ENBRIDGE

Enbridge
Suite 1100 – 425 West Superior St.
Duluth, MN 55802

Submitted to BRRTS

February 25, 2025

Caroline Rice
Hydrogeologist – Bureau of Remediation & Redevelopment
Wisconsin Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, WI 53711

RE: BRRTS Activity Number 02-28-595980 Cambridge Station
Surface Water Sampling Plan

Dear Caroline,

A surface water sampling plan for the Cambridge Site (BRRTS Activity Number 02-28-595980) in Jefferson County is enclosed for your review and approval.

Sincerely,

Shane E. Yokom

Shane E. Yokom
Environment Operations Supervisor, LPUS

Enclosure: Cambridge Surface Water Sampling Plan

GEI Consultants

February 25, 2025
Project No. 2408314

VIA EMAIL: Shane.Yokom@enbridge.com

Responsible Party:
Enbridge Energy, Limited Partnership
Shane Yokom, Environment Supervisor - LPUS
425 W. Superior Street, Suite 1100
Duluth, Minnesota 55802
218-269-0369

Re: Enbridge Energy Line 6 Cambridge Station
W8375 US Highway 18, Cambridge, Wisconsin 53523
Surface Water Sampling Plan
WDNR BRRTS Activity No. 02-28-595980

Dear Mr. Yokom:

At the request of Enbridge Energy, Limited Partnership (Enbridge), GEI Consultants, Inc. (GEI) has prepared this Surface Water Sampling Plan (SWSP) related to Wisconsin Department of Natural Resources (WDNR) Bureau for Remediation and Redevelopment Tracking System (BRRTS) Activity No. 02-28-595980 - Enbridge Energy Line 6 Cambridge Station.

Background and Plan Overview

On November 11, 2024, Enbridge discovered and reported a crude oil release at the Cambridge Station, located at W8375 US Highway 18, Cambridge, Town of Oakland, Wisconsin 53523 (Site). The Site location is shown on **Figure 1**. Since the release notification, Site activities have been ongoing under the oversight of the WDNR and in accordance with Wisconsin Administrative Code (WAC) Chapter NR 700-799.

Immediately following the release discovery, an evaluation of nearby surface water resources was completed. The surface waterbody nearest the Site is an unnamed agricultural drainage ditch (WDNR Waterbody Identification Code 809700), located along the facility's eastern property boundary. The unnamed agricultural drainage ditch generally flows south and west through a series of interconnected or intermittent channelized ditches and wetland complexes, having a flow path of approximately 16,000 feet (originating approximately 0.50 miles north of the Site), and drains to the southeastern corner of Lake Ripley. Wet and marshy areas, predominantly emergent/wet meadow wetlands, are common along its flow path. Lake Ripley is the nearest significant surface water feature and is located approximately 1.7 miles southwest of the Site. Nearby surface water features are shown on **Figure 1**.

Based on the evaluation of surface water resources, and with consideration of the type and nature of crude oil discharged at the Site, the unnamed agricultural drainage ditch located along the facility's eastern property boundary was identified as a surface water resource warranting monitoring.

This SWSP is being implemented to provide methodologies, procedures, and guidance related to continued surface water monitoring/sampling at the unnamed agricultural drainage ditch.

Summary of Previously Completed Sampling Activities

On December 4, 2024, grab surface water samples were collected from location CSRWS001 at the unnamed agricultural drainage ditch. These samples were collected in accordance with GEI standard operating procedures (SOPs), placed in laboratory-provided containers, immediately transferred to an ice-filled cooler, and submitted to Pace Analytical (Green Bay, Wisconsin) under chain-of-custody protocol for the analysis of total petroleum hydrocarbons (TPH) by Wisconsin method gasoline range organics and diesel range organics. On December 23, 2024, additional surface water samples were collected from locations CSRWS002, CSRWS003, and CSRWS004. These samples were submitted for volatile organic compound (VOC) analysis per EPA Method 8260. Sample locations are shown on **Figure 2**. The December 23rd sampling event included a representative background location (CSRWS002), a near-Site location (CSRWS003), and a downgradient location (CSRWS004).

The December 4, 2024, sampling event included TPH analysis to assess the potential presence of petroleum-related compounds in surface water at sample location CSRWS001. This location was selected due to the observed presence of significant organic material, including biological sheen, on the water surface. The analysis of TPH did not yield conclusive evidence of petroleum-related compounds in surface water, and considering the potential for interference from naturally occurring organic matter in the samples, subsequent sampling on December 23, 2024, included analysis for VOCs to more specifically evaluate potential impacts from crude oil. No VOCs were detected at any of the sample locations. In addition to the three (3) samples collected on December 23, 2024, residual media retained by the laboratory from the December 4, 2024, sampling event was also analyzed for VOCs. No VOCs were detected; however, the analysis for VOCs on this sample was conducted outside of the recognized method holding time. A summary of VOC analytical data from surface water sampling completed in December 2024 are included on **Table 1**. The laboratory analytical reports are included in **Attachment I**.

Proposed Surface Water Sampling Plan

GEI proposes to implement continued surface water sampling prescribed by the schedule and methodologies outlined below at the unnamed agricultural drainage ditch located along the Site's eastern property boundary.

Schedule & Notifications

Surface water sampling will be conducted quarterly, beginning in March 2025 (Q1). Subsequent sampling is tentatively scheduled for June 2025 (Q2), September 2025 (Q3), and December 2025 (Q4). Enbridge will notify the WDNR approximately one (1) week prior to each sampling event. To avoid potential ice cover, the Q4 sampling may be conducted in November 2025. Following Q4 sampling, a comprehensive data review will be conducted to assess the need for continued surface water monitoring/sampling.

Analysis

Surface water samples will be collected for the laboratory analysis of VOCs by EPA Method 8260. Samples will be relinquished to Pace Analytical located in Green Bay, Wisconsin for analysis. Quality Assurance/Quality Control samples will be collected during each sampling event to monitor the reproducibility and representativeness of the field sampling, including:

- One (1) duplicate sample from a random sample location during each sampling event.
- One (1) trip blank will be included with the sample shipment container to be analyzed for VOCs.
- One (1) temperature blank will be included with the sample shipment container.

Sample Locations and Collection Methodology

GEI intends to collect discrete surface water samples from locations CSRWS001, CSRWS002, CSRWS003, and CSRWS004. The proposed sample locations are shown on **Figure 2**. Sample location CSRWS002 will be accessible from the US Highway 18 right-of-way, and sample locations CSRWS003 and CSRWS004 will be accessible from Enbridge property. Enbridge will coordinate access to sample location CSRWS001 with the private property landowner in that area. Sampling will be conducted in accordance with GEI SOPs and WDNR guidance. GEI SOPs are included in **Attachment II**.

At each location, a single-use disposable sample dipper will be used to collect surface water which will be transferred to laboratory-supplied containers. Sample containers and preservatives will be provided by the laboratory. Sample container orders, when shipped by the laboratory, will include a packing list that details the number and type of bottles shipped, the bottle lot numbers, chemical preservatives, and the packer’s signature.

Samples will be stored according to the applicable storage criteria from the time of collection until the time of analysis by the laboratory. Following collection, sample containers will be placed in a cooler on ice. A chain-of-custody record will be properly completed and followed by field sampling personnel and delivered to the laboratory with the samples.

Sample holding times (the period between sample collection, digestion, and analysis) will be strictly adhered to in order to minimize analyte degradation. These times are measured from the verified field collection time. Samples will be shipped via overnight carrier or same-day courier to ensure they arrive at the laboratory within the required holding time. Upon receipt, the laboratory will store samples under appropriate preservation conditions until analysis.

Reporting

Following each sampling event, Enbridge will provide the WDNR with analytical results within ten (10) days of receiving final laboratory data. The data deliverable will include a summary of the activities completed, any exceptions to the prescribed procedural methods discussed herein, a discussion of analytical results compared to WDNR surface water quality criteria established in WAC Chapter NR 105, data table(s), and figure(s).

Additional Considerations

Enbridge intends to collaborate with the Lake Ripley Management District (LRMD) on surface water monitoring/sampling. This collaboration is expected to include notifying the LRMD of quarterly sampling events, inviting their participation and observation during those events, and sharing the resulting analytical data.

If you have any questions or concerns about this SWSP, please do not hesitate to contact Brad Dal Santo at (815) 289-3895.

Sincerely,

GEI Consultants, Inc.

Bradley Dal Santo	Ken Kytta, P.E.
Senior Professional, Environment	Senior Consultant, Vice President

BJD/kdk/mhs/cg

Figures
Table
Attachments

cc: Karl Beaster, Enbridge Energy

Certifications

Surface Water Sampling Plan
Enbridge Energy Line 6 Cambridge Station
Cambridge, Wisconsin
WDNR BRRTS Activity No. 02-28-595980

I, Mitchell Salzwedel, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed in accordance with the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

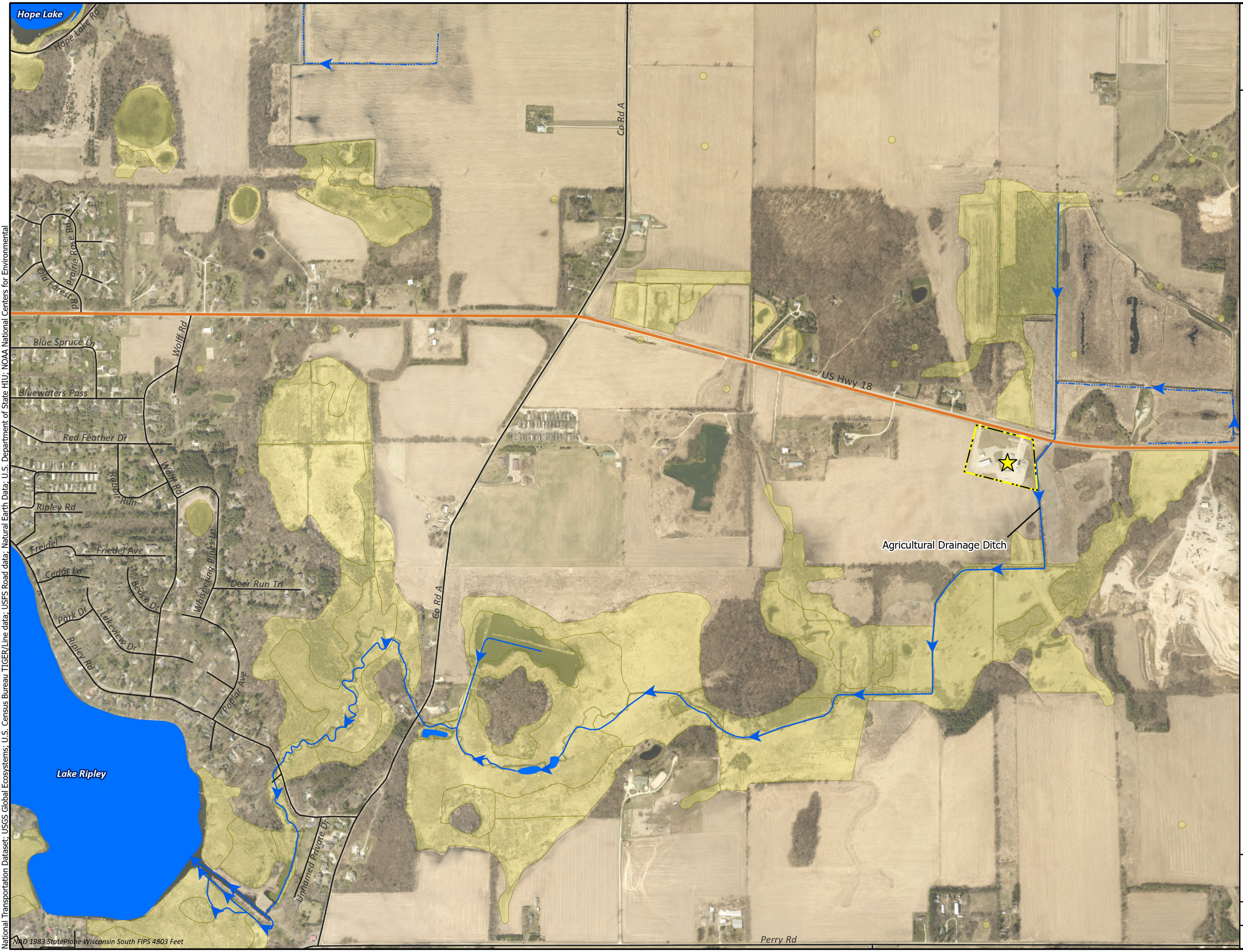
Mitch Salzwedel

Mitchell Salzwedel, P.G.
Senior Professional
Wisconsin P.G. # 1392-13

2/25/2025
Date

Figures

SITE LOCATION



LEGEND:

- ★ Release Location - November 2024
- ➤ Stream/River (NHD)
- ➤ Stream/River - Intermittent (NHD)
- 🟨 USA Wetlands (NWI)
- ▭ Facility Boundary

Cambridge Station
BRRTS No. 02-28-595980

Cambridge, Wisconsin

Project 2408314 February 2025 Figure 1

USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road data; Natural Earth Data; U.S. Department of State HIU; NOAA National Centers for Environmental

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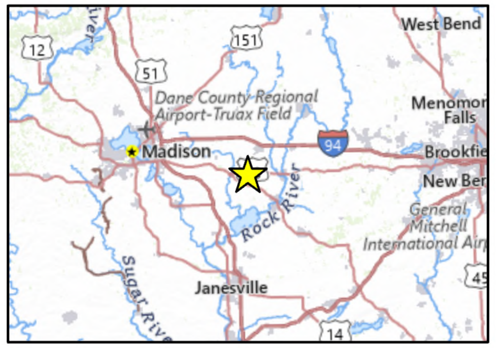
SURFACE WATER SAMPLE LOCATION MAP

NAD 1983 StatePlane Wisconsin South FIPS 4803 Feet

LEGEND:

- ★ Release Location - November 2024
- ◎ Surface Water Sample Location
- ● Continued Monitoring (Proposed)
- → Culvert
- → Agricultural Drainage Ditch
- — Elevation Contour - ftamsl (3DEP)
- ▭ USA Wetlands (NWI)
- ▭ Facility Boundary

GEI Consultants



Cambridge Station
BRRTS No. 02-28-595980

Cambridge, Wisconsin

Project 2408314 February 2025 Figure 2

USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road data; Natural Earth Data; U.S. Department of State HIU; NOAA National Centers for Environmental

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Table

Table 1
Surface Water Quality - VOCs

Cambridge Station
BRRTS No. 02-28-595980

Jefferson County, Wisconsin

Analyte	CAS No.	Unit of Measure	WDNR Surface Water Standards [A]		Sample ID CSRWS001	Sample ID CSRWS002	Sample ID CSRWS003	Sample ID CSRWS004
			Human Threshold Criteria [B]	Human Cancer Criteria [C]	Date: 12/4/2024	Date: 12/23/2024	Date: 12/23/2024	Date: 12/23/2024
Volatile Organic Compounds (VOCs) by Method EPA 8260								
Benzene	71-43-2	µg/L	260	45	<0.30 H1	<0.30	<0.30	<0.30
Toluene	108-88-3	µg/L	5201	NE	<0.29 H1	<0.29	<0.29	<0.29
Ethylbenzene	100-41-4	µg/L	931	NE	<0.33 H1	<0.33	<0.33	<0.33
Xylene (Total) [D]	1330-20-7	µg/L	NE	NE	<1.0	<1.0	<1.0	<1.0
1,1,1,2-Tetrachloroethane	630-20-6	µg/L	NE	NE	<0.36 H1	<0.36	<0.36	<0.36
1,1,1-Trichloroethane	71-55-6	µg/L	110000	NE	<0.30 H1	<0.30	<0.30	<0.30
1,1,2,2-Tetrachloroethane	79-34-5	µg/L	NE	22	<0.25 H1	<0.25	<0.25	<0.25
1,1,2-Trichloroethane	79-00-5	µg/L	NE	87	<0.34 H1	<0.34	<0.34	<0.34
1,1-Dichloroethane	75-34-3	µg/L	NE	NE	<0.30 H1	<0.30	<0.30	<0.30
1,1-Dichloroethene	75-35-4	µg/L	NE	NE	<0.58 H1	<0.58	<0.58	<0.58
1,1-Dichloropropene	563-58-6	µg/L	260	NE	<0.41 H1	<0.41	<0.41	<0.41
1,2,3-Trichlorobenzene	87-61-6	µg/L	NE	NE	<1.0 H1	<1.0	<1.0	<1.0
1,2,3-Trichloropropane	96-18-4	µg/L	NE	NE	<0.56 H1	<0.56	<0.56	<0.56
1,2,4-Trichlorobenzene	120-82-1	µg/L	NE	NE	<0.95 H1	<0.95	<0.95	<0.95
1,2,4-Trimethylbenzene	95-63-6	µg/L	NE	NE	<0.45 H1	<0.45	<0.45	<0.45
1,2-Dibromo-3-chloropropane	96-12-8	µg/L	NE	NE	<0.36 H1	<0.36	<0.36	<0.36
1,2-Dibromoethane (EDB)	106-93-4	µg/L	NE	NE	<0.31 H1	<0.31	<0.31	<0.31
1,2-Dichlorobenzene	95-50-1	µg/L	481	NE	<0.33 H1	<0.33	<0.33	<0.33
1,2-Dichloroethane	107-06-2	µg/L	NE	159	<0.29 H1	<0.29	<0.29	<0.29
1,2-Dichloropropane	78-87-5	µg/L	NE	NE	<0.45 H1	<0.45	<0.45	<0.45
1,3,5-Trimethylbenzene	108-67-8	µg/L	NE	NE	<0.36 H1	<0.36	<0.36	<0.36
1,3-Dichlorobenzene	541-73-1	µg/L	1000	NE	<0.35 H1	<0.35	<0.35	<0.35
1,3-Dichloropropane	142-28-9	µg/L	NE	NE	<0.30 H1	<0.30	<0.30	<0.30
1,4-Dichlorobenzene	106-46-7	µg/L	NE	54	<0.89 H1	<0.89	<0.89	<0.89
2,2-Dichloropropane	594-20-7	µg/L	NE	NE	<0.42 H1	<0.42	<0.42	<0.42
2-Chlorotoluene	95-49-8	µg/L	NE	NE	<0.89 H1	<0.89	<0.89	<0.89
4-Chlorotoluene	106-43-4	µg/L	NE	NE	<0.89 H1	<0.89	<0.89	<0.89
Bromobenzene	108-86-1	µg/L	NE	NE	<0.36 H1	<0.36	<0.36	<0.36
Bromochloromethane	74-97-5	µg/L	NE	NE	<0.36 H1	<0.36	<0.36	<0.36
Bromodichloromethane	75-27-4	µg/L	NE	NE	<0.21 H1	<0.21	<0.21	<0.21
Bromoform	75-25-2	µg/L	NE	NE	<0.43 H1	<0.43	<0.43	<0.43
Bromomethane	74-83-9	µg/L	NE	NE	<1.2 H1	<1.2	<1.2	<1.2
Carbon tetrachloride	56-23-5	µg/L	NE	9.5	<0.37 H1	<0.37	<0.37	<0.37
Chlorobenzene (Monochlorobenzene)	108-90-7	µg/L	400	NE	<0.86 H1	<0.86	<0.86	<0.86
Chloroethane	75-00-3	µg/L	NE	NE	<1.4 H1	<1.4	<1.4	<1.4
Chloroform	67-66-3	µg/L	NE	922	<0.50 H1	<0.50	<0.50	<0.50
Chloromethane	74-87-3	µg/L	NE	NE	<1.6 H1	<1.6	<1.6	<1.6
Dibromochloromethane	124-48-1	µg/L	NE	NE	<2.6 H1	<2.6	<2.6	<2.6
Dibromomethane	74-95-3	µg/L	NE	NE	<0.99 H1	<0.99	<0.99	<0.99
Dichlorodifluoromethane	75-71-8	µg/L	NE	NE	<0.46 H1	<0.46	<0.46	<0.46
Diisopropyl ether	108-20-3	µg/L	NE	NE	<1.1 H1	<1.1	<1.1	<1.1
Hexachloro-1,3-butadiene	87-68-3	µg/L	NE	0.2	<2.7 H1	<2.7	<2.7	<2.7
Isopropylbenzene (Cumene)	98-82-8	µg/L	NE	NE	<1.0 H1	<1.0	<1.0	<1.0
Methyl-tert-butyl ether	1634-04-4	µg/L	NE	NE	<1.1 H1	<1.1	<1.1	<1.1
Methylene Chloride	75-09-2	µg/L	72000	NE	<0.32 H1	<0.32	<0.32	<0.32
Naphthalene	91-20-3	µg/L	NE	NE	<1.9 H1	<1.9	<1.9	<1.9
Styrene	100-42-5	µg/L	NE	NE	<0.36 H1	<0.36	<0.36	<0.36
Tetrachloroethene	127-18-4	µg/L	NE	15	<0.41 H1	<0.41	<0.41	<0.41
Trichloroethene (TCE)	79-01-6	µg/L	NE	194	<0.32 H1	<0.32	<0.32	<0.32
Trichlorofluoromethane	75-69-4	µg/L	NE	NE	<0.42 H1	<0.42	<0.42	<0.42
Vinyl chloride	75-01-4	µg/L	NE	6.8	<0.17 H1	<0.17	<0.17	<0.17

Table 1
Surface Water Quality - VOCs

Cambridge Station
BRRTS No. 02-28-595980

Jefferson County, Wisconsin

Analyte	CAS No.	Unit of Measure	WDNR Surface Water Standards [A]		Sample ID CSRWS001	Sample ID CSRWS002	Sample ID CSRWS003	Sample ID CSRWS004
			Human Threshold Criteria [B]	Human Cancer Criteria [C]	Date: 12/4/2024	Date: 12/23/2024	Date: 12/23/2024	Date: 12/23/2024
Volatile Organic Compounds (VOCs) by Method EPA 8260								
cis-1,2-Dichloroethene	156-59-2	µg/L	9000	NE	<0.47 H1	<0.47	<0.47	<0.47
cis-1,3-Dichloropropene	10061-01-5	µg/L	260	NE	<0.24 H1	<0.24	<0.24	<0.24
m&p-Xylene	179601-23-1	µg/L	NE	NE	<0.70 H1	<0.70	<0.70	<0.70
n-Butylbenzene	104-51-8	µg/L	NE	NE	<0.86 H1	<0.86	<0.86	<0.86
n-Propylbenzene	103-65-1	µg/L	NE	NE	<0.35 H1	<0.35	<0.35	<0.35
o-Xylene	95-47-6	µg/L	NE	NE	<0.35 H1	<0.35	<0.35	<0.35
p-Isopropyltoluene	99-87-6	µg/L	NE	NE	<1.0 H1	<1.0	<1.0	<1.0
sec-Butylbenzene	135-98-8	µg/L	NE	NE	<0.42 H1	<0.42	<0.42	<0.42
tert-Butylbenzene	98-06-6	µg/L	NE	NE	<0.59 H1	<0.59	<0.59	<0.59
trans-1,2-Dichloroethene	156-60-5	µg/L	13000	NE	<0.53 H1	<0.53	<0.53	<0.53
trans-1,3-Dichloropropene	10061-02-6	µg/L	260	NE	<0.27 H1	<0.27	<0.27	<0.27

Notes:

All results reported in micrograms per liter (µg/L).

A = Wisconsin Department of Natural Resources (WDNR) NR Chapter 105 Wisconsin Administrative Code, November 2024.
B = Human Threshold Criteria for Non-Public Water Supply Cold Water Communities (NR 105.08 - Table 8).
C = Human Cancer Criteria for Non-Public Water Supply Cold Water Communities (NR 105.09 - Table 9).
D = Xylene includes meta-, ortho-, and para-xylene combined.
CAS No. = Chemical Abstracts Service Registry Number.
Date = Field Sample Collection Date.
NE = No surface water standard established.
H1 = Analysis conducted outside the recognized method holding time.
< = Analyte not detected above the laboratory limit of detection.

Attachments

I. Laboratory Analytical Reports

II. GEI SOPs

I. Laboratory Analytical Reports

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

December 20, 2024

Brad DalSanto
GEI Consultants
1600 Aspen Commons
Suite 680
Middleton, WI 53562

RE: Project: 2408314 Cambridge Station Rel
Pace Project No.: 40289121

Dear Brad DalSanto:

Enclosed are the analytical results for sample(s) received by the laboratory on December 05, 2024. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Green Bay

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Christopher Hyska

Christopher Hyska
christopher.hyska@pacelabs.com
(920)469-2436
Project Manager

Enclosures

cc: Caitlin Graeber, GEI Consultants
Ken Kytta, GEI Consultants

CERTIFICATIONS

Project:	2408314 Cambridge Station Rel
Pace Project No.:	40289121

Pace Analytical Services Green Bay

1241 Bellevue Street, Green Bay, WI 54302
Florida/NELAP Certification #: E87948
Illinois Certification #: 200050
Kentucky UST Certification #: 82
Louisiana Certification #: 04168
Minnesota Certification #: 055-999-334
New York Certification #: 12064
North Dakota Certification #: R-150
South Carolina Certification #: 83006001
Texas Certification #: T104704529-21-8
Virginia VELAP Certification ID: 11873
Wisconsin Certification #: 405132750
Wisconsin DATCP Certification #: 105-444
USDA Soil Permit #: P330-21-00008
Federal Fish & Wildlife Permit #: 51774A

SAMPLE SUMMARY

Project: 2408314 Cambridge Station Rel
Pace Project No.: 40289121

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40289121001	**CSRWS001**	Water	12/04/24 09:23	12/05/24 08:04

SAMPLE ANALYTE COUNT

Project:	2408314 Cambridge Station Rel
Pace Project No.:	40289121

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
40289121001	**CSRWS001**	EPA 8260	EIB	65	PASI-G

PASI-G = Pace Analytical Services - Green Bay

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rel
Pace Project No.: 40289121

Sample: CSRWS001 **Lab ID: 40289121001** Collected: 12/04/24 09:23 Received: 12/05/24 08:04 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
Benzene	**<0.30**	ug/L	1.0	0.30	1		12/20/24 12:36	71-43-2	H1
Bromobenzene	**<0.36**	ug/L	1.0	0.36	1		12/20/24 12:36	108-86-1	H1
Bromochloromethane	**<0.36**	ug/L	1.0	0.36	1		12/20/24 12:36	74-97-5	H1
Bromodichloromethane	**<0.21**	ug/L	1.0	0.21	1		12/20/24 12:36	75-27-4	H1
Bromoform	**<0.43**	ug/L	1.0	0.43	1		12/20/24 12:36	75-25-2	H1
Bromomethane	**<1.2**	ug/L	5.0	1.2	1		12/20/24 12:36	74-83-9	H1
n-Butylbenzene	**<0.86**	ug/L	1.0	0.86	1		12/20/24 12:36	104-51-8	H1
sec-Butylbenzene	**<0.42**	ug/L	1.0	0.42	1		12/20/24 12:36	135-98-8	H1
tert-Butylbenzene	**<0.59**	ug/L	1.0	0.59	1		12/20/24 12:36	98-06-6	H1
Carbon tetrachloride	**<0.37**	ug/L	1.0	0.37	1		12/20/24 12:36	56-23-5	H1
Chlorobenzene	**<0.86**	ug/L	1.0	0.86	1		12/20/24 12:36	108-90-7	H1
Chloroethane	**<1.4**	ug/L	5.0	1.4	1		12/20/24 12:36	75-00-3	H1
Chloroform	**<0.50**	ug/L	5.0	0.50	1		12/20/24 12:36	67-66-3	H1
Chloromethane	**<1.6**	ug/L	5.0	1.6	1		12/20/24 12:36	74-87-3	H1
2-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/20/24 12:36	95-49-8	H1
4-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/20/24 12:36	106-43-4	H1
1,2-Dibromo-3-chloropropane	**<0.36**	ug/L	5.0	0.36	1		12/20/24 12:36	96-12-8	H1
Dibromochloromethane	**<2.6**	ug/L	5.0	2.6	1		12/20/24 12:36	124-48-1	H1
1,2-Dibromoethane (EDB)	**<0.31**	ug/L	1.0	0.31	1		12/20/24 12:36	106-93-4	H1
Dibromomethane	**<0.99**	ug/L	5.0	0.99	1		12/20/24 12:36	74-95-3	H1
1,2-Dichlorobenzene	**<0.33**	ug/L	1.0	0.33	1		12/20/24 12:36	95-50-1	H1
1,3-Dichlorobenzene	**<0.35**	ug/L	1.0	0.35	1		12/20/24 12:36	541-73-1	H1
1,4-Dichlorobenzene	**<0.89**	ug/L	1.0	0.89	1		12/20/24 12:36	106-46-7	H1
Dichlorodifluoromethane	**<0.46**	ug/L	5.0	0.46	1		12/20/24 12:36	75-71-8	H1
1,1-Dichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/20/24 12:36	75-34-3	H1
1,2-Dichloroethane	**<0.29**	ug/L	1.0	0.29	1		12/20/24 12:36	107-06-2	H1
1,1-Dichloroethene	**<0.58**	ug/L	1.0	0.58	1		12/20/24 12:36	75-35-4	H1
cis-1,2-Dichloroethene	**<0.47**	ug/L	1.0	0.47	1		12/20/24 12:36	156-59-2	H1
trans-1,2-Dichloroethene	**<0.53**	ug/L	1.0	0.53	1		12/20/24 12:36	156-60-5	H1
1,2-Dichloropropane	**<0.45**	ug/L	1.0	0.45	1		12/20/24 12:36	78-87-5	H1
1,3-Dichloropropane	**<0.30**	ug/L	1.0	0.30	1		12/20/24 12:36	142-28-9	H1
2,2-Dichloropropane	**<0.42**	ug/L	1.0	0.42	1		12/20/24 12:36	594-20-7	H1
1,1-Dichloropropene	**<0.41**	ug/L	1.0	0.41	1		12/20/24 12:36	563-58-6	H1
cis-1,3-Dichloropropene	**<0.24**	ug/L	1.0	0.24	1		12/20/24 12:36	10061-01-5	H1
trans-1,3-Dichloropropene	**<0.27**	ug/L	1.0	0.27	1		12/20/24 12:36	10061-02-6	H1
Diisopropyl ether	**<1.1**	ug/L	5.0	1.1	1		12/20/24 12:36	108-20-3	H1
Ethylbenzene	**<0.33**	ug/L	1.0	0.33	1		12/20/24 12:36	100-41-4	H1
Hexachloro-1,3-butadiene	**<2.7**	ug/L	5.0	2.7	1		12/20/24 12:36	87-68-3	H1
Isopropylbenzene (Cumene)	**<1.0**	ug/L	5.0	1.0	1		12/20/24 12:36	98-82-8	H1
p-Isopropyltoluene	**<1.0**	ug/L	5.0	1.0	1		12/20/24 12:36	99-87-6	H1
Methylene Chloride	**<0.32**	ug/L	5.0	0.32	1		12/20/24 12:36	75-09-2	H1
Methyl-tert-butyl ether	**<1.1**	ug/L	5.0	1.1	1		12/20/24 12:36	1634-04-4	H1
Naphthalene	**<1.9**	ug/L	5.0	1.9	1		12/20/24 12:36	91-20-3	H1
n-Propylbenzene	**<0.35**	ug/L	1.0	0.35	1		12/20/24 12:36	103-65-1	H1
Styrene	**<0.36**	ug/L	1.0	0.36	1		12/20/24 12:36	100-42-5	H1

ANALYTICAL RESULTS

Project:	2408314 Cambridge Station Rel
Pace Project No.:	40289121

Sample: CSRWS001 **Lab ID: 40289121001** Collected: 12/04/24 09:23 Received: 12/05/24 08:04 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
1,1,1,2-Tetrachloroethane	**<0.36**	ug/L	1.0	0.36	1		12/20/24 12:36	630-20-6	H1
1,1,2,2-Tetrachloroethane	**<0.25**	ug/L	1.0	0.25	1		12/20/24 12:36	79-34-5	H1
Tetrachloroethene	**<0.41**	ug/L	1.0	0.41	1		12/20/24 12:36	127-18-4	H1
Toluene	**<0.29**	ug/L	1.0	0.29	1		12/20/24 12:36	108-88-3	H1
1,2,3-Trichlorobenzene	**<1.0**	ug/L	5.0	1.0	1		12/20/24 12:36	87-61-6	H1
1,2,4-Trichlorobenzene	**<0.95**	ug/L	5.0	0.95	1		12/20/24 12:36	120-82-1	H1
1,1,1-Trichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/20/24 12:36	71-55-6	H1
1,1,2-Trichloroethane	**<0.34**	ug/L	1.0	0.34	1		12/20/24 12:36	79-00-5	H1
Trichloroethene	**<0.32**	ug/L	1.0	0.32	1		12/20/24 12:36	79-01-6	H1
Trichlorofluoromethane	**<0.42**	ug/L	1.0	0.42	1		12/20/24 12:36	75-69-4	H1
1,2,3-Trichloropropane	**<0.56**	ug/L	1.0	0.56	1		12/20/24 12:36	96-18-4	H1
1,2,4-Trimethylbenzene	**<0.45**	ug/L	1.0	0.45	1		12/20/24 12:36	95-63-6	H1
1,3,5-Trimethylbenzene	**<0.36**	ug/L	1.0	0.36	1		12/20/24 12:36	108-67-8	H1
Vinyl chloride	**<0.17**	ug/L	1.0	0.17	1		12/20/24 12:36	75-01-4	H1
Xylene (Total)	**<1.0**	ug/L	3.0	1.0	1		12/20/24 12:36	1330-20-7	
m&p-Xylene	**<0.70**	ug/L	2.0	0.70	1		12/20/24 12:36	179601-23-1	H1
o-Xylene	**<0.35**	ug/L	1.0	0.35	1		12/20/24 12:36	95-47-6	H1
Surrogates									
1,2-Dichlorobenzene-d4 (S)	105	%	70-130		1		12/20/24 12:36	2199-69-1	H3
4-Bromofluorobenzene (S)	94	%	70-130		1		12/20/24 12:36	460-00-4	
Toluene-d8 (S)	97	%	70-130		1		12/20/24 12:36	2037-26-5	

QUALITY CONTROL DATA

Project: 2408314 Cambridge Station Rel
Pace Project No.: 40289121

QC Batch:	493225	Analysis Method:	EPA 8260
QC Batch Method:	EPA 8260	Analysis Description:	8260 MSV
		Laboratory:	Pace Analytical Services - Green Bay

Associated Lab Samples: 40289121001

METADATA BLANK: 2823294 Matrix: Water

Associated Lab Samples: 40289121001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	<0.36	1.0	12/20/24 08:51	
1,1,1-Trichloroethane	ug/L	<0.30	1.0	12/20/24 08:51	
1,1,2,2-Tetrachloroethane	ug/L	<0.25	1.0	12/20/24 08:51	
1,1,2-Trichloroethane	ug/L	<0.34	1.0	12/20/24 08:51	
1,1-Dichloroethane	ug/L	<0.30	1.0	12/20/24 08:51	
1,1-Dichloroethene	ug/L	<0.58	1.0	12/20/24 08:51	
1,1-Dichloropropene	ug/L	<0.41	1.0	12/20/24 08:51	
1,2,3-Trichlorobenzene	ug/L	<1.0	5.0	12/20/24 08:51	
1,2,3-Trichloropropane	ug/L	<0.56	1.0	12/20/24 08:51	
1,2,4-Trichlorobenzene	ug/L	<0.95	5.0	12/20/24 08:51	
1,2,4-Trimethylbenzene	ug/L	<0.45	1.0	12/20/24 08:51	
1,2-Dibromo-3-chloropropane	ug/L	<0.36	5.0	12/20/24 08:51	
1,2-Dibromoethane (EDB)	ug/L	<0.31	1.0	12/20/24 08:51	
1,2-Dichlorobenzene	ug/L	<0.33	1.0	12/20/24 08:51	
1,2-Dichloroethane	ug/L	<0.29	1.0	12/20/24 08:51	
1,2-Dichloropropane	ug/L	<0.45	1.0	12/20/24 08:51	
1,3,5-Trimethylbenzene	ug/L	<0.36	1.0	12/20/24 08:51	
1,3-Dichlorobenzene	ug/L	<0.35	1.0	12/20/24 08:51	
1,3-Dichloropropane	ug/L	<0.30	1.0	12/20/24 08:51	
1,4-Dichlorobenzene	ug/L	<0.89	1.0	12/20/24 08:51	
2,2-Dichloropropane	ug/L	<0.42	1.0	12/20/24 08:51	
2-Chlorotoluene	ug/L	<0.89	5.0	12/20/24 08:51	
4-Chlorotoluene	ug/L	<0.89	5.0	12/20/24 08:51	
Benzene	ug/L	<0.30	1.0	12/20/24 08:51	
Bromobenzene	ug/L	<0.36	1.0	12/20/24 08:51	
Bromochloromethane	ug/L	<0.36	1.0	12/20/24 08:51	
Bromodichloromethane	ug/L	<0.21	1.0	12/20/24 08:51	
Bromoform	ug/L	<0.43	1.0	12/20/24 08:51	
Bromomethane	ug/L	<1.2	5.0	12/20/24 08:51	
Carbon tetrachloride	ug/L	<0.37	1.0	12/20/24 08:51	
Chlorobenzene	ug/L	<0.86	1.0	12/20/24 08:51	
Chloroethane	ug/L	<1.4	5.0	12/20/24 08:51	
Chloroform	ug/L	<0.50	5.0	12/20/24 08:51	
Chloromethane	ug/L	<1.6	5.0	12/20/24 08:51	
cis-1,2-Dichloroethene	ug/L	<0.47	1.0	12/20/24 08:51	
cis-1,3-Dichloropropene	ug/L	<0.24	1.0	12/20/24 08:51	
Dibromochloromethane	ug/L	<2.6	5.0	12/20/24 08:51	
Dibromomethane	ug/L	<0.99	5.0	12/20/24 08:51	
Dichlorodifluoromethane	ug/L	<0.46	5.0	12/20/24 08:51	
Diisopropyl ether	ug/L	<1.1	5.0	12/20/24 08:51	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 2408314 Cambridge Station Rel
Pace Project No.: 40289121

METHOD BLANK: 2823294 Matrix: Water
Associated Lab Samples: 40289121001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Ethylbenzene	ug/L	<0.33	1.0	12/20/24 08:51	
Hexachloro-1,3-butadiene	ug/L	<2.7	5.0	12/20/24 08:51	
Isopropylbenzene (Cumene)	ug/L	<1.0	5.0	12/20/24 08:51	
m&p-Xylene	ug/L	<0.70	2.0	12/20/24 08:51	
Methyl-tert-butyl ether	ug/L	<1.1	5.0	12/20/24 08:51	
Methylene Chloride	ug/L	<0.32	5.0	12/20/24 08:51	
n-Butylbenzene	ug/L	<0.86	1.0	12/20/24 08:51	
n-Propylbenzene	ug/L	<0.35	1.0	12/20/24 08:51	
Naphthalene	ug/L	<1.9	5.0	12/20/24 08:51	
o-Xylene	ug/L	<0.35	1.0	12/20/24 08:51	
p-Isopropyltoluene	ug/L	<1.0	5.0	12/20/24 08:51	
sec-Butylbenzene	ug/L	<0.42	1.0	12/20/24 08:51	
Styrene	ug/L	<0.36	1.0	12/20/24 08:51	
tert-Butylbenzene	ug/L	<0.59	1.0	12/20/24 08:51	
Tetrachloroethene	ug/L	<0.41	1.0	12/20/24 08:51	
Toluene	ug/L	<0.29	1.0	12/20/24 08:51	
trans-1,2-Dichloroethene	ug/L	<0.53	1.0	12/20/24 08:51	
trans-1,3-Dichloropropene	ug/L	<0.27	1.0	12/20/24 08:51	
Trichloroethene	ug/L	<0.32	1.0	12/20/24 08:51	
Trichlorofluoromethane	ug/L	<0.42	1.0	12/20/24 08:51	
Vinyl chloride	ug/L	<0.17	1.0	12/20/24 08:51	
Xylene (Total)	ug/L	<1.0	3.0	12/20/24 08:51	
1,2-Dichlorobenzene-d4 (S)	%	102	70-130	12/20/24 08:51	
4-Bromofluorobenzene (S)	%	94	70-130	12/20/24 08:51	
Toluene-d8 (S)	%	97	70-130	12/20/24 08:51	

LABORATORY CONTROL SAMPLE: 2823295

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1-Trichloroethane	ug/L	50	57.6	115	70-133	
1,1,2,2-Tetrachloroethane	ug/L	50	50.9	102	70-130	
1,1,2-Trichloroethane	ug/L	50	52.1	104	70-130	
1,1-Dichloroethane	ug/L	50	54.9	110	70-130	
1,1-Dichloroethene	ug/L	50	58.0	116	66-130	
1,2,4-Trichlorobenzene	ug/L	50	47.5	95	68-130	
1,2-Dibromo-3-chloropropane	ug/L	50	49.1	98	66-130	
1,2-Dibromoethane (EDB)	ug/L	50	53.2	106	70-130	
1,2-Dichlorobenzene	ug/L	50	51.4	103	70-130	
1,2-Dichloroethane	ug/L	50	55.1	110	70-130	
1,2-Dichloropropane	ug/L	50	56.4	113	70-130	
1,3-Dichlorobenzene	ug/L	50	51.8	104	70-130	
1,4-Dichlorobenzene	ug/L	50	52.2	104	70-130	
Benzene	ug/L	50	56.4	113	70-130	
Bromodichloromethane	ug/L	50	54.7	109	70-130	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project:	2408314 Cambridge Station Rel
Pace Project No.:	40289121

LABORATORY CONTROL SAMPLE: 2823295

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Bromoform	ug/L	50	52.1	104	61-130	
Bromomethane	ug/L	50	43.4	87	40-157	
Carbon tetrachloride	ug/L	50	61.7	123	70-139	
Chlorobenzene	ug/L	50	54.3	109	70-130	
Chloroethane	ug/L	50	63.6	127	61-145	
Chloroform	ug/L	50	57.2	114	70-130	
Chloromethane	ug/L	50	56.4	113	22-163	
cis-1,2-Dichloroethene	ug/L	50	54.7	109	70-130	
cis-1,3-Dichloropropene	ug/L	50	54.4	109	70-130	
Dibromochloromethane	ug/L	50	52.3	105	70-130	
Dichlorodifluoromethane	ug/L	50	66.9	134	10-185	
Ethylbenzene	ug/L	50	57.2	114	70-130	
Isopropylbenzene (Cumene)	ug/L	50	53.5	107	70-134	
m&p-Xylene	ug/L	100	116	116	70-130	
Methyl-tert-butyl ether	ug/L	50	53.0	106	62-130	
Methylene Chloride	ug/L	50	50.3	101	70-130	
o-Xylene	ug/L	50	55.9	112	70-130	
Styrene	ug/L	50	58.5	117	70-130	
Tetrachloroethene	ug/L	50	54.9	110	70-130	
Toluene	ug/L	50	53.5	107	70-130	
trans-1,2-Dichloroethene	ug/L	50	58.1	116	70-130	
trans-1,3-Dichloropropene	ug/L	50	52.1	104	70-130	
Trichloroethene	ug/L	50	56.0	112	70-130	
Trichlorofluoromethane	ug/L	50	62.7	125	70-149	
Vinyl chloride	ug/L	50	65.3	131	37-145	
Xylene (Total)	ug/L	150	172	114	70-130	
1,2-Dichlorobenzene-d4 (S)	%			100	70-130	
4-Bromofluorobenzene (S)	%			97	70-130	
Toluene-d8 (S)	%			97	70-130	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	2408314 Cambridge Station Rel
Pace Project No.:	40289121

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above LOD.

J - The reported result is an estimated value.

LOD - Limit of Detection adjusted for dilution factor, percent moisture, initial weight and final volume.

LOQ - Limit of Quantitation adjusted for dilution factor, percent moisture, initial weight and final volume.

DL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Analyte was not detected and is reported as less than the LOD or as defined by the customer.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

H1	Analysis conducted outside the recognized method holding time.
H3	Sample was received or analysis requested beyond the recognized method holding time.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 2408314 Cambridge Station Rel
Pace Project No.: 40289121

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40289121001	**CSRWS001**	EPA 8260	493225		

Pace®

Pace® Location Requested (City/State):
Pace Analytical Green Bay
1241 Bellevue Street, Suite 9
Green Bay, WI 54302

CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevant fields

LAB USE ONLY- Affix Workorder/Login Label Here

Scan QR Code for instructions

Company Name:	GEI - Madison, WI	Contact/Report To:	Brad DalSanto
Street Address:	1600 Aspen Commons, Suite 680 Middleton, WI 53562	Phone #:	(815) 289-3895
		E-Mail:	BDalSanto@geiconsultants.com
		Cc E-Mail:	
Customer Project #:			
Project Name:	Cambridge Station Release	Invoice To:	Accounts Payable
		Invoice E-Mail:	geipayables@geiconsultants.com
Site Collection Info/Facility ID (as applicable):		Purchase Order # (if applicable):	
		Quote #:	

Time Zone Collected: [ ] AK [ ] PT [ ] MT [X] CT [ ] ET

County / State origin of sample(s): Wisconsin

Data Deliverables:

[ ] Level II [ ] Level III [ ] Level IV

[ ] EQUIS

[ ] Other

Regulatory Program (DW, RCRA, etc.) as applicable: Reportable [ ] Yes [ ] No

Rush (Pre-approval required):
[ ] Same Day [X] 1 Day [ ] 2 Day ~~[X] 3 Day~~ [ ] Other ____

DW PWSID # or WW Permit # as applicable:

Date Results Requested: 1 Day

Field Filtered (if applicable): [ ] Yes [ ] No
Analysis:

* Matrix Codes (insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Waste Water (WW), Product (P), Soil/Solid (SS), Oil (OL), Wipe (WP), Tissue (TS), Bioassay (B), Vapor (V), Surface Water (SW), Sediment (SED), Sludge (SL), Caulk (CK), Leachate (LL), Biosolid (BS), Other (OT)

Specify Container Size **: ~~[illegible]~~, ~~[illegible]~~, , , ~~[illegible]~~, ~~[illegible]~~

Identify Container Preservative Type***: ~~[illegible]~~, ~~[illegible]~~, , , ~~[illegible]~~, ~~[illegible]~~

**Container Size: (1) 1L, (2) 500mL, (3) 250mL, (4) 125mL, (5) 100mL, (6) 40mL vial, (7) EnCore, (8) TerraCore, (9) 90mL, (10) Other

*** Preservative Types: (1) None, (2) HNO3, (3) H2SO4, (4) HCl, (5) NaOH, (6) Zn Acetate, (7) NaHSO4, (8) Sod. Thiosulfate, (9) Ascorbic Acid, (10) MeOH, (11) Other

Analysis Requested

Customer Sample ID	Matrix *	Comp / Grab	Composite Start Date	Composite Start Time	Collected or Composite End Date	Collected or Composite End Time	# Cont.	Res. Chlorine Results	Res. Chlorine Units	~~[illegible]~~	~~PAHs 8270sim, Dry Weight~~	TPH - GRO	WI - DRO	~~TCLP VOC 8260, TCLP SVOCs 8270,~~ ~~TCLP RCRA metals 6010+7470~~	~~[illegible]~~	8260 VOCs*				Sample Comment
CSRWS001	SW	G	--	--	12/4/24	0923	4	--	--			X	X			X				001

BRD BRD BRD BRD BRD

Lab Use Only
Proj. Mgr: **Christopher Hyska**
AcctNum / Client ID:
Table #:
Profile / Template: **5978**
Prelog / Bottle Ord. ID: **EZ 3167069**

Preservation non-conformance identified for sample.

Additional instructions from Pace®:
*Added VOC on 12/20/24 per Ken K- GEI, rush TAT. 12/20/24 CDH

Collected By: (Printed Name) Brad DalSanto
Signature: BRD

Customer Remarks / Special Conditions / Possible Hazards:

# Coolers:	Thermometer ID:	Correction Factor (°C):	Obs. Temp. (°C)	Corrected Temp. (°C)	On Ice:
1	9	0.5	3.0	3.5	Y

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
GEI (BRD)	12/4/24 1300	GEI (CRG)	12/4/2024 1300
GEI (CRG)	12/4/2024 1700		12/04/24 1700
CS Logistics	12/5/24 0920	Kes Staub-Pace	12/5/24 0920

Tracking Number:

Delivered by: [ ] In-Person [ ] Courier
[ ] FedEX [ ] UPS [X] Other

Page: of

Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace® Terms and Conditions found at https://www.pacelabs.com/resource-library/resource/pace-terms-and-conditions/

ENV-FRM-CORQ-0019_v02_110123 ©

Sample Preservation Receipt Form

Client Name: GEI- Madison

Project #

All containers needing preservation have been checked and noted below: ☐Yes ☐No ☒N/A

Lab Lot# of pH paper:

Lab Std #ID of preservation (if pH adjusted):

Initial when completed:

Date/ Time:

	Glass							Plastic						Vials						Jars				General										
Pace Lab #	AG1U	BG1U	AG1H	AG4S	AG5U	AG2S	BG3U	BP1U	BP3U	BP3B	BP3N	BP3S	BP2Z	VG9C	DG9T	VG9U	VG9H	VG9M	VG9D	JGFU	JG9U	WGFU	WPFU	SP5T	ZPLC	GN 1	GN 2	VOA Vials (>6mm) *	H_2SO_4 pH ≤2	NaOH+Zn Act pH ≥9	NaOH pH ≥12	HNO_3 pH ≤2	pH after adjusted	Volume (mL)
001			1														3																	2.5 / 5
002																																		2.5 / 5
003																																		2.5 / 5
004																																		2.5 / 5
005																																		2.5 / 5
006																																		2.5 / 5
007																																		2.5 / 5
008																																		2.5 / 5
009																																		2.5 / 5
010																																		2.5 / 5
011																																		2.5 / 5
012																																		2.5 / 5
013																																		2.5 / 5
014																																		2.5 / 5
015																																		2.5 / 5
016																																		2.5 / 5
017																																		2.5 / 5
018																																		2.5 / 5
019																																		2.5 / 5
020																																		2.5 / 5

12/5/24 KKS

Exceptions to preservation check: VOA, Coliform, TOC, TOX, TOH, O&G, [✓ WI DRO], Phenolics, Other:

Headspace in VOA Vials (>6mm) : ☐Yes ☒No ☐N/A ***If yes look in headspace column**

AG1U	1 liter amber glass	**BP1U**	1 liter plastic unpres	**VG9C**	40 mL clear ascorbic w/ HCl	**JGFU**	4 oz amber jar unpres
BG1U	1 liter clear glass	**BP3U**	250 mL plastic unpres	**DG9T**	40 mL amber Na Thio	**JG9U**	9 oz amber jar unpres
AG1H	1 liter amber glass HCL	**BP3B**	250 mL plastic NaOH	**VG9U**	40 mL clear vial unpres	**WGFU**	4 oz clear jar unpres
AG4S	125 mL amber glass H_2SO_4	**BP3N**	250 mL plastic HNO_3	**VG9H**	40 mL clear vial HCL	**WPFU**	4 oz plastic jar unpres
AG5U	100 mL amber glass unpres	**BP3S**	250 mL plastic H_2SO_4	**VG9M**	40 mL clear vial MeOH	**SP5T**	120 mL plastic Na Thiosulfate
AG2S	500 mL amber glass H_2SO_4	**BP2Z**	500 mL plastic NaOH + Zn	**VG9D**	40 mL clear vial DI	**ZPLC**	ziploc bag
BG3U	250 mL clear glass unpres					**GN 1**	
						GN 2	

Page 1 of 2

DC#_Title: ENV-FRM-GBAY-0014 v03_SCUR
Effective Date: 8/17/2022

Sample Condition Upon Receipt Form (SCUR)

Project #:

WO# : 40288321

40288321

Client Name: GEI - Madison

Courier: ☒ CS Logistics ☐ Fed Ex ☐ Speedee ☐ UPS ☐ Waltco
☐ Client ☐ Pace Other:

Tracking #:

Custody Seal on Cooler/Box Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Custody Seal on Samples Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Packing Material: ☐ Bubble Wrap ☒ Bubble Bags ☐ None ☐ Other

Thermometer Used SR - 9 **Type of Ice:** [✓ Wet] Blue Dry None ☐ Meltwater Only

Cooler Temperature Uncorr: 3.0 /Corr: 3.5

Temp Blank Present: ☐ yes ☒ no **Biological Tissue is Frozen:** ☐ yes ☐ no

Temp should be above freezing to 6°C.
Biota Samples may be received at ≤ 0°C if shipped on Dry Ice.

Person examining contents:
Date: 12/5/24 **Initials:** KKS
Labeled By Initials:

Chain of Custody Present:	☒ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out:	☒ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished:	☒ Yes	☐ No	☐ N/A	3.
Sampler Name & Signature on COC:	☒ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time:	☒ Yes	☐ No		5.
- DI VOA Samples frozen upon receipt	☐ Yes	☐ No		Date/Time:
Short Hold Time Analysis (<72hr):	☐ Yes	☒ No		6.
Rush Turn Around Time Requested:	☒ Yes	☐ No		7. 1 Day rush 12/5/24 KKS
Sufficient Volume:				8.
For Analysis: ☒ Yes ☐ No MS/MSD:	☐ Yes	☒ No	☐ N/A	
Correct Containers Used:	☒ Yes	☐ No		9.
Correct Type: [✓ Pace Green Bay], Pace IR, Non-Pace				
Containers Intact:	☒ Yes	☐ No		10.
Filtered volume received for Dissolved tests	☐ Yes	☐ No	☒ N/A	11.
Sample Labels match COC:	☒ Yes	☐ No	☐ N/A	12.
-Includes date/time/ID/Analysis Matrix: SW				
Trip Blank Present:	☐ Yes	☐ No	☒ N/A	13.
Trip Blank Custody Seals Present	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased):				

Client Notification/ Resolution: If checked, see attached form for additional comments ☐

Person Contacted: Date/Time:

Comments/ Resolution:

PM Review is documented electronically in LIMs. By releasing the project, the PM acknowledges they have reviewed the sample logi

Page 2 of 2

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

December 26, 2024

Brad DalSanto
GEI Consultants
1600 Aspen Commons
Suite 680
Middleton, WI 53562

RE: Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Dear Brad DalSanto:

Enclosed are the analytical results for sample(s) received by the laboratory on December 24, 2024. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Green Bay

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Christopher Hyska

Christopher Hyska
christopher.hyska@pacelabs.com
(920)469-2436
Project Manager

Enclosures

cc: Caitlin Graeber, GEI Consultants
Ken Kytta, GEI Consultants

CERTIFICATIONS

Project:	2408314 Cambridge Station Rele
Pace Project No.:	40289214

Pace Analytical Services Green Bay

1241 Bellevue Street, Green Bay, WI 54302
Florida/NELAP Certification #: E87948
Illinois Certification #: 200050
Kentucky UST Certification #: 82
Louisiana Certification #: 04168
Minnesota Certification #: 055-999-334
New York Certification #: 12064
North Dakota Certification #: R-150
South Carolina Certification #: 83006001
Texas Certification #: T104704529-21-8
Virginia VELAP Certification ID: 11873
Wisconsin Certification #: 405132750
Wisconsin DATCP Certification #: 105-444
USDA Soil Permit #: P330-21-00008
Federal Fish & Wildlife Permit #: 51774A

SAMPLE SUMMARY

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40289214001	**CSRWS002**	Water	12/23/24 10:30	12/24/24 09:05
40289214002	**CSRWS003**	Water	12/23/24 10:42	12/24/24 09:05
40289214003	**CSRWS004**	Water	12/23/24 11:05	12/24/24 09:05
40289214004	**TRIP BLANK**	Water	12/23/24 00:01	12/24/24 09:05

SAMPLE ANALYTE COUNT

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
40289214001	**CSRWS002**	EPA 8260	CXJ	65	PASI-G
40289214002	**CSRWS003**	EPA 8260	CXJ	65	PASI-G
40289214003	**CSRWS004**	EPA 8260	CXJ	65	PASI-G
40289214004	**TRIP BLANK**	EPA 8260	CXJ	65	PASI-G

PASI-G = Pace Analytical Services - Green Bay

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: CSRWS002 **Lab ID: 40289214001** Collected: 12/23/24 10:30 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
Benzene	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:06	71-43-2	
Bromobenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:06	108-86-1	
Bromochloromethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:06	74-97-5	
Bromodichloromethane	**<0.21**	ug/L	1.0	0.21	1		12/24/24 12:06	75-27-4	
Bromoform	**<0.43**	ug/L	1.0	0.43	1		12/24/24 12:06	75-25-2	
Bromomethane	**<1.2**	ug/L	5.0	1.2	1		12/24/24 12:06	74-83-9	
n-Butylbenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 12:06	104-51-8	
sec-Butylbenzene	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:06	135-98-8	
tert-Butylbenzene	**<0.59**	ug/L	1.0	0.59	1		12/24/24 12:06	98-06-6	
Carbon tetrachloride	**<0.37**	ug/L	1.0	0.37	1		12/24/24 12:06	56-23-5	
Chlorobenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 12:06	108-90-7	
Chloroethane	**<1.4**	ug/L	5.0	1.4	1		12/24/24 12:06	75-00-3	
Chloroform	**<0.50**	ug/L	5.0	0.50	1		12/24/24 12:06	67-66-3	
Chloromethane	**<1.6**	ug/L	5.0	1.6	1		12/24/24 12:06	74-87-3	
2-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 12:06	95-49-8	
4-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 12:06	106-43-4	
1,2-Dibromo-3-chloropropane	**<0.36**	ug/L	5.0	0.36	1		12/24/24 12:06	96-12-8	
Dibromochloromethane	**<2.6**	ug/L	5.0	2.6	1		12/24/24 12:06	124-48-1	
1,2-Dibromoethane (EDB)	**<0.31**	ug/L	1.0	0.31	1		12/24/24 12:06	106-93-4	
Dibromomethane	**<0.99**	ug/L	5.0	0.99	1		12/24/24 12:06	74-95-3	
1,2-Dichlorobenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 12:06	95-50-1	
1,3-Dichlorobenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:06	541-73-1	
1,4-Dichlorobenzene	**<0.89**	ug/L	1.0	0.89	1		12/24/24 12:06	106-46-7	
Dichlorodifluoromethane	**<0.46**	ug/L	5.0	0.46	1		12/24/24 12:06	75-71-8	
1,1-Dichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:06	75-34-3	
1,2-Dichloroethane	**<0.29**	ug/L	1.0	0.29	1		12/24/24 12:06	107-06-2	
1,1-Dichloroethene	**<0.58**	ug/L	1.0	0.58	1		12/24/24 12:06	75-35-4	
cis-1,2-Dichloroethene	**<0.47**	ug/L	1.0	0.47	1		12/24/24 12:06	156-59-2	
trans-1,2-Dichloroethene	**<0.53**	ug/L	1.0	0.53	1		12/24/24 12:06	156-60-5	
1,2-Dichloropropane	**<0.45**	ug/L	1.0	0.45	1		12/24/24 12:06	78-87-5	
1,3-Dichloropropane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:06	142-28-9	
2,2-Dichloropropane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:06	594-20-7	
1,1-Dichloropropene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 12:06	563-58-6	
cis-1,3-Dichloropropene	**<0.24**	ug/L	1.0	0.24	1		12/24/24 12:06	10061-01-5	
trans-1,3-Dichloropropene	**<0.27**	ug/L	1.0	0.27	1		12/24/24 12:06	10061-02-6	
Diisopropyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 12:06	108-20-3	
Ethylbenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 12:06	100-41-4	
Hexachloro-1,3-butadiene	**<2.7**	ug/L	5.0	2.7	1		12/24/24 12:06	87-68-3	
Isopropylbenzene (Cumene)	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:06	98-82-8	
p-Isopropyltoluene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:06	99-87-6	
Methylene Chloride	**<0.32**	ug/L	5.0	0.32	1		12/24/24 12:06	75-09-2	
Methyl-tert-butyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 12:06	1634-04-4	
Naphthalene	**<1.9**	ug/L	5.0	1.9	1		12/24/24 12:06	91-20-3	
n-Propylbenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:06	103-65-1	
Styrene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:06	100-42-5	

ANALYTICAL RESULTS

Project:	2408314 Cambridge Station Rele
Pace Project No.:	40289214

Sample: CSRWS002 **Lab ID: 40289214001** Collected: 12/23/24 10:30 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
1,1,1,2-Tetrachloroethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:06	630-20-6	
1,1,2,2-Tetrachloroethane	**<0.25**	ug/L	1.0	0.25	1		12/24/24 12:06	79-34-5	
Tetrachloroethene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 12:06	127-18-4	
Toluene	**<0.29**	ug/L	1.0	0.29	1		12/24/24 12:06	108-88-3	
1,2,3-Trichlorobenzene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:06	87-61-6	
1,2,4-Trichlorobenzene	**<0.95**	ug/L	5.0	0.95	1		12/24/24 12:06	120-82-1	
1,1,1-Trichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:06	71-55-6	
1,1,2-Trichloroethane	**<0.34**	ug/L	1.0	0.34	1		12/24/24 12:06	79-00-5	
Trichloroethene	**<0.32**	ug/L	1.0	0.32	1		12/24/24 12:06	79-01-6	
Trichlorofluoromethane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:06	75-69-4	
1,2,3-Trichloropropane	**<0.56**	ug/L	1.0	0.56	1		12/24/24 12:06	96-18-4	
1,2,4-Trimethylbenzene	**<0.45**	ug/L	1.0	0.45	1		12/24/24 12:06	95-63-6	
1,3,5-Trimethylbenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:06	108-67-8	
Vinyl chloride	**<0.17**	ug/L	1.0	0.17	1		12/24/24 12:06	75-01-4	
Xylene (Total)	**<1.0**	ug/L	3.0	1.0	1		12/24/24 12:06	1330-20-7	
m&p-Xylene	**<0.70**	ug/L	2.0	0.70	1		12/24/24 12:06	179601-23-1	
o-Xylene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:06	95-47-6	
Surrogates									
1,2-Dichlorobenzene-d4 (S)	103	%	70-130		1		12/24/24 12:06	2199-69-1	
4-Bromofluorobenzene (S)	100	%	70-130		1		12/24/24 12:06	460-00-4	
Toluene-d8 (S)	96	%	70-130		1		12/24/24 12:06	2037-26-5	

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: CSRWS003 **Lab ID: 40289214002** Collected: 12/23/24 10:42 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
Benzene	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:25	71-43-2	
Bromobenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:25	108-86-1	
Bromochloromethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:25	74-97-5	
Bromodichloromethane	**<0.21**	ug/L	1.0	0.21	1		12/24/24 12:25	75-27-4	
Bromoform	**<0.43**	ug/L	1.0	0.43	1		12/24/24 12:25	75-25-2	
Bromomethane	**<1.2**	ug/L	5.0	1.2	1		12/24/24 12:25	74-83-9	
n-Butylbenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 12:25	104-51-8	
sec-Butylbenzene	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:25	135-98-8	
tert-Butylbenzene	**<0.59**	ug/L	1.0	0.59	1		12/24/24 12:25	98-06-6	
Carbon tetrachloride	**<0.37**	ug/L	1.0	0.37	1		12/24/24 12:25	56-23-5	
Chlorobenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 12:25	108-90-7	
Chloroethane	**<1.4**	ug/L	5.0	1.4	1		12/24/24 12:25	75-00-3	
Chloroform	**<0.50**	ug/L	5.0	0.50	1		12/24/24 12:25	67-66-3	
Chloromethane	**<1.6**	ug/L	5.0	1.6	1		12/24/24 12:25	74-87-3	
2-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 12:25	95-49-8	
4-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 12:25	106-43-4	
1,2-Dibromo-3-chloropropane	**<0.36**	ug/L	5.0	0.36	1		12/24/24 12:25	96-12-8	
Dibromochloromethane	**<2.6**	ug/L	5.0	2.6	1		12/24/24 12:25	124-48-1	
1,2-Dibromoethane (EDB)	**<0.31**	ug/L	1.0	0.31	1		12/24/24 12:25	106-93-4	
Dibromomethane	**<0.99**	ug/L	5.0	0.99	1		12/24/24 12:25	74-95-3	
1,2-Dichlorobenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 12:25	95-50-1	
1,3-Dichlorobenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:25	541-73-1	
1,4-Dichlorobenzene	**<0.89**	ug/L	1.0	0.89	1		12/24/24 12:25	106-46-7	
Dichlorodifluoromethane	**<0.46**	ug/L	5.0	0.46	1		12/24/24 12:25	75-71-8	
1,1-Dichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:25	75-34-3	
1,2-Dichloroethane	**<0.29**	ug/L	1.0	0.29	1		12/24/24 12:25	107-06-2	
1,1-Dichloroethene	**<0.58**	ug/L	1.0	0.58	1		12/24/24 12:25	75-35-4	
cis-1,2-Dichloroethene	**<0.47**	ug/L	1.0	0.47	1		12/24/24 12:25	156-59-2	
trans-1,2-Dichloroethene	**<0.53**	ug/L	1.0	0.53	1		12/24/24 12:25	156-60-5	
1,2-Dichloropropane	**<0.45**	ug/L	1.0	0.45	1		12/24/24 12:25	78-87-5	
1,3-Dichloropropane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:25	142-28-9	
2,2-Dichloropropane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:25	594-20-7	
1,1-Dichloropropene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 12:25	563-58-6	
cis-1,3-Dichloropropene	**<0.24**	ug/L	1.0	0.24	1		12/24/24 12:25	10061-01-5	
trans-1,3-Dichloropropene	**<0.27**	ug/L	1.0	0.27	1		12/24/24 12:25	10061-02-6	
Diisopropyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 12:25	108-20-3	
Ethylbenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 12:25	100-41-4	
Hexachloro-1,3-butadiene	**<2.7**	ug/L	5.0	2.7	1		12/24/24 12:25	87-68-3	
Isopropylbenzene (Cumene)	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:25	98-82-8	
p-Isopropyltoluene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:25	99-87-6	
Methylene Chloride	**<0.32**	ug/L	5.0	0.32	1		12/24/24 12:25	75-09-2	
Methyl-tert-butyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 12:25	1634-04-4	
Naphthalene	**<1.9**	ug/L	5.0	1.9	1		12/24/24 12:25	91-20-3	
n-Propylbenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:25	103-65-1	
Styrene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:25	100-42-5	

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: CSRWS003 **Lab ID: 40289214002** Collected: 12/23/24 10:42 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
1,1,1,2-Tetrachloroethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:25	630-20-6	
1,1,2,2-Tetrachloroethane	**<0.25**	ug/L	1.0	0.25	1		12/24/24 12:25	79-34-5	
Tetrachloroethene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 12:25	127-18-4	
Toluene	**<0.29**	ug/L	1.0	0.29	1		12/24/24 12:25	108-88-3	
1,2,3-Trichlorobenzene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:25	87-61-6	
1,2,4-Trichlorobenzene	**<0.95**	ug/L	5.0	0.95	1		12/24/24 12:25	120-82-1	
1,1,1-Trichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:25	71-55-6	
1,1,2-Trichloroethane	**<0.34**	ug/L	1.0	0.34	1		12/24/24 12:25	79-00-5	
Trichloroethene	**<0.32**	ug/L	1.0	0.32	1		12/24/24 12:25	79-01-6	
Trichlorofluoromethane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:25	75-69-4	
1,2,3-Trichloropropane	**<0.56**	ug/L	1.0	0.56	1		12/24/24 12:25	96-18-4	
1,2,4-Trimethylbenzene	**<0.45**	ug/L	1.0	0.45	1		12/24/24 12:25	95-63-6	
1,3,5-Trimethylbenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:25	108-67-8	
Vinyl chloride	**<0.17**	ug/L	1.0	0.17	1		12/24/24 12:25	75-01-4	
Xylene (Total)	**<1.0**	ug/L	3.0	1.0	1		12/24/24 12:25	1330-20-7	
m&p-Xylene	**<0.70**	ug/L	2.0	0.70	1		12/24/24 12:25	179601-23-1	
o-Xylene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:25	95-47-6	
Surrogates									
1,2-Dichlorobenzene-d4 (S)	99	%	70-130		1		12/24/24 12:25	2199-69-1	
4-Bromofluorobenzene (S)	95	%	70-130		1		12/24/24 12:25	460-00-4	
Toluene-d8 (S)	95	%	70-130		1		12/24/24 12:25	2037-26-5	

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: CSRWS004 **Lab ID: 40289214003** Collected: 12/23/24 11:05 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
Benzene	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:43	71-43-2	
Bromobenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:43	108-86-1	
Bromochloromethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:43	74-97-5	
Bromodichloromethane	**<0.21**	ug/L	1.0	0.21	1		12/24/24 12:43	75-27-4	
Bromoform	**<0.43**	ug/L	1.0	0.43	1		12/24/24 12:43	75-25-2	
Bromomethane	**<1.2**	ug/L	5.0	1.2	1		12/24/24 12:43	74-83-9	
n-Butylbenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 12:43	104-51-8	
sec-Butylbenzene	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:43	135-98-8	
tert-Butylbenzene	**<0.59**	ug/L	1.0	0.59	1		12/24/24 12:43	98-06-6	
Carbon tetrachloride	**<0.37**	ug/L	1.0	0.37	1		12/24/24 12:43	56-23-5	
Chlorobenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 12:43	108-90-7	
Chloroethane	**<1.4**	ug/L	5.0	1.4	1		12/24/24 12:43	75-00-3	
Chloroform	**<0.50**	ug/L	5.0	0.50	1		12/24/24 12:43	67-66-3	
Chloromethane	**<1.6**	ug/L	5.0	1.6	1		12/24/24 12:43	74-87-3	
2-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 12:43	95-49-8	
4-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 12:43	106-43-4	
1,2-Dibromo-3-chloropropane	**<0.36**	ug/L	5.0	0.36	1		12/24/24 12:43	96-12-8	
Dibromochloromethane	**<2.6**	ug/L	5.0	2.6	1		12/24/24 12:43	124-48-1	
1,2-Dibromoethane (EDB)	**<0.31**	ug/L	1.0	0.31	1		12/24/24 12:43	106-93-4	
Dibromomethane	**<0.99**	ug/L	5.0	0.99	1		12/24/24 12:43	74-95-3	
1,2-Dichlorobenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 12:43	95-50-1	
1,3-Dichlorobenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:43	541-73-1	
1,4-Dichlorobenzene	**<0.89**	ug/L	1.0	0.89	1		12/24/24 12:43	106-46-7	
Dichlorodifluoromethane	**<0.46**	ug/L	5.0	0.46	1		12/24/24 12:43	75-71-8	
1,1-Dichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:43	75-34-3	
1,2-Dichloroethane	**<0.29**	ug/L	1.0	0.29	1		12/24/24 12:43	107-06-2	
1,1-Dichloroethene	**<0.58**	ug/L	1.0	0.58	1		12/24/24 12:43	75-35-4	
cis-1,2-Dichloroethene	**<0.47**	ug/L	1.0	0.47	1		12/24/24 12:43	156-59-2	
trans-1,2-Dichloroethene	**<0.53**	ug/L	1.0	0.53	1		12/24/24 12:43	156-60-5	
1,2-Dichloropropane	**<0.45**	ug/L	1.0	0.45	1		12/24/24 12:43	78-87-5	
1,3-Dichloropropane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:43	142-28-9	
2,2-Dichloropropane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:43	594-20-7	
1,1-Dichloropropene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 12:43	563-58-6	
cis-1,3-Dichloropropene	**<0.24**	ug/L	1.0	0.24	1		12/24/24 12:43	10061-01-5	
trans-1,3-Dichloropropene	**<0.27**	ug/L	1.0	0.27	1		12/24/24 12:43	10061-02-6	
Diisopropyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 12:43	108-20-3	
Ethylbenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 12:43	100-41-4	
Hexachloro-1,3-butadiene	**<2.7**	ug/L	5.0	2.7	1		12/24/24 12:43	87-68-3	
Isopropylbenzene (Cumene)	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:43	98-82-8	
p-Isopropyltoluene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:43	99-87-6	
Methylene Chloride	**<0.32**	ug/L	5.0	0.32	1		12/24/24 12:43	75-09-2	
Methyl-tert-butyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 12:43	1634-04-4	
Naphthalene	**<1.9**	ug/L	5.0	1.9	1		12/24/24 12:43	91-20-3	
n-Propylbenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:43	103-65-1	
Styrene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:43	100-42-5	

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: CSRWS004 **Lab ID: 40289214003** Collected: 12/23/24 11:05 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
1,1,1,2-Tetrachloroethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:43	630-20-6	
1,1,2,2-Tetrachloroethane	**<0.25**	ug/L	1.0	0.25	1		12/24/24 12:43	79-34-5	
Tetrachloroethene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 12:43	127-18-4	
Toluene	**<0.29**	ug/L	1.0	0.29	1		12/24/24 12:43	108-88-3	
1,2,3-Trichlorobenzene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 12:43	87-61-6	
1,2,4-Trichlorobenzene	**<0.95**	ug/L	5.0	0.95	1		12/24/24 12:43	120-82-1	
1,1,1-Trichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 12:43	71-55-6	
1,1,2-Trichloroethane	**<0.34**	ug/L	1.0	0.34	1		12/24/24 12:43	79-00-5	
Trichloroethene	**<0.32**	ug/L	1.0	0.32	1		12/24/24 12:43	79-01-6	
Trichlorofluoromethane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 12:43	75-69-4	
1,2,3-Trichloropropane	**<0.56**	ug/L	1.0	0.56	1		12/24/24 12:43	96-18-4	
1,2,4-Trimethylbenzene	**<0.45**	ug/L	1.0	0.45	1		12/24/24 12:43	95-63-6	
1,3,5-Trimethylbenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 12:43	108-67-8	
Vinyl chloride	**<0.17**	ug/L	1.0	0.17	1		12/24/24 12:43	75-01-4	
Xylene (Total)	**<1.0**	ug/L	3.0	1.0	1		12/24/24 12:43	1330-20-7	
m&p-Xylene	**<0.70**	ug/L	2.0	0.70	1		12/24/24 12:43	179601-23-1	
o-Xylene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 12:43	95-47-6	
Surrogates									
1,2-Dichlorobenzene-d4 (S)	102	%	70-130		1		12/24/24 12:43	2199-69-1	
4-Bromofluorobenzene (S)	98	%	70-130		1		12/24/24 12:43	460-00-4	
Toluene-d8 (S)	96	%	70-130		1		12/24/24 12:43	2037-26-5	

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: TRIP BLANK **Lab ID: 40289214004** Collected: 12/23/24 00:01 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
Benzene	**<0.30**	ug/L	1.0	0.30	1		12/24/24 11:48	71-43-2	
Bromobenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 11:48	108-86-1	
Bromochloromethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 11:48	74-97-5	
Bromodichloromethane	**<0.21**	ug/L	1.0	0.21	1		12/24/24 11:48	75-27-4	
Bromoform	**<0.43**	ug/L	1.0	0.43	1		12/24/24 11:48	75-25-2	
Bromomethane	**<1.2**	ug/L	5.0	1.2	1		12/24/24 11:48	74-83-9	
n-Butylbenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 11:48	104-51-8	
sec-Butylbenzene	**<0.42**	ug/L	1.0	0.42	1		12/24/24 11:48	135-98-8	
tert-Butylbenzene	**<0.59**	ug/L	1.0	0.59	1		12/24/24 11:48	98-06-6	
Carbon tetrachloride	**<0.37**	ug/L	1.0	0.37	1		12/24/24 11:48	56-23-5	
Chlorobenzene	**<0.86**	ug/L	1.0	0.86	1		12/24/24 11:48	108-90-7	
Chloroethane	**<1.4**	ug/L	5.0	1.4	1		12/24/24 11:48	75-00-3	
Chloroform	**<0.50**	ug/L	5.0	0.50	1		12/24/24 11:48	67-66-3	
Chloromethane	**<1.6**	ug/L	5.0	1.6	1		12/24/24 11:48	74-87-3	
2-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 11:48	95-49-8	
4-Chlorotoluene	**<0.89**	ug/L	5.0	0.89	1		12/24/24 11:48	106-43-4	
1,2-Dibromo-3-chloropropane	**<0.36**	ug/L	5.0	0.36	1		12/24/24 11:48	96-12-8	
Dibromochloromethane	**<2.6**	ug/L	5.0	2.6	1		12/24/24 11:48	124-48-1	
1,2-Dibromoethane (EDB)	**<0.31**	ug/L	1.0	0.31	1		12/24/24 11:48	106-93-4	
Dibromomethane	**<0.99**	ug/L	5.0	0.99	1		12/24/24 11:48	74-95-3	
1,2-Dichlorobenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 11:48	95-50-1	
1,3-Dichlorobenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 11:48	541-73-1	
1,4-Dichlorobenzene	**<0.89**	ug/L	1.0	0.89	1		12/24/24 11:48	106-46-7	
Dichlorodifluoromethane	**<0.46**	ug/L	5.0	0.46	1		12/24/24 11:48	75-71-8	
1,1-Dichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 11:48	75-34-3	
1,2-Dichloroethane	**<0.29**	ug/L	1.0	0.29	1		12/24/24 11:48	107-06-2	
1,1-Dichloroethene	**<0.58**	ug/L	1.0	0.58	1		12/24/24 11:48	75-35-4	
cis-1,2-Dichloroethene	**<0.47**	ug/L	1.0	0.47	1		12/24/24 11:48	156-59-2	
trans-1,2-Dichloroethene	**<0.53**	ug/L	1.0	0.53	1		12/24/24 11:48	156-60-5	
1,2-Dichloropropane	**<0.45**	ug/L	1.0	0.45	1		12/24/24 11:48	78-87-5	
1,3-Dichloropropane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 11:48	142-28-9	
2,2-Dichloropropane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 11:48	594-20-7	
1,1-Dichloropropene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 11:48	563-58-6	
cis-1,3-Dichloropropene	**<0.24**	ug/L	1.0	0.24	1		12/24/24 11:48	10061-01-5	
trans-1,3-Dichloropropene	**<0.27**	ug/L	1.0	0.27	1		12/24/24 11:48	10061-02-6	
Diisopropyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 11:48	108-20-3	
Ethylbenzene	**<0.33**	ug/L	1.0	0.33	1		12/24/24 11:48	100-41-4	
Hexachloro-1,3-butadiene	**<2.7**	ug/L	5.0	2.7	1		12/24/24 11:48	87-68-3	
Isopropylbenzene (Cumene)	**<1.0**	ug/L	5.0	1.0	1		12/24/24 11:48	98-82-8	
p-Isopropyltoluene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 11:48	99-87-6	
Methylene Chloride	**<0.32**	ug/L	5.0	0.32	1		12/24/24 11:48	75-09-2	
Methyl-tert-butyl ether	**<1.1**	ug/L	5.0	1.1	1		12/24/24 11:48	1634-04-4	
Naphthalene	**<1.9**	ug/L	5.0	1.9	1		12/24/24 11:48	91-20-3	
n-Propylbenzene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 11:48	103-65-1	
Styrene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 11:48	100-42-5	

ANALYTICAL RESULTS

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Sample: TRIP BLANK **Lab ID: 40289214004** Collected: 12/23/24 00:01 Received: 12/24/24 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV	Analytical Method: EPA 8260 Pace Analytical Services - Green Bay								
1,1,1,2-Tetrachloroethane	**<0.36**	ug/L	1.0	0.36	1		12/24/24 11:48	630-20-6	
1,1,2,2-Tetrachloroethane	**<0.25**	ug/L	1.0	0.25	1		12/24/24 11:48	79-34-5	
Tetrachloroethene	**<0.41**	ug/L	1.0	0.41	1		12/24/24 11:48	127-18-4	
Toluene	**<0.29**	ug/L	1.0	0.29	1		12/24/24 11:48	108-88-3	
1,2,3-Trichlorobenzene	**<1.0**	ug/L	5.0	1.0	1		12/24/24 11:48	87-61-6	
1,2,4-Trichlorobenzene	**<0.95**	ug/L	5.0	0.95	1		12/24/24 11:48	120-82-1	
1,1,1-Trichloroethane	**<0.30**	ug/L	1.0	0.30	1		12/24/24 11:48	71-55-6	
1,1,2-Trichloroethane	**<0.34**	ug/L	1.0	0.34	1		12/24/24 11:48	79-00-5	
Trichloroethene	**<0.32**	ug/L	1.0	0.32	1		12/24/24 11:48	79-01-6	
Trichlorofluoromethane	**<0.42**	ug/L	1.0	0.42	1		12/24/24 11:48	75-69-4	
1,2,3-Trichloropropane	**<0.56**	ug/L	1.0	0.56	1		12/24/24 11:48	96-18-4	
1,2,4-Trimethylbenzene	**<0.45**	ug/L	1.0	0.45	1		12/24/24 11:48	95-63-6	
1,3,5-Trimethylbenzene	**<0.36**	ug/L	1.0	0.36	1		12/24/24 11:48	108-67-8	
Vinyl chloride	**<0.17**	ug/L	1.0	0.17	1		12/24/24 11:48	75-01-4	
Xylene (Total)	**<1.0**	ug/L	3.0	1.0	1		12/24/24 11:48	1330-20-7	
m&p-Xylene	**<0.70**	ug/L	2.0	0.70	1		12/24/24 11:48	179601-23-1	
o-Xylene	**<0.35**	ug/L	1.0	0.35	1		12/24/24 11:48	95-47-6	
Surrogates									
1,2-Dichlorobenzene-d4 (S)	98	%	70-130		1		12/24/24 11:48	2199-69-1	
4-Bromofluorobenzene (S)	95	%	70-130		1		12/24/24 11:48	460-00-4	
Toluene-d8 (S)	97	%	70-130		1		12/24/24 11:48	2037-26-5	

QUALITY CONTROL DATA

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

QC Batch: 493298
QC Batch Method: EPA 8260
Analysis Method: EPA 8260
Analysis Description: 8260 MSV
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40289214001, 40289214002, 40289214003, 40289214004

METHOD BLANK: 2823720
Matrix: Water
Associated Lab Samples: 40289214001, 40289214002, 40289214003, 40289214004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	<0.36	1.0	12/24/24 09:03	
1,1,1-Trichloroethane	ug/L	<0.30	1.0	12/24/24 09:03	
1,1,2,2-Tetrachloroethane	ug/L	<0.25	1.0	12/24/24 09:03	
1,1,2-Trichloroethane	ug/L	<0.34	1.0	12/24/24 09:03	
1,1-Dichloroethane	ug/L	<0.30	1.0	12/24/24 09:03	
1,1-Dichloroethene	ug/L	<0.58	1.0	12/24/24 09:03	
1,1-Dichloropropene	ug/L	<0.41	1.0	12/24/24 09:03	
1,2,3-Trichlorobenzene	ug/L	<1.0	5.0	12/24/24 09:03	
1,2,3-Trichloropropane	ug/L	<0.56	1.0	12/24/24 09:03	
1,2,4-Trichlorobenzene	ug/L	<0.95	5.0	12/24/24 09:03	
1,2,4-Trimethylbenzene	ug/L	<0.45	1.0	12/24/24 09:03	
1,2-Dibromo-3-chloropropane	ug/L	<0.36	5.0	12/24/24 09:03	
1,2-Dibromoethane (EDB)	ug/L	<0.31	1.0	12/24/24 09:03	
1,2-Dichlorobenzene	ug/L	<0.33	1.0	12/24/24 09:03	
1,2-Dichloroethane	ug/L	<0.29	1.0	12/24/24 09:03	
1,2-Dichloropropane	ug/L	<0.45	1.0	12/24/24 09:03	
1,3,5-Trimethylbenzene	ug/L	<0.36	1.0	12/24/24 09:03	
1,3-Dichlorobenzene	ug/L	<0.35	1.0	12/24/24 09:03	
1,3-Dichloropropane	ug/L	<0.30	1.0	12/24/24 09:03	
1,4-Dichlorobenzene	ug/L	<0.89	1.0	12/24/24 09:03	
2,2-Dichloropropane	ug/L	<0.42	1.0	12/24/24 09:03	
2-Chlorotoluene	ug/L	<0.89	5.0	12/24/24 09:03	
4-Chlorotoluene	ug/L	<0.89	5.0	12/24/24 09:03	
Benzene	ug/L	<0.30	1.0	12/24/24 09:03	
Bromobenzene	ug/L	<0.36	1.0	12/24/24 09:03	
Bromochloromethane	ug/L	<0.36	1.0	12/24/24 09:03	
Bromodichloromethane	ug/L	<0.21	1.0	12/24/24 09:03	
Bromoform	ug/L	<0.43	1.0	12/24/24 09:03	
Bromomethane	ug/L	<1.2	5.0	12/24/24 09:03	
Carbon tetrachloride	ug/L	<0.37	1.0	12/24/24 09:03	
Chlorobenzene	ug/L	<0.86	1.0	12/24/24 09:03	
Chloroethane	ug/L	<1.4	5.0	12/24/24 09:03	
Chloroform	ug/L	<0.50	5.0	12/24/24 09:03	
Chloromethane	ug/L	<1.6	5.0	12/24/24 09:03	
cis-1,2-Dichloroethene	ug/L	<0.47	1.0	12/24/24 09:03	
cis-1,3-Dichloropropene	ug/L	<0.24	1.0	12/24/24 09:03	
Dibromochloromethane	ug/L	<2.6	5.0	12/24/24 09:03	
Dibromomethane	ug/L	<0.99	5.0	12/24/24 09:03	
Dichlorodifluoromethane	ug/L	<0.46	5.0	12/24/24 09:03	
Diisopropyl ether	ug/L	<1.1	5.0	12/24/24 09:03	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

METHOD BLANK: 2823720 Matrix: Water

Associated Lab Samples: 40289214001, 40289214002, 40289214003, 40289214004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Ethylbenzene	ug/L	<0.33	1.0	12/24/24 09:03	
Hexachloro-1,3-butadiene	ug/L	<2.7	5.0	12/24/24 09:03	
Isopropylbenzene (Cumene)	ug/L	<1.0	5.0	12/24/24 09:03	
m&p-Xylene	ug/L	<0.70	2.0	12/24/24 09:03	
Methyl-tert-butyl ether	ug/L	<1.1	5.0	12/24/24 09:03	
Methylene Chloride	ug/L	<0.32	5.0	12/24/24 09:03	
n-Butylbenzene	ug/L	<0.86	1.0	12/24/24 09:03	
n-Propylbenzene	ug/L	<0.35	1.0	12/24/24 09:03	
Naphthalene	ug/L	<1.9	5.0	12/24/24 09:03	
o-Xylene	ug/L	<0.35	1.0	12/24/24 09:03	
p-Isopropyltoluene	ug/L	<1.0	5.0	12/24/24 09:03	
sec-Butylbenzene	ug/L	<0.42	1.0	12/24/24 09:03	
Styrene	ug/L	<0.36	1.0	12/24/24 09:03	
tert-Butylbenzene	ug/L	<0.59	1.0	12/24/24 09:03	
Tetrachloroethene	ug/L	<0.41	1.0	12/24/24 09:03	
Toluene	ug/L	<0.29	1.0	12/24/24 09:03	
trans-1,2-Dichloroethene	ug/L	<0.53	1.0	12/24/24 09:03	
trans-1,3-Dichloropropene	ug/L	<0.27	1.0	12/24/24 09:03	
Trichloroethene	ug/L	<0.32	1.0	12/24/24 09:03	
Trichlorofluoromethane	ug/L	<0.42	1.0	12/24/24 09:03	
Vinyl chloride	ug/L	<0.17	1.0	12/24/24 09:03	
Xylene (Total)	ug/L	<1.0	3.0	12/24/24 09:03	
1,2-Dichlorobenzene-d4 (S)	%	101	70-130	12/24/24 09:03	
4-Bromofluorobenzene (S)	%	100	70-130	12/24/24 09:03	
Toluene-d8 (S)	%	97	70-130	12/24/24 09:03	

LABORATORY CONTROL SAMPLE: 2823721

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1-Trichloroethane	ug/L	50	54.5	109	70-133	
1,1,2,2-Tetrachloroethane	ug/L	50	49.8	100	70-130	
1,1,2-Trichloroethane	ug/L	50	48.9	98	70-130	
1,1-Dichloroethane	ug/L	50	53.7	107	70-130	
1,1-Dichloroethene	ug/L	50	55.5	111	66-130	
1,2,4-Trichlorobenzene	ug/L	50	39.4	79	68-130	
1,2-Dibromo-3-chloropropane	ug/L	50	42.2	84	66-130	
1,2-Dibromoethane (EDB)	ug/L	50	45.5	91	70-130	
1,2-Dichlorobenzene	ug/L	50	48.4	97	70-130	
1,2-Dichloroethane	ug/L	50	50.1	100	70-130	
1,2-Dichloropropane	ug/L	50	56.1	112	70-130	
1,3-Dichlorobenzene	ug/L	50	47.8	96	70-130	
1,4-Dichlorobenzene	ug/L	50	49.7	99	70-130	
Benzene	ug/L	50	53.6	107	70-130	
Bromodichloromethane	ug/L	50	53.2	106	70-130	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

LABORATORY CONTROL SAMPLE: 2823721

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Bromoform	ug/L	50	45.5	91	61-130	
Bromomethane	ug/L	50	45.0	90	40-157	
Carbon tetrachloride	ug/L	50	56.8	114	70-139	
Chlorobenzene	ug/L	50	51.6	103	70-130	
Chloroethane	ug/L	50	53.1	106	61-145	
Chloroform	ug/L	50	52.1	104	70-130	
Chloromethane	ug/L	50	50.1	100	22-163	
cis-1,2-Dichloroethene	ug/L	50	49.0	98	70-130	
cis-1,3-Dichloropropene	ug/L	50	49.6	99	70-130	
Dibromochloromethane	ug/L	50	51.8	104	70-130	
Dichlorodifluoromethane	ug/L	50	38.5	77	10-185	
Ethylbenzene	ug/L	50	53.1	106	70-130	
Isopropylbenzene (Cumene)	ug/L	50	51.1	102	70-134	
m&p-Xylene	ug/L	100	111	111	70-130	
Methyl-tert-butyl ether	ug/L	50	49.0	98	62-130	
Methylene Chloride	ug/L	50	54.5	109	70-130	
o-Xylene	ug/L	50	54.8	110	70-130	
Styrene	ug/L	50	55.8	112	70-130	
Tetrachloroethene	ug/L	50	51.8	104	70-130	
Toluene	ug/L	50	50.9	102	70-130	
trans-1,2-Dichloroethene	ug/L	50	56.9	114	70-130	
trans-1,3-Dichloropropene	ug/L	50	47.4	95	70-130	
Trichloroethene	ug/L	50	53.5	107	70-130	
Trichlorofluoromethane	ug/L	50	61.8	124	70-149	
Vinyl chloride	ug/L	50	57.0	114	37-145	
Xylene (Total)	ug/L	150	165	110	70-130	
1,2-Dichlorobenzene-d4 (S)	%			94	70-130	
4-Bromofluorobenzene (S)	%			101	70-130	
Toluene-d8 (S)	%			98	70-130	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2824683 2824684

Parameter	Units	40289090036 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,1,1-Trichloroethane	ug/L	<0.30	50	50	56.6	57.2	113	114	70-136	1	20	
1,1,2,2-Tetrachloroethane	ug/L	<0.25	50	50	53.4	54.1	107	108	70-130	1	20	
1,1,2-Trichloroethane	ug/L	<0.34	50	50	49.8	54.3	100	109	70-130	8	20	
1,1-Dichloroethane	ug/L	<0.30	50	50	54.9	54.1	110	108	70-130	1	20	
1,1-Dichloroethene	ug/L	<0.58	50	50	58.0	57.9	116	116	65-131	0	20	
1,2,4-Trichlorobenzene	ug/L	<0.95	50	50	43.1	44.3	86	89	63-130	3	20	
1,2-Dibromo-3-chloropropane	ug/L	<0.36	50	50	45.4	50.6	91	101	65-130	11	20	
1,2-Dibromoethane (EDB)	ug/L	<0.31	50	50	49.9	53.2	100	106	70-130	6	20	
1,2-Dichlorobenzene	ug/L	<0.33	50	50	51.7	53.7	103	107	70-130	4	20	
1,2-Dichloroethane	ug/L	<0.29	50	50	53.8	55.4	108	111	70-131	3	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2824683 2824684

Parameter	Units	40289090036 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1,2-Dichloropropane	ug/L	<0.45	50	50	55.9	57.7	112	115	70-130	3	20	
1,3-Dichlorobenzene	ug/L	<0.35	50	50	50.9	53.5	102	107	70-130	5	20	
1,4-Dichlorobenzene	ug/L	<0.89	50	50	52.1	54.6	104	109	70-130	5	20	
Benzene	ug/L	<0.30	50	50	54.8	56.3	110	113	70-130	3	20	
Bromodichloromethane	ug/L	<0.21	50	50	55.9	56.8	112	114	70-130	2	20	
Bromoform	ug/L	<0.43	50	50	48.5	50.7	97	101	61-130	4	20	
Bromomethane	ug/L	<1.2	50	50	54.4	51.2	109	102	40-170	6	20	
Carbon tetrachloride	ug/L	<0.37	50	50	59.4	60.2	119	120	70-141	1	20	
Chlorobenzene	ug/L	<0.86	50	50	53.4	56.5	107	113	70-130	6	20	
Chloroethane	ug/L	<1.4	50	50	54.6	55.2	109	110	59-148	1	20	
Chloroform	ug/L	<0.50	50	50	54.4	54.7	109	109	70-130	1	20	
Chloromethane	ug/L	<1.6	50	50	51.3	51.0	103	102	19-170	1	20	
cis-1,2-Dichloroethene	ug/L	<0.47	50	50	52.2	53.0	104	106	70-130	2	20	
cis-1,3-Dichloropropene	ug/L	<0.24	50	50	52.2	54.2	104	108	70-130	4	20	
Dibromochloromethane	ug/L	<2.6	50	50	53.9	57.2	108	114	70-130	6	20	
Dichlorodifluoromethane	ug/L	<0.46	50	50	39.6	38.6	79	77	10-190	3	20	
Ethylbenzene	ug/L	<0.33	50	50	54.3	56.4	109	113	70-130	4	20	
Isopropylbenzene (Cumene)	ug/L	<1.0	50	50	53.6	55.1	107	110	70-137	3	20	
m&p-Xylene	ug/L	<0.70	100	100	113	118	113	118	70-130	4	20	
Methyl-tert-butyl ether	ug/L	<1.1	50	50	42.6	43.6	85	87	62-130	2	20	
Methylene Chloride	ug/L	<0.32	50	50	56.8	56.8	114	114	70-133	0	20	
o-Xylene	ug/L	<0.35	50	50	57.6	58.7	115	117	70-130	2	20	
Styrene	ug/L	<0.36	50	50	57.8	59.4	116	119	70-130	3	20	
Tetrachloroethene	ug/L	0.77J	50	50	55.7	57.8	110	114	70-130	4	20	
Toluene	ug/L	<0.29	50	50	53.1	54.2	106	108	70-130	2	20	
trans-1,2-Dichloroethene	ug/L	<0.53	50	50	57.5	49.3	115	99	70-133	15	20	
trans-1,3-Dichloropropene	ug/L	<0.27	50	50	49.8	52.4	100	105	68-130	5	20	
Trichloroethene	ug/L	<0.32	50	50	56.2	56.0	112	112	70-130	0	20	
Trichlorofluoromethane	ug/L	<0.42	50	50	63.4	64.4	127	129	65-153	2	20	
Vinyl chloride	ug/L	<0.17	50	50	59.5	58.8	119	118	37-150	1	20	
Xylene (Total)	ug/L	<1.0	150	150	170	177	114	118	70-130	4	20	
1,2-Dichlorobenzene-d4 (S)	%						97	99	70-130			
4-Bromofluorobenzene (S)	%						101	99	70-130			
Toluene-d8 (S)	%						97	99	70-130			

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	2408314 Cambridge Station Rele
Pace Project No.:	40289214

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above LOD.

J - The reported result is an estimated value.

LOD - Limit of Detection adjusted for dilution factor, percent moisture, initial weight and final volume.

LOQ - Limit of Quantitation adjusted for dilution factor, percent moisture, initial weight and final volume.

DL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Analyte was not detected and is reported as less than the LOD or as defined by the customer.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 2408314 Cambridge Station Rele
Pace Project No.: 40289214

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40289214001	**CSRWS002**	EPA 8260	493298		
40289214002	**CSRWS003**	EPA 8260	493298		
40289214003	**CSRWS004**	EPA 8260	493298		
40289214004	**TRIP BLANK**	EPA 8260	493298		

Pace®

Pace® Location Requested (City/State):
Pace Analytical Green Bay
1241 Bellevue Street, Suite 9
Green Bay, WI 54302

CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevant fields

LAB USE ONLY- Affix Workorder/Login Label Here

40289214

Scan QR Code for instructions

Company Name: GEI - Madison, WI
Street Address: 1600 Aspen Commons
Suite 680
Middleton, WI 53562
Contact/Report To: Brad DalSanto
Phone #: (815)289-3895
E-Mail: bdalsanto@geiconsultants.com
Cc E-Mail:
Customer Project #: 2408314
Project Name: Cambridge Station Release
Invoice To: Accounts Payable
Invoice E-Mail: geipayables@geiconsultants.com
Site Collection Info/Facility ID (as applicable):
Purchase Order # (if applicable):
Quote #:
Time Zone Collected: [ ] AK [ ] PT [ ] MT [☒] CT [ ] ET
County / State origin of sample(s): Wisconsin
Data Deliverables: [ ] Level II [ ] Level III [ ] Level IV [ ] EQUIS [☒] Other Standard
Regulatory Program (DW, RCRA, etc.) as applicable: Reportable [ ] Yes [ ] No
Rush (Pre-approval required): [☒] Same Day [☒] 1 Day [ ] 2 Day [ ] 3 Day [ ] Other
DW PWSID # or WW Permit # as applicable:
Date Results Requested: 12-27-2024
Field Filtered (if applicable): [ ] Yes [ ] No
Analysis:

Specify Container Size **: 1 | 6
Identify Container Preservative Type***: 1 | 4

**Container Size: (1) 1L, (2) 500mL, (3) 250mL, (4) 125mL, (5) 100mL, (6) 40mL vial, (7) EnCore, (8) TerraCore, (9) 90mL, (10) Other

*** Preservative Types: (1) None, (2) HNO3, (3) H2SO4, (4) HCl, (5) NaOH, (6) Zn Acetate, (7) NaHSO4, (8) Sod. Thiosulfate, (9) Ascorbic Acid, (10) MeOH, (11) Other

Lab Use Only
Proj. Mgr: **Christopher Hyska**
AcctNum / Client ID:
Table #:
Profile / Template: **8140**
Prelog / Bottle Ord. ID: **EZ 3172673**

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Waste Water (WW), Product (P), Soil/Solid (SS), Oil (OL), Wipe (WP), Tissue (TS), Bioassay (B), Vapor (V), Surface Water (SW),Sediment (SED), Sludge (SL), Caulk (CK), Leachate (LL), Biosolid (BS), Other (OT)

Analysis Requested: Full List VOCs

Customer Sample ID	Matrix *	Comp / Grab	Composite Start Date	Composite Start Time	Collected or Composite End Date	Collected or Composite End Time	# Cont.	Res. Chlorine Results	Res. Chlorine Units	Full List VOCs	Sample Comment	Preservation non-conformance identified for sample.
CSR WS 002	SW	G	--	--	12-23-24	1031	3	--	--	X	001	
CSR WS 003	↓	↓	--	--	↓	1042	3	--	--	X	002	
CSR WS 004	↓	↓	-	--	↓	1105	3	—	—	X	003	
Trip Blank										X	004	

Additional Instructions from Pace®:

Collected By: (Printed Name) Brad DalSanto
Signature: BSDalSanto

Customer Remarks / Special Conditions / Possible Hazards:

# Coolers:	Thermometer ID:	Correction Factor (°C):	Obs. Temp. (°C)	Corrected Temp. (°C)	On Ice:
1	9	0.5	0.0	0.5	Y

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
GEI	12-23-24 1300	Marissa Mellider	12-23-24 1300
CS Logistics	12/24/24 0905	Kes Haub-Pace	12/24/24 0905

Tracking Number:
Delivered by: [ ] In- Person [ ] Courier [ ] FedEX [ ] UPS [☒] Other

Page: 1 of 1

Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace® Terms and Conditions found at https://www.pacelabs.com/resource-library/resource/pace-terms-and-conditions/

ENV-FRM-CORQ-0019_v02_110123 ©

DC#_Title: ENV-FRM-GBAY-0035 v03_Sample Preservation Receipt Form
Effective Date: 8/16/2022

Sample Preservation Receipt Form

Client Name: GEI
Project #

All containers needing preservation have been checked and noted below: ☐Yes ☐No ☒N/A

Lab Lot# of pH paper:

Lab Std #ID of preservation (if pH adjusted):

Initial when completed:

Date/ Time:

	Glass							Plastic						Vials						Jars				General										
Pace Lab #	AG1U	BG1U	AG1H	AG4S	AG5U	AG2S	BG3U	BP1U	BP3U	BP3B	BP3N	BP3S	BP2Z	VG9C	DG9T	VG9U	VG9H	VG9M	VG9D	JGFU	JG9U	WGFU	WPFU	SP5T	ZPLC	GN 1	GN 2	VOA Vials (>6mm) *	H2SO4 pH ≤2	NaOH+Zn Act pH ≥9	NaOH pH ≥12	HNO3 pH ≤2	pH after adjusted	Volume (mL)
001																	3																	2.5 / 5
002																	3																	2.5 / 5
003																	3																	2.5 / 5
004																	2																	2.5 / 5
005																																		2.5 / 5
006																																		2.5 / 5
007																																		2.5 / 5
008																																		2.5 / 5
009																																		2.5 / 5
010																																		2.5 / 5
011																																		2.5 / 5
012																																		2.5 / 5
013																																		2.5 / 5
014																																		2.5 / 5
015																																		2.5 / 5
016																																		2.5 / 5
017																																		2.5 / 5
018																																		2.5 / 5
019																																		2.5 / 5
020																																		2.5 / 5

12/24/24 KKS

Exceptions to preservation check: [✓ VOA], Coliform, TOC, TOX, TOH, O&G, WI DRO, Phenolics, Other:

Headspace in VOA Vials (>6mm) : ☐Yes ☒No ☐N/A *If yes look in headspace column

AG1U	1 liter amber glass	**BP1U**	1 liter plastic unpres	**VG9C**	40 mL clear ascorbic w/ HCl	**JGFU**	4 oz amber jar unpres
BG1U	1 liter clear glass	**BP3U**	250 mL plastic unpres	**DG9T**	40 mL amber Na Thio	**JG9U**	9 oz amber jar unpres
AG1H	1 liter amber glass HCL	**BP3B**	250 mL plastic NaOH	**VG9U**	40 mL clear vial unpres	**WGFU**	4 oz clear jar unpres
AG4S	125 mL amber glass H2SO4	**BP3N**	250 mL plastic HNO3	**VG9H**	40 mL clear vial HCL	**WPFU**	4 oz plastic jar unpres
AG5U	100 mL amber glass unpres	**BP3S**	250 mL plastic H2SO4	**VG9M**	40 mL clear vial MeOH	**SP5T**	120 mL plastic Na Thiosulfate
AG2S	500 mL amber glass H2SO4	**BP2Z**	500 mL plastic NaOH + Zn	**VG9D**	40 mL clear vial DI	**ZPLC**	ziploc bag
BG3U	250 mL clear glass unpres					**GN 1**	
						GN 2	

Page 1 of 2

DC#_Title: ENV-FRM-GBAY-0014 v03_SCUR
Effective Date: 8/17/2022

Sample Condition Upon Receipt Form (SCUR)

Project #:

WO#:40289214

40289214

Client Name: GEI

Courier: ☒ CS Logistics ☐ Fed Ex ☐ Speedee ☐ UPS ☐ Waltco
☐ Client ☐ Pace Other:

Tracking #:

Custody Seal on Cooler/Box Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Custody Seal on Samples Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Packing Material: ☐ Bubble Wrap ☒ Bubble Bags ☐ None ☐ Other

Thermometer Used SR - 9 **Type of Ice:** [✓ Wet] Blue Dry None ☐ Meltwater Only

Cooler Temperature Uncorr: 0.0 /Corr: 0.5

Temp Blank Present: ☐ yes ☒ no **Biological Tissue is Frozen:** ☐ yes ☐ no

Temp should be above freezing to 6°C.
Biota Samples may be received at ≤ 0°C if shipped on Dry Ice.

Person examining contents:
Date: 12/24/24 **Initials:** KKS
Labeled By Initials:

Chain of Custody Present:	☒Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☒Yes ☐No ☐N/A	2.
Chain of Custody Relinquished:	☒Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☒Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time: - DI VOA Samples frozen upon receipt	☒Yes ☐No ☐Yes ☐No	5. Date/Time:
Short Hold Time Analysis (<72hr):	☐Yes ☒No	6.
Rush Turn Around Time Requested:	☒Yes ☐No	7. Same Day; 1Day; 12/27/24. KKS 12/24/24
Sufficient Volume: For Analysis: ☒Yes ☐No MS/MSD:	☐Yes ☒No ☐N/A	8.
Correct Containers Used: Correct Type: [✓ Pace Green Bay], Pace IR, Non-Pace	☒Yes ☐No	9.
Containers Intact:	☒Yes ☐No	10.
Filtered volume received for Dissolved tests	☐Yes ☐No ☒N/A	11.
Sample Labels match COC: -Includes date/time/ID/Analysis Matrix: SW	☒Yes ☐No ☐N/A	12.
Trip Blank Present: Trip Blank Custody Seals Present Pace Trip Blank Lot # (if purchased): 538	☒Yes ☐No ☐N/A ☐Yes ☐No ☒N/A	13.

Client Notification/ Resolution: If checked, see attached form for additional comments ☐

Person Contacted: Date/Time:

Comments/ Resolution:

PM Review is documented electronically in LIMs. By releasing the project, the PM acknowledges they have reviewed the sample logi

Page 2 of 2

II. GEI SOPs

STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

---

1. Objective

Describe installation procedures for overburden monitoring wells screened across or below the groundwater table.

Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan. This SOP assumes the monitoring wells will be constructed of flush-joint PVC pipe and the screened section will have factory-slotted openings.

2. Execution

Attachment A provides a diagram of typical shallow, intermediate, and deep groundwater monitoring well construction detail. A Groundwater Monitoring Well Installation Log is in Attachment B.

- Measure and record the depth of the completed soil boring before beginning the well installation.
- If possible, measure the depth to groundwater in the borehole over a 10 to 15 minute period to ensure that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole. If drilling water has been used during boring advancement, pump the water out of the borehole to the static water depth, based on examination of the soil samples, and monitor the recovery of groundwater until the level has stabilized.
- If it is not possible to accurately measure the depth to groundwater in the borehole due to low permeability in the formation, use the saturated soil depth observed in the collected samples or measured water depth in a nearby existing monitoring well to estimate the depth to water in the borehole.
- For shallow monitoring wells, select the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table. Screen lengths of 15 feet or less are preferred and 10 foot screens are most common. If the water table is seasonally high or low or if the well is in a location where the water table is likely to be tidally influenced, appropriately place the screened section to allow for the screen to intersect likely future water tables.
- For intermediate or deep wells screened entirely below the water table, select the monitoring well screen and riser lengths as described in the Work Plan. Screen lengths of 10 feet or less are preferred.
- If the borehole is deeper than the desired well depth or the bottom of the well is close to a change in soil strata, then fill the base of the borehole with bentonite. Keep in mind that bentonite swells when hydrated, and that filter

sand should be placed at the bottom of the borehole above the bentonite before installing the well.

- Prevent well materials from contacting foreign substances during installation. Precautions may include requiring the driller to wear clean gloves while handling well materials and requiring that well materials not be placed onto the ground or pavement without a protective barrier such as polyethylene sheeting being present
- Confirm that the driller installs a minimum one-inch sump with a bottom cap to the bottom of the well screen. See the Work Plan for locations that may require larger sumps.
- Monitoring wells can be constructed of either 1, 1.5, 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC. Refer to the work plan for the site-specific requirements. Flush-threaded well materials should be used. Do not allow the driller to use glues, as they typically contain solvents that could affect on groundwater quality.
- Stainless steel well materials may be used if required in the Work Plan. Select slot size based on grain size of the formation and on requirements in the Work Plan.
- Confirm that the driller places at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole, if required in the Work Plan.
- The driller should remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals, at the same time that filter sand is added. The drillers should take frequent measurements of the depth to sand.
- Confirm that the driller has added adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.
- The driller should place a bentonite seal above the filter pack. If the seal is above the water table, use at least 5-gallons of potable water to hydrate the bentonite before grouting the remaining annular space, or otherwise backfilling the remaining annular space as discussed with the Project Manager. Tamp seal. It should extend 1 to 2 feet above the filter sand.
- If required by the Work Plan, the driller should use bentonite-cement and grout the annular space from the top of the bentonite seal to the ground surface. Bentonite cement grout should be placed using tremie methods. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using a pump (such as one on the rig) to ensure proper mixing.
- The drillers should cut the monitoring well riser at an angle or make "V"-notch in the riser pipe as a benchmark for surveying and groundwater measurements. The driller should cut the well riser so that the top of the well will be approximately 3 inches below the top of protective casing. The top of

the riser should be close enough to the top of the surface casing to allow reading of depth markings on a water level indicator tape.

- The protective surface casing is either a flush-mounted roadbox or a steel “stick up” pipe. The base of either type of casing should extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- The protective casing should be set by placing cement in the annular space between the protective casing and the borehole up to the ground surface. If possible, the driller should slope the cement radially away from the protective casing at the ground surface to promote surface water runoff.
- In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox flush with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area and is completed with a steel “stick up” pipe, additional protection such as steel pole bumpers around the steel “stick up” pipe may be necessary.
- If possible a locking cap should be placed on the steel “stick up” pipe. If the surface casing is flush mounted, a locking expansion plug should be placed, if possible, inside the top of the well riser pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the outside of the protective well casing with a paint pen. If the well is not going to be surveyed, measure the location to nearby landmarks so that the well may be located in the future and plotted on figures. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- Do not screen across different hydrostratigraphic units (for example, outwash sands, confining layers or till) unless specified in the Work Plan or approved by the Project Manager.

- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand should be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.

- Do not use drill cuttings to backfill during monitoring well installation unless specified by the work plan or project manager.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

5. Attachments

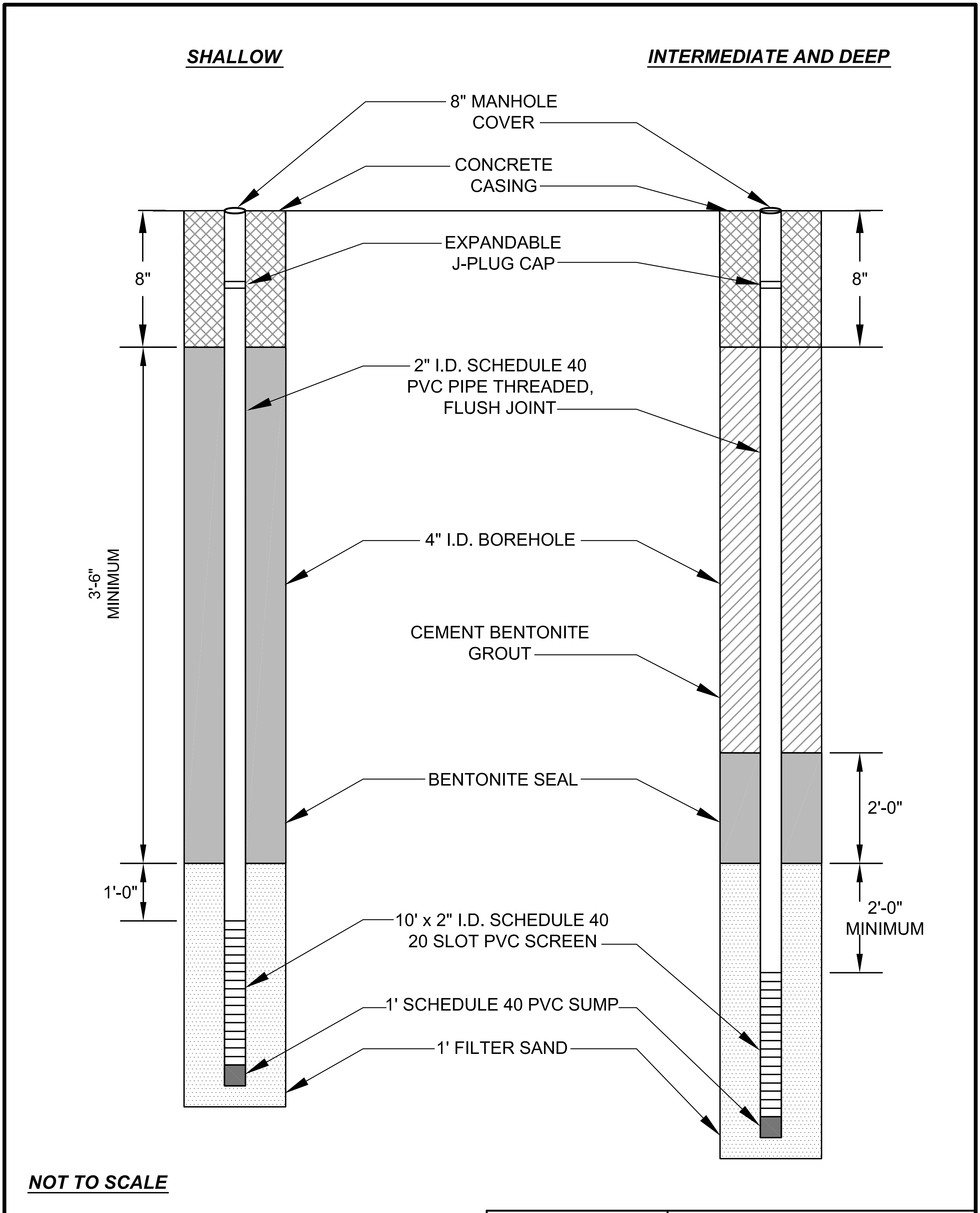
Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Groundwater Monitoring Well Installation Log

6. Contact

David Terry
Anne Leifer

Attachment A - Well Detail



GEI Consultants

TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

June 2008

I:\GEI\SOPs\ Well Detail.dwg \Jun 10, 2008

Attachment B - Groundwater Monitoring Well Installation Log

Groundwater Well Installation Log

Well ID

Project ____________________

City / Town ____________________

Client ____________________

Contractor ____________________

Driller ____________________ **GEI Rep.** ____________________

GEI Proj. No. ____________________

Location ____________________

N ____________________

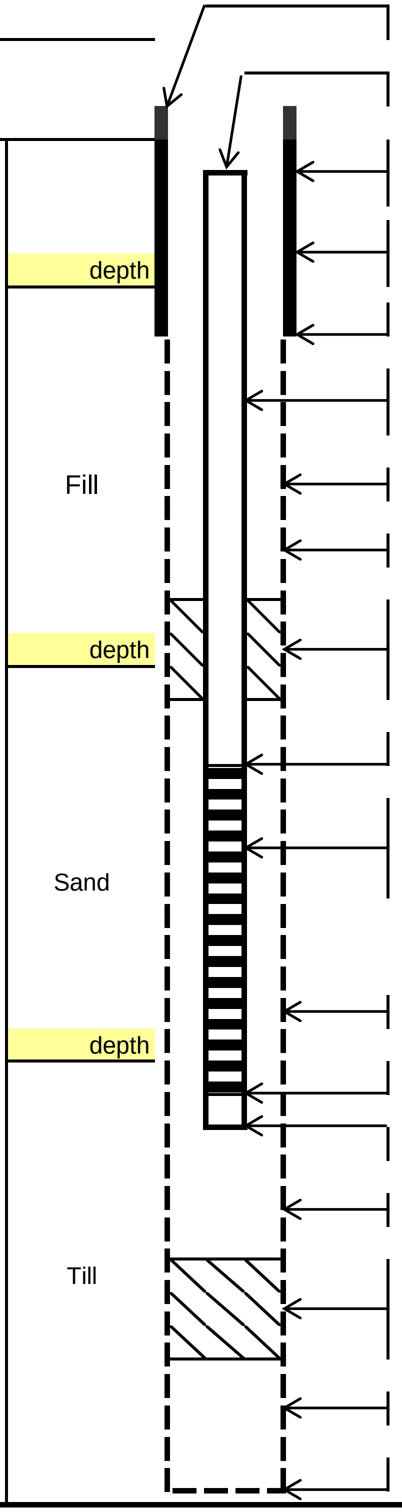
E ____________________

Install Date ____________________

Survey Datum: ____________________

Ground Elevation:

General Soil Conditions (Not to Scale)



Length of Surface Casing above Ground ____________________

Dist. Top of Surf. Casing to Top of Riser Pipe ____________________

Type and Thickness of Seal around Surface Casing ____________________

ID of Surface Casing ____________________

Type of Surface Casing ____________________

Depth Bottom of Surface Casing ____________________

ID and OD of Riser Pipe ____________________

Type of Riser Pipe ____________________

Type of Backfill around Riser Pipe ____________________

Diameter of Borehole ____________________

Depth Top of Seal ____________________

Type of Seal ____________________

Depth Bottom of Seal ____________________

Depth Top of Screened Section ____________________

Type of Screen ____________________

Description of Screen Openings ____________________

ID and OD of Screened Section ____________________

Type of Filter Material ____________________

Depth Bottom of Screened Section ____________________

Depth Bottom of Silt Trap ____________________

Depth Bottom of Filter Material ____________________

Depth Top of Seal ____________________

Type of Seal ____________________

Depth Bottom of Seal ____________________

Type of Backfill below Filter Material ____________________

Bottom of Borehole ____________________

Date	Time	Distance to ▼ below top of riser pipe

Notes:

GEI Consultants

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

---

1. Objective

Describe standard procedures to remove fluids from monitoring wells (introduced during drilling) and maximize the movement of groundwater into the well by removing fine particles in the well and sand pack around the screen.

2. Execution

To prevent cross contamination between monitoring wells, use dedicated equipment and/or appropriately decontaminated equipment to perform monitoring well development. See SOP QA-001 Equipment Decontamination and the Work Plan for more information.

For deep or large diameter monitoring wells, it may be necessary to use a re-usable pump system, such as a Grundfos pump, to develop monitoring wells.

- Calculate the volume of water in the monitoring well (one well volume) using the following table:

Well diameter (inches)	Volume (gal/ft)
1	0.04
1.5	0.09
2	0.16
3	0.36
4	0.65
6	1.50

  The equation used to establish these volumes is presented in Section 4.

- Calculate or estimate the amount of water introduced to the borehole during drilling. At a minimum, this is the amount of water that should be removed during development. Removing less water than was introduced and allowing additional time for the surrounding formation to clear of injected drilling fluids may be considered as an alternative if the volume of introduced water was large.

- Record the volume of water purged in the field notebook or on the Monitoring Well Sampling Form (Attachment A).

- Collect a sample of water from the monitoring well with the selected submersible pump (e.g. 12-volt whale pump or Grundfos pump), a bailer, or a

Waterra system. Record the physical properties (color, turbidity, odors, etc.) of the sample.

- The volume of water that should be removed will depend on the work plan, local regulatory guidance, and/or the volume of water that was introduced during drilling and well installation. Typical guidance for the removal volume includes:
    - Ten well volumes.
    - The volume of fluid added during drilling.
    - The volume required to remove enough suspended particles so that the turbidity of the water is less than 50 nephelometric turbidity units.

If needed, pump the ground water into a 5-gallon pail so that the volumetric flow rate and total water volume from the pump or bailer can be calculated.

Measure the groundwater level in the well during development to assess if the pumping rate is sufficient to create a drawdown in the well.

Observe the groundwater every few well volumes during the pumping and record the physical properties (color and turbidity).

If required by the Work Plan, conduct surging in the monitoring well. See the Work Plan for the method of well surging to be used. If surging is necessary, do so only after initial pumping at the well has occurred and fine sediments have been removed.

Slowly move the surge block up and down in the well. Periodically remove the surge block and purge the groundwater until it is relatively clear again. Start at a slow pace and progress to a faster surging action through time.

3. Limitations

Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action. They may also damage the pump.

If the ground water in the monitoring well is contaminated, the water removed during well development may need to be placed in a properly-labeled drum and disposed of in accordance with local, state, and federal regulations (see SC-003 Investigation Derived Waste).

If the soils around the well screen are composed of fine-grained silts and clays, over-pumping and mechanical surging is not recommended since these more vigorous techniques can cause mixing of the fines into the filter pack. To develop these wells, use of a bailer is recommended.

There are occasions when the turbidity of groundwater cannot be meaningfully reduced. On these occasions, a minimum of ten volumes should be removed, and the Project manager should be consulted.

Sampling of groundwater should generally not occur within one week after development. In some regions or regulatory jurisdictions, a minimum of two weeks may be required before sampling. If no water was introduced to the formation during drilling, this waiting period may be shortened if required by the project. See the Work Plan for additional information.

4. References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

"The Methods & Mechanics of Well Development, Part 2 of 5," National Drillers Buyers Guide, March 1993, p. 17.

Massachusetts Department of Environmental Protection, "WSC-310-91Standard References for Monitoring Wells, Section 4.5 Decommissioning of Monitoring Wells", January 1991
.

U. S. EPA Environmental Response Team Standard Operating Procedure SOP: 2044 ," Monitor Well Development" REV: 0.1, 10/23/01

5. Attachments

Attachment A - Monitoring Well Sampling Form

6. Contact

Gary Fuerstenberg
Anne Leifer

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________ Job Name ____________________

Job Number ____________ By ____________ Date ____________

Location ____________ Measurement Datum ____________________

Well Number ____________

Pre-Development Information Time (start) ____________________

Water Level ____________ Total Depth of Well ____________________

One Purge Vol ____________ Three Well Volume ____________________

Water Characteristics

Color ____________ ______ Clear _____ Cloudy

Odor _____ None _____ Weak ______ Moderate _____ Strong

Any films or immiscible material ________________________________

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (µS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) ____________ pH ____________

Temperature (°C) ____________ Specific Conductance (µS/cm) ____________

DO Concentration (mg/L) ____________ ORP (mV) ____________

TDS ____________

Post Development Information Time (Finished) ____________

Water Level ____________ Total Depth of Well ____________

Approximate Volume Removed (gal) ________________________

Water Characteristics

Color ________________ _____ Clear _____ Cloudy

Odor _____ None _____ Weak _____ Moderate _____ Strong

Any films or immiscible material ________________________________

Comments

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

---

1. Objective

Describe methods for documentation of field activities.

Documentation of site activities is a crucial part of the field investigation process. The field notebook serves as the record of field activities performed or observed during the project. It provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Attachment A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. Spiral notebooks should not be used because pages can be easily removed.
- Write neatly using black or blue pen, preferably a waterproof pen. Use of pencil is also acceptable only with approval of the project manager, such as in but not limited to, certain field conditions [e.g., cold or wet weather].
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and “Return Book To:” the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur. Record only facts and observations, regardless of whether they appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions (e.g. snow-covered ground surface, inability to access areas of interest).
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted.
    - If an error is made on an entry in the field notebook, the individual who made the entry should make the corrections. The corrections must be initialed and dated by the person making the correction.
- Sign or initial and date the bottom of every page with an entry if the project requires such documentation.
- Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    - Date/time/weather.
    - GEI personnel.
    - Purpose of visit/daily objectives.
    - People (client, contractor, landowners, etc.) present upon GEI arrival.

- Record the following information during the course of the day:
    - Conversations with contractors/subcontractors, clients, visitors, GEI staff, landowners (site or abutters). If possible, record complete names, titles, and affiliations.
    - Time of arrival and departure of individuals.
    - Activities as they occur.

- Additional examples of observations to record may include and are not limited to:
    - Type and quantity of monitoring well construction materials used.
    - Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.).
    - Ambient air monitoring data.
    - Field equipment calibration information.
    - Locations and descriptions of sampling points.
    - Contractor/Subcontractor progress.
    - Sample media (soil, sediment, groundwater, etc.).
    - Sample collection method.
    - Number and volume of sample(s) collected and sample bottle preservatives used.
    - Sample identification number (s) and date and time of sample collection.
    - Approximate volume of groundwater removed before sampling.
    - Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
    - References for maps and photographs of the sampling site(s).
    - Information pertaining to sample documentation: bottle lot numbers/ dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
    - Surveying data (including sketches with north arrows).
    - Changes in weather.
    - Rationale for critical field decisions.
    - Recommendations made to the client representative and GEI Project Manager.
    - Site sketch of conditions at the end of the day.
    - Summary of work completed/work remaining.
    - Allow time at the end of the day to complete entries in the notebook.

3. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

ASFE Daily Field Report for Geotechnical Field Observation, 2nd Edition (2001), ASFE, Inc.

4. Attachments

Attachment A - Example Field Notes

5. Contact

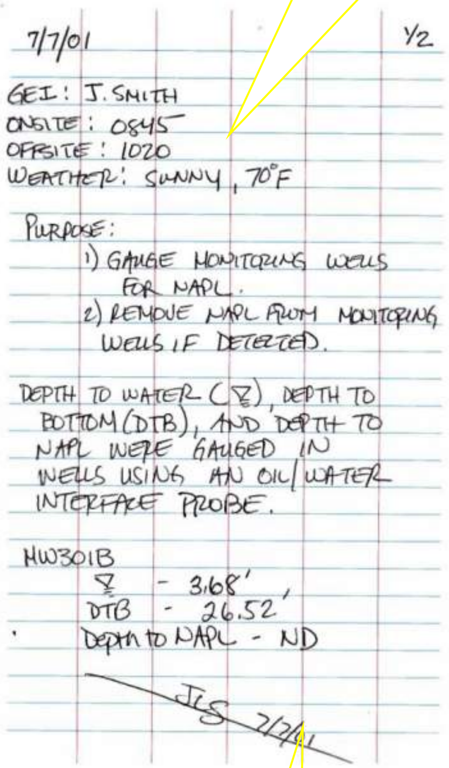
Melissa Felter
Leslie Lombardo

SOP FD-001

Attachment A – Example Field Notes

Start of each day includes:
- **Date**
- **Project Number**
- **People on site**
- **Purpose of Work**
- **Weather Conditions**

Each page is numbered



7/7/01 1/2

GEI: J. SMITH
ONSITE: 0845
OFFSITE: 1020
WEATHER: SUNNY, 70°F

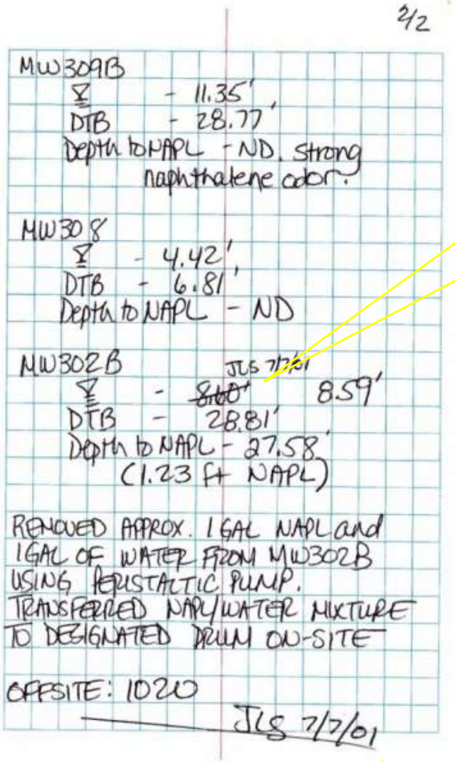
PURPOSE:
1) GAUGE MONITORING WELLS FOR NAPL.
2) REMOVE NAPL FROM MONITORING WELLS IF DETECTED.

DEPTH TO WATER (∇), DEPTH TO BOTTOM (DTB), AND DEPTH TO NAPL WERE GAUGED IN WELLS USING AN OIL/WATER INTERFACE PROBE.

MW301B
∇ - 3.68',
DTB - 26.52'
Depth to NAPL - ND

JLS 7/7/01

Errors are single line crossed out and initialed



2/2

MW309B
∇ - 11.35',
DTB - 28.77'
Depth to NAPL - ND. Strong naphthalene odor.

MW308
∇ - 4.42',
DTB - 6.81'
Depth to NAPL - ND

MW302B
JLS 7/7/01
∇ - ~~8.60'~~ 8.59'
DTB - 28.81',
Depth to NAPL - 27.58'
(1.23 ft NAPL)

REMOVED APPROX. 1 GAL NAPL and 1 GAL OF WATER FROM MW302B USING PERISTALTIC PUMP. TRANSFERRED NAPL/WATER MIXTURE TO DESIGNATED DRUM ON-SITE

OFFSITE: 1020

JLS 7/7/01

Blank Space crossed out and initialed

Bottom of each page signed and dated

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

---

1. Objective

Describe methods to generate a Field Observation Report.

The Field Observation Report is used to record a summary of activities, observations, and decisions made during the day's field work. The daily field observation report serves as a permanent record of the day's activity for the Project Manager (PM), In-House Consultant (IHC), and/or client.

2. Execution

- If required, at the close of the day's field work, a Field Observation Report should be prepared by the individual responsible for the field notebook. This report should be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information:
    - A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
    - A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
    - A summary of deviation(s) from the field plan or objectives.
    - A summary of field decisions made, who made them, and the basis for such decisions.
    - A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
    - Recommendations that may result from field observations and actions that may result from implementation of those recommendations.
    - A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review. Complete any editorial changes, sign, date, and submit the report to PM/IHC for approval/signature. Field Observation Reports should be written neatly. They are not required to be typed unless specifically requested by the PM.

3. Limitations

- The Field Observation Report is not a substitute for the field notebook.
- Not all projects require daily Field Observation Reports.
- The Field Observation Report should be based primarily on factual information. Opinions, if necessary, should be identified as such. Any speculation should be clearly noted in the report as such.

- The Field Observation Report should never be released to anyone other than the PM/IHC prior to review and sign-off unless explicitly authorized by the PM/IHC.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

ASFE Daily Field Report for Geotechnical Field Investigations, 2nd Edition (2001), ASFE, Inc.

5. Attachments

Attachment A - Example Field Observation Report

6. Contact

Melissa Felter
Leslie Lombardo

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	1 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

SOP FD-002 - Attachment A – Example Field Observation Report

Time of Arrival: 0700 **Departure: 1440** **Weather: Overcast, Raining, 55^{0}F**

Persons Contacted, Company	**GEI Representatives**
Jane Doe, ABC Contracting	Bill Smith

Purpose of Site Visit: To observe excavation of soils for new guard booth and sidewalk.

Observations:

1. **Excavation**
   - a. Areas for guard booth and sidewalk were laid out by ABC with stakes, string, and spray paint. Locations were between the pavement and wetland area; no excavation occurred in the wetland area.
   - b. Staging area for soil stockpile was located to the west of the excavation, along the fenceline; polyethylene sheeting was placed beneath the pile.
   - c. HDPE membrane delivered to site; stored in garage area through the inside fence.
   - d. ABC crew began hand digging area for sidewalk and guard booth. Sidewalk area measured 22 feet long by 4 feet wide by 4 inches deep. Guard booth area measured 12 feet long by 10 feet wide by 9 inches deep. Utility pole and bollard locations started today.
   - e. Rain continued to get worse in the afternoon; ABC covered the entire excavation and soil stockpile with poly sheeting and secured the sheeting with grade stakes.

2. **Subgrade Preparation**
   - a. Subgrade preparation for the sidewalk and guard booth areas at the site is complete.

3. **Dewatering**
   - a. No dewatering occurred today.

4. **Air Monitoring**
   - a. During excavation, I monitored the breathing zone of the workers with an organic vapor meter (OVM). No headspace readings were measured in soil samples S-1 through S-8.

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	2 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

Picture 1: Sidewalk excavation and bollard layout

By: Bill Smith	**Reviewed By:**

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

---

1. Objective

Describe methods to label sample containers, manage the samples, and prepare Chain of Custody documentation for the samples. Sample transport is also addressed.

2. Project Setup

When setting up a sampling event, inform the recipients of the samples (laboratories) and recipients of laboratory results (data group and project managers). Discuss with the laboratory the sampling media, turnaround times, and reporting limits for appropriate regulatory criteria for the site. Include the data group on correspondence so that turnaround times, data validation, and project deliverable schedules can be tracked successfully.

- Laboratory - Number of samples, analyses needed: bottle orders and holding times, turnaround times needed, reporting limits needed for regulatory criteria.
- Data group - Number of samples, analyses requested, turnaround times and reporting limits requested, data validation needed, regulatory criteria to use for tabulating results, deliverables needed, and project name and number.
- Schedule - Inform the laboratory and Data Group of schedule delays, changes to analyses, and expediting.

3. Sampling Execution

- Review the work plan prior to sampling to determine the following:
    - Sample matrix and sampling method.
    - Required analysis and sample volumes.
    - Sample container type and preservative requirements.
    - Required analysis methods and/or report formats.
    - The turnaround time required by the project.
    - If the data will be sent directly from the laboratory to the data validator, Project Manager, or Data Group.
    - Holding time restrictions for sampling media and analytical methods.
    - Sample naming convention used for this project site.
- Sample labels should be filled out using a waterproof or permanent marker or pen. Required information includes:
    - Sample ID.
    - Date and time (military time) of sample collection.
    - Project number.
    - Sample preservatives.
    - Sampler’s initials.
    - Laboratory analytical methods.

- Place the label on the jar or bottle, not on the cap. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material, if needed. See SOP SC-002 for guidance on packaging samples for shipment to the laboratory by way of common carrier. Place samples in a cooler with bagged ice or freezer packs (blue ice) immediately after collection. Add sufficient ice or freezer packs to cool samples to approximately 4°C.
- Complete a chain of custody (COC) for the samples as described below. GEI or laboratory COCs may be used as long as they contain fields for all required sample information as described in Section 2.1.

3.1. Chain-of-Custody (COC) Completion

- Fill out COC neatly and in permanent ink. Alternatively, an Excel version of the GEI COC is available and can be filled out electronically.
- Certain analyses (i.e. air analysis by TO-15) require specialized, laboratory issued COCs. Make sure any specialized COCs are available before sample collection.
- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, the number of sample containers, and any additional information to fulfill project, client or regulatory requirements.
- Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field notebook. If required by the Project Manager or Data Group, also document this information on or attach a note to the GEI copy of the COC.
- Trip blanks for large sites should be named similar to the samples they are collected with so that there are not two of the same sample name for the same site. For example, "OU1TB-122509" and "OU3TB-122509" would avoid any mistakes.
- Strike incorrect entries on the COC with a single line, followed by the initials of the person making the correction, the date, and the correct entry.
- When sample custody is ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the

COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.

- If the samples are placed in a designated secure area (e.g. GEI sample fridge), note this location in the “Received by” box on the COC.
- GEI uses both single sheet and triplicate COCs. If using the triplicate COCs (white, yellow, and pink copies), the pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- If you are using the single sheet COC, make a copy of the COC after it has been signed by the lab courier and forward it to the Data Group.
- Prior to sample shipment by common carrier, the COC must be placed inside the cooler in a Ziplock bag or other watertight package.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the “Received by” box on the COC.
- If a courier is used to transport samples to the laboratory (lab courier or GEI personnel), the courier signs the COC in the “Received by” box.
- Place a custody seal on the cooler if shipping via common carrier.
- Transport samples to the laboratory as soon as possible. It is preferable to transport the samples directly to the laboratory from the field. Samples brought back to the office for storage prior to submission to the laboratory must be kept cold (4° C).
- Unused sampling containers/media that are sent back to the lab should be included on a separate COC.
- After the samples are sent to the laboratory, the GEI copy of the COC must be forwarded to the Data Group: datagroup@geiconsultants.com.

4. Limitations

- Keep the number of people involved in handling samples to a minimum.
- Where practical, only allow people associated with the project to handle the samples.
- Always document the transfer of samples from one person to another on the COC.
- The COC should always accompany the samples.
- Give samples positive identification at all times that is legible and written with waterproof or permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Where practical, avoid sending samples from more than one site with separate COCs in a single package.

5. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

6. Attachments

Attachment A - Example Chains of Custody
Attachment B - Shipping Info Pics

7. Contact

Brian Skelly
Leslie Lombardo

Chain of Custody Record

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

Example
COC

SEVERN TRENT **STL**
Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client: GEI
Address: 455 Winding Brook Dr
City: Glastonbury
State: CT
Zip Code: 06033
Project Name and Location (State): Carroll Gardens NY
Contract/Purchase Order/Quote No.:
Project Manager: Dave Terry
Telephone Number (Area Code)/Fax Number: 860 368 5300 / 860 368 5307
Site Contact: M. Felter
Lab Contact: Paul Hobart
Carrier/Waybill Number: FedEx 9383 7603 0879
Date: 12-31-07
Chain of Custody Number: 00452
Lab Number:
Page 1 of 1

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix					Containers & Preservatives							Analysis (Attach list if more space is needed)			Special Instructions/ Conditions of Receipt
			Air	Aqueous	Sed.	Soil		Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH		VOC 8260B	SVOC 8270C	TO-15 + NAPHTHALENE	
CGSB-01 (0-2)	12-31-07	1130				X		X							X	X		
CGSB-02 (3-4)	12-31-07	1250				X		X							X	X		
CGSB-02 (3-4) MS	12-31-07	1250				X		X							X	X		
CGSB-02 (3-4) MSD	12-31-07	1250				X		X							X	X		
CGSB-XX (5-6)	12-31-07	0800				X		X							X	X		
CGTB-123107	12-31-07	1400					TB				X				X			
CGGW-01	12-31-07	1430		X				X			X				X	X		
CGSG-01	12-31-07	0700-1500	X														X	CANISTER# 2013 REGULATOR# 779

~~B NEW JERSEY : "CLP data package deliverables"~~

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other See contract

QC Requirements (Specify) NYS Cat B ASP deliverable send to Lorie Mackinnon
Send EDD to datagroup@geiconsultants.com

1. Relinquished By: Melissa J Felter — Date: 12-31-07 — Time: 1600
1. Received By: FedEx WAYBILL 923117-4432 — Date: 12-31-07 — Time:
2. Relinquished By: — Date: — Time:
2. Received By: — Date: — Time:
3. Relinquished By: — Date: — Time:
3. Received By: — Date: — Time:

Comments
USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED

RIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

EXAMPLE COC

Chain-of-Custody Record

Laboratory: Accutest

Laboratory Job #
(Lab use only)

GEI Consultants
400 Unicorn Park Dr.
Woburn, MA 01801
PH: 781.721.4000
FX: 781.721.4073

Project Information

Project Name: MWRA - Low Service Storage Tank

Project Location: Stoneham, MA

Project Number: 093400

Project Manager: D. Aghjayan

Page _1_ of _1_

Send Report to: rseigener@geiconsultants.com

Send EDD to: labdata@geiconsultants.com

MCP PRESUMPTIVE CERTAINTY REQUIRED – YES NO

If Yes, Are MCP Analytical Methods Required? YES NO NA

If Yes, Are Drinking Water Samples Submitted? YES NO NA

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Sample Handling

Samples Field Filtered YES NO NA

Sampled Shipped With Ice YES NO

Lab Sample Number	GEI Sample ID	Collection Date	Collection Time	Matrix	No. of Bottles	Sampler(s) Initials	PCBs	VPH Fractions Only	EPH Fractions Only	SVOCs	VOCs, % Solids**	Conductivity	RCRA 8 Metals*	TPH by GC/FID DRO	Sample Specific Remarks
						Preservative	None	MeOH	None	None	MeOH	None	None	None	
	093400-LS6-S5(19'-21')	12/29/2009	9:30	SO	3	JMR		x			x				
	093400-LS6-COMP (FILL)	12/29/2009	9:30	SO	1	JMR	x		x	x		x	x	x	
	093400-LS6-COMP (NATIVE)	12/29/2009	15:00	SO	1	JMR	x		x	x		x	x	x	
	093400-LS8-COMP	12/29/2009	14:00	SO	1	JMR	x		x	x		x	x	x	
	093400-LS9-S4 (8'-8'-5")	12/30/2009	14:30	SO	3	JMR		x			x				
	093400-LS9-COMP	12/30/2009	15:00	SO	1	JMR	x		x	x		x	x	x	

MCP Level Needed: GEI requires the most stringent Method 1 MCP standard be met for all analytes whenever possible.

Relinquished by: (signature)	Date :	Time:	Received by: (signature)
1. Joseph M. [illegible]	12/30/09	16:30	1. GEI FRIDGE
2. GEI FRIDGE	1/4/10	1310	2. Naomi [illegible]
3. Naomi [illegible]	1/4/10	1310	3.
4.			4.

Turnaround Time (Business days):

Normal __X__ Other _____
10-Day _____ 7-Day _____
5-Day _____ 3-Day _____

Before submitting rush turnaround samples, you must notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

Please use MA Landfill List

* Please run TCLP analysis for RCRA 8 Metals results that exceed the 20 times rule.

** Please use % solids sample for VOC and VPH analysis of 093400-LS6-COMP (FILL), 093400-LS6-COMP (NATIVE), 093400-LS8-COMP. and 093400-LS9-COMP

Chain-of-Custody Record

Laboratory:

Laboratory Job #
(Lab use only)

GEI Consultants
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
PH: 860.368.5300
FX: 860.368.5307

Project Information

Project Name/Number:	**Project Location:**
Project Contact:	**Phone Number:**

Page __ of __

Send Report to:

Send EDD to: datagroup@geiconsultants.com

Preservative

Analysis

Sample Handling

Samples Field Filtered
YES NO NA

Samples Shipped With Ice
YES NO

Deliverables:

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Lab Sample Number	GEI Sample ID	Collection		Matrix	No. of Bottles	Sampler(s) Initials										Sample Specific Remarks
		Date	Time													

Relinquished by sampler: (signature) 1.	Date :	Time:	Received by: (signature) 1.
Relinquished by: (signature) 2.	Date :	Time:	Received by: (signature) 2.
Relinquished by: (signature) 3.	Date :	Time:	Received by: (signature) 3.
Relinquished by: (signature) 4.	Date :	Time:	Received by: (signature) 4.

Turnaround Time (Business days):

Normal _____ **Other** _____
10-Day _____ **7-Day** _____
5-Day _____ **3-Day** _____

Before submitting rush turnaround samples, you **must** notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

1/17/2011
H:\STAFDATA\Data Management\Procedures\Chains-of-Custody (COCs)\Chain of Custody_Atlantic 2010.xls

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY

A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.

B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.

C. Place double bagged or loose ice randomly around bottles throughout the cooler.

D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.

E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.

F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY

A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.

B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.

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F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

STANDARD OPERATING PROCEDURE

FD-004 Photo Documentation

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1. Objective

Describe methods to document and retain photographic records.

Keeping a record of photographs taken is crucial to their validity as a representation of existing conditions.

2. Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- Set the camera to record the time and date for each photograph.
- All photographic records, along with the following information, should be recorded in the field notebook (SOP FD-001).
    - If applicable, the compass direction describing the direction the photograph was taken (e.g. looking southeast). This may not apply to photographs of individual samples.
    - Brief description of what the photograph is intended to show.
- The field notebook should note who took the photographs.
- The photographs should be electronically backed up on a computer or other data storage device.
- If photographs will be used in a report, memo, or letter, they should be placed on a photograph record template and the relevant information describing the photograph should be inserted into the caption section for each photograph.

3. Limitations

- Some clients and regulatory agencies require photographs of every subsurface soil sample collected. These photographs typically include a “whiteboard” which indicates the site, the boring ID, and the depth of the sample, while logging details are recorded in the field notebook. Under these circumstances, it is not necessary to include compass directions or descriptions.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

5. Attachments

Attachment A – Example of Photo Documentation Template

6. Contact

Melissa Felter
Leslie Lombardo

Attachment A – Example of Photo Documentation Template

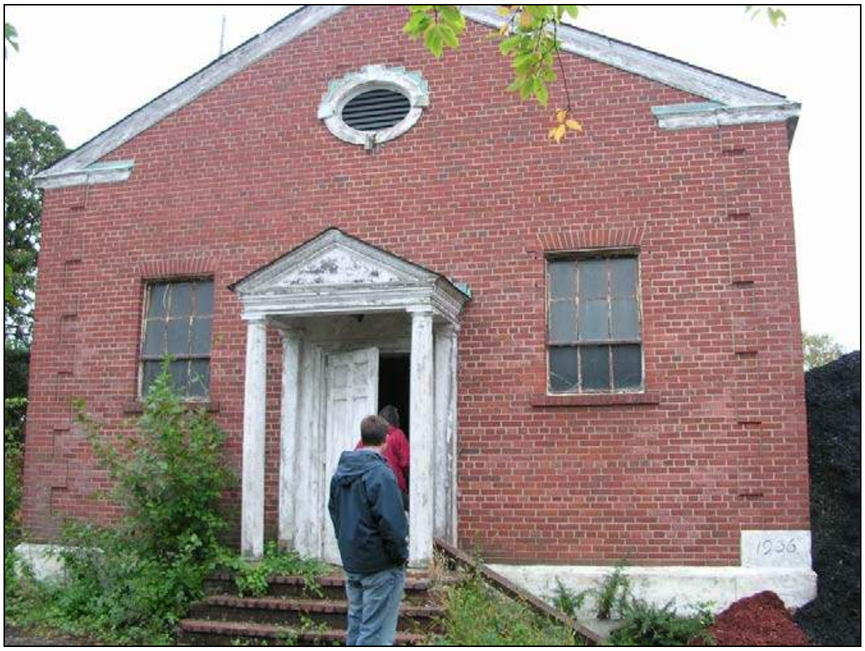
GEI Consultants, Inc.

Project: Project Name

Location: Project Location

Photographer:	K. Barber
Date:	10/25/07
Photo No.:	1
Direction:	N

Comments:
Entrance of site with tree mulching operations.



Photographer:	K.Barber
Date:	10/25/07
Photo No.:	2
Direction:	W

Comments:
On-site building built in 1936.

GEI CONSULTANTS, INC.
Environmental Standard Operating Procedures
Atlantic and New England Regions

SOP No. FD-006
Revision No. 2
Effective Date: June 2011

STANDARD OPERATING PROCEDURE

FD-006 Handheld Global Positioning Receiver Operation

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1. Objective

Use handheld global positioning system (GPS) receivers to locate sample points and site features with “Mapping-Grade” accuracy.

Use handheld GPS receivers to “stake out” proposed sample point locations within the limits of “Mapping Grade” accuracy.

2. Execution

- Handheld GPS receivers provide a low-cost and user-friendly method for locating sample points and site features with a fair degree of horizontal accuracy.
- In simplistic terms, GPS works by measuring the distance from numerous orbiting satellites to a point on the earth surface. Individual satellites broadcast their real-time location in terms of x,y and z coordinates, and the distance from each satellite is measured as a function of the length of time that a time-stamped signal takes to reach the receiver. Built-in GPS software derives new points by intersecting the distances from known orbital locations – in much the same way that points are located by intersecting tape-measured distances from building corners or other pre-existing site features.
- Late-model handheld GPS receivers utilize a real-time differential correction technique called WAAS (Wide Area Augmentation System). This system was designed to provide greater confidence and reliability in using GPS data for commercial aircraft landing approaches, and the additional correction improves all GPS operations.
- Handheld GPS receivers display navigational information on a variety of standard pages. Although each manufacturer uses slightly different formats, all receivers toggle back and forth between the following visual presentations:
- A “satellite” page displays the relative orbital location of all GPS satellites that are currently being tracked by the receiver. The display may include information on the real-time geometrical strength of the solution: satellite intercepts that cross at right angles provide more accurate solutions than intercepts that cross at acute or obtuse angles.
- A “track” page that displays the travel path of the receiver while it is turned on, along with the relative location of recorded points. Many GPS models have a “track-back” function that will guide the user on the same path back to the starting point
- A “navigation” page that displays instantaneous location and the real-time direction and velocity of travel. Some units provide two pages to display this information in different formats. Most units will report the overall “course

made good" (straight-line bearing and distance from the starting point) at any point.

- A "waypoint" page that allows users to "Go To" a created point or previously recorded point by providing a straight-line bearing and distance to the point. The information is instantaneously updated as the user moves along; some units display a pointing arrow that directs the user to the direction of travel. Be careful of go-to lines that lead through swamps or over cliffs – if you will be travelling in difficult terrain have a paper copy of the USGS quadrangle and a compass on hand for navigation.
- Signal strength degrades significantly next to buildings and underneath tree canopy. Most GPS receivers have an "averaging" function to improve the accuracy of shielded locations. GPS users can also improve precision by locating points three times, at different times of the day. Two of the solutions will generally be closer to each other than to the third and can be averaged for a more reliable fix.
- Most GPS receivers default to latitude and longitude, but data is more accurate and easier to input and when expressed in UTM coordinates to the nearest meter. The handheld GPS setup will have a function somewhere to change to UTM. Most of Connecticut is in UTM Zone 18 but the easternmost parts are in Zone 19.
- Consult "Corpscon" the datum translator available from the National Geodetic Survey website. Corpscon translates instantly from latitude/longitude to UTM coordinates to state plane coordinates and provides tools to identify UTM Zones. Also consult the Trimble, Garmin and Magellan websites for technological improvements and discussion of advanced techniques.

3. Limitations

- Handheld GPS receivers operating in unobstructed locations are currently reckoned to provide 2-5 meter accuracy, meaning that the true location of measured points lie within an "error ellipse" with axes of 2-5 meters centered on the measured location. In other words, even under the best of conditions a real-time GPS solution may be as much as 20 feet off the true horizontal location of a point.
- Due to geodetic restrictions, vertical locations (elevations) have less than half the accuracy of horizontal locations, meaning that even under the best of conditions, a surface elevation displayed on a handheld GPS receiver may be off by more than 50 feet.
- Horizontal and vertical data derived from handheld GPS receivers should never be considered more than relatively accurate, and this level of uncertainty should be identified in any discussion of positional tolerance.

4. References

Trimble Website: .trimble.com
Garmin Website: .garmin.com

Magellan Website: **.magellan**gps.com
National Geodetic Survey: ://www.ngs.noaa.gov/

5. Contact

Doug Bonoff, PLS

STANDARD OPERATING PROCEDURE

GW-001 Water Level and NAPL Measurement

1. Objective

Describe procedures to measure the depth to water and non-aqueous phase liquid (NAPL) thickness in an open borehole, cased borehole, monitoring well or piezometer.

2. Equipment and Materials

Field forms and/or field notebook.

- Decontamination fluids
- Bailer
- Weighted cotton string
- Oil/Water interface probe
- Water level meter (if oil/water interface probe is not available)

Water level and NAPL measurements can be collected by a variety of methods. A water level meter is used to collect depth to water measurements however an oil/water interface probe or other methods must be used to gauge NAPL depths. An electronic oil/water interface meter, consists of a cable divided into incremental measurements of 0.01 feet, and probe that consists of an infra-red circuit that detects the presence of a liquid, and a conductivity circuit that differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or dense non-aqueous phase liquid [DNAPL] product). Typically, a steady tone and light indicate a non-conductive liquid (e.g. product) and an intermittent tone and light indicate a conductive liquid (e.g. water). Refer to the manufacturer's instructions for details. Alternately, water level and NAPL measurements can be collected using a water level meter, clear bailer and weighted cotton string. Each method of data collection is described below.

3. General Information

- The water level in a monitoring well or piezometer should be allowed to stabilize for a minimum of 24 hours after development or construction before groundwater elevation and/or NAPL measurements are collected. The water level in a borehole can be measured during drilling; however, this should be noted in the field notebook.
- Water levels in multiple wells should be collected within the shortest timeframe practicable.
- Water and NAPL levels should be measured from the designated survey point as specified by the surveyor or highest point (or “V” notch) on the PVC. If the well is new, mark the datum point with an indelible marker and note reference location in

field book. Discuss with the project manager what reference point should be used to collect water measurements for specific sites.

- Water level and/or NAPL measurements should be made before any water is removed from wells because doing so may influence groundwater levels in the area of the investigation.
- Measurements should be made approximately three times to confirm the measurement. Each time a measurement is made it should be determined to the nearest one-hundredth of a foot (0.01).
- Water level and/or NAPL measurements should first be collected at the wells that are least contaminated and proceed towards the wells that are most contaminated. Decontaminate the water level meter or oil/water interface probe prior to initial use and after use at each location. If NAPL is encountered at a well where it was previously not observed, contact your project manager before continuing.
- Refer to the oil/water interface probe or water level meter instruction manual for guidance on indicator signals, as these may differ by manufacturer.

4. Execution

4.1 Water Level and NAPL Measurements Using Interface Probe

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- LNAPL Depth (if present): Measure the LNAPL/air interface by slowly lowering the interface probe to the LNAPL surface. Be ready to stop as soon as the probe signals the LNAPL surface.
- Record the depth to LNAPL.
- Groundwater Depth: Continue slowly lowering the probe until it signals the presence of water.
- Record the depth to water.
- The LNAPL thickness is determined by subtracting the water depth from the LNAPL depth.

The depth and thickness of DNAPL can sometimes be determined by slowly lowering the interface probe past the LNAPL (if present) and water layers. Record the depth to the DNAPL layer. Finally, measure the depth to the well bottom.

The DNAPL thickness is determined by subtracting the DNAPL depth from the depth to well bottom.

- Decontaminate the interface probe and tape according to SOP QA-001.
- Dispose of any NAPL-impacted debris properly.
- Check with the Project Manager if you are uncertain of the appropriate disposal method.

4.2 LNAPL Measurements Using Clear Bailer

If LNAPL is suspected at a site, an oil/water interface probe should be used when gauging water level and NAPL measurements. However, a water level meter and a clear bailer may be used instead to estimate approximate LNAPL thickness if an oil/water interface probe is not available.

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- Slowly lower the water level meter until contact with fluid is indicated by the meter.
- Record the depth to fluid measurement.
- Lower a clear bailer into the well and slowly into the LNAPL. Do not submerge the bailer.
- Slowly raise the bailer out of the well and measure LNAPL thickness in the bailer using a ruler or tape measure.

Calculating Depth to Groundwater

The depth to water can be calculated as follows:

DTW = DTF + PT
DTW = Depth to Groundwater
DTF = Depth to Fluid
PT = Measured Product Thickness

Calculating Corrected Depth to Groundwater

Once the LNAPL thickness is known and the depth to groundwater is known, the corrected depth to groundwater can be calculated.

Corrected DTW = Static DTW – (PT x G)
DTW = Depth to Ground Water
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4.3 DNAPL Measurements Using Weighted Cotton String

A weighted cotton string may be used to estimate approximate DNAPL thickness.

- Secure cotton string.
- Secure clean steel nuts and/or washers.

- Tie the string to the nuts/washers, so that there is adequate weight.
- Lower the weighted string into the well slowly, until a firm bottom is sensed.
- Remove the weighed string and measure the DNAPL coated portion of the string.
- Record the thickness.
- Dispose of any NAPL-impacted debris properly. Check with the Project Manager if you are uncertain of the appropriate disposal method.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

6. Considerations

- Weak batteries in water level and oil/water interface meters frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water or NAPL. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Electronic oil/water interface meters do not respond to distilled water. Do not use de-ionized water to test these units.
- Wells that are not vertical may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface. The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe and tape may need to be retrieved and dried off before trying again.
- Accumulation of sediment, organic material, or floating debris in the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible ground water-level measurements because the inner sides of the well casing are conductive.

- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that it cannot contact the inner casing.
- Well gauging equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Water levels in wells may be influenced by changes in river stages, pumping of nearby wells, precipitation, tides, etc.
- Using a bailer to estimate LNAPL thickness can result in inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.
- The optical sensor on interface probes may become damaged if solvents are used to clean NAPL from the probes.
- The optical sensor may become smeared when used to measure NAPL, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.
- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPL can pose a problem when measuring the level of groundwater. Floating LNAPL can depress the groundwater level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown above should be applied to groundwater level measurements in monitoring points where LNAPL are present:
- Some interface probes are factory-calibrated based on an assumed conductivity of NAPL and water, both of which may vary. An interface probe that is functioning properly may not be able to discern different NAPLs at all sites.
- An interface probe may not successfully provide both LNAPL and DNAPL measurements in the same well because the probe is coated by LNAPL and loses its ability to detect DNAPL.
- DNAPL, in particular, may be only slightly heavier than water, or may be neutrally buoyant. As a result, it can be easily disturbed. Once it is disturbed, meaningful measurements can be difficult or impossible to obtain. As such, all tapes or probes used for measurements should be used slowly.

7. References

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 2/11/00

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2044," Monitor Well Development" REV: 0.1, 10/23/01.

8. Contacts

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STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

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1. Objective

Describe methods to collect groundwater samples most likely to produce results that represent aquifer conditions, primarily collected from either temporarily or permanently installed groundwater monitoring wells. Groundwater sampling may be required for several reasons including, but not limited to, investigating potable water supplies, investigating a site where groundwater is thought to be impacted, and assessing site impacts and contaminant plume migration.

Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Execution

- Site plans, well logs and previous sampling/purging data and field notes should be reviewed prior to implementing the field program if available.
- Prior to groundwater sampling consult with the Project Manager to confirm that the sample collection device/pumping method is appropriate and consistent with the approved work plan.
- Record activities in the field notebook (see SOP FD-001 Field Notebook) and on a Monitoring Well Sampling Record such as the examples in Attachment A. Use a separate form for each sampling location and event. You may forego the forms and record all information in the field notebook if the Project Manager approves. Similarly, you may forego the field notebook and record all information in the forms if the Project Manager approves.
- Calibrate pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) on the meter(s) (if monitoring water quality indicator parameters). Use calibration methods provided by the manufacturer of the equipment. Note that appropriate calibration for dissolved oxygen requires a water saturated air environment, along with measured temperature and barometric pressure.
- Begin with the monitoring well believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater to reduce cross-contamination potential. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Slowly and gently measure the depth to water with a water level probe and/or oil-water interface probe. Measure water level in accordance with SOP GW-001 Water Level Measurement.

- Attach new polyethylene or Teflon lined tubing to the sampling pump and the flow-through cell that contains the meter probes unless dedicated tubing is present in the well.
- Slowly and gently insert new polyethylene or Teflon lined tubing to the pump intake (or use dedicated tubing that remains in the well) and to the middle of the saturated screened interval or to the pre-determined sampling depth.
- The tubing intake should be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well.
- If possible, position your sampling equipment and tubing so that it is in the shade. The goal is to minimize the effect of sunlight raising the temperature of water being collected.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less is desirable but not mandatory). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure flow rate on the pump or by using a graduated container and record.
- While purging, record water levels and, if appliable, monitor and record the water quality indicator parameters: pH, temperature, specific conductance (SC), dissolved oxygen (DO), and turbidity. If specified by the Project Manager, also include ORP.
- Purging is complete when three times the volume of water in the well has been removed.
- If purging three well volumes is not practical, the Project Manager may elect to monitor water quality indicator parameters. Stabilization is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:

    - pH (+/- 0.1 standard units)
    - temperature (+/- 3%)
    - SC (+/- 3%)
    - turbidity (+/- 10% if >5 NTU; if 3 values are <5 NTU, consider the values as stabilized)
    - DO (+/-10% if >0.5 mg/L; if 3 values are <0.5 mg/L, consider the values as stabilized)
    - ORP (+/- 10 mV)

- Dispose of purge water to the ground adjacent to the well or to a specified container as directed by the Project Manager.

Sample Collection:

- Following purge, remove the discharge tubing from the flow-through cell. Do not disturb pump and tubing between stabilization and sample collection.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds (VOC) samples are collected first; see SOP SC-002 Sampling Handling). Fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to the steady state purge rate.
- If not using a dedicated pump, remove sampling device and decontaminate (see SOP QA-001 Equipment Decontamination). Discard used tubing.
- Store samples in a cooler on ice for transport to the laboratory.
- Secure the well cap.

3. Limitations

- Due to the nature of the well, purging and monitoring water quality indicator parameters for stabilization may not be practical when sampling temporary monitoring wells. Consult with the Project Manager prior to mobilization to determine feasibility of purging and/or monitoring stabilization parameters when sampling temporary monitoring wells.
- When monitoring water quality indicator parameters, if parameters do not stabilize after 2 hours, contact the Project Manager. Three options will be available: 1) continue monitoring until stabilization; 2) discontinue monitoring and do not sample; or 3) discontinue monitoring and sample.
- Prior to departure for the field, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If possible, when using dedicated equipment, install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Consult with the Project Manager before field filtering samples for metals if using low-flow sampling.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (2010), EQASOP-GW 001 Low Stress (Low Flow) SOP, Revision 3, U.S. Environmental Protection Agency, Region I, January 19, 2010.

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contacts

Brad Dal Santo
Ken Kytta

7. Revision Log

Revision No.	Date of Revision	Individual Sections Revised	Comments
0	11/11/2024		BJD

Low-Flow Groundwater Sampling Form

Project number and name ____________________ Sampling personnel ____________________ Sample date ____________ Well ID ____________

Well location description: ____________

Well Construction

Well diameter ____________

Well measurement point ____________

Roadbox condition ____________

Well screen interval ____________

Well depth ____________

Sampling Information

Initial depth to water ____________ Time: ____________

Sample intake depth ____________

Pump type and ID ____________

Stabilized flow rate ____________

Stabilized flow rate = flow rate with no further drawdown

Samples Collected

VOCs 8260 ☐

SVOCs 8270 ☐

VPH ☐

EPH ☐

Metals ☐

PCBs ☐

Other ☐

Field values at time of sample collection:

Time: ____________ Depth to water: ____________

Sp.Cond. ____________ mS/cm

DO ____________ mg/L

ORP ____________ mV

pH ____________ s.u.

Temp. ____________ °C

Turb. ____________ NTU

Cumulative Time (min.)	**Volume (gal)**	**Water depth (ft)**	**Temp. (^{o}C)**	**Sp.Cond. (mS/cm)**	**D.O. (mg/L)**	**pH (s.u.)**	**ORP (mV)**	**Turb. (NTU)**
Typical Groundwater Values			5 to 15	0.05 to 5	0 to 4	5 to 7	-100 to +500	aim for <10

Notes: ____________

Sample Information:

Sample ID ____________

Sample Time: ____________

Color: ____________

Turbidity: ____________

Field Filtered YES / NO Analyses: ____________

Filter type: ____________

Odor/Sheen/NAPL ____________

Duplicate Collected YES / NO

If yes, duplicate ID: ____________

Purge water disposal? to ground drummed other:

Well Volume Conversion:

Diam. (in)	Factor (gal/ft)
1	0.04
1.5	0.09
2	0.16
4	0.65
6	1.50

well volume =
3.14 x (r)^2 x 7.48 gal/ft
where r = 1/2 diameter in ft

Stabilization Criteria:
Sp.Cond. +/- 3%
DO +/- 10%
ORP +/- 10 mV
pH +/- 0.1 Std Units
Temp. +/- 3%
Turb. +/- 10% if values >1 NTU

Guidance:

1. Position tubing at midpoint of saturated screened interval
2. Minimize drop in water level and purge until parameters are stable
3. Disconnect flow thru cell during sampling
4. Call Project Manager if issues arise (e.g. stabilization takes more than 2 hrs, well goes dry, odd data).
5. For VPH and VOC samples, if stabilization flow rate is less than 200 ml/min, contact PM

STANDARD OPERATING PROCEDURE
GW-009 Potable Well Sampling

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1. Objective

Describe methods to collect a drinking water supply sample and to reduce the bias of system related variables (pumps, piping, holding tanks, etc.).

2. General Information

- Inquire if any treatment units are used on the system. Softening (pH adjustment), iron removal, turbidity removal, and chlorination are often used; these may give misleading results depending upon the parameters of interest. Consult with the Project Manager if these treatment units may affect the sample to be collected.
- Home carbon filters used for the removal of organics have become increasingly popular. Basement and outside faucets may by-pass such treatment systems.
- Important considerations to record in the field book, if available, are:
    - Well driller and date drilled
    - Construction of well and casing depth
    - Well and pump location
    - Well depth and pump capacity (if available)
    - Storage tank capacity
    - Treatment or conditioning unit (if any)
    - Plumbing arrangement
    - Possible sample collection points
    - Distance of well to any septic systems or underground storage tanks
    - Aesthetic information (color, odor, observed suspended material)
- If possible, obtain the name(s) of the resident or water supply owner/operator, the resident's mailing address, and the resident's home and work telephone numbers. The information is needed so that the residents or water supply owner/operators can be informed of the results of the sampling program.
- For long term monitoring projects a specific tap or faucet should be designated as the target sample access point for consistency and data comparability of future samples.

3. Execution

- If possible, collect the sample from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units.
- It may not be possible to collect the sample at or near the well head or pump house.
- If the sample must be collected at the downstream side water tanks/system equipment, calculate the volume of water in the system prior to the sampling point. For example, if the closest sampling point follows a 30-gallon pressure tank and four gallons of water in the piping then a 34-gallon volume should be recorded.

- If possible, purge at least three volumes of water in the system prior to the sampling point. This allows a complete exchange of fresh water where the sample is collected and avoids sampling stagnant water.
- If the volume of water cannot be determined or the owner prohibits purging, then a 15-minute purge time should be used. The Project Manager should be informed that the sample was collected in this manner and the information should be recorded in the field book.
- Home faucets, particularly kitchen faucets, usually have a screen (aerator) installed on the discharge. The screen must be removed prior to sampling for bacteria or for volatile organics, since the screen tends to aerate the water and some organics may be lost. Also, when sampling for bacteria, do not take a sample from a swivel faucet since the joint may harbor a significant bacterial population.
- Open several taps during the purge to ensure a rapid and complete exchange of water in the tanks and reduce system backflow.
- After purging for several minutes, measure the turbidity, pH, specific conductivity, and temperature of the water. Continue to monitor these parameters until three consistent readings are obtained. Consistent readings means:
    - pH remains constant within 0.1 standard units.
    - Specific conductance and turbidity does not vary more than 10 percent. Turbidity readings should be below 10 Nephelometric Turbidity Units (NTUs).
    - Temperature remains constant.
- After three consistent readings have been obtained, collect the sample.
- If consistent readings cannot be attained, but adequate volume has been purged, collect the sample.

4. Limitations

- When sampling for bacterial content, the sample container should not be rinsed before use due to possible contamination of the sample container or removal of the thiosulfate dechlorinating agent (if used).
- Homeowners' plumbing systems should not be tampered with in any way except for removal of the faucet screen (aerator) with permission of the homeowner.
- When filling any sample container, care should be taken that no splashing drops of water from the ground or sink enter into either the bottle or cap.
- When sampling at a water treatment plant, samples are often collected from the raw water supply and the treated water after chlorination.
- Do not remove the pump from a homeowner's well unless the removal is authorized by the homeowner and is performed by a licensed pump installer.
- Continually running wells do not require purging and can be sampled immediately.

5. References

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6. Contacts

Brad Dal Santo
Ken Kytta

7. Revision Log

Revision No.	Date of Revision	Individual Sections Revised	Comments
0	11/11/2024		BJD

STANDARD OPERATING PROCEDURE

GW-010 Slug Tests

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1. Objective

Describe methods to use slugs, pressure transducers, and data loggers to collect data that will support calculation of horizontal hydraulic conductivity of distinct geologic strata.

General Information

Slug tests are performed on single monitoring wells to estimate the hydraulic conductivity of the aquifer in which the well is screened. The test consists of adding or removing a known volume (slug) to or from the well to instantaneously change the water level. Subsequently, the recovery of the water level back to the static water level is measured. The resulting data are used to determine the hydraulic conductivity of the aquifer test zone using an appropriate analytical method.

Falling head tests can only be performed in fully-penetrating wells (well screened completely below the water table). Rising head tests can be performed in both fully- and partial-penetrating wells.

2. Execution

2.1 Setup

- Determine how water levels will be recorded. If the geologic materials in the test zone are expected to be slightly permeable (e.g., a glacial till or clay), then measurements may be recorded manually with an electronic water level indicator. If the geologic materials in the test zone are expected to be moderately- or highly-permeable (e.g., outwash sands), record measurements using a pressure transducer attached to an automatic data logger.

  The remainder of this SOP assumes that an automatic data logger is being used to measure water levels.

- Check to see if test equipment functions prior to leaving for the site.
- Decontaminate the transducer and cable using alconox and distilled water. Do not use methanol. Do not use transducer in wells containing non-aqueous phase liquid (NAPL).
- Make initial water level measurements
- Test wells in the following order: from the least contaminated to the most contaminated, and from low to high expected permeability, where possible.
- Measure the static water level (i.e., depth to water) in the well to be tested manually using an electronic water level indicator. Record all

measurements taken during the test in the field log book or on the attached log form.

- Install the pressure transducer as far below the deepest point of insertion of the slug bar or bailer as possible. Allow the transducer to thermally equilibrate for 15 to 30 minutes (to allow instrumentation wiring to expand/contract) before measurements are taken.
- Secure the transducer cable at ground surface with tape or weight to keep the transducer at a constant depth.
- Cover sharp edges of the well casing with duct tape to protect the transducer cables.
- Transducer measurement setup: For wells screened in sand and silty sand, a linear setting of one reading per second is generally used. In coarser soil where full recovery may occur over a few seconds, a linear setting for more frequent readings is necessary. If a transducer is used for silt and clay, a linear setting of one reading per minute, or a logarithmic setting, may be used to avoid risk of exceeding the memory capacity of the transducer.

2.2 Field Procedure – Rising Head Test

In this test, a slug is inserted in the well prior to the test and the water level is allowed to return back to static level. The test is then started by removing the slug from the well and immediately measuring rising water levels. In wells where recovery is slow, this test can be performed by pumping or bailing water from the well and immediately starting measurements.

- Record the initial water level and other setup information on the attached form.
- Fully submerge the slug bar or bailer into the water column of the well.
- Allow the water level in the well to return to static condition after both the slug and transducer have been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to static condition, start the transducer (“Start Test” if using Win Situ software). Periodically view graphical data during the test, to confirm adequate data collection.
- Rapidly remove the slug bar or bailer from the water column and well. Avoid moving or pulling up the transducer cable when removing the slug.
- Continue recording water levels with the transducer until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect measurements every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

2.3 Field Procedure – Falling Head Test

In this test, a slug is inserted in the well at the start of the test and the falling water levels are measured immediately. In wells where recovery is slow, this test can be performed by adding water to the well and immediately starting measurements.

- Record the initial water level and other set up information on the attached form.
- Allow the water level in the well to return to static conditions after the transducer has been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to a static condition, begin recording transducer readings ("Start Test" if using Win Situ software).
- Fully submerge the slug bar or bailer into the water column of the well.
- Periodically view graphical data during test, to confirm adequate data collection. The transducer should continue to record water levels until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect a measurement every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

3. Additional Information

- Do not perform hydraulic conductivity tests on wells that have not previously been developed and allowed to equilibrate.
- It is critical to either add or remove the slug to the well as quickly as possible and to start collecting depth-to-water measurements immediately.
- The early-time data is critical because the rate of recovery of head in the well is exponential. Collect measurements frequently at the start of all variable head tests.
- The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation, and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. Two bailers connected in series can be used to increase the slug volume, provided the water column is deep enough.
- Decontaminate all down well equipment before using it in the well.

- NAPL will damage the transducer. Gauge recovery manually in these instances.
- Where possible, take periodic water level readings manually during recovery. The manual data are used to check for transducer noise or movement.
- If using automatic data loggers, download the data as soon as possible. Batteries in the data loggers may run down and result in a loss of data.
- Be prepared to containerize water generated from rising head tests if the water is contaminated.
- Where possible, take more than one pressure transducer to site. This will provide backup and allow testing of multiple wells simultaneously.

4. Calculations

The simplest interpretations of piezometer recovery are Hvorslev (1951) and Bouwer and Rice (1976). The analyses assume a homogenous, isotropic medium in which soil and water are incompressible. Spreadsheets and software are available to calculate hydraulic conductivity from slug test data according to the methods below.

Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (L/R)}{2\, L\, T_0} \qquad \text{for } L/R > 8$$

where:
K = hydraulic conductivity [ft/sec]
r = casing radius [ft]
L = length of open screen (or borehole) [ft]
R = filter pack (borehole) radius [ft]
$\boldsymbol{T_0}$ = Basic Time Lag [sec]; value of t on semi-logarithmic plot of $H-h/H-H_0$ vs. t, where H-h/H-Ho = 0.37
H = initial water level prior to removal
of slug
$\boldsymbol{H_0}$ = water level at t = 0
h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bouwer-Rice expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (R_e/R) \ln(h_o/h_t)}{2\, L\, t}$$

where:
r = casing radius [ft]
t = time of drawdown measurement since start of test [sec]

h = drawdown of water in well at time = t [ft]
h_o = drawdown of water in well at t = 0 (initial drawdown) [ft]
L = length of open screen (or borehole) [ft]
R_e = effective radius (radius of influence) [ft]
R = gravel pack radius [ft]

Both the Hvorslev and Bouwer-Rice methods can be applied for partially-penetrating wells. Hvorslev is generally applicable only to fully penetrating wells.

5. References

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U. S. EPA ENVIRONMENTAL RESPONSE TEAM STANDARD OPERATING PROCEDURES SOP: 2046,"Slug Tests" REV: 0.0, 10/03/94

6. Attachments

Attachment A – Slug Test Data Form

7. Contacts

Andy Adinolfi
Saskia Oosting

Attachment A. Slug Test Data Form

SITE ID: ________________

SLUG TYPE (solid/bailer/pumped)

LOCATION/WELL ID ___________

SLUG DIAMETER: _____________

DATE: ______________________

SLUG LENGTH: _____________

FIELD PERSONNEL: ______________

____

METHOD:

RISING HEAD ____________

FALLING HEAD __________

DATALOGGER TYPE:

____

____

COMMENTS:

____

____

==

SETUP

Time _______________
Depth to Water - Initial Static (before installing troll/slug) ___________
Confirm well recovers to static after installing slug, or note otherwise
____

==

MANUAL CONFIRMATORY MEASUREMENTS

ELAPSED TIME (min.)	DTW	ELAPSED TIME	DTW
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________

Form based on:
USEPA, 1994; Sanders, 1998.

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

---

1. Objective

This SOP describes methods used to decontaminate reusable sampling equipment for projects that require collection of organic and inorganic analytical samples. The goal is to minimize cross-contamination between samples. This maximizes confidence that field samples will be representative of specific locations and conditions.

Refer to the work plan or project manager to determine if different decontamination methods are acceptable.

2. Execution

- All contractor-provided equipment (augers, rods, spoons, backhoe buckets) should be decontaminated by steam cleaning or pressure washing prior to coming on site. If there is doubt about cleanliness of drilling tools, they should be decontaminated before use at the site.
- Sampling equipment decontamination is a sequential procedure consisting of the following steps:

    - Alconox-solution wash (or equivalent non-phosphate detergent)
    - Potable water rinse
    - A ten percent reagent grade nitric acid wash should be used to strip potential inorganic contaminants from sampling devices.
    - Laboratory grade 100 percent methanol, should be used to strip potential organic contaminants from sampling devices.
    - Three distilled/deionized water rinses.

- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution to remove visible contamination or dirt from sampling devices.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The procedure follows:

    - Overall wash and scrub in a bucket of Alconox solution
    - Potable water rinse.
    - 10% nitric rinse
    - 100% laboratory grade methanol rinse
    - Three distilled-water rinses.

  The same procedure is applied to all devices that may contact soil or groundwater slated for analytical samples - spoons and knifes used to inspect or sample soils; water level indicators; oil/water interface probes.

Equipment used for well development of multiple wells must be decontaminated between wells.

Pumps and tubing should be flushed using a minimum of one gallon of Alconox-solution followed by a gallon of potable water. Some projects may require methanol (in much lower quantities) and distilled water instead of or in addition to the Alconox-solution and potable water.

For pumps and tubing, a final rinse of the sampling equipment may be performed with the water being sampled.

Equipment blanks measure the effectiveness of the decontamination procedures. Blanks should be collected per guidance provided in QA-002, Field Quality Control Samples.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- Decontamination procedures may also require modification based on state or federal requirements.
- Steam cleaning or pressure washing with potable water is generally an acceptable decontamination method for drilling equipment (i.e., augers). Check with the work plan.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1.September 1999.

5. Contacts

Brian Conte
Bill Simons

STANDARD OPERATING PROCEDURE

QA-002 Field Quality Control Samples

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1. Objective

Field Quality Control (QC) samples are used to monitor the reproducibility and representativeness of field sampling. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, equipment blanks, and field duplicates.

2. Execution

2.1. Trip blanks

- Used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies.
- Sample containers filled at the laboratory with analyte-free water are transported to and from the site, and are not opened until time of analysis.
- Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed.
- Generally, one trip blank per volatiles analysis (e.g. volatile organic compounds) shipment.
- Consider submitting a trip blank when sample shipment is by Fed Ex or other large carrier, or laboratory courier.
- Trip blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.2. Equipment blanks

- Equipment blanks (also known as equipment rinsate blanks) are used to monitor possible sources of contamination associated with sample collection. Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions
- Equipment blanks are collected by pouring laboratory supplied or distilled or deionized water over sampling tools that have been decontaminated per the work plan, into sample containers.
- Equipment blanks are stored with the associated field samples until submitted for analysis.
- Generally collected when site conditions indicate site related contamination is a concern. Check project-specific work plan and/or quality assurance project plan for required frequency.
- Prepare equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
- Prepare equipment blanks by rinsing the decontaminated sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers.

- If a potable water rinse is the typical final step, collect the equipment blank with analyte-free water after the potable water rinse.
- Equipment blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.3. Field Duplicates

- Used to evaluate the precision and representativeness of the sampling procedures.
- Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.
- Field duplicates from groundwater sampling for all analyses except volatiles analysis are collected by alternating filling sample containers from the same sampling device. Field duplicates for volatiles analysis are filled sequentially.
- Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations.
- Each sample is assigned different sample identifications.
- Field duplicates are generally collected at frequency of 1/20 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.
- All field QC samples should be labeled in the field and submitted “blind” to the laboratory – as if they are separate, primary samples.
- Field duplicates should be recorded in the field notebook and on the chain-of-custody that same as all other samples.
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2.4. Matrix-Spike samples (MS/MSD)

- Matrix spike and matrix spike duplicate samples (MS/MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries.
- Matrix spike and matrix spike duplicate samples are primarily used to check sample matrix interferences. They can also be used to monitor error due to laboratory bias and poor precision. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.
- Generally, the laboratory is required to extract and analyze MS or MS / MSDs at a minimum frequency of 5% of samples being analyzed for the target analyte(s). If the project or client criteria require an MS or MS/MSD, collect sufficient volume in the appropriate containers, and designate the sample to be used as the MS or MS/MSD on the chain of custody.
- Calculate the percent recovery for all spiked analytes for both the MS and MSD. For MS/MSDs also calculate the relative percent difference (RPD). The

RPD for each spiked analyte is calculated using the amount detected not percent recovery. If your data will be subjected to validation, the % recovery and the RPD will generally be determined by the validator.

2.5. Typical QA/QC Frequency

- QA/QC frequency is determined by project, client or regulatory criteria and should be verified prior to sample collection. Generally, QA/QC samples are collected according to the frequency described below:

Duplicate Samples	One per sampling event, one per 10 samples collected, or one every two weeks, whichever comes first.
Equipment Blanks	For each equipment type that is not dedicated or disposable - one per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.
Trip Blanks	One per sample delivery group, or in each cooler containing VOC soil or aqueous samples, depending on project.
MS or MS / MSDs	One MS or MS/MSD per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.

3. Limitations

- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.
- Laboratory-grade water must be used during the collection of equipment blanks.
- Field duplicates must have different sample identifications.

4. References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (November 1986), U.S. Environmental Protection Agency Department of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final, April, 1990.

5. Contact

Brian Conte
Pat King

STANDARD OPERATING PROCEDURE

SC-002 Environmental Sample Handling

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1. Objective

Describe appropriate environmental sample handling procedures.

The procedures include collection and transport of environmental samples to a laboratory for chemical analysis. Appropriate sample handling should ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported

2. Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., FedEx or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- A waterproof or permanent ink pen should be used for all labels. The label should have an adhesive backing and be placed on the jar or bottle, not on the cap. In addition, clear packing tape can be placed over the sample label to secure it to the bottle as moisture from the samples can loosen the label adhesive.
- Record the following information on the label and in the field notebook (See SOPs FD-001 and FD-003):
  - Project number
  - Sample identification (i.e. MW-201 or SS-2)
  - Date and time (military time) of collection
  - Sampler's initials
  - Analysis methods
  - Preservative, if present
- Pre-preserved laboratory jars are preferable and should be used whenever practicable. If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples should be collected in order of volatility, most volatile first. Samples collected for volatile analysis should be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis should be collected without air bubbles.
- The collection and preservation method of soil samples for volatile analysis may depend on project, client, or state regulatory requirements. Check with your Project Manager and/or SOPs SM-001 and SM-002 where appropriate.

- Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing samples in the field, specify the basis for composite (i.e. volume, weight, spoon recovery, etc.) and record in the field book the procedure for compositing the sample.
- Once samples have been collected and labeled, place samples in a cooler with sufficient bagged ice or freezer packs (blue ice) (if allowed) to chill samples to 4°C. If using ice, use double-bagged ice.
- Complete the chain-of-custody (COC) (SOP FD-003).
- If transporting the samples by way of a shipper:
    i. The sample cooler should have water drains securely sealed with duct tape, both on the inside and outside of the cooler.
    ii. Place a layer of packing material on the bottom of the cooler as a cushion.
    iii. Individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles upright in the cooler with sufficient packing material between samples to avoid breakage.
    iv. Methanol preserved samples for volatiles analysis should be packed so they remain upright with the soil completely covered by the methanol during transport.
    v. Place a layer of packing material on top of the sample bottles.
    vi. Place bagged ice or freezer packs on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
    vii. Place the completed and signed chain-of-custody form in a sealable plastic bag and place on top of the packing material in the cooler, or tape it to the inside lid of the cooler.
    viii. Fill out the appropriate shipping or courier forms and attach to the top or handle of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FEDEX, UPS, etc. with date and time). Place a signed and dated custody seal on the cooler.
- All samples should be submitted to the laboratory as soon as possible. In many cases, same day shipping will be required by the client or the project manager. Be clear on this before beginning the field work.
- A copy of the waybills should be kept by the field supervisor to track shipments if necessary.

3. Limitations

- If samples are shipped on a Friday, call the laboratory ahead of time to confirm that personnel will be at the laboratory to receive and log-in the samples.
- During warm weather, make sure to use plenty of ice in the shipping container.

- Field personnel should be aware of analyses which have short hold times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short hold times must be arranged for in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when shipping samples with short hold time to ensure the lab is prepared for these analyses.
- For glassware containing preservatives (e.g., HCl, HNO_3), take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing, if needed.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.
- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc… unless these materials are of interest.

4. References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Preservation Techniques for Volatile Organic Compound (VOC) Soil Sample Analyses, WSC#99-415. Massachusetts Department of Environmental Protection.

5. Contacts

Jennifer Belonsoff
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

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1. Objective

Describe characterization and management of Investigation Derived Waste (IDW) resulting from site investigation activities.

IDW is solid and/or aqueous waste generated during environmental site investigations.

2. Execution

- Determine the suspected contamination type and impacted media based on previous investigations, available analytical data, and/or site history.
- Consider the following when selecting IDW management option(s):
    - Anticipated volume of IDW to be generated during on-site activities
    - Potential contaminants and their concentrations
    - Proximity to population centers and the potential for unauthorized site access
    - Potential exposures to workers
    - Potential for environmental impacts
    - Community concerns
    - Potential storage areas
    - Regulatory constraints
    - Potential on-site treatment options
    - Duration of storage
    - Client concerns or requirements
- Review IDW Management Options summarized in Attachment A for each media suspected of contamination.
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- Include the selected IDW Management Option(s) in the Field Plan or other project documents.

2.1. IDW Management

The following information related to IDW management was obtained from the Wisconsin Department of Natural Resources (WDNR), Addendum to Publication RR-556, General Interim Guidelines for the Management of Investigative Waste, April 2002:

A. General - IDW management methods should be protective of human health and the environment and comply, to the extent practicable, with all applicable laws and rules, including wastewater, solid waste and hazardous waste laws and rules. As a general rule, it will be necessary to use best professional judgement, in light of the site specific conditions, to determine if a management option is protective of human health and the environment. In some instances, a variance, waiver or exemption may be available to allow certain on-site management methods, including redisposal of IDW back on the site, that normally would not be allowed under the solid or hazardous waste laws and rules. In other instances, managers may make enforcement discretion decisions. This is discussed in more detail under the next section - Complying with Requirements and Obtaining Approvals.

B. Minimization - The amount of IDW produced should be minimized as much as possible. Work plans for investigations should outline drilling and sampling techniques that minimize the generation of IDW. Non-intrusive investigation methods may be used, when such methods are considered appropriate for the site. The potential problems of managing IDW should be a factor in choosing investigative methods.

C. In-State/On-Site Policy - Management of hazardous IDW should be in accordance with our "Interim Policy for Promoting the In-State and On-Site Management of Hazardous Waste in Wisconsin", dated March 14, 1991.

D. Liquid IDW - Contaminated liquids should generally not be disposed of on the ground or back onto waste at a site. Aqueous wastes may be collected, properly characterized for possible treatment or incorporation into on-site remediation, such as for ground water or leachate, or collected for management at a permitted waste water treatment plant willing to accept these wastes, and having the appropriate approvals to do so. The preferred method for managing contaminated pump test discharges or other large volumes of aqueous wastes with low levels of contamination is to provide any necessary treatment to meet Waste Water program requirements and discharge them to surface wasters in accordance with those program requirements. It may be necessary to provide a temporary treatment unit for such discharges. Liquids generated from areas known to be free of contamination need not be handled as IDW, but should not be disposed of over areas known to be contaminated or over waste, to avoid the leaching of additional contaminants into the environment.

E. Management as Part of Remedial Action - For sites where it is known that some sort of remedial action will be conducted in the future, secure on-site storage (see the long-term storage guidelines, attachment 3) and subsequent management of the IDW through incorporation into the remedial action is preferred to off-site management, where possible. This will avoid the need for separate treatment and/or disposal arrangements. IDW (with the exception of non-indigenous IDW) generated during the course of an investigation can be considered part of the site and managed with other wastes from the site, consistent with a final remedy.

F. Field Screening - Where appropriate, field screening methods may be used to help determine if IDW contains contaminants of concern, in lieu of laboratory testing. Staff project managers should decide if field screening is an appropriate method for making this determination on a site specific basis. In many instances, field screening might be used to help reduce the number of samples requiring laboratory analysis.

2.2. IDW Containerization

IDW may be placed in an 55-gallon Department of Transportation (DOT) approved drums pending characterization and appropriate disposal.

- Each drum is labeled with the date it was filled, contents (e.g., soil cuttings), investigation location the IDW was generated at, and telephone number of the contact or owner (if in an uncontrolled or open storage area). The drum is sealed with a lid and ring assembly.
- Depending upon site usage, the drums either remain adjacent to the boring locations or are placed in secured storage on the site, at a location approved by the owner or operator of the site.

2.3. IDW Types

Considerations and guidelines for IDW management for specific field tasks are provided below.

2.3.1. Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (such as two layers of 6-ml plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.
- Backfill test pits with uncontaminated soil, unless otherwise directed by project manager.
- If directed by the Project Manager to return contaminated soil to the test pit, backfill soil in the same order as the soil was excavated from the test pit.

2.3.2. Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if it is acceptable to the client

and the governing regulatory agency. If not, IDW may be placed in an 55-gallon drums pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55-gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-I.D. augers).

- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground near the boring location, if acceptable to the client and governing regulatory agency, or containerizing the fluid in drums or tanks.

2.3.3. Well Development/Sampling

Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling should be containerized in drums or tanks or appropriately treated for disposal at permitted waste water treatment plant.

2.3.4. Decontamination Fluids

Decontamination fluids should be containerized in drums or tanks or appropriately treated for disposal at permitted waste water treatment plant.

2.3.5. Disposable Personal Protective Equipment

Disposable personal protective equipment (PPE) should be managed like any other IDW. However, with the clients' and project manager's approval, it may be removed from the site and disposed of as ordinary rubbish if it has not come into contact with contaminated materials.

3. Limitations

- The simplest IDW management option is to return the IDW to its source location.
- However, the selected IDW management options must meet state/federal regulations and have the client's approval. Consult with state/federal policies for IDW-related matters.
- The client is responsible for the disposal of IDW, should disposal be necessary.

4. References

Wisconsin Department of Natural Resources (WDNR), A Practical Guide to Green Remediation in the State of Wisconsin (PUB RR-911), January 2012

WDNR, Addendum to Publication RR-556, General Interim Guidelines for the Management of Investigative Waste, April 2002

Guide to Management of Investigation - Derived Wastes (April 1992), United States Environmental Protection Agency, Publication 9345.3-03FS.

5. Attachments

Attachment A – Summary of Investigation Derived Waste Management Options
Attachment B – WDNR Addendum to Publication RR-556, General Interim Guidelines for the Management of Investigative Waste

6. Contacts

David Terry
Leslie Lombardo

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Soil	Boring/monitoring well installation Test pit excavation Soil sampling	Return to source location immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Spread around boring, test pit, or original source location	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Containerize and temporarily store on site	Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure. Storage consistent with state/federal regulations.
		Send to off-site, treatment or disposal facility within appropriate timeframes	Requires proper shipping documents (i.e. manifest, Bill of Lading, etc.), analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Store temporarily awaiting laboratory analysis.	Storage consistent with state/federal regulations. Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure.
Sediment/Sludge	Sludge pit sampling Sediment sampling	Return to source immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Store temporarily on site.	Storage consistent with state/federal regulations.
		Send to off-site facility within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

Type of IDW	Generation Processes	Management Options	Remarks
Aqueous liquids (groundwater, surface water, drilling fluids, other wastewater)	Well installation/development Well purging during sampling Ground water discharge - pump tests Surface water sampling	Pour onto ground close to well	Non-hazardous liquids only. Should not exhibit a sheen or separate phase product. Do not discharge to the ground up-gradient of the source location. Ensure that it is permissible by local, state, and Federal regulations Is acceptable to the client, the governing regulatory agency, and the project manager.
		Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site commercial treatment unit within appropriate timeframes	Refer to State regulations for appropriate timeframe. Requires appropriate shipping documents (i.e., manifest, Bill of Lading), analytical characterization
		Send to POTW	Obtain appropriate discharge permit(s)
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. Consistent with final remedial action
		Discharge to surface water	OK if it complies with state and federal regulations. Obtain appropriate discharge permit(s).
Decontamination fluids	Decontamination of PPE and equipment	Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site facility within appropriate timeframes	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent with final remedial action
Disposable PPE	Sampling, drilling, and test pit excavation observation, other on-site activities	Store temporarily on site	Dispose of appropriately after characterization
		Place in on-site industrial dumpster	Project-specific determination required – must be acceptable to client and project manager
		Send to off-site facility within 90 days	Project-specific determination required
		Store for future treatment and disposal.	Storage consistent with state/federal regulations. Project-specific determination required

Notes:

1) PPE - personal protective equipment
2) POTW - publicly owned treatment works
3) Generation processes listed here are provided as examples.
   IDW may also be generated as a result of other site activities.
4) RCRA Container/Waste Pile/Tank requirements:
   Containers; 40 CFR 264 Subpart I and 265 Subpart I
   Waste Piles; 40 CFR 264 Subpart L and 265 Subpart L
   Tanks; 40 CFR 264 Subpart J and 265 Subpart J

Wisconsin DNR Remediation and Redevelopment Program
Publication RR-556

General Interim Guidelines for the Management of Investigative Waste

1. Addendum to General Interim Guidelines for the Management of Investigative Wastes (April 1, 2002)
2. Jan 14, 1993 Memo: General Interim Guidelines for the Management of Investigative Wastes
3. Attachment 1: Regulatory Requirements and Policies Affecting Investigative Waste (IW) management
4. Appendix A to Attachment 1: Excerpts from Omega Hills Approval
5. Appendix B to Attachment 1: EPA Publication 9345.3-03FS Facsimile: Guide to Management of Investigation-Derived Wastes
6. Attachment 2: Sampling and Testing of Investigative Wastes
7. Attachment 3: Long-Term On-Site Storage of Investigative Wastes (IW)

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Addendum to Publication RR-556
General Interim Guidelines for the Management of Investigative Waste
April, 2002

Chapter NR 718

Chapter NR 718, Wis. Adm. Code, has been promulgated since the development of this guidance. The provisions of that chapter may be applied to investigative waste soils.

Attachment 1 Statutory and Rule Cites

Some of the statutory and rule citations in attachment 1 to the guidance have changed since the guidance was issued. They're outlined below.

Solid Waste Statutes:

The solid waste statutes previously found in ch. 144, Wis. Stats. (ss. 144.43 to 144.47) are now found in ch. 289, Wis. Stats.

The definition of "solid waste" that was previously found in s. 144.01 (15), Wis. Stats., is now found in s. 289.01 (33), Wis. Stats.

Hazardous Waste Statutes:

The hazardous waste statutes previously found in ch. 144, Wis. Stats., (ss. 144.60 to 144.74) are now found in ch. 291, Wis. Stats.

Air Management Statutes:

The state statutes that provide the legal basis for the Air management program are now found in ch. 285, Wis. Stats.

Solid Waste, Hazardous Waste and Air Management Administrative Rules:

Solid waste program rules are found in the NR 500 rule series (chs. NR 500 to 590), hazardous waste program rules are found in the NR 600 rule series (chs. NR 600 to 690), and air management rules are found in the NR 400 rule series.

CORRESPONDENCE/MEMORANDUM

DATE: January 14, 1993 FILE REF:

TO: District Solid and Hazardous Waste Program Supervisors and
Bureau Section Chiefs (SW, HW & ERR)

FROM: Paul Didier - SW/3

SUBJECT: General Interim Guidelines for the Management of Investigative Waste

Contents

I. Purpose
II. Investigative Waste - Definition
III. General Management Principles
    A. General
    B. Minimization
    C. In-State/On-Site Policy
D. Liquid IW
    E. Management as Part of the Remedial Action
IV. Complying With Requirements and Obtaining Approvals
    A. Description of Requirements
    B. Variances, Waivers and Enforcement Discretion
    C. Responsibilities
V. Specific Management Principles
    A. Decontamination
    B. Sampling, Testing and Short-Term Storage
    C. Long-Term Storage
    D. Test Pits
VI. Working Group

Attachment 1 - Regulatory Requirements and Policies Affecting IW Management
    Appendix A - Excerpts from Omega Hills Approval
    Appendix B - EPA Superfund IW Factsheet

Attachment 2 - Guidelines for Sampling, Testing and Short-Term Storage

Attachment 3 - Guidelines for Long-Term Storage

I. Purpose

The purpose of this memo is to provide you with general interim guidelines for making decisions regarding the management of investigative waste (IW), produced at sites regulated by our various program authorities. The ERR program formed an investigative waste committee earlier, and some of the recommendations and materials they developed are considered in these guidelines and the attachments. It is my understanding that Mark Giesfeldt, Barb Zellmer and Lakshmi Sridharan will form a second workgroup, including District staff, to develop more specific guidance on this topic, as needed. I would like the Districts to try to implement the guidelines for a 1 year period and then provide comments to this second workgroup. If you would like to provide comments before the workgroup is formed, please send them to Gary Edelstein - SW/3.

II. Investigative Waste - Definition

For the purposes of these guidelines, IW (or investigation-derived waste) is defined to include any solid waste, including any contaminated media (soil, rock or ground water) generated as a result of typical investigative activities. This includes, but is not limited to: drill cuttings from boring or monitoring well installations, decontamination fluids from cleaning investigative equipment (i.e., drill rigs, backhoes, sampling equipment such as bailers and pumps), spoils from backhoe pits, development water, purge water, water from pump tests, excess samples and dirty personal protective equipment and clothing intended to be thrown away. For purposes of these guidelines, IW does not include any wastes from activities generated as a result of remediation activities. Remediation wastes include wastes from petroleum tank/piping excavations, petroleum tank bottoms/sludges and other wastes that are picked up, treated and returned to the site. Also, the term does not include wastes used for treatability studies, including off-site bench scale tests and on-site pilot tests. We expect to develop separate guidelines in the future addressing the management of wastes generated as a result of remedial action, treatability and pilot test activities. Some of the principles outline in these guidelines may be found to be appropriate for those wastes.

III. General Management Principles

Whenever making decisions regarding the management of IW, the following general principles should be followed:

A. **General** - IW management methods should be protective of human health and the environment and comply, to the extent practicable, with all applicable laws and rules, including wastewater, solid waste and hazardous waste laws and rules. As a general rule, it will be necessary to use best professional judgement, in light of the site specific conditions, to determine if a management option is protective of human health and the environment. In some instances, a variance, waiver or exemption may be available to allow certain on-site management methods, including redisposal of IW back on the site, that normally would not be allowed under the solid or hazardous waste laws and rules. In other instances, managers may make enforcement discretion decisions. This is discussed in more detail under the next section - Complying with Requirements and Obtaining Approvals.

B. **Minimization** - The amount of IW produced should be minimized as much as possible. Work plans for investigations should outline drilling and sampling techniques that minimize the generation of IW. Non-intrusive investigation methods may be used, when such methods are considered appropriate for the site. The potential problems of managing IW should be a factor in choosing investigative methods. For additional specific suggestions for IW minimization methods, please refer to page 5 of the attached (appendix B) U.S. EPA Superfund fact sheet, under the title "IDW Minimization".

C. **In-State/On-Site Policy** - Management of hazardous IW should be in accordance with our "Interim Policy for Promoting the In-State and On-Site Management of Hazardous Waste in Wisconsin", dated March 14, 1991.

D. **Liquid IW** - Contaminated liquids should generally not be disposed of on the ground or back onto waste at a site. Aqueous wastes may be collected, properly characterized for possible treatment or incorporation into on-site remediation, such as for ground water or leachate, or collected for management at a permitted waste water treatment plant willing to accept these wastes, and having the appropriate approvals to do so. The preferred method for managing contaminated pump test discharges or other large volumes of aqueous wastes with low levels of contamination is to provide any necessary treatment to meet Waste Water program requirements and discharge them to surface wasters in accordance with those program requirements. It may be necessary to provide a temporary treatment unit for such discharges. Liquids generated from areas known to be free of contamination need not be handled as IW, but should not be disposed of over areas known to be contaminated or over waste, to avoid the leaching of additional contaminants into the environment.

E. **Management as Part of Remedial Action** - For sites where it is known that some sort of remedial action will be conducted in the future, secure on-site storage (see the long-term storage guidelines, attachment 3) and subsequent management of the IW through incorporation into the remedial action is preferred to off-site management, where possible. This will avoid the need for separate treatment and/or disposal arrangements. IW (with the exception of non-indigenous IW) generated during the course of an investigation can be considered part of the site and managed with other wastes from the site, consistent with a final remedy.

F. **Field Screening** - Where appropriate, field screening methods may be used to help determine if IW contains contaminants of concern, in lieu of laboratory testing. Staff project managers should decide if field screening is an appropriate method for making this determination on a site specific basis. In many instances, field screening might be used to help reduce the number of samples requiring laboratory analysis.

IV. Complying with Requirements and Obtaining Approvals

A. **Description of Requirements** - Attachment 1 describes the solid waste, hazardous waste, wastewater and air management requirements that may apply to IW. Whenever IW is produced, appropriate steps need to be taken to characterize the waste to determine whether it should be handled as a hazardous waste, and to determine the options available for both the short term and long term management of that IW.

B. **Variances, Waivers and Enforcement Discretion** - For activities requiring a hazardous waste license, it may be possible to obtain a variance from that licensing requirement. In addition, in an emergency situation a waiver from any of the hazardous waste requirements may be possible (limited to 90 days in duration). For activities requiring a solid waste license, a written exemption may be possible. **In other situations, a decision may be made to use discretion and not enforce certain solid and/or hazardous waste program requirements.** Each situation must be reviewed and considered individually regarding the appropriate course of action. The following criteria should be considered when making such decisions:

1. The contaminants, their concentrations, and total volume of IW;

2. Media potentially affected (e.g., groundwater, soil) under management options;

3. Location of nearest population(s) and the likelihood and/or degree of site access;

4. Potential exposure to workers; and

5. Potential for environmental impacts.

C. **Responsibilities** - If a project manager is assigned to and is actively overseeing a project, then that person is responsible for assuring that steps are taken to properly characterize the IW, that a plan is in place for the management of those wastes, and that appropriate approvals are obtained. In all cases I expect the District Program Supervisor to be responsible for determinations on whether, for example, a license is required for a specific waste management activity, along with the other applicable requirements, and whether a variance, waiver or exemption from that licensing requirement is appropriate and possible, or whether discretion is proposed to be used to not enforce certain requirements. In cases where hazardous investigative wastes or large volumes of solid investigative wastes are to be managed or unusual or unique management principles are involved, the determination should be made in writing along with the basis for the determination.

V. Specific Management Principles

A. **Decontamination** - Equipment decontamination should occur on a pad that is lined and designed to prevent surface water from running on to the pad and to prevent contaminated liquids from running off. Generally, these pads are sloped to drain to a sump that can be pumped out into a storage tank. Often, the pads are constructed of concrete with sealed joints or with a geomembrane covered with a geotextile and gravel. At many sites, it may be necessary to construct such a pad before the investigation begins. It may be necessary to decontaminate and/or manage as waste any contaminated material from the pad once it is decommissioned.

B. **Sampling, Testing and Short-Term Storage** - Guidelines for sampling, testing and short-term storage of IW are outlined in attachment 2. Where appropriate, field screening methods may be used to help determine if IW contains contaminants of concern, in lieu of laboratory testing. ERR staff project managers should decide if field screening is an appropriate method for making this determination on a site-specific basis.

C. **Long-term Storage** - Guidelines for long-term storage are outlined in attachment 3. For hazardous IW, a storage facility license may be required for long-term storage.

D. **Test Pits** - Test pit spoils returned to the same excavation immediately (generally on the same day), where returning the spoils does not pose an increased threat to human health or the environment has been allowed in the past without meeting all approval/licensing requirements using enforcement discretion, and this should be allowed to continue.

VI. Working Group

I expect that the working group formed to develop the specific guidance on this issue will provide direction for which circumstances it is appropriate to use the various authorities to approve the management of investigative waste, and that guidance will provide the direction staff need to assure that we are being consistent state wide on this issue. I also anticipate that this group will develop the specific procedures to use in making decisions regarding the management of investigative waste.

I hope that the working group can be formed and develop the specific guidance on this topic in the next several months. In the mean time please use the general guidelines I have laid out in this memo, as you and your staff address IW management issues.

Attachs.

GAE:BJZ:MFG

cc: Solid & Hazardous Waste Program Unit Leaders, District & Central Office
Darsi Foss - SW/3
Linda Meyer, Patti Hanz, Deb Johnson, & Pete Flaherty - LC/5

ATTACHMENT 1

REGULATORY REQUIREMENTS AND POLICIES AFFECTING INVESTIGATIVE WASTE (IW) MANAGEMENT

Solid Waste Program, Ch. 144, Stats. and Chs. NR 500-520, Wis. Adm. Code

The Solid Waste Program has no regulations or guidance aimed specifically at IW. Under that program's rules and statutes, any material or media from an investigation, even if it is uncontaminated, that is generated and is to be discarded is a solid waste, because the statutory definition of solid waste (s. 144.01(15), Stats.) is very broad. The definition of disposal is also very broad and includes the replacement of solid waste in a closed landfill or other site under investigation. Chapters NR 500-520, Wis. Adm. Code, require persons to obtain a license and meet operating and design standards in order to dispose of solid waste. However, there are exemptions in the rule for the disposal of clean media in s. NR 500.08, Wis. Adm. Code, and wastewater facilities for liquid wastes are also exempt from the rule. Therefore, under the statute and rules, any on-site management of IW consisting of contaminated media or any other material must be in a licensed solid waste facility that meets all operating and design standards or, for liquid wastes, in an exempt wastewater facility. Therefore, re-disposal of such wastes in a closed landfill or disposal area is not allowed without meeting standards and obtaining a license. However, the engineering unit leaders in the program have indicated that there is no site they're aware of where excavated waste from a solid (non-hazardous) waste landfill wasn't allowed to be redisposed of. The program does have a policy (no specific policy memo, although letters and plan approvals may have mentioned it) concerning the re-disposal of solid waste at closed, covered sites. The program will generally allow waste within the site to be moved around on the site, within licensed acreage, for the purposes of grading for site drainage or cover improvement, provided the total waste volume (called design capacity) is not exceeded. Written exemptions from any program requirement, including licensing, may be granted if a written application is submitted and the applicant can show the activity will not cause environmental pollution.

State Hazardous Waste Program, S. 144.60-144.64, Stats. and Chs. NR 600-685, Wis. Adm. Code

The Hazardous Waste Program has no regulations aimed specifically at IW. The only policy memo relating to them is a 4/28/89 memo from Barb Zellmer to the District SW Coordinators specifying who makes determinations on whether a remedial action waste is hazardous. Again, there is a policy on the re-disposal of waste. This policy was documented in the September 29, 1989 closure and long-term plan approval for the Omega Hills North Landfill (appendix A). In summary, the policy generally prohibits the re-disposal of hazardous waste in closed facilities, however, the Program can review such re-disposal proposals on case-by-case basis for each remedial action or investigation proposal, accounting for the latest U. S. EPA guidance (see Superfund, below for the U. S. EPA guidance and regulations discussion).

Although not specifically aimed at IW, the Program has some important requirements that affect its management:

-The definitions of hazardous waste (HW) and solid waste. The IW must be a solid waste to be a HW. The definition of solid waste comes from the solid waste program statutes (s. 144.01(15), Stats.), so any material from an investigation is a solid waste. How a solid waste is identified as hazardous is complicated, but there is considerable guidance available on the subject from both the Program and U. S. EPA. For quick reference, one of the better guidelines is the Superfund Program's land disposal restriction (LDR) fact sheet #5. This discusses how a HW determination is made for waste managed in sites before the HW regulations took effect. There are some exceptions, but for the most part, the state HW rules identify HW the same way the federal rules do. The most notable exceptions are the state F027 and F500 waste listings and the federal TCLP rule, discussed in the next section. The F027 listing is broader than U. S. EPA's, the F500 listing only exists in the state rules and the state rules do not yet have the TCLP test.

-Generator requirements apply to IW that is hazardous. An EPA ID number must be obtained, the manifest system used and the waste must be managed at an approved HW facility. Licensed HW transporters must haul any waste if taken off-site. On-site temporary tank and container storage standards apply to waste as it is generated. Generators who fall under small quantity generator categories must comply with rules less extensive than large quantity generators (it is expected that at most remedial action sites, the amount of IW waste generated would exceed the small quantity generator amounts of 100 and 1000 kg. generated per month).

-Licensing and facility operating and design standards apply to units where HW is treated, stored or disposed of. Large quantity generators must utilize a licensed storage facility for wastes held for more than 90 days. Under a strict interpretation of the rules, any on-site management of hazardous IW (if the quantity is over 100 kg. per month) must be in a licensed HW facility that meets all operating and design standards (under certain circumstances, wastes from generators who produce <100 kg. per month may also be disposed of at a solid waste landfill approved for such disposal by the Department). Therefore, under this interpretation, re-disposal of such wastes in a closed landfill or disposal area is not allowed. Exemptions from the facility design and operating standards (but not licensing) are allowed if the applicant can show equivalent protection. Variances from licensing are allowed for up to 5 years if a hardship to any person exists, and an application is submitted showing how the facility design and operating standards will be met. The variance section has been revised, as part of the NR 600 renumbering revisions, to allow certain types of land disposal. Waivers from any requirement may be granted if an emergency condition exists. As part of the recent revisions, the waiver provision is being expanded to allow waivers for HW management as part of an immediate response to a discharge.

Federal Hazardous Waste Program

Wisconsin is authorized to implement the HW program in lieu of U. S. EPA. However, there are 2 aspects of the federal program that affect IW management that are not yet part of Wisconsin's program. These are the LDR's and the TCLP characteristic.

The LDR's apply to HW that is land disposed. Usually, the waste must be treated before disposal occurs. The requirements are complex, but guidance is available. For quick reference, the Superfund LDR fact sheet series is recommended. Again, under a strict interpretation, re-disposal of IW on-site would trigger the LDR restrictions. There is no LDR guidance that specifically addresses IW. U. S. EPA may grant several types of variances from the LDR's. For Superfund soil and debris, a treatability variance will be normally be granted if a remedy is selected that will not meet LDR treatment levels. However, even under the variance, a certain level of treatment would still be required.

The recently promulgated TCLP test brings many more solid wastes into the HW program. The leach procedure allows wastes that contain certain organics to become characteristic HW, based on the amount of organics that leach out of the waste under the test. Certain contaminated media from the federal underground storage tank program are temporarily excluded. Many IW's that would not be listed HW under the rules are now hazardous under TCLP. There is no TCLP guidance that specifically addresses IW.

Federal Superfund Program

The Superfund Program has no regulations specifically addressing the procedures for managing IW. However, this program has developed general policies on the issue. There is discussion in the proposed (53 FR 51442, 12/21/88) and final (55 FR 8755, 3/8/90) National Contingency NCP preambles on the program's policies for IW. There is a statement that all state and federal standards (applicable or relevant and appropriate requirements - ARARs) should be met for IW management, but for on-site management, "best management practices" are the rule, and compliance is only required to "the extent practicable". U. S. EPA's position is that all investigations (apparently including preremedial site inspections) are conducted pursuant to the CERCLA removal authority, and strict compliance with all standards is not required for a removal (It is important to note that Wisconsin has no equivalent authority under any of the response programs.). Under the federal policy, if IW is managed off-site, however, the facility must be approved for the waste, and in compliance with the Superfund off-site facility policy.

IW managed as part of a Superfund remedial action entirely on-site fall under the on-site permit exemption in §121(e) of CERCLA. Such actions must comply with the substantive technical requirements that are applicable or relevant and appropriate to a management method, but no federal, state or local approvals, permits or licenses are required for the on-site action.

The proposed NCP discussion gives only 2 extreme examples of how to manage IW. The first is that if the IW is from an area with significant dioxin contamination, it will be containerized, tested and managed in accordance with all ARARs. It then mentions that it is standard practice to leave IW on-site until the remedial action commences. The second example is offered as a contrast to the first, stating that the routine testing and containerization of large volumes of drilling muds and purge waters not suspected to contain hazardous substances may be unnecessary.

In January, 1992, the Superfund Program issued a quick reference fact sheet that apparently only applies to the remedial program (copy attached).

The federal preremedial program has developed a more extensive draft guidance manual addressing IW management. The draft manual has information on regulatory requirements, identification of the specific types of IW, and specific guidelines on how to manage the waste in specific situations. It is generally written to allow flexibility for investigators, consistent with the NCP preamble policies discussed above. Most importantly, it states that:

-Non-hazardous IW, including liquids, may be re-disposed of on-site, regardless of its hazard or the concentration of hazardous constituents in the waste.

-Hazardous IW may be re-disposed of on-site if it poses no immediate threat to human health and the environment, considering the potential for community relations problems with residents in the area. Hazardous organic decontamination fluids may be evaporated (small amounts), or should be disposed of off-site.

Wastewater Program

Liquid IW that is to be discharged to a surface water or sewage treatment plant (POTW) must meet this program's requirements. It should be noted that such discharges are, for the most part, exempt from regulation under the solid or hazardous waste programs.

For surface water discharges, the Wastewater program normally requires a WPDES permit be obtained and specific discharge standards be met, including standards for toxics. It is possible, following future revisions to the Department's general permit that fluids containing very low concentrations of regulated substances may be discharged without treatment or a specific permit. If the concentrations of these substances are above levels of concern, treatment will be required under the general permit, or under a specific permit for more long-term or high volume discharges, such as certain pump tests. However, a short form application for discharge is required. Any person may be issued a general permit if its requirements are met. The program has allowed "on-site" wastewater discharges that are part of a federal Superfund site remedial action to only meet the substantive requirements of a permit, and has not required specific permits for those discharges.

For POTW discharge, the state requirements are usually minimal for these types of wastes. Ch. NR 211, Wis. Adm. Code, prohibits discharges that interfere with or pass through a POTW as well as discharges that exhibit certain characteristics, i. e., explosive, corrosive, fire hazard or could cause a sewer blockage. However, the local authority that operates the facility must give permission for the discharge, and will impose pretreatment requirements, which can vary, depending on the local pretreatment ordinance, and the potential for the discharge to interfere with the

POTW's operation. The local pretreatment requirements can include specific numeric limits for specific contaminants.

Air Management Program

Very briefly, this program regulates air emissions above certain amounts. In some cases it may be advantageous to evaporate certain IW's, such as organic decontamination liquids. This may be done without controls if the emissions do not exceed certain amounts.

Appendix A
Excerpts from Omega Hills Approval

September 29, 1989

IN REPLY REFER TO: 4430

Mr. Kevin O'Toole
District Manager
Waste Management of Wisconsin, Inc.
Two Park Plaza
10850 West Park Place, Suite 1200
Milwaukee, WI 53224

SUBJECT: Conditional Approval (Modification) of the
Chapter NR 181 Closure and Long-Term Care Plan
Omega Hills North Landfill
EPA ID# WID000808568

REVIEW COMMENTS

Management of Newly Generated Waste after Covering and Facility Decontamination

Since the landfill is defined as one unit, and there are no effective barriers we are aware of to prevent hazardous constituent migration, any waste, removed from the landfill as a result of any construction, remediation or investigation must be managed as a listed hazardous waste at an on or off-site facility that is licensed, permitted or approved to accept such hazardous wastes. This is because such waste or material is a mixture of solid and hazardous waste and/or is derived from the previous disposal of listed hazardous waste (see s. NR 181.12(l)(b)2. and 4., Wis. Adm. Code). Therefore, there are no "documented non-hazardous waste areas" which would contain non-hazardous wastes we are aware of.

In view of the above discussion, any remedial or other construction work at this site will likely contaminate the equipment used for construction with hazardous constituents. Therefore, all such equipment must be subject to an approved decontamination procedure that must be developed now. The closure plan indicates such a procedure will only be developed if needed at a later date. Therefore, the determination contains a condition requiring WMI to develop and submit that procedure for approval within 30 days.

RESPONSE TO COMMENTS

On September 13, 1989, WMI submitted, through its attorneys, comments on the Departments August 14, 1989 draft determination, along with other legal documents that requested various actions by the Department. The legal documents will be responded to under separate cover. A meeting was held on September 14, 1989 to discuss certain technical issues related to the draft determination.WMI submitted additional comments related to the statistical test used for groundwater monitoring on September 14, 1989, through its attorneys. WMI submitted additional comments on the final use plan issue and a copy of an August 13, 1976 soil documentation report prepared by STS Engineers, Inc. on September 19, 1989. WMI submitted information on a site in Pennsylvania on September 26, 1989. Department staff had additional conversations with WMI staff regarding statistical analysis issues on September 28, 1989. The Departments response to all the comments, submittals (except the legal documents) and the meeting are outlined below.

Condition No. 4

This condition sets out the requirements relating to the re-disposal of wastes in the landfill that are generated from on-site remedial actions and investigations, herein referred to as the "re-disposal issue." This issue involves both Department and U. S. EPA regulations and policies. U. S. EPA's policies relating to this issue are still evolving To give a clear response to the comments, it is helpful to briefly describe both the Department's and U.S. EPA's regulations and policies.

Under s. NR 181.44(1), Wis. Adm. Code, a landfill may not operate (i. e. accept hazardous waste for disposal) without having an operating or interim license or waiver issued under ch. NR 181, Wis. Adm. Code (variances aren't available to landfills under s. NR 181.55(10), Wis. Adm. Code). In accordance with the Chapter, hazardous waste can be generated from on-site remedial or investigative activities at the landfill. Under the "derived-from" and "mixture" rules, s. NR 181.12(1)(b)4. and 2., Wis. Adm. Code, material removed from the landfill, once removed for management, are hazardous wastes if they are contaminated by hazardous constituents from the past disposal of listed hazardous wastes. A closed landfill which doesn't have an operating or interim license may not accept such material for disposal, even if the material originated there, without violating the rule. The Department has, as a matter of policy, allowed closing landfills that formerly accepted hazardous waste (the Department may allow a closing hazardous waste landfill to continue to operate and accept solid waste under s. NR 181.44(12)(a), Wis. Adm. Code) and still have open hazardous waste units to continue to accept remedial waste generated on-site without a license or waiver, but only until the open hazardous waste unit closes.

U.S. EPA's regulations are similar and require a landfill to have a permit or interim status to continue to accept hazardous waste, and also require a landfill to close within 180 days after ceasing to accept hazardous waste (U.S. EPA is proposing regulations that would allow disposal facilities to continue to accept non-hazardous solid wastes without closing). It's regulations also include the "derived-from" and "mixture" rules. In addition, U. S. EPA has developed a "contained In" policy for non-solid waste media, such as soil or groundwater that is contaminated by hazardous wastes. Such contaminated media must be managed as a hazardous waste until all the contamination is removed, if contaminated by listed waste, or until the contaminated media no longer displays a characteristic, if contaminated by characteristic waste. U. S. EPA has been petitioned to develop a "deminimus" rule setting specific concentration levels for hazardous constituents in media below which it would no longer be regulated as a hazardous waste. Until such a rule is promulgated, U. S. EPA and the states may look at each situation involving potentially contaminated media an a case by case basis.

U. S. EPA has developed additional policy and guidance related to the application of the HSWA land disposal restrictions for on-site actions at sites remediated under a federal Superfund project. The Department understands that U. S. EPA intends that this policy apply to RCRA hazardous waste facilities. WMI's comments referred to some of this guidance, as related to Superfund sites. In summary, this guidance describes how to determine when a RCRA waste is being managed and when a disposal activity takes place on-site that triggers the land disposal restrictions. A new term, "placement", was developed to help determine when disposal occurs that cause the land disposal restrictions to apply. This term does not appear in the federal regulations. However, the Department understands that U. S. EPA plans to codify the policy in the future. In short, "placement", and hence disposal, takes place if waste is managed in a different unit than it came from, or in the same unit it came from if it is first managed in an intervening treatment or storage unit. If the waste is moved around or consolidated in the same unit or "area of contamination", consolidated without being managed in an intervening unit, then "placement" does not occur.

The Department has not yet incorporated the land disposal prohibitions into ch. NR 181, Wis. Adm. Code, but intends to do so in the future. Once those rules are adopted, the Department will consider adopting the U. S. EPA policies and guidance related to them. In the meantime, the Department can consider, on a case by case basis, U. S. EPA's policies when formulating its own policies on the re-disposal issue.

WMI has requested that the Department regulate wastes removed from the landfill differently. Specifically, WMI has requested that:

1. Material removed from the landfill that has "clearly been significantly contaminated by demonstrable mixing and are removed for placement at a different management unit..." would be the only material managed as a hazardous waste in accordance with the condition.

2. The Department grant a treatability variance for soil and debris from the landfill and allow removed waste to replaced In the existing fill or disposed of at Parkview Landfill.

3. That leachate from the landfill be assigned the hazardous waste number for all the hazardous wastes known to be accepted at the landfill.

In response to request 1, limiting the requirements to material that has "clearly been significantly contaminated by demonstrable mixing" would not meet the intent of the "derived-from" and "mixture" rules under ch. NR 181, Wis. Adm. Code. In addition, such a limit would be contrary to U. S. EPA's regulations; we are not aware of any federal policy that limits these two rules as this proposed language would. Finally, it is not clear who would make such a demonstration. Any material from the landfill that has the potential to be contaminated by hazardous constituents must be managed as a hazardous waste. However, in response to the submitted comments and the

September 14 meeting discussion, the Department can further refine the condition to more clearly indicate that if soil, including cover soil, and groundwater is demonstrated by WMI to not be contaminated, then it would not be regulated as a hazardous waste in accordance with the condition. This was the condition's original intent. Until a "deminimus" rule is in place, the Department has latitude in judging if a demonstration method is adequate. Generally, the Department's policy is to require testing of the material, and field screening methods can be considered, depending on the hazardous constituents of concern (i. e., if VOC's are of concern, an Hnu or OVA screening method may be appropriate). Also, Department field staff may determine, on a case by case basis, that certain materials are not considered contaminated based on field observations.

Request 1 also has language further limiting the requirements only to material "removed for placement in a different management unit". This limitation would defeat the purpose of the condition and would generally allow re-disposal on site without limits. This would be in clear violation of ch. NR 181, Wis. Adm. Code, as outlined in the second paragraph of the response to the Condition No. 4 comments, above. We also note this would be in conflict with the Closure and Long-Term Care plan, page 2-10. The Department does not intend to grant a "blanket" approval to the re-disposal of waste in the landfill during the entire long-term care period. Therefore, the condition will not be revised to conform with this request. However, in light of U. S. EPA's policies, as discussed above, the Department is willing to consider, on a case by case basis, requests for re-disposal of wastes associated with remedial actions and investigations, with <u>each separate</u> remedial action or investigation proposal. That will allow the Department to take into account any changes in U. S. EPA guidance or policy, the kinds of wastes being generated, any testing requirements, and the portion of the landfill the wastes are being re-disposed of in. The Department will not approve such proposals unless they conform with any U. S. EPA guidance, policy or regulations in effect at the time.

Request 2 refers to a variance authority under the HSWA land disposal prohibitions, which are not contained in ch. NR 181, Wis. Adm. Code at this time. Therefore, the Department does not have the authority to consider such a variance, so the condition can't be changed in response. In addition, it is not clear that U. S. EPA will grant this variance authority to a state as part of the authorization process.

Request 3 refers to a letter regarding a leachate pretreatment pilot facility that has since closed at the landfill. The Department has no objection to the suggested waste code designation. The proper procedure to formally notify the Department and U. S. EPA of a waste code designation is through specific correspondence and a revised notification form. However, it should be noted that if such material (or any other material from the site covered by this condition) is manifested, a specific waste code or code(s) will be needed on the manifest form. Questions on this issue should be directed to the Department's Southeast district hazardous waste staff. No revision to the determination appears to be necessary to respond to the request.

BEFORE THE
STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

CONDITIONAL CLOSURE AND
LONG-TERM CARE PLAN APPROVAL (MODIFICATION)
OMEGA HILLS NORTH LANDFILL
EPA ID# WID000808568

CONDITIONAL CLOSURE AND LONG-TERM CARE PLAN APPROVAL (MODIFICATION)

The Department hereby approves the Closure and Long-Term Care Plan for the landfill, subject to the following conditions which hereby modify the plan:

4. All wastes, liquids, contaminated groundwater, contaminated soils or other materials removed from the landfill as a result of any construction, remediation or investigation shall be managed as a hazardous waste at a facility licensed, permitted or approved to accept such wastes, in accordance with s. NR 181.21(4), Wis. Adm. Code, regardless of where the material originates. The Department shall consider specific requests by WMI, on a case by case basis, on whether soil or groundwater to be removed from the landfill is contaminated and therefore subject to this condition. The Department shall consider specific requests by WMI, on a case by case basis, on whether material removed as part of a particular remedial action or investigation may be managed in an different fashion than set out in this condition, but only when such requests accompany the particular remedial action or investigation proposal.

Appendix B. **NOTE: This is a WDNR scanned version of this USEPA Quick Reference Fact Sheet. The WDNR believes it is an accurate facsimile of the Fact Sheet, but the reader should obtain a copy of the original if there is any question of accuracy.**

EPA-	Publication: 9345.3-O3FS April 1992 United States Environmental Protection Agency, Office of Solid Waste and Emergency Response **Office of Emergency and Remedial Response Hazardous Site Control Division OS-220W Quick Reference Fact Sheet**

Guide to Management of investigation—Derived Wastes

CERCLA field investigation activities (e.g., remedial investigation/feasibility studies and remedial designs) may result in the generation of waste materials that may pose a risk to human health and the environment These investigation-derived wastes (IDW) may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues (e.g., ash, spent carbon, well development purge water) from testing of treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE); and solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment. The management of IDW must ensure protection of human health and the environment and comply with (or waive) regulatory requirements that are applicable or relevant and appropriate requirements (ARAR). **This fact sheet presents an overview of possible IDW management options, discusses the protectiveness requirements and ARARs associated with these options, and outlines general objectives established for IDW management under Superfund.**

The general options for managing IDW (see Highlight 1) are collection and either (1) immediate disposal or (2) some type of interim management. Interim management may include storage or other temporary measures. As discussed below, the specific option selected will depend on the type of waste produced, its relative threat to human health and the environment, and other site-specific conditions.

IDW MANAGEMENT REQUIREMENTS

When managing IDW, site managers are required to choose an option that: (1) is protective of human health and the environment and (2) complies with (or waives) ARARs, as described below.

Protectiveness

In determining if a particular management/disposal option is protective, site managers should consider the following:
- The contaminants, their concentrations, and total volume of IDW;
- Media potentially affected (e.g., ground water, soil) under management options;
- Location of the nearest population(s) and the likelihood and/or degree of site access;
- Potential exposures to workers; and
- Potential for environmental impacts.

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[1] Management of treatability study and treatment pilot wastes is discussed in Guide for Conducting Treatability Studies Under CERCLA, Interim Final, December 1989, EPA/540/2-89/058. Information on management of IDW generated during Preliminary Assessments and Site Investigations is provided in Management of Investigation-Derived Waste During Site Investigations, May 1990, EPA/540/G-91/009.

As a general rule, it will be necessary to use best professional judgment, in light of the site-specific conditions, to determine whether an option is protective of human health and the environment. For example, a site manager may determine that storing IDW temporarily until the final action or returning IDW to its source is protective, based on knowledge that the material **poses** low risk and/or that the final action will address any risks posed by the wastes and there will be no unacceptable risks in the interim.

Alternatively, if the site includes or is near residential areas, the site is unsecured, and/or contaminants appear to be present at unacceptable levels, it may not be protective to return excavated soil to the source. Storing IDW in containers in an on-site, secure location, or sending it off site immediately may be more appropriate.

Site managers also need to consider the potential effects of IDW management-related activities on environmental media. For example, pouring contaminated purge water on the ground around a well may not be prudent, because such an action could mobilize any hazardous constituents present in the soil or introduce contaminants into clean soil.

Compliance with ARARs

Remedial Investigation/Feasibility Study (RI/FS) and Remedial Design (RD) actions must comply with ARARs "to the extent practicable, considering the exigencies of the situation" (NCP, 55 FR 8756, emphasis added); therefore, it generally will not be necessary to obtain a waiver if an ARAR cannot be attained during these actions. If a site manager determines that, based on site-

Highlight 1: IDW Management Options

Type of IDW	**Generation Processes**	**Management Options**
Soil	• Well/test pit installation • Borehole drilling • Soil sampling	• Return to boring, pit, or source immediately after generation • Spread around boring pit, or source within the AOC+ • Consolidate in a pit (within the AOC) • Send to on-site TDU+ • Send to TDU off site immediately • Store for future treatment and/or disposal
Sludges/sediment	• Sludge pit/sediment sampling	• Return to boring pit, or source immediately after generation • Send to on-site TDU • Send to TDU off site immediately • Store for future treatment and/or disposal
Aqueous liquids (ground water, surface water, drilling fluids, other wastewaters)	• Well installation/development • Well purging during sampling • Ground water discharge during pump tests • Surface water sampling	• Discharge to surface water • Pour onto ground close to well (non-hazardous waste) • Send to on-site TDU • Send to off-site commercial treatment unit • Send to POTW+ • Store for future treatment and/or disposal
Decontamination fluids	• Decontamination of PPE+ and equipment	• Send to on-site TDU • Evaporate (for small amounts of low contamination organic fluids) • Send to TDU off site immediately • Store for future treatment and/or disposal
Disposable PPE	• Sampling procedures or other on-site activities	• Send to on-site TDU • Place in on-site industrial dumpster • Send to TDU off site immediately • Store for future treatment and/or disposal

*The generation processes listed here are provided as examples. IDW may also be produced as a result of activities not listed here.
+AOC: Area of Contamination (AOCs at a site may not yet have been identified at the time of the RI/FS); TDU: Treatment/disposal Unit; POTW: Publicly Owned Treatment Works; PPE Personal Protective Equipment

specific factors, compliance with an ARAR is practicable but an ARAR waiver is warranted for an RI/FS or RD action, an interim action waiver may be available if the final remedy will attain the ARAR. An action memorandum should be prepared for the waiver, the state given an opportunity to comment, and the decision document placed in the administrative record.

Potential ARARs for IDW at CERCLA sites include regulations under the Resource Conservation and Recovery Act (RCRA) (including both Federal and State underground injection control (UIC) regulations), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), and other State environmental laws. How these various requirements may direct or influence IDW management decisions is described below.

Resource Conservation and Recovery Act (RCRA). Certain sections of the RCRA Subtitle C hazardous waste regulations (e.g., land disposal restrictions and storage restrictions) may be ARARs for IDW should RCRA hazardous waste be identified at a site. (Note that RCRA may be relevant and appropriate even if the IDW is not a RCRA hazardous waste.) A waste is hazardous under RCRA if it is listed as such in 40 CFR 261.31 - 261.33 or if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Site managers should not assume that a waste considered to pose a potential risk at a CERCLA site is a listed or characteristic RCRA hazardous waste. Until there Is positive evidence (records, test results, other knowledge of waste properties) that the IDW Is a RCRA hazardous waste, site managers should manage it in a protective manner (but not necessarily In accordance with Subtitle C requirements). Business records or facility processes should be examined to determine whether RCRA listed wastes were generated and are present in the IDW. For characteristic wastes, site managers should rely on testing results or on knowledge of the material’s properties. If best professional judgment and available information indicate that, for protectiveness reasons (or because RCRA requirements are relevant and appropriate), IDW is best managed as a “hazardous waste,” management in accordance with Subtitle C requirements is prudent, regardless of whether it is known to be a RCRA waste.

If aqueous liquid IDW is considered a RCRA hazardous waste, the site manager should determine whether the Domestic Sewage Exclusion (DSE) applies to the discharge of that IDW to a POTW. The RCRA DSE exempts domestic sewage and any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment from classification as a solid waste and, therefore, as a RCRA hazardous waste (40 CFR 261.4).

- Land Disposal Restrictions

If IDW is determined to be a RCRA hazardous waste and subject to the land disposal restrictions (LDRs), “land disposal” of the IDW will be prohibited unless specified treatment standards are met (see Superfund LDR Guides #5 and #7, Determining When LDRs Are Applicable to CERCLA Response Actions and Determining When LDRs Are Relevant and Appropriate to CERCLA Response Actions OSWER Directive 93473.05FS and 9347.3-08FS, June 1989 and December 1989 and the NCP, 55 FR 8759, March 8, 1990). “Land disposal” occurs when wastes from different AOCs are consolidated into one AOC; when wastes are moved outside an AOC (for treatment or storage) and returned to the same or a different AOC; or when wastes are excavated, placed in a separate hazardous waste management unit such as an incinerator or tank within the AOC, and then redeposited into the AOC.

Storing IDW In a container (“a portable device In which a material Is stored, transported, treated, disposed of, or otherwise handled” (40 CFR 260.10)) within the AOC and then returning it to Its source, however, Is allowable without meeting the specified LDR treatment standards. Under the definition of “hazardous waste management unit” (40 CFR 260.10), EPA states that “a container alone does not constitute a unit; the unit includes the containers and the land or pad upon which they are placed.” Therefore, returning IDW that has been stored in containers (not tanks or other RCRA-regulated units) within the AOC to its source does not constitute land disposal, as long as containers are not managed in such a manner as to constitute a RCRA storage unit as defined in 40 CFR 260.10. In addition, sampling and direct replacement of wastes within an AOC do not constitute land disposal.

- Storage

Subtitle C outlines the storage requirements for RCRA hazardous wastes. Under RCRA, “storage” is defined as “the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere” (40 CFR 260.10).

On-site Superfund actions are only required to comply with the substantive standards of other laws (see 40 CFR 300.5, definitions of applicable or relevant and appropriate requirements). Superfund sites are also exempt from permit requirements under CERCLA §121(e). Therefore, site managers are not required to comply with administrative requirements triggered by RCRA storage deadlines (e.g., contingency planning, inspections, recordkeeping). Generally equivalent administrative activities are undertaken at Superfund sites, however, under existing Superfund management practices.

Site managers storing known RCRA hazardous waste must comply with the substantive, technical requirements of 40 CFR Parts 264 and 265 Subparts I (containers), J (tanks), and L (waste piles), to the extent practicable. (See Highlight 2 for a summary of these technical requirements for each type of unit). In addition, the ground-water monitoring requirements of 40 CFR Parts 264 and 265 Subpart F are potential ARARs, and to the extent they are determined to be ARARs at a site, they should be attained to the extent practicable (or waived). (In many cases, ground-water monitoring conducted during the RI/FS will provide protection equivalent to the Subpart F requirements.)

[NOTE: Under the LDRs, restricted RCRA hazardous waste may not be stored at a site unless the storage is solely for the purpose of accumulating sufficient quantities of the waste to facilitate proper disposal, treatment, or recovery (see 40 CFR 268.50). Generally, storing IDW until a final disposal option is selected in a Record of Decision (ROD) and Implemented during the remedial action is allowable storage under the RCRA LDR storage prohibition.]

- Recordkeeping and Manifesting

If hazardous wastes are sent off site, the site manager must comply with both administrative and substantive elements of the RCRA generator requirements of 40 CFR Pan 262 and LDR notification and certification requirements of Part 268. (For example, a site manager must prepare an LDR notification and certification when restricted wastes are sent off site to a land disposal facility.) These standards include requirements such as manifests for shipping waste that list all hazardous waste listing and characteristics applicable to the waste (see 40 CFR 262.11), packaging and transport requirements, and recordkeeping requirements.

If the LDRs are applicable, the following information should be collected and available before the removal of wastes to an off-site disposal facility: EPA hazardous waste number, LDR treatment standards, manifest number for the waste shipment, and waste analysis data.

Highlight 2:

Examples of RCRA Technical Storage Requirements

RCRA storage requirements, applicable to both less-than-90-days generators and permitted or interim status storage facilities, may include the following substantive requirements:

Containers 40 CFR 264 Subpart I and 265 Subpart I
- Containers must be in good condition
- Wastes must be compatible with containers
- Container must be closed during storage
- Container storage areas must have a containment system that can contain 10 percent of the volume of containers or of the largest container
- Spilled or leaked waste must be removed from the collection area as necessary to prevent overflow

Tanks 40 CFR 264 Subpart J and 265 Subpart J
- Tanks must have a secondary containment system that includes a liner, a vault, a double-walled tank, or an equivalent device (applies only to certain tanks)

Waste Piles 40 CFR 264 Subpart L and 265 Subpart L
- Waste piles must have a liner and a leachate collection and removal system
- Owners/operators must have a run-on control system to prevent flow on to the active portion of the pile during peak discharge from at least 25 year storm
- Owners/operators must have a run-off management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm

- This is a partial list of substantive requirements. For more detail, see 40 CFR Part 264 and 265.

- Underground Injection Control (UIC) Program

Under the UIC regulations, RCRA hazardous wastes may be injected into Class I permitted wells. In some cases, hazardous liquids, such as extracted ground water from pump and treat operations, may be injected into a Class IV

UIC well. For example, ground water contaminated with RCRA hazardous wastes may be injected into Class IV permitted wells if it is part of a CERCLA response action or a RCRA corrective action and if it has been treated to 'substantially reduce hazardous constituents prior to such injection..." (RCRA § 3020(b)). (See Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Reinjection OSWER Directive #9234,1-06, December 1989.)

- Non-RCRA Hazardous Wastes

Some non-RCRA hazardous waste may be subject to management requirements under Subtitle D of RCRA as solid wastes. Subtitle D regulates disposal of solid waste in facilities such as municipal landfills. Therefore, non-RCRA hazardous IDW, such as decontaminated PPE or equipment, may need to be disposed of in a Subtitle D facility (depending on State requirements).

Clean Water Act (CWA). Discharges of aqueous IDW to surface water and publicly owned treatment works (POTWs) may be required to comply with CWA Federal, State, and local requirements. Requirements to be met may include water quality criteria, pre-treatment standards, State water quality standards, and NPDES permit conditions. Direct discharges to on-site waters are subject only to substantive requirements, while discharges to POTWs and other off-site discharges must comply with both a substantive and administrative CWA requirements (including Permitting requirements). (See Guide to Discharging CERCLA Aqueous Wastes to POTWs. June 1991 and CERCLA Compliance with the CWA and SDWA, #9234.2-06FS, January 1991.)

Toxic Substances Control Act (TSCA). If IDW contains PCBs, TSCA treatment and/or disposal requirements may apply during its management TSCA requirements regulate the disposal of material contaminated with PCBs at concentrations of 50 ppm or greater as found on site (i.e., based on sample analysis and not the PCB concentration of the source material {e.g., transformer fluid}). (See PCB Guidance Manual, EPA/540/G-90/007, August 1990.) In addition, TSCA storage requirements may apply that limit the time that PCBs may be stored to one year. Furthermore, if PCB materials are mixed with a RCRA hazardous waste, they may be regulated by the LDR California list prohibitions. (See RCRA sections 3004(d)(2)(D) and (E).)

Department of Transportation (DOT) requirements. Where IDW will be disposed of off site or transported on public roads to a site, DOT requirements for containerizing, labeling, and transporting hazardous materials and substances may apply.

State requirements. Promulgated State regulations that are legally enforceable, timely identified, and more stringent than Federal regulations may be potential ARARs for IDW managed on site. Substantive requirements of State law that may be ARARs for IDW management include State water quality standards, direct discharge limits and RCRA requirements (including underground injection control regulations) promulgated m a State with an authorized RCRA hazardous waste management program (as well as programs authorized by State laws). Off-site, substantive and administrative requirements of State law may apply.

Off-Site Policy. In addition to complying with requirements of Federal and State laws all off-site disposal of wastes must comply with CERCLA section 121(d)(3) and the CERCLA Off-Site Policy (OSWER Directive No.9834.11 (November 13, 1987)). The Off-Site Policy establishes criteria for selecting an appropriate treatment, storage, or disposal facility (TSDF), including release criteria for all facilities that receive wastes from CERCL A authorized or funded response actions. In addition, receiving facilities must be in compliance with all "applicable laws."

Before shipping wastes off site, approval should be obtained for the proposed disposal facility from EPA's Regional Off-Site Policy Coordinator. In addition, EPA has adopted a policy for Superfund wastes shipped out of State that written notification should be provided to receiving States (OSWER Directive 9330.2-07, September 14, 1989).

GENERAL OBJECTIVES FOR IDW MANAGEMENT

In addition to the two requirements of protectiveness and compliance with ARARs to the extent practicable (on site) or compliance with applicable law (off site), EPA has identified two general objectives that Superfund site managers should consider when managing IDW: (1) minimization of IDW generation; and (2) management of IDW consistent with the final remedy for the site. The extent to which these objectives can be achieved is highly dependent on site-specific circumstances.

IDW Minimization

Site managers should strive to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information from the site inspection. The potential problems of managing IDW should be a factor in choosing an investigative method. Site managers may wish to consider techniques such as replacing solvent-based cleaners with aqueous based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between clean and hot zones and drilling methods and sampling techniques that generate little waste. Examples of such techniques include using gridding techniques to minimize the number of test pits or using soil boring instead of test pits. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer instead of coring. Site managers should also be careful to keep hazardous wastes separate from nonhazardous wastes.

Management Consistent with Final Remedy

Most IDW (with the exception of non-indigenous IDW) generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements.

Because early planning for IDW management can prevent unnecessary costs and the use of treatment or disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated/disposed of immediately or addressed with the final remedy. If addressed with the final remedy, IDW volumes should be considered in the FS. In addition, when IDW is stored on site, it should be managed as part of the first remedial action/operable unit that addresses the affected media.

SELECTION OF IDW DISPOSAL OPTIONS

The following sections present the Agency’s presumptions for IDW management that have been established based on the above considerations. The actual option selected should be based upon best professional judgment and should take into account the following factors:

- The type and quantity of IDW generated (sludge/soil, aqueous liquid, non-indigenous IDW);
- Risk posed by managing the IDW on site (e.g., based on site access controls, contaminant concentrations);
- Compliance with ARARs, to the extent practicable (on site);
- IDW minimization; and
- Whether the final remedy is anticipated to be an off-site or on-site remedy (or this information is unknown) and whether IDW can be managed consistent with the final remedy.

Off-site Final Remedies

If a site manager believes that the final remedy will involve off-site disposal of wastes, EPA’s presumption is to manage the IDW as part of the remedial action addressing the waste/medium. Thus, until the final action, the IDW may be stored (e.g., drummed, covered waste pile) or returned to its source. However, the management option selected should also take into account any protectiveness concerns, ARARs, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

There are several potential reasons why it may be advisable to store IDW until the final action. First, because wastes at the site will be shipped off site eventually, returning IDW (especially sludges and soil) to its source would require that it be excavated again. Thus, site managers may consider it practical to containerize IDW as soon as it is generated. Second, storing IDW in containers may be more protective than returning it to its source. Third, because off-site actions may trigger such requirements as the LDRs, temporary storage will eliminate the need to meet these additional requirements until the final remedy.

In some cases, circumstances may lead site managers to choose to return the IDW to its source. This may be appropriate if it is determined that returning IDW to the source is protective and that storage at the site is not possible or practicable (i.e., given State or community concerns). In other cases, long-term storage may not be protective, and immediate off-site disposal may be a better option.

Example: A site involves volatile organic RCRA hazardous wastes that will likely be sent off site for final treatment and disposal. Site conditions are such that temporary storage of IDW is considered protective until the remedial action begins. Because off-site disposal will trigger RCRA disposal requirements such as the LDRs and immediate containerization would be more protective than redepositing into the source area at the time of sampling, the site manager decides to containerize the IDW (and comply with RCRA substantive technical tank and container standards) until the final action is initiated.

On-site Final Remedies (or Final Management in an Unknown Location)

When final management of wastes is likely to occur on site, the management presumptions vary depending on the type of IDW produced.

Sludge/soil

Generally, the Agency expects sludge or soil IDW will be returned to its source if short-term protectiveness is not an issue. The reason behind this presumption is that IDW that may pose a risk to human health and the environment in the long term will be addressed by the final action. Storage of RCRA hazardous IDW in container-s within the AOC prior to returning It to the source will not trigger the LDRs as long as the containers are not managed In such a way as to constitute a RCRA storage unit as defined in 40 CFR 260.10. Therefore, it may be possible to store IDW temporarily before redisposing of it. However, EPA believes that, in many cases, returning sludges and soils to their source immediately will be protective and will avoid potentially increased costs and requirements associated with storage. Site-specific decisions on how to manage sludge and soil IDW may ultimately vary from the presumption based on protectiveness, ARARs, and/or community concerns.

Example 1: The soil at a site contains wastes that are expected to be stabilized on site during the final remedial action. The site manager determines that sending soil IDW off site is not cost-effective, because off-site disposal would involve testing and transport costs for a relatively small amount of waste. Instead, knowing that the site is secure and that redisposing the waste at the source will not increase site risk or violate ARARs, the site manager decides to return soil IDW to the source area from which it originated.

Example 2: A site manager determines that returning highly contaminated PCB wastes to the ground at a site is not protective because of the potential risks associated with the material; instead, the site manager chooses to drum the waste and send it off site (in compliance with TSCA). (Off-site disposal may occur immediately or at a later date.)

Example 3: Soil IDW contaminated with a RCRA hazardous waste is generated from a soil boring. The site manager decides to put the IDW back into the borehole immediately after generation, but ensures that site risks will not be increased (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate “clean” areas) and that the contamination will be addressed in the final remedy.

Aqueous liquids

EPA has not established a presumption for the management of aqueous liquid IDW (e.g., ground water). Site managers should determine the most appropriate disposal option for aqueous liquids on a site-specific basis. Parameters to consider, especially in making the protectiveness decision, include the volume of IDW, the contaminants present in the ground water, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the ground-water plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components. Examples of aqueous liquid management decisions considering these factors are presented in the following box.

Example 1: A site manager has large volumes of ground water IDW and does not know if it is contaminated. Pouring this IDW on the ground would not be protective, because it may contaminate previously uncontaminated soil or may mobilize contaminants that are present in the soil. Therefore, the site manager stores the water in a mobile tank until a determination is made as to whether the water and soil are contaminated or until the final action.

Example 2: IDW is generated from the sampling of background, upgradient wells. Because there are no community concerns or evidence of any soil contamination from other sources, the site manager decides to pour this presumably uncontaminated IDW on the pound around the well.

Example 3: Purge water from a deep aquifer is known to be contaminated with a RCRA hazardous waste. At this site, if this water were poured on the pound, it could contaminate a previously uncontaminated shallow aquifer that is a potential drinking water source and would have to comply with the LDRs. The site manager decides to containerize the water within the AOC and store it until the final remedy.

Non-indigenous IDW

Non-indigenous IDW (e.g., sampling materials, disposable PPE, decontamination fluids) should be stored until the final remedy or disposed of immediately. If contaminated, such waste may not be disposed of onto the ground because such an action would add contamination that was not present when activities began at the site (e.g., solvents used for decontamination). If non-indigenous IDW is contaminated with RCRA hazardous waste, it must be managed in accordance with RCRA Subtitle C requirements. Otherwise, site managers may generally dispose of it in an on-site dumpster (for PPE).

Example 1: Disposable PPE (e.g, gloves, shoe covers) becomes contaminated with RCRA hazardous waste during the field investigation. The site manager containerizes and disposes of this IDW in compliance with RCRA Subtitle C requirements.

Example 2: Disposable equipment becomes contaminated during a field investigation. The site manager decontaminates them and sends them to a Subtitle D facility.

COMMUNITY CONCERNS

Residents of communities near a CERCLA site, local governments or States may have concerns about certain disposal methods or long-term storage of IDW at the site. As with all CERCLA activities, site managers should evaluate community concerns regarding disposal of IDW in deciding what action to take. For example, if a community is concerned about the direct discharge of IDW water to surface water on site, site managers may want to consider sending the water to a POTW, if one is located nearby. In some instances, it may be appropriate to prepare fact sheets include options in other community relations documents or explain IDW management decisions at public meeting prior to actions.

NOTICE: The policies set out in this memorandum are not final agency action, but are intended solely a guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance any time without public notice.

ATTACHMENT 2

SAMPLING AND TESTING OF INVESTIGATIVE WASTES

During the installation of monitoring wells and soil borings the amount of waste material generated in the form of drilling fluids and soil cuttings should be minimized. Waste materials generated from these activities will require containerization and sampling in order to determine proper disposal or treatment options. The following is a discussion of ways to not only minimize the amount of materials accumulated and thereby minimize the number of samples which have to be collected and analyzed, but also how to sample these wastes in order to best obtain representative results.

An attempt should be made to identify the exact depth within the formation where the soil cuttings originated or, in the case of drilling fluids, were in contact with the formation, if possible. When borings are extended into or below the water table it is advisable to segregate materials from a point approximately 10 feet above the top of the water table from those collected below the water table. In that way you can potentially minimize the amount of materials which may need to be sampled and characterized because they were in contact with contaminated groundwater.

When drilling off-site, or away from the area where a release occurred, an assumption can be made that soils above the water table do not contain contaminants, and therefore do not need to be containerized or sampled. This may not be true in those situations where soil gas migration may have carried contaminants off-site to adjacent properties. Field screening equipment, such as an OVM or PID, can be used to help isolate contaminated materials from `clean' soils and cuttings for the contaminants in question, when appropriate.

Materials collected as the result of drilling or soil boring activities which require containerization should be collected and stored in 55 gallon drums, roll-off containers, or similar containers which can be closed or covered watertight and are compatible with the wastes being stored in them. These drums or containers should be marked such that they can be clearly identified as to the exact location and depths the materials came from. These drums or containers should also be stored in a secured location, if possible, and labeled as special waste materials until an exact determination can be made.

If soil samples are being analyzed from a soil boring or well location, the results from those analyses must be directly tied back to the material collected and the container it was placed in. In certain cases, you may be analyzing specific samples based upon elevated readings from field screening devices. This is why very precise labeling and identification of containers is necessary. Should the samples be too widely distributed or should you be unable to field screen for elevated readings, such as with pesticide contamination, all samples will need to be analyzed for the contaminants of concern.

Samples should be taken such that they are representative of the waste material to be analyzed. For material stored in 55 gallon drums, if field readings do not detect a hot spot or area from the boring, a representative sample should be collected for every 5-55 gallon drums or portion thereof. This sample should be a discrete sample taken from approximately the middle of one of the 5 drums. If the drum contains both liquid and solid fractions, these should be sampled and analyzed separately. This assumes that soil formations for the material collected in the 5 drums are consistent in their unified soil classification system (USCS) rating and there was no visual or other indications of contamination present. Where visual observations or field readings detect elevated readings, the sample should be collected from that depth or from the container where those specific materials were placed. Standard sampling methods and procedures should be followed to ensure that the results are representative of the materials in question.

If materials are being stored in a large container, such as a covered rolloff, a minimum of two samples should be collected from opposite ends of the soil pile. Two additional samples should be collected for every additional 100 cubic yards of material being collected and stored. These should be discrete samples and should be taken from at least 18 inches below the surface of the soil pile. An attempt should be made to identify those areas of a soil pile which may contain elevated concentrations or hot spots and these areas should be segregated out and sampled individually.

Liquids collected as part of well installation or development should be segregated from soils as much as possible. If the area is served by a sanitary sewerage system, permission should be obtained from it's operator as well as the local District wastewater engineer for permission to directly discharge these liquids into that system. In most cases an analysis of the liquids will be required by the sewage treatment plant if information is not available on what contaminants are present.

All analyses should be performed using a method listed in EPA SW-846 designed to detect the target compounds. The method chosen should be one which gives an acceptable detection limit and will allow for characterization of the materials as hazardous or non-hazardous waste. Based upon these results, a determination will need to be made as to proper disposal or treatment options.

ATTACHMENT 3

LONG-TERM ON-SITE STORAGE OF INVESTIGATIVE WASTES (IW)

General

Storage of IW should be in above ground tanks or containers. Examples of tanks include large metal or fiberglass tanks and trailer tanks for hauling liquids on roads. Examples of containers are 55-gallon drums, rolloff boxes (also called "luggers") and U. S. DOT approved boxes for solids. Storage should not be in underground tanks, in-ground pits, surface impoundments, trenches or lagoons. The tanks or containers should be water tight and compatible with the IW being stored. Permanent labels that indicate the source of the wastes and their descriptions should be attached to all containers.

Containers or tanks should be stored in area with limited access, such as a fenced area or a building. If vandalism is a potential concern, consideration should be given to storing the IW in a building. Temporary buildings can be constructed for this purpose. For liquids, and especially highly contaminated liquids, consideration should be given to providing secondary containment for spills and leaks in accordance with the hazardous waste regulations (see below). For outdoor secondary containment, precipitation run on and run off control should be provided in accordance with those regulations.

Stored IW should be periodically inspected, with records kept. Deteriorating containers or tanks should be immediately replaced. Deteriorating 55-gallon drums can be overpacked. If a container label has deteriorated, it should also be replaced.

Hazardous IW Storage

Storage of hazardous IW should be in accordance with the Hazardous Waste Program regulation technical standards. The standards for containers are outlined in ss. NR 640.08 - 640.15. The standards for tanks are outlined in ss. NR 645.08 - 645.15.

STANDARD OPERATING PROCEDURE

SC-004 Headspace VOC Screening

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1. Objective

Describe methods to obtain site-specific measurement of the total volatile organic compound (VOC) concentrations present in the headspace of a jar or zip-closing bag containing soil.

This information can be used for several purposes:

- Segregate soil based on degree of contamination.
- Identify samples for quantitative analysis of VOCs.
- Evaluate the presence or absence of VOCs in soil.

2. Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar or zip-closing bag headspace screening.
- Select the appropriate instrument, lamp, and calibration gas for the site-specific contaminants. Calibrate the instrument in accordance with the manufacturer's instructions before screening begins. Record the type of calibration gas, detector, lamp, and results of calibration in the field notebook.
- Note the highest VOC concentration that the instrument measures in air in the work area before performing screening. Record this as the initial background concentration.
- Option 1: Half-fill a clean, glass jar with the soil. Quickly cover the open top with one or two sheets of clean, aluminum foil and screw on the cap to tightly seal the jar. Label the jar with the sample location and sample depth.
- Option 2: Fill one quarter to one half full a clean, zip-closing bag with soil. Tightly seal the zip-closing bag. Label the bag with the sample location and sample depth.
- Allow headspace development for at least 10 minutes at an ambient temperature of 50°F or greater. Shake the jar or zip-closing bag for 15 seconds at the beginning and end of the headspace development period. When ambient temperatures are below 50°F, place the sample in a heated vehicle or building during the headspace development period.
- Option 1: After headspace development, remove the jar's screw cap to expose the foil seal. Quickly puncture the foil seal with the instrument's sampling probe and insert it to a point at about one-half of the headspace depth.
- Option 2: After headspace development, unzip a corner of the bag and insert the sampling probe to a point at about one-half of the headspace depth, holding the bag tightly around the inserted probe. Alternatively, the probe may be used to quickly puncture the zip-closing bag.

- Record the highest VOC concentration that the instrument displays as the headspace concentration. The highest concentration should occur between 2 and 5 seconds after probe insertion.

3. Limitations

- The instruments may work poorly in the rain and in freezing temperatures. Under such conditions, operate the instrument in a heated vehicle or building if possible.
- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- Headspace screening is a guide that helps the screener to segregate soils into broadly defined categories. Headspace screening results may differ by orders of magnitude from laboratory testing results.
- Note that some states may have specific procedures for field monitoring.

4. Contacts

Brad Dal Santo
Ken Kytta

5. Revision Log

Revision No.	Date of Revision	Individual Sections Revised	Comments
0	11/11/2024		BJD

STANDARD OPERATING PROCEDURE

SG-001 General Guidance on Soil Vapor Intrusion Evaluations

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1. Objective

The goal of a soil vapor intrusion evaluation is to assess whether complete exposure pathways of soil vapor to indoor air exist. A complete exposure pathway exists if vapors from constituents are migrating through various pathways into residential or commercial buildings at concentrations that may result in an unacceptable human health risk. If a complete exposure pathway does not exist, then further assessment of soil vapor intrusion is not required.

Depending on the status of investigation performed at the site it may be appropriate to approach an evaluation of soil vapor intrusion at different tiers. If little work has been performed relative to the potential for contaminants to affect soil vapor near a structure, then a screening level assessment is an appropriate first step. However, if a plume is well delineated and the potential for groundwater impacts, or nearby source material, to affect soil vapor near a potential receptor structure is well understood, then it may be more appropriate to directly develop and implement a soil vapor and/or indoor air sampling plan. To accommodate the potential varied states of knowledge when a vapor intrusion evaluation is required, a flexible approach is needed that incorporates the following elements.

- SOP SG-002 Soil Vapor Sample Collection
- SOP SG-003 Sub-Slab Soil Vapor Collection
- Indoor Air Sampling
- SOP SG-004 Ambient Air Sample Collection

Soil vapor intrusion evaluations should be approached on a site-specific basis and depending on the site-specific setting and proximity to impacted groundwater or source material, it may be appropriate to proceed in a hierarchical fashion through each tier of evaluation or a variety of tiers may be combined and implemented simultaneously. The SOPs presented in this SOP address each of these sampling procedures.

2. Execution

2.1. Implementation Triggers

Soil vapor intrusion evaluations may be implemented at various times based on event triggers throughout the Site Characterization (SC), Remedial Investigation (RI), and site remedial action plan. The following event triggers would require the implementation of this soil vapor intrusion investigation.

- Identification of a potential complete exposure pathway
- Private property owner request for sampling

- State or Federal administrative order

2.2. Factors Affecting Soil Vapor Intrusion

Prior to conducting a soil vapor intrusion assessment at a private property, an analysis of the factors contributing to the migration of soil vapor to indoor air should be conducted. The completion of this analysis should take into account the two types of factors: environmental and building factors.

2.2.1. Environmental Factors

Environmental factors include site specific conditions in the subsurface and above the ground surface that may affect the rate and direction at which soil vapor may migrate.

The soil and groundwater conditions between the contamination and the residential/commercial building should be evaluated and recorded in any soil vapor intrusion investigation. If the SC/RI has been completed, then the data are available for this review. If the SC/RI has not been completed, then at a minimum the nature and extent of impacted soil and/or groundwater between the site and the residential/commercial building should be defined.

After compiling the necessary site-specific data, that information should be reviewed to determine groundwater conditions at the site. The potential for man-made or natural preferential pathways for vapor migration in the vadose zone and/or for groundwater migration in the saturated zone should also be determined at this time.

- The depth to groundwater below the residential or commercial building will be determined. For example, in cases where groundwater intersects the foundation there is no vadose zone to collect a sub-slab sample. In cases where the groundwater is close to the foundation, there is a risk of causing/exacerbating groundwater intrusion through the foundation during periods of high groundwater.

Additional Site Observations

- Direction of groundwater flow from the contaminant source to the residential or commercial building;
- The location, depth, extent, and concentration of potential constituents in unsaturated soil and groundwater on the property; and,
- Presence of an overlying water bearing zone that does not have impacts beneath the residential or commercial building. An un-impacted shallow water zone will significantly retard or completely prohibit the potential for deeper impacted groundwater to affect soil vapor.
- Potential “smear zones” (residual non-aqueous phase liquid (NAPL) present at depths over which the water table fluctuates) should also be identified as they may also affect the rate of soil vapor migration.
- Location, depth, extent of NAPL, if present.

Soils which are highly organic, wet, and/or of low permeability should be identified. If these soils are present beneath a structure and above impacted groundwater or soil, they may effectively shield the building from potential vapor intrusion. Conversely, dry and porous soils underlying a building may provide a less inhibited soil vapor intrusion pathway. The limits of backfill surrounding residential or commercial building should be also noted.

2.2.2. Building Factors

Building Factors include the physical characteristics, such as structure, floor layout, air flow, and physical conditions. These conditions will be documented during the evaluation. The New York State Department of Health (NYSDOH) Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory form is presented in Attachment A. At a minimum, the following information should be recorded.

- Building foundation construction characteristics (basement, footers, crawl spaces, etc), including potential preferential vapor intrusion pathways such as foundations cracks and utility penetrations.
- Basement wall materials (hollow block, stone, or poured concrete, etc.)
- Presence of an attached garage.
- Recent renovations to the building such as new paint or new carpet.
- Mechanical heating/cooling equipment that may affect air flow.
- Use and storage of petroleum products such as home heating oil storage tanks, underground storage tanks (USTs), or kerosene heaters.
- Recent use of petroleum-based finish or other products containing volatile organic compounds (VOCs).
- Areas of pavement on the property should also be identified in the event sub slab vapor sampling is not feasible or appropriate due to a high groundwater table. Paved areas could serve as surrogate locations in lieu of sub slab soil vapor sampling if high water table conditions exist.

The construction materials and integrity of the floor of the structure closest to the potential point of entry for soil vapor (basement level or first floor for slab-on-grade constructions) should be identified. In addition to the foundation type and integrity, this survey should note any preferential pathways (utility lines/pipes, sumps, etc.) that may exist within the bottom-most level of the structure.

The operation and presence of heating systems, including fireplaces and clothes dryers, may create a pressure differential between the structure and the outside environment, causing an increase of migration of soil vapor into the building. The NYSDOH guidance document suggests limiting indoor air sampling to the heating season (with the exception of immediate inhalation hazard situations), which is roughly defined as November 15th to March 31st. However, sampling may be completed at any time during the year for any sampling completed in response to a request by a community member. In situations where non-heating season sampling has taken place, consideration should be given to re-sampling the property within the heating season. The operation of HVAC systems should be noted on the building inventory form (Attachment A).

During the initial building assessment and visit, and again when sub-slab soil vapor and/or indoor air sampling are performed, differential pressure measurements between indoor air, ambient air, and soil vapor should be collected and recorded to document the potential effect building conditions have on soil vapor migration.

2.2.3. Property Visit

A property visit will be conducted prior to sampling. During the site visit, technical representatives will complete site visit observations, inventories and occupant questionnaire forms (Appendix A). During the course of the interview, observations will be made to identify any potential areas or issues of concern or the presence of any odors, and if sampling appears necessary, identify potential sampling points and general building characteristics. The questionnaire is also used to identify potential sources and activities that may interfere with sampling results. The questionnaire will specifically address the activities of the occupant's (e.g., smoking, work place activities) that may contribute to indoor air concentrations of volatile chemicals.

The responses to the questionnaire will be evaluated and a determination will be made as to whether additional investigation is required.

2.2.4. Chemical Inventory

The chemical inventory complements the identification of the building factors affecting soil vapor intrusion. The chemical inventory will identify the occurrence and use of chemicals and products throughout the building. These products can be used to develop an indoor environmental profile. A separate inventory should be prepared for each room on the floor being tested as well as any other indoor areas physically connected to the areas being tested. Inventories will include product names, chemical ingredients, or both. If possible, photographs of the products should be taken of the location and condition of the inventoried products and the photographic records should be indexed with the inventory records. The products inventory can also be used to document odors and if possible portable vapor monitoring equipment measurements should be taken and recorded. A product inventory will be repeated prior to each round of testing at the building. If available, the volatile ingredients should be recorded for each product. If the ingredients are not listed on the label, record the manufacturer's name and address or phone number if available. The product inventory form is presented in Attachment A.

2.2.5. Water Table Conditions and Vapor Intrusion Assessment Approach

Sub-slab soil vapor sampling is intended to evaluate the potential for vapor intrusion. However, there are circumstances where collection of sub-slab soil vapor samples may not be feasible if the water table is near, at, or above the elevation of a buildings foundation slab. An evaluation of the water table elevation relative to the building slab should be made before attempting to install a sub-slab vapor sampling point.

If the water table is found to be sufficiently below the building slab and sub-slab vapor sampling can be performed, then the following Low Water Table Scenario should be followed.

2.2.5.1. Low Water Table Scenario

If the water table elevation is lower than the basement slab, then the following samples should be collected.

- Sub-slab soil vapor samples
- Indoor air samples from basement level
- Indoor air samples from main living space (First floor)
- Outdoor ambient air sample

If the water table is deemed to be at too high of an elevation to allow sub-slab vapor sampling, then alternate means of evaluating the potential for vapor intrusion must be employed. If a building has a groundwater sump, the sump should be evaluated to determine if there is water present in the sump and if that water is representative of groundwater or if the water is stagnant. If water in the sump represents groundwater, then a sample from the sump should be collected. The High Water Scenario below summarizes the methods to evaluate potential vapor intrusion if sub-slab vapor sampling cannot be conducted due to high groundwater conditions.

2.2.5.2. High Water Table Scenario

If the water table elevation is higher than the basement slab, then the following tasks should be performed.

- Determine if a sump pump is present and actively pumping water.
- If sump is actively pumping, collect a sample of groundwater from the sump.
- Collect an indoor air sample from basement level.
- Collect an indoor air sample from main living space (first floor).
- Identify exterior soil vapor sample location near foundation (outside of foundation backfill) and preferably beneath a surrogate vapor cap (e.g. paved driveway, patio).
- Collect soil vapor samples from exterior soil vapor location
- Collect an outdoor ambient air sample.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Attachments

Attachment A - NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory Form

5. Contact

Chris Berotti

ATTACHMENT A

Off-Site Property Sampling Documentation Form

Property Location/Address: ____________________________

Property: ___________________________

Sampling Date: ___________________________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Preparer’s Name: ________________________________ Date/Time Prepared: ______________

Preparer’s Affiliation: ________________________________ Phone No.: __________________

Purpose of Investigation:____

1. OCCUPANT Interviewed: Yes ☐ No ☐

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

Number of Occupants/persons at this location _______ Age of Occupants__________________

2. OWNER OR LANDLORD (Check if same as occupant __) Interviewed: Yes ☐ No ☐

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

3. CONTACT NAME (Check if same as Occupant ____, Owner ____)

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

4. PROPERTY LOCATION: ____

Relative to Site:

Direction ________ Direction to Nearest Cross Street: _________

Distance ________ Distance to Nearest Cross Street: _________

Surrounding Land Use:

North: ________________ East: ________________

South: ________________ West: ________________

Property Location/Address: ____________________________
Property: ___________________________
Sampling Date: ___________________________

5. PROPERTY BOUNDARIES

Delineate the boundaries of the property (on a separate project map, outline property location, private well location, septic/leachfield location, groundwater flow, compass direction, windrose.)

6. BUILDING CONSTRUCTION

Type of Building (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _________________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) _____________________________________

Does it include residences (i.e., multi-use)? Yes ☐ No ☐

If yes, how many? ______

Other characteristics:

Number of floors______ Building age______

Is the building insulated? Yes ☐ No ☐ How air tight? Tight / Average / Not Tight

Construction Material ___________________________________

7. BASEMENT AND CONSTRUCTION CHARACTERISTICS

Does the building have a basement and/or crawl space, or is it slab-on-grade construction?

____

Describe the construction of the basement/crawl space (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor surface:	uncovered	covered	covered with ____________	
e. Concrete floor:	unsealed	sealed	sealed with _____________	
	unpainted	painted	painted with ____________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with _____________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

Does your basement have a sump? Yes ☐ No ☐

Is, is there water in the sump? Yes ☐ No ☐

Describe sump conditions:____

____

Have you observed standing water in your basement? Yes ☐ No ☐

If so, what is the frequency of this observation? _____________During rain events? ☐

Have you observed sheen atop the standing water? Yes ☐ No ☐

Basement/Lowest level depth below grade: ________(feet)

Are there any cracks in the floor of your basement? Yes ☐ No ☐

Description: ____

____

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Description: ____

____

What activities occur in the finished basement?

Description: ____

____

Approximately how many hours per day (or week) do you spend in your basement? __________

8. HEATING, VENTING AND AIR CONDITIONING

Type of heating system(s) used in building: (Circle all that apply – note primary)

Property Location/Address: ______________________________
Property: ______________________________
Sampling Date: ______________________________

Hot Air Circulation   Hot Water Baseboard   Steam Radiation
Electric Baseboard   Heat Pump   Wood Stove
Space Heaters   Radiant Floor   Outdoor wood boiler
Unvented Kerosene Heater   Other ______________________________

The primary type of fuel used is:

Fuel Oil   Natural Gas   Electric
Kerosene   Propane   Solar
Wood   Coal   Other? ____________________

Time of use of each type of heating? ____

Domestic hot water tank fueled by: ____

Boiler/furnace located in: Basement   Outdoors   Main Floor   Other________________

Air conditioning: Central Air   Window units   Open Windows   None

Are there air distribution ducts present?   Yes ☐   No ☐

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____
____
____
____

Type of insulation (e.g. blown, fiber, etc.)? ____

Does building have energy efficient windows (e.g. double paned)   Yes ☐   No ☐

Was weather-stripping recently added/upgraded?   Yes ☐   No ☐

Particleboard used in construction?   Yes ☐   No ☐

9. OCCUPANCY

Property Location/Address: ______________________________
Property: ______________________________
Sampling Date: ______________________________

Level	General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)
Basement	____
1st Floor	____
2nd Floor	____
3rd Floor	____
4th Floor	____

10. BULK PETROLEUM STORAGE

Aboveground storage tank on the property Yes ☐ No ☐

If yes, how old is tank? ________________ Condition? ___________________

Last inspected? ________________ Location: _____________________

Describe conduits to building (type, location, and entry portal condition): __________________

____

Underground storage tank on the property. Yes ☐ No ☐

If yes, how old is tank? ________________ Condition? ___________________

Last inspected? ________________ Location: _____________________

Describe conduits to building (type, location, and entry portal condition): __________________

____

11. WATER AND SEWAGE

Water Supply:

Public Water Drilled Well Driven Well Dug Well Other _______________

Is there use of groundwater water for irrigation purposes? Yes ☐ No ☐

Sewage Disposal:

Public Sewer Septic Tank Leach Field Dry Well Other _______________

12. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Yes ☐ No ☐

If not, is there a separate garage or carport? Yes ☐ No ☐

b. Does the garage have a separate heating unit? Yes ☐ No ☐ NA ☐

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)
Yes ☐ No ☐ NA ☐ Please specify__________________

Is gasoline stored in the garage? Yes ☐ No ☐

Quantity? ________________

d. Has the building ever had a fire? Yes ☐ No ☐

When?_________________

e. Is a kerosene or unvented gas space heater present? Yes ☐ No ☐

Where? ________________

f. Is there a workshop or hobby/craft area? Yes ☐ No ☐

Where & Type? ________________

g. Is there smoking in the building? Yes ☐ No ☐

How frequently? _______________

h. Have cleaning products been used recently? Yes ☐ No ☐

When & Type? ________________

i. Have cosmetic products been used recently? Yes ☐ No ☐

When & Type? ________________

j. Has painting/staining been done in the last 6 months? Yes ☐ No ☐

Where & When? _______________

Is house paint stored inside? Yes ☐ No ☐

Where? _______________

k. Is there new carpet, drapes or other textiles? Yes ☐ No ☐

Where & When? _______________

l. Have air fresheners been used recently? Yes ☐ No ☐

When & Type? ________________

m. Is there a kitchen exhaust fan? Yes ☐ No ☐

If yes, where vented?____________

n. Is there a bathroom exhaust fan? Yes ☐ No ☐

If yes, where vented?____________

o. Is there a clothes dryer? Yes ☐ No ☐

If yes, is it vented outside? Yes ☐ No ☐

p. Has there been a pesticide/chemical fertilizer application? Yes ☐ No ☐

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

When & Type?____

Conducted by Owner or Private Yard Service ___________________________

Is yard waste/trash burned on-site? Yes ☐ No ☐

Do any of the building occupants use solvents at work? Yes ☐ No ☐

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Yes ☐ No ☐

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, Use dry-cleaning regularly (weekly) No

Use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Yes ☐ No ☐

Date of Installation: ____________

Is the system active or passive? Active ☐ Passive ☐

Are there any recent/past improvements to building? Yes ☐ No ☐

Interior painting? ____

Any landscaping improvements that involved bringing fill on site? Yes ☐ No ☐

Other ____

Approximately when (how long ago) did these improvements occur? ______________

Does anyone living here engage in any of the following activities or hobbies?

a. Art projects (e.g. oil painting, ceramics, pottery, stained glass, metal sculpture)

Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

Property Location/Address: ____________________________
Property: ___________________________
Sampling Date: ___________________________

b. Furniture refinishing Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________
Name: ____________________________ Age: _________ Sex: _____________

c. Model building(e.g. planes,boats,cars) Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________
Name: ____________________________ Age: _________ Sex: _____________

d. Gardening Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________
Name: ____________________________ Age: _________ Sex: _____________

e. Automotive work Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________
Name: ____________________________ Age: _________ Sex: _____________

f. Ammunition reloading Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________
Name: ____________________________ Age: _________ Sex: _____________

Is there a wood burning stove? Yes ☐ No ☐

If so, how frequently is it used?

____
____

Is there a barbeque grill? Yes ☐ No ☐

If so, how frequently is it used? What is the type of fuel?

____
____

Has the building ever had fumigation? Yes ☐ No ☐

Property Location/Address: ____________________________
Property: ____________________________
Sampling Date: ____________________________

If so, when and how frequently? Type?

____

____

13. ODOR SUMMARY

Have the occupants observed any unusual odors? ________________________________

____

____

____

____

History of odor observation – date of onset, duration, severity, etc.

____

____

____

____

____

____

____

14. PRODUCT INVENTORY

Record the specific products found in building that have the potential to affect indoor air quality on the attached product inventory form.

15. INDOOR SKETCH

Draw a plan view sketch (on grid paper) of the basement, first floor, and any other floor where sampling was conducted in the building as well as any outdoor sample locations. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Product Inventory
Off-Site Property Sampling Documentation
Soil Vapor Intrusion Investigation

Property Address:	**Performed by:**
Date of Inventory:	**Field Instrument Make & Model:**

Location	Product Description	Size (units)	Condition *	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y/N

Notes

* Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D)

** Photographs of the front and back of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

STANDARD OPERATING PROCEDURE

SG-002 Soil Vapor Sample Collection

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1. Objective

This procedure outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary soil vapor probes should be installed using the procedures outlined below. All soil vapor probes should be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe points.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North);
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Soil Vapor Point Installation Specifications

Each soil vapor point should be constructed as follows:

- Six-inch stainless steel Geoprobe® AT86 series Permanent Implants (soil vapor screens) or equivalent and threaded to an (expendable) stainless steel anchor point.
- The implants should be fitted with inert Teflon or stainless steel tubing of laboratory or food grade quality.
- The annular space surrounding the vapor screen interval and a minimum of 6-inches above the top of the screen should be filled with a porous backfill

material (e.g., glass beads or coarse silica sand) to create a sampling zone 1 foot in length.

For temporary points, a hydrated bentonite surface seal should be created at the surface to minimize infiltration. For permanent points, the additional measures described below should be included.

- The soil vapor points should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet (or to grade, whichever is smaller) to prevent ambient air infiltration.
- If needed, the remainder of the borehole should be backfilled with clean material.
- A protective casing should be set around the top of the point tubing and grouted in place to the top of the bentonite to minimize infiltration of water or ambient air, as well as to prevent accidental damage to the soil vapor point.
- The tubing top should be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

2.3. Soil Vapor Sample Collection

Soil vapor samples should be collected as indicated in the work plan and in accordance with applicable state or federal guidance documents. Specifically, samples from the points should be collected as follows:

- Permanent soil vapor points should not be sampled or purged for a minimum of 24 hours after installation. Temporary points may be purged and sampled immediately following installation.
- Document pertinent field conditions prior to sampling as described above.
- A suction pump should be used to remove a minimum of three implant volumes from the soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples should be collected for volatile organic compounds (VOCs) in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate should not exceed 0.2 liters per minute.
- A helium tracer gas should be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing

laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Connect the tubing from the soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample should be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data should be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample.

A tracer gas evaluation should be conducted on the each temporary soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent soil vapor probe during the initial sampling event and a minimum of 10% of the soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.

- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber should have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber should have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that should be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary.

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred, however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-003 Sub-slab Soil Vapor Collection

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1. Objective

This procedure outlines the general steps to collect sub-slab soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary sub-slab soil vapor probes will be installed using the procedures outlined below. All sub-slab soil vapor probes will be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe locations.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions (temperature, heating/cooling system active, windows open/closed, etc.).
- Measure the differential pressure at the building. Measure the indoor and outdoor barometric pressure using a high resolution device. Where possible, measure the sub-slab barometric pressure at the sampling point.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Indoor floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, heating, ventilating and air conditioning (HVAC) system air supply and return registers, compass orientation (North), footings that create separate foundation sections, and any other pertinent information should be completed;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sub-Slab Soil Vapor Point Installation Specifications

Each sub-slab soil vapor point will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab. If necessary, advance the drill bit 2-3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert Teflon or stainless steel tubing of laboratory or food grade quality, insert the inlet of the tubing to the specified depth below the slab. For permanent installation, only stainless steel tubing and fittings will be used.
- For permanent point installations, the annular space surrounding the vapor probe tip will be filled with a porous backfill material (e.g., glass beads or coarse silica sand) to cover 1-inch of the above the tip of the probe.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100% beeswax, permagum grout, putty, etc. For permanent installations, cement may be used.
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place minimize infiltration of water or ambient air, as well as to prevent accidental damage to he permanent point.
- The tubing top will be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

In cases where sub-slab sampling is impractical or infeasible, a surrogate location (attached garage, concrete patio, asphalt driveway, etc.) may be used if it is representative of sub-slab conditions. In surrogate locations, the vapor sampling point may be installed in accordance with SOP SG-002 Soil Vapor Collection.

2.3. Sub-Slab Soil Vapor Sample Collection

Sub-slab soil vapor samples will be collected as indicated in the site-specific Sampling and Analysis Work Plan and in accordance with state or Federal guidance documents. Specifically, sub-slab samples from the points will be collected as follows:

- Document pertinent field conditions prior to sampling as described above.
- A suction pump will be used to remove one to three implant volumes from the sub-slab soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples will be collected in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate will not exceed 0.2 liters per minute.
- A helium tracer gas will be used to identify any potential migration or short circuiting of ambient air during sampling as described below.

- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the sub-slab soil vapor probe seal and assess the potential for introduction of indoor air into the sub-slab soil vapor sample. A tracer gas evaluation should be conducted on the each temporary sub-slab soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent sub-slab soil vapor probe during the initial sampling event and a minimum of 10% of the sub-slab soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

- Retain the tracer gas around the sub-slab sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the sub-slab soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract sub-slab soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and purge one to three tubing volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation will be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary:

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred; however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

---

1. Objective

Describe standard procedures for the collection of discrete or composite surface and subsurface soil samples.

The definition of “surface” soil varies considerably between regulatory organizations. Surface soils may be classified as soils between the ground surface and 2 inches below ground surface, ground surface and 6 inches below ground surface, and ground surface and 24 inches below ground surface.

Overall, the definition of subsurface soil will vary in relation to the definition of surface soil. In general, subsurface soil is everything deeper than surface soil.

Refer to state-specific regulations for the definitions of surface and subsurface soils, as applicable.

2. Execution

2.1. Pre-Planning

A general understanding of site features and a basic conceptual site plan are important in determining soil sample locations and depths that are likely to be most representative of site conditions.

- In general, a background review and an inspection of the site, if possible, should be completed to identify pertinent site features (e.g. rock outcrops, drainage, surface water run-off, surface water features, wet areas, fill areas etc.).
- Additionally, an adequate number of soil samples should be collected and submitted for chemical analysis and contaminant source characterization (as applicable). It is noted that contaminant delineation is often an iterative process, with the potential need for additional sampling depending on the results of previous sampling. Sufficient samples are needed to adequately delineate the horizontal and vertical extent of contamination. What is considered sufficient is dependent on the scope and desired goals of the project.

2.2. Sample Locations

- Environmental soil sample locations may be selected either:
  (i) Randomly from several areas within the site;
  (ii) Based on observations made by field personnel which may be indicative of the presence of contamination, such as staining, odors, or vegetative stress; and/or,

(iii) Field/headspace screening readings obtained from a hand-held gas detector used to identify the potential presence and relative magnitude of chemical contamination.

- Soil screening (as applicable), whether based on qualitative observations or quantitative readings, is conducted to facilitate the selection of the number, location and depth of soil samples that will be collected for laboratory analysis. Careful screening will help to reduce the number of soil samples requiring laboratory analysis, thereby optimizing the sampling program.
- Consideration should be given to the presence of structures and drainage pathways that may affect the contaminant migration pathway(s).
- If the potential for, or area of, contamination is not evident, then soil sample locations may be randomly selected. When soil sampling investigations involve a large area, a grid-based soils sampling program can be used, depending on the scope of the project.

2.3. Surface Soil Sampling

Collection of surface soil samples or soil samples within a safely accessible excavation can be accomplished with sample collection devices such as spades, shovels, trowels, scoops, etc. A flat, pointed sample collection device to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned sample collection device.
- Using a decontaminated sample collection device, remove and discard a thin layer of soil from the area which contacted the device.
- If volatile organic compound (VOC) analysis is to be performed, care should be taken during sampling to limit the potential for VOCs to off-gas from the soil sample prior to being analyzed by the laboratory. Transfer the sample directly into an appropriate, labeled sample container and secure the cap tightly.
- Place the remainder of the sample into a decontaminated stainless steel, plastic, or other appropriate container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.
- Either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the container and mix thoroughly.
- When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

2.4. Sampling with Hand Augers and Thin Wall Tube Samplers

Several types of augers are available; these include bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are generally better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and generally cannot be used below a depth of approximately three feet.

2.2.1 Auger Sampling

- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the sampling location.
- Attach the decontaminated auger bit to an extension rod and attach the "T" handle to the rod.
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole and avoids possible contamination of the surrounding area.
- After reaching the desired depth, carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole.

2.2.2 Thin-Walled Core Sampling

- Remove the auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- Remove the tube sampler and unscrew the drill rods.
- Remove the cutting tip and the core from the device.
- Discard the top of the core (approximately 1 inch), as this may represent material knocked down from the sides of the boring and not the layer of interest. Place the remaining core into the appropriate, labeled sample container.

One type of thin-wall sampler is depicted in Attachment A (this is typically used with a mechanical drill rig).

For either method, if VOC analysis is to be performed, transfer the sample into an appropriate, labeled sample container and secure the cap tightly. VOC samples should be collected first to minimize the potential for losing volatiles prior to sample collection.

Place the remainder of the sample into a stainless steel, plastic, or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the container and mix thoroughly.

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow previous steps, making sure to decontaminate the auger and tube sampler between samples.

Abandon the hole according to applicable state regulations or project specifications. Generally, shallow holes can simply be backfilled with the removed soil material.

2.5. Sampling at Depth with a Split-Spoon (Barrel) Sampler

Split-spoon sampling is generally used with a mechanical drill rig to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split-spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. A diagram of the split-spoon sampler assembly is provided as Attachment A.

When split-spoon soil sampling is performed to gain geologic information, work should be performed in accordance with ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split-spoon:

- Select the size (length and diameter) of split-spoon sampler based on the amount of soil that is needed for characterization. The ASTM standard for N-values is 1 3/8 - inch I.D. (2-inch O.D.). Specify spoon size and basket type to the driller prior to mobilization to the site. Split spoon samplers are typically available in 1 3/8 – and 3 – inch I.D. sizes. A larger barrel may be necessary to obtain the required sample volume. Note on the boring log where larger split spoon barrels are used because the ASTM standard penetration test does not apply when driving split spoons larger than 1 3/8 I.D. (2-inch O.D.).
- Select a soft or stiff basket for the spoon (a softer basket generally works better for loose or soft material).
- Prior to hammering the split spoon to collect the sample, verify that the split-spoon is seated at the beginning of the desired sample interval. If it is seated above the interval, have the driller clean out the hole prior to sampling. Record all depth measurements relative to ground surface.

- Assemble the sampler by aligning both sides of the barrel and then screwing the drive shoe on the bottom and the head piece on top. See diagram in Attachment A.
- Place the sampler in a perpendicular position on the sample material.
- For all soil samples, use a 140-lb hammer falling 30 inches to drive the sampler, unless conditions necessitate using a 300-lb hammer.
- Record in the site field book or on field data sheets the length of the tube used to penetrate the material being sampled, the split-spoon inside and outside diameters, and the hammer weight.
- Count and record the number of blow counts per 6-inch increments (confirming blow counts with driller if necessary).
- Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The length of recovery and soil type should be recorded on the boring log. If a soil sample is desired, a decontaminated stainless steel knife or spatula should be used to divide the tube contents in half, longitudinally. If possible, avoid collecting soil that has come in contact with the walls of the spoon, and soil at the top of the spoon.
- Without disturbing the core, transfer it to appropriate, labeled sample container(s) and seal tightly.
- Note any material in the nose (shoe) of the spoon.
- Immediately collect a sample for VOCs (if required by the site-specific field sampling plan) by collecting soil from the entire length of the split spoon, unless otherwise specified by the Project Manager. When the most impacted interval is sampled for laboratory analysis, screen the spoon with the field instrument first, then collect the soil sample for VOC analysis from the appropriate interval.

3. Limitations

- Weather conditions (e.g., frozen ground) may prevent the collection of samples and should be considered prior to sample collection.
- Tools plated with chrome or other materials should not be used.
- Be aware of local laws regarding subsurface utility clearance prior to conducting subsurface investigations. Contact local utility companies as required.
- Be aware of the length of the drill string, the sample depth, and the required stickup of the drill string to ensure accurate sample interval measurement.
- If drilling with hollow-stem augers, the removal of the drill string from the hole, prior to attaching the split-spoon sampler, may cause soils to be sucked up into the augers (blow-in running sands). Upon recovery, determine if there is blow-in in the split spoon sampler. In general, blow-in is more unconsolidated than the rest of the sample and lacks stratification (do not include blow-in for recovery of sample collection).
- If soils consist of loose sands or soft clay, the drill string and sampler may advance slightly under its own weight, giving a false depth for soil collection.

- Never sample more than two spoons consecutively without advancing the augers unless material is tight. Do not let the split spoon penetrate more than it can hold.
- In many instances, groundwater will fill the auger and the split-spoon.

4. References

ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". 2008.

United States Environmental Protection Agency, SOP 2012 “Soil Sampling”, Revision 0.0, February 18, 2000.

5. Attachments

Attachment A - Sampler Design Assembly

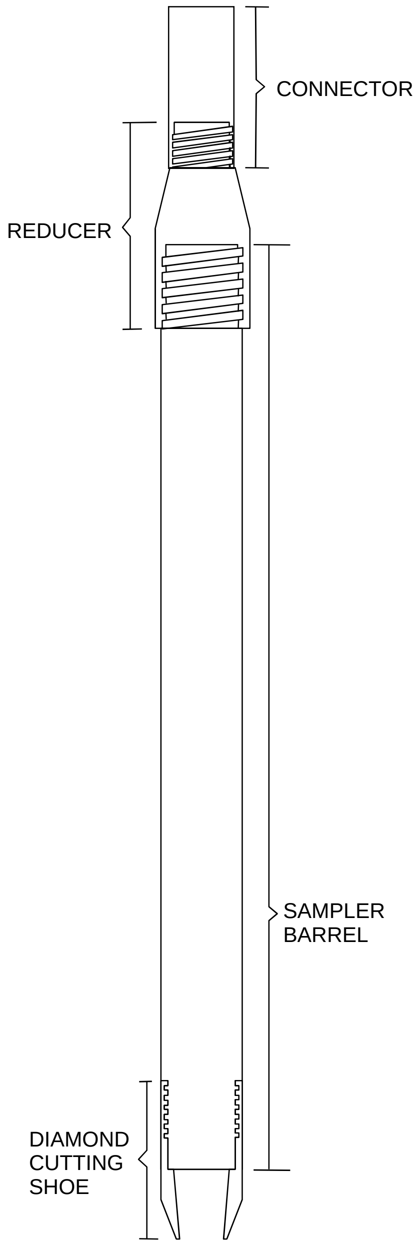
6. Contacts

Brad Dal Santo
Ken Kytta

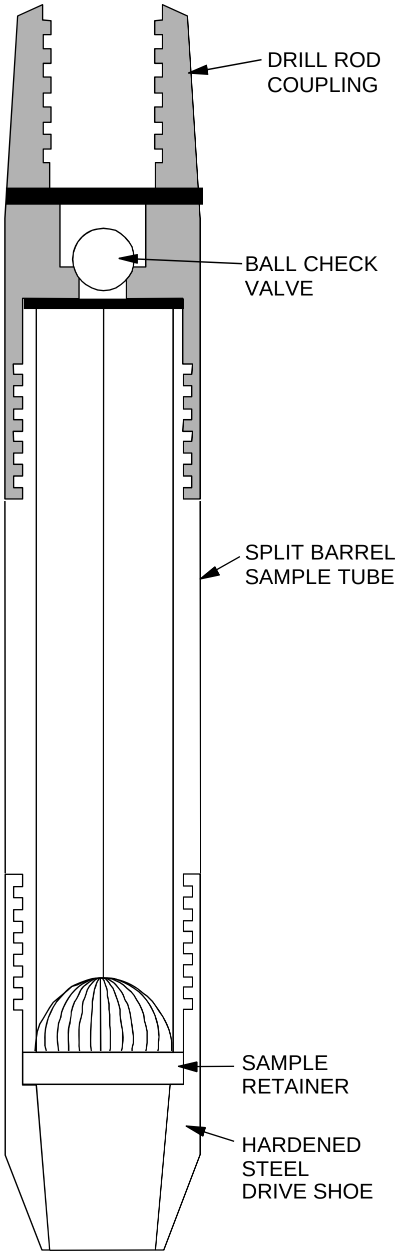
7. Revision Log

Revision No.	Date of Revision	Individual Sections Revised	Comments
0	11/11/2024		BJD

THIN WALL HQ CORE SAMPLER
(2" width x 60" length)



SPLIT-SPOON SAMPLER
(2" width x 24” length)



STANDARD OPERATING PROCEDURES

SM-001 SOIL SAMPLING TECHNIQUES

GEI Consultants

January 2011

THIN WALL AND SPLIT-SPOON SAMPLERS

Attachment A

I:\STANDARD\DETAILS\SUBSURFACE\SAMPLERS\SPLIT-SPOON.ppt

STANDARD OPERATING PROCEDURE

SM-003 Classification of Soil Samples in the Field

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1. Objective

Describe methods to classify soil samples collected in the field in a consistent manner.

2. Execution

- Describe soil samples according to *ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and* Attachments A and B*.* This standard is the basis for the Unified oil Classification System.
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment C).
- GEI consistently applies one modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded," respectively.

3. Limitations

Certain projects or clients will require the use of other classification systems. Other classification systems should not be used unless specifically required by the client. If the client requires that we use the Burmister method, obtain the details from the client. An example breakdown is shown below, but some clients (MassDOT, for example) have their own breakdown.

- “and” = 35-50%
- “some” = 20-35%
- “little” = 10-20%
- “trace” = 1-10%

- Describing soil samples is often difficult during cold or wet weather. Make sure your field notes describe these conditions. When possible, collect archive samples and verify sample descriptions in the office.

- The ASTM Standard Practice for Classification of Soils for Engineering Purposes (D2487) may be used in conjunction with the Visual-Manual Method to confirm the soil classification. D2487 includes laboratory testing.

4. References

ASTM D2487-06e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM, 2006.

ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM, 2009.

Field Guide for Soil and Stratigraphic Analysis, Midwest Geosciences Group Press, 2001-2005.

Coarse-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

Fine-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

5. Attachments

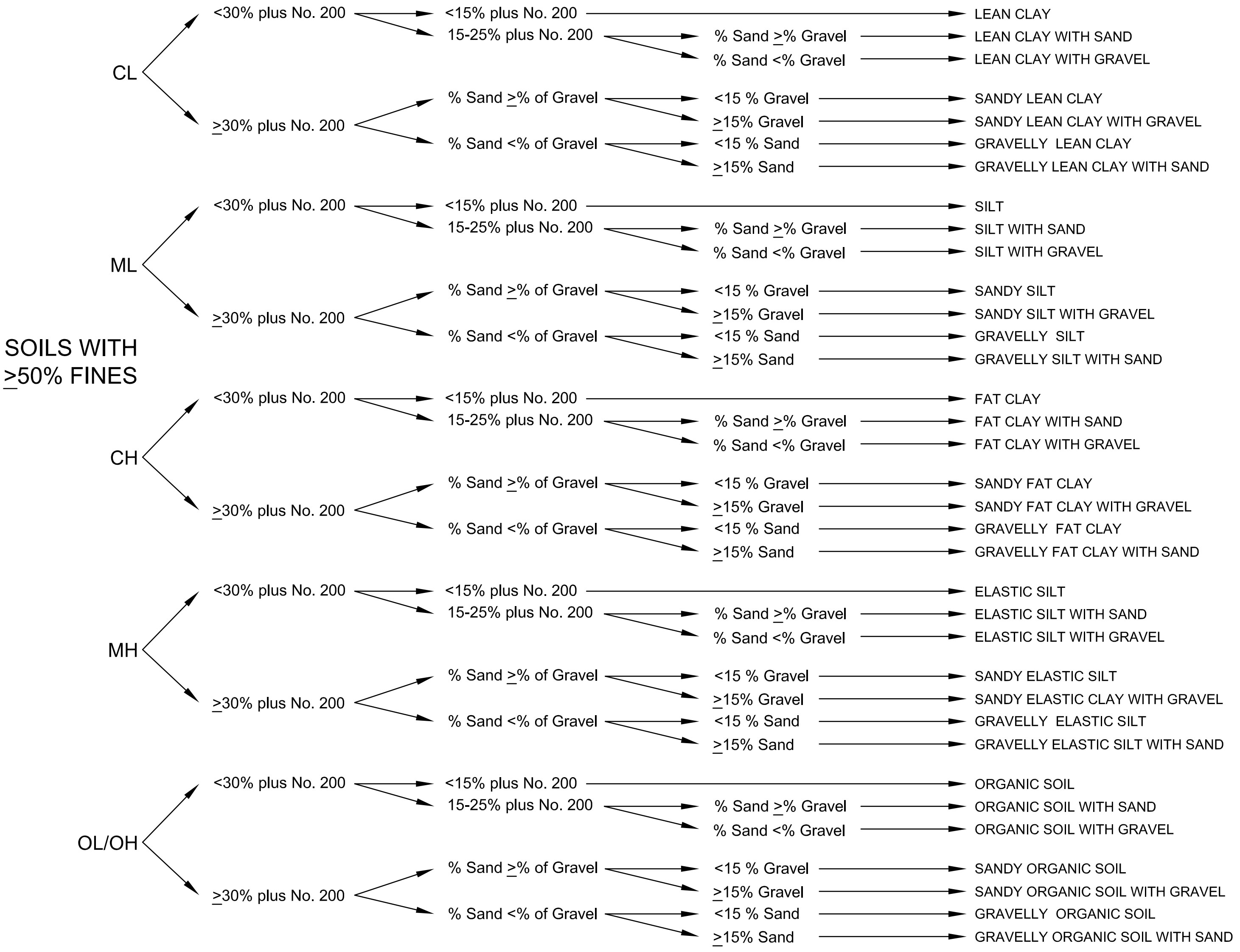
Attachment A – GEI Soil Description Charts (2007)
Attachment B – Visual Manual Descriptions with example boring log
Attachment C – Describing the Plasticity of Soil Samples

6. Contacts

Lynn Willey
Cathy Johnson

FINE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

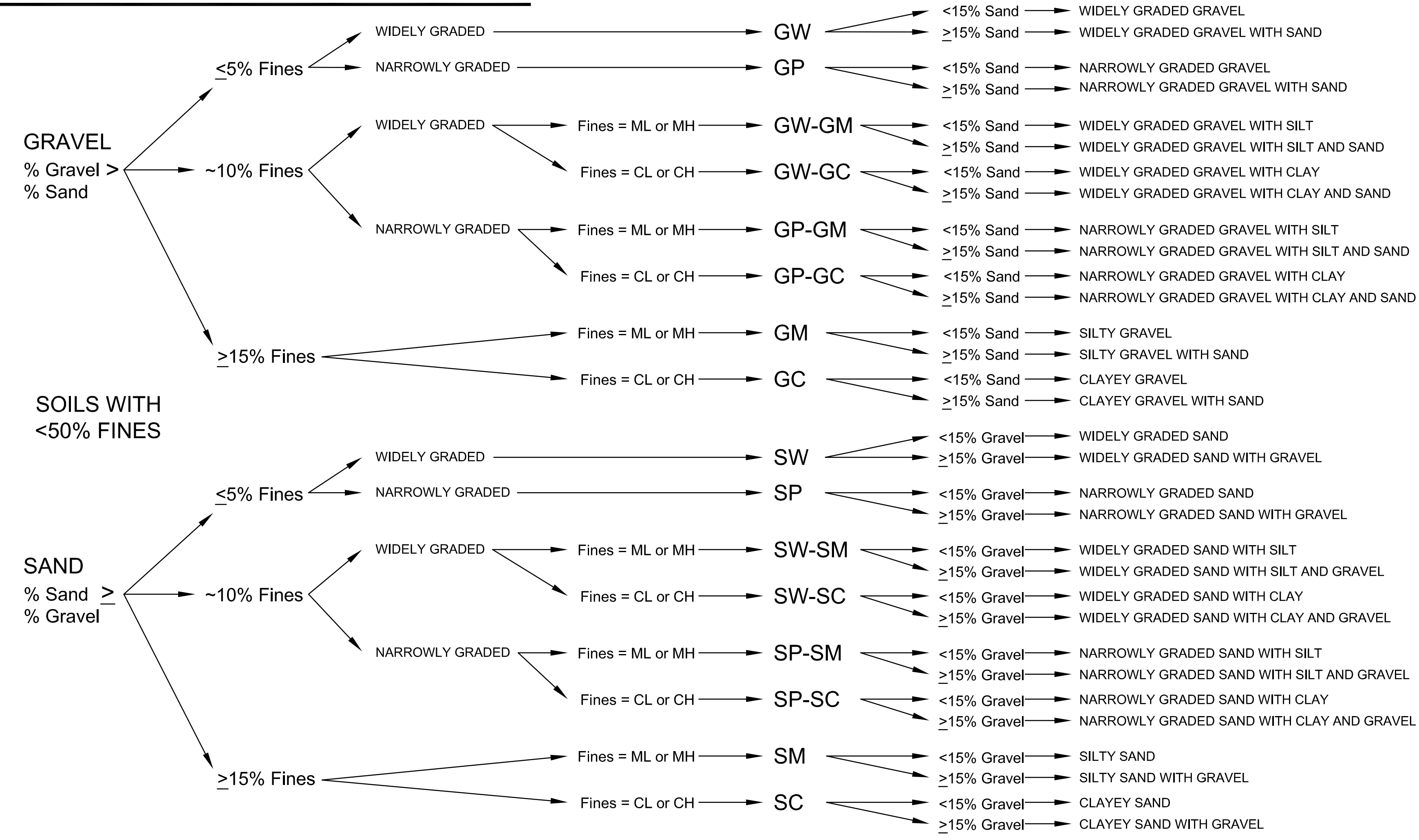
GEI Consultants

COARSE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

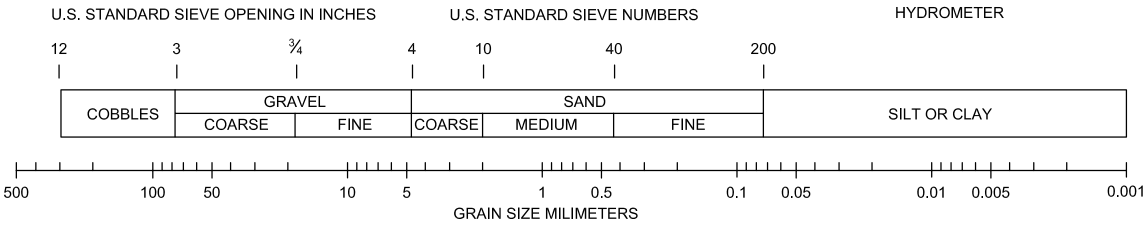
TYPICAL SOIL COLORS

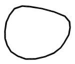
- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK



SOILS WITH <50% FINES

				GROUP SYMBOL		GROUP NAME
GRAVEL % Gravel > % Sand	≤5% Fines	WIDELY GRADED		GW	<15% Sand	WIDELY GRADED GRAVEL
					≥15% Sand	WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED		GP	<15% Sand	NARROWLY GRADED GRAVEL
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH	GW-GM	<15% Sand	WIDELY GRADED GRAVEL WITH SILT
					≥15% Sand	WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GW-GC	<15% Sand	WIDELY GRADED GRAVEL WITH CLAY
					≥15% Sand	WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH	GP-GM	<15% Sand	NARROWLY GRADED GRAVEL WITH SILT
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GP-GC	<15% Sand	NARROWLY GRADED GRAVEL WITH CLAY
					≥15% Sand	NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH	GM	<15% Sand	SILTY GRAVEL
					≥15% Sand	SILTY GRAVEL WITH SAND
			Fines = CL or CH	GC	<15% Sand	CLAYEY GRAVEL
					≥15% Sand	CLAYEY GRAVEL WITH SAND
SAND % Sand ≥ % Gravel	≤5% Fines	WIDELY GRADED		SW	<15% Gravel	WIDELY GRADED SAND
					≥15% Gravel	WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED		SP	<15% Gravel	NARROWLY GRADED SAND
					≥15% Gravel	NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH	SW-SM	<15% Gravel	WIDELY GRADED SAND WITH SILT
					≥15% Gravel	WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SW-SC	<15% Gravel	WIDELY GRADED SAND WITH CLAY
					≥15% Gravel	WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH	SP-SM	<15% Gravel	NARROWLY GRADED SAND WITH SILT
					≥15% Gravel	NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SP-SC	<15% Gravel	NARROWLY GRADED SAND WITH CLAY
					≥15% Gravel	NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH	SM	<15% Gravel	SILTY SAND
					≥15% Gravel	SILTY SAND WITH GRAVEL
			Fines = CL or CH	SC	<15% Gravel	CLAYEY SAND
					≥15% Gravel	CLAYEY SAND WITH GRAVEL

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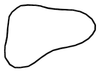
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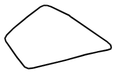
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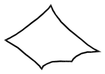
ANGULAR

1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

Describing the Plasticity of Soil Samples

M. Paster – November 2008

References ASTM D 2487 – Soil descriptions – lab
ASTM D 2488 – Soil descriptions – field
ASTM D 4318 – Atterberg limits testing

GEI Practice for Boring and Test Pit Logs

Describe the fines as:

Non-plastic
Low plasticity (The GEI laminated sheets incorrectly use "slightly plastic" for "low plasticity.")
Medium plasticity
High plasticity

Example: ~25% low plasticity fines

Toughness and dry strength:

You should use these tests to help decide how plastic the fines are. Record the results in the remarks column of the field log, but not in the soil description and not necessarily in the typed log.

On final logs, if Atterberg limits tests have been performed:

Do not use the descriptive terms non-plastic, low plasticity, etc. for samples on which Atterberg limits tests have been run. Instead, just give the percentage of fines and then report the actual Atterberg limits at the end of the description.

For example, the end of a silty sand description might be:

. . . ~25% fines, ~10% gravel max size ½ inch, gray. PL=23, LL=35.

(Atterberg limits tests are performed on the fraction of the sample finer than the No. 40 sieve, not just the fines. So the Atterberg limits data applies to the sample, not just to the fines.)

Hints:

High plasticity soils are rare in New England. If you think it's high plasticity, it's probably medium. Some Boston blue clay and some Connecticut River varved clays are high plasticity, but if you think you've found some, check with the project manager.

In New England, if ~10% fines or more, generally stick with GM, SM, ML, and CL. Occasionally GC, SC, CH. Don't use MH unless you have Atterberg limits data.

Estimating plasticity in the field, GEI guidance based on ASTM D 2488:

Plasticity	1/8-inch thread	Dry strength	Toughness
non	Cannot be rolled at any water content.	Dry specimen crumbles when handled.	Only slight pressure needed to roll thread near plastic limit.
low	Thread can barely be rolled.	Dry specimen crumbles with some finger pressure.	Slight to medium pressure needed to roll thread near plastic limit.
medium	Thread is easy to roll. Not much time needed to reach plastic limit.	Dry specimen crumbles with considerable finger pressure.	Medium pressure needed to roll thread near plastic limit.
high	Takes considerable time rolling and kneading to reach plastic limit.	Dry specimen cannot be broken with finger pressure.	Considerable pressure needed to roll thread near plastic limit.

Non-plastic vs. low plasticity:

ASTM D 2488 (soil descriptions - field) defines non-plastic and low plasticity based on the 1/8-inch thread as shown in the table above.

ASTM D 4318 (Atterberg limits testing) indicates that a sample should be called non-plastic for either of the following cases:

- The liquid limit test (dropping the cup) or the plastic limit test (rolling out the thread) cannot be performed because the plasticity is too low.
- The plastic limit is greater than or equal to the liquid limit.

Unfortunately, there are some soils that are low plasticity based on D 2488 (a thread can be rolled), but are non-plastic based on D 4318 (the liquid limit cannot be measured or $PL \geq LL$).

GEI considers these soils to have low plasticity, because that is how they “look” and “feel.” We want to document this information so that other people will have a better feel for what the soil looks like and how it behaves. So, if the soil was low plasticity based on D 2488, but non-plastic based on D 4318, that should be explained in the letter or report, and possibly in a note on the log.

BORING LOCATION Maple Ave Sidewalk
GROUND ELEVATION (NGVD)
GROUNDWATER EL. DATE
DATE START/FINISH 2/14/07 - 2/15/07
DRILLED BY Geologic: M. Costigan
LOGGED BY T. Kahl/M. Yako TOTAL DEPTH (FT) 25

B101

PG. 1 OF 1

EL. FT.	DEPTH FT.	SAMPLE TYPE and NO.	SAMPLE BLOWS PER 6 IN.	SAMPLE PEN IN.	SAMPLE REC IN.	PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS
								4" pavement
	2.5	S1	13-9 17-14	24	0	0.5 ppm		S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sand, ~10% gravel to 1", <5% nonplastic fines, brown. Contains brick fragments and ash. Fill.
	5					hard drilling 3 to 4 ft, possible boulder		
		S2	7-7 11-13	24	8	2.0 ppm	FILL	S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% gravel to 3/4 inch ~10% non-plastic fines, brown. Fill.
	7.5	S3	9-10 2-1	24	16	0.0 ppm		S3 (0-10"): Similar to S2.
	10						ORGANICS	S3 (10"-16"): ORGANIC SILT (OL) ~100% slightly plastic fines, dark gray, organic odor, contains white shell fragments.
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm		
	15					hard drilling at 15.5 ft		S4: Similar to S3, bot 6".
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.	TILL	S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sand, ~25% slightly plastic fines, ~15% gravel to 1/2 inch, olive. Glacial Till.
	20							
	22.5	C1	RQD 70%	60	54	lost ~10 gallons drill fluid from 23 to 25 ft	ROCK	C1: SCHIST, hard, slight weathering at joint surfaces, joints at ~30 degrees from horizontal and generally parallel to foliation, gray. Marlborough Formation.
	25							Bottom of Boring 25 ft Truck-mounted drill rig. 4-inch casing to 19 ft. Safety-hammer with rope and cathead for SPT. Backfilled with drill cuttings.
	27.5							
	30							

BLOWS PER 6 IN.–140 LB. HAMMER FALLING 30 IN. TO DRIVE A 2.0 IN. OD SPLIT SPOON SAMPLER
PEN–PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC–RECOVERY LENGTH OF SAMPLE
RQD–LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, %
S–SPLIT SPOON SAMPLE
U–UNDISTURBED SAMPLES,
UF–FIXED PISTON
UO–OSTERBERG
▽ GROUNDWATER

NOTES:
1: Groundwater at 10 ft depth at start of day 2/15/07.

PROJECT 07999-0
DATE

GEI Consultants

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. Sv = 0.5, 0.5, 0.8 tsf, Qp = 1.0, 1.5, 1.6 tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.
(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

ARGILLITE, medium hard, moderately weathered joints, gray. Cambridge Argillite.

GEOPROBE AND ROTOSONIC

When SPTs are not performed, note sample density (sands) or stiffness (clays) in description.

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

SPT: Standard Penetration Test

30-inch drop with 140-lb hammer
1 3/4 to 2 1/4 turns around cathead
2-inch O.D. split spoon sampler

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

- **Ash** - Typically silt-size to medium sand-size.
- Do not use the term "cinders." This is not a technical term. Instead, use "ash," "burnt wood," "burnt material," or a similar term.
- **Coal-like material** - If it looks like coal but you aren't sure.
- **Clinker** - Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag** - Similar to clinker, but normally refers to residue from metal ore processing.

- **Sheen** - Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained** - Use with a color ("brown-stained") to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated** - Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor.")
- **Saturated** - The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs** - Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("Occasional blebs of reddish-brown tar.")
- **Oil** - Exhibits a petroleum odor, different from MGP odors.
- **Tar** - Exhibits an MGP odor (e.g. naphthalene-like odor).

- **Odors** - Use terms such as "naphthalene-like odor" or "petroleum-like odor." Use modifiers (strong, moderate, slight) to indicate odor intensity.

STANDARD OPERATING PROCEDURE

SW-001 Surface Water Sampling

---

1. Objective

Describe methods used to collect representative surface water samples.

This standard operating procedure (SOP) is applicable to the collection of representative surface water samples from streams, rivers, ditches, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth as well as samples collected from the surface. Location, equipment, and sampling situations will dictate the applicable method of sample collection for each point. Four recommended techniques for collecting representative surface water samples are:

- Kemmerer bottle
- Van Doran sampler
- Direct method
- Peristaltic pump

Materials

Depending on the sampling method, the following is a list of typical equipment that may be used for collection of surface water samples:

- Kemmerer bottles
- Van Doran sampler
- Hand-held dipper
- Line and messengers
- Peristaltic pump
- Teflon™/polyethylene tubing
- Laboratory provided sample bottles
- Resealable plastic bags Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Nitrile gloves
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent marker
- Sample bottle labels
- Paper towels
- Secchi Disk – Illustration provided as Figure 1

- Personal Protection Equipment (PPE)
- Global Positioning System (GPS) survey equipment or another appropriate method to document the location of surface water sampling locations.

2. Execution

2.1. Pre-Sampling Procedures

2.1.1. Sample Location

Samples should be collected from locations that are selected based upon knowledge of site conditions and the objectives of the sampling program. The location of the sampling point in relation to a potential source area is an important consideration. For instance, if the objective is to determine the overall water quality of a stream, a sample can be obtained from the center of the channel. Whereas, if the objective is to determine the quality of ground water discharging to a stream, a sample may be taken along the stream bed close to the interpreted source area.

Sample locations should be established relative to known reference points, including existing structures (e.g., culverts, bridges, outfalls, etc.). A GPS navigation system may be used to identify and record the sample location coordinates. The proposed locations may be adjusted if there are issues with sample location access and/or obstructions. Location changes should be recorded appropriately in a field notebook.

2.1.2. Water Quality Data

If applicable to the project, water quality data may be collected during sampling from the sample depth interval, if appropriate, using an appropriate instrument to measure select water quality parameters (e.g., pH, specific conductance, temperature, turbidity, dissolved oxygen, and/or oxidation-reduction potential). In addition, water clarity may be measured at each sample location using a secchi disk (Figure 1). If utilized, the water quality meter should be calibrated daily in accordance with manufacturer's specifications.

2.2. Sample Collection Methods

2.2.1. Kemmerer Bottle

A Kemmerer bottle can be used in most situations to collect representative samples from specific depths. A picture of the Kemmerer bottle is provided as Figure 2. Sampling procedures are as follows:

- Prior to sample collection, properly decontaminate the Kemmerer (see SOP QA-001 Equipment Decontamination). The sampling device should be set so that the upper and lower stoppers pull away from the body of the sampler, allowing the surface water to enter tube.
- Lower the pre-set sampling device to the predetermined depth while avoiding disturbance of the bottom sediments.
- When the Kemmerer bottle is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.

- Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve.
- This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited (except for samples analyzed for volatiles) or transferred directly to appropriate sample containers.

2.2.2. Van Doran Sampler

A Van Doran sampler can be used to collect surface water from very specific sampling depths or from a shallow water body. A picture of the Van Doran sampler is provided as Figure 3. Since the sampler is suspended horizontally, the depth interval sampled is equal to the diameter of the sampling tube. The sampling procedure is as follows:

- Prior to sample collection, properly decontaminate the Van Doran Sampler (see SOP QA-001 Equipment Decontamination). The sampling device should be set so that the end stoppers are pulled away from the body allowing surface water to enter the tube.
- Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom sediments.
- When the Van Doran is at the selected depth, send the weighted messenger down the suspension line, closing the sampling device.
- Retrieve the sampler and discharge the first 10-20 mL from the drain to clear potential contamination from the valve.
- This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited (except for samples analyzed for volatiles) or transferred directly to appropriate sample containers.

2.2.3. Direct Method

For surface water samples collected within the top 6-inches of the water column, or in waters shallow enough that wading is feasible and safe.

- Near surface samples can be collected by submerging a sample container with no preservative or a disposable sampling device into the water body with a gloved hand or extension device and removing the container when a sufficient volume of sample has been collected. Preserved sample containers shall not be submerged or otherwise directly filled from the surface water body.
    i. Analytical samples that require field preservation will be transferred from the unpreserved container/disposable sampling device to a laboratory pre-preserved sampling container. To the extent practicable, samples collected for volatiles analysis should be obtained directly from the surface water body rather than decanted from the sample collection vessel, unless sample collection is likely to flush preservatives out of the container.
- Samples should be collected in a downstream to upstream direction.

- Avoid disturbing the sediment surface during collection.
- In shallow locations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector.
- Hold the sample container below the surface to avoid the collection of floating debris.
- If a low flow rate or shallow channel prohibits direct filling, a trowel can be used to dig a small hole into which the water can collect. Sufficient time should be allowed for disturbed sediments to settle before the sample is obtained.

2.2.4. Peristaltic Pump

A peristaltic pump can be used to collect surface water from very specific sampling depths or at a remote location that cannot be accessed with other sampling methods. Since the tubing can be weighted and suspended horizontally, the depth interval sampled is equal to the opening of the sampling tubing. The sampling procedure is as follows:

- Prior to sample collection, the tubing weights will be thoroughly decontaminated. Cut a length of the clean, Teflon™ or polyethylene tubing to match the predetermined sampling depth. Lower the tubing and water quality meter to the predetermined sample depth. Avoid disturbance of the bottom sediments.
- When the tubing is at the required depth, attach it to a multi-parameter water quality meter to gather information on water quality at the sample collection interval.
- Turn on the peristaltic pump.
- Discharge approximately two volumes of water from the submerged tubing to collect a representative sample from the predetermined depth interval.

2.2.5. Precautions

Proper sampling procedures should be used to collect samples in accordance with this SOP to prevent cross contamination and improper sample collection. Common problems are listed below to ensure that the samplers can avoid potential sample collection problems.

- Cross Contamination: Eliminated or minimized through the use of dedicated or disposable sampling equipment where appropriate. Where the use of dedicated or disposable sampling equipment is not possible or practical, the equipment will be decontaminated in accordance with the SOP QA-001 Equipment Decontamination.
- Improper Sample Collection: Typical improper sample collection techniques include:
    - Use of sampling equipment or sample containers that are not compatible with the contaminants of concern or the laboratory analytical method.

- Excess sediment in the sample due to disturbance of the sediments by sampling equipment.
- Sample collection in an obviously disturbed or non-representative area.
- Sample collection during a period of increased surface water velocity that causes significant re-suspension of sediments (i.e. tidal influences, storm surge).

3. References

Wilde, F.D., D.B. Radtke, J. Gibs and R.T. Iwatsubo. 1998. National Field Manual for the Collection of Water-Quality Data - Selection of Equipment for Water Sampling. U.S. Geological Survey Techniques of Water - Resources Investigations, Book 9, Chap. A2, variously paged. http://water.usgs.gov/owq/FieldManual/index.html and http://water.usgs.gov/owq/FieldManual/mastererrat.html

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

U.S. Environmental Protection Agency. 2002. U.S. EPA Environmental Response Team, Standard Operating Procedures #2013, Surface Water Sampling. EPA, 12/17/02.

4. Attachments

Figures 1, 2, and 3 (included on following pages)
Attachment A – USEPA Surface Water Sampling SOP

5. Contacts

Brad Dal Santo
Ken Kytta

6. Revision Log

Revision No.	Date of Revision	Individual Sections Revised	Comments
0	11/11/2024		BJD

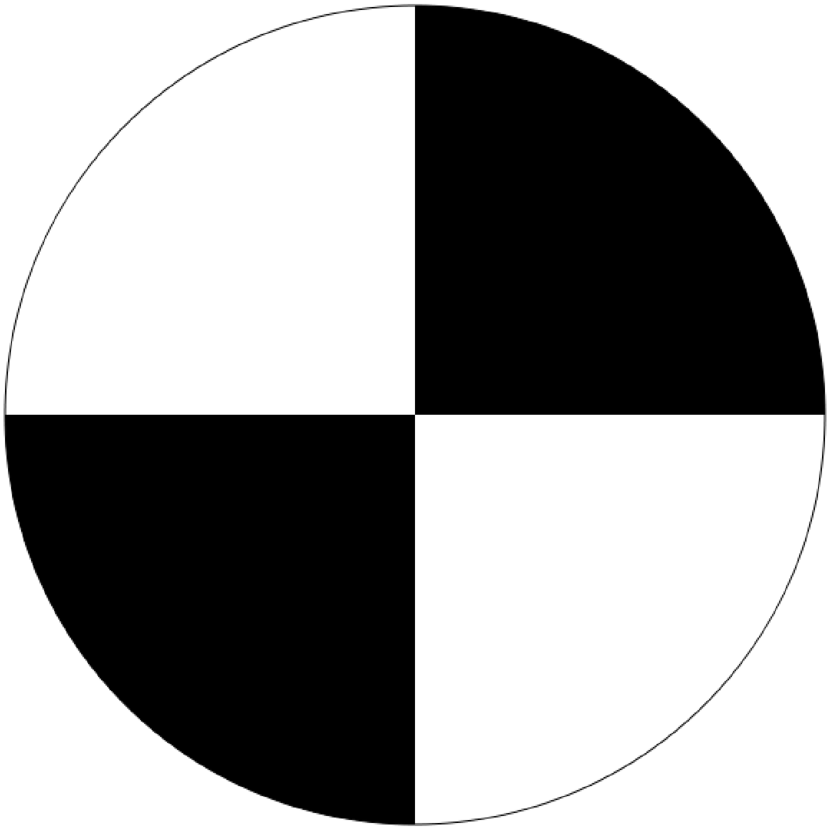

Figure 1 - Secchi Disk

Figure 2 – Kemmerer Bottle

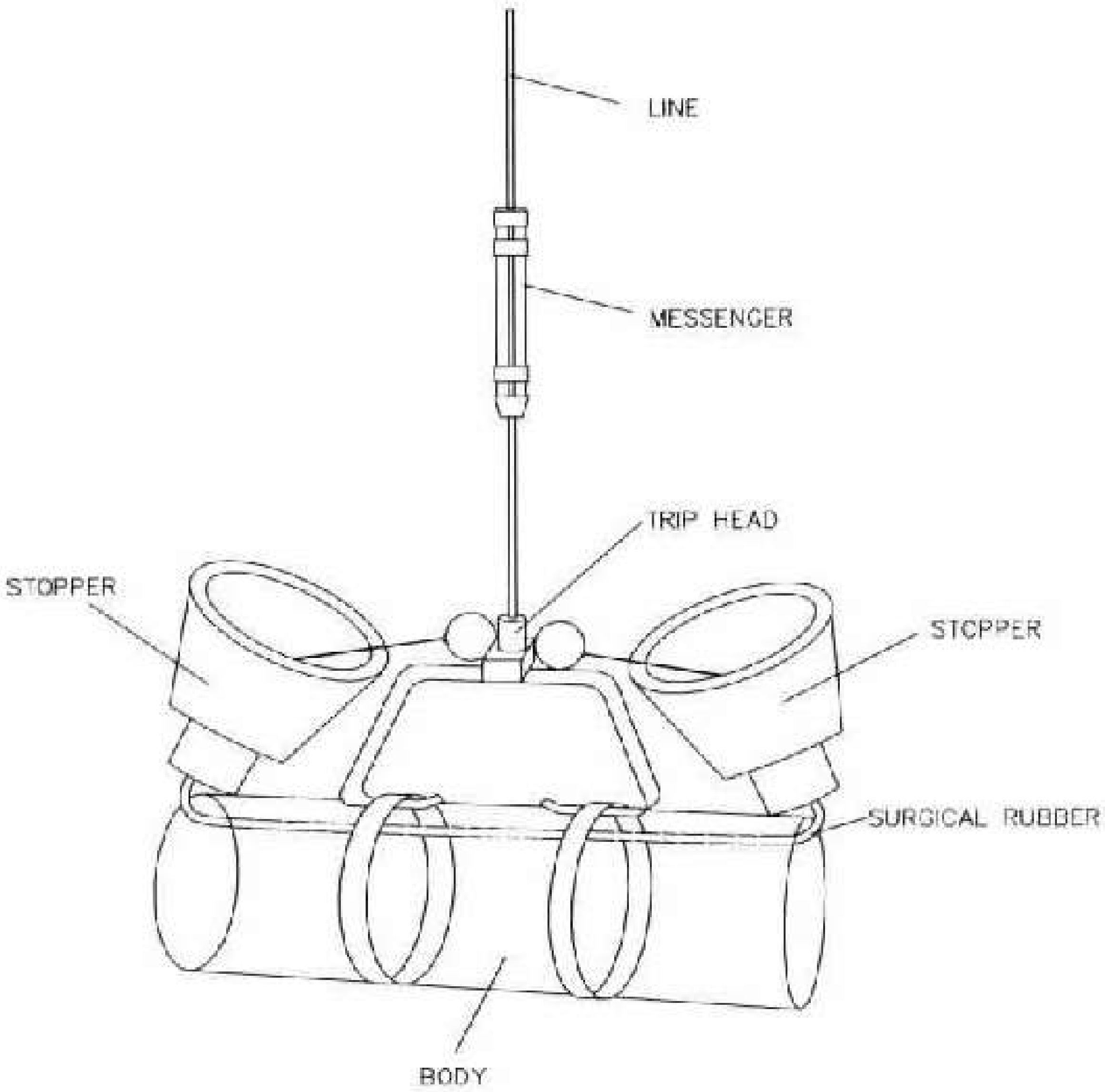

Figure 3 - Van Doran Sampler

U. S. EPA ENVIRONMENTAL RESPONSE TEAM

STANDARD OPERATING PROCEDURES

SURFACE WATER SAMPLING

CONTENTS

1.0 SCOPE AND APPLICATION

2.0 METHOD SUMMARY*

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

5.0 EQUIPMENT/APPARATUS*

6.0 REAGENTS

7.0 PROCEDURES

  7.1 Preparation
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CONTENTS (Cont'd)

12.0 REFERENCES*

13.0 APPENDICES*

A - Figures*

* These sections affected by Revision 0.0.

SUPERSEDES: SOP #2013; Revision 0.0; 11/17/94; U.S. EPA Contract 68-C4-0022.

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative surface water samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sampling situations vary widely; therefore, no universal sampling procedure can be recommended. However, surface water sampling is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- Van Doren sampler
- Bacon bomb sampler
- Dip sampler
- Direct method

These samplers and sampling techniques will result in the collection of representative samples from the majority of surface waters and impoundments encountered.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Once samples have been collected, the following procedures should be followed:

1. Transfer the sample(s) into suitable, labeled sample containers specific for the analyses to be performed.

2. Preserve the sample, if appropriate, or use pre-preserved sample bottles. Do not overfill bottles if they are pre-preserved.

3. Cap the container securely, place in a resealable plastic bag, and cool to 4^{o}C.

4. Record all pertinent data in the site logbook and/or on field data sheets.

5. Complete the Chain of Custody record.

6. Attach custody seals to cooler prior to shipment.

7. Decontaminate all non-dedicated sampling equipment prior to the collection of additional samples.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems associated with surface water sampling. These include cross contamination of samples and improper sample collection.

1. Cross contamination problems can be eliminated or minimized through the use of dedicated or disposable sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to ERT/REAC SOP #2006, *Sampling Equipment Decontamination*.

2. Improper sample collection can involve using contaminated equipment, equipment that is potentially not compatible with the contaminants of concern, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed or non-representative area. Be sure to use sampling equipment of an appropriate composition based upon the suspected contaminants and analyses to be performed.

Following proper decontamination procedures, minimizing disturbance of the sample site, and careful selection of sampling locations will eliminate these problems. Proper timing for the collection of samples must be taken into consideration due to tidal influences and low or fast-flowing streams or rivers.

5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of surface water samples may include (depending on technique chosen):

- Kemmerer bottles
- Van Doren sampler
- Bacon bomb sampler
- Dip sampler
- Line and messengers
- Peristalic pump
- Tygon tubing
- 0.45 micron (: m) filters
- Sample bottles/preservatives
- pH paper
- Resealable plastic bags
- Ice

- Coolers, packing material
- Chain of Custody records, custody seals
- Field data sheets
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Logbook/waterproof pen
- Sample bottle labels
- Paper towels
- Disposable pipets
- Hydrolab
- Personal protection equipment (PPE)*
- Global positioning system (GPS)

* Be sure to use types appropriate for analytes to be measured to avoid contamination of samples. Powdered gloves may contain contaminants of concern.

6.0 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed and are summarized in ERT/REAC SOP #2003, *Sample Storage, Preservation and Handling*. Decontamination solutions are specified in ERT/REAC SOP #2006, *Sampling Equipment Decontamination.*

7.0 PROCEDURES

7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain the necessary sampling and monitoring equipment.

3. Decontaminate or pre-clean equipment, and ensure that it is in working order.

4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry, in accordance with the site specific Health

and Safety Plan (HASP).

6. Use stakes, flags, or buoys to identify and mark all sampling locations. Alternatively, a GPS radio-navigation system may be used to identify and record sample location coordinates. If required, the proposed locations may be adjusted based on site access, property boundaries, and obstructions.

7.2 Representative Sampling Considerations

In order to collect a representative sample, the hydrology and morphometrics of a stream, river, pond, lake or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths.

Water quality data should be collected in ponds, lakes and impoundments to determine if stratification is present. Measurements of dissolved oxygen, pH, conductivity, oxidation-potential, temperature and turbidity can indicate if strata exist that would affect analytical results. Measurements should be collected at one-meter intervals from the surface to the bottom using the appropriate instrument (i.e., a Hydrolab or equivalent). These water quality measurements can assist in the interpretation of analytical data, and the selection of sampling sites and depths when surface water samples are collected.

Factors that contribute to the selection of a sampling device used for sampling surface waters in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

- Width, depth, flow and accessibility of the location being sampled
- Whether the sample will be collected onshore or offshore

7.2.1 Sampler Composition

The appropriate sampling device must be of a proper composition. Selection of samplers constructed of glass, stainless steel, polyvinyl chloride (PVC) or PFTE (Teflon®) should be based upon the suspected contaminants and the analyses to be performed.

7.3 Sample Collection

7.3.1 Kemmerer Bottle

A Kemmerer bottle (Figure 1, Appendix A) may be used in most situations where site access is from a boat or structure, such as a bridge or pier, and where samples at specific depths are required. Sampling procedures are as follows:

1. Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the upper and lower stoppers are pulled away from the body, allowing the surface water to enter tube.

2. Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom.

3. When the Kemmerer bottle is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.

4. Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.2 Van Doren Sampler

A Van Doren sampler (Figure 2, Appendix A) is used to collect a surface water from a very specific sampling depth or from a shallow water body. Since the sampler is suspended horizontally, the depth interval sampled is the diameter of the sampling tube. The sampling procedure is as follows:

1. Use a properly decontaminated Van Doren sampler. Set the device so that the end stoppers are pulled away from the body allowing surface water to enter the tube.

2. Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom.

3. When the Van Doren is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.

4. Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.3 Bacon Bomb Sampler

A bacon bomb sampler (Figure 3, Appendix A) may be used in situations similar to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for

the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut. This will allow the sampler to fill.

2. Release the trigger line and retrieve the sampler.

3. Discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.4 Dip Sampler

A dip sampler (Figure 4, Appendix A) is useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.

2. Extend the device to the sample location and collect the sample by dipping the sampler into the water.

3. Retrieve the sampler and transfer the sample to the appropriate sample container(s).

7.3.5 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples directly into the sample container(s). Health and safety considerations must be addressed when sampling lagoons or other impoundments where specific conditions may exist that warrant the use of additional safety equipment. These issues must be addressed in the site-specific HASP.

Using adequate protective clothing, access the sampling station by appropriate means. When possible, collect samples in a downstream to upstream direction. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface while avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

3. To avoid the incidental inclusion of disturbed sediment in the sample, surface water should be collected from a downstream to upstream direction and upstream of any activity that may disturb the sediment (i.e., wading).

4. While collecting surface water using the direct method, the sample container should be held below the surface to avoid the collection of floating debris.

5. Water quality data should be collected to detect the presence of stratified layers or other site-specific characteristics that would affect the sample.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA and Occupational Health and Safety (OSHA) health and safety procedures.

More specifically, when sampling lagoons or surface impoundments containing known or suspected hazardous substances, adequate health and safety and boating precautions must be taken to ensure the safety of sampling personnel.

12.0 REFERENCES

Wilde, F.D., D.B. Radtke, J. Gibs and R.T. Iwatsubo. 1998. National Field Manual for the Collection of Water-Quality Data - Selection of Equipment for Water Sampling. U.S. Geological Survey Techniques of Water -

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http://water.usgs.gov/owq/FieldManual/index.html and http://water.usgs.gov/owq/FieldManual/mastererrat.html

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

13.0 APPENDICES

A - Figures

APPENDIX A
Figures
SOP #2013
December 2002

FIGURE 1. Kemmerer Bottle

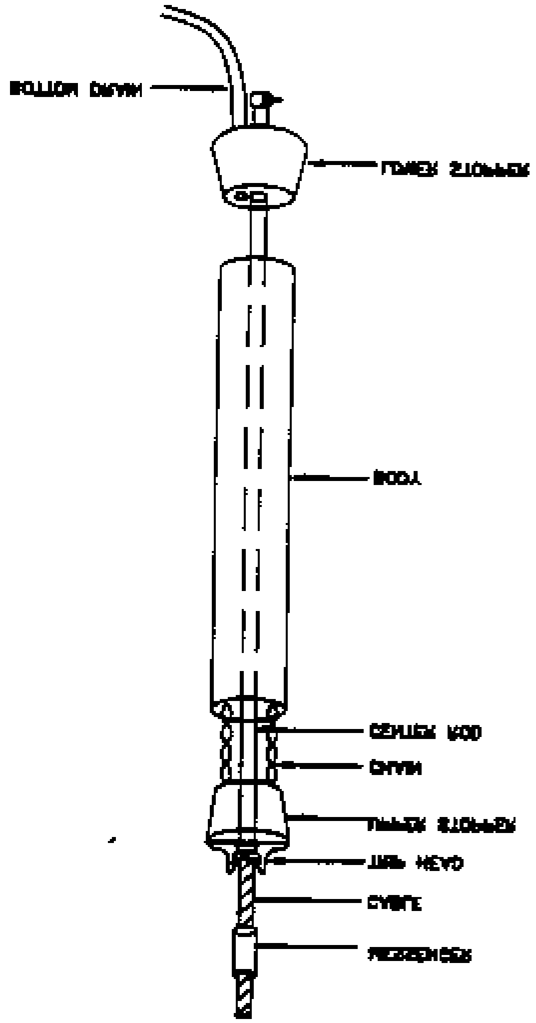


FIGURE 2. Van Doren Sampler

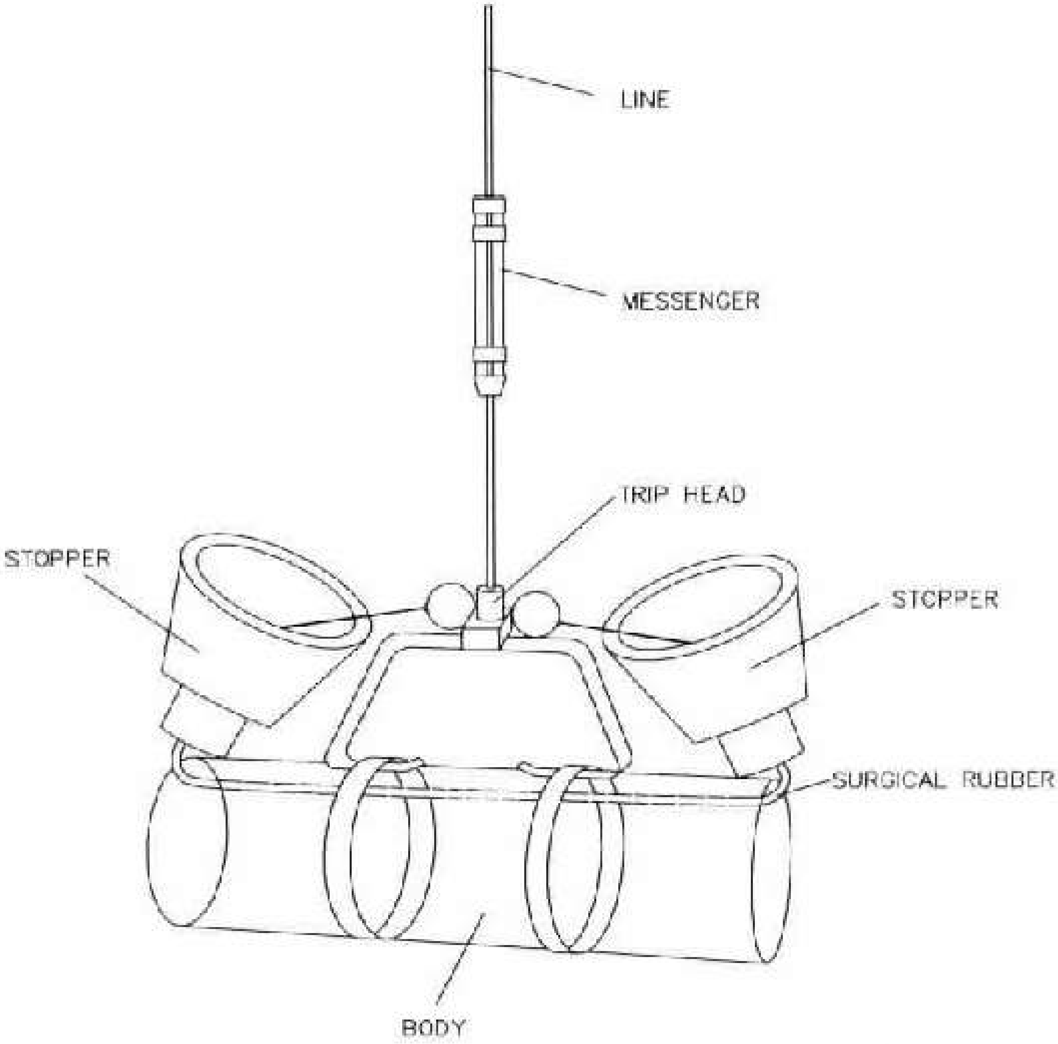
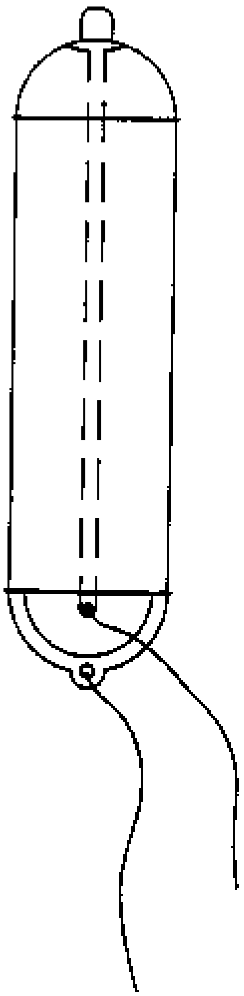


FIGURE 3. Bacon Bomb Sampler



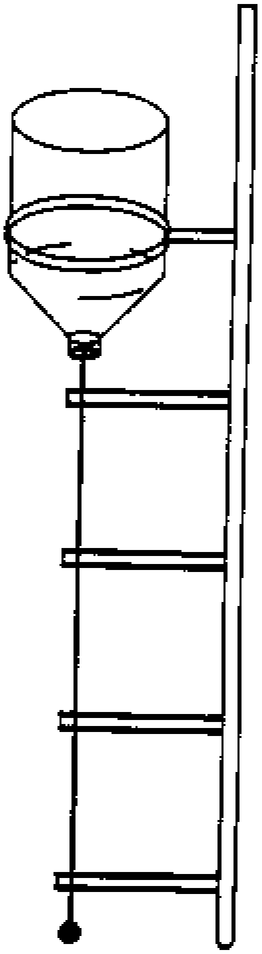


FIGURE 4. Dip Sampler