Monitoring Well												
			CEF-BP-1S						CEF-BP-4S						
			7/23/2008	1/26/2009	7/14/2009	1/18/2010	7/21/2010	1/18/2011	7/23/2008	1/28/2009		7/14/2009	1/18/2010	7/21/2010	1/18/2011
		Sample	Duplicate												
VOCs (USEPA Method 8260B) (µg/L)															
1,2,4-Trimethylbenzene	10	100	440 [G]	664 [G] [N]	480 [G] [N]	450 D [G] [N]	379 [G] [N]	77.5 [G]	0.38 U	0.22 U	2.2 U	0.14 U	0.14 U	0.30 U	0.150 U
1,3,5-Trimethylbenzene	10	100	140 [G]	212 [G] [N]	150 [G] [N]	140 D [G] [N]	117 [G] [N]	49.7 [G]	0.22 U	0.2 U	0.2 U	0.1 U	0.1 U	0.30 U	0.180 U
Benzene	1	10	2.3 U [G]	2 U [G]	1.2 U [G]	0.55 UD	0.60 U	0.140 U	0.23 U	0.40 U	0.40 U	0.12 U	0.12 U	0.30 U	0.140 U
Ethylbenzene	30	300	200 [G]	304 [G] [N]	220 [G]	170 D [G]	196 [G]	47.5 [G]	0.34 U	0.43 U	0.43 U	0.1 U	0.1 U	0.30 U	0.150 U
Isopropylbenzene	0.8	8	20 [G] [N]	28.1 [G] [N]	19 [G] [N]	16 D [G] [N]	15.1 [G] [N]	6.37 [G]	0.23 U	0.2 U	0.2 U	0.11 U	0.11 U	0.30 U	0.150 U
Toluene	40	400	2.8 U	1.9 J	1.4 U	0.67 JD	0.628 J	0.190 U	0.28 U	0.35 U	0.35 U	0.14 U	0.14 U	0.30 U	0.190 U
Total Xylenes	20	200	670 [G] [N]	705 [G] [N]	770 [G] [N]	520 D [G] [N]	552 [G] [N]	120 [G]	0.38 U	1.2 U	1.2 U	0.21 U	0.21 U	0.30 U	0.220 U
PAHs (USEPA Method 8270C SIM) (µg/L)															
1-Methylnaphthalene	28	280	7.3	16.4	12	9.9	11.1	2.61	0.01 U	0.24 U	0.24 U	0.3 U	0.018 U	0.0185 U	0.0185 U
2-Methylnaphthalene	28	280	17	31.3 [G]	22	20	18.1	5.86	0.02 U	0.24 U	0.24 U	0.3 U	0.018 U	0.0185 U	0.0185 U
Acenaphthene	20	200	0.08 J	0.48 U	0.3 U	0.12 J	0.0980 U	NA	0.02 U	0.48 U	0.48 U	0.3 U	0.018 U	0.0185 U	NA
Acenaphthylene	210	2100	0.01 U	0.48 U	0.023 U	0.066 J	0.0980 U	NA	0.01 U	0.48 U	0.48 U	0.023 U	0.018 U	0.0185 U	NA
Anthracene	2100	21000	0.02 U	0.48 U	0.046 U	0.068 J	0.0980 U	NA	0.02 U	0.48 U	0.48 U	0.046 U	0.026 J	0.0185 U	NA
Benzo(a)anthracene	0.05	5	0.01 U	0.048 U	0.023 U	0.048 J	0.0980 U	NA	0.01 U	0.048 U	0.048 U	0.023 U	0.092 U	0.0185 U	NA
Benzo(a)pyrene	0.2	2	0.01 U	0.048 U	0.078 J	0.018 U	0.0980 U	NA	0.01 U	0.048 U	0.048 U	0.023 U	0.092 U	0.0185 U	NA
Benzo(b)fluoranthene	0.05	5	0.01 U	0.048 U	0.023 U	0.039 J	0.0980 U	NA	0.01 U	0.048 U	0.048 U	0.023 U	0.092 U	0.0185 U	NA
Benzo(k)fluoranthene	0.5	50	0.03 U	0.048 U	0.023 U	0.038 J	0.0980 U	NA	0.03 U	0.048 U	0.048 U	0.023 U	0.092 U	0.0185 U	NA
Benzo(g,h,i)perylene	210	2100	0.03 U	0.048 U	0.023 U	0.018 U	0.0980 U	NA	0.03 U	0.048 U	0.048 U	0.023 U	0.018 U	0.0185 U	NA
Chrysene	4.8	480	0.01 U	0.095 U	0.023 U	0.049 J	0.0980 U	NA	0.01 U	0.095 U	0.095 U	0.023 U	0.092 U	0.0185 U	NA
Dibenzo(a,h)anthracene	0.005	0.05	0.02 U	0.048 U	0.0046 U	0.018 U	0.0980 U	NA	0.02 U	0.048 U	0.048 U	0.0046 U	0.018 U	0.0185 U	NA
Fluoranthene	280	2,800	0.04 J	0.24 U	0.046 U	0.23 U	0.0980 U	NA	0.01 U	0.24 U	0.24 U	0.046 U	0.23 U	0.0261 J	NA
Fluorene	280	2,800	0.1	0.48 U	0.3 U	0.15 J	0.114 J	NA	0.01 U	0.48 U	0.48 U	0.3 U	0.018 U	0.0185 U	NA
Indeno(1,2,3-cd)pyrene	0.05	5	0.02 U	0.048 U	0.43 J	0.018 U	0.0980 U	NA	0.02 U	0.048 U	0.048 U	0.023 U	0.018 U	0.0185 U	NA
Naphthalene	14	140	66 [G]	103 [G]	NA	60 [G]	79.6 [G]	17.1 [G]	0.11	0.24 U	0.24 U	NA	0.018 U	0.0185 U	0.0185 U
Phenanthrene	210	2100	0.11	0.24 U	0.28	0.26	0.140 J	NA	0.02 U	0.24 U	0.24 U	0.023 U	0.092 U	0.213 J	NA
Pyrene	210	2100	0.009 U	0.24 U	0.046 U	0.076 U	0.0980 U	NA	0.009 U	0.24 U	0.24 U	0.046 U	0.023 U	0.0250 J	NA
Petroleum Hydrocarbons (FL-PRO) (µg/L)															
TRPH	5000	50,000	2,520	2,580	3,700	2,650	2,020	1,400	42 U	160 U	160 U	160 U	235 U	157 U	78.7 U

Notes:
 µg/L = micrograms per Liter.
 U = Less than laboratory method detection limit.
 J = Estimated value.
 I = Reported value is between laboratory method detection limit and laboratory practical quantitation limit.
 GCTL = Groundwater Cleanup Target Level.
 NADC = Natural Attenuation Default Concentration.
 [G] indicates that the concentration exceeds the FDEP GCTLs.
 [N] indicates that the concentration exceeds the NADC.
Bolded values indicate detected concentrations.
 Shaded values indicate exceedances.
 NS = Not Sampled.
 NA = Not analyzed for that constituent.
 D = This sample was rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve.

Table 2: Summary of Detections in Groundwater

2nd Semi-Annual, 3rd Year - January 2011 Groundwater Sampling Event
 BP Wells Site
 Naval Air Station Cecil Field
 Jacksonville, Florida
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Constituent	FDEP GCTL	FDEP NADC	Monitoring Well											
			CEF-BP-5I						CEF-BP-6S					
			7/23/2008	1/26/2009	7/14/2009	1/18/2010	7/21/2010	1/18/2011	7/23/2008	1/26/2009	7/14/2009	8/17/2009	1/18/2010	7/21/2010
VOCs (USEPA Method 8260B) (µg/L)														
1,2,4-Trimethylbenzene	10	100	0.38 U	0.22 U	0.18 J	0.1 U	0.30 U	0.150 U	0.38 U	17.8 [G]	28 [G]	19 [G]	170 [G] [N]	332 [G] [N]
1,3,5-Trimethylbenzene	10	100	0.22 U	0.2 U	0.1 U	0.13 U	0.30 U	0.180 U	0.22 U	2.2	5.3	3.1	40 [G]	70.0 [G]
Benzene	1	10	0.23 U	0.40 U	0.12 U	0.11 U	0.30 U	0.140 U	0.23 U	0.40 U	0.12 U	0.10 U	0.11 U	0.60 U
Ethylbenzene	30	300	0.34 U	0.43 U	0.1 U	0.13 U	0.30 U	0.150 U	6.5	17.3	18	12	150 [G]	185 [G]
Isopropylbenzene	0.8	8	0.23 U	0.2 U	0.11 U	0.15 U	0.30 U	0.150 U	1.1 [G]	2 [G]	2.3 [G]	1.3 [G]	28 [G] [N]	15.3 [G] [N]
Toluene	40	400	0.28 U	0.35 U	0.14 U	0.1 U	0.30 U	0.190 U	0.28 U	0.35 U	0.16 J	0.10 U	1.5	3.22
Total Xylenes	20	200	0.38 U	1.2 U	0.21 U	0.22 U	0.30 U	0.220 U	0.53 J	10.9	22 [G]	10	200 [G]	251 [G] [N]
PAHs (USEPA Method 8270C SIM) (µg/L)														
1-Methylnaphthalene	28	280	0.01 U	0.24 U	0.3 U	0.032 J	0.0196 U	0.0197 I	0.31	0.99	1.3	2.1	7.4	9.63
2-Methylnaphthalene	28	280	0.3 J	0.24 U	0.3 U	0.043 U	0.0196 U	0.0266 I	0.28	1.3	1.6	3.1	7.1	16.8
Acenaphthene	20	200	0.02 U	0.48 U	0.3 U	0.027 J	0.0196 U	NA	0.02 U	0.48 U	0.3 U	0.32 U	0.083 J	0.108
Acenaphthylene	210	2100	0.01 U	0.48 U	0.023 U	0.02 J	0.0196 U	NA	0.01 U	0.48 U	0.023 U	0.24 U	0.018 U	0.02 U
Anthracene	2100	21000	0.02 U	0.48 U	0.046 U	0.03 J	0.0196 U	NA	0.02 U	0.48 U	0.046 U	NA	0.018 U	0.02 U
Benzo(a)anthracene	0.05	5	0.01 U	0.048 U	0.023 U	0.037 J	0.0196 U	NA	0.03 J	0.048 U	0.097	0.024 U	0.018 U	0.02 U
Benzo(a)pyrene	0.2	2	0.01 U	0.048 U	0.023 U	0.018 U	0.0196 U	NA	0.01 U	0.048 U	0.023 U	0.024 U	0.018 U	0.02 U
Benzo(b)fluoranthene	0.05	5	0.01 U	0.048 U	0.023 U	0.031 J	0.0196 U	NA	0.01 U	0.048 U	0.023 J	0.024 U	0.018 U	0.02 J
Benzo(k)fluoranthene	0.5	50	0.03 U	0.048 U	0.023 U	0.031 J	0.0196 U	NA	0.03 U	0.048 U	0.1	0.024 U	0.018 U	0.02 U
Benzo(g,h,i)perylene	210	2100	0.03 U	0.048 U	0.023 U	0.018 U	0.0196 U	NA	0.03 U	0.048 U	0.023 U	NA	0.018 U	0.02 U
Chrysene	4.8	480	0.01 U	0.095 U	0.023 U	0.037 J	0.0196 U	NA	0.01 U	0.095 U	0.023 U	0.024 U	0.018 U	0.02 U
Dibenzo(a,h)anthracene	0.005	0.05	0.02 U	0.048 U	0.0046 U	0.018 U	0.0196 U	NA	0.02 U	0.048 U	0.0046 U	0.019 U	0.018 U	0.02 U
Fluoranthene	280	2,800	0.01 U	0.24 U	0.046 U	0.23 U	0.0196 U	NA	0.01 U	0.24 U	0.1	0.048 U	0.23 U	0.0217 J
Fluorene	280	2,800	0.01 U	0.48 U	0.3 U	0.031 J	0.0196 U	NA	0.03 J	0.48 U	0.3 U	0.032 U	0.053 J	0.111
Indeno(1,2,3-cd)pyrene	0.05	5	0.02 U	0.048 U	0.023 U	0.018 U	0.0196 U	NA	0.02 U	0.048 U	0.023 U	0.027 J	0.018 U	0.02 U
Naphthalene	14	140	0.04 J	0.24 U	NA	0.043 J	0.0330 J	0.0695 I	0.97	3.5	NA	7	29 [G]	36.2 [G]
Phenanthrene	210	2100	0.02 U	0.24 U	0.023 U	0.044 U	0.0241 J	NA	0.02 U	0.24 U	0.026 J	0.068 J	0.028 U	0.0437 J
Pyrene	210	2100	0.009 U	0.24 U	0.046 U	0.044 U	0.0218 J	NA	0.009 U	0.24 U	0.046 U	NA	0.018 U	0.024 J
Petroleum Hydrocarbons (FL-PRO) (µg/L)														
TRPH	5000	50,000	42 U	160 U	160 U	235 U	189 U	78.7 U	106 J	428	180 J	NA	1300	1530

Notes:
 µg/L = micrograms per Liter.
 U = Less than laboratory method detection limit.
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 I = Reported value is between laboratory method detection limit and laboratory practical quantitation limit.
 GCTL = Groundwater Cleanup Target Level.
 NADC = Natural Attenuation Default Concentration.
 [G] indicates that the concentration exceeds the FDEP GCTLs.
 [N] indicates that the concentration exceeds the NADC.
Bolded values indicate detected concentrations.
 Shaded values indicate exceedances.
 NS = Not Sampled.
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 Naval Air Station Cecil Field
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Constituent	FDEP GCTL	FDEP NADC	Monitoring Well										
			CEF-BP-6S cont		CEF-BP-7S			CEF-BP-8S			CEF-BP-9S		
			1/18/2011	1/18/2011	7/15/2009	1/19/2010		7/21/2010	7/15/2009	1/18/2010	7/21/2010	7/15/2009	
			Sample	Duplicate		Sample	Duplicate					Sample	Duplicate
VOCs (USEPA Method 8260B) (µg/L)													
1,2,4-Trimethylbenzene	10	100	162 [G] [N]	196 [G] [N]	0.1 U	0.14 U	0.14 U	0.30 U	0.1 U	0.38 J	0.30 U	0.1 U	0.1 U
1,3,5-Trimethylbenzene	10	100	41.8 [G]	44.4 [G]	0.13 U	0.1 U	0.1 U	0.30 U	0.13 U	0.13 U	0.30 U	0.13 U	0.13 U
Benzene	1	10	0.140 U	0.280 U	0.11 U	0.12 U	0.12 U	0.30 U	0.11 U	0.11 U	0.30 U	0.11 U	0.11 U
Ethylbenzene	30	300	113 [G]	151 [G]	0.13 U	0.1 U	0.1 U	0.30 U	0.13 U	0.23 J	0.30 U	0.13 U	0.13 U
Isopropylbenzene	0.8	8	13.9 [G] [N]	15.0 [G] [N]	0.15 U	0.11 U	0.11 U	0.30 U	0.15 U	0.15 U	0.30 U	0.15 U	0.15 U
Toluene	40	400	1.38	1.57 I	0.1 U	0.14 U	0.14 U	0.30 U	0.1 U	0.1 U	0.30 U	0.1 U	0.1 U
Total Xylenes	20	200	247 [G] [N]	253 [G] [N]	0.22 U	0.21 U	0.21 U	0.30 U	0.22 U	0.25 J	0.30 U	0.22 U	0.22 U
PAHs (USEPA Method 8270C SIM) (µg/L)													
1-Methylnaphthalene	28	280	5.22	6.15	0.3 U	0.03 J	0.018 U	0.0185 U	0.3 U	0.018 U	0.02 U	0.3 U	0.3 U
2-Methylnaphthalene	28	280	8.98	9.89	0.3 U	0.035 J	0.018 U	0.0185 U	0.3 U	0.018 U	0.02 U	0.3 U	0.3 U
Acenaphthene	20	200	NA	NA	0.3 U	0.018 U	0.018 U	0.0185 U	0.3 U	0.018 U	0.02 U	0.3 U	0.3 U
Acenaphthylene	210	2100	NA	NA	0.039 J	0.018 U	0.018 U	0.0185 U	0.023 U	0.018 U	0.02 U	0.023 U	0.023 U
Anthracene	2100	21000	NA	NA	0.046 U	0.026 J	0.018 U	0.0185 U	0.046 U	0.018 U	0.02 U	0.046 U	0.046 U
Benzo(a)anthracene	0.05	5	NA	NA	0.16 [G]	0.092 U	0.018 U	0.0185 U	0.023 U	0.022 J	0.02 U	0.097 [G]	0.098 [G]
Benzo(a)pyrene	0.2	2	NA	NA	0.058 J	0.018 U	0.018 U	0.0185 U	0.023 U	0.018 U	0.02 U	0.023 U	0.023 U
Benzo(b)flouranthene	0.05	5	NA	NA	0.086 J [G]	0.018 U	0.018 U	0.0185 U	0.023 U	0.019 J	0.02 U	0.025 J	0.027 J
Benzo(k)flouranthene	0.5	50	NA	NA	0.14	0.018 U	0.018 U	0.0185 U	0.1	0.02 J	0.02 U	0.11	0.11
Benzo(g,h,i)perylene	210	2100	NA	NA	0.023 U	0.018 U	0.018 U	0.0185 U	0.023 U	0.018 U	0.02 U	0.023 U	0.023 U
Chrysene	4.8	480	NA	NA	0.053 J	0.092 U	0.018 U	0.0185 U	0.023 U	0.023 J	0.02 U	0.023 U	0.023 U
Dibenzo(a,h)anthracene	0.005	0.05	NA	NA	0.19 [G]	0.018 U	0.018 U	0.0185 U	0.0046 U	0.018 U	0.02 U	0.0046 U	0.17 [G]
Fluoranthene	280	2,800	NA	NA	0.046 U	0.23 U	0.018 U	0.0185 U	0.046 U	0.23 U	0.02 U	0.046 U	0.046 U
Fluorene	280	2,800	NA	NA	0.3 U	0.018 U	0.018 U	0.0185 U	0.3 U	0.018 U	0.02 U	0.3 U	0.3 U
Indeno(1,2,3-cd)pyrene	0.05	5	NA	NA	0.35 [G]	0.018 U	0.018 U	0.0185 U	0.23 U	0.018 U	0.02 U	0.023 UJ	0.32 J [G]
Naphthalene	14	140	18.1 [G]	20.2 [G]	NA	0.028 J	0.018 U	0.0185 U	NA	0.026 J	0.02 U	NA	NA
Phenanthrene	210	2100	NA	NA	0.023 U	0.092 U	0.018 U	0.0185 U	0.23 U	0.026 U	0.0278 J	0.23 U	0.23 U
Pyrene	210	2100	NA	NA	0.046 U	0.23 U	0.23 U	0.0185 U	0.046 U	0.026 U	0.0213 J	0.046 U	0.046 U
Petroleum Hydrocarbons (FL-PRO) (µg/L)													
TRPH	5000	50,000	2360	2490	160 U	235 U	235 U	157 U	235 U	235 U	167 U	160 U	160 U

Notes:
 µg/L = micrograms per Liter.
 U = Less than laboratory method detection limit.
 J = Estimated value.
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 GCTL = Groundwater Cleanup Target Level.
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 [G] indicates that the concentration exceeds the FDEP GCTLs.
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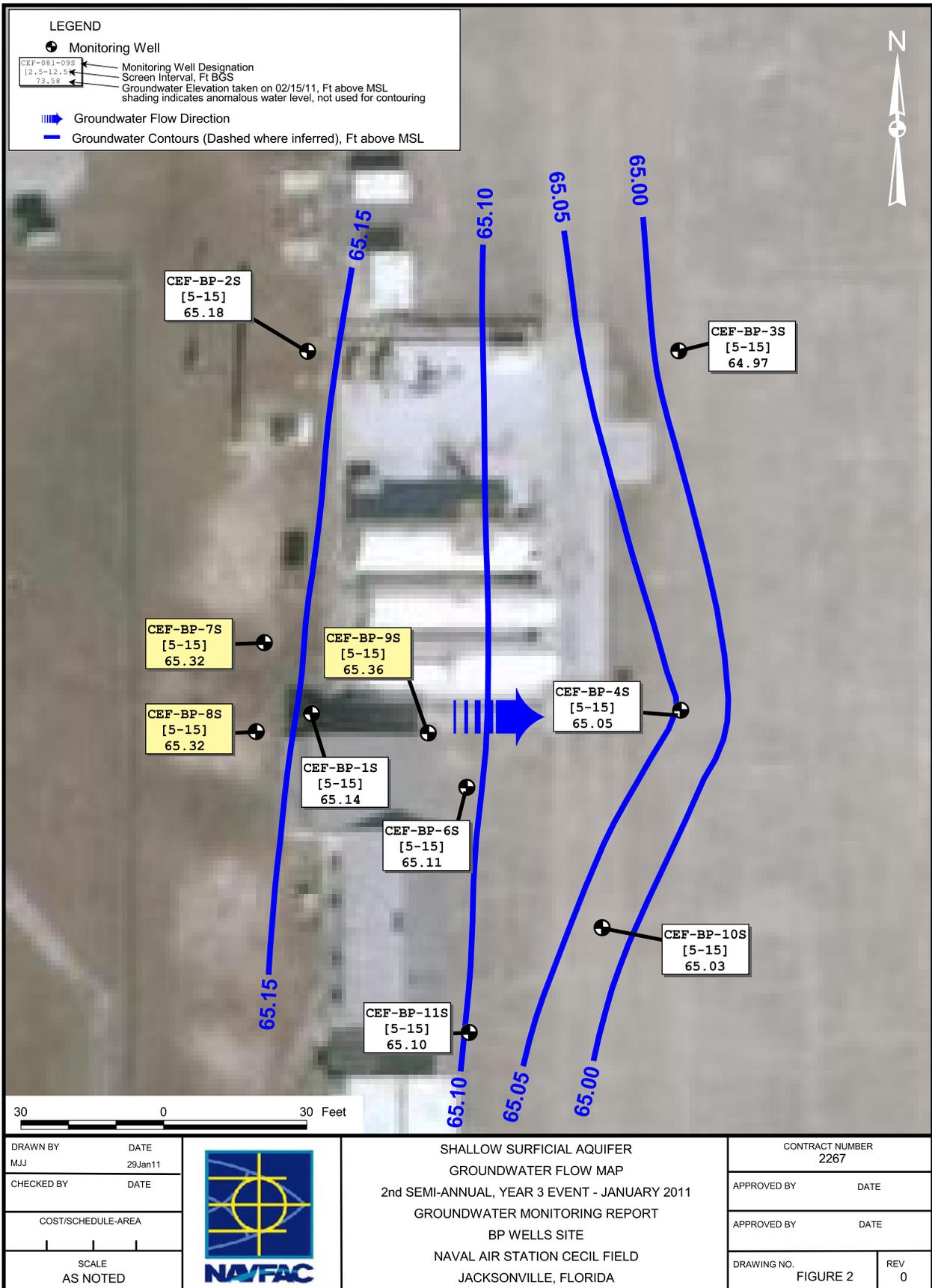
Constituent	FDEP GCTL	FDEP NADC	Monitoring Well							
			CEF-BP-9S			CEF-BP-10S		CEF-BP-11S		
			1/19/2010	7/21/2010	1/18/2011	7/21/2010	1/18/2011	7/21/2010		1/18/2011
								Sample	Duplicate	
VOCs (USEPA Method 8260B) (µg/L)										
1,2,4-Trimethylbenzene	10	100	0.14 U	0.30 U	0.717 I	0.30 U	0.150 U	0.30 U	0.386 J	0.150 U
1,3,5-Trimethylbenzene	10	100	0.1 U	0.30 U	0.180 U	0.309 J	0.180 U	0.30 U	0.30 U	0.180 U
Benzene	1	10	0.12 U	0.30 U	0.140 U	0.30 U	0.140 U	0.30 U	0.30 U	0.140 U
Ethylbenzene	30	300	0.1 U	0.30 U	0.279 I	1.42	0.150 U	0.30 U	0.30 U	0.150 U
Isopropylbenzene	0.8	8	0.11 U	0.30 U	0.150 U	0.424 J	0.150 U	0.30 U	0.30 U	0.150 U
Toluene	40	400	0.14 U	0.30 U	0.190 U	0.30 U	0.190 U	0.30 U	0.30 U	0.190 U
Total Xylenes	20	200	0.21 U	0.30 U	0.725 I	0.30 U	0.220 U	0.30 U	0.30 U	0.220 U
PAHs (USEPA Method 8270C SIM) (µg/L)										
1-Methylnaphthalene	28	280	0.035 J	0.0185 U	0.0185 U	0.39	0.0185 U	0.0185 U	0.0332 J	0.0185 U
2-Methylnaphthalene	28	280	0.038 J	0.0185 U	0.0185 U	0.336	0.0185 U	0.0185 U	0.0351 J	0.0185 U
Acenaphthene	20	200	0.05 J	0.0185 U	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Acenaphthylene	210	2100	0.042 J	0.0185 U	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Anthracene	2100	21000	0.057 J	0.0369 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Benzo(a)anthracene	0.05	5	0.092 U	0.0664 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Benzo(a)pyrene	0.2	2	0.092 U	0.0256 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Benzo(b)fluoranthene	0.05	5	0.092 U	0.0358 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Benzo(k)fluoranthene	0.5	50	0.092 U	0.0346 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Benzo(g,h,i)perylene	210	2100	0.018 U	0.0406 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Chrysene	4.8	480	0.092 U	0.0679 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Dibenzo(a,h)anthracene	0.005	0.05	0.018 U	0.0448 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Fluoranthene	280	2,800	0.23 U	0.0636 J	NA	0.0345 J	NA	0.0185 U	0.0345 J	NA
Fluorene	280	2,800	0.056 J	0.0287 J	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Indeno(1,2,3-cd)pyrene	0.05	5	0.018 U	0.0185 U	NA	0.0200 U	NA	0.0185 U	0.0187 U	NA
Naphthalene	14	140	0.034 J	0.0185 U	0.0260 I	0.903	0.0185 U	0.0185 U	0.0308 J	0.0185 U
Phenanthrene	210	2100	0.092 U	0.0518 J	NA	0.0417 J	NA	0.0185 U	0.0471 J	NA
Pyrene	210	2100	0.23 U	0.0631 J	NA	0.0290 J	NA	0.0185 U	0.0328 J	NA
Petroleum Hydrocarbons (FL-PRO) (µg/L)										
TRPH	5000	50,000	235 U	157 U	79.1 U	170 U	250 I	157 U	157 U	78.7 U

Notes:
 µg/L = micrograms per Liter.
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FIGURES

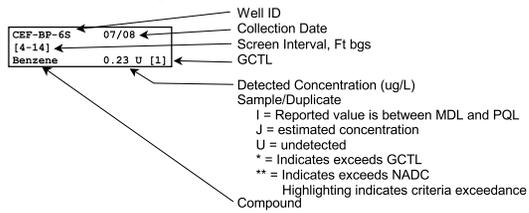


DATE 09Apr10		MONITORING WELL LOCATION MAP 2nd SEMI-ANNUAL, YEAR 3 EVENT - JANUARY 2011 GROUNDWATER MONITORING REPORT BP WELLS SITE NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA		DRAWN BY	CONTRACT NUMBER 2267
CHECKED BY		DATE	APPROVED BY	DATE	
COST/SCHEDULE-AREA		APPROVED BY	DATE		
SCALE AS NOTED		DRAWING NO. FIGURE 1	REV 0		



Legend

Monitoring Well



Well ID	07/08	01/09	07/09	01/10	07/10	01/11
CEF-BP-1S [5-15]						
Benzene	2.3 U	2 U	1.2 U	0.55 U	0.60 U	0.140 U [1]
Toluene	2.8 U	1.9 J	1.4 U	0.67 J	0.628 J	0.190 U [40]
Ethylbenzene	200*	304**	220*	170*	196*	47.5* [30]
Total Xylenes	670**	705**	770**	520**	552**	120* [20]
Isopropyl benzene	20**	28.1**	19**	16**	15.1**	6.37* [0.8]
1,2,4-Trimethylbenzene	440**	664**	480**	450**	379**	77.5* [10]
1,3,5-Trimethylbenzene	140**	212**	150**	140**	117**	49.7* [10]

Well ID	07/08	01/09	07/09	01/10	07/10	01/11
CEF-BP-5I [30-35]						
Benzene	0.23 U	0.4 U	0.12 U	0.11 U	0.30 U	0.140 U [1]
Toluene	0.28 U	0.35 U	0.14 U	0.10 U	0.30 U	0.190 U [40]
Ethylbenzene	0.34 U	0.43 U	0.10 U	0.13 U	0.30 U	0.150 U [30]
Total Xylenes	0.38 U	1.2 U	0.21 U	0.22 U	0.30 U	0.220 U [20]
Isopropyl benzene	0.23 U	0.2 U	0.11 U	0.15 U	0.30 U	0.150 U [0.8]
1,2,4-Trimethylbenzene	0.38 U	0.22 U	0.18 J	0.10 U	0.30 U	0.150 U [10]
1,3,5-Trimethylbenzene	0.22 U	0.2 U	0.10 U	0.13 U	0.30 U	0.180 U [10]

Well ID	07/09	01/10	07/10	01/11
CEF-BP-9S [5-15]				
Benzene	0.11 U	0.12 U	0.30 U	0.140 U [1]
Toluene	0.10 U	0.14 U	0.30 U	0.190 U [40]
Ethylbenzene	0.13 U	0.10 U	0.30 U	0.279 I [30]
Total Xylenes	0.22 U	0.21 U	0.30 U	0.725 I [20]
Isopropyl benzene	0.15 U	0.11 U	0.30 U	0.150 U [0.8]
1,2,4-Trimethylbenzene	0.10 U	0.14 U	0.30 U	0.717 I [10]
1,3,5-Trimethylbenzene	0.13 U	0.10 U	0.30 U	0.180 U [10]

Well ID	07/08	01/09	07/09	01/10	07/10	01/11
CEF-BP-4S [5-15]						
Benzene	0.23 U	0.4 U	0.12 U	0.12 U	0.30 U	0.140 U [1]
Toluene	0.28 U	0.35 U	0.14 U	0.14 U	0.30 U	0.190 U [40]
Ethylbenzene	0.34 U	0.43 U	0.10 U	0.10 U	0.30 U	0.150 U [30]
Total Xylenes	0.38 U	1.2 U	0.21 U	0.21 U	0.30 U	0.220 U [20]
Isopropyl benzene	0.23 U	0.2 U	0.11 U	0.11 U	0.30 U	0.150 U [0.8]
1,2,4-Trimethylbenzene	0.38 U	0.22 U	0.14 U	0.14 U	0.30 U	0.150 U [10]
1,3,5-Trimethylbenzene	0.22 U	0.2 U	0.10 U	0.10 U	0.30 U	0.180 U [10]

Well ID	07/09	01/10	07/10	01/11
CEF-BP-7S [5-15]	Less than GCTLs			Not Sampled

Well ID	07/09	01/10	07/10	01/11
CEF-BP-8S [5-15]	Less than GCTLs			Not Sampled

Well ID	07/10	01/11
CEF-BP-11S [5-15]		
Benzene	0.30 U	0.140 U [1]
Toluene	0.30 U	0.190 U [40]
Ethylbenzene	0.30 U	0.150 U [30]
Total Xylenes	0.30 U	0.220 U [20]
Isopropyl benzene	0.30 U	0.150 U [0.8]
1,2,4-Trimethylbenzene	0.30 U	0.150 U [10]
1,3,5-Trimethylbenzene	0.30 U	0.180 U [10]

Well ID	07/08	01/09	07/09	08/09	01/10	07/10	01/11
CEF-BP-6S [4-14]							
Benzene	0.23 U	0.4 U	0.12 U	0.10 U	0.11 U	0.60 U	0.140 U/0.280 U [1]
Toluene	0.28 U	0.35 U	0.16 J	0.10 U	1.5	3.22	1.38/1.57 I [40]
Ethylbenzene	6.5	17.3	18	12	150*	185*	113*/151* [30]
Total Xylenes	0.53 J	10.9	22*	10	200**	251**	247**/253** [20]
Isopropyl benzene	1.1*	2 *	2.3*	1.3*	28**	15.3**	13.9**/15.0** [0.8]
1,2,4-Trimethylbenzene	0.38 U	17.8*	28*	19*	170**	332**	162**/196** [10]
1,3,5-Trimethylbenzene	0.22 U	2.2	5.3	3.1	40*	70*	41.8*/44.4* [10]

Well ID	07/10	01/11
CEF-BP-10S [5-15]		
Benzene	0.30 U	0.140 U [1]
Toluene	0.30 U	0.190 U [40]
Ethylbenzene	1.42	0.150 U [30]
Total Xylenes	0.30 U	0.220 U [20]
Isopropyl benzene	0.424 J	0.150 U [0.8]
1,2,4-Trimethylbenzene	0.30 U	0.150 U [10]
1,3,5-Trimethylbenzene	0.309 U	0.180 U [10]

VOC Plume



DATE	MJJ	30Jan10
CHECKED BY		
COST/SCHEDULE-AREA		
SCALE	AS NOTED	



VOC ANALYTICAL RESULTS - GROUNDWATER
 2nd SEMI-ANNUAL, YEAR 3 EVENT - JANUARY 2011
 GROUNDWATER MONITORING REPORT
 BP WELLS SITE
 NAVAL AIR STATION CECIL FIELD
 JACKSONVILLE, FLORIDA

DRAWN BY	CONTRACT NUMBER 2267	
APPROVED BY		DATE
APPROVED BY		DATE
DRAWING NO.	FIGURE 3	REV 0

:\GIS\NAS_CecilField\bp-g82_20110127.apr 29Mar11 MJJ Layout04a

Legend

Monitoring Well

Well ID
Collection Date
Screen Interval, Ft bgs
GCTL
Detected Concentration (ug/L)
Sample/Duplicate

I = Reported value is between MDL and PQL
J = estimated concentration
U = undetected
* = Indicates exceeds GCTL
** = Indicates exceeds NADC
Highlighting indicates criteria exceedance
Compound

CEF-BP-1S [5-15]	07/08	01/09	07/09	01/10	07/10	01/11
1-Methylnaphthalene	7.3	16.4	12	9.9	11.1	2.61 [28]
2-Methylnaphthalene	17	31.3*	22	20	18.1	5.86 [28]
Benzo (a) anthracene	0.01 U	0.048 U	0.023 U	0.048 J	0.098 U	NA [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 U	0.039 J	0.098 U	NA [0.05]
Dibenzo (a, h) anthracene	0.02 U	0.048 U	0.0046 U	0.018 U	0.098 U	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.02 U	0.048 U	0.43 J	0.018 U	0.098 U	NA [0.05]
Naphthalene	110*	183**	160**	60*	79.6*	17.1* [14]

CEF-BP-5I [30-35]	07/08	01/09	07/09	01/10	07/10	01/11
1-Methylnaphthalene	0.1 U	0.24 U	0.3 U	0.032 U	0.0196 U	0.197 I [28]
2-Methylnaphthalene	0.3 J	0.24 U	0.3 U	0.043 J	0.0196 U	0.266 I [28]
Benzo (a) anthracene	0.01 U	0.048 U	0.023 U	0.037 J	0.0196 U	NA [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 U	0.031 J	0.0196 U	NA [0.05]
Dibenzo (a, h) anthracene	0.02 U	0.048 U	0.0046 U	0.018 U	0.0196 U	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.02 U	0.048 U	0.023 U	0.018 U	0.0196 U	NA [0.05]
Naphthalene	0.35 U	1 U	0.42 J	0.043 J	0.0330 J	0.0695 I [14]

CEF-BP-9S [5-15]	07/09	01/10	07/10	01/11
1-Methylnaphthalene	0.3 U	0.035 J	0.0185 U	0.0185 U [28]
2-Methylnaphthalene	0.3 U	0.038 J	0.0185 U	0.0185 U [28]
Benzo (a) anthracene	0.098 *	0.092 U	0.0664 J	NA [0.05]
Benzo (b) flouranthene	0.027 J	0.092 U	0.0358 J	NA [0.05]
Dibenzo (a, h) anthracene	0.17 *	0.018 U	0.0448 J	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.32 J *	0.018 U	0.0185 U	NA [0.05]
Naphthalene	0.12 U	0.034 J	0.0185 U	0.0260 I [14]

CEF-BP-4S [5-15]	07/08	01/09	07/09	01/10	07/10	01/11
1-Methylnaphthalene	0.01 U	0.24 U	0.3 U	0.018 U	0.0185 U	0.0185 U [28]
2-Methylnaphthalene	0.02 U	0.24 U	0.3 U	0.018 U	0.0185 U	0.0185 U [28]
Benzo (a) anthracene	0.01 U	0.048 U	0.023 U	0.092 U	0.0185 U	NA [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 U	0.092 U	0.0185 U	NA [0.05]
Dibenzo (a, h) anthracene	0.02 U	0.048 U	0.0046 U	0.018 U	0.0185 U	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.02 U	0.048 U	0.023 U	0.018 U	0.0185 U	NA [0.05]
Naphthalene	0.35 U	1 U	NA	0.018 U	0.0185 U	0.0185 U [14]

CEF-BP-7S [5-15]	01/10	07/10	01/11
	Less than GCTLs	Not Sampled	

CEF-BP-8S [5-15]	01/10	07/10	01/11
	Less than GCTLs	Not Sampled	

CEF-BP-11S [5-15]	07/10	01/11
1-Methylnaphthalene	0.0185 U	0.0185 U [28]
2-Methylnaphthalene	0.0185 U	0.0185 U [28]
Benzo (a) anthracene	0.0185 U	NA [0.05]
Benzo (b) flouranthene	0.0185 U	NA [0.05]
Dibenzo (a, h) anthracene	0.0185 U	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.0185 U	NA [0.05]
Naphthalene	0.0185 U	0.0185 U [14]

CEF-BP-6S [4-14]	07/08	01/09	07/09	08/09	01/10	07/10	01/11
1-Methylnaphthalene	0.31	0.99	1.3	2.1	7.4	9.63	5.22/6.15 [28]
2-Methylnaphthalene	0.28	1.3	1.6	3.1	7.1	16.8	8.98/9.89 [28]
Benzo (a) anthracene	0.03 J	0.048 U	0.097	0.024 U	0.018 U	0.02 U	NA [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 J	0.024 U	0.018 U	0.02 J	NA [0.05]
Dibenzo (a, h) anthracene	0.02 U	0.048 U	0.0046 U	0.019 U	0.018 U	0.02 U	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.02 U	0.048 U	0.023 U	0.027 J	0.018 U	0.02 U	NA [0.05]
Naphthalene	0.91 J	8.3	11	9.8	29*	36.2*	18.1*/20.2* [14]

CEF-BP-10S [5-15]	07/10	01/11
1-Methylnaphthalene	0.390	0.0185 U [28]
2-Methylnaphthalene	0.336	0.0185 U [28]
Benzo (a) anthracene	0.020 U	NA [0.05]
Benzo (b) flouranthene	0.020 U	NA [0.05]
Dibenzo (a, h) anthracene	0.020 U	NA [0.005]
Indeno (1, 2, 3-cd) pyrene	0.020 U	NA [0.05]
Naphthalene	0.903	0.0185 U [14]

Naphthalene Plume



DATE	30Jan10
CHECKED BY	
COST/SCHEDULE-AREA	
SCALE	AS NOTED



PAH ANALYTICAL RESULTS - GROUNDWATER
2nd SEMI-ANNUAL, YEAR 3 EVENT - JANUARY 2011
GROUNDWATER MONITORING REPORT
BP WELLS SITE
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

DRAWN BY	CONTRACT NUMBER
	2267
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	FIGURE 4
REV	0

ATTACHMENT A

SELECT WORKSHEETS FROM THE UFP-SAP **FOR PETROLEUM**
SITES: North-South Apron Plume, Building 82, Tank G82, BP Wells, and 815 Wash Rack

FTMR NO. 01 - FULL VERSION INCLUDED IN ELECTRONIC COPY

AND FTMR NO. 02

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP
Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites
Revision: 2
April 2010

11C BP WELLS

11C.1 PROBLEM DEFINITION

The COCs exceeded their action levels (GCTLs and NADCs) in groundwater. Contaminant concentrations appear to be increasing and migrating downgradient. The current downgradient well (CEF-BP-6S) exceeded the GCTL from July 2008 to July 2009 and has not shown GCTL exceedances prior to July 2008. Natural attenuation was the selected remedy for the site, so groundwater monitoring is required to determine whether natural attenuation is occurring at the site or other actions should be taken.

11C.2 INFORMATION INPUTS

Requirements for groundwater sampling and analysis methods are described below. Additional detail (e.g., the exact methods and SOPs to be used) is provided in [Worksheet #s 15, 19, and 21](#).

Required Analyses

COC	USEPA Method	GCTL (µg/L)	NADC (µg/L)
Ethylbenzene	8260	30	300
2-Methylnaphthalene	8270	28	280
Isopropyl benzene (LOQ = 1.0 µg/L)	8260	0.8	8
Naphthalene	8270	14	140
1,2,4-TMB	8260	10	100
1,3,5-TMB	8260	10	100
Total xylenes	8260	20	200
TRPH	FDEP FLPRO	5000	50000

Analytical Methods

Analytical methods were selected to be the same as those used previously or at least comparable to previously used analytical methods with respect to PARCCS parameters. See [Worksheets Nos. 20 and 23](#) for a list of the analytical methods applicable to each site.

Sampling Methods

Sampling methods were selected to be the same as those used previously or to at least be consistent with the representativeness and comparability of data for each media being sampled at each site. See [Worksheet No. 21](#) for a list of sampling methods.

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites

Revision: 2
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Action Levels

The groundwater data will be screened against the FDEP GCTLs and NADCs. A full list of PALs which, in this case are the lower of the NADC and GCTL for each parameter, is included within [Worksheet 15](#). The BCT has ensured that the selected laboratory LOQs are generally low enough to measure constituent concentrations in site media that are less than the PALs in order to conduct comparisons of site data to the PALs. Results of a magnitude between the LOQ and MDL will be “J” flagged to indicate than the reported results are less precise than results that are greater than the LOQ. The BCT will accept these analytic results as usable (without additional qualification) unless quality evaluations indicate that the data quality has been compromised. If, for any analyte in any site medium, the PAL is less than the laboratory MDL, (as with isopropylbenzene) the BCT accepts the laboratory LOQ as the PAL for decision making purposes, as is suggested in “Guidance for the Selection of Analytical Methods for the Evaluation of Practical Quantitation Limits” (FDEP, 2004).

11C.3 STUDY BOUNDARIES

The BP Wells area covers approximately 9,375 ft² surrounding Building 82. The area is delineated from the northwest corner by CEF-BP-2S to the southeast corner by CEF-BP-6S and CEF-BP-4S, as shown on [Figure 10C-1](#). The vertical boundary for the groundwater contaminant plume is the water table. The contaminated groundwater is the population of interest and constitutes the spatial decision unit. The temporal decision unit is each round of monitoring when determined whether an exceedance of GTCTL has occurred and it is two consecutive monitoring rounds when determining whether parameters or wells may be eliminated from monitoring.

11C.4 ANALYTIC APPROACH

A direct comparison of measured concentrations within the groundwater will be made against the appropriate PAL. PALs are detailed for each COC in [Worksheet No. 15](#). Additionally, if none of the measured COC concentrations within any groundwater sample exceed criteria after two consecutive rounds of monitoring, then the monitoring program will be discontinued after coordination with the BCT. The following decision rules govern data use for the monitoring programs at BP Wells.

Decision Rule #1: If any measured source well groundwater COC concentration in any sample is greater than its GCTL, then continue long-term monitoring until measured COC concentrations are less than their GCTL for two consecutive sampling rounds.

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites

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Decision Rule #2: If any measured COC concentration in any sample is greater than its GCTL in the compliance well, then conduct additional delineation of contamination in groundwater. An FTMR would be issued to govern the delineation.

Decision Rule #3: If the measured COC concentration exceeds the GCTL in any sample but no migration is detected outside of the compliance wells for four consecutive quarters, then a permanent groundwater restriction will be evaluated for RMO III (62-780.680, F.A.C.). This will indicate that contamination exists and the contaminated area is defined. RMO III will put a restriction on the use of the groundwater, but allow it to remain onsite.

Decision Rule #4: If all measured COC concentrations in all groundwater samples are less than action levels for two consecutive quarters in all wells within the BP Wells area, then recommend NFA.

Decision Rule #5: If measured COC concentrations are between GCTLs and NADCs in the source wells, then a Monitored Natural Attenuation Plan will be developed by Tetra Tech once it is deemed necessary by the BCT Team.

Decision Rule #6: Throughout the groundwater monitoring, if any particular measured COC concentration is less its than GCTL for two consecutive sampling rounds or all measured COC concentrations in any particular well are less than GCTLs for at least two consecutive sampling rounds, then the BCT will discuss the elimination of the well or COC from the monitoring program, in accordance with the Navy guidance on groundwater monitoring well optimization. The well (or COC) will be eliminated unless the well is a compliance well, or the BCT determines that the inclusion of the well (or COC) provides useful information on evaluating the overall program and should not be removed.

11C.5 PERFORMANCE CRITERIA

Refer to Section 11A.5.

11C.6 PLAN FOR OBTAINING DATA

The plans for obtaining data at the BP Wells site are described in detail on [Worksheet #17](#) along with the sampling designs and rationales.

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites

Revision: 2
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[SAP Worksheet #14 -- Summary of Project Tasks](#) ([UFP-QAPP Manual Section 2.8.1](#))

Long-term monitoring at the petroleum sites includes the following tasks:

- Mobilization/Demobilization
- Site-Specific Health and Safety Training
- Monitoring Equipment Calibration
- Groundwater Sampling
- Water Level Measurements
- Investigation-Derived Waste (IDW) Management
- Field Decontamination Procedures

Mobilization/Demobilization

Mobilization shall consist of the delivery of all equipment, materials, and supplies to the site; the complete assembly in satisfactory working order of all such equipment at the site; and the satisfactory storage of all such materials and supplies at the site. Tetra Tech will coordinate with the Base to identify locations for the storage of equipment and supplies. Site-specific Health and Safety Training to all Tetra Tech subcontractors will be provided as part of the site mobilization.

Demobilization shall consist of the prompt and timely removal of all equipment, materials, and supplies from the site following completion of the work. Demobilization includes the cleanup and removal of IDW generated during the conduct of the investigation.

Site-Specific Health and Safety Training

Site-specific health and safety training to all Tetra Tech field staff and subcontractors will be provided as part of the site mobilization and is also addressed in [Worksheet #8](#). A photoionization detector (PID) will be used as field instrumentation for health and safety reasons.

Monitoring Equipment Calibration

These procedures are described in [Worksheet #22](#).

Water Level Measurements

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites

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One synoptic round of water-level measurements will be conducted at the site as part of each groundwater sampling event to provide information regarding groundwater flow patterns and gradients. Water-level measurements will be completed within the shortest time possible on the same day, and no sooner than 24 hours after a significant precipitation event to minimize the precipitation effects on the data sets. Water level measurements will be recorded to the nearest 0.01 foot and referenced to a top of casing notch or, if a notch is absent, to the north side of the top of the well casing. The measurement instrument will be decontaminated prior to conducting the measurement event and between each monitoring well.

Groundwater Sampling

Groundwater samples will be collected using low-flow purging techniques (discharge rate of less than 1 liter per minute) with a peristaltic pump using Teflon™ tubing dedicated to each well. When a well is developed for sampling, a water quality meter will be used to monitor pH, ORP, dissolved oxygen, turbidity, and conductivity. All groundwater samples will be collected using the procedures specified in FS 2200, Groundwater Sampling. [Worksheet #s 17 and 18](#) specify the groundwater sample locations and analytes for this investigation [Worksheet #23](#) specifies the analytical methods to be used.

Prior to groundwater sample collection, the monitoring wells will be purged. Both purging and sampling operations will be conducted at a flow rate that results in a groundwater turbidity measurement of 20 Nephelometric turbidity units (NTUs) or less (inherent turbidity will be minimized to the greatest extent possible using low flow techniques; individual well conditions and local geology may preclude meeting the 20 NTU criteria).

The sample aliquot for VOC analysis will be collected last by slowly pulling the Teflon™ tubing out of the well to minimize agitation of the water in the monitoring well and then transferring the contents of the tubing to a VOC vial. After collection, the samples will be placed in a cooler, chilled with ice, and shipped under chain of custody protocol to the off-site laboratory for analysis.

IDW Management

IDW generated during the activities will be managed in accordance with the NAS Cecil Field IDW Plan and will be conducted in an environmentally responsible manner consistent with NAS Cecil Field requirements (e.g. designation of staging areas). The objectives of the IDW management are:

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites

Revision: 2
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- Management of IDW in a manner that prevents contamination of uncontaminated areas (by IDW) and that is protective of human health and the environment.
- Minimization of IDW, thereby reducing costs and the potential for human or ecological exposure to contaminated materials.
- Compliance with federal and state requirements that are Applicable or Relevant and Appropriate Requirements.
- Used personal protective equipment, such as gloves, will be bagged and disposed of as regular trash in an appropriate facility waste container.

Field Decontamination Procedure

Decontamination of major equipment and sampling equipment will be in general accordance with FDEP SOP FC 1000, Cleaning / Decontamination Procedures.

Field Documentation Procedures

Pre-preserved, certified-clean bottleware will be supplied by the subcontracted laboratory. Matrix-specific sample logsheets will be maintained for each sample collected. In addition, sample collection information will be recorded in bound field notebooks or specific field forms. Samples will be packaged and shipped according to FDEP SOP FS 1000, General Sampling Procedures.

Field documentation will be performed in accordance with Tetra Tech SOP SA-6.3. A summary of all field activities will be properly recorded in a bound logbook with consecutively number pages that cannot be removed. Logbooks will be assigned to field personnel and will be stored in a secured area when not in use. Field documentation forms and SOPs can be found in [Appendix A](#).

At a minimum, the following information will be recorded in the site logbook:

- Name of the person to whom the logbook is assigned.
- Project name.
- Project start date.
- Names and responsibilities of on-site project personnel including subcontractor personnel.
- Arrival/departure of site visitors.

Attachment A – BP Wells

The following was extracted from the UFP-SAP for BP Wells for information purposes and it not the complete approved document.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long-Term Monitoring SAP for Petroleum Sites

Revision: 2
April 2010

- Arrival/departure of equipment.
- Sampling activities and sample log sheet references.
- Description of subcontractor activities.
- Sample pick-up information, including chain of custody numbers, air bill numbers, carrier, time, and date.
- Description of borehole or monitoring well installation activities and operations.
- Health and safety issues.
- Description of photographs including date, time, photographer, roll and picture number, location, and compass direction of photograph.

All entries will be written in ink and no erasures will be made. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; the person making the correction will initial and date the change.

Long-term Monitoring Reports

Long-term monitoring reports will be issued following each sampling event. The reports will include appropriate sections concerning site background, investigation activities, physical characteristics, nature and extent of contamination, and conclusions and recommendations.

Each long-term monitoring report will be issued in draft to BRAC PMO SE for initial review. BRAC PMO SE comments will be addressed, and the draft final report will be issued for regulatory review.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
 Site Location: Jacksonville, Florida

Long Term Monitoring SAP for Petroleum Sites

Revision: 2
 April 2010

SAP Worksheet #15C -- Reference Limits for Groundwater – BP Wells

Matrix: Groundwater
 Analytical Group: VOCs

Analyte	CAS Number	PAL ⁽¹⁾ (µg/L)	PAL Reference	Project QL Goal (µg/L)	Empirical ⁽²⁾		
					LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Ethylbenzene	100-14-4	30	FDEP GCTL	10	1.0	0.50	0.3
Isopropyl benzene	98-82-8	0.8	FDEP GCTL	0.26 ⁽³⁾	1.0	0.50	0.3
1,2,4-TMB	95-63-6	10	FDEP GCTL	3.3	1.0	0.50	0.3
1,3,5-TMB	108-67-8	10	FDEP GCTL	3.3	1.0	0.50	0.3
Total xylenes	1330-20-7	20	FDEP GCTL	6.7	3.0	1.5	0.3

1 FDEP GCTLs. Groundwater Cleanup Target Levels F.A.C. 62-777 Table I, April 2005.

2 Empirical MDLs are current as of May 2009.

3 The laboratory LOQ does not meet the Project QL Goal or the PAL; however, the MDL is below the Action Level. The LOQ will be used as the comparison criteria for this analyte. Results reported between the LOQ and the MDL will be flagged by the laboratory (“J”) and these results will also receive additional scrutiny by the Project Chemist to ensure the data support attainment of project objectives.

Matrix: Groundwater
 Analytical Group: PAHs

Analyte	CAS Number	PAL ⁽¹⁾ (µg/L)	PAL Reference	Project QL Goal (µg/L)	Empirical ⁽²⁾		
					LOQ (µg/L)	LOD (µg/L)	MDL (µg/L)
Naphthalene	91-20-3	14	FDEP GCTL	4.6	0.10	0.04	0.013
2-Methylnaphthalene	91-57-6	28	FDEP GCTL	9.3	0.10	0.04	0.013

1 FDEP GCTLs. Groundwater Cleanup Target Levels F.A.C. 62-777 Table I, April 2005.

2 Empirical MDLs are current as of May 2009.

Project-Specific SAPSite Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida**Long Term Monitoring SAP for Petroleum Sites**Revision: 2
April 2010Matrix: Groundwater
Analytical Group: TRPH

Analyte	CAS Number	PAL ⁽¹⁾ (mg/L)	PAL Reference	Project QL Goal (mg/L)	Empirical ⁽²⁾		
					LOQ (mg/L)	LOD (µg/L)	MDL (mg/L)
TRPH	No CAS	5	FDEP GCTL	1.67	0.34	0.17	0.085

1 FDEP GCTLs. Groundwater Cleanup Target Levels F.A.C. 62-777 Table I, April 2005.

2 Empirical MDLs are current as of May 2009.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
 Site Location: Jacksonville, Florida

Long Term Monitoring SAP for Petroleum Sites

Revision: 2
 April 2010

SAP Worksheet #18C -- Sampling Locations and Methods/SOP Requirements Table – BP Wells

Sampling Location / Identification Number	Matrix	Screen Interval	Analytical Group	Number of Samples (identify field duplicates)⁽¹⁾	Sampling SOP Reference⁽²⁾
CEF-BP-1S, CEF-BP-4S, CEF-BP-6S, CEF-BP-7S, CEF-BP-8S, CEF-BP-9S	Groundwater	5 to 15 feet bgs or 4 to 14 feet bgs	VOCs (Ethylbenzene, Isopropyl benzene, 1,2,4-TMB 1,3,5-TMB, Total xylenes)	7 plus 1 duplicate for each Analytical Group	FDEP FS 2200, 2008; TtNUS, SA-1.1, April 2008
CEF-BP-5I		30 to 35 feet bgs	PAHs (2- Methylnaphthalene Naphthalene) TRPH		

1 Field duplicates may be consolidated across sites at FOL's discretion so as to yield one field duplicate per 10 environmental samples.

2 SOP that describes the sample collection procedures.

Project-Specific SAP

Site Name/Project Name: NAS Cecil Field
Site Location: Jacksonville, Florida

Long Term Monitoring SAP for Petroleum Sites

Revision: 2
April 2010

SAP Worksheet #20C -- Field QC Sample Summary Table -- BP Wells

Matrix	Analytical Group	Number of Sampling Locations	Number of Field Duplicates	Number of MS/MSD	Number of Rinsate Blanks	Number of Equipment Blanks	Number of (VOA) Trip Blanks	Number of Proficiency Testing Samples	Total Number of Samples to Lab
Groundwater	VOCs PAHs TRPH	7	1	0	1	0	1	0	10



**TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM**

LTM/NAS Cecil Field
Project/Installation Name

CTO JM09, 112G02267
CTO & Project Number

01
Task Mod. Number

SAP for Petroleum Sites (April 2010)
Modification To (e.g. Work Plan)

BP Wells
Site/Sample Location

5/14/10
Date

Activity Description: At BP Wells, seven wells are being sampled on a Semi-Annual basis to monitor the groundwater COC concentrations by comparing the results against FDEP Groundwater Cleanup Target Levels (GCTLs) and Natural Attenuation Default Criteria (NADCs). Volatile Organic Compounds (VOCs) concentrations in the source area well (CEF-BP-01S) continue to remain elevated at levels significantly greater than the NADC, and the downgradient well (CEF-BP-06S) now exceeds the NADC for VOCs, also. No known soil investigation has occurred in the vicinity of the assumed source area impacted wells to date. Figures 1 and 2 present the VOCs and PAHs results from the most recent four sampling events at the BP Wells sites. During the February 2010 BCT meeting, the Team agreed that additional assessment was needed to establish a new downgradient groundwater monitoring point for the shallow zone of the aquifer and to ensure a continuing source was not contributing to the plume via soil contamination. Four soil samples in the vicinity of BP-CEF-1S (BP-SS01, BP-SS02, BP-SS03, and BP-SS04) are to be obtained by hand auger and analyzed for VOCs, PAHs, and TRPH. The soil sample locations are to the north of CEF-BP5I, at the location of CEF-BP-1S, due west of CEF-BP-1S, and northwest of CEF-BP-1S. In addition, the Team agreed that two additional shallow monitoring wells need to be installed in the Ramp Area approximately 40 feet south and 40 feet southeast of CEF-BP-6S. The new downgradient monitoring wells will subsequently be sampled for VOCs, PAHs and TRPH as part of the on-going LTM program. Table 1 shows the parameters and number of samples to be taken for both groundwater and soil. Figure 3 shows the locations of the existing wells, the proposed locations of the two new monitoring wells, and the proposed locations of the soil samples to be collected in the vicinity of CEF-BP-1S. These locations were confirmed at the May 2010 BCT meeting (Minute 2621). Attachments 3 and 4 include the field and analytical Standard Operating Procedures (SOPs) necessary in the sampling and analysis of these 4 soil samples and 9 groundwater samples which are not already included in the associated UFP-SAP.

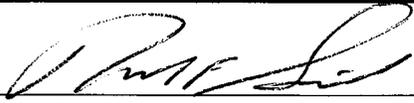
Reason for Change: Over the three preceding sampling events, groundwater levels in BP-CEF-1S have been increasing and the groundwater contamination has migrated downgradient to the southeast to BP-CEF-6S. Concentrations of several VOCs and PAHs in the downgradient well, BP-CEF-6S exceeded their GCTLs and NADCs and have been increasing for the past four sampling events. Soil samples will be collected to determine if a source exists in the vicinity of the source area well, BP-CEF-1S. Results of this additional assessment will provide information to be used in determining if additional remedial action is appropriate. Changes to the sampling plan are in accordance with the decision rules established in the April 2010 Petroleum Sites SAP.

Recommended Disposition: Verification of acceptance of the revised sampling program via approval of this FTMR via e-mail approval from Tetra Tech PM, BRAC PMO RPM, and FDEP (attached in project file).

J E Johnston
Quality Assurance Manager (QAPP lead developer)

5-10-10
Date

Approved Disposition:



Project/Task Order Manager (Signature)

5/10/10

Date

Distribution:

Program/Project File – 112G02267
Project/Task Order Manager – Robert Simcik
Field Operations Leader – Kara Wimble
BRAC PMO RPM – Art Sanford

Other: _____

ATTACHMENT 1

Table

TABLE 1
BP Wells
ANALYTICAL SAMPLING SUMMARY

Field Task Modification Request
 Naval Air Station Cecil Field
 Jacksonville, Florida

GROUNDWATER				
COC	# of Samples	Sample IDs	# of QC Samples	Laboratory Method ¹
VOCs: BTEX/Isopropylbenzene/1,2,4-trimethylbenzene/1,3,5-trimethylbenzene	9	CEF-BP-1S, CEF-BP-4S, CEF-BP-5I, CEF-BP-6S, CEF-BP-7S, CEF-BP-8S, CEF-BP-9S, CEF-BP-10S, CEF-BP-11S	1 Duplicate	SW 846 8260B
PAHs: 1-methylnaphthalene/2-methylnaphthalene/naphthalene				8270 SIM
TRPH				FL-PRO
SOIL				
COC	# of Samples	Sample IDs	# of QC Samples	Laboratory Method ¹
VOCs: BTEX/Isopropylbenzene/1,2,4-trimethylbenzene/1,3,5-trimethylbenzene	4	BPSS01, BPSS02, BPSS03, BPSS04	1 Duplicate	SW 846 8260B
PAHs: 1-methylnaphthalene/2-methylnaphthalene/naphthalene				8270 SIM
TRPH				FL-PRO

1 - Laboratory SOPs are included in Attachment 4.

ATTACHMENT 2

Figures

Legend



Monitoring Well

CEF-BP-6S	07/08	Well ID
[4-14]		Collection Date
		Screen Interval, Ft bgs
Benzene	0.23 U [1]	GCTL
		Detected Concentration (ug/L)
		Sample/Duplicate
		J = estimated concentration
		U = undetected
		* = Indicates exceeds GCTL
		** = Indicates exceeds NADC Compound



CEF-BP-7S	07/09	01/10
[5-15]		
Benzene	0.12 U	0.12 U [1]
Toluene	0.14 U	0.14 U [40]
Ethylbenzene	0.10 U	0.10 U [30]
Total Xylenes	0.21 U	0.21 U [20]
Isopropyl benzene	0.11 U	0.11 U [0.8]
1,2,4-Trimethylbenzene	0.14 U	0.14 U [10]
1,3,5-Trimethylbenzene	0.10 U	0.10 U [10]

CEF-BP-5I	07/08	01/09	07/09	01/10
[30-35]				
Benzene	0.23 U	0.4 U	0.12 U	0.11 U [1]
Toluene	0.28 U	0.35 U	0.14 U	0.10 U [40]
Ethylbenzene	0.34 U	0.43 U	0.10 U	0.13 U [30]
Total Xylenes	0.38 U	1.2 U	0.21 U	0.22 U [20]
Isopropyl benzene	0.23 U	0.2 U	0.11 U	0.15 U [0.8]
1,2,4-Trimethylbenzene	0.38 U	0.22 U	0.18 U	0.10 U [10]
1,3,5-Trimethylbenzene	0.22 U	0.2 U	0.10 U	0.13 U [10]

CEF-BP-1S	07/08	01/09	07/09	01/10
[5-15]				
Benzene	2.3 U	2 U	1.2 U	0.55 U [1]
Toluene	2.8 U	1.9 U	1.4 U	0.67 U [40]
Ethylbenzene	200*	304**	220*	170** [30]
Total Xylenes	670**	705**	770**	520** [20]
Isopropyl benzene	20**	28**	19**	16** [0.8]
1,2,4-Trimethylbenzene	440**	664**	480**	450** [10]
1,3,5-Trimethylbenzene	140**	212**	150**	140** [10]

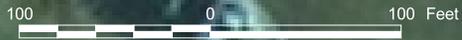
CEF-BP-8S	07/09	01/10
[5-15]		
Benzene	0.12 U	0.11 U [1]
Toluene	0.14 U	0.10 U [40]
Ethylbenzene	0.10 U	0.23 U [30]
Total Xylenes	0.21 U	0.25 U [20]
Isopropyl benzene	0.11 U	0.15 U [0.8]
1,2,4-Trimethylbenzene	0.14 U	0.38 U [10]
1,3,5-Trimethylbenzene	0.10 U	0.13 U [10]

CEF-BP-4S	07/08	01/09	07/09	01/10
[5-15]				
Benzene	0.23 U	0.4 U	0.12 U	0.12 U [1]
Toluene	0.28 U	0.35 U	0.14 U	0.14 U [40]
Ethylbenzene	0.34 U	0.43 U	0.10 U	0.10 U [30]
Total Xylenes	0.38 U	1.2 U	0.21 U	0.21 U [20]
Isopropyl benzene	0.23 U	0.2 U	0.11 U	0.11 U [0.8]
1,2,4-Trimethylbenzene	0.38 U	0.22 U	0.14 U	0.14 U [10]
1,3,5-Trimethylbenzene	0.22 U	0.2 U	0.10 U	0.10 U [10]

CEF-BP-9S	07/09	01/10
[5-15]		
Benzene	0.11 U	0.12 U [1]
Toluene	0.14 U	0.14 U [40]
Ethylbenzene	0.10 U	0.10 U [30]
Total Xylenes	0.21 U	0.21 U [20]
Isopropyl benzene	0.11 U	0.11 U [0.8]
1,2,4-Trimethylbenzene	0.14 U	0.14 U [10]
1,3,5-Trimethylbenzene	0.10 U	0.10 U [10]

CEF-BP-6S	07/08	01/09	07/09	08/09	01/10
[4-14]					
Benzene	0.23 U	0.4 U	0.12 U	0.10 U	0.11 U [1]
Toluene	0.28 U	0.35 U	0.16 U	0.10 U	1.5 [40]
Ethylbenzene	6.5	17.3	18	12	150** [30]
Total Xylenes	0.53 U	10.9	22*	10	200** [20]
Isopropyl benzene	1.1*	2 *	2.3*	1.3*	28** [0.8]
1,2,4-Trimethylbenzene	0.76 U	17.8*	28*	19*	170** [10]
1,3,5-Trimethylbenzene	0.22 U	2.2	5.3	3.1	40** [10]

VOC Plume



DATE	30Jan10
CHECKED BY	
COST/SCHEDULE-AREA	
SCALE	AS NOTED



VOC ANALYTICAL RESULTS
 BP WELLS SITE
 NAVAL AIR STATION CECIL FIELD
 JACKSONVILLE, FLORIDA

DRAWN BY	CONTRACT NUMBER
	2267
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 1	0

Legend



Monitoring Well

CEF-BP-6S	07/08	Well ID
[4-14]		Collection Date
		Screen Interval, Ft bgs
Benzene	0.23 U [1]	GCTL
		Detected Concentration (ug/L)
		Sample/Duplicate
		J = estimated concentration
		U = undetected
		* = indicates exceeds GCTL
		NS = not sampled
		Compound



CEF-BP-7S	07/09	01/10	
[5-15]			
2-Methylnaphthalene	0.3 U	0.035 J	[28]
Benzo (a) anthracene	0.16 *	0.092 U*	[0.05]
Benzo (b) flouranthene	0.086 J*	0.018 U	[0.05]
Dibenzo (a,h) anthracene	0.19 *	0.018 U	[0.005]
Indeno (1,2,3-cd)pyrene	0.35 *	0.018 U	[0.05]
Naphthalene	0.12 U	0.028 J	[14]

Naphthalene Plume

CEF-BP-5I	07/08	01/09	07/09	01/10
[30-35]				
2-Methylnaphthalene	0.3 J	0.24 U	0.3 U	0.043 J [28]
Benzo (a) anthracene	0.01 U	0.048 U	0.023 U	0.037 J [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 U	0.031 J [0.05]
Dibenzo (a,h) anthracene	0.02 U	0.048 U	0.0046 U	0.018 U [0.005]
Indeno (1,2,3-cd)pyrene	0.02 U	0.048 U	0.023 U	0.018 U [0.05]
Naphthalene	0.35 U	1 U	0.42 J	0.043 J [14]

CEF-BP-1S	07/08	01/09	07/09	01/10
[5-15]				
2-Methylnaphthalene	17	31.3*	22	20 [28]
Benzo (a) anthracene	0.01 U	0.048 U	0.023 U	0.048 J [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 U	0.039 J [0.05]
Dibenzo (a,h) anthracene	0.02 U	0.048 U	0.0046 U	0.018 U [0.005]
Indeno (1,2,3-cd)pyrene	0.02 U	0.048 U	0.43 J	0.018 U [0.05]
Naphthalene	110*	183**	160**	60* [14]

CEF-BP-4S	07/08	01/09	07/09	01/10
[5-15]				
2-Methylnaphthalene	0.02 U	0.24 U	0.3 U	0.018 U [28]
Benzo (a) anthracene	0.01 U	0.048 U	0.023 U	0.092 U* [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 U	0.092 U* [0.05]
Dibenzo (a,h) anthracene	0.02 U	0.048 U	0.0046 U	0.018 U [0.005]
Indeno (1,2,3-cd)pyrene	0.02 U	0.048 U	0.023 U	0.018 U [0.05]
Naphthalene	0.35 U	1 U	NS	0.018 U [14]

CEF-BP-6S	07/08	01/09	07/09	08/09	01/10
[4-14]					
2-Methylnaphthalene	0.28	1.3	1.6	3.1	7.1 [28]
Benzo (a) anthracene	0.03 J	0.048 U	0.097	0.024 U	0.018 U [0.05]
Benzo (b) flouranthene	0.01 U	0.048 U	0.023 J	0.024 U	0.018 U [0.05]
Dibenzo (a,h) anthracene	0.02 U	0.048 U	0.0046 U	0.019 U	0.018 U [0.005]
Indeno (1,2,3-cd)pyrene	0.02 U	0.048 U	0.023 U	0.027 J	0.018 U [0.05]
Naphthalene	0.91 J	8.3	11	9.8	29* [14]

CEF-BP-8S	07/09	01/10
[5-15]		
2-Methylnaphthalene	0.3 U	0.018 U [28]
Benzo (a) anthracene	0.023 U	0.022 J [0.05]
Benzo (b) flouranthene	0.023 U	0.019 J [0.05]
Dibenzo (a,h) anthracene	0.0046 U	0.018 U [0.005]
Indeno (1,2,3-cd)pyrene	0.23 U	0.018 U [0.05]
Naphthalene	0.12 U	0.026 J [14]

CEF-BP-9S	07/09	01/10
[5-15]		
2-Methylnaphthalene	0.3 U	0.038 J [28]
Benzo (a) anthracene	0.098 *	0.092 U* [0.05]
Benzo (b) flouranthene	0.027 J	0.092 U* [0.05]
Dibenzo (a,h) anthracene	0.17 *	0.018 U [0.005]
Indeno (1,2,3-cd)pyrene	0.32 J *	0.018 U [0.05]
Naphthalene	0.12 U	0.034 J [14]



DATE	30Jan10
CHECKED BY	
COST/SCHEDULE-AREA	
SCALE	AS NOTED



PAH ANALYTICAL RESULTS
BP WELLS SITE
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

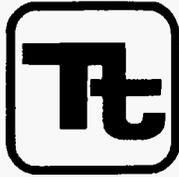
DRAWN BY	CONTRACT NUMBER
	2267
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 2	0



DATE 09Apr10		DRAWN BY		CONTRACT NUMBER 2267	
CHECKED BY		APPROVED BY		DATE	
COST/SCHEDULE-AREA		APPROVED BY		DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 3			
<p>FTMR FOR SOIL SAMPLES AND NEW SENTINEL WELLS BP WELLS SITE NAVAL AIR STATION CECIL FIELD JACKSONVILLE, FLORIDA</p>					

ATTACHMENT 3

Field SOPs



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

Number GH-2.8	Page 1 of 12
Effective Date 09/03	Revision 3
Applicability Tetra Tech NUS, Inc.	
Prepared Earth Sciences Department	
Approved D. Senovich <i>DS</i>	

Subject
GROUNDWATER MONITORING WELL INSTALLATION

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Subject GROUNDWATER MONITORING WELL INSTALLATION	Number GH-2.8	Page 2 of 12
	Revision 3	Effective Date 09/03

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development.

2.0 SCOPE

This procedure is applicable to the construction of monitoring wells. The methods described herein may be modified by project-specific requirements for monitoring well construction. In addition, many regulatory agencies have specific regulations pertaining to monitoring well construction and permitting. These requirements must be determined during the project planning phases of the investigation, and any required permits must be obtained before field work begins. Innovative monitoring well installation techniques, which typically are not used, will be discussed only generally in this procedure.

3.0 GLOSSARY

Monitoring Well - A well which is screened, cased, and sealed which is capable of providing a groundwater level and groundwater sample representative of the zone being monitored. Some monitoring wells may be constructed as open boreholes.

Piezometer - A pipe or tube inserted into the water bearing zone, typically open to water flow at the bottom and to the atmosphere at the top, and used to measure water level elevations. Piezometers may range in size from 1/2-inch-diameter plastic tubes to well points or monitoring wells.

Potentiometric Surface - The surface representative of the level to which water will rise in a well cased to the screened aquifer.

Well Point (Drive Point) - A screened or perforated tube (Typically 1-1/4 or 2 inches in diameter) with a solid, conical, hardened point at one end, which is attached to a riser pipe and driven into the ground with a sledge hammer, drop weight, or mechanical vibrator. Well points may be used for groundwater injection and recovery, as piezometers (i.e., to measure water levels) or to provide groundwater samples for water quality data.

4.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

Subject GROUNDWATER MONITORING WELL INSTALLATION	Number GH-2.8	Page 3 of 12
	Revision 3	Effective Date 09/03

5.0 PROCEDURES

5.1 Equipment/Items Needed

Below is a list of items that may be needed when installing a monitoring well or piezometer:

- Health and safety equipment (hard hats, safety glasses, etc.) as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).
- Drive point installation tools (sledge hammer, drop hammer, or mechanical vibrator; tripod, pipe wrenches, drive points, riser pipe, and end caps).

5.2 Well Design

The objectives and intended use for each monitoring well must be clearly defined before the monitoring system is designed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well design, attention must be given to clearly documenting the basis for design decisions, the details of well construction, and the materials used. The objectives for installing the monitoring wells may include:

- Determining groundwater flow directions and velocities.
- Sampling or monitoring for trace contaminants.
- Determining aquifer characteristics (e.g., hydraulic conductivity).

Siting of monitoring wells shall be performed after a preliminary estimation of the groundwater flow direction. In most cases, groundwater flow directions and potential well locations can be determined by an experienced hydrogeologist through the review of geologic data and the site terrain. In addition, data from production wells or other monitoring wells in the area may be used to determine the groundwater flow direction. If these methods cannot be used, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary investigative phase to determine groundwater flow direction.

5.2.1 Well Depth, Diameter, and Monitored Interval

The well depth, diameter, and monitored interval must be tailored to the specific monitoring needs of each investigation. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. Wells of different depth, diameter, and monitored interval can be employed in the same groundwater monitoring system. For instance, varying the monitored interval in several wells, at the same location (cluster wells) can help to determine the vertical gradient and the depths at which contaminants are present. Conversely, a fully penetrating well is usually not used to quantify or vertically locate a contaminant plume, since groundwater samples collected in wells that are screened over the full thickness of the water-bearing zone will be representative of average conditions across the entire monitored interval. However, fully penetrating wells can be used to establish the existence of contamination in the water-bearing zone. The well diameter desired depends upon the hydraulic characteristics of the water-bearing zone, sampling requirements, drilling method and cost.

Subject GROUNDWATER MONITORING WELL INSTALLATION	Number GH-2.8	Page 4 of 12
	Revision 3	Effective Date 09/03

The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- The vertical location of the contaminant source in relation to the water-bearing zone.
- The depth, thickness and uniformity of the water-bearing zone.
- The anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume.
- Fluctuation in groundwater levels (due to pumping, tidal influences, or natural recharge/discharge events).
- The presence and location of contaminants encountered during drilling.
- Whether the purpose of the installation is for determining existence or non-existence of contamination or if a particular stratigraphic zone is being investigated.
- The analysis of borehole geophysical logs.

In most situations where groundwater flow lines are horizontal, depending on the purpose of the well and the site conditions, monitored intervals are 20 feet or less. Shorter screen lengths (5 feet or less) are usually required where flow lines are not horizontal, (i.e., if the wells are to be used for accurate measurement of the potentiometric head at a specific point).

Many factors influence the diameter of a monitoring well. The diameter of the monitoring well depends on the application. In determining well diameter, the following needs must be considered:

- Adequate water volume for sampling.
- Drilling methodology.
- Type of sampling device to be used.
- Costs.

Standard monitoring well diameters are 2, 4, 6, or 8 inches. Drive points are typically 1-1/4 or 2 inches in diameter. For monitoring programs which require screened monitoring wells, either a 2-inch or 4-inch-diameter well is preferred. Typically, well diameters greater than 4 inches are used in monitoring programs in which open-hole bedrock monitoring wells are used. With smaller diameter wells, the volume of stagnant water in the well is minimized, and well construction costs are reduced; however, the sampling devices that can be used are limited.

In specifying well diameter, sampling requirements must be considered (up to a total of 4 gallons of water may be required for a single sample to account for full organic and inorganic analyses, and split samples), particularly if the monitored formation is known to be a low-yielding formation. The unit volume of water contained within a monitoring well is dependent on the well diameter as follows:

Casing Inside Diameter (Inch)	Standing Water Length to Obtain 1 Gallon Water (Feet)
2	6.13
4	1.53
6	0.68

If a well recharges quickly after purging, then well diameter may not be an important factor regarding sample volume requirements.

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Pumping tests for determining aquifer characteristics may require larger diameter wells (for installation of high capacity pumps); however, in small-diameter wells in-situ permeability tests can be performed during drilling or after well installation is completed.

5.2.2 Riser Pipe and Screen Materials

Well materials are specified by diameter, type of material, and thickness of pipe. Well screens require an additional specification of slot size. Thickness of pipe is referred to as "Schedule" for polyvinyl chloride (PVC) casing and is usually Schedule 40 (thinner wall) or 80 (thicker wall). Steel pipe thickness is often referred to as "Strength". Standard Strength is usually adequate for monitoring well purposes. With larger diameter pipe, the wall thickness must be greater to maintain adequate strength. The required thickness is also dependent on the method of installation; risers for drive points require greater strength than wells installed inside drilled borings.

The selection of well screen and riser materials depends on the method of drilling, the type of subsurface materials the well penetrates, the type of contamination expected, and natural water quality and depth. Cost and the level of accuracy required are also important. The materials generally available are Teflon, stainless steel, PVC galvanized steel, and carbon steel. Each has advantages and limitations (see Attachment A of this guideline for an extensive presentation on this topic). The two most commonly used materials are PVC and stainless steel. Properties of these two materials are compared in Attachment B. Stainless steel is a good choice where trace metals or organic sampling is required; however, costs are high. Teflon materials are extremely expensive, but are relatively inert and provide the least opportunity for water contamination due to well materials. PVC has many advantages, including low cost, excellent availability, light weight, ease of manipulation, and widespread acceptance. The crushing strength of PVC may limit the depth of installation, but the use of Schedule 80 materials may overcome some of the problems associated with depth. However, the smaller inside diameter of Schedule 80 pipe may be an important factor when considering the size of bailers or pumps required for sampling or testing. Due to this problem, the minimum well pipe size recommended for Schedule 80 wells is 4-inch I.D.

Screens and risers may have to be decontaminated before use because oil-based preservatives and oil used during thread cutting and screen manufacturing may contaminate samples. Metal pipe may corrode and release metal ions or chemically react with organic constituents, but this is considered a minor issue. Galvanized steel is not recommended where samples may be collected for metals analyses, as zinc and cadmium levels in groundwater samples may become elevated from leaching of the zinc coating.

Threaded, flush-joint casing is most often preferred for monitoring well applications. PVC, Teflon, and steel can all be obtained with threaded joints. Welded-joint steel casing is also acceptable. Glued PVC may release organic contaminants into the well, and therefore, should not be used if the well is to be sampled for organic constituents.

When the water-bearing zone is in consolidated bedrock, such as limestone or fractured granite, a well screen is often not necessary (the well is simply an open hole in bedrock). Unconsolidated materials, such as sands, clay, and silts require a screen. A screen slot size of 0.010 or 0.020 inch is generally used when a screen is necessary, and the annular borehole space around the screened interval is artificially packed with an appropriately sized sand, selected based on formation grain size. The slot size controls the quantity of water entering the well and prevents entry of natural materials or sand pack. The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The site geologist shall specify the combination of screen slot size and sand pack which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells. For example, as a standard procedure, a Morie No. 1 or No. 10 to No. 20 U.S. Standard Sieve size filter pack is typically appropriate for a 0.020-inch slot screen; however, a No. 20 to No. 40 U.S. Standard Sieve size filter pack is typically appropriate for a 0.010-inch slot screen.

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5.2.3 Annular Materials

Materials placed in the annular space between the borehole and riser pipe and screen include a sand pack when necessary, a bentonite seal, and cement-bentonite grout. The sand pack is usually a medium-to coarse-grained poorly graded, silica sand and should relate to the grain size of the aquifer sediments. The quantity of sand placed in the annular space is dependent upon the length of the screened interval, but should always extend at least 1 foot above the top of the screen. At least 1 to 3 feet of bentonite pellets or equivalent shall be placed above the sand pack. Cement-bentonite grout (or equivalent) is then placed to extent from the top of the bentonite pellets to the ground surface.

On occasion, and with the concurrence of the involved regulatory agencies, monitoring wells may be packed naturally (i.e., no artificial sand pack installed). In this case, the natural formation material is allowed to collapse around the well screen after the well is installed. This method has been used where the formation material itself is a relatively uniform grain size, or when artificial sand packing is not possible due to borehole collapse.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets, extending to the surface. The grout effectively seals the remaining borehole annulus and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom upward, to prevent bridging, and to provide a better seal. In shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite pellet seal. Grout, most of the time, is made up of one or two assemblages of material, (e.g., cement and/or bentonite). A cement-bentonite grout, which is the most common type of grout used in monitoring well completions, normally is a mixture of cement, bentonite, and water at a ratio of one 90-pound bag of Portland Type I cement, plus 3 to 5 pounds of granular or flake-type bentonite, and 6-7 gallons of water. A neat cement consists of one ninety-pound bag of Portland Type I cement and 6-7 gallons of water. A bentonite slurry (bentonite and water mixed to a thick but pumpable mixture) is sometimes used instead of grout for deep well installations where placement of bentonite pellets is difficult. Bentonite chips are also occasionally used for annular backfill in place of grout.

In certain cases, the borehole may be drilled to a depth greater than the anticipated well installation depth. For these cases, the well shall be backfilled to the desired depth with bentonite pellets/chips or sand. A short (1- to 2-foot) section of capped riser pipe sump is sometimes installed immediately below the screen, as a silt reservoir, when significant post-development silting is anticipated. This will ensure that the entire screen surface remains unobstructed.

5.2.4 Protective Casing

When the well is completed and grouted to the surface, a protective steel casing is typically placed over the top of the well. This casing generally has a hinged cap and can be locked to prevent vandalism. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

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A protective casing which is level with the ground surface (flush-mounted) is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the riser pipe is placed 4 to 5 inches below the pavement, and a locking protective casing is cemented in place to 3 inches below the pavement. A large diameter, manhole-type protective collar is set into the wet cement around the well with the top set level with or slightly above the pavement. An appropriately-sized id is placed over the protective sleeve. The cement should be slightly mounded to direct pooled water away from the well head.

5.3 Monitoring Well Installation

Pertinent data regarding monitoring well installation shall be recorded on log sheets as depicted and discussed in SOP SA-6.3. Attachments to this referenced SOP illustrate terms and physical construction of various types of monitoring wells.

5.3.1 **Monitoring Wells in Unconsolidated Sediments**

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. If the borehole collapses immediately after the drilling tools are withdrawn, then a temporary casing must be installed and well installation will proceed through the center of the temporary casing, and continue as the temporary casing is withdrawn from the borehole. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe are lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is slowly poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur. Centralizers may be used at the geologist's discretion, one above and one below the screen, to assure enough annular space for sand pack placement.

After the sand pack is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent), can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack. Pellets should be added slowly and their fall monitored closely to ensure that bridging does not occur.

The cement-bentonite grout is then mixed and tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed as detailed in Section 5.2.4.

5.3.2 **Confining Layer Monitoring Wells**

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between aquifers. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 5 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting a large-diameter casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for

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installation of the monitoring well as detailed for overburden monitoring wells. Sufficient time (determined by the field geologist), must be allowed for setting of the grout prior to drilling through the confined layer.

5.3.3 Bedrock Monitoring Wells

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 –10 feet into bedrock. A casing (typically steel) is installed and either pressure grouted or tremie grouted in place. After the grout has cured, a smaller diameter boring is continued into bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. If a screen is to be used, then the casing which is installed through the overburden and into the bedrock does not require grouting and can be removed when the final well installation is completed.

5.3.4 Drive Points

Drive points can be installed with either a sledge hammer, drop hammer, or a mechanical vibrator. The screen section is threaded and tightened onto the riser pipe with pipe wrenches. The drive point is simply pounded into the subsurface to the desired depth. If a heavy drop hammer is used, then a tripod and pulley setup is required to lift the hammer. Drive points typically cannot be manually driven to depths exceeding 10 feet.

Direct push sampling/monitoring point installation methods, using a direct push rig or drilling rig, are described in SOP SA-2.5.

5.3.5 Innovative Monitoring Well Installation Techniques

Certain innovative sampling devices have proven advantageous. These devices are essentially screened samplers installed in a borehole with only small-diameter tubes extending to the surface. This reduces drilling costs, decreases the volume of stagnant water, and provides a sampling system that minimizes cross-contamination from sampling equipment. Four manufacturers of these samplers include Timco Manufacturing Company, Inc., of Prairie du Sac, Wisconsin, BARCAD Systems, Inc., of Concord, Massachusetts, Westbay Instruments Ltd. of Vancouver, British Columbia, Canada and the University of Waterloo at Waterloo, Ontario, Canada.. Each manufacturer offers various construction materials.

5.4 Well Development Methods

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, conductivity, turbidity, and temperature taken during development may yield information (stabilized values) regarding whether sufficient development has been performed. The selection of the well development method shall be made by the field geologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation that the well is screened in. The primary methods of well development are summarized below. A more detailed discussion may be found in Driscoll (1986).

5.4.1 Overpumping and Backwashing

Wells may be developed by alternatively drawing the water level down at a high rate (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the formation. This back and forth movement of water through the well screen and gravel pack serves to

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remove fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains. Backwashing can be accomplished by several methods, including pouring water into the well and then bailing, starting and stopping a pump intermittently to change water levels, or forcing water into the well under pressure through a water-tight fitting ("rawhiding"). Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen.

5.4.2 Surging with a Surge Plunger

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is aggressively moved up and down within the well to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

5.4.3 Compressed Air

Compressed air can be used to develop a well by either of two methods: backwashing or surging. Backwashing is done by forcing water out through the screens, using increasing air pressure inside a sealed well, then releasing the pressurized air to allow the water to flow back into the well. Care should be taken when using this method so that the water level does not drop below the top of the screen, thus introducing air into the formation and reducing well yield. Surging, or the "open well" method, consists of alternately releasing large volumes of air suddenly into an open well below the water level to produce a strong surge by virtue of the resistance of water head, friction, and inertia. Pumping of the well is subsequently done using the air lift method.

5.4.4 High Velocity Jetting

In the high velocity jetting method, water is forced at high velocities from a plunger-type device and through the well screen to loosen fine particles from the sand pack and surrounding formation. The jetting tool is slowly rotated and raised and lowered along the length of the well screen to develop the entire screened area. Jetting using a hose lowered into the well may also be effective. The fines washed into the screen during this process can then be bailed or pumped from the well.

6.0 RECORDS

A critical part of monitoring well installation is recording of all significant details and events in the site logbook or field notebook. The geologist must record the exact depths of significant hydrogeological features, screen placement, gravel pack placement, and bentonite placement.

A Monitoring Well Sheet (see Attachments to SOP SA-6.3) shall be completed, ensuring the uniform recording of data for each installation and rapid identification of missing information. Well depth, length, materials of construction, length and openings of screen, length and type of riser, and depth and type of all backfill materials shall be recorded. Additional information shall include location, installation date, problems encountered, water levels before and after well installation, cross-reference to the geologic boring log, and methods used during the installation and development process. Documentation is very important to prevent problems involving questionable sample validity. Somewhat different information will need to be recorded, depending on whether the well is completed in overburden (single- or double-cased), as a cased well in bedrock, or as an open hole in bedrock.

The quantities of sand, bentonite, and grout placed in the well are also important. The geologist shall calculate the annular space volume and have an idea of the quantity of material needed to fill the annular

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space. Volumes of backfill significantly higher than the calculated volume may indicate a problem such as a large cavity, while a smaller backfill volume may indicate a cave-in or bridging of the backfill materials. Any problems with rig operation or down-time shall be recorded and may affect the driller's final fee.

7.0 REFERENCES

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U.S. EPA, 1980. Procedures Manual for Groundwater Monitoring of Solid Waste Disposal Facilities. Publication SW-611, Office of Solid Waste, U.S. EPA, Washington, D.C.

Driscoll, Fletcher G., 1986. Groundwater and Wells. Johnson Division, St. Paul, Minnesota, 1989.

ATTACHMENT A

RELATIVE COMPATIBILITY OF RIGID WELL CASING MATERIAL (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/ High Solids Content	100	48	57	60	80	82	100
Aqueous/Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials:

- | | | | |
|----|---------------------|---|------------------|
| 1 | Teflon® | 5 | Lo-Carbon Steel |
| 2 | Stainless Steel 316 | 6 | Galvanized Steel |
| 3. | Stainless Steel 304 | 7 | Carbon Steel |
| 4 | PVC 1 | | |

* Trademark of DuPont

RELATIVE COMPATIBILITY OF SEMI-RIGID OR ELASTOMERIC MATERIALS (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material								
	PVC Flexible	PP	PE Conv.	PE Linear	PMM	Viton®*	Silicone	Neoprene	Teflon®*
Buffered Weak Acid	97	97	100	97	90	92	87	85	100
Weak Acid	92	90	94	96	78	78	75	75	100
Mineral Acid/ High Solids Content	100	100	100	100	95	100	78	82	100
Aqueous/Organic Mixtures	62	71	40	60	49	78	49	44	100
Percent Overall Rating	88	90	84	88	78	87	72	72	100

Preliminary Ranking of Semi-Rigid or Elastomeric Materials:

- | | | | |
|----|------------------------|---|------------------------|
| 1 | Teflon® | 5 | PE Conventional |
| 2 | Polypropylene (PP) | 6 | Plexiglas/Lucite (PMM) |
| 3. | PVC Flexible/PE Linear | 7 | Silicone/Neoprene |
| 4 | Viton® | | |

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Source: Barcelona et al., 1983

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ATTACHMENT B

COMPARISON OF STAINLESS STEEL AND PVC FOR MONITORING WELL CONSTRUCTION

Characteristic	Stainless Steel	PVC
Strength	Use in deep wells to prevent compression and closing of screen/riser.	Use when shear and compressive strength are not critical.
Weight	Relatively heavier.	Light-weight; floats in water.
Cost	Relatively expensive.	Relatively inexpensive.
Corrosivity	Deteriorates more rapidly in corrosive water.	Non-corrosive -- may deteriorate in presence of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons.
Ease of Use	Difficult to adjust size or length in the field.	Easy to handle and work with in the field.
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled.	Never use glue fittings -- pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells.
Interaction with Contaminants*	May sorb organic or inorganic substances when oxidized.	May sorb or release organic substances.

* See also Attachment A.

FS 3000. SOIL

See also the following Standard Operating Procedures:

- FA 1000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FT 1000 – FT 2000 Field Testing and Calibration

1. Introduction and Scope

1.1. Use these SOPs during field investigations to collect soil samples that are representative of current site conditions. It is very important to ensure that the collected samples are neither altered nor contaminated by sampling and handling techniques.

1.2. The following topics include: equipment choice, equipment construction materials, grab and areal or depth composite sampling techniques. Sample collection methods fall into three general depth classifications: surface, shallow subsurface, and deep subsurface. Once the samples are acquired, the handling procedures are very similar and are described below.

2. GENERAL

2.1. Select sampling equipment based on the type of sample to be collected and the analytes of interest. Choose soil sampling locations such that a representative portion of the soil is collected with minimal disturbance. Locations where natural vegetation is stressed or dead and/or areas that have surficial soil staining may be indicative of improper waste disposal practices.

2.2. If background and/or quality control sampling is warranted and feasible as determined in the site's work plan or by the project manager, select an up gradient, undisturbed location for obtaining the background and/or quality control samples. Be aware that differences in soil types may affect these background samples (e.g., sands vs. clays).

2.3. **Do not collect** samples for chemical analysis from auger flights or cuttings from hollow stem auger flights, except for waste characterization purposes for disposal.

2.4. Do not use samples that are collected for geological/lithological or vapor meter determinations for chemical analyses.

3. EQUIPMENT AND SUPPLIES

3.1. All equipment must be constructed of materials consistent with the analytes of interest. Refer to FS 1000, Tables FS 1000-1, FS 1000-2 and FS 1000-3 for selection of appropriate equipment and materials.

3.2. For information on sample container size and construction, see FS 1000, Table FS 1000-6.

3.3. For information on sampling equipment cleaning requirements, see FC 1000.

3.4. For information on preservation and holding time requirements, see FS 1000, Table FS 1000-6.

3.5. For information on documentation requirements, see FD 1000.

4. PROCEDURES FOR COMPOSITING

4.1. The following is not a complete discussion regarding all available sampling protocols nor the appropriateness or inappropriateness of compositing soil samples. The appropriateness of compositing soil samples will depend on the data quality objectives of the project. However, it is sometimes advantageous to composite soil samples to minimize the number of samples to be analyzed when sampling highly contaminated areas. Obtain permission from the DEP program.

4.1.1. Select sampling points from which to collect each aliquot.

4.1.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

4.1.3. **Combine the aliquots of the sample directly in the sample container with no pre-mixing.**

4.1.4. Record the amount of each aliquot (volume or weight).

4.1.5. Label container, preserve on wet ice to 4°C and complete field notes.

4.1.6. Notify the laboratory that the sample is an unmixed composite sample, and request that the sample be thoroughly mixed before sample preparation or analysis.

5. SPECIFIC PROCEDURES FOR VOLATILE ORGANIC COMPOUNDS

Follow the procedures specified in EPA Method 5035 for sample collection and sample preparation. The protocols listed below **do not replace Method 5035** but clarify and/or modify certain method procedures. Therefore, it is essential that all organizations have a copy of Method 5035 as a reference document.

5.1. Container Preparation

5.1.1. All containers must be cleaned according to the FC 1000 sample container cleaning procedures for volatile organics.

5.1.2. Sample Vials: If sample vials are filled in the field, they must be provided with all reagents, stirring devices, label **and vial cap** to be used during sample analysis. These vials must be preweighed by the laboratory and records must be maintained so that there is an unambiguous link between the tare weight and the filled sample vial.

5.2. Collection Procedure

5.2.1. The sample vials (when used) will contain a premeasured amount of liquid. The laboratory must weigh the vials before sending into the field, and must weigh them again after receipt. Therefore:

- Do not lose any of the liquid either through evaporation or spillage
- Do not use a vial if some of the contents has spilled, or if it appears that some has leaked during transport
- Use the laboratory-supplied container label for identification information. **DO NOT apply any additional labels to the container**

- Do not interchange vial caps or septa
- 5.2.2. Minimize exposure to air by obtaining the sample directly from the sample source, using a coring device or a commercially designed sampling tool.
- 5.2.2.1. The sample collection device must be designed to fit tightly against the mouth of the vial or be small enough to be inserted into the vial. Use:
- EnCore or equivalent sampling devices or
 - Disposable plastic syringes with the syringe end cut off prior to sampling (use **once** per sampling location).
- 5.2.2.2. Extrude the sample directly into the sample container.
- 5.2.3. Follow the method procedures for field transfer into the vial.
- 5.2.4. Procedures for determining the sample weight in the field are not required unless the project manager requires an accurate determination of the 5-gram sample size.
- 5.2.4.1. If the vials are returned to the laboratory for weighing, the sampler must be proficient in estimating the requisite 5-gram weight necessary for each sample.
- 5.2.4.2. If an accurate estimate of the 5-gram sample size is desired prior to starting sample collection activities, use a balance with a sensitivity of 0.1 gram. Check the balance calibration before each day's use with a set of weights that have been calibrated against NIST-traceable weights at least annually.
- 5.2.5. If the sampling device is transported to the laboratory with a sample, make sure the seals are intact, especially if collecting samples from sandy soils.
- 5.2.6. Collect at least two replicate samples from the same soil stratum and within close proximity to the original sample location.
- 5.2.7. Collect an additional aliquot of sample for screening and dry weight determinations.
- 5.3. Preservation (see FS 1000, Table FS 1000-7)
- 5.3.1. Low Level ($\leq 200 \mu\text{g}/\text{kg}$ volatile organics)
- 5.3.1.1. Method 5035 discusses the use of sodium bisulfate, which is an acid. Since Florida soils contain significant amounts of calcium carbonate that reacts with acids, DEP does not recommend using this preservative.
- 5.3.1.2. Properly pack the samples (see FS 2004, section 5), and place all samples on wet ice.
- 5.3.1.3. Analyze unpreserved samples (no acid) within 48 hours.
- 5.3.1.4. Analyze acid-preserved samples within the specified 14-day holding time.
- 5.3.1.5. Analyze unpreserved samples that have been collected in a septum vial with premeasured analyte-free water within 48 hours.
- 5.3.1.6. If unpreserved samples collected in a septum vial with premeasured analyte-free water are frozen to -10°C at the laboratory within 48 hours of sample collection, analyze the samples within 14 days.
- 5.3.1.7. Analyze samples that have been collected with and transported in a sealed coring device within 48 hours.

5.3.1.8. If unpreserved samples collected in a sealed coring device are extruded from the corer into an appropriate liquid and frozen to -10°C at the laboratory within 48 hours of sample collection, analyze the samples within 14 days.

5.3.2. High Level (> 200 µg/kg volatile organics)

5.3.2.1. Properly pack the samples (see FS 2004, section 5), and place all samples on wet ice.

5.3.2.2. Analyze samples that have been collected with and transported in a sealed coring device within 48 hours.

5.3.2.3. If unpreserved samples collected in a sealed coring device are extruded from the corer into an appropriate liquid and stored at 4°C at the laboratory within 48 hours of sample collection, analyze the samples within 14 days.

5.3.2.4. Analyze samples that that have been preserved in methanol in the field within 14-days.

6. BULK SAMPLES: The collection of bulk samples will depend on the data quality objectives of the project.

6.1. Do not composite or mix VOC samples unless required by the DEP program or if mandated by a formal DEP document (permit, order or contract).

6.2. Select sampling points from which to collect each aliquot.

6.3. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

6.3.1. **Combine the aliquots of the sample directly in the sample container with no pre-mixing..**

6.3.2. Pack soil tightly minimizing as much headspace as possible in the sample container.

6.3.3. Cap container tightly with Teflon side facing sample.

6.4. Record the amount of each aliquot (volume or weight) in the field notes.

6.5. Label container. Refer to FS 1000, Table FS 1000-7 for preservation and holding time requirements.

6.6. Notify the laboratory that the sample is an unmixed composite sample, and request that the sample be thoroughly mixed before sample preparation or analysis.

FS 3100. Surface Soil Sampling

Surface soil is generally classified as soil between the ground surface and 6-12 inches below ground surface.

1. Remove leaves, grass and surface debris from the area to be sampled.
2. Collect samples for volatile organic analyses as described in FS 3000, section 5.
3. Select an appropriate precleaned sampling device and collect the sample.
4. Transfer the sample to the appropriate sample container.
5. Clean the outside of the sample container to remove excess soil.

6. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

FS 3200. Subsurface Soil Sampling

Interval begins at approximately 12 inches below ground surface.

FS 3210. SAMPLE COLLECTION PROCEDURE

Use the following after the desired depth has been reached by one of the methods outlined in FS 3220.

1. Collect samples for volatile organic analyses as described in FS 3000, section 5.
2. For other analyses, select an appropriate precleaned sampling device and collect the sample.
3. Transfer the sample to the appropriate sample container.
4. Clean the outside of the sample container to remove excess soil.
5. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

FS 3220. REACHING THE APPROPRIATE DEPTH

1. **SHOVELS AND DIGGERS:** Used for soils from approximately 12 inches to a point when using the implement becomes impractical.
 - 1.1. Dig a hole or trench to the required depth.
 - 1.2. Follow the sample collection procedures outlined in FS 3210.
2. **BACKHOE:** Used for soils from approximately 12 inches to a point when using the implement becomes impractical.
 - 2.1. Dig a trench to the appropriate depth.
 - 2.2. Expose the sample, in the trench, by using a precleaned spoon, spatula or equivalent to clean away the soil that came in contact with the backhoe bucket.
 - 2.3. Use a **second** precleaned utensil to actually collect the sample from the trench.
 - 2.4. Follow the procedures outlined in FS 3210 to collect the sample.
3. **BUCKET AUGERS AND HOLLOW CORERS:** Suitable to reach soils from approximately 12 inches to a point when using the implement becomes impractical.
 - 3.1. Push and rotate the auger into the soil until the bucket is filled.
 - 3.2. Addition of a non-contaminating sleeve may allow an undisturbed soil sample to be obtained.
 - 3.2.1. The device consists of a standard auger head with a removable sleeve, which is inserted into the auger barrel. In this case it is the sleeve, which fills with soil.
 - 3.2.2. Remove the sleeve from the auger and cap.
 - 3.3. If the auger hole is prone to collapse due to low cohesion in some soils, DEP recommends inserting a temporary rigid PVC casing into the hole. The casing prevents hole collapse and minimizes cross-contamination between soil zones as the auger is advanced.

- 3.4. Remove the sample from the sampler by pushing or scraping the soil with an appropriate precleaned utensil into an appropriately precleaned tray or aluminum foil.
- 3.5. Remove any portion of the sample that has been disturbed and discard.
- 3.6. Follow the sample collection procedures outlined in FS 3210.

NOTE: If a confining layer has been breached during sampling, grout the hole to land surface with Type-1 Portland cement. This requirement may be different throughout Florida; contact the local Water Management District office for local requirements.

4. SPLIT SPOON SAMPLER: Suitable for reaching soils from approximately 12 inches to depths greater than 10 feet.

- 4.1. A split spoon sampler, useful for sampling unconsolidated soil, consists of two half cylinders (spoons) that fit together to form a tube approximately two feet in length and two inches in diameter.
 - 4.1.1. The cylindrical arrangement is maintained by a retaining head and bit rings that screw on at each end of the split spoon.
 - 4.1.2. The bit ring has beveled edges to facilitate sampling as the split spoon is forced into the ground.
 - 4.1.3. Advance the sampler using the weight of the drilling stem and rods or a mechanical hammer.
 - 4.1.4. Insert a catcher device in the head ring to prevent loss of unconsolidated sample during recovery.
- 4.2. After retrieving the split spoon sampler, expose the soil by unscrewing the bit and head rings and splitting the barrel.
- 4.3. If the recovery is enough to accommodate discarding a portion of the sample, discard the top and bottom two to three inches of the sample.
- 4.4. For volatile organic compounds collect the sample immediately from the **center portion of the split spoon** using the procedures described in FS 3000, section 5.
- 4.5. For other analyses, slice the sample from the center portion of the split spoon using a clean, decontaminated utensil.
- 4.6. Select an appropriate precleaned sampling device and collect the sample.
- 4.7. Transfer the sample to the appropriate sample container.
- 4.8. Clean the outside of the sample container to remove excess soil.
- 4.9. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

5. DIRECT PUSH RIGS: May be used for depths greater than 10 feet below ground surface.

- 5.1. Liners: The clear liners are used with direct push rigs. This method is appropriate only for unconsolidated materials. The sampling depth that can be achieved varies depending on the rig and the lithologies that are encountered. Typically, the rig operator will:

- Place the liner inside the metal probe rod
- Select a point holder with an opening appropriate for the site lithology and screw it on the probe rod
- Advance the rod a full rod length
- Retrieve the rod
- Remove the point holder
- Remove the liner, and
- Slice the liner to expose the soil.

5.2. After the liner has been sliced, follow the procedures outlined in FS 3210, collecting volatile organic samples (if needed) immediately after the liner is sliced.

5.3. If samples for organic vapor analysis screening are required, collect them by slicing the sample(s) using a clean, decontaminated utensil and place them in 8-ounce (preferred) or 16-ounce jars, immediately cover the opening with aluminum foil and screw on the lid ring. If the contamination is derived from petroleum products, it is acceptable to use a clean gloved hand to transfer the sample(s) to the sample container(s).

5.4. For other analyses, slice the sample from the center portion of the split spoon using a clean, decontaminated utensil.

5.5. Select an appropriate precleaned sampling device and collect the sample.

5.6. Transfer the sample to the appropriate sample container.

5.7. Clean the outside of the sample container to remove excess soil.

5.8. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

6. SHELBY TUBE SAMPLER

6.1. The Shelby tube sampler is used to sample unconsolidated soil and consists of a tube approximately 30 inches long and two inches (or larger) in diameter.

6.2. One end of the tube has edges beveled into a cutting edge. The other end can be mounted to an adapter, which allows attachment to the drilling rig assembly.

6.3. After drilling to the required depth with an auger or rotary drill bit, a soil sample is obtained through the auger or directly in the borehole.

6.4. Push the Shelby tube into the soil using the drilling rig's hydraulic ram or manually with a sledge hammer.

6.5. Remove the tube from the sampler head.

6.6. Extrude the sample from the Shelby tube.

6.7. Use a decontaminated utensil to remove any portion of the sample that has been disturbed.

6.8. Collect samples for volatile organics immediately from the center portion of the Shelby tube using the procedures described in FS 3000, section 5.

6.9. For other analyses, slice the sample from the center portion of the Shelby tube using a clean, decontaminated utensil.

- 6.10. Transfer the sample to the appropriate sample container.
- 6.11. Clean the outside of the sample container to remove excess soil.
- 6.12. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.

7. CORE BARREL

- 7.1. A standard core barrel is utilized when consolidated samples (such as limestone or dolomite) are to be sampled.
 - 7.1.1. The core barrel is a cylinder approximately three feet long and two inches in diameter.
 - 7.1.2. The barrel has a removable head ring with small embedded diamonds which allow the device to cut through rock or consolidated soil as the drilling rods are rotated.
- 7.2. Retrieve the sample core by unscrewing the head ring and sliding the sample into a precleaned container.
- 7.3. Use a decontaminated utensil to remove any portion of the sample that has been disturbed.
- 7.4. Remove the sample from the sampler (corer) with a precleaned tool.
- 7.5. Transfer the sample to the appropriate sample container.
- 7.6. Clean the outside of the sample container to remove excess soil.
- 7.7. Label the sample container, place on wet ice to preserve to 4°C and complete the field notes.



STANDARD OPERATING PROCEDURES

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Applicability Tetra Tech NUS, Inc.	
Prepared Earth Sciences Department	
Approved Tom Johnston <i>T.E. Johnston</i>	

Subject
SOIL SAMPLING

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used to collect surface, near-surface, and subsurface soil samples. Additionally, it describes the methods for sampling of test pits and trenches to determine subsurface soil and rock conditions and for recovery of small-volume or bulk samples from pits.

2.0 SCOPE

This document applies to the collection of surface, near-surface, and subsurface soil samples exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites for laboratory testing, onsite visual examination, and onsite testing.

3.0 GLOSSARY

Composite Sample - A composite sample is a combination of more than one grab sample from various locations and/or depths and times that is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples shall not be collected for volatile organics analysis.

Confined Space - As stipulated in 29 Code of Federal Regulations (CFR) 1910.146, a confined space means a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and (3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

Grab Sample - One sample collected at one location and at one specific time.

Hand Auger - A sampling device used to extract soil from the ground.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

Sample for Non-Volatile Analyses - Includes all chemical parameters other than volatile organics (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2 to 3.5 inches OD. The larger sizes are commonly used when a larger volume of sample material is required (see Attachment B).

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher, excavator, or bulldozer).

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Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, selecting proposed sampling locations, and selecting field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring, and excavation activities and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation, and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface, near-surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits, and trenches and for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and/or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.

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- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Health and safety precautions are identified for individual sample collection procedures throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard or uneven surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas, along roadways and highways.

Methods of avoiding these hazards are provided below.

Knee injuries – If kneeling is required during soil sampling, this could result in knee injuries from stones/foreign objects and general damage due to stress on the joints. To minimize this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.
- Stretch ligaments, tendons and muscles before, during and after. Take breaks as frequently as necessary.
- Report pre-existing conditions to the SSO if you feel this activity will aggravate an existing condition.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample locations. To minimize these hazards:

- Pre-survey sampling locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations - To prevent cuts and lacerations associated with soil sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.

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- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.
- Secure items to be cut – do not hold them against the opposing hand, a leg, or other body part.
- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken sample jars or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities – ASSUME THEY DO NOT SEE YOU OR MEMBERS OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind spot.
- **Provide a required free space of travel.** Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver. Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

6.0 PROCEDURES

The following procedures address surface and subsurface sampling.

CAUTION

Each situation must be evaluated individually to determine the applicability and necessity for obtaining a utility clearance ticket/dig permit. Common sense dictates, prior to digging or boring with power equipment, no matter what the depth, or digging by hand in a manner that could damage unprotected underground utilities, that a dig permit is required. See SOP HS-1.0, Utility Locating and Excavation Clearance, for additional clarification. If you do not know or are unsure as to whether a ticket is necessary – **Get the Ticket.**

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6.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate to the water table, and can establish the amount of contamination absorbed or adsorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during sampling operations, particularly noting sampling locations, depths, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. Certain vegetation species can create degradation products that can alter contaminant concentrations in soil. This is why vegetation types and extent of degradation of this foliage must be recorded. To prevent degradation, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible after collection. In addition, to the extent possible, vegetation should be removed from the sample.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. It is the intent of this document to present the most commonly employed soil sampling methods used at hazardous waste sites.

6.2 Soil Sample Collection

6.2.1 Procedure for Preserving and Collecting Soil Samples for Volatile Organic Compound Analysis

Samples collected using traditional methods such as collection in a jar with no preservation have been known to yield non-representative samples due to loss of volatile organic compounds (VOCs). To prevent such losses, preservation of samples with methanol or sodium bisulfate may be used to minimize volatilization and biodegradation. This preservation may be performed either in the field or laboratory, depending on the sampling methodology employed. Because of the large number of sampling methods and associated equipment required, careful coordination between field and laboratory personnel is needed.

Soil samples to be preserved by the laboratory are currently being collected using Method SW-846, 5035. For samples preserved in the field, laboratories are currently performing low-level analyses (sodium bisulfate preservation) and high- to medium-level analyses (methanol preservation) depending on the needs of the end user.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

6.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organic analysis that are to be preserved at the laboratory shall be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample shall be

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obtained using a reusable sampling handle (T-handle) that can be provided with the EnCore™ sampler when requested and purchased. Collect the sample in the following manner for each EnCore™ sampler:

1. Scene Safety - Evaluate the area where sampling will occur. Ensure that the area is safe from physical, chemical, and natural hazards. Clear or barricade those hazards that have been identified.
2. Wear the appropriate personal protective equipment (PPE). This will include, at a minimum, safety glasses and nitrile surgeon's gloves. If you must kneel on the ground or place equipment on the surface being sampled, cover the ground surface with plastic to minimize surface contamination of your equipment and clothing. Wear knee pads to protect your knees from kneeling on hard or uneven surfaces.
3. Load the Encore™ sampler into the T-handle with the plunger fully depressed.
4. Expose the area to be sampled using a hand trowel or similar device to remove surface debris.
5. Press the T-handle against the freshly exposed soil surface, forcing soil into the sampler. The plunger will be forced upward as the cavity fills with soil.
6. When the sampler is full, rotate the plunger and lock it into place. If the plunger does not lock, the sampler is not full. This method ensures there is no headspace. Soft soil may require several plunges or forcing soil against a hard surface such as a sample trowel to ensure that headspace is eliminated.
7. Use a paper towel to remove soil from the side of the sampler so a tight seal can be made between the sample cap and the rubber O-ring.
8. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.
9. Remove any surface soil from the outside of the sampler and place in the foil bag provided with the sampler. Good work hygiene practices and diligent decontamination procedures prevents the spread of contamination even on the outside of the containers.
10. Label the bag with appropriate information in accordance with SOP SA-6.3.
11. Place the full sampler inside a lined cooler with ice and cool to 4°C ± 2 °C. Make sure any required trip blanks and temperature blanks are also in the cooler. Secure custody of the cooler in accordance with SOP SA-6.3.
12. Typically, collect three Encore™ samplers at each location. Consult the SAP or laboratory to determine the required number of Encore™ samplers to be collected.
13. The T-handle shall be decontaminated before moving to the next interval or location using a soap and water wash and rinse, and where applicable, the selected solvent as defined in the project planning documents.

Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each Encore™ sampler.

After the Encore™ samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

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6.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) and high- to medium-level (methanol preservation) methods.

Safety Reminder

When using chemicals in the field to preserve samples, the FOL and/or SSO must ensure that Materials Safety Data Sheets (MSDSs) have been provided with the chemicals to be used. They also must ensure that these chemicals have been added to the Chemical Inventory List contained within Section 5.0, Hazard Communication, of your Health and Safety Guidance Manual (HSGM). Lastly, but most importantly, the FOL and/or SSO must review the hazards with personnel using these chemicals and ensure that provisions are available for recommended PPE and emergency measures (e.g., eyewash, etc.).

Methanol Preservation (High to Medium Level):

Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Soil samples to be preserved in the field with methanol shall utilize 40 to 60 mL glass vials with septum-lined lids. Each sample bottle shall be filled with 25 mL of demonstrated analyte-free purge-and-trap grade methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

CAUTION

NEVER attempt to pipette by mouth

In situations where personnel are required to spike the septum using a hypodermic needle, the following provisions for handling sharps must be in place:

- Training of personnel regarding methods for handling of sharps
- Hard-sided containers for the disposal of sharps
- Provisions for treatment in cases where persons have received a puncture wound

Soil shall be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol-preserved sample bottle. Calibration of the scale shall be performed prior to use and intermittently throughout the day according to the manufacturer's requirements.

The sample should be collected as follows:

1. Weigh the unused syringe and plunger to the nearest 0.01 gram.
2. Pull the plunger back and insert the syringe into the soil to be sampled.
3. Collect 8 to 12 grams of soil by pushing the syringe barrel into the soil.
4. Weigh the sample and adjust until obtaining the required amount of sample.

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5. Record the sample weight to the nearest 0.01 gram in the field logbook and/or on the sample log sheet.
6. Extrude the weighed soil sample into the methanol-preserved sample bottle taking care not to contact the sample container with the syringe.
7. If dirty, wipe soil particles from the threads of the bottle and cap. Cap the bottle tightly.
8. After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol.
9. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

Sodium Bisulfate Preservation (Low Level):

CAUTION

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soil containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode. To avoid this hazard or hazards of this type, a small sample aliquot should be subjected to the sample preservative. If it effervesces in an open air environment, utilize an alternative method such as Encore™ or 2-ounce jar.

Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be preserved in the field using the sodium bisulfate method are to be prepared and collected as follows:

1. Add 1 gram of sodium bisulfate to 5 mL of laboratory-grade deionized water in a 40 to 60 mL glass vial with septum-lined lid.
2. Collect the soil sample and record the sample weight to the nearest 0.01 gram in the field logbook or on the sample log sheet as described for methanol preservation
3. Add the weighed sample to the sample vial.
4. Collect duplicate samples using the methanol preservation method on a one-for-one sample basis because it is necessary for the laboratory to perform both low-level and medium-level analyses.
5. Place the samples on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

NOTE

If lower detection limits are necessary, an option to field preserving with sodium bisulfate may be to collect EnCore™ samplers at a given sample location. Consult the planning documents to determine whether this is required. If it is, collect samples in accordance with the Encore™ sampling procedure above and then send all samplers to the laboratory to perform the required preservation and analyses.

6.2.2 Procedure for Collecting Soil Samples for Non-Volatile Analyses

Samples collected for non-volatile analyses may be collected as either grab or composite samples as follows:

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1. With a stainless steel trowel or other approved tool, transfer a portion of soil to be sampled to a stainless steel bowl or disposable inert plastic tray.
2. Remove roots, vegetation, sticks, and stones larger than the size of a green pea.
3. Thoroughly mix the soil in the bowl or tray to obtain as uniform a texture and color as practicable. The soil type, moisture content, amount of vegetation, and other factors may affect the amount of time required to obtain a properly mixed sample. In some cases, it may be impossible to obtain a uniform sample appearance. Use the field logbook to describe any significant difficulties encountered in obtaining a uniform mixture.
4. Transfer the mixed soil to the appropriate sample containers and close the containers.
5. Label the sample containers in accordance with SOP SA-6.3.
6. Place the containers in a cooler of ice as soon after collection as possible.
7. Prepare the sample shipment and ship the samples in accordance with SOP SA-6.1.

NOTE

Cooling may not be required for some samples depending on the scheduled analyses. Consult the planning documents if in doubt regarding correct sample preservation conditions. When in doubt – Cool to 4° C.

NOTE

Head space is permitted in soil sample containers for non-volatile analyses to allow for sample expansion.

6.2.3 Procedure for Collecting Undisturbed Soil Samples

NOTE

Use of thin-walled undisturbed tube samplers is restricted by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soil with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soil. Using these devices normally increases sampling costs, and therefore their use should be weighed against the need for acquiring an undisturbed sample. These devices are not discussed in this SOP because they are not commonly used.

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) shall be employed using the following collection procedure:

1. In preparation for sampling utilizing a drill rig, field personnel must complete the following activities:
 - Ensure that all subsurface drilling activities are preceded by a utility clearance for the area to be investigated. This includes activities described in SOP HS-1.0, Utility Location and Excavation Clearance, as well as any location-specific procedures that may apply.

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REMEMBER

If you are digging near a marked utility (within the diameter of an underground utility that has been marked plus 18 inches), you must first locate the utility through vacuum extraction or hand digging to ensure that your activities will not damage the utility.

- Complete an Equipment Inspection Checklist for the drill rig or direct-push technology (DPT) rig. This checklist will be provided in the HASP.
 - Review the Safe Work Permit prior to conducting the activity.
 - Review the activity to be conducted.
2. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and/or clean out the borehole to the desired sampling depth. Be careful to minimize potential disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.

CAUTION

The use of bottom-discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Only the use of side-discharge bits is permitted.

3. Determine whether a stationary piston-type sampler is required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used.
4. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal. In addition, the check valve maintains a positive suction within the tube to help retain the sample.
5. A stainless steel tube sampler is typically used to minimize chemical reaction between the sample and the sampling tube.
6. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil with a continuous and rapid motion, without impacting or twisting. If the soil is too hard to penetrate by pushing alone, careful hammering may be used by minimizing drop distance (tapping) of the hammer. Before pulling the tube, turn it at least one revolution to shear the sample off at the bottom. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
7. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated.
8. Remove disturbed material in the upper end of the tube and measure the length of sample again.
9. After removing at least 1 inch of soil from the lower end, place enough packing material (clean inert material such as paper or cloth) tightly in each end of the Shelby tube and then pour melted wax into each end to make at least a ½-inch wax plug and then add more packing material to fill the voids at both ends.

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10. Place plastic caps on the ends, tape the caps in place, and dip the ends in wax to prevent loss of soil.
11. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label.
12. Mark the "up" direction on the side and upper end of the tube with indelible ink.
13. Complete a chain-of-custody form (see SOP SA-6.3) and other required forms (including Attachment A of this SOP).
14. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

CAUTION

To preserve sample integrity do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times.

CAUTION

A primary concern in the preparation of the wax plugs is the potential for the heat source and melted wax to cause a fire and/or burns. Follow the directions below to prevent injury or fire.

Electrical Heating

Using hot plates to melt the wax is acceptable. In an outdoor setting, make sure a Ground Fault Circuit Interrupter (GFCI) is employed within the electrical circuit. If a portable generator is used, ensure that the generator is an adequate distance from the sampling operation (at least 50 feet). Ensure that the extension cord is rated for the intended load and for outdoor use and is free from recognizable damage. Ensure flammable preservatives are not employed or stored near the hot plate. Although a Hot Work Permit is not required, scene safety evaluation by site personnel of the above elements is. As always, if a fire potential exists, the provisions for extinguishing must be immediately accessible as well as any provisions for first aid measures.

Open Flame

If an open flame is used, the following provisions are necessary:

- Complete a Hot Work Permit and any local permit required for elevated temperature applications. The Hot Work Permit, provided in your HASP, will aid the FOL and/or the SSO in ensuring that fire protection provisions (extinguishers, fire watches, etc.) are in place as well as ensuring that local requirements have been addressed.
- Ensure that water is available to address any wax splashes or contact. If possible, immerse the contacted area. Where this is not possible, run water over the area and apply cold compresses. The need for medical attention or first aid shall be determined on site under the direction of the SSO.

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6.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples for subsequent analysis is by use of a stainless steel shovel, hand auger, soil corer, or stainless steel or disposable plastic trowel.

NOTE

Multiple depth intervals are used to describe surface soil. Sometimes surface soil is defined as soil from 0 to 2 inches below ground surface (bgs), and sometimes it is defined as soil from other depths such as 0 to 2 feet bgs. Ensure that the definition of surface soil depth is clear before collecting surface soil samples.

For the purposes of instruction, the terms "surface soil" and "near-surface soil" are used in this SOP as follows:

- Surface soil - 0 to 6 inches bgs
- Near-surface soil - 6 to 18 inches bgs

If these intervals are defined differently in the planning documents, substitute the appropriate depth ranges.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Stainless steel hand auger, soil corer, or shovel.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in project planning document.
- Required PPE.
 - Nitrile surgeon's or latex gloves may be used, layered as necessary.
 - Safety glasses
 - Other – Items identified on the Safe Work Permit may be required based on location-specific requirements such as hearing protection, steel-toed work boots, and a hard hat when working near a drill rig. These provisions will be listed in the HASP or directed by the FOL and/or SSO.

Safety Reminder

The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP)
- Required decontamination equipment
- Required sample container(s)
- Wooden stakes or pin flags

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- Sealable polyethylene bags (e.g., Ziploc® baggies)
- Heavy duty cooler
- Ice
- Chain-of-custody records and custody seals

When acquiring surface soil samples, use the following procedure:

1. Place padding or use knee pads when kneeling near the sample location. If necessary, place plastic sheeting to provide a clean surface for sample equipment to avoid possible cross- contamination.
2. Carefully remove vegetation, roots, twigs, litter, etc. to expose an adequate soil surface area to accommodate sample volume requirements.
3. Using a precleaned syringe or EnCore™ samplers, follow the procedure in Section 6.2.1 for collecting surface soil samples for volatile analysis. Surface soil samples for volatile organic analysis should be collected deeper than 6 inches bgs because shallower material has usually lost most of the volatiles through evaporation. Ensure that the appropriate surface soil depth is being analyzed in accordance with the planning document.
4. Using decontaminated sampling tools, thoroughly mix in place a sufficient amount of soil to fill the remaining sample containers. See Section 6.5 of this procedure for hand auger instruction, as needed.
5. Transfer the sample into those containers utilizing a stainless steel trowel.
6. Cap and securely tighten all sample containers.
7. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.
8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.
9. Site restoration – Whenever removing sample materials, always restore the surface. It is our intent to leave the area better than we found it. Do NOT create trip hazards in areas when pedestrian traffic may exist.

6.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6 to 18 inches) can be accomplished with tools such as shovels, hand auger, soil corers, and stainless steel or pre-cleaned disposable trowels and the equipment listed under Section 6.5 of this procedure.

To obtain near-surface soil samples, the following protocol shall be used:

1. With a clean shovel, make a series of vertical cuts in the soil to the depth required to form a square approximately 1 foot by 1 foot.
2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.

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3. Follow steps 1 through 9 of Section 6.3.

6.5 Subsurface Soil Sampling With a Hand Auger

A hand augering system generally consists of a variety of stainless steel bucket bits (approximately 6.5 inches long and 2, 2.75, 3.25, and 4 inches in diameter), series of extension rods (available in 2-, 3-, 4- and 5-inch lengths), and a T-handle connected to extension rods and to the auger bucket. A larger-diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then it is withdrawn. The larger-diameter bit is then replaced with a smaller-diameter bit, lowered down the hole, and slowly turned into the soil to the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil either from the surface, or to depths in excess of 12 feet. However, the presence of subsurface rocks and landfill material and collapse of the borehole normally limit sampling depth.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes)
- Stainless steel mixing bowls
- The equipment listed in Section 6.3
- Miscellaneous hand tools as required to assemble and disassemble the hand auger units

CAUTION

Potential hazards associated with hand augering include:

- Muscle strain and sprain due to over twisting and/or over compromising yourself.
- Equipment failure due to excessive stress on the T-handle or rods through twisting. Failure of any of these components will result in a sudden release and potential injury due to that failure.

As in all situations, any intrusive activities that could damage underground utilities shall be preceded by a Dig/Excavation permit/ticket. Call the Utility Locating service in the area or your Project Health and Safety Officer for more information. When in doubt – **Get the Ticket!**

To obtain soil samples using a hand auger, use the following procedure:

1. Wearing designated PPE, attach a properly decontaminated bucket bit to a clean extension rod and attach the T-handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Twist the bucket into the ground while pushing vertically downward on the auger. The cutting shoes fill the bucket as it is advanced into the ground.
4. As the auger bucket fills with soil, periodically remove any unneeded soil.

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5. Add rod extensions as necessary to extend the reach of the auger. Also, note (in a field notebook, boring log, and/or on a standardized data sheet) any changes in the color, texture or odor of the soil as a function of depth. The project-specific planning document (SAP, HASP, etc.) describe requirements for scanning the soil with a real-time air monitoring instrument (e.g., PID, FID, etc.) and recording the measurements.
6. After reaching the desired depth (e.g., the top of the interval to be sampled), slowly and carefully withdraw the apparatus from the borehole to prevent or minimize movement of soil from shallower intervals to the bottom of the hole.
7. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is to be smaller in diameter than the bucket bit employed to initiate the borehole.
8. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
9. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
10. Discard the top of the core (approximately 1 inch), which represents any loose material collected by the bucket bit before penetrating the sample material.
11. Using a precleaned syringe or EnCore™ samplers, follow the procedure in Section 6.2.1 for collecting a soil sample for volatile compound analysis directly from the bucket bit.
12. Utilizing a properly decontaminated stainless steel trowel or dedicated disposable trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl.
13. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers. Refer to Section 6.2.2.
14. Follow steps 4 through 7 listed in Section 6.3.

6.5.1 Sampling Using Stainless Steel Soil Corers

A soil corer is a stainless steel tube equipped with a cutting shoe and sample window in the side. The soil corer is advanced into the soil by applying downward pressure (body weight). The soil is unloaded by then forcing a ram towards the cutting shoe, which results in the discharge of the soil core through a window in the sleeve.

Use, application, and sample protocol is the same as for hand augering provided above, but without necessarily rotating the corer while advancing it.

SAFETY REMINDER

Hand augering and soil corer sampling can be physically demanding based on the type of geology and subsurface encumbrances encountered. Soil coring has some added hazards such as the corer collapsing under your weight. To reduce the potential for muscle strain and damage, the following measures will be incorporated:

- Stretch and limber your muscles before heavy exertion. This hazard becomes more predominant in the early morning hours (prior to muscles becoming limber) and later in the day (as a result of fatigue).

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- Job rotation – Share the duties so that repetitive actions do not result in fatigue and injury.
- Increase break frequencies as needed, especially as ambient conditions of heat and/or cold stress may dictate.
- Do not force the hand tools or use cheater pipes or similar devices to bypass an obstruction. Move to another location near the sampling point. Exerting additional forces on the sampling devices can result in damage and/or failure that could potentially injure someone in the immediate vicinity.
- Do not over compromise yourself when applying force to the soil corer or hand auger. If there is a sudden release, it could result in a fall or muscle injury due to strain.

6.6 Subsurface Soil Sampling with a Split-Barrel Sampler

A split-barrel (split-spoon) sampler consists of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-pound or larger casing driver.

Safety Reminder

It is intended through the Equipment Inspection for Drill Rigs form provided in the HASP that the hammer and hemp rope, where applicable, associated with this activity will be inspected (no physical damage is obvious), properly attached to the hammer (suitable knots or sufficient mechanical devices), and is in overall good condition.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (2-inch OD, 1-3/8-inch ID, either 20 inches or 26 inches long); Larger OD samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-pound weight, driving head, and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed in Section 6.3.

The following steps shall be followed to obtain split-barrel samples (Steps 1 through 4 are typically performed by the drilling subcontractor):

1. Attach the split-barrel sampler to the sampling rods.

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2. Lower the sampler into the borehole inside the hollow stem auger bits.
3. Advance the split-barrel sampler by hammering the length (typically 18 or 24 inches) of the split-barrel sampler into the soil using 140-pound or larger hammer.
4. When the desired depth is achieved, extract the drill rods and sampler from the augers and/or borehole.
5. Detach the sampler from the drill rods.
6. Place the sampler securely in a vise so it can be opened using pipe wrenches.

CAUTION

Pipe wrenches are used to separate the split spoon into several components. The driller's helper should not apply excessive force through the use of cheater pipes or push or pull in the direction where, if the wrench slips, hands or fingers will be trapped against an immovable object.

7. Remove the drive head and nosepiece with the wrenches, and open the sampler to reveal the soil sample.
8. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.) (as project-specific planning documents dictate). Carefully separate (or cut) the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.
9. If elevated vapor readings were observed, collect the sample scheduled for volatile analysis from the center of the core where elevated readings occurred. If no elevated readings were encountered, the sample material should be collected from the core's center (this area represents the least disturbed area with minimal atmospheric contact) (refer to Section 6.2.1).
10. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl.
11. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers (refer to Section 6.2.2).
12. Follow steps 4 through 7 in Section 6.3.

6.7 Subsurface Soil Sampling Using Direct-Push Technology

Subsurface soil samples can be collected to depths of 40+ feet using DPT. DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

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6.8 Excavation and Sampling of Test Pits and Trenches

6.8.1 **Applicability**

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

CAUTION

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise from the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden, steel, or aluminum support structures or through sloping and benching. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments; therefore, monitoring will be conducted by the Competent Person to determine if it is safe to enter. Any entry into a trench greater than 4 feet deep will constitute a Confined Space Entry and must be conducted in conformance with OSHA standard 29 CFR 1910.146. In all cases involving entry, substantial air monitoring, before entry, appropriate respiratory gear and protective clothing determination, and rescue provisions are mandatory. There must be at least three people present at the immediate site before entry by one of the field team members. This minimum number of people will increase based on the potential hazards or complexity of the work to be performed. The reader shall refer to OSHA regulations 29 CFR 1926.650, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146. High-hazard entries such as this will be supported by members of the Health Sciences Group professionally trained in these activities.

Excavations are generally not practical where a depth of more than about 15 to 20-feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If soil data at depths greater than 15-feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

6.8.2 **Test Pit and Trench Excavation**

Test pits or trench excavations are constructed with the intent that they will provide an open view of subsurface lithology and/or disposal conditions that a boring will not provide. These procedures describe the methods for excavating and logging test pits and trenches installed to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

Test pits and trenches may be excavated by hand or power equipment to permit detailed descriptions of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration

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- The space required for efficient excavation
- The chemicals of concern
- The economics and efficiency of available equipment

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table provides guidelines for design consideration based on equipment efficiencies.

Equipment	Typical Widths, in Feet
Trenching machine	0.25 to 1.0
Backhoe/Track Hoe	2 to 6

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, the following field conditions may necessitate revisions to the initial plans:

- Subsurface utilities
- Surface and subsurface encumbrances
- Vehicle and pedestrian traffic patterns
- Purpose for excavation (e.g., the excavation of potential ordnance items)

The final depth and construction method shall be collectively determined by the FOL and designated Competent Person. The actual layout of each test pit, temporary staging area, and spoils pile may further be predicated based on site conditions and wind direction at the time the test pit is excavated. Prior to excavation, the area may be surveyed by magnetometer or metal detector or other passive methods specified in SOP HS1.0, Utility Location and Excavation Clearance, to identify the presence of underground utilities or drums. Where possible, the excavator should be positioned upwind and preferably within an enclosed cab.

No personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is required, OSHA requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be placed for every 25 feet of lateral travel and extended 3 feet above ground surface). A temporary guard rail or vehicle stop must be placed along the surface of the hole before entry in situations where the excavation may be approached by traffic. Spoils will be stockpiled no closer than 2 feet from the sidewall of the excavation. The excavation equipment operator shall be careful not to undercut sidewalls and will, where necessary, bench back to increase stability. The top cover, when considered clean, will be placed separately from the subsurface materials to permit clean cover. It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example,

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samples of leachate, groundwater, or sidewall soil can be collected with telescoping poles or similar equipment.

Dewatering and watering may be required to ensure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation stable. This is an important consideration for excavations in cohesionless material below the groundwater table and for excavations left open greater than a day. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

Where possible excavations and test pits shall be opened and closed within the same working day. Where this is not possible, the following engineering controls shall be put in place to control access:

- Trench covers/street plates
- Fences encompassing the entire excavation intended to control access
- Warning signs warning personnel of the hazards
- Amber flashing lights to demarcate boundaries of the excavation at night

Excavations left open will have emergency means to exit should someone accidentally enter.

6.8.3 Sampling in Test Pits and Trenches

6.8.3.1 General

Log test pits and trenches as they are excavated in accordance with the Test Pit Log presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable health and safety and OSHA requirements have been met as stated above. These provisions will be reiterated as appropriate in the project-specific HASP.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information includes soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples that can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

6.8.3.2 Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

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- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottle ware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps, and right angle adapter for conduit (see Attachment D).

6.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 6.8.3.4.

- Excavate the trench or pit in several 0.5- to 1.0-foot depth increments. Where soil types support the use of a sand bar cutting plate, use of this device is recommended to avoid potentially snagging utilities with the excavator teeth. It is recommended that soil probes or similar devices be employed where buried items or utilities may be encountered. This permits the trench floor to be probed prior to the next cut.
- After each increment:
 - the operator shall wait while the sampler inspects the test pit from grade level
 - the sampler shall probe the next interval where this is considered necessary. Practical depth increments for lithological evaluations may range from 2 to 4 feet i or where lithological changes are noted.
- The backhoe operator, who will have the best view of the test pit, shall immediately cease digging if:
 - Any fluid phase, including groundwater seepage, is encountered in the test pit
 - Any drums, other potential waste containers, obstructions, or utility lines are encountered
 - Distinct changes of material being excavated are encountered

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending on the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Use the backhoe to remove loose material from the excavation walls and floor to the greatest extent possible.
- Secure the walls of the pit, if necessary. (There is seldom any need to enter a pit or trench that would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)

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- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material after it has been deposited on the ground, as follows:
 - a. The sampler or FOL shall direct the backhoe operator to remove material from the selected depth or location within the test pit/trench.
 - b. The backhoe operator shall bring the bucket over to a designated location on the sidewall a sufficient distance from the pit (at least 5 feet) to allow the sampler to work around the bucket.
 - c. After the bucket has been set on the ground, the backhoe operator shall either disengage the controls or shut the machine down.
 - d. When signaled by the operator that it is safe to do, the sampler will approach the bucket.
 - e. The soil shall be monitored with a photoionization or flame ionization detector (PID or FID) as directed in the project -specific planning documents.
 - f. The sampler shall collect the sample from the center of the bucket or pile in accordance with surface soil sampling procedures of Section 6.3 or 6.4, as applicable. Collecting samples from the center of a pile or bucket eliminates cross-contamination from the bucket or other depth intervals.
- If a composite sample is desired, several depths or locations within the pit/trench will be selected, and the bucket will be filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.

CAUTION

Care must be exercised when using the remote sampler described in the next step because of potential instability of trench walls. In situations where someone must move closer than 2 feet to the excavation edge, a board or platform should be used to displace the sampler's weight to minimize the chance of collapse of the excavation edge. Fall protection should also be employed when working near the edges or trenches greater than 6 feet deep. An immediate means to extract people who have fallen into the trench will be immediately available. These means may include ladders or rope anchor points.

- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the sidewall or bottom of the pit as follows:
 - a. Scrape the face of the pit/trench using a long-handled shovel or hoe to remove the smeared zone that has contacted the backhoe bucket.
 - b. Collect the sample directly into the sample jar, by scraping with the jar edge, eliminating the need for sample handling equipment and minimizing the likelihood of cross-contamination.
 - c. Cap the sample jar, remove it from the remote sampler assembly, and package the sample for shipment in accordance with SOP SA-6.3.
- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

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6.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soil or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- There are no practical alternative means of obtaining such data.
- The SSO and Competent Person determine that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of oxygen concentration, flammable gases, and toxic compounds, in that order). Action levels will be provided in project-specific planning documents.
- A company-designated Competent Person determines that the pit/trench is stable through soil classification evaluation/inspections or is made stable (by cutting/grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements shall be strictly observed.

If these conditions are satisfied, only one person may enter the pit/trench. On potentially hazardous waste sites, this individual shall be dressed in selected PPE as required by the conditions in the pit. He/she shall be affixed to a harness and lifeline and continuously monitored while in the pit.

A second and possible third individual shall be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations to support self rescue or assisted self rescue. The individual entering the pit shall remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon.

6.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 6.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., thin-walled tube samplers), that can be pushed or driven into the floor of the test pit.
- Suitable driving (e.g., sledge hammer) or pushing (e.g., backhoe bucket) equipment used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

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Disturbed grab or bulk geotechnical soil samples may be collected for most soil in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification: larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soil using thin-walled tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability, and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the tube when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 6.8.3.4 shall be followed. The thin-walled tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate because the sample will not have the correct orientation.

A sledge hammer or backhoe may be used to drive or push the tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. When using a sledge hammer, it is recommended that the sampler be stabilized using a rope/strap wrench or pipe wrench to remove the person's hands holding the sampler from the strike zone. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hook the sampler to the excavator or backhoe and extract. This means an alternative head will be used as a connection point or that multiple choke hitches will be applied to extract the sampler. If this fails and the excavator can dig deeper without potentially impacting subsurface utilities, excavate the sampler. If this fails or if the excavator cannot be used due to subsurface utilities, hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry into the test pit, the requirements in Section 6.8.3.4 must be followed. Prepare the sample as described in Steps 9 through 13 in Section 6.2.3, and label, pack and transport the sample in the required manner, as described in SOPs SA-6.3 and SA-6.1.

6.8.4 Backfilling of Trenches and Test Pits

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew may photograph, if required by the project-specific work plan, all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL. Backfill should be returned to the trench or test pit in 6-inch to 1-foot lifts and compacted with the bucket. Remote controlled tampers or rollers may be lowered into the trench and operated from top side. This procedure will continue to the grade surface. It is recommended that the trench be tracked or rolled in. During excavation, clean soil from the top 2 feet may have been separated to be used to cover the last segments. Where these materials are not clean, it is recommended that clean fill be used for the top cover.

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If a low-permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

6.9 Records

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler for all samples collected. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining GPS coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. If the project-specific work plan requires photographs, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits, and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job
- Date of boring and excavation
- Approximate surface elevation
- Total depth of boring and excavation
- Dimensions of pit
- Method of sample acquisition
- Type and size of samples
- Soil and rock descriptions
- Photographs if required
- Groundwater levels
- PID/FID/LEL/O₂ meter readings
- Other pertinent information, such as waste material encountered

In addition, site-specific documentation to be maintained by the SSO and/or Competent Person will be required including:

- Calibration logs
- Excavation inspection checklists

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- Soil type classification

7.0 REFERENCES

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

USEPA, November 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.

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**ATTACHMENT A
SOIL & SEDIMENT SAMPLE LOG SHEET**



Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page ___ of ___

Project Site Name: _____	Sample ID No.: _____
Project No.: _____	Sample Location: _____
<input type="checkbox"/> Surface Soil	Sampled By: _____
<input type="checkbox"/> Subsurface Soil	C.O.C. No.: _____
<input type="checkbox"/> Sediment	Type of Sample:
<input type="checkbox"/> Other: _____	<input type="checkbox"/> Low Concentration
<input type="checkbox"/> QA Sample Type: _____	<input type="checkbox"/> High Concentration

GRAB SAMPLE DATA:			
Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

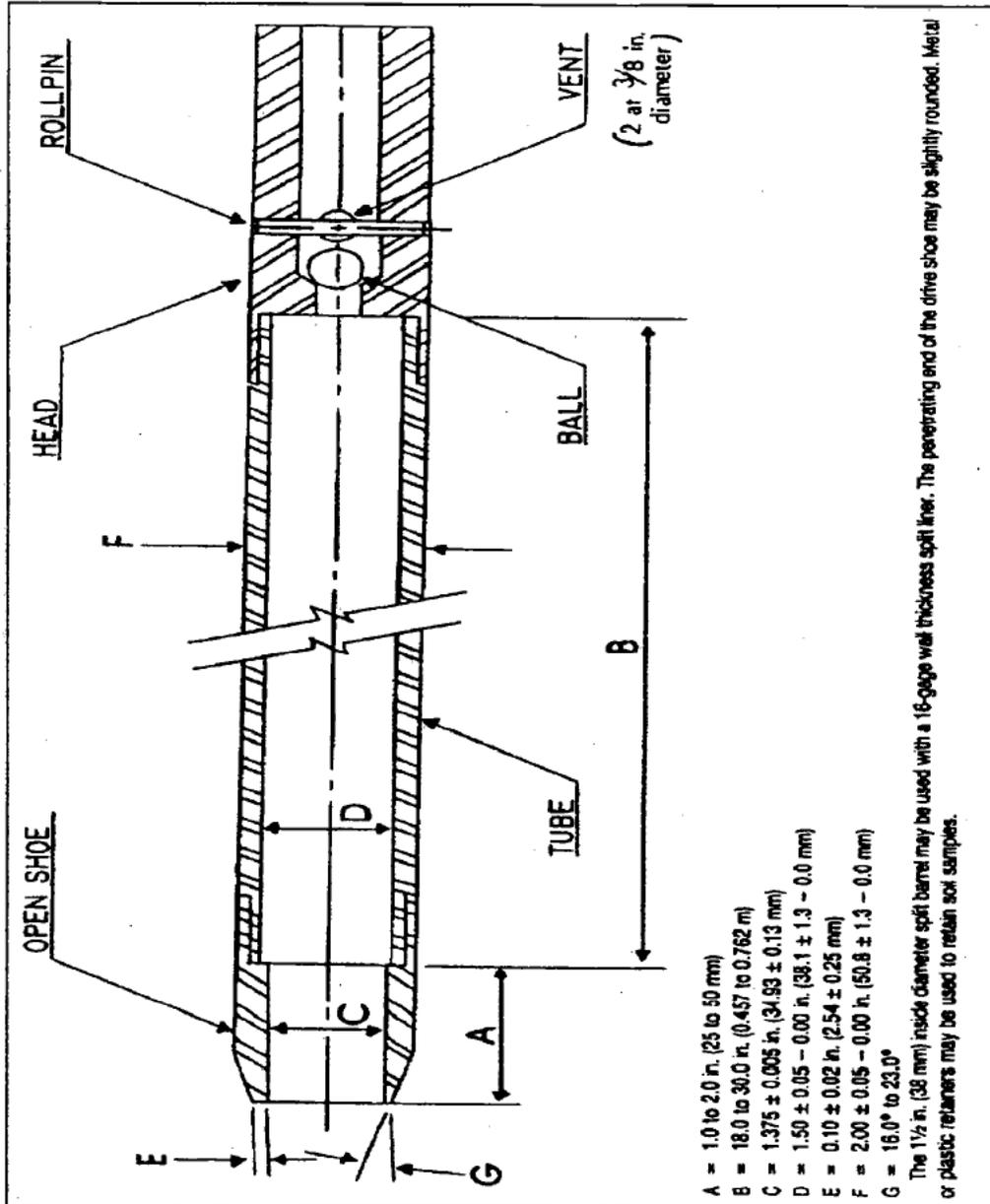
COMPOSITE SAMPLE DATA:				
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:			
Analysis	Container Requirements	Collected	Other

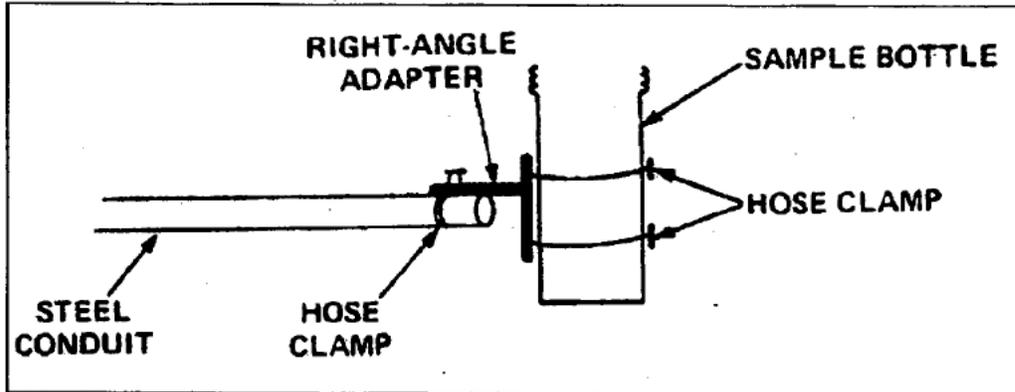
OBSERVATIONS / NOTES:	MAP:

Circle if Applicable:	Signature(s):
MS/MSD Duplicate ID No.:	

ATTACHMENT B SPLIT-SPOON SAMPLER



ATTACHMENT D
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING



ATTACHMENT 4

Laboratory SOPs

**EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURE**

ORGANICS: SOP 338

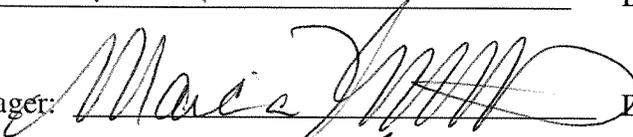
REVISION #: 08

EFFECTIVE DATE: 042910

**FLPRO
METHOD FOR DETERMINATION OF PETROLEUM RANGE
ORGANICS**

APPROVALS:

Lab Director:  Date: 4/29/10

Data Quality Manager:  Date: 4/29/10

Section Supervisor:  Date: 4/29/10

Changes Summary

Revision Date: 042910

- The SOP is a revision of rev07 dated 022410.
- Additional requirements, based upon the DoD QSM 4.1, have been integrated into the routine sample flow; however, if the requirement is different from routine sample flow, then the requirement is outlined and documented as such to be followed only when DoD samples are analyzed.
- Table 2 has been updated to reflect method surrogate limits and in-house action limits for samples.

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1. Identification of the Test Method
2. Applicable Matrix or Matrices
3. Detection Limit
4. Scope of Application, Including components to be Analyzed
5. Summary of the Test Method
6. Definitions
7. Interferences
8. Safety
9. Equipment & Supplies
10. Reagents and Standards
11. Sample Collection, Preservation, Shipment, and Storage
12. Quality Control
13. Calibration and Standardization
14. Procedure
15. Data Analysis and Calculations
16. Method Performance
17. Pollution Prevention
18. Data Assessment and Acceptance Criteria for Quality Control Measures
19. Contingencies for Handling out-of-control or unacceptable data
20. Waste Management
21. References
22. Tables, Diagrams, Flowcharts and Validation Data

PETROLEUM HYDROCARBONS

1. Test Method

1.1. This SOP is based upon method FL PRO.

2. Applicable Matrix

2.1. This SOP is applicable to the determination of the concentration of Petroleum Hydrocarbons in ground water, sediments, and wastes in the alkane range of C-8 to C-40.

3. Detection Limit

3.1. The detection limit for method FL-PRO is 0.085mg/L in water and 5.6 mg/Kg in soil.

4. Scope and Application

4.1. Water samples are preserved with sulfuric acid to pH <2 and cooled to 4°C. Soils are stored at 4°C. Waters must be extracted within 7 days and soils within 14 days from collection and analyzed within 40 days of extraction. Extracts are kept at 4°C. Observe all safety guidelines when handling samples and extracts.

4.2. This method is recommended for use by experienced analysts or under the close supervision for such qualified personnel.

5. Summary of Record

5.1. Samples are extracted via proper extraction methods. A 1µL aliquot of the extract is injected into a GC system equipped with a flame ionization detector (FID). Quantification is based on the detector response in comparison to a series of alkane standards.

6. Definitions

6.1. Laboratory Quality System SOP QS08 "Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures" provides information on the commonly used definitions.

6.2. Petroleum Hydrocarbons: All chromatographic peaks, both resolved and unresolved, eluting between the peak of n-octane (n-C8) and the peak end after n-tetracontane (n-C40). Quantitation is based on direct comparison of the area within this range to the total area of the Petroleum Hydrocarbon standard as determined from the FID response using baseline – baseline integration.

6.3. Petroleum Hydrocarbon Standard: A 17-component mix of all even-numbered alkanes from C8 to C40. This standard serves as a quantitation standard and a retention time window defining Petroleum Hydrocarbons.

7. Interferences

7.1. All materials utilized during this analysis and the GC system must be demonstrated to be free from interference. Running frequent instrument blanks and methods blanks along with using pure, GC grade solvents will assist with the monitoring of interference's within the analytical system.

7.2. Any interference's co-extracted with the samples will vary considerably from source to source. Individual samples may require additional cleanup.

8. Health and Safety

- 8.1. Laboratory SOP QS13 "Safety Program & Chemical Hygiene Plan" discusses the safety program that is to be followed lab wide.

9. Equipment and Supplies

- 9.1 Separatory Funnel - 2-Liter with Teflon stopcock
9.2 Beakers- 250 ml
9.3 Turbo-Vap evaporation tube - 200 mL tube made by Zymark to fit into Turbo-Vap evaporator
9.4 Metal or wood rack - capable of holding at a minimum six glass evaporation tubes
9.5 Turbo-Vap Evaporator - heated and capable of temperature control ($\pm 5^{\circ}\text{C}$); the bath should be vented into a hood.
9.6 Silica Gel 60
9.7 Vials - 2 mL glass clear, with Teflon-lined screw cap
9.8 pH indicator paper - close range (0-6.0) and (7.0 - 14.0); wide range (1.0 - 12.0)
9.9 Syringe - 1000 μL
9.10 Graduated cylinder - Glass, Class A, 1000 mL
9.11 Pasteur pipette - length 9" and 5-3/4"
9.12 Pipette bulb
9.13 Aluminum foil - heavy duty
9.14 Nitrogen tank - equipped with pressure regulator
9.15 Ultrasonic Disrupter – capable of 300watts output, set on 10 Full power, pulse mode of 50%
9.16 A HP GC system, equipped with a flame ionization detector (FID), is used for analyzing extracts for all target analytes.
9.17 A Restek capillary column (RTX-5, 30m x 0.32mm x 0.25 μm) is used for analysis.
9.18 HP Chemstation Datasystem is used for data collection, detecting and storage.
9.19 Autosampler vials and caps appropriate to the sample tray are used for sample injection.
9.20 Microsyringes suitable for aliquoting 1.0 μL to 1000 μL s are used for standard preparation and sample dilution.
9.21 Class A volumetrics ranging from 1.0 ml to 250 mls are used for standard, spike and surrogate preparation.

10. Standards and Reagents

- 10.1. The laboratory's LIMS system allows for complete documentation and for the traceability of reagents and standards used within the laboratory. The following information relates to the specific reagents and standards used for the performance of the method:
- 10.1.1. ASTM Type II Water.
10.1.2. Sodium Hydroxide Solution - (10N), Weigh 400 g NaOH into a 1L volumetric and cover with less than 1L reagent water. Use extreme caution when performing this step. Swirl the beaker until all pellets are dissolved (a stir plate can be used to mix the solution). This mixture gets very hot. Let stand until cool. Bring the solution up to the 1L mark with reagent water. Transfer to a 1-liter volumetric flask with several rinses of reagent water and dilute to 1 liter with reagent water. Transfer to a 1000-mL Teflon container.
10.1.3. Sodium Sulfate - Granular, anhydrous, trace pure 10 - 60 mesh placed in a Pyrex pan and heated at 400 $^{\circ}\text{C}$ overnight (minimum 4hrs), removed and cooled . Once cooled place in a labelled glass amber jar.
10.1.4. Silica Gel 60 - Granular, anhydrous, trace pure 70-230 mesh. Weigh 60g in a 250 mL glass amber jar and add 1ml DI water to deactivate. Stored at room temperature.
10.1.5. Glass Wool – Pre-rinse all glass wool used during the extraction process with Methylene Chloride.
10.1.6. Sulfuric Acid Solution - (1:1), slowly add 500 mL of Sulfuric Acid to 500 mL of reagent water in a
10.1.7. 1000 mL pyrex container. This mixture will get very warm. Allow to cool before use.

- 10.1.8. Extraction Solvent - Methylene Chloride (Dichloromethane (Please read SOP-336 before using this solvent in our laboratory)- Omnisolv - suitable for spectrophotometry and gas chromatography (JT Baker) or equivalent.
 - 10.1.9. Carbon Disulfide– (Omnisolv - suitable for spectrophotometry, liquid chromatography and gas chromatography (JT Baker) or equivalent.
 - 10.1.10. Verify the amount of surrogate/spike to add to the sample prior to addition. It can change if a different detection limit is required or the volume of sample being analyzed changes.
- 10.2. Stock Standards: Are non-Neat standards, received from vendors. These standards are used as intermediate standards to prepare working level standards. For unopened standards, if there is no expiration date assigned by the vendor, the expiration date must be assigned as 1 year from the date of receipt. For open stock standards, the expiration date is 6 months from the date the ampoule is opened or the vendor expiration date, whichever comes first. The following standards are used for the extraction and analysis of Petroleum Hydrocarbons:

<u>Vendor</u>	<u>Catalog #</u>	<u>Description/Conc</u>	<u>Used for Preparation of:</u>
Restek	31097	o-Terphenyl (OTP) 10,000 ug/ml	Curve & Surrogate Soln.
Restek	31096	2-Fluorobiphenyl (2FBP) 10,000 ug/ml	Curve & Surrogate Soln.
NSI	UST-100-08	New Jersey Petroleum Range Mix 17 comps. @ 2.0mg/ml each (total conc.=34,000ug/mL)	Spike Solution.
NSI	C-443-13	Florida TPH Mix 2000 ug/ml ea	Curve Solution
NSI	UST-100-08	New Jersey Petroleum Range Mix 17 comps. @ 2.0mg/ml each (total conc.=34,000ug/mL)	Second Source Standard

NOTE: The FL-PRO Petroleum Range Mix used for the preparation of the Spike Solution should always be a different Lot# from the Curve Standard.

10.3 Working Standards

10.3.1 Are standards made from Neat or from stock standards, and are intended for analytical runs. The expiration date for these standards is 6 months from the date of preparation or the expiration of the parent stock, whichever date is first.

10.3.2 Follow analytical judgement when using standards. Evaluate standards on a daily basis versus past standards and instrument performance. A standard may evaporate or breakdown if proper storage processes are not used. Therefore, standards may have to be discarded before expiration dates.

11. Sample Collections, Preservation, Shipment, and Storage

11.1. Quality Systems SOP QS10 related to Sample Receipt, Handling, & Processing provides details for collection, preservation, shipment, and storage.

11.2. Water samples are preserved with sulfuric acid to pH <2 and cooled to 4°C. Soils are stored at 4°C. Waters must be extracted within 7 days and soils within 14 days from collection and analyzed within 40 days of extraction. Extracts are kept at 4°C. Observe all safety guidelines when handling samples and extracts.

12. Quality Control

12.1 An extraction batch must contain of no more than 20 client samples.

12.2 One BLK1, a BS1, BSD1, and a MS, MSD must be extracted in each batch.

12.3 Please follow guideline from Table 2 for meeting QC criteria.

12.4 All surrogates must pass the established laboratory criteria.

12.4.1 With samples requiring high level dilutions due to matrix interference or due to the abundance of target analytes, the surrogate will be diluted out and no recovery will be recorded. These samples can be reported.

12.4.2 For samples failing surrogate recovery high biased due to matrix interference, document the recoveries and notify the supervisor. In most cases, a Case Narrative should be filled out, the client should be notified, and the sample should be reported without a re-extraction. For samples failing the surrogate recovery (OTP) low biased, a re-extraction may need to be performed – check with supervisor. Any low recovery for surrogates reported to client must be noted in case narrative and a CAR must be filled out. This is on a case by case basis and at the discretion of the department supervisor.

13. Calibration and Standardization

13.1 Quality Systems SOP QS08 “Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures” related to Calibration Procedures provides laboratory wide protocols for calibration and standardization. See section 14.3 of this SOP.

14. Procedure

14.1 Aqueous Extraction: All waters have a seven-day holding time. Determine the samples necessary to extract from the following sources. Note: never extract samples of unknown origin without discussion with supervisor):

14.1.1 Each day a print backlog from LIMS indicating sample numbers with the respective analysis required

14.1.2 Samples requiring RUSH turn around time may be logged in throughout the day which will require your immediate attention. Log-in personnel and or PM will generally communicate this need.

14.1.3 Periodically check LIMS throughout the day to determine what new samples have arrived. If an analysis is ongoing, extra QC may be avoided by picking up those extractions on the same day.

14.1.4 Batch samples together in the LIMS, and print the bench sheet for the batch. Make sure appropriate number of BLK1, BS1, BSD1, MS1, and MSD1 are listed. From the beginning until the end of the extraction process, continue to fill in pertinent information into the LIMS system.

14.1.5 Wearing lab coat, gloves and safety glasses, get samples from refrigerator. Samples must be signed out of the walk-in refrigerator. Enter the sample numbers, your initials and the date and time removed on the log provided. Inspect as to whether they are in glass amber jars and have a Teflon lid. Find out if any special dilutions are needed for the client. Routine procedures for difficult matrices are listed below.

14.1.6 BAD MATRIX – for example a liquid that is partially sediment, see your supervisor to find out what dilution, if any should be made.

14.1.7 Verify the ID and amount of surrogate/spike to add to the batch prior to addition. It can change if a different detection limit is required or the volume of sample being analyzed changes. Set out the surrogate/spike at least ten minutes before use to allow it to warm to room temperature.

14.1.8 Set up enough separatory funnels to extract the number of samples you have plus any additional spikes and a method blank. A BLK1, BS1, and a BSD1 must be processed with each batch of samples.

14.1.9 Place an Avery label on each separatory funnel containing the Lab #.

14.1.10 Pre-rinse all glassware with Methylene Chloride. Dispose this rinsate into the waste Methylene Chloride reservoir after each rinse. The lab batch code is generated by LIMS. The BLK1 and BS1 label should include all lab #s in this set of samples.

14.1.11 Mark the amber glass container of each sample at the water meniscus with “white out” or with a sharpie for later determination of sample volume. Determine the initial pH of sample and record on extraction sheet. If needed, adjust pH to between 1.0 and 2.0.

14.1.12 ACID pH Adjusting: Adjust the pH to between 1.0 and 2.0, using 1:1 H₂SO₄. Add the acid solution to each sample, spike and method blank. Stopper and shake to insure that pH throughout

the sample is changed. Check the pH using a 9" pipette with short-range pH paper. Compare the color to the chart on the pH paper. If the color is not within range add more H₂SO₄ solution in small increments, as required to attain the proper pH. If sample is received without proper acid preservation, pH adjustment details must be recorded in LIMS.

- 14.1.13 Using the 1000-mL glass graduated cylinder measure 1000 mL of DI water and transfer it to a separatory funnel for each BLK1, BS1 & BSD1. Transfer sample to separatory funnel that corresponds to the lab # on the sample bottle. Rinse the sample bottle about 3-5 times with 10 mls aliquots of Methylene Chloride. Transfer this rinsate into the separatory funnel labeled with the sample ID.
- 14.1.14 Fill the sample bottle up to the mark with regular water. Now pour the water into a 1000 mL graduated cylinder. The volume measured is the initial volume to be documented for the sample in the LIMS.
Add appropriate amount of spike to BS1, BSD1, MS & MSD. Also, add surrogate to all samples, BLK1, BS1, BSD1, MS & MSD.

NOTE: If using a syringe to add spike and surrogate, be sure to invert syringe and eliminate air bubble when obtaining surrogate solution and spiking solution. Add solution below the surface of the sample. Someone must verify that the spike and surrogate has been added by placing a check mark on the extraction sheet (& initialing the extraction sheet) as it is added.
- 14.1.15 Add 50 mL of Methylene Chloride to each sample and to all the batch QC. Shake the sep funnel twice and vent into the hood. Repeat this venting process 3-4 more times and then manually shake the sep funnel for two minutes. Vent the sep funnel at the end of the two minutes. Some samples may require additional venting due to excess pressure buildup. Please use precaution with highly volatile and reactive samples. Place sep funnel, inverted, in shaker apparatus with stopcock open for 3 minutes.
- 14.1.16 Allow the sample to sit for 10 minutes, if necessary, after it has been shaken. It will separate into two layers with the solvent layer on the bottom. Drain the bottom organic layer into a labeled 250 ml glass beaker first passing the extract through a funnel with glass wool and baked sodium sulfate all pre-rinsed with Methylene Chloride.
- 14.1.17 Follow Steps 14.1.15 and 14.1.16, two more times with 40 mLs of methylene chloride using the automatic shaker. Collect the extract from this step into the same beaker.
- 14.1.18 Transfer the extract to a pre-rinsed zymark tube by first passing through a funnel with glass wool and baked sodium sulfate all pre-rinsed with methylene chloride. After pouring the extract into the zymark tube, rinse the collection beaker 3-5 times with Methylene Chloride and transfer the rinsate to the zymark tube. Finally rinse the funnel with an adequate amount of Methylene Chloride using a Teflon squirt bottle. This ensures optimum transfer of all compounds of interest. Now concentrate the extract to 1.0 mL using the turbovap concentrator.
- 14.1.19 Turbo-Vap Operation: Adjust the pressure of nitrogen gas tank to 30 psi. Make sure the tank has 200 psi or more on the main valve. The temperature of the bath should be approximately 45-50°C. The pressure target range should be about 15-20 psi. Place the glass evaporator tube in the Turbo-Vap. Be sure to push tube down so the tip slides into the sensor well. Close the lid to start concentration. Check that each position with a tube has an orange light showing. If the orange light is not steady, bubbles may be detected by the sensor and need removal. (See Turbo-Vap manual).
- 14.1.20 When the beep sounds indicating the end of concentration, the extract will be at approximately 1 mL. Remove the tube from the bath.
- 14.1.21 Add methylene chloride to dissolve any precipitate. Transfer extract to a 4.0 ml vial, rinsing with methylene chloride. Adjust volume with methylene chloride to 2 ml. Add 0.3 g of silica gel and shake for 5 min.
- 14.1.22 Sign the batch into the extraction laboratory Hobart. Refrigerate at 4°C or carry directly to the instrument operator. Remit custody of the batch to the analyst or technician. The extract is now ready to be analyzed.
- 14.1.23 The extraction is now complete. Clean all glassware used during the extraction and store appropriately. Please refer to the glassware cleaning SOP for additional guidance.

- 14.2 Solid Extraction (may also follow extraction procedure outlined in SOP 343). All solids have a fourteen-day holding time counted. Determine the samples necessary to extract from the following sources (Note: never extract samples of unknown origin without discussion with supervisor):
- 14.2.1 Each day a print backlog from LIMS indicating sample numbers with the respective analysis required
 - 14.2.2 Samples requiring RUSH turn around time may be logged in throughout the day which will require your immediate attention. Log-in personnel and or PM will generally communicate this need.
 - 14.2.3 Periodically check LIMS throughout the day to determine if new samples have arrived. If an analysis is ongoing, extra QC may be avoided by picking up those extractions on the same day.
 - 14.2.5 Batch samples together in the LIMS, and print the bench sheet for the batch. Make sure appropriate number of BLK1, BS1, BSD1, MS1, and MSD1 are listed. From the beginning until the end of the extraction process, continue to fill in pertinent information into the LIMS system.
 - 14.2.6 Wearing lab coat, gloves and safety glasses, get samples from refrigerator. Samples must be signed out of the walk-in refrigerator. Enter the sample numbers, your initials and the date and time removed on the log provided. Inspect as to whether they are in glass jar. Routine procedures for difficult matrices are listed below:
 BAD MATRIX – for example a solid that is partially oil, see your supervisor to find out what dilution, if any should be made. Verify the ID and amount of surrogate/spike to add to the batch prior to addition. It can change if a different detection limit is required or the volume of sample being analyzed changes. Set out the surrogate/spike at least ten minutes before use to allow it to warm to room temperature.
 - 14.2.7 Get out enough 250mL beakers to extract the number of samples you have plus any additional spikes and a method blank. A BLK1, BS1, and a BSD1 must be processed with each batch of samples. A matrix spike and a duplicate or a matrix spike duplicate must be processed for each extraction batch (up to a maximum of 20 samples). If sufficient sample is not available to perform a batch MS & MSD indicate such on the extraction sheet.
 - 14.2.8 Pre-rinse all glassware with Methylene Chloride. Dispose this rinsate into the waste Methylene Chloride reservoir after each rinse. Label each 250mL beaker with the Lab ID.
 - 14.2.9 Pre-weigh beakers and tare. Weigh 25g aliquot of the sample to the beaker and record weight to nearest 0.01g in extraction log. Add 25g dried Sodium Sulfate powder and stir the mixture well with a stainless steel spatula to a free-flowing sandy texture. If sample mixture forms large clumps, add more Sodium Sulfate to achieve proper texture (note in extraction log).
 - 14.2.10 *It is extremely important that waste (when appropriate), soil and sediment samples be mixed thoroughly to ensure that the sample is as representative as possible of the sample media. The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:*
 - 14.2.10.1 *The material in the sample pan (inorganic-plastic/organic-aluminum) should be divided into quarters and each quarter should be mixed individually.*
 - 14.2.10.2 *Two quarters should then be mixed to form halves.*
 - 14.2.10.3 *The two halves should be mixed to form a homogenous matrix. This procedure should be repeated several times until the sample is adequately mixed.*
 NOTE: Samples that are clay type materials should be handled in a different manner. Due to these type sample matrices having an affinity to stick to most anything that touches it, another approach must be followed. Obtain a representative sub-sample aliquot from the center or middle section of the sample container.
 - 14.2.11 Add appropriate amount of spike to BS1, BSD1, MS & MSD. Also, add surrogate to all samples, BLK1, BS1, BSD1, MS & MSD.
 NOTE: If using a syringe to add spike and surrogate, be sure to invert syringe and eliminate air bubble when obtaining surrogate solution and spiking solution. Add solution below the surface of the sample. Someone must verify that the spike and surrogate has been added by placing a check mark on the extraction sheet (& initialing the extraction sheet) as it is added.
 - 14.2.12 Add 60 mL of Methylene Chloride to each sample and to all the batch QC. Sonicate each sample for 3 minutes in Ultrasonic Disruptor (set on 10 Full power – pulse mode) at a pulse rate of 50%.

- 14.2.13 Decant the Methylene Chloride extract through a funnel with glass wool and baked sodium sulfate all pre-rinsed with Methylene Chloride, into a rinsed zymark tube.
- 14.2.14 Follow Steps 14.2.12 and 14.2.13, one more time with 60 mLs of methylene chloride. Collect the extract from this step into the appropriately labeled tube.
- 14.2.15 After pouring the extract into the zymark tube, rinse the beaker 3-5 times with Methylene Chloride and transfer the rinsate to the zymark tube. Finally rinse the funnel with an adequate amount of Methylene Chloride using a Teflon squirt bottle. This ensures optimum transfer of all compounds of interest. Now concentrate the extract to 1.0 mL using the turbovap concentrator.
- 14.2.16 Turbo-Vap Operation: Adjust the pressure of nitrogen gas tank to 30 psi. Make sure the tank has 200 psi or more on the main valve. The temperature of the bath should be approximately 45-50°C. The pressure target range should be about 15-20 psi. Note the turbovap pressure and temperature on the extraction logbook.
- 14.2.17 Place the glass evaporator tube in the Turbo-Vap. Be sure to push tube down so the tip slides into the sensor well. Close the lid to start concentration. Check that each position with a tube has an orange light showing. If the orange light is not steady, bubbles may be detected by the sensor and need removal. (See Turbo-Vap manual).
- 14.2.18 When the beep sounds indicating the end of concentration, the extract will be at approximately 1 mL. Remove the tube from the bath.
- 14.2.19 Add methylene chloride to dissolve any precipitate. Transfer extract to a 4.0 ml vial, rinsing with methylene chloride. Adjust volume with methylene chloride to 2 ml. Add 0.3 g of silica gel and shake for 5 min.
- 14.2.20 Sign the batch into the GC laboratory Hobart. Refrigerate at 4°C or carry directly to the instrument operator. Remit custody of the batch to the analyst or technician. The extract is now ready to be analyzed.
- 14.2.21 The extraction is now complete. Clean all glassware used during the extraction and store appropriately. Please refer to the glassware cleaning SOP for additional guidance.

14.3 GCFID Analysis

- 14.3.1 Quality Systems SOP QS09 “General and Commonly used Laboratory Calculations” provides details on general calculations used throughout the laboratory.
- 14.3.2 Follow guidelines provided in the method for GC-FID conditions and sample volume to be injected for method FL Pro.
- 14.3.3 It is recommended that a solvent Blank be analyzed at the beginning of every sequence to ensure that the analytical instrument is free of contaminants.
- 14.3.4 All extracts within a batch are run on the Instrument after meeting calibration criteria as described in Table 2.
- 14.3.5 Qualitative and quantitative analysis is performed on samples.
 - 14.3.5.1 Qualitative Analysis for specific carbon ranges or fuel patterns, such as; mineral spirits, kerosene, JP-4 and heavy oils are performed per client request compared to specific standards. (See Table 3)
 - 14.3.5.2 Quantitative Analysis is performed using the following tools:
 - 14.3.5.2.1 Retention times for the range FL PRO C8-C40 are set daily using the mid-level of the calibration (if applicable) or the first CCV of the run by subtracting 0.05min. from the RT of C8 and adding 0.05min. to the RT of C40. FL PRO analysis is performed by running 6 calibration levels of a TPH mix from C-8 through C-40 (17 peaks). A response factor is calculated for each calibration standard (amount sum of 17 peaks/ std amount * 17), then an Average Response factor is calculated for all 6 standards. This Average Response Factor is put in the method for uncalibrated peaks. Percent RSD must be less than or equal to 20%.
 - 14.3.5.2.2 Surrogates o-Terphenyl and 2-fluorobiphenyl are added to each calibration standard at the same concentration. Initial calibration must pass acceptance criteria in Table 2.

14.3.5.2.3 Analyte concentration must be within the calibration curve range. If the analyte concentration exceeds the calibration curve range, the extract must be diluted & rerun to bring the concentration within the calibration range. Use the calculation in section 15 to report the final results for the sample.

14.3.5.2.4 Target analytes are calculated using the calibration curve and by incorporating any adjustments for initial or final volume and dilutions.

15. Data Analysis and Calculations

15.1 Quality Systems SOP QS09 “General and Commonly used Laboratory Calculations” provides details on general calculations throughout the laboratory.

15.2 Calculate the calibration factor for each analyte at each concentration as:

$$CF = \frac{\text{Peak Area (or Height) of the Compound in the Standard}}{\text{Mass of the Compound Injected (in nanograms)}}$$

The mean CF is calculated as follows:

15.3 The standard deviation (SD) and the relative standard deviation (RSD) of the calibration factors for each analyte are calculated as follows:

$$SD = \sqrt{\frac{\sum_{i=1}^n (CF_i - \overline{CF})^2}{n - 1}}$$

$$RSD = \frac{SD \times 100}{\text{Avg}CF}$$

15.4 Calibration verification involves the calculation of the percent drift (linear or quadratic) or the percent difference (average) of the instrument response between the initial calibration and each subsequent analysis of the verification standard. Use the equations below to calculate % Drift or % Difference, depending on the calibration procedure used.

$$\% \text{ Drift} = \frac{(\text{Calculated concentration} - \text{Theoretical concentration}) \times 100}{\text{Theoretical Concentration}}$$

where the calculated concentration is determined from the initial calibration and the theoretical concentration is the concentration at which the standard was prepared.

$$\% \text{ Difference} = \frac{(\text{CCV } CF - \text{Average } CF) \times 100}{\text{Average } CF}$$

- 15.5 External standard calibration - The concentration of each analyte in the sample may be determined by calculating the amount of standard injected, from the peak response, using the calibration curve. The concentration of a specific analyte is calculated as follows:

Aqueous Samples:

$$\text{Concentration } (\mu\text{g/L}) = [(A_s) (V_t) (D)] / [(CF) (\overline{V_i}) (D)]$$

where:

A_s = Response for the analyte in the sample, units may be in area counts or peak height.

V_t = Total volume of sample, mL.

D = Dilution factor, if dilution was made on the sample prior to analysis. If no dilution was made, $D = 1$.

\overline{CF} = Mean calibration factor from initial calibration (area/ng)

V_i = Volume of extract injected, μL .

V_s = Volume of aqueous sample, mL.

Using the units specified here for these terms will result in concentration units of ng/mL, which is $\mu\text{g/L}$.

Nonaqueous Samples:

$$\text{Concentration } (\mu\text{g/kg}) = [(A_s) (V_t) (D)] / [(CF) (V_i) (\overline{W_s})]$$

where:

W_s = Weight of dry sample extracted, g.

A_s , V_t , D , \overline{CF} and V_i have the same definition as for aqueous samples.

16. Method Performance

16.1 Demonstration of Capability (DOC): Each analyst must perform a DOC prior to reporting data. The analyst must prepare (for prep technicians) and analyze (analysts reviewing and reporting data) 4-LCS samples. The data is calculated for accuracy and precision requirements. The DOC form, as listed within section 2.5 of the Quality is completed by each analyst and then provided to the supervisor for further processing and approval.

16.2 See method FL-PRO for method performance.

17. Pollution Prevention

17.1 Quantity of chemicals purchased should be based on expected usage during its shelf life and the disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

18. Data Assessment and Acceptance Criteria for Quality Control Measures

18.1 Quality Control SOP QS05, “Data Deviations/Interpretations/Exceptions: Laboratory Non-Conformance/ Corrective Action Procedures, Decision Making Guidelines for Evaluating Laboratory Analytical Sample and Quality Control Results,” provides details on data assessment and acceptance criteria for Quality Control Measures. Table 2 of this SOP provides information on QC samples, frequency, and the associated criteria specific to the performance of this method.

19. Contingencies for Handling out-of-control or unacceptable data

19.1 Quality Control SOP QS05, “Data Deviations / Interpretations / Exceptions: Laboratory Non-Conformance / Corrective Action Procedures, Decision Making Guidelines for Evaluating Laboratory Analytical Sample and Quality Control Results”, provides details on handling out of control data. Table 2 within this SOP also lists corrective actions associated with the failure of the various QC samples employed for the performance of this method.

20. Waste Management and Pollution Prevention

- 20.1 Please see Waste Disposal SOPs 210 and 405 for proper waste disposal.
- 20.2 Quantity of chemicals purchased should be based on expected usage during it’s shelf-life and the disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

21. References

- 21.1 Method for Determination of Petroleum Range Organics (Method FL-PRO)

22. Tables, Diagrams, Flowcharts and Validation Data

Parameter	DL	LOD	LOQ/RL	Low Cal
FL-PRO	0.085ug/L	0.16ug/L	0.34ug/L	0.17ug/L
FL-PRO	5.6ug/Kg	10.7ug/Kg	22.6ug/Kg	11.3ug/Kg

Table 2 - Method Quality Control Requirements Summary

QC Check	Minimum Frequency / Requirements	Acceptance Criteria	Corrective Action for Failures / Data Useability
Calibration Curve	<ul style="list-style-type: none"> • Prior to analyzing any samples • A minimum of 5-points for linear fits • A minimum of 6-points for quadratic fits • Low standard at the RL/LOQ level 	<ul style="list-style-type: none"> • Linear correlation coefficient of at least 0.995 • Quadratic squared correlation coefficient of at least 0.99 • Average CF = < 20% RSD • Manual integrations on curve standards must have supervisory approval • Must follow curve processing requirements from SOP QS08 	<ul style="list-style-type: none"> • Re-evaluate curve mix and makeup • Re-run curve • Check instrument for maintenance needs • Re-prepare the curve standards <p>Samples cannot be analyzed until there is a passing calibration</p>
ICV	Alternate source standard to be analyzed after every calibration curve	<ul style="list-style-type: none"> • ≤ 25% drift or difference for all analytes 	<ul style="list-style-type: none"> • Re-analyze an ICV from a different source • Re-prepare and re-analyze the ICV • Re-calibrate and verify standard preps and sources
CCV	<ul style="list-style-type: none"> • At the beginning of every sequence • For every 10-client samples and at the end of the sequence • The concentration must be varied from low to mid range 	<ul style="list-style-type: none"> • ≤ 25% drift or difference for all analytes 	<ul style="list-style-type: none"> • Evaluate the system for required maintenance • Obtain passing CCV • Reanalyze all samples injected since last passing CCV • Q-qualify if reanalysis is not possible
MB	One per prep batch	<ul style="list-style-type: none"> • Must be less than ½ the RL/LOQ or <1/10th any sample concentration or <1/10th the regulatory limit – whichever is greater. 	<ul style="list-style-type: none"> • Re-analyze to confirm the positive value • If MB results are between the LOD and RL/LOQ, assess the data and notify the PM for possible further action • Re-extract affected samples associated with the MB • NCR and final report qualification will be required for affected samples if re-extraction is not possible.

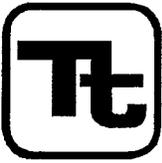
Table 2 - Method Quality Control Requirements Summary

QC Check	Minimum Frequency / Requirements	Acceptance Criteria	Corrective Action for Failures / Data Useability									
Surrogates	Spike in every field or QC sample and standard	<table border="0"> <tr> <td>Surrogate</td> <td>Water</td> <td>Soil</td> </tr> <tr> <td>OTP</td> <td>82-142 (method) 30-140 (in-house)</td> <td>62-109 (method) 45-135 (in-house)</td> </tr> <tr> <td>2-FBP</td> <td>50-150 (default)</td> <td>50-150 (default)</td> </tr> </table> <p>Note: Project limits will be used when specified.</p>	Surrogate	Water	Soil	OTP	82-142 (method) 30-140 (in-house)	62-109 (method) 45-135 (in-house)	2-FBP	50-150 (default)	50-150 (default)	<ul style="list-style-type: none"> • Batch QC should pass method limits. • Reanalyze to confirm recovery if failing in-house limits. • Re-extract associated samples, if still failing in-house limits. • Q-qualify if re-extraction is not possible or verifies exceedence.
Surrogate	Water	Soil										
OTP	82-142 (method) 30-140 (in-house)	62-109 (method) 45-135 (in-house)										
2-FBP	50-150 (default)	50-150 (default)										
LCS	One per prep batch	<p>Water 55-118% Soil 63-143% Note: Project limits will be used when specified.</p>	<ul style="list-style-type: none"> • Reanalyze to confirm recovery. • Re-extract associated samples, if still failing • Q-qualify if re-extraction is not possible 									
LCSD	One per prep batch, when MS/MSD not included.	<p>Water 55-118% RPD $\leq 20\%$ Soil 63-143% RPD $\leq 25\%$ Note: Project limits will be used when specified.</p>	<ul style="list-style-type: none"> • See LCS 									
MS/MSD	One per prep batch, if sample volume available.	<p>Water 41-110% RPD $\leq 20\%$ Soil 51-215% RPD $\leq 25\%$ Note: Project limits will be used when specified.</p>	<ul style="list-style-type: none"> • Reanalyze to confirm recovery. • Re-extract if failure is judged to be due to extraction/analysis. • J-qualify associated parent sample if reporting from results exceeding limits. 									
DOC Study	<ul style="list-style-type: none"> • Initially per analyst prior to reporting data • Annually • Follow specific guidelines from section 16 for the preparation and analysis of DOC samples 	<ul style="list-style-type: none"> • Must meet the criteria of the LCS for average recovery • Precision criteria is 20% standard deviation. 	<ul style="list-style-type: none"> • Re-prep and / or • Re-analysis 									
LOD Verification	Every quarter	<ul style="list-style-type: none"> • Parameter must be detected with response 3x the noise level 	<ul style="list-style-type: none"> • Re-prep and / or re-analysis • Raise concentration 									
LOQ Verification	Every quarter	<ul style="list-style-type: none"> • Bias Requirement: Organics 50-150% • The LOQ value must be greater than the LOD value 	<ul style="list-style-type: none"> • Re-prep and / or re-analysis • Raise concentration 									

Table 2 - Method Quality Control Requirements Summary

QC Check	Minimum Frequency / Requirements	Acceptance Criteria	Corrective Action for Failures / Data Useability
Retention Time Study	<ul style="list-style-type: none"> • Prior to running samples • With major instrument changes 	3 injections over 72 hours – calculate standard deviation of the measured retention times. Windows +/- 3xSD	If <0.05minutes use +/-0.05 minutes.

Table-3
Qualitative Analysis Tool



**TETRA TECH NUS
FIELD TASK MODIFICATION REQUEST FORM**

LTM/NAS Cecil Field
Project/Installation Name

CTO JM09, 112G02267
CTO & Project Number

02
Task Mod. Number

SAP for Petroleum Sites (April 2010)
Modification To (e.g. Work Plan)

BP Wells
Site/Sample Location

12/6/10
Date

Activity Description: At BP Wells site, nine wells are being sampled on a semi-annual basis to monitor the groundwater contaminant of concern (COC) concentrations by comparing the results against FDEP Groundwater Cleanup Target Levels (GCTLs) and Natural Attenuation Default Criteria (NADCs). All groundwater samples are being analyzed for volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and total recoverable petroleum hydrocarbon (TRPH) in accordance with the Uniform Federal Policy - Sampling and Analysis Plan (UFP-SAP) for Petroleum Sites and associated Field Task Modification Request (FTMR) 01. Although contaminant concentrations in groundwater from source area well CEF-BP-1S and downgradient area well CEF-BP-6S continue to remain at elevated levels, no contamination has been detected at levels greater than GCTLs in upgradient wells CEF-BP-7S and CEF-BP-8S for at least two events. During the November 2010 BCT meeting, the Team agreed that monitoring concentrations of COCs in groundwater from these upgradient wells was no longer required (Minute 2651, Decision 795). Water level measurements will continue to be collected from these two wells during semi-annual sampling events. The remaining seven wells in the on-going long-term monitoring program (CEF-BP-1S, CEF-BP-4S, CEF-BP-5I, CEF-BP-6S, CEF-BP-9S, CEF-BP-10S, and CEF-BP-11S) will continue to be sampled on a semi-annual basis and analyzed as described in UFP-SAP and FTMR 01.

Reason for Change: Over the two preceding sampling events, contaminant concentrations in groundwater samples from upgradient wells CEF-BP-7S and CEF-BP-8S were found to less than their respective GCTLs. Changes to the sampling plan are in accordance with the decision rules established in the April 2010 Petroleum Sites UFP-SAP.

Recommended Disposition: Verification of acceptance of the revised sampling program via approval of this FTMR via e-mail approval from Tetra Tech PM, BRAC PMO RPM, and FDEP (attached in project file).

D. Johnson
Quality Assurance Manager (QAPP lead developer)

12-6-10
Date

Approved Disposition:

Robert Simcik
Project/Task Order Manager (Signature)

12/6/10
Date

Distribution:

Program/Project File – 112G02267
Project/Task Order Manager – Robert Simcik
Field Operations Leader – Kara Wimble
BRAC PMO RPM – Art Sanford

Other: _____

ATTACHMENT B
ANALYTICAL LABORATORY REPORT
JANUARY 2011



TO: R. SIMCIK **DATE:** MARCH 3, 2011

FROM: MICHELLE ALLEN **COPIES:** DV FILE

SUBJECT: ORGANIC DATA VALIDATION – VOC/PAH/PET
CTO JM09, NAS CECIL FIELD
SDG CTOJM09CF_10

SAMPLES: 9/Aqueous /VOC

CEF-BP-01S-201101	CEF-BP-04S-201101	CEF-BP-05I-201101
CEF-BP-06S-201101	CEF-BP-09S-201101	CEF-BP-10S-201101
CEF-BP-11S-201101	CEF-BP-DUP-01-201101	TRIP BLANK

8/Aqueous/PAH/PET

CEF-BP-01S-201101	CEF-BP-04S-201101	CEF-BP-05I-201101
CEF-BP-06S-201101	CEF-BP-09S-201101	CEF-BP-10S-201101
CEF-BP-11S-201101	CEF-BP-DUP-01-201101	

OVERVIEW

The sample set for NAS Cecil Field SDG CTOJM09CF_10 consisted of nine (9) aqueous environmental samples including one (1) aqueous trip blank sample. The samples were analyzed for volatile organic compounds (VOC), polynuclear aromatic hydrocarbons (PAH), and petroleum extractables (PET). The trip blank sample was only analyzed for VOC. One field duplicate pair was associated with this Sample Delivery Group (SDG); CEF-BP-DUP-01-201101/CEF-BP-06S-201101.

The samples were collected by TetraTech NUS on January 18, 2011 and analyzed by Empirical Laboratories, LLC. All analyses were conducted in accordance with SW-846 Methods 8260B, 8270C, and Method FL-PRO analytical and reporting protocols.

The data contained in this SDG were validated with regard to the following parameters:

- * • Data Completeness
- * • Holding Times/Sample Preservation
- * • Initial/Continuing Calibrations
- * • Laboratory Method Blank Results
- * • Field Duplicate Results
- * • Detection Limits

The symbol (*) indicates that quality control criteria were met for this parameter. Problems affecting data quality are discussed below; documentation supporting these findings is presented in Appendix C. Qualified Analytical results are presented in Appendix A. Results as reported by the laboratory are presented in Appendix B.

The text of this report is formatted to address only gross non-compliances resulting in the rejection of data and the elimination of false positives.

TO: R. SIMCIK
SDG: CTOJM09CF_10

PAGE 2

VOC

No issues were identified.

PAH

No issues were identified.

PET

No issues were identified.

NOTES

Positive results reported below the Limit of Quantitation (LOQ) but above the Method Detection Limit (MDL) were qualified as estimated, (J).

EXECUTIVE SUMMARY

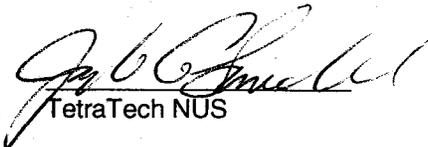
Laboratory Performance Issues: There were no laboratory issues.

Other Factors Affecting Data Quality: Positive results reported below the LOQ but above the MDL were qualified as estimated, (J).

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (10/99), SW-846 Methods 8260B, 8270C, and Method FL-PRO analytical and reporting protocols, and the Department of Defense (DoD) document entitled "Quality Systems Manual (QSM) for Environmental Laboratories" (January 2006). The text of this report has been formulated to address only those problem areas affecting data quality.



Tetra Tech NUS
Michelle L. Allen
Chemist/Data Validator



Joseph A. Samchuck
Data Validation Quality Assurance Officer

Attachments:

Appendix A – Qualified Analytical Results
Appendix B – Results as Reported by the Laboratory
Appendix C – Support Documentation

APPENDIX A

QUALIFIED ANALYTICAL RESULTS

Data Validation Qualifier Codes:

- A = Lab Blank Contamination
- B = Field Blank Contamination
- C = Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
- C01 = GC/MS Tuning Noncompliance
- D = MS/MSD Recovery Noncompliance
- E = LCS/LCSD Recovery Noncompliance
- F = Lab Duplicate Imprecision
- G = Field Duplicate Imprecision
- H = Holding Time Exceedance
- I = ICP Serial Dilution Noncompliance
- J = GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
- K = ICP Interference - includes ICS % R Noncompliance
- L = Instrument Calibration Range Exceedance
- M = Sample Preservation Noncompliance
- N = Internal Standard Noncompliance
- N01 = Internal Standard Recovery Noncompliance Dioxins
- N02 = Recovery Standard Noncompliance Dioxins
- N03 = Clean-up Standard Noncompliance Dioxins
- O = Poor Instrument Performance (e.g. base-line drifting)
- P = Uncertainty near detection limit ($< 2 \times$ IDL for inorganics and $<$ CRQL for organics)
- Q = Other problems (can encompass a number of issues; e.g. chromatography,interferences, etc.)
- R = Surrogates Recovery Noncompliance
- S = Pesticide/PCB Resolution
- T = % Breakdown Noncompliance for DDT and Endrin
- U = % Difference between columns/detectors $>25\%$ for positive results determined via GC/HPLC
- V = Non-linear calibrations; correlation coefficient $r < 0.995$
- W = EMPC result
- X = Signal to noise response drop
- Y = Percent solids $<30\%$
- Z = Uncertainty at 2 sigma deviation is greater than sample activity

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: OV MEDIA: WATER	NSAMPLE	CEF-BP-01S-201101			CEF-BP-04S-201101			CEF-BP-05I-201101			CEF-BP-06S-201101		
	LAB_ID	1101070-06			1101070-03			1101070-07			1101070-04		
	SAMP_DATE	1/18/2011			1/18/2011			1/18/2011			1/18/2011		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF												
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
1,2,4-TRIMETHYLBENZENE	77.5			0.15 U			0.15 U			162			
1,3,5-TRIMETHYLBENZENE	49.7			0.18 U			0.18 U			41.8			
BENZENE	0.14 U			0.14 U			0.14 U			0.14 U			
ETHYLBENZENE	47.5			0.15 U			0.15 U			113			
ISOPROPYLBENZENE	6.37			0.15 U			0.15 U			13.9			
TOLUENE	0.19 U			0.19 U			0.19 U			1.38			
TOTAL XYLENES	120			0.22 U			0.22 U			247			

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: OV MEDIA: WATER	NSAMPLE	CEF-BP-09S-201101			CEF-BP-10S-201101			CEF-BP-11S-201101			CEF-BP-DUP-01-201101		
	LAB_ID	1101070-05			1101070-02			1101070-01			1101070-08		
	SAMP_DATE	1/18/2011			1/18/2011			1/18/2011			1/18/2011		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF										CEF-BP-06S-201101		
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
1,2,4-TRIMETHYLBENZENE	0.717	J	P	0.15	U		0.15	U		196			
1,3,5-TRIMETHYLBENZENE	0.18	U		0.18	U		0.18	U		44.4			
BENZENE	0.14	U		0.14	U		0.14	U		0.28	U		
ETHYLBENZENE	0.279	J	P	0.15	U		0.15	U		151			
ISOPROPYLBENZENE	0.15	U		0.15	U		0.15	U		15			
TOLUENE	0.19	U		0.19	U		0.19	U		1.57	J	P	
TOTAL XYLENES	0.725	J	P	0.22	U		0.22	U		253			

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: OV MEDIA: WATER	NSAMPLE	TRIP BLANK		
	LAB_ID	1101070-09		
	SAMP_DATE	1/18/2011		
	QC_TYPE	NM		
	UNITS	UG/L		
	PCT_SOLIDS	0.0		
	DUP_OF			
PARAMETER	RESULT	VQL	QLCD	
1,2,4-TRIMETHYLBENZENE	0.15	U		
1,3,5-TRIMETHYLBENZENE	0.18	U		
BENZENE	0.14	U		
ETHYLBENZENE	0.15	U		
ISOPROPYLBENZENE	0.15	U		
TOLUENE	0.19	U		
TOTAL XYLENES	0.22	U		

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: PAH MEDIA: WATER	NSAMPLE	CEF-BP-01S-201101			CEF-BP-04S-201101			CEF-BP-05I-201101			CEF-BP-06S-201101		
	LAB_ID	1101070-06			1101070-03			1101070-07			1101070-04		
	SAMP_DATE	1/18/2011			1/18/2011			1/18/2011			1/18/2011		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF												
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
1-METHYLNAPHTHALENE	2.61			0.0185	U		0.0197	J	P	5.22			
2-METHYLNAPHTHALENE	5.86			0.0185	U		0.0266	J	P	8.98			
NAPHTHALENE	17.1			0.0185	U		0.0695	J	P	18.1			

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: PAH MEDIA: WATER	NSAMPLE	CEF-BP-09S-201101			CEF-BP-10S-201101			CEF-BP-11S-201101			CEF-BP-DUP-01-201101		
	LAB_ID	1101070-05			1101070-02			1101070-01			1101070-08		
	SAMP_DATE	1/18/2011			1/18/2011			1/18/2011			1/18/2011		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	UG/L			UG/L			UG/L			UG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF										CEF-BP-06S-201101		
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
1-METHYLNAPHTHALENE	0.0185	U		0.0185	U		0.0185	U		6.15			
2-METHYLNAPHTHALENE	0.0185	U		0.0185	U		0.0185	U		9.89			
NAPHTHALENE	0.026	J	P	0.0185	U		0.0185	U		20.2			

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: PET MEDIA: WATER	NSAMPLE	CEF-BP-01S-201101			CEF-BP-04S-201101			CEF-BP-05I-201101			CEF-BP-06S-201101		
	LAB_ID	1101070-06			1101070-03			1101070-07			1101070-04		
	SAMP_DATE	1/18/2011			1/18/2011			1/18/2011			1/18/2011		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	MG/L			MG/L			MG/L			MG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF												
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
TPH (C08-C40)	1.4			0.0787	U		0.0787	U		2.36			

PROJ_NO: 02267 SDG: CTOJM09CF_10 FRACTION: PET MEDIA: WATER	NSAMPLE	CEF-BP-09S-201101			CEF-BP-10S-201101			CEF-BP-11S-201101			CEF-BP-DUP-01-201101		
	LAB_ID	1101070-05			1101070-02			1101070-01			1101070-08		
	SAMP_DATE	1/18/2011			1/18/2011			1/18/2011			1/18/2011		
	QC_TYPE	NM			NM			NM			NM		
	UNITS	MG/L			MG/L			MG/L			MG/L		
	PCT_SOLIDS	0.0			0.0			0.0			0.0		
	DUP_OF										CEF-BP-06S-201101		
PARAMETER	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	RESULT	VQL	QLCD	
TPH (C08-C40)	0.0791	U		0.25	J	P	0.0787	U		2.49			

APPENDIX B

RESULTS AS REPORTED BY THE LABORATORY

ANALYSIS DATA SHEET

CEF-BP-01S-201101

Laboratory:	<u>Empirical Laboratories, LLC</u>	SDG:	<u>CTOJM09CF_010</u>
Client:	<u>Tetra Tech NUS, Inc. (T010)</u>	Project:	<u>CTO JM09 BP Wells_2010</u>
Matrix:	<u>Ground Water</u>	Laboratory ID:	<u>1101070-06</u>
Sampled:	<u>01/18/11 14:30</u>	Prepared:	<u>01/20/11 12:10</u>
Solids:		Preparation:	<u>EXT 3510</u>
Batch:	<u>1A20003</u>	Sequence:	<u>1A02411</u>
		Calibration:	<u>1017001</u>
		Instrument:	<u>MS-BNA4</u>

CAS NO.	COMPOUND	CONC. (ug/L)	DL	LOD	LOQ	Q
90-12-0	1-Methylnaphthalene	2.61	0.0185	0.0370	0.0926	
91-57-6	2-Methylnaphthalene	5.86	0.0185	0.0370	0.0926	
91-20-3	Naphthalene	17.1	0.0185	0.0370	0.0926	
SYSTEM MONITORING COMPOUND		ADDED (ug/L)	CONC (ug/L)	% REC	QC LIMITS	Q
2-Fluorobiphenyl		46.30	23.03	49.8	34 - 167	
Terphenyl-d14		46.30	14.46	31.2	34 - 167	*

APPENDIX C

SUPPORT DOCUMENTATION

HOLDTIME

SDG CTOJM09CF_

<u>SORT</u>	<u>UNITS</u>	<u>NSAMPLE</u>	<u>LAB_ID</u>	<u>QC_TYPE</u>	<u>SAMP_DATE</u>	<u>EXTR_DATE</u>	<u>ANAL_DATE</u>	<u>SMP_EXTR</u>	<u>EXTR_ANL</u>	<u>SMP_ANL</u>
OV	UG/L	CEF-BP-DUP-01-201101	1101070-08	NM	01/18/2011	01/24/2011	01/24/2011	6	0	6
OV	UG/L	CEF-BP-01S-201101	1101070-06	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
OV	UG/L	TRIP BLANK	1101070-09	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
OV	UG/L	CEF-BP-11S-201101	1101070-01	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
OV	UG/L	CEF-BP-10S-201101	1101070-02	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
OV	UG/L	CEF-BP-09S-201101	1101070-05	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
OV	UG/L	CEF-BP-06S-201101	1101070-04	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
OV	UG/L	CEF-BP-05I-201101	1101070-07	NM	01/18/2011	01/24/2011	01/24/2011	6	0	6
OV	UG/L	CEF-BP-04S-201101	1101070-03	NM	01/18/2011	01/22/2011	01/23/2011	4	1	5
SIM	UG/L	CEF-BP-09S-201101	1101070-05	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-06S-201101	1101070-04	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-01S-201101	1101070-06	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-04S-201101	1101070-03	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-04S-201101	1101070-03	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-05I-201101	1101070-07	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4

SORT	UNITS	NSAMPLE	LAB ID	QC_TYPE	SAMP_DATE	EXTR_DATE	ANAL_DATE	SMP_EXTR	EXTR_ANL	SMP_ANL
SIM	UG/L	CEF-BP-05I-201101	1101070-07	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-01S-201101	1101070-06	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-DUP-01-201101	1101070-08	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-06S-201101	1101070-04	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-DUP-01-201101	1101070-08RE1	NM	01/18/2011	01/20/2011	01/24/2011	2	4	6
SIM	UG/L	CEF-BP-DUP-01-201101	1101070-08	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-11S-201101	1101070-01	SUR	01/18/2011	01/20/2011	01/21/2011	2	1	3
SIM	UG/L	CEF-BP-11S-201101	1101070-01	NM	01/18/2011	01/20/2011	01/21/2011	2	1	3
SIM	UG/L	CEF-BP-10S-201101	1101070-02	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-10S-201101	1101070-02	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
SIM	UG/L	CEF-BP-09S-201101	1101070-05	SUR	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-DUP-01-201101	1101070-08	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-04S-201101	1101070-03	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-05I-201101	1101070-07	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-06S-201101	1101070-04	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-09S-201101	1101070-05	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-10S-201101	1101070-02	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4
TPH	MG/L	CEF-BP-11S-201101	1101070-01	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4

SORT	UNITS	NSAMPLE	LAB ID	QC TYPE	SAMP DATE	EXTR_DATE	ANAL_DATE	SMP_EXTR	EXTR_ANL	SMP_ANL
TPH	MG/L	CEF-BP-01S-201101	1101070-06	NM	01/18/2011	01/20/2011	01/22/2011	2	2	4



PROJECT NO: 112602267	FACILITY: WAS Coal Field BP wells	PROJECT MANAGER Rob Simcik	PHONE NUMBER 412 951 8163	LABORATORY NAME AND CONTACT: Empirical Labs/ Kim Kostzer
SAMPLERS (SIGNATURE) Zach Scribner		FIELD OPERATIONS LEADER Kara Wimble	PHONE NUMBER 904 636 6125	ADDRESS 621 Mainstream Drive Suite 270
STANDARD TAT <input checked="" type="checkbox"/> RUSH TAT <input type="checkbox"/> <input type="checkbox"/> 24 hr. <input type="checkbox"/> 48 hr. <input type="checkbox"/> 72 hr. <input type="checkbox"/> 7 day <input type="checkbox"/> 14 day		CARRIER/WAYBILL NUMBER 8660 1730 2300	CITY, STATE Nashville TN 37228	

DATE YEAR	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G)			PRESERVATIVE USED	COMMENTS
									VOLs (8660 G)	TRPH (FL PRO)	PHHs (BPD Sim)		
1/18	1020	CEF-BP-115-201101				GW	G	3	2	2	HCl G	1101070-61	Cool to 4°C
1/18	1056	CEF-BP-105-201101				GW	G	3	2	2	HCl G	-62	
1/18	1140	CEF-BP-045-201101				GW	G	3	2	2	HCl G	-63	
1/18	1220	CEF-BP-065-201101				GW	G	9	6	6	HCl G	-64	
1/18	1335	CEF-BP-095-201101				GW	G	3	2	2	HCl G	-65	
1/18	1430	CEF-BP-015-201101				GW	G	3	2	2	HCl G	-66	
1/18	1500	CEF-BP-051-201101				GW	G	3	2	2	HCl G	-67	
1/18	0000	CEF-BP-DUP-01-201101				GW	G	3	2	2	HCl G	-68	

1. RELINQUISHED BY Zach Scribner	DATE 6/1/18/2011	TIME 1700	1. RECEIVED BY [Signature]	DATE 1-12-11	TIME 08:30
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY [Signature]	DATE	TIME

CTOJM09CF_010

112402267

NAS-CF-BP Wells-GW Sampling

18 Jan., 2011

Personnel: Zach Scribner

Truck: 2001 F-250

PPE: Level D

Weather: Partly Sunny 70°

Objective: Groundwater Sampling

0700 Departed office for NAS-CF

0815 Arrived at NAS-CF (Delayed due to an accident blocking traffic)

0845 Obtained Contractor Pass; @ Departed JAA tower for BP Wells

0930 Completed Calibrations; obtained H₂O levels; began sampling. (see table below for details.)

Well ID	SAMPLE ID	SAMPLE TIME	ANALYSIS
CEF-BP-11\$	CEF-BP-11\$-201101	1020	1, 2, 3
CEF-BP-10\$	CEF-BP-10\$-201101	1056	1, 2, 3
CEF-BP-04\$	CEF-BP-04\$-201101	1140	1, 2, 3
CEF-BP-06\$	CEF-BP-06\$-201101*	1220	1, 2, 3
CEF-BP-09\$	CEF-BP-09\$-201101	1335	1, 2, 3
CEF-BP-01\$	CEF-BP-01\$-201101	1430	1, 2, 3
CEF-BP-05I	CEF-BP-05I-201101	1500	1, 2, 3

* Indicates MS/MSD + DuP; (1-VOCs); (2-TRPHs); (3-NAPHTHALENES)

1640 completed sampling; packed samples on ice for transport (Fed Ex)

AIRBILL # 8660 1730 2300; repaired belt threads at @ for

MW → CEF-BP-04\$ 201101

1715 Transferred IDW to Tote # 3

1730 Departed NAS-CF

1815 Arrived @ office

Z

Z

WORK ORDER

Printed: 2/1/2011 5:40:38PM

1101070

Empirical Laboratories, LLC

Client: Tetra Tech NUS, Inc. (T010) Project Manager: Kim Kostzer
 Project: CTO JM09 BP Wells_2010 Project Number: CTO JM09_2010

Report To:
 Tetra Tech NUS, Inc. (T010)
 Tobrena Skeen
 Foster Plaza 7, 661 Anderson Drive
 Pittsburgh, PA 15220
 Phone: (412) 921-8182
 Fax: (412) 921-4040

Invoice To:
 Tetra Tech NUS, Inc. (T010)
 Accounts Payable
 661 Andersen Drive
 Pittsburgh, PA 15220-2745
 Phone : (412) 921-8182
 Fax: (412) 921-4040

Date Due: 02/02/2011 16:00 (10 day TAT)

Received By: Chris Donald

Logged In By: Chris Donald

Date Received: 01/19/2011 08:30

Date Logged In 01/19/2011 15:48

Samples Received at: 0.9°C
 Custody Seals Yes Received On Ice Yes
 Containers Intact Yes
 COC/Labels Agree Yes
 Preservation Confir Yes

Analysis	Due	TAT	Expires	Version	Comments
1101070-01 CEF-BP-11S-201101 [Water] Sampled 01/18/2011 10:20 Eastern					
SW8270C	01/28/2011 14:00	10	01/25/2011 09:20	Naphthalene, 1&2 MN	
SW8260B	01/28/2011 14:00	10	02/01/2011 09:20	BTEX, Isopropylbenzene,13	See Version
FLPRO	01/28/2011 14:00	10	01/25/2011 09:20		
1101070-02 CEF-BP-10S-201101 [Water] Sampled 01/18/2011 10:56 Eastern					
FLPRO	01/28/2011 14:00	10	01/25/2011 09:56		
SW8270C	01/28/2011 14:00	10	01/25/2011 09:56	Naphthalene, 1&2 MN	
SW8260B	01/28/2011 14:00	10	02/01/2011 09:56	BTEX, Isopropylbenzene,13	See Version

WORK ORDER

Printed: 2/1/2011 5:40:38PM

1101070

Empirical Laboratories, LLC

Client: Tetra Tech NUS, Inc. (T010)
Project: CTO JM09 BP Wells_2010

Project Manager: Kim Kostzer
Project Number: CTO JM09_2010

17

Analysis	Due	TAT	Expires	Version	Comments
1101070-03 CEF-BP-04S-201101 [Water] Sampled 01/18/2011 11:40 Eastern					
FLPRO	01/28/2011 14:00	10	01/25/2011 10:40		
SW8270C	01/28/2011 14:00	10	01/25/2011 10:40	Naphthalene, 1&2 MN	
SW8260B	01/28/2011 14:00	10	02/01/2011 10:40	BTEX, Isopropylbenzene,13	See Version
1101070-04 CEF-BP-06S-201101 [Water] Sampled 01/18/2011 12:20 Eastern					
					MS/MSD
SW8260B	01/28/2011 14:00	10	02/01/2011 11:20	BTEX, Isopropylbenzene,13	MS/MSD,See Version
FLPRO	01/28/2011 14:00	10	01/25/2011 11:20		MS/MSD
SW8270C	01/28/2011 14:00	10	01/25/2011 11:20	Naphthalene, 1&2 MN	MS/MSD
1101070-05 CEF-BP-09S-201101 [Water] Sampled 01/18/2011 13:35 Eastern					
SW8270C	01/28/2011 14:00	10	01/25/2011 12:35	Naphthalene, 1&2 MN	
SW8260B	01/28/2011 14:00	10	02/01/2011 12:35	BTEX, Isopropylbenzene,13	See Version
FLPRO	01/28/2011 14:00	10	01/25/2011 12:35		
1101070-06 CEF-BP-01S-201101 [Water] Sampled 01/18/2011 14:30 Eastern					
FLPRO	01/28/2011 14:00	10	01/25/2011 13:30		
SW8270C	01/28/2011 14:00	10	01/25/2011 13:30	Naphthalene, 1&2 MN	
SW8260B	01/28/2011 14:00	10	02/01/2011 13:30	BTEX, Isopropylbenzene,13	See Version
1101070-07 CEF-BP-05I-201101 [Water] Sampled 01/18/2011 15:00 Eastern					
FLPRO	01/28/2011 14:00	10	01/25/2011 14:00		
SW8270C	01/28/2011 14:00	10	01/25/2011 14:00	Naphthalene, 1&2 MN	
SW8260B	01/28/2011 14:00	10	02/01/2011 14:00	BTEX, Isopropylbenzene,13	See Version

CTOJM09CF_010

WORK ORDER

Printed: 2/1/2011 5:40:38PM

1101070

Empirical Laboratories, LLC

Client: Tetra Tech NUS, Inc. (T010)
Project: CTO JM09 BP Wells_2010

Project Manager: Kim Kostzer
Project Number: CTO JM09_2010

Analysis	Due	TAT	Expires	Version	Comments
1101070-08 CEF-BP-DUP-01-201101 [Water] Sampled 01/18/2011 00:00 Eastern					
SW8260B	01/28/2011 14:00	10	01/31/2011 23:00	BTEX, Isopropylbenzene,13	See Version
FLPRO	01/28/2011 14:00	10	01/24/2011 23:00		
SW8270C	01/28/2011 14:00	10	01/24/2011 23:00	Naphthalene, 1&2 MN	
1101070-09 TRIP BLANK [Water] Sampled 01/18/2011 00:00 Central					
SW8260B	01/28/2011 14:00	10	02/01/2011 00:00	BTEX, Isopropylbenzene,13	See Version

Sample Delivery Group Case Narrative

Receipt Information

The samples were received within the preservation guidelines for the associated methods. The information associated with sample receipt and the Sample Delivery Group (SDG) are included within section 4 of this package, which also provides information on the link between the client sample ID listed on the COC and laboratory's assigned unique sample ID or WorkOrder #. The sample is tracked through the laboratory for all analysis via the assigned WorkOrder #.

All samples that were received were analyzed and none of the samples were placed on hold without analyses. There were no subcontracted analyses for this SDG.

A Trip Blank was received in the shipment but was not marked on the CoC. The Trip Blank was tagged as 1101070-09.

Changes to the Revision

This is an original submittal of the final report package.

Analytical Information

All samples were prepped (where applicable) and analyzed within the standard allowed holding times, unless noted within the exceptions listed below. The laboratory analyzed all samples within the program and method guidelines. The following information is provided specific to individual methods:

Chromatographic Flags for Manual Integration:

The following letters are used to denote manual integrations on the laboratory's raw data in association with chromatographic integrations:

- A:** The peak was manually integrated as it was not integrated in the original chromatogram.
- B:** The peak was manually integrated due to resolution or coelution issues in the original chromatogram.
- C:** The peak was manually integrated to correct the baseline from the original chromatogram.
- D:** The peak was manually integrated to identify the correct peak as the wrong peak was identified in the original chromatogram.
- E:** The peak was manually integrated to include the entire peak as the original chromatogram only integrated part of the peak.

SW8260B:

The matrix spikes associated to sample 1101070-04 exceeded criteria with a negative bias for Ethylbenzene, 1,2,4-Trimethylbenzene and Xylene(total).

No additional anomalies or deviations are noted and the proper data qualifiers have been applied.

SW8270C:

The surrogate Terphenyl-d-14 exceeded criteria with a negative bias in sample 1101070-03, -04, -05, -06, -07, -08 and -08RE1 and in the matrix spikes 1A20003-MS2 and -MSD2.

The matrix spikes associated to sample 1101070-04 exceeded criteria for 1-Methylnaphthalene, 2-Methylnaphthalene and Naphthalene but the parent sample concentrations for these compounds were greater than 4 times the amount spiked.

No additional anomalies or deviations are noted and the proper data qualifiers have been applied.

FLPRO:

The surrogate o-Terphenyl exceeded criteria with a negative bias in samples 1101070-01, -03, -04, -05, -07 and -08. The retention time window was exceeded for the surrogate 2-Fluorobiphenyl in sample 1101070-01, -03, -05 and -07. The result bias due to the retention time shift was determined to be negligible for all affected samples.

The matrix spike duplicate associated to sample 1101070-04 exceeded criteria with a positive bias for Petroleum Range Organics.

No additional anomalies or deviations are noted and the proper data qualifiers have been applied.

Data Qualifiers

As applicable and where required, the following general qualifiers are associated with the sample results. Additional qualifiers will be specified within the reporting sections of the data package or within the body of the Case Narrative.

Analytical Report Terms and Qualifiers

- MDL:** The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from analysis of a sample containing the analyte in a given matrix. For DoD QSM 4.1 reporting purposes, this definition is also applied to the reported Detection Limit (DL).
- LOD:** The Limit of Detection is an estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent. This definition is further clarified in the DoD QSM 4.1 revisions as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%.
- LOQ:** The Limit of Quantitation is the minimum level, concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. This term is further clarified within the DoD QSM 4.1 as the lowest concentration that produces a quantitative result within specified limits of precision and bias.
- *:** An exceeding quality control criteria is associated with the reported result.
- B:** The presence of a "B" to the right of an analytical value indicates that this compound was also detected in the method blank and the data should be interpreted with caution. One should consider the possibility that the correct sample result might be less than the reported result and, perhaps, zero. **For Florida DEP reports this qualifier is "V".**
- D:** When a sample (or sample extract) is rerun diluted because one of the compound concentrations exceeded the highest concentration range for the standard curve, all of the values obtained in the dilution run will be flagged with a "D".
- E:** The concentration for any compound found which exceeds the highest concentration level on the standard curve for that compound will be flagged with an "E". Usually the sample will be rerun at a dilution to quantitate the flagged compound. **For Florida DEP reports this qualifier is "L".**
- H1:** The result was analyzed outside of the EPA recommended holding time.

- H2:** The result was extracted outside of the EPA recommended holding time.
- H3:** The sample for this analyte was received outside of the EPA recommended holding time.
- J:** The presence of a "J" to the right of an analytical result indicates that the reported result is estimated. The mass spectral data pass the identification criteria showing that the compound is present, but the calculated result is less than the EQL. One should feel confident that the result is greater than zero and less than the EQL. **For Florida DEP reports this qualifier is "I".**
- M:** Indicates that the sample matrix interfered with the quantitation of the analyte. In dual column analysis the result is reported from the column with the lower concentration. In inorganics, it indicates that the parameters MDL/RL has been raised.
- N:** The MS/MSD accuracy and/or precision are outside criteria. The predigested spike recovery is not within control limits for the associated parameter.
- P:** The associated numerical value is an estimated quantity. There is greater than a 40% difference between the two GC columns for the detected concentrations. The higher of the two values is reported unless matrix interference is obvious or for HPLC analysis where the primary column is reported.
- Q:** The RPD and/or percent recovery exceeded limits in the associated Blank Spike and/or Blank Spike Duplicate.
- S:** The associated internal standard failed criteria.
- U:** The presence of a "U" indicates that the analyte was analyzed for but was not detected or the concentration of the analyte quantitated below the DL.
- X:** The parameter shows a potential positive bias on a reported concentration due to an ICV or CCV exceeding the upper control limit on the high side.
- Y:** The parameter shows a potential negative bias on a reported concentration due to an ICV or CCV exceeding the lower control limit on the low side.
- Z:** The parameter shows lack of confirmation/detection, which may be due to a negative bias in the ICV or CCV which exceeds the lower control limit.

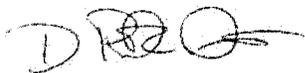
LIMS Definitions / Naming Conventions:

The following are general naming conventions that are used throughout the laboratory; however, on a method by method basis, there are additional QAQC items that are named in a consistent format.

- BLK:** LIMS assigns a unique identifier to the Method Blank by naming it as the letters BLK appended to the Batch ID. A Method Blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The Method Blank is used to assess for possible contamination during preparation and/or analysis steps. Method Blanks within a Batch or Analytical sequence will be appended with a numerical value beginning with 1 that will increase incrementally.
- BS:** LIMS assigns a unique identifier to the Blank Spike by naming it as the letters BS appended to the Batch ID. The Blank Spike or Lab Control Sample is a controlled analyte-free matrix, which is spiked with known and verified concentrations of target analytes. Spiking concentrations can be referenced in the method SOP. The BS is used to evaluate the viability of analytes taken through the entire prep (when applicable) and analytical process. Blank Spikes within a Batch or Analytical sequence will be appended with a numerical value beginning with 1 that will increase incrementally. A duplicate Blank Spike will be designated as a BSD.
- MS:** The LIMS assigns each Client sample with a unique identifier. The Matrix Spike is designated with a MS at the end of the sample's unique identifier. The Matrix Spike sample is used to assess the effect of the sample matrix on the precision and accuracy of the results generated using the selected method. A duplicate Matrix Spike will be designated as a MSD.
- IDs:** The LIMS assigns each Client sample with a unique identifier. The letter "RE" may potentially be appended to the end of the LIMS Sample ID. And "RE" implies that the sample was either re-prepped, re-analyzed straight, or re-analyzed at a dilution. Subsequent re-analysis for the sample will be appended with a numerical value beginning with 1 that will increase incrementally. Eg: RE1, RE2, RE3, etc.

Statement of Data Authenticity:

I certify that, based upon my inquiry of those individuals immediately responsible for obtaining the information and to the best of my knowledge, the data package is in compliance with the terms and conditions of the contract, both technically and for completeness, with the exception of the conditions detailed in this Case Narrative, as verified by my signature below. During absences, Ms. Marcia K. McGinnity is authorized to sign this Statement of Data Authenticity.



Mr. Rick D. Davis
Laboratory Technical Director / VP Operations

Sample Delivery Group Assignment Form

CLIENT: Tetra Tech NUS, Inc. (T010)
 PROJECT NAME: CTO JM09 BP Wells_2010
 SDG #: CTOJM09CF_010
 MATRIX: Water

QC LEVEL: EDD/IVQSM
 Report Due: 2/2/2011
 Client Sample Count: :

Sample Type	Sampled	Received	Lab ID	Client ID	FLPRO	SW8260B	SW8270C
Client Sample	1/18/2011	1/19/2011	1101070-01	CEF-BP-11S-201101	X	X	X
Client Sample	1/18/2011	1/19/2011	1101070-02	CEF-BP-10S-201101	X	X	X
Client Sample	1/18/2011	1/19/2011	1101070-03	CEF-BP-04S-201101	X	X	X
Client Sample	1/18/2011	1/19/2011	1101070-04	CEF-BP-06S-201101	MS/MSD	MS/MSD	MS/MSD
Client Sample	1/18/2011	1/19/2011	1101070-05	CEF-BP-09S-201101	X	X	X
Client Sample	1/18/2011	1/19/2011	1101070-06	CEF-BP-01S-201101	X	X	X
Client Sample	1/18/2011	1/19/2011	1101070-07	CEF-BP-05I-201101	X	X	X
Client Sample	1/18/2011	1/19/2011	1101070-08	CEF-BP-DUP-01-201101	X	X	X
Trip Blank	1/18/2011	1/19/2011	1101070-09	TRIP BLANK		X	

HOLDING TIME SUMMARY

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF 010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
CEF-BP-11S-201101	01/18/11 10:20	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 02:05	4.70	14.00	
CEF-BP-10S-201101	01/18/11 10:56	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 02:34	4.69	14.00	
CEF-BP-04S-201101	01/18/11 11:40	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 03:04	4.68	14.00	
CEF-BP-06S-201101	01/18/11 12:20	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 03:34	4.68	14.00	
CEF-BP-09S-201101	01/18/11 13:35	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 04:03	4.64	14.00	
CEF-BP-01S-201101	01/18/11 14:30	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 04:33	4.63	14.00	
CEF-BP-05I-201101	01/18/11 15:00	01/19/11 08:30	01/24/11 00:00	N/A	14.00	01/24/11 12:47	5.95	14.00	
CEF-BP-DUP-01-201101	01/18/11 00:00	01/19/11 08:30	01/24/11 00:00	N/A	14.00	01/24/11 17:14	6.76	14.00	
TRIP BLANK	01/18/11 00:00	01/19/11 08:30	01/22/11 00:00	N/A	14.00	01/23/11 01:05	5.05	14.00	

ANALYSIS SEQUENCE SUMMARY

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF 010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 1A01301

Instrument: MS-VOA3

Calibration: 1013002

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
MS Tune	1A01301-TUN1	0112TU1.D	01/12/11 11:23
Cal Standard	1A01301-CAL1	SEQ-CAL1.D	01/12/11 11:53
Cal Standard	1A01301-CAL2	SEQ-CAL2.D	01/12/11 12:22
Cal Standard	1A01301-CAL3	SEQ-CAL3.D	01/12/11 12:52
Cal Standard	1A01301-CAL4	SEQ-CAL4.D	01/12/11 13:22
Cal Standard	1A01301-CAL5	SEQ-CAL5.D	01/12/11 13:51
Cal Standard	1A01301-CAL6	SEQ-CAL6.D	01/12/11 14:21
Cal Standard	1A01301-CAL7	SEQ-CAL7.D	01/12/11 14:51
Cal Standard	1A01301-CAL8	SEQ-CAL8.D	01/12/11 15:20
Cal Standard	1A01301-CAL9	SEQ-CAL9.D	01/12/11 15:50
Initial Cal Check	1A01301-ICV1	SEQ-ICV1.D	01/12/11 16:20

MASS SPECTROMETER INSTRUMENT PERFORMANCE CHECK

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Lab File ID: 0112TUI.D

Injection Date: 01/12/11

Instrument ID: MS-VOA3

Injection Time: 11:23

Sequence: 1A01301

Lab Sample ID: 1A01301-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
50	15 - 40% of 95	19.1	PASS
75	30 - 60% of 95	43.3	PASS
95	Base peak, 100% relative abundance	100	PASS
96	5 - 9% of 95	5.72	PASS
173	Less than 2% of 174	0.659	PASS
174	50 - 200% of 95	86.6	PASS
175	5 - 9% of 174	7.09	PASS
176	95 - 101% of 174	96.6	PASS
177	5 - 9% of 176	6.05	PASS

INITIAL CALIBRATION DATA (Continued)

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Calibration: 1013002

Instrument: MS-VOA3

Matrix: Water

Calibration Date: 1/12/2011 11:53:57AM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
Acetone	8.064984E-02	8.405808	5.359333	0.1130282			15	
Acrolein	3.623719E-02	26.8551	5.204	0.1147555	0.9984696		0.995	
Acrylonitrile	9.866283E-02	10.20931	6.044222	7.883985E-02			15	
Benzene	0.9147224	6.5206	12.09622	3.696975E-02			15	
Bromobenzene	0.6446848	8.326313	17.21033	2.104903E-02			15	
Bromochloromethane	0.1136967	14.6434	9.603125	0.1068052			15	
Tert-Amyl Methyl Ether	0.6670554	14.64619	12.44475	2.909129E-02			15	
Bromodichloromethane	0.2777846	12.51998	13.10111	3.364502E-02			15	
Bromoform	0.2502681	25.67797	16.50367	0.0230264	0.9988092		SPCC (0.1)	
Bromomethane	0.119565	24.04905	4.374778	6.853443E-02	0.9968107		0.995	
Bromofluorobenzene	0.8693917	5.084001	17.043	2.212189E-02			15	
n-Butylbenzene	1.364455	9.40366	18.393	1.513749E-02			15	
2-Butanone	9.788035E-02	41.3497	8.8595	0.3230605	0.9992354		0.995	
sec-Butylbenzene	1.790365	7.450728	17.94367	1.921279E-02			15	
tert-Butylbenzene	1.442027	7.065618	18.071	1.373776E-02			15	
Carbon disulfide	0.7085108	9.721389	6.581	4.532016E-02			15	
Carbon tetrachloride	0.2092528	16.57798	12.052	3.056224E-02	0.9995585		0.995	
Chlorobenzene	1.379148	12.57317	16.09589	2.812794E-02			SPCC (0.3)	
Chloroethane	0.1499881	13.0599	4.543	0.1144359			15	
Chloroform	0.4003395	7.781734	9.759444	0.0541458			CCC (20)	
2-Chloroethyl vinyl ether	0.1504082	17.6726	13.69756	5.424746E-02	0.9993532		0.995	
Chloromethane	0.3090919	8.82089	3.716889	0.1232293			SPCC (0.1)	
1-Chlorohexane	1.141253	12.42603	16.055	1.674673E-02			15	
2-Chlorotoluene	1.569179	6.232869	17.42867	2.109436E-02			15	
4-Chlorotoluene	1.619296	5.956415	17.487	0.0227698			15	
Cyclohexane	0.3604052	9.634262	11.94678	2.386268E-02			15	
Dibromochloromethane	0.3832343	17.80407	15.08133	2.570645E-02	0.9982534		0.995	
1,2-Dibromo-3-chloropropane	9.946732E-02	26.61525	18.74133	2.445055E-02	0.9981616		0.995	
1,2-Dibromoethane (EDB)	0.4676748	6.780443	15.313	2.585748E-02			15	
Dibromomethane	0.1628485	8.711286	12.91933	1.346488E-02			15	
1,2-Dichlorobenzene	1.015586	5.479385	18.367	9.859982E-03			15	
1,3-Dichlorobenzene	1.051632	8.026897	18.02333	2.563658E-03			15	

INITIAL CALIBRATION DATA (Continued)

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Calibration: 1013002

Instrument: MS-VOA3

Matrix: Water

Calibration Date: 1/12/2011 11:53:57AM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
1,4-Dichlorobenzene	1.123631	8.934171	18.07167	4.418164E-03			15	
Dichlorodifluoromethane	0.1927224	10.32147	3.507	1.820138E-02			15	
1,1-Dichloroethane	0.4275324	6.15943	7.884333	9.332373E-02			SPCC (0.1)	
1,2-Dichloroethane	0.3389077	6.875599	11.251	5.774366E-02			15	
1,1-Dichloroethene	0.1808032	8.4975	6.006333	0.1065342			CCC (20)	
cis-1,2-Dichloroethene	0.2429771	8.06032	9.235111	7.930925E-02			15	
trans-1,2-Dichloroethene	0.2265366	10.05672	7.374	0.1155533			15	
1,2-Dichloroethene (total)	0.2347569	8.066436	0	0			15	
1,2-Dichloropropane	0.2705505	7.90964	12.98233	2.895518E-02			CCC (20)	
1,3-Dichloropropane	0.7651451	8.521785	14.83867	3.226204E-02			15	
2,2-Dichloropropane	0.249069	11.9522	9.993222	0.133028			15	
1,1-Dichloropropene	0.2969522	8.037406	11.805	5.227225E-02			15	
cis-1,3-Dichloropropene	0.3436351	16.66489	13.94067	4.677926E-02	0.9991764		0.995	
trans-1,3-Dichloropropene	0.5486816	19.63362	14.42967	3.360889E-02	0.9984019		0.995	
Diisopropyl Ether	0.8991741	14.74941	9.006667	9.641568E-02			15	
Ethylbenzene	2.174706	11.24759	16.26067	1.949862E-02			CCC (20)	
Ethyl tert-Butyl Ether	0.6821686	15.02387	10.08975	7.473357E-02	0.999432		0.995	
Ethyl Methacrylate	0.4811612	30.46642	14.91122	7.619157E-02	0.9989028		0.995	
Hexachlorobutadiene	0.2650331	12.00178	20.297	0.0167408			15	
2-Hexanone	0.3117348	32.71218	15.0245	0.1255279	0.9992453		0.995	
Iodomethane	0.1911641	34.64014	6.045667	0.1166378	0.9995772		0.995	
Isopropylbenzene	1.654514	8.969675	17.012	1.049839E-02			15	
p-Isopropyltoluene	1.218248	8.095274	17.77433	9.325871E-03			15	
Methylene chloride	0.2636496	9.932986	6.22	8.175985E-02			15	
Methyl Acetate	0.2047375	7.514991	6.263111	0.1591514			15	
Methylcyclohexane	0.2787263	8.796608	13.72633	4.451275E-02			15	
Naphthalene	1.432295	16.47061	20.259	1.825011E-02	0.9997482		0.995	
Methyl Methacrylate	0.1986159	32.71145	13.3825	9.795862E-02	0.999672		0.995	
4-Methyl-2-pentanone	0.228089	24.924	14.086	0.0598532	0.9994717		0.995	
Methyl t-Butyl Ether	0.5014836	13.3066	7.630556	0.1192416			15	
n-Propylbenzene	2.262125	6.162005	17.347	2.228063E-02			15	
Styrene	1.33712	11.61301	16.67522	3.134616E-02			15	

INITIAL CALIBRATION DATA (Continued)

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells_2010

Calibration: 1013002

Instrument: MS-VOA3

Matrix: Water

Calibration Date: 1/12/2011 11:53:57AM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
1,1,2,2-Tetrachloroethane	0.5787994	7.683674	16.73978	1.584485E-02			SPCC (0.3)	
1,1,1,2-Tetrachloroethane	0.3617513	11.29277	16.03767	0.0230695			15	
tert-Butyl alcohol	1.687927E-02	22.96425	6.01	0.1776952	0.9960037		0.995	
Tetrachloroethene	0.4936913	9.298253	15.50256	1.414961E-02			15	
Toluene	1.227229	8.434471	14.77611	3.129201E-02			CCC (20)	
1,2,3-Trichlorobenzene	0.5583232	12.43673	20.502	2.261096E-02			15	
1,2,4-Trichlorobenzene	0.602543	10.95007	19.99433	0.0293537			15	
1,1,2-Trichloroethane	0.3919917	5.496525	14.581	2.309597E-02			15	
1,1,1-Trichloroethane	0.2966137	9.180517	11.45333	2.758216E-02			15	
Tetrahydrofuran	6.614518E-02	18.73379	10.62375	0.2296526	0.9996939		0.995	
Trichloroethene	0.2555685	6.673099	13.06667	3.707834E-02			15	
Trichlorofluoromethane	0.3134891	7.463325	5.248111	7.876223E-02			15	
1,2,3-Trichloropropane	0.1687538	13.12445	16.84467	0.019802			15	
1,3,5-Trimethylbenzene	1.488186	9.066003	17.54911	1.497229E-02			15	
1,2,4-Trimethylbenzene	1.510137	11.75851	17.852	2.790448E-03			15	
1,1,2-Trichloro-1,2,2-trifluoroethane	0.1855971	6.201379	6.325778	8.645985E-02			15	
Vinyl chloride	0.275803	9.259583	3.921445	0.1307371			CCC (20)	
m,p-Xylene	1.622515	12.77942	16.41667	2.024565E-02			15	
o-Xylene	1.800957	8.888939	16.73267	1.621916E-02			15	
Vinyl acetate	0.2696653	26.95271	8.175125	0.1975992	0.9995176		0.995	
Xylenes (total)	1.681996	11.18592	0	0			15	
Dibromofluoromethane	0.2526019	3.058941	10.07433	2.899251E-02			15	
1,2-Dichloroethane-d4	0.055187	3.814733	11.10033	1.871227E-02			15	
Toluene-d8	2.020509	6.710572	14.70022	1.957189E-03			15	
tert-Amyl alcohol	9.511786E-03	37.13722	10.96425	0.1525271		0.9996011	0.99	
tert-Amyl ethyl ether	0.5731055	15.90077	13.61989	1.612336E-02	0.9993112		0.995	

INITIAL CALIBRATION CHECK

SW8260B

Laboratory: Empirical Laboratories, LLC
 Client: Tetra Tech NUS, Inc. (T010)
 Instrument ID: MS-VOA3
 Lab File ID: SEQ-ICV1.D
 Sequence: 1A01301
 Lab Sample ID: 1A01301-ICV1

SDG: CTOJM09CF_010
 Project: CTO JM09 BP Wells 2010
 Calibration: 1013002
 Calibration Date: 01/12/11 11:53
 Injection Date: 01/12/11
 Injection Time: 16:20

COMPOUND	TYPE	CONC. (ug/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	ICV	ICAL	ICV	MIN (#)	ICV	LIMIT (#)
Benzene	A	100.0	105.1	0.9147224	0.961065		5.1	20
Ethylbenzene	A	100.0	97.70	2.174706	2.124621		-2.3	20
Isopropylbenzene	A	100.0	106.7	1.654514	1.765542		6.7	20
Toluene	A	100.0	98.73	1.227229	1.211666		-1.3	20
1,3,5-Trimethylbenzene	A	100.0	113.9	1.488186	1.695621		13.9	20
1,2,4-Trimethylbenzene	A	100.0	119.0	1.510137	1.796628		19.0	20
Xylenes (total)	A	300.0	292.6	1.681996	1.641728		-2.4	20
Bromofluorobenzene	A	30.00	29.11	0.8693917	0.8435694		-3.0	20
Dibromofluoromethane	A	30.00	29.14	0.2526019	0.2453821		-2.9	20
1,2-Dichloroethane-d4	A	30.00	28.81	0.055187	5.299266E-02		-4.0	20
Toluene-d8	A	30.00	28.48	2.020509	1.91838		-5.1	20

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

ANALYSIS SEQUENCE SUMMARY

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 1A02401

Instrument: MS-VOA3

Calibration: 1013002

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
MS Tune	1A02401-TUN1	0122TU1E.D	01/22/11 22:14
Calibration Check	1A02401-CCV1	0122CC1E.D	01/22/11 22:40
LCS	1A22002-BS1	0122LS1E.D	01/22/11 23:10
Blank	1A22002-BLK1	0122BL1E.D	01/23/11 00:36
TRIP BLANK	1101070-09	0107009.D	01/23/11 01:05
CEF-BP-11S-201101	1101070-01	0107001.D	01/23/11 02:05
CEF-BP-10S-201101	1101070-02	0107002.D	01/23/11 02:34
CEF-BP-04S-201101	1101070-03	0107003.D	01/23/11 03:04
CEF-BP-06S-201101	1101070-04	0107004.D	01/23/11 03:34
CEF-BP-09S-201101	1101070-05	0107005.D	01/23/11 04:03
CEF-BP-01S-201101	1101070-06	0107006.D	01/23/11 04:33
CEF-BP-06S-201101	1A22002-MS1	0107004M.D	01/23/11 07:01
CEF-BP-06S-201101	1A22002-MSD1	0107004S.D	01/23/11 07:30

MASS SPECTROMETER INSTRUMENT PERFORMANCE CHECK

SW8260B

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells 2010</u>
Lab File ID: <u>0122TU1E.D</u>	Injection Date: <u>01/22/11</u>
Instrument ID: <u>MS-VOA3</u>	Injection Time: <u>22:14</u>
Sequence: <u>1A02401</u>	Lab Sample ID: <u>1A02401-TUN1</u>

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
50	15 - 40% of 95	24.4	PASS
75	30 - 60% of 95	46.7	PASS
95	Base peak, 100% relative abundance	100	PASS
96	5 - 9% of 95	7.02	PASS
173	Less than 2% of 174	0.677	PASS
174	50 - 200% of 95	66.4	PASS
175	5 - 9% of 174	6.86	PASS
176	95 - 101% of 174	99.6	PASS
177	5 - 9% of 176	6.07	PASS

CONTINUING CALIBRATION CHECK

SW8260B

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF 010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells 2010</u>
Instrument ID: <u>MS-VOA3</u>	Calibration: <u>1013002</u>
Lab File ID: <u>0122CC1E.D</u>	Calibration Date: <u>01/12/11 11:53</u>
Sequence: <u>1A02401</u>	Injection Date: <u>01/22/11</u>
Lab Sample ID: <u>1A02401-CCV1</u>	Injection Time: <u>22:40</u>

COMPOUND	TYPE	CONC. (ug/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
Benzene	A	100.0	108.4	0.9147224	0.9917292		8.4	20
Ethylbenzene	A	100.0	96.95	2.174706	2.108451		-3.0	20
Isopropylbenzene	A	100.0	98.22	1.654514	1.62506		-1.8	20
Toluene	A	100.0	97.54	1.227229	1.197084		-2.5	20
1,3,5-Trimethylbenzene	A	100.0	113.6	1.488186	1.689855		13.6	20
1,2,4-Trimethylbenzene	A	100.0	111.9	1.510137	1.690474		11.9	20
Xylenes (total)	A	300.0	287.4	1.681996	1.611223		-4.2	20
Bromofluorobenzene	A	30.00	28.69	0.8693917	0.8314299		-4.4	20
Dibromofluoromethane	A	30.00	29.14	0.2526019	0.2453239		-2.9	20
1,2-Dichloroethane-d4	A	30.00	29.92	0.055187	5.503606E-02		-0.3	20
Toluene-d8	A	30.00	28.16	2.020509	1.896786		-6.1	20

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

PREPARATION BATCH SUMMARY

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Batch: 1A22002 Batch Matrix: Water

Preparation: 5030B

SAMPLE NAME	LAB SAMPLE ID	DATE PREPARED	INITIAL VOL./WEIGHT	FINAL VOL.
CEF-BP-11S-201101	1101070-01	01/22/11 00:00	5.00	5.00
CEF-BP-10S-201101	1101070-02	01/22/11 00:00	5.00	5.00
CEF-BP-04S-201101	1101070-03	01/22/11 00:00	5.00	5.00
CEF-BP-06S-201101	1101070-04	01/22/11 00:00	5.00	5.00
CEF-BP-09S-201101	1101070-05	01/22/11 00:00	5.00	5.00
CEF-BP-01S-201101	1101070-06	01/22/11 00:00	5.00	5.00
TRIP BLANK	1101070-09	01/22/11 00:00	5.00	5.00
Blank	1A22002-BLK1	01/22/11 00:00	5.00	5.00
LCS	1A22002-BS1	01/22/11 00:00	5.00	5.00
CEF-BP-06S-201101	1A22002-MS1	01/22/11 00:00	5.00	5.00
CEF-BP-06S-201101	1A22002-MSD1	01/22/11 00:00	5.00	5.00

ANALYSIS SEQUENCE SUMMARY

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 1A02601

Instrument: MS-VOA3

Calibration: 1013002

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
MS Tune	1A02601-TUN1	0124TU1.D	01/24/11 08:55
Calibration Check	1A02601-CCV1	0124CC1.D	01/24/11 09:22
LCS	1A24006-BS1	0124LS1.D	01/24/11 09:52
Blank	1A24006-BLK1	0124BL1.D	01/24/11 11:48
CEF-BP-05I-201101	1101070-07	0107007.D	01/24/11 12:47
CEF-BP-DUP-01-201101	1101070-08	0107008D.D	01/24/11 17:14

MASS SPECTROMETER INSTRUMENT PERFORMANCE CHECK

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells_2010

Lab File ID: 0124TUI.D

Injection Date: 01/24/11

Instrument ID: MS-VOA3

Injection Time: 08:55

Sequence: 1A02601

Lab Sample ID: 1A02601-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
50	15 - 40% of 95	22.8	PASS
75	30 - 60% of 95	49.7	PASS
95	Base peak, 100% relative abundance	100	PASS
96	5 - 9% of 95	6.85	PASS
173	Less than 2% of 174	0.703	PASS
174	50 - 200% of 95	76	PASS
175	5 - 9% of 174	7.15	PASS
176	95 - 101% of 174	97.2	PASS
177	5 - 9% of 176	6.3	PASS

CONTINUING CALIBRATION CHECK

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Instrument ID: MS-VOA3

Calibration: 1013002

Lab File ID: 0124CC1.D

Calibration Date: 01/12/11 11:53

Sequence: 1A02601

Injection Date: 01/24/11

Lab Sample ID: 1A02601-CCV1

Injection Time: 09:22

COMPOUND	TYPE	CONC. (ug/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
Benzene	A	100.0	106.8	0.9147224	0.9765182		6.8	20
Ethylbenzene	A	100.0	93.98	2.174706	2.043817		-6.0	20
Isopropylbenzene	A	100.0	96.30	1.654514	1.593265		-3.7	20
Toluene	A	100.0	94.78	1.227229	1.163162		-5.2	20
1,3,5-Trimethylbenzene	A	100.0	106.1	1.488186	1.579692		6.1	20
1,2,4-Trimethylbenzene	A	100.0	109.0	1.510137	1.64597		9.0	20
Xylenes (total)	A	300.0	286.8	1.681996	1.608263		-4.4	20
Bromofluorobenzene	A	30.00	28.82	0.8693917	0.8352917		-3.9	20
Dibromofluoromethane	A	30.00	30.43	0.2526019	0.2562086		1.4	20
1,2-Dichloroethane-d4	A	30.00	29.09	0.055187	5.352004E-02		-3.0	20
Toluene-d8	A	30.00	27.40	2.020509	1.845652		-8.7	20

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

PREPARATION BATCH SUMMARY

SW8260B

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Batch: 1A24006 Batch Matrix: Water

Preparation: 5030B

SAMPLE NAME	LAB SAMPLE ID	DATE PREPARED	INITIAL VOL./WEIGHT	FINAL VOL.
CEF-BP-05I-201101	1101070-07	01/24/11 00:00	5.00	5.00
CEF-BP-DUP-01-201101	1101070-08	01/24/11 00:00	5.00	5.00
Blank	1A24006-BLK1	01/24/11 00:00	5.00	5.00
LCS	1A24006-BS1	01/24/11 00:00	5.00	5.00

HOLDING TIME SUMMARY

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
CEF-BP-11S-201101	01/18/11 10:20	01/19/11 08:30	01/20/11 12:10	2.12	7.00	01/21/11 23:46	1.48	40.00	
CEF-BP-10S-201101	01/18/11 10:56	01/19/11 08:30	01/20/11 12:10	2.09	7.00	01/22/11 00:18	1.51	40.00	
CEF-BP-04S-201101	01/18/11 11:40	01/19/11 08:30	01/20/11 12:10	2.06	7.00	01/22/11 00:50	1.53	40.00	
CEF-BP-06S-201101	01/18/11 12:20	01/19/11 08:30	01/20/11 12:10	2.03	7.00	01/22/11 01:23	1.55	40.00	
CEF-BP-09S-201101	01/18/11 13:35	01/19/11 08:30	01/20/11 12:10	1.98	7.00	01/22/11 01:55	1.57	40.00	
CEF-BP-01S-201101	01/18/11 14:30	01/19/11 08:30	01/20/11 12:10	1.94	7.00	01/22/11 02:27	1.60	40.00	
CEF-BP-05I-201101	01/18/11 15:00	01/19/11 08:30	01/20/11 12:10	1.92	7.00	01/22/11 03:00	1.62	40.00	
CEF-BP-DUP-01-201101	01/18/11 00:00	01/19/11 08:30	01/20/11 12:10	2.55	7.00	01/22/11 03:32	1.64	40.00	
CEF-BP-DUP-01-201101	01/18/11 00:00	01/19/11 08:30	01/20/11 12:10	2.55	7.00	01/24/11 16:56	4.20	40.00	

PREPARATION BATCH SUMMARY

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Batch: 1A20003 Batch Matrix: Water

Preparation: EXT 3510

SAMPLE NAME	LAB SAMPLE ID	DATE PREPARED	INITIAL VOL./WEIGHT	FINAL VOL.
CEF-BP-11S-201101	1101070-01	01/20/11 12:10	1,080.00	1.00
CEF-BP-10S-201101	1101070-02	01/20/11 12:10	1,080.00	1.00
CEF-BP-04S-201101	1101070-03	01/20/11 12:10	1,080.00	1.00
CEF-BP-06S-201101	1101070-04	01/20/11 12:10	1,080.00	1.00
CEF-BP-09S-201101	1101070-05	01/20/11 12:10	1,080.00	1.00
CEF-BP-01S-201101	1101070-06	01/20/11 12:10	1,080.00	1.00
CEF-BP-05I-201101	1101070-07	01/20/11 12:10	1,080.00	1.00
CEF-BP-DUP-01-201101	1101070-08	01/20/11 12:10	1,080.00	1.00
CEF-BP-DUP-01-201101	1101070-08RE1	01/20/11 12:10	1,080.00	1.00
Blank	1A20003-BLK1	01/20/11 12:10	1,000.00	1.00
LCS	1A20003-BS1	01/20/11 12:10	1,000.00	1.00
CEF-BP-06S-201101	1A20003-MS2	01/20/11 12:10	1,075.00	1.00
CEF-BP-06S-201101	1A20003-MSD2	01/20/11 12:10	1,075.00	1.00

ANALYSIS SEQUENCE SUMMARY

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 1A01702

Instrument: MS-BNA4

Calibration: 1017001

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
MS Tune	1A01702-TUN1	SEQ-TUN1.D	01/13/11 14:40
Cal Standard	1A01702-CAL1	SEQ-CAL1.D	01/13/11 15:18
Cal Standard	1A01702-CAL2	SEQ-CAL2.D	01/13/11 15:51
Cal Standard	1A01702-CAL3	SEQ-CAL3.D	01/13/11 16:24
Cal Standard	1A01702-CAL4	SEQ-CAL4.D	01/13/11 16:56
Cal Standard	1A01702-CAL5	SEQ-CAL5.D	01/13/11 17:29
Cal Standard	1A01702-CAL6	SEQ-CAL6.D	01/13/11 18:01
Cal Standard	1A01702-CAL7	SEQ-CAL7.D	01/13/11 18:34
Cal Standard	1A01702-CAL8	SEQ-CAL8.D	01/13/11 19:07
Cal Standard	1A01702-CAL9	SEQ-CAL9.D	01/13/11 19:39
Cal Standard	1A01702-CALA	SEQ-CALA.D	01/13/11 20:12
Cal Standard	1A01702-CALB	SEQ-CALB.D	01/13/11 20:44
Initial Cal Check	1A01702-ICV1	SEQ-ICV1.D	01/13/11 21:16

MASS SPECTROMETER INSTRUMENT PERFORMANCE CHECK

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Lab File ID: SEQ-TUN1.D

Injection Date: 01/13/11

Instrument ID: MS-BNA4

Injection Time: 14:40

Sequence: 1A01702

Lab Sample ID: 1A01702-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
51	30 - 60% of 198	52.1	PASS
68	Less than 2% of 69	1.49	PASS
69	Less than 200% of 198	46.3	PASS
70	Less than 2% of 69	0.519	PASS
127	40 - 60% of 198	54.4	PASS
197	Less than 1% of 198	0.813	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	6.65	PASS
275	10 - 30% of 198	27.9	PASS
365	1 - 200% of 198	4.48	PASS
441	0.001 - 100% of 443	82.3	PASS
442	40 - 200% of 198	169	PASS
443	17 - 23% of 442	19.7	PASS

INITIAL CALIBRATION DATA (Continued)

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells_2010

Calibration: 1017001

Instrument: MS-BNA4

Matrix: Water

Calibration Date: 1/13/2011 2:40:26PM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
Acenaphthene	1.064587	14.69008	10.64264	3.018197E-02			CCC (30)	
Acenaphthylene	1.738125	12.64186	10.4318	3.455132E-02			15	
Anthracene	1.39437	13.33867	12.55209	5.444971E-02			15	
Benzo(a)anthracene	0.9603081	11.52618	15.9373	6.716114E-02			15	
Benzo(a)pyrene	1.450046	7.620801	18.71518	9.290077E-02			CCC (30)	
Benzo(b)fluoranthene	1.628094	6.601661	18.00182	8.407371E-02			15	
Benzo(g,h,i)perylene	1.447688	10.22999	21.96927	0.1108766			15	
Benzo(k)fluoranthene	1.755158	10.54425	18.06073	9.946353E-02			15	
Chrysene	0.9621793	12.63864	16.0013	7.042101E-02			15	
Dibenz(a,h)anthracene	1.386916	8.958084	21.38564	0.1044225			15	
Fluoranthene	1.330654	14.33717	13.9608	3.637571E-02			CCC (30)	
Fluorene	1.035571	12.19163	11.28836	3.200913E-02			15	
2-Fluorobiphenyl	1.132059	11.98818	9.763455	6.055318E-02			15	
Indeno(1,2,3-cd)pyrene	1.721918	9.00371	21.34118	0.126876			15	
1-Methylnaphthalene	1.061797	12.79651	9.426182	6.849264E-02			15	
2-Methylnaphthalene	1.095514	10.9101	9.301545	6.291415E-02			15	
Naphthalene	7.214082	11.7661	8.451778	4.622356E-02			15	
Phenanthrene	1.410267	14.18051	12.4847	3.322328E-02			15	
Pyrene	1.337161	14.92941	14.2449	3.444772E-02			15	
Terphenyl-d14	0.5337225	14.20642	14.42236	3.831439E-02			15	

INITIAL CALIBRATION CHECK

SW8270C

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells_2010</u>
Instrument ID: <u>MS-BNA4</u>	Calibration: <u>1017001</u>
Lab File ID: <u>SEQ-ICV1.D</u>	Calibration Date: <u>01/13/11 14:40</u>
Sequence: <u>1A01702</u>	Injection Date: <u>01/13/11</u>
Lab Sample ID: <u>1A01702-ICV1</u>	Injection Time: <u>21:16</u>

COMPOUND	TYPE	CONC. (ug/mL)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	ICV	ICAL	ICV	MIN (#)	ICV	LIMIT (#)
1-Methylnaphthalene	A	5.000	5.405	1.061797	1.147858		8.1	20
2-Methylnaphthalene	A	5.000	5.256	1.095514	1.15171		5.1	20
Naphthalene	A	5.000	4.894	7.214082	7.060505		-2.1	20
2-Fluorobiphenyl	A	5.000	5.128	1.132059	1.160996		2.6	20
Terphenyl-d14	A	5.000	4.891	0.5337225	0.5220806		-2.2	20

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

ANALYSIS SEQUENCE SUMMARY

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 1A02411

Instrument: MS-BNA4

Calibration: 1017001

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
MS Tune	1A02411-TUN1	SEQ-TUN1.D	01/21/11 17:23
Calibration Check	1A02411-CCV1	SEQ-CCV1.D	01/21/11 17:46
Blank	1A20003-BLK1	A20003B1.D	01/21/11 18:21
LCS	1A20003-BS1	A20003L1.D	01/21/11 18:53
CEF-BP-11S-201101	1101070-01	0107001.D	01/21/11 23:46
CEF-BP-10S-201101	1101070-02	0107002.D	01/22/11 00:18
CEF-BP-04S-201101	1101070-03	0107003.D	01/22/11 00:50
CEF-BP-06S-201101	1101070-04	0107004.D	01/22/11 01:23
CEF-BP-09S-201101	1101070-05	0107005.D	01/22/11 01:55
CEF-BP-01S-201101	1101070-06	0107006.D	01/22/11 02:27
CEF-BP-05I-201101	1101070-07	0107007.D	01/22/11 03:00
CEF-BP-DUP-01-201101	1101070-08	0107008.D	01/22/11 03:32

MASS SPECTROMETER INSTRUMENT PERFORMANCE CHECK

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Lab File ID: SEQ-TUN1.D

Injection Date: 01/21/11

Instrument ID: MS-BNA4

Injection Time: 17:23

Sequence: 1A02411

Lab Sample ID: 1A02411-TUN1

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
51	30 - 60% of 198	53.2	PASS
68	Less than 2% of 69	1.6	PASS
69	Less than 200% of 198	47.2	PASS
70	Less than 2% of 69	0.505	PASS
127	40 - 60% of 198	52.9	PASS
197	Less than 1% of 198	0.907	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	6.74	PASS
275	10 - 30% of 198	27.9	PASS
365	1 - 200% of 198	4.44	PASS
441	0.001 - 100% of 443	80.3	PASS
442	40 - 200% of 198	168	PASS
443	17 - 23% of 442	19.4	PASS

CONTINUING CALIBRATION CHECK

SW8270C

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells 2010</u>
Instrument ID: <u>MS-BNA4</u>	Calibration: <u>1017001</u>
Lab File ID: <u>SEQ-CCV1.D</u>	Calibration Date: <u>01/13/11 14:40</u>
Sequence: <u>1A02411</u>	Injection Date: <u>01/21/11</u>
Lab Sample ID: <u>1A02411-CCV1</u>	Injection Time: <u>17:46</u>

COMPOUND	TYPE	CONC. (ug/mL)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
1-Methylnaphthalene	A	5.000	4.382	1.061797	0.9304985		-12.4	20
2-Methylnaphthalene	A	5.000	4.629	1.095514	1.014134		-7.4	20
Naphthalene	A	5.000	4.295	7.214082	6.197014		-14.1	20
2-Fluorobiphenyl	A	5.000	4.644	1.132059	1.051435		-7.1	20
Terphenyl-d14	A	5.000	5.747	0.5337225	0.6134343		14.9	20

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

ANALYSIS SEQUENCE SUMMARY

SW8270C

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 1A02504

Instrument: MS-BNA4

Calibration: 1017001

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
MS Tune	1A02504-TUN1	SEQ-TUN1.D	01/24/11 15:40
Calibration Check	1A02504-CCV1	SEQ-CCV1.D	01/24/11 15:59
CEF-BP-DUP-01-201101	1101070-08RE1	0107008D.D	01/24/11 16:56
CEF-BP-06S-201101	1A20003-MS2	0107004M.D	01/24/11 17:28
CEF-BP-06S-201101	1A20003-MSD2	0107004S.D	01/24/11 18:01

MASS SPECTROMETER INSTRUMENT PERFORMANCE CHECK

SW8270C

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF 010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells 2010</u>
Lab File ID: <u>SEQ-TUN1.D</u>	Injection Date: <u>01/24/11</u>
Instrument ID: <u>MS-BNA4</u>	Injection Time: <u>15:40</u>
Sequence: <u>1A02504</u>	Lab Sample ID: <u>1A02504-TUN1</u>

m/z	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE	
51	30 - 60% of 198	52.3	PASS
68	Less than 2% of 69	1.72	PASS
69	Less than 200% of 198	45.2	PASS
70	Less than 2% of 69	0.492	PASS
127	40 - 60% of 198	52.1	PASS
197	Less than 1% of 198	0.226	PASS
198	Base peak, 100% relative abundance	100	PASS
199	5 - 9% of 198	6.73	PASS
275	10 - 30% of 198	28.4	PASS
365	1 - 200% of 198	4.29	PASS
441	0.001 - 100% of 443	80.7	PASS
442	40 - 200% of 198	166	PASS
443	17 - 23% of 442	19.3	PASS

CONTINUING CALIBRATION CHECK

SW8270C

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells_2010</u>
Instrument ID: <u>MS-BNA4</u>	Calibration: <u>1017001</u>
Lab File ID: <u>SEQ-CCV1.D</u>	Calibration Date: <u>01/13/11 14:40</u>
Sequence: <u>1A02504</u>	Injection Date: <u>01/24/11</u>
Lab Sample ID: <u>1A02504-CCV1</u>	Injection Time: <u>15:59</u>

COMPOUND	TYPE	CONC. (ug/mL)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
1-Methylnaphthalene	A	5.000	4.314	1.061797	0.9162031		-13.7	20
2-Methylnaphthalene	A	5.000	4.485	1.095514	0.9827282		-10.3	20
Naphthalene	A	5.000	4.173	7.214082	6.021152		-16.5	20
2-Fluorobiphenyl	A	5.000	4.547	1.132059	1.029523		-9.1	20
Terphenyl-d14	A	5.000	5.768	0.5337225	0.6157463		15.4	20

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

HOLDING TIME SUMMARY

FLPRO

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sample Name	Date Collected	Date Received	Date Prepared	Days to Prep	Max Days to Prep	Date Analyzed	Days to Analysis	Max Days to Analysis	Q
CEF-BP-11S-201101	01/18/11 10:20	01/19/11 08:30	01/20/11 09:10	1.99	7.00	01/22/11 00:18	1.63	40.00	
CEF-BP-10S-201101	01/18/11 10:56	01/19/11 08:30	01/20/11 09:10	1.97	7.00	01/22/11 01:00	1.66	40.00	
CEF-BP-04S-201101	01/18/11 11:40	01/19/11 08:30	01/20/11 09:10	1.94	7.00	01/22/11 01:42	1.69	40.00	
CEF-BP-06S-201101	01/18/11 12:20	01/19/11 08:30	01/20/11 09:10	1.91	7.00	01/22/11 02:24	1.72	40.00	
CEF-BP-09S-201101	01/18/11 13:35	01/19/11 08:30	01/20/11 09:10	1.86	7.00	01/22/11 04:30	1.81	40.00	
CEF-BP-01S-201101	01/18/11 14:30	01/19/11 08:30	01/20/11 09:10	1.82	7.00	01/22/11 05:12	1.83	40.00	
CEF-BP-05I-201101	01/18/11 15:00	01/19/11 08:30	01/20/11 09:10	1.80	7.00	01/22/11 05:54	1.86	40.00	
CEF-BP-DUP-01-201101	01/18/11 00:00	01/19/11 08:30	01/20/11 09:10	2.42	7.00	01/22/11 06:36	1.89	40.00	

METHOD DETECTION AND REPORTING LIMITS

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF 010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Matrix: Water

Instrument: GL-GCFID2

Analyte	MDL	MRL	Units	Method
Petroleum Range Organics	0.0850	0.340	mg/L	FLPRO

PREPARATION BATCH SUMMARY

FLPRO

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Batch: 1A20002 Batch Matrix: Water

Preparation: EXT_3510

SAMPLE NAME	LAB SAMPLE ID	DATE PREPARED	INITIAL VOL./WEIGHT	FINAL VOL.
CEF-BP-11S-201101	1101070-01	01/20/11 09:10	1,080.00	2.00
CEF-BP-10S-201101	1101070-02	01/20/11 09:10	1,080.00	2.00
CEF-BP-04S-201101	1101070-03	01/20/11 09:10	1,080.00	2.00
CEF-BP-06S-201101	1101070-04	01/20/11 09:10	1,080.00	2.00
CEF-BP-09S-201101	1101070-05	01/20/11 09:10	1,075.00	2.00
CEF-BP-01S-201101	1101070-06	01/20/11 09:10	1,080.00	2.00
CEF-BP-05I-201101	1101070-07	01/20/11 09:10	1,080.00	2.00
CEF-BP-DUP-01-201101	1101070-08	01/20/11 09:10	1,080.00	2.00
Blank	1A20002-BLK1	01/20/11 09:10	1,000.00	2.00
LCS	1A20002-BS1	01/20/11 09:10	1,000.00	2.00
CEF-BP-06S-201101	1A20002-MS1	01/20/11 09:10	1,080.00	2.00
CEF-BP-06S-201101	1A20002-MSD1	01/20/11 09:10	1,080.00	2.00

ANALYSIS SEQUENCE SUMMARY

FLPRO

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Sequence: 0L36411

Instrument: GL-GCFID2

Calibration: 0364001

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
Cal Standard	0L36411-CAL6	003F0901.D	12/29/10 18:11
Cal Standard	0L36411-CAL5	004F1001.D	12/29/10 18:53
Cal Standard	0L36411-CAL4	005F1101.D	12/29/10 19:36
Cal Standard	0L36411-CAL3	006F1201.D	12/29/10 20:18
Cal Standard	0L36411-CAL2	007F1301.D	12/29/10 21:00
Cal Standard	0L36411-CAL1	008F1401.D	12/29/10 21:42
Initial Cal Check	0L36411-ICV1	009F1501.D	12/29/10 22:25

INITIAL CALIBRATION STANDARDS

FLPRO

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells_2010

Sequence: 0L36411

Instrument: GL-GCFID2

Calibration: 0364001

Standard ID	Description	Lab Sample ID	Lab File ID	Analysis Date/Time
10K0198	FLPRO CAL6 85ppm	0L36411-CAL6	003F0901.D	12/29/10 18:11
10K0199	FLPRO CAL5 850ppm	0L36411-CAL5	004F1001.D	12/29/10 18:53
10K0200	FLPRO CAL4 2550ppm	0L36411-CAL4	005F1101.D	12/29/10 19:36
10L0688	FLPRO CAL3 4250ppm	0L36411-CAL3	006F1201.D	12/29/10 20:18
10K0202	FLPRO CAL2 5950ppm	0L36411-CAL2	007F1301.D	12/29/10 21:00
10K0203	FLPRO CAL1 8500ppm	0L36411-CAL1	008F1401.D	12/29/10 21:42

INITIAL CALIBRATION DATA (Continued)

FLPRO

Laboratory: Empirical Laboratories, LLC

SDG: CTOJM09CF_010

Client: Tetra Tech NUS, Inc. (T010)

Project: CTO JM09 BP Wells 2010

Calibration: 0364001

Instrument: GL-GCFID2

Matrix: Water

Calibration Date: 12/29/2010 6:11:36PM

Compound	Mean RF	RF RSD	Mean RT	RT RSD	Linear r	Quad COD	LIMIT	Q
Petroleum Range Organics	846.2533	11.13636	2.807	9.406812E-03			20	
2-Fluorobiphenyl	1294.737	4.223345	11.45083	2.783708E-02			20	
o-Terphenyl	1329	10.13905	16.96417	2.080324E-02			20	

INITIAL CALIBRATION CHECK

FLPRO

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells_2010</u>
Instrument ID: <u>GL-GCFID2</u>	Calibration: <u>0364001</u>
Lab File ID: <u>009F1501.D</u>	Calibration Date: <u>12/29/10 18:11</u>
Sequence: <u>0L36411</u>	Injection Date: <u>12/29/10</u>
Lab Sample ID: <u>0L36411-ICV1</u>	Injection Time: <u>22:25</u>

COMPOUND	TYPE	CONC. (mg/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	ICV	ICAL	ICV	MIN (#)	ICV	LIMIT (#)
Petroleum Range Organics	A	4000	4363	846.2533	922.973		9.1	25

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

CONTINUING CALIBRATION CHECK

FLPRO

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells_2010</u>
Instrument ID: <u>GL-GCFID2</u>	Calibration: <u>0364001</u>
Lab File ID: <u>002F0201.D</u>	Calibration Date: <u>12/29/10 18:11</u>
Sequence: <u>1A02205</u>	Injection Date: <u>01/21/11</u>
Lab Sample ID: <u>1A02205-CCV1</u>	Injection Time: <u>14:29</u>

COMPOUND	TYPE	CONC. (mg/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
Petroleum Range Organics	A	4250	4124	846.2533	821.2179		-3.0	25
2-Fluorobiphenyl	A	25.00	26.99	1294.737	1397.68		8.0	25
o-Terphenyl	A	25.00	25.95	1329	1379.48		3.8	25

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

CONTINUING CALIBRATION CHECK

FLPRO

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells 2010</u>
Instrument ID: <u>GL-GCFID2</u>	Calibration: <u>0364001</u>
Lab File ID: <u>015F1501.D</u>	Calibration Date: <u>12/29/10 18:11</u>
Sequence: <u>1A02205</u>	Injection Date: <u>01/21/11</u>
Lab Sample ID: <u>1A02205-CCV2</u>	Injection Time: <u>23:36</u>

COMPOUND	TYPE	CONC. (mg/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
Petroleum Range Organics	A	4250	4259	846.2533	847.9995		0.2	25
2-Fluorobiphenyl	A	25.00	27.34	1294.737	1416.08		9.4	25
o-Terphenyl	A	25.00	26.89	1329	1429.32		7.5	25

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

CONTINUING CALIBRATION CHECK

FLPRO

Laboratory: <u>Empirical Laboratories, LLC</u>	SDG: <u>CTOJM09CF_010</u>
Client: <u>Tetra Tech NUS, Inc. (T010)</u>	Project: <u>CTO JM09 BP Wells_2010</u>
Instrument ID: <u>GL-GCFID2</u>	Calibration: <u>0364001</u>
Lab File ID: <u>026F2601.D</u>	Calibration Date: <u>12/29/10 18:11</u>
Sequence: <u>1A02205</u>	Injection Date: <u>01/22/11</u>
Lab Sample ID: <u>1A02205-CCV3</u>	Injection Time: <u>07:18</u>

COMPOUND	TYPE	CONC. (mg/L)		RESPONSE FACTOR			% DIFF / DRIFT	
		STD	CCV	ICAL	CCV	MIN (#)	CCV	LIMIT (#)
Petroleum Range Organics	A	4250	3666	846.2533	730.0395		-13.7	25
2-Fluorobiphenyl	A	25.00	23.04	1294.737	1193.36		-7.8	25
o-Terphenyl	A	25.00	22.54	1329	1198.08		-9.9	25

Column to be used to flag Response Factor and %Diff/Drift values with an asterisk

* Values outside of QC limits

ANALYSIS SEQUENCE SUMMARY

FLPRO

Laboratory:	<u>Empirical Laboratories, LLC</u>	SDG:	<u>CTOJM09CF_010</u>
Client:	<u>Tetra Tech NUS, Inc. (T010)</u>	Project:	<u>CTO JM09 BP Wells 2010</u>
Sequence:	<u>1A02205</u>	Instrument:	<u>GL-GCFID2</u>
Calibration:	<u>0364001</u>		

Sample Name	Lab Sample ID	Lab File ID	Analysis Date/Time
Calibration Check	1A02205-CCV1	002F0201.D	01/21/11 14:29
Blank	1A20002-BLK1	003F0301.D	01/21/11 15:11
LCS	1A20002-BS1	004F0401.D	01/21/11 15:53
Calibration Check	1A02205-CCV2	015F1501.D	01/21/11 23:36
CEF-BP-11S-201101	1101070-01	016F1601.D	01/22/11 00:18
CEF-BP-10S-201101	1101070-02	017F1701.D	01/22/11 01:00
CEF-BP-04S-201101	1101070-03	018F1801.D	01/22/11 01:42
CEF-BP-06S-201101	1101070-04	019F1901.D	01/22/11 02:24
CEF-BP-06S-201101	1A20002-MS1	020F2001.D	01/22/11 03:06
CEF-BP-06S-201101	1A20002-MSD1	021F2101.D	01/22/11 03:48
CEF-BP-09S-201101	1101070-05	022F2201.D	01/22/11 04:30
CEF-BP-01S-201101	1101070-06	023F2301.D	01/22/11 05:12
CEF-BP-05I-201101	1101070-07	024F2401.D	01/22/11 05:54
CEF-BP-DUP-01-201101	1101070-08	025F2501.D	01/22/11 06:36
Calibration Check	1A02205-CCV3	026F2601.D	01/22/11 07:18

**NAS CECIL FIELD
WATER DATA
CTOJM09CF_10**

FRACTION	CHEMICAL	CEF-BP-06S-201101	UNITS	CEF-BP-DUP-01-201101	RPD	D
OV	1,2,4-TRIMETHYLBENZENE	162	UG/L	196	18.99	34.00
OV	1,3,5-TRIMETHYLBENZENE	41.8	UG/L	44.4	6.03	2.60
OV	ETHYLBENZENE	113	UG/L	151	28.79	38.00
OV	ISOPROPYLBENZENE	13.9	UG/L	15	7.61	1.10
OV	TOLUENE	1.38	UG/L	1.57 J	12.88	0.19
OV	TOTAL XYLENES	247	UG/L	253	2.40	6.00
PAH	1-METHYLNAPHTHALENE	5.22	UG/L	6.15	16.36	0.93
PAH	2-METHYLNAPHTHALENE	8.98	UG/L	9.89	9.64	0.91
PAH	NAPHTHALENE	18.1	UG/L	20.2	10.97	2.10
PET	TPH (C08-C40)	2.36	MG/L	2.49	5.36	0.13

Current RPD Quality Control Limit: 30 %.

Shaded cells indicate RPDs that exceed the applicable quality control limit.

ATTACHMENT C
FIELD DATA SHEETS



Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME: NAS-CF

INSTRUMENT NAME/MODEL: V51

SITE NAME: _____

MANUFACTURER: _____

PROJECT No.: 112 GO 2267

SERIAL NUMBER: 10M100160

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
01-18-2011	10M100160	(ZS)	ORP 240		234	240	2741	BP Wells-11s, 10s 4s, 6s, 9s, 1s, 5I ↓
			Con 1413		1476	1413	8114	
			pH 7.00		6.95	7.00	2005605	
			pH 10.00		10.32	10.00	1007143	
			pH 4.00		4.16	4.00	2004466	
01-19-2011	10M100160	(S)	ORP 240		244	240	2741	81 A, B, C
			Con 1413		1395	1413	8114	
			pH 7.00		7.01	7.00	2005605	
			↓ 10.00		10.00	10.00	1007143	
			↓ 4.00		3.94	4.00	2004466	



PROJECT NO: 112602067	FACILITY: NAS Coal Field BP Wells	PROJECT MANAGER Kob Simcik	PHONE NUMBER 412 951 8163	LABORATORY NAME AND CONTACT: Empirical Labs/ Kim Koszler
SAMPLERS (SIGNATURE) Zach Scribner		FIELD OPERATIONS LEADER Kara Wimble	PHONE NUMBER 904 636 6125	ADDRESS 621 Mainstream Drive Suite 270
		CARRIER/WAYBILL NUMBER FED EX AIRBILL 8660 1730 2300		CITY, STATE Nashville, TN 37208

STANDARD TAT RUSH TAT
 24 hr. 48 hr. 72 hr. 7 day 14 day

DATE YEAR	TIME	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS			COMMENTS
								CONTAINER TYPE PLASTIC (P) or GLASS (G)	PRESERVATIVE USED		
1/18	1020	CEF-BP-115-201101			GW	G	3	Z	Z		Cool to 4°C
1/18	1056	CEF-BP-105-201101			GW	G	3	Z	Z		
1/18	1140	CEF-BP-045-201101			GW	G	3	Z	Z		
1/18	1220	CEF-BP-065-201101			GW	G	9	6	6		
1/18	1335	CEF-BP-095-201101			GW	G	3	Z	Z		
1/18	1430	CEF-BP-015-201101			GW	G	3	Z	Z		
1/18	1500	CEF-BP-051-201101			GW	G	3	Z	Z		
1/18	0000	CEF-BP-DUP-01-2016			GW	G	3	Z	Z		

1. RELINQUISHED BY Zach Scribner	DATE 01/18/2011	TIME 1700	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

112402267

NAS-CF-BP Wells - GW Sampling

18 Jan., 2011

Personnel: Zach Scribner

Truck: 2001 F-250

PPE: Level D

Weather: Partly Sunny 70°

Objective: Groundwater Sampling

0700 Departed office for NAS-CF

0815 Arrived at NAS-CF (Delayed due to an accident blocking traffic)

0845 Obtained Contractor Pass; Departed JAA tower for BP Wells

0930 Completed Calibrations; obtained H₂O levels; began sampling. (see table below for details.)

Well ID	SAMPLE ID	SAMPLE TIME	ANALYSIS
CEF-BP-11\$	CEF-BP-11\$-201101	1020	1, 2, 3
CEF-BP-10\$	CEF-BP-10\$-201101	1056	1, 2, 3
CEF-BP-04\$	CEF-BP-04\$-201101	1140	1, 2, 3
CEF-BP-06\$	CEF-BP-06\$-201101*	1220	1, 2, 3
CEF-BP-09\$	CEF-BP-09\$-201101	1335	1, 2, 3
CEF-BP-01\$	CEF-BP-01\$-201101	1430	1, 2, 3
CEF-BP-05I	CEF-BP-05I-201101	1500	1, 2, 3

* Indicates MS/MSD + DUP; (1-VOCs); (2-TRPHs); (3-NAPHTHALENES)

1640 completed sampling; packed samples on ice for transport (Fed Ex)

AIRBILL # B666 1730 2300; repaired bolt threads ~~at~~ for

MW → CEF-BP-04\$ 201101

1715 Transferred IDW to Tote #3

1730 Departed NAS-CF

1815 Arrived @ office

25

ZS

Tetra Tech NUS / FDEP Groundwater Sampling Sheet

SITE NAME: G82/BP Wells WELL NO: CEF-BP-1S	SITE LOCATION: NAS Cecil Field SAMPLE ID: CEF-BP-1S-201101 DATE: 01/18/11
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PURGING DATA

WELL DIAMETER (in): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 15	STATIC DEPTH TO WATER (ft): 8.20	PURGE PUMP TYPE OR BAILER: Peristaltic Pump							
WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY only fill out if applicable $3.95 \text{ Liters} = 14.72 - 8.20 \times 0.16 (3.785)$											
EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable)											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 8.7	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 9.1	PURGE INITIATED AT: 1410	PURGE ENDED AT: 1430	TOTAL VOLUME PURGED (Liters): 5.0							
TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (mlpm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1410	—	—	400	8.20	—	—	—	—	27.3	—	muddy
1415	2.0	2.0	200	8.41	6.32	20.10	0.237	0.16	26.7	26.4	clear
1420	1.0	3.0	200	8.52	6.36	20.17	0.259	0.19	24.1	32.8	clear
1425	1.0	4.0	200	8.53	6.44	20.21	0.313	0.13	15.7	37.4	clear
1430*	1.0	5.0	200	8.60	6.48	20.21	0.345	0.14	9.13	37.6	clear
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Jeff Krone ZACH SCRIBNER		SAMPLER(S) SIGNATURES: 		SAMPLING INITIATED AT: 1430	SAMPLING ENDED AT: 1443			
PUMP OR TUBING DEPTH IN WELL (feet): 9.1		SAMPLE PUMP FLOW RATE (ml per minute): 200		TUBING MATERIAL CODE: Teflon				
FIELD DECONTAMINATION: <input checked="" type="checkbox"/> N		FIELD-FILTERED: Y <input checked="" type="checkbox"/> N		FILTER SIZE: ___ µm				
SAMPLE CONTAINER SPECIFICATION		SAMPLE PRESERVATION				DUPLICATE: Y <input checked="" type="checkbox"/> N		
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH	INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE
TRPH	2	AG	1 L	H ₂ SO ₄		6.48	FL-PRO	
BTEX/Naph /VOCs	3	CG	40 ml	HCL		6.48	8260B	
PAHS	2	AG	1 L	None		6.48	8270 SIM	
REMARKS:								
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)								
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)								

Tetra Tech NUS / FDEP Groundwater Sampling Sheet

SITE NAME: G82/BP Wells	SITE LOCATION: NAS Cecil Field
WELL NO: CEF-BP-4S	DATE: 01 / 18 / 2011
SAMPLE ID: CEF-BP-04S-201101	

PURGING DATA

WELL DIAMETER (in): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 15 to 5	STATIC DEPTH TO WATER (ft): 9.39	PURGE PUMP TYPE OR BAILER: Peristaltic Pump							
WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY only fill out if applicable 3.25 Liters = 14.75 - 9.39 x 0.16 (3.785)											
EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable)											
Liters											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 9.89	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 9.89	PURGE INITIATED AT: 1125	PURGE ENDED AT: 1140	TOTAL VOLUME PURGED (Liters): 3.5							
TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (mlpm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1125	—	—	400	9.39	—	—	—	—	21.6	—	clear
1130	2.0	2.0	200	9.41	6.42	22.68	6.257	0.73	13.3	88.4	clear
1135	1.0	3.0	100	9.40	6.43	22.73	0.245	0.60	13.5	76.7	plw
1140	0.5	3.5	200	9.39	6.46	22.77	0.255	0.48	8.8	65.1	plw
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Jeff Krohn		SAMPLER(S) SIGNATURES: [Signature]		SAMPLING INITIATED AT: 1140		SAMPLING ENDED AT: 1155		
PUMP OR TUBING DEPTH IN WELL (feet): 9.89		SAMPLE PUMP FLOW RATE (mL per minute): 200		TUBING MATERIAL CODE: Teflon				
FIELD DECONTAMINATION: (Y) N		FIELD-FILTERED: Y (N)		FILTER SIZE: _____ µm		DUPLICATE: Y (N)		
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH		
TRPH	2	AG	1 L	HCl		6.46	FL-PRO	
BTEX/ Naph/VOCs	3	CG	40 ml	HCl		6.46	8260B	
PAHS	2	AG	1 L	None		6.46	8270 SIM	
REMARKS:								
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)								
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)								

Tetra Tech NUS / FDEP Groundwater Sampling Sheet

SITE NAME: G82/BP Wells	SITE LOCATION: NAS Cecil Field
WELL NO: CEF-BP-51	DATE: 01 / 18 / 2011
SAMPLE ID: CEF-BP-051-201101	

PURGING DATA

WELL DIAMETER (in): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 35 30	STATIC DEPTH TO WATER (ft): 8.56	PURGE PUMP TYPE OR BAILER: Peristaltic Pump							
WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY only fill out if applicable $15.6 \text{ Liters} = 34.39 - 8.56 \times 0.16 \text{ (3.785)}$											
EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable)											
Liters											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 32	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 32	PURGE INITIATED AT: 1355	PURGE ENDED AT: 1500	TOTAL VOLUME PURGED (Liters): 16.0							
TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (mlpm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1355	—	—	200	8.56	—	—	—	—	0.84	—	clear
1446	10.0L	10.0L	400	8.89	5.74	22.51	0.068	1.27	0.73	12.34	↓
1450	2.0L	12.0L	400	8.89	5.72	22.49	0.66	0.96	0.69	19.4	↓
1455	2.0L	14.0L	400	8.89	5.72	22.49	0.66	0.95	0.64	22.4	↓
1500	2.0L	16.0L	400	8.89	5.71	22.49	0.66	0.94	0.65	18.3	↓
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Jeff Krone Zach Scribner		SAMPLER(S) SIGNATURES: 		SAMPLING INITIATED AT: 1500	SAMPLING ENDED AT: 1510			
PUMP OR TUBING DEPTH IN WELL (feet): 32		SAMPLE PUMP FLOW RATE (mL per minute): 700		TUBING MATERIAL CODE: Teflon				
FIELD DECONTAMINATION: <input checked="" type="checkbox"/> N		FIELD-FILTERED: <input checked="" type="checkbox"/> Y Filtration Equipment Type: _____		DUPLICATE: <input checked="" type="checkbox"/> Y <input checked="" type="checkbox"/> N				
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH		
TRPH	2	AG	1 L	HCl			FL-PRO	
BTEX/ Naph/VOC	3	CG	40 ml	HCl			8260B	
PAHS	2	AG	1 L	None			8270 SIM	
REMARKS:								
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)								
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)								

Tetra Tech NUS / FDEP Groundwater Sampling Sheet

SITE NAME: G82/BP Wells	SITE LOCATION: NAS Cecil Field
WELL NO: CEF-BP-6S	SAMPLE ID: CEF-BP-06S-201101 DATE: 01 / 18 / 2011

PURGING DATA

WELL DIAMETER (in): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 14.2 to 4	STATIC DEPTH TO WATER (ft): 8.89	PURGE PUMP TYPE OR BAILER: Peristaltic Pump							
WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY only fill out if applicable 3.2 Liters = 14.2 - 8.89 x 0.16 (3.785)											
EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable)											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 9.4		FINAL PUMP OR TUBING DEPTH IN WELL (feet): 9.8		PURGE INITIATED AT: 1200	PURGE ENDED AT: 1220	TOTAL VOLUME PURGED (Liters): 5.0					
TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (ml/pm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1200			400	8.89					30.1		clear
1205	2.0	2.0	200	9.14	6.47	21.69	0.339	0.65	21.3	-49.9	
1210	1.0	3.0	200	9.19	6.46	21.72	0.337	0.31	17.4	-33.4	
1215	1.0	4.0	200	9.24	6.47	21.67	0.339	0.28	13.2	-21.4	
1220	1.0	5.0	200	9.26	6.47	21.72	0.341	0.21	9.06	-9.10	↓
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Johanna Zach Scribner			SAMPLER(S) SIGNATURES: 			SAMPLING INITIATED AT: 1220		SAMPLING ENDED AT: 1305	
PUMP OR TUBING DEPTH IN WELL (feet): 9.8			SAMPLE PUMP FLOW RATE (mL per minute): 300			TUBING MATERIAL CODE: Teflon			
FIELD DECONTAMINATION: <input checked="" type="checkbox"/> Y <input type="checkbox"/> N			FIELD-FILTERED: <input checked="" type="checkbox"/> Y <input type="checkbox"/> N FILTER SIZE: _____ µm			DUPLICATE: <input checked="" type="checkbox"/> Y <input type="checkbox"/> N			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH			
TRPH	2 ms/msd (+4)	AG	1 L	H₂		6.47	FL-PRO		
BTEX/ Naph/VOC	3 ms/msd (+6)	CG	40 ml	HCl		6.47	8260B		
PAHS	2 ms/msd (+4)	AG	1 L	None		6.47	8270 SIM		
REMARKS: * Dup ** ms/msd									
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)									
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)									

Tetra Tech NUS / FDEP Groundwater Sampling Sheet

SITE NAME: G82/BP Wells	SITE LOCATION: NAS Cecil Field
WELL NO: CEF-BP-9S	DATE: 01 / 18 / 2011

PURGING DATA

WELL DIAMETER (in): 2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 5-15'	STATIC DEPTH TO WATER (ft): 9.02	PURGE PUMP TYPE OR BAILER: Peristaltic Pump							
WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY only fill out if applicable) 3.6 Liters = 14.97 - 9.02 x 0.16 (3.785)											
EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME (only fill out if applicable) Liters											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 9.5	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 9.9	PURGE INITIATED AT: 1320	PURGE ENDED AT: 1335	TOTAL VOLUME PURGED (Liters): 4.0							
TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (mlpm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1320	—	—	400	9.02	6.46	—	—	—	12.6	—	clear
1325	2.0	2.0	200	9.26	6.46	21.38	0.334	0.33	10.4	16.4	
1330	1.0	3.0	200	9.34	6.48	21.47	0.334	0.33	8.56	26.6	
1335	1.0	4.0	200	9.40	6.48	21.46	0.333	0.30	6.41	24.1	
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Jeff Krone		SAMPLER(S) SIGNATURES: Zach Scribner		SAMPLING INITIATED AT: 1335	SAMPLING ENDED AT: 1350			
PUMP OR TUBING DEPTH IN WELL (feet): 9.9		SAMPLE PUMP FLOW RATE (mL per minute): 200		TUBING MATERIAL CODE: Teflon				
FIELD DECONTAMINATION: <input checked="" type="radio"/> Y <input type="radio"/> N		FIELD-FILTERED: <input checked="" type="radio"/> Y <input type="radio"/> N		FILTER SIZE: _____ µm				
FIELD-FILTERED: <input checked="" type="radio"/> Y <input type="radio"/> N		FILTRATION EQUIPMENT TYPE: _____		DUPLICATE: <input type="radio"/> Y <input checked="" type="radio"/> N				
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH		
TRPH	2	AG	1 L	HCl		6.48	FL-PRO	
VOCs	3	CG	40 ml	HCl		6.48	8260B	
PAHs	2	AG	1 L	none		6.48	SW-846/8270C	
REMARKS:								
MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)								
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)								

SITE NAME: BP Wells		SITE LOCATION: NAS Cecil Field	
WELL NO: CEF-BP-10S		SAMPLE ID: CEF-BP-10S-201101	
DATE: 01/18/2011			

PURGING DATA

WELL DIAMETER (in): 1"	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 5-15'	STATIC DEPTH TO WATER (ft): 9.02	PURGE PUMP TYPE OR BAILER: Peristaltic Pump
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WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY
 only fill out if applicable)
 $0.9 \text{ Liters} = 14.97 - 9.02 \times 0.04 (3.785)$

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
 (only fill out if applicable)

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 9.5	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 9.8	PURGE INITIATED AT: 1045	PURGE ENDED AT: 1056	TOTAL VOLUME PURGED (Liters):
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TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (mlpm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1045			200	9.02					4.11		clear
1050	1.0	1.0	200	9.27	6.24	22.31	0.340	0.19	3.73	-26.1	
1052	0.4	1.4	200	9.30	6.24	22.30	0.340	0.18	3.71	-16.4	
1054	0.4	1.8	200	9.31	6.24	22.30	0.340	0.16	3.64	-9.3	
1056	0.4	2.2	200	9.31	6.25	22.34	0.329	0.25	3.70	-7.4	

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88
 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Jeff Krone	SAMPLER(S) SIGNATURES: <i>[Signature]</i>	SAMPLING INITIATED AT: 1056	SAMPLING ENDED AT: 1110
PUMP OR TUBING DEPTH IN WELL (feet): 9.8	SAMPLE PUMP FLOW RATE (mL per minute): 200	TUBING MATERIAL CODE: Teflon	
FIELD DECONTAMINATION: <input checked="" type="radio"/> Y <input type="radio"/> N	FIELD-FILTERED: <input type="radio"/> Y <input checked="" type="radio"/> N	FILTER SIZE: µm	DUPLICATE: <input type="radio"/> Y <input checked="" type="radio"/> N

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH		
TRPH	2	AG	1 L	H ₂		6.25	FL-PRO	
VOCs	3	CG	40 ml	HCl		6.25	8260B	
PAHs	2	AG	1 L	none		6.25	SW-846/8270C	

REMARKS:

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

SITE NAME: BP Wells	SITE LOCATION: NAS Cecil Field
WELL NO: CEF-BP-11S	SAMPLE ID: CEF-BP-11S-201101
DATE: 01 / 18 / 2011	

PURGING DATA

WELL DIAMETER (in): 1 1/2	TUBING DIAMETER (inches): 3/16	WELL SCREEN INTERVAL DEPTH: 5-15'	STATIC DEPTH TO WATER (ft): 8.74
PURGE PUMP TYPE OR BAILER: Peristaltic Pump			

WELL VOLUME PURGE: 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY
only fill out if applicable
 $0.96 \text{ Liters} = 15.05 - 8.74 \times 0.04 \text{ (3.785)}$

EQUIPMENT VOLUME PURGE: 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME
only fill out if applicable

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 9.3		FINAL PUMP OR TUBING DEPTH IN WELL (feet): 9.6		PURGE INITIATED AT: 1005		PURGE ENDED AT: 1020		TOTAL VOLUME PURGED (Liters):			
TIME	VOLUME PURGED (Liters)	CUMUL. VOLUME PURGED (Liters)	PURGE RATE (mlpm)	DEPTH TO WATER (ft)	pH (standard units)	TEMP. (°C)	COND. (µS/cm)	DISSOLVED OXYGEN (mg/L)	TURBIDITY (NTUs)	ORP (mV)	COLOR
1005	—	—	200	8.74	—	—	—	—	12.0	—	<i>clear</i>
1010	1.0	1.0	200	8.9	08.40	21.51	0.201	0.47	8.00	87.6	↓
1013	0.6	1.6	200	9.02	08.35	21.53	0.178	0.40	6.37	92.3	↓
1016	0.6	2.2	200	9.08	6.36	21.54	0.199	0.37	6.41	98.4	↓
1020	0.8	3.0	200	9.11	6.36	21.54	0.199	0.34	6.39	102.3	↓

WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88
 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.0006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: TINUS/ Zach Seibert	SAMPLER(S) SIGNATURES: <i>[Signature]</i>	SAMPLING INITIATED AT: 1020	SAMPLING ENDED AT: 1035
PUMP OR TUBING DEPTH IN WELL (feet): 9.6	SAMPLE PUMP FLOW RATE (mL per minute): 200	TUBING MATERIAL CODE: Teflon	
FIELD DECONTAMINATION: <input checked="" type="radio"/> Y <input type="radio"/> N	FIELD-FILTERED: <input type="radio"/> Y <input checked="" type="radio"/> N	FILTER SIZE:	DUPLICATE: <input type="radio"/> Y <input checked="" type="radio"/> N

SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD	SAMPLING EQUIPMENT CODE
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL ADDED IN FIELD (mL)	FINAL pH		
TRPH	2	AG	1 L	H ₂			FL-PRO	
VOCs	3	CG	40 ml	HCl			8260B	
PAHs	2	AG	1 L	none			SW-846/8270C	

REMARKS:

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (Tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

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Date 1/19/11 Sender's FedEx Account Number 1772-0315-7

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Company TETRA TECH NUS INC/GOVT

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Your Internal Billing Reference 112602267
First 24 characters will appear on invoice.

To
Recipient's Name Sample Receiving Phone (615) 345-1115

Company Empirical Laboratories

Recipient's Address 621 Mainstream Drive Dept./Floor/Suite/Room

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0383105710

4a Express Package Service

FedEx Priority Overnight Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

FedEx Standard Overnight Next business afternoon.* Saturday Delivery NOT available.

FedEx First Overnight Earliest next business morning delivery to select locations.* Saturday Delivery NOT available.

FedEx 2Day Second business day.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

FedEx Express Saver Third business day.* Saturday Delivery NOT available.

* To most locations.

4b Express Freight Service

FedEx 1Day Freight* Next business day.** Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

FedEx 2Day Freight Second business day.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

FedEx 3Day Freight Third business day.** Saturday Delivery NOT available.

* Call for Confirmation. ** To most locations.

5 Packaging

FedEx Envelope* FedEx Pak* Includes FedEx Small Pak, FedEx Large Pak, and FedEx Sturdy Pak. FedEx Box FedEx Tube Other

* Declared value first \$500.

6 Special Handling

SATURDAY Delivery **NOT Available for** FedEx Standard Overnight, FedEx First Overnight, FedEx Express Saver, or FedEx 3Day Freight.

HOLD Weekday at FedEx Location **NOT Available for** FedEx First Overnight.

HOLD Saturday at FedEx Location **Available ONLY for** FedEx Priority Overnight and FedEx 2Day to select locations.

Does this shipment contain dangerous goods?
One box must be checked.

No Yes As per attached Shipper's Declaration. Yes Shipper's Declaration not required. Dry Ice Dry Ice, 6, UN 1845 x _____ lb

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging. Cargo Aircraft Only

7 Payment Bill to: Enter FedEx Acct. No. or Credit Card No. below.

Sender Acct. No. in Section 1 will be billed. Recipient Third Party Credit Card Cash/Check

FedEx Acct. No. / Credit Card No. Exp. Date

Total Packages	Total Weight	Total Declared Value*
1	42	\$ 100.00

*Our liability is limited to \$100 unless you declare a higher value. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

8 Residential Delivery Signature Options If you require a signature, check Direct or Indirect.

No Signature Required Package may be left without obtaining a signature for delivery.

Direct Signature Someone at recipient's address may sign for delivery. *Fee applies.*

Indirect Signature If no one is available at recipient's address, someone at a neighboring address may sign for delivery. *Fee applies.*

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FedEx OfficeSM

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JACKSONVILLE, FL 32257

Location: NRBKK
Device ID: NRBKK-POS2
Employee: 2263818
Transaction: 76098771794

PRIORITY OVERNIGHT

866017302300	355.00 lb (M)	289.98
799526801717		
799526801728		
799526801739		
799526801740		
799526801750		
799526801761		

Scheduled Delivery Date 01/19/2011

Shipment subtotal: 289.98

Total Due: 289.98

FedEx Account: 289.98

*****3157

M = Weight entered manually
S = Weight read from scale
I = Taxable item

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