VIA ELECTRONIC MAIL

December 9, 2019

Richelle Hanson, Project Manager
Voluntary Cleanup Program
Maryland Department of the Environment
Land and Materials Administration
1800 Washington Blvd., Suite 625
Baltimore, Maryland 21230

Subject: **Quarterly Status Report No. 12 - Offsite Area**
Former Kop-Flex Facility Site, Hanover, Maryland

Dear Richelle:

On behalf of EMERSUB 16 LLC, a subsidiary of Emerson Electric Co., WSP USA Inc. (WSP) is submitting this quarterly status report describing the investigation and remediation activities conducted in the third quarter 2019 in the offsite portion of the Former Kop-Flex Facility Site in Hanover, Maryland. The report also describes the activities planned for the fourth quarter of 2019. In addition to this electronic version, a hard copy of the status report is being submitted to the Maryland Department of Environment (MDE) under separate cover.

If you have any questions concerning the submittal of this status report, please do not hesitate to contact us at 703-709-6500.

Kind regards,

Robert E. Johnson
Senior Technical Manager
Water & Environment

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k:\emerson\kop-flex_reports_progress reports\mde reports\2019\september 2019

Encl.

cc: Mr. John Hopkins, U.S. Environmental Protection Agency (EPA), Region III
Mr. Stephen Clarke, Emerson Electric Co.
Sheila Harvey, Esquire, Pillsbury Winthrop Shaw Pittman

WSP USA
Suite 300
13530 Dulles Technology Drive
Herndon, VA 20171

Tel.: +1 703 709-6500
Fax: +1 703 709-8505
wsp.com

QUARTERLY STATUS REPORT NO. 12 – OFFSITE AREA

FORMER KOP-FLEX FACILITY SITE

July 2019 through September 2019

Site Name:	Former Kop-Flex Facility
Site Address:	7565 Harmans Road Hanover, Maryland 21076
Consultant:	WSP USA Inc.
Address:	13530 Dulles Technology Drive, Suite 300 Herndon, Virginia 20171
Phone No.:	(703) 709-6500
Project Coordinator:	Eric Johnson, WSP USA
Alternate:	Lisa Kelly**,** WSP USA

1.0 Offsite Activities Conducted During July 2019 through September 2019

1.1 Residential Well Sampling

- Pursuant to MDE's request, water samples were collected from the residential well at 1227 Old Camp Meade Road (Figure 1) on the following dates during the reporting period:
  - July 2, 2019
  - August 1, 2019
  - September 4, 2019

  Historical analytical results, including those for the third quarter 2019 samples, are summarized in Table 1. Copies of the certified laboratory analytical reports for the July 2019 through September 2019 sampling events are included in Enclosure A.
- As with samples collected in the first and second quarters 2019, site-related constituents of concern (COCs) were detected in both the untreated and treated water samples, with none of these chemicals present at levels above the applicable groundwater comparative criteria (Table 1). In the pre-treatment samples, concentrations of 1,1-dichloroethene (DCE) ranged from 4.4 micrograms per liter (µg/l) to 4.8 µg/l, while 1,4-dioxane was present at levels between 1.7 µg/l and 2.7 µg/l. Based on the 2019 sampling data, concentrations of 1,1-DCE in the untreated water have typically ranged from 4 µg/l to 7 µg/l (Figure 2), and 1,4-dioxane has varied between 1.5 µg/l and 3 µg/l (Figure 3). The post-treatment water samples for the July 2019 through September 2019 events had non-detect concentrations of 1,1-DCE, and 1,4-dioxane concentrations similar to the levels detected in the untreated water (1.7 µg/l to 2.7 µg/l). Trace levels (<0.5 µg/l) of 1,1,1-trichloroethane (TCA) were also detected in both the untreated and treated samples.

  EMERSUB 16 and WSP have communicated the analytical results for these water samples in writing to the homeowner and MDE.

1.2 Residential Water Service Connection for 1227 Old Camp Meade Road

- A potable water line easement agreement was prepared and executed between the property owners at 1227 Old Camp Meade Road and at 1229 Old Camp Meade Road in mid-July 2019. This easement agreement will allow for connection of the residence at 1227 Old Camp Meade Road to the county water main located along Reece Road. Recordation of the easement agreement with the deed for 1229 Old Camp Meade Road on file in the Clerk of the Circuit Court Land Records Department for Anne Arundel County, Maryland was completed in late August 2019. WSP also provided an electronic copy of the recorded easement agreement to the Bureau of Utility Operations for the county Department of Public Works (DPW).

- During September 2019, WSP communicated with the Bureau of Utility Operations to finalize the process for installing the water connection to the home at 1227 Old Camp Meade Road. Based on these discussions, the steps for completing the public water service connection will include the following:
  - Payment of all county fees and issuance of the connection permit;
  - Tapping of the Reece Road water main and installation of a water meter box along the west side of the public road right of way by the county DPW; and
  - Installation of the water line from the new meter box to the home by a Master Plumber retained by WSP and EMERSUB 16.

  As of the end of the reporting period, WSP and its plumbing subcontractor were in the process of paying the applicable county fees and obtaining the water connection permit.

1.3 Offsite Groundwater Monitoring

- On August 6, 2019, WSP obtained water level measurements from the deep offsite monitoring wells. The depth to water measurements for these monitoring wells are provided in the table below. Historical field measurements and corresponding water level elevations, including the August 2019 data, are provided in Table 2.

Well ID	Hydrologic Unit	Depth to Water (ft BGS)	Well Depth (ft BGS)	Well Screen Interval (ft BGS)
MW-24D	Confined Lower Patapsco	52.37	128	118 – 128
MW-25D-130	Confined Lower Patapsco	60.79	130	120 – 130
MW-25D-192	Confined Lower Patapsco	60.37	192	182 – 192
MW-28D	Confined Lower Patapsco	94.34	210	200 – 210
MW-29D	Confined Lower Patapsco	67.20	151	141 – 151
MW-30D-273	Confined Lower Patapsco	104.74	273	263 – 273
MW-30D-413	Patuxent	145.27	413	403 – 413
MW-31D	Confined Lower Patapsco	113.35	280	270 – 280
MW-32D	Confined Lower Patapsco	99.43	236	226 – 236

Well ID	Hydrologic Unit	Depth to Water (ft BGS)	Well Depth (ft BGS)	Well Screen Interval (ft BGS)
MW-33D-235	Confined Lower Patapsco	132.76	235	225 – 235
MW-33D-295	Confined Lower Patapsco	131.14	295	285 – 295
MW-34D	Confined Lower Patapsco/Arundel Clay	141.48	385	375 – 385
MW-35D	Confined Lower Patapsco	127.51	298	288 – 298
MW-36D	Patuxent	147.65	360	350 – 360
MW-46D	Confined Lower Patapsco	38.40	90	80 – 90

FT BGS = feet below ground surface

- A potentiometric surface contour map for the confined portion of the Lower Patapsco aquifer south of Maryland Route 100 is shown in Figure 4 using the August 2019 water level measurements. The general direction of groundwater flow in this portion of the aquifer system is to the south-southeast from the former Kop-Flex facility.
- Pursuant to the approval from MDE and USEPA, shallow monitoring wells at the MW-25 and MW-28 locations in the Harmans Woods neighborhood were abandoned in place on August 6, 2019. (The locations of the MW-25 well cluster and MW-28 well pair are shown on Figure 4.) The well decommissioning was performed in accordance with the procedures specified in the Maryland well abandonment standards. The appropriate well abandonment forms were submitted to the MDE and are provided in Enclosure B.

1.4 Evaluation of Monitored Natural Attenuation (MNA) for Groundwater Constituents of Concern

- During the week of August 5th, 2019, groundwater samples were collected from the following deep offsite monitoring wells to characterize the chemical and microbial characteristics of the affected groundwater as they relate to the natural attenuation of 1,1-DCE and 1,4-dioxane (Figure 5).
  - MW-24D
  - MW-25D-130 and MW-25D-190
  - MW-30D-273
  - MW-33D-295

  The sampling network was designed to evaluate variability in the characteristics of the offsite groundwater and includes locations with detectable concentrations of COCs at various distances from the source area (*i.e.*, former Kop-Flex facility).
- Samples for VOC and 1,4-dioxane analysis were collected using the previously deployed HydraSleeve™ samplers, consistent with the method in use for the offsite groundwater monitoring program. Groundwater samples for the

analysis of natural attentuation parameters (listed below), and microbiological and isotopic testing were obtained using the low flow purging method.

- Alkalinity
- Chloride
- Sulfate
- Sulfide
- Dissolved gases (ethene, ethane and methane)

Additionally, field measurements of hydrogeochemical parameters (pH, dissolved oxygen, oxidation-reduction potential, conductivity, and turbidity) and total and ferrous iron were also collected during low flow purging and sampling.

The advanced microbiological and isotopic testing involved deoxyribonucleic acid (DNA)-based diagnostics of oxygenase enzymes that have been found to react co-metabolically with both 1,1-DCE and 1,4-dioxane, and radioactive carbon isotope (^{14}C) assays for measuring the degradation of radio-labeled 1,4-dioxane spiked into site groundwater. A ^{14}C assay has not yet been developed for 1,1-DCE; therefore, this test was not performed for this site-related COC. (Information on the use of the ^{14}C assay method to quantify degradatrion rates is provided in Enclosure C.)

- As of the end of the reporting period, analytical results had been received for the COCs (VOCs and 1,4-dioxane), natural attenuation parameters, and the microbiological tests. A complete evaluation of the sampling data with regards to natural attenuation processes for 1,1-DCE and 1,4-dioxane in the impacted portion of the Lower Patapsco aquifer will be provided following receipt of the ^{14}C assay results and review of these data together with the other analytical results.

2.0 Planned Offsite Activities for Next Reporting Period (October 2019 through December 2019)

- Collect a synoptic round of water level measurements from the deep offsite monitoring wells in November 2019.
- Perform semi-annual sampling of the offsite groundwater monitoring wells in the confined portion of the Lower Patapsco aquifer and Patuxent aquifer in November 2019.
- Continue to conduct monthly monitoring of the untreated and treated water from the residential well at 1227 Old Camp Meade Road.
- Coordinate with the county DPW to complete the public water service connection to the home at 1227 Old Camp Meade Road by tapping the water main in Reece Road.

3.0 Key Personnel/Facility Changes

In late August, the EPA Project Manager, Erich Weissbart, informed EMERSUB 16 and WSP that he was transitioning toward retirement by the end of October 2019 and would no longer be involved in the oversight of the corrective action activities. Mr. Weissbart indicated that John Hopkins would serve as the new EPA Project Manager for the Site.

FIGURES

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THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK AND WHITE COPIES MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

LEGEND

- PROPERTY LINE
- WATER MAIN
- STREAM
- WATER BODY
- CONFINED LOWER PATAPSCO AQUIFER MONITORING WELL
- CONFINED LOWER PATAPSCO AQUIFER AND PATUXENT AQUIFER MONITORING WELLS
- PROPERTY WITH POTABLE WELL FOR SAMPLING
- 1229 STREET ADDRESS NUMBER

REFERENCE:
PARCEL INFORMATION OBTAINED FROM ANNE ARUNDEL COUNTY, DEPARTMENT OF PUBLIC WORKS http://gis-world2.aacounty.org/DPWcounter/countermap.html

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SCALE IN FEET

Drawn By:	EGC
Checked:	CC 4/29/2019
Approved:	RG 5/2/2019
DWG Name:	314V1545.011-030

FORMER KOP-FLEX FACILITY
HANOVER, MARYLAND

PREPARED FOR
EMERSUB 16 LLC
ST. LOUIS, MISSOURI

Figure 1

PROPERTY WITH RESIDENTIAL WELL IDENTIFIED FOR REGULAR MONITORING AND PUBLIC WATER CONNECTION

WSP USA Inc.
13530 DULLES TECHNOLOGY DR
SUITE 300
HERNDON, VA 20171
TEL: +1 703.709.6500

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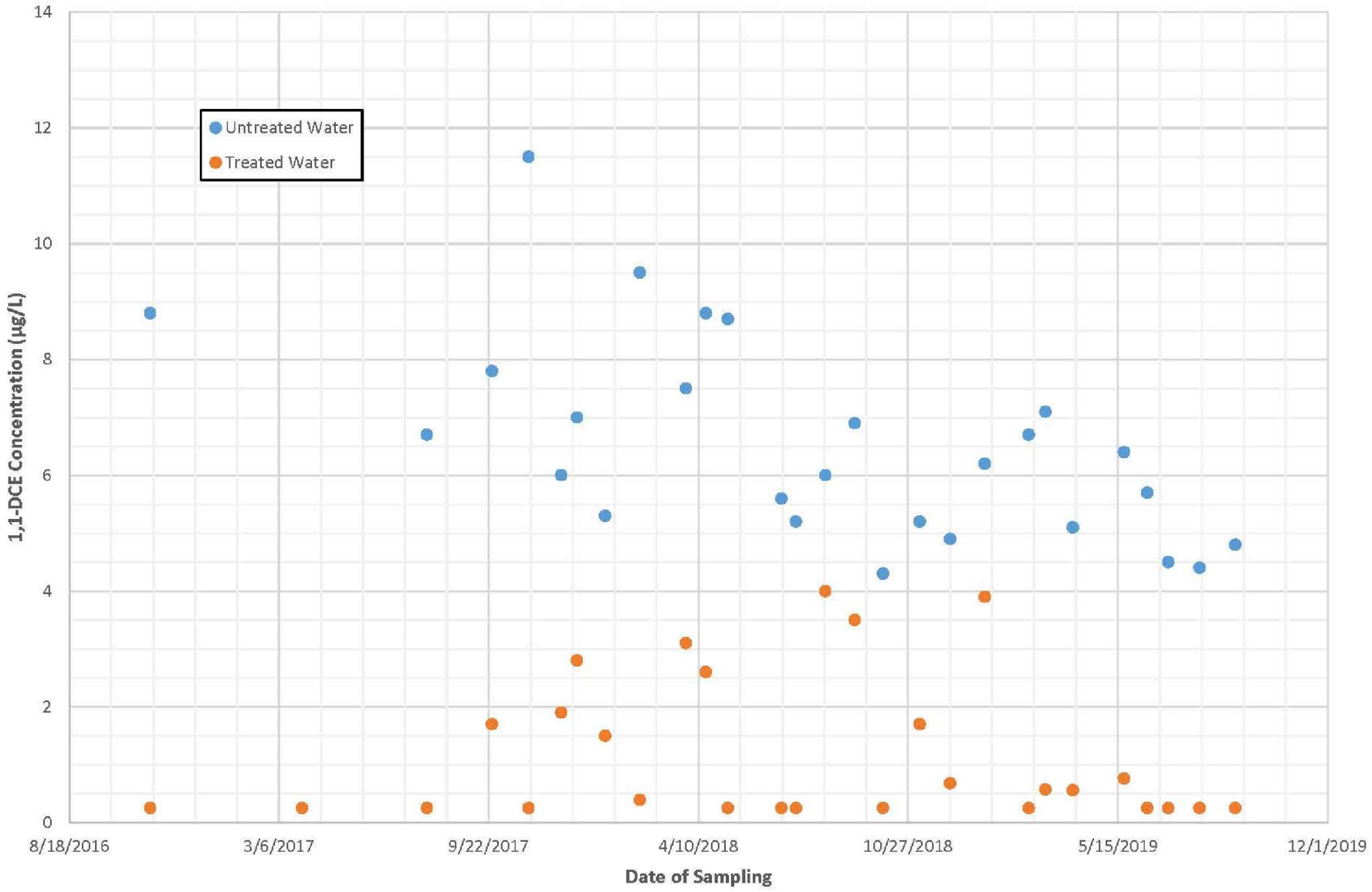

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WSP USA Inc.
13530 DULLES TECHNOLOGY DR
SUITE 300
HERNDON, VA 20171
TEL: +1 703.709.6500

Figure 2

1227 OLD CAMP MEADE ROAD
CONCENTRATION vs TIME PLOT
1,1-DCE

FORMER KOP-FLEX FACILITY
HANOVER, MARYLAND

PREPARED FOR
EMERSUB16 LLC
ST. LOUIS, MISSOURI

Drawn By: EGC
Checked: CC 9/26/2019
Approved: RKJ
DWG Name: 314V1545.011-038

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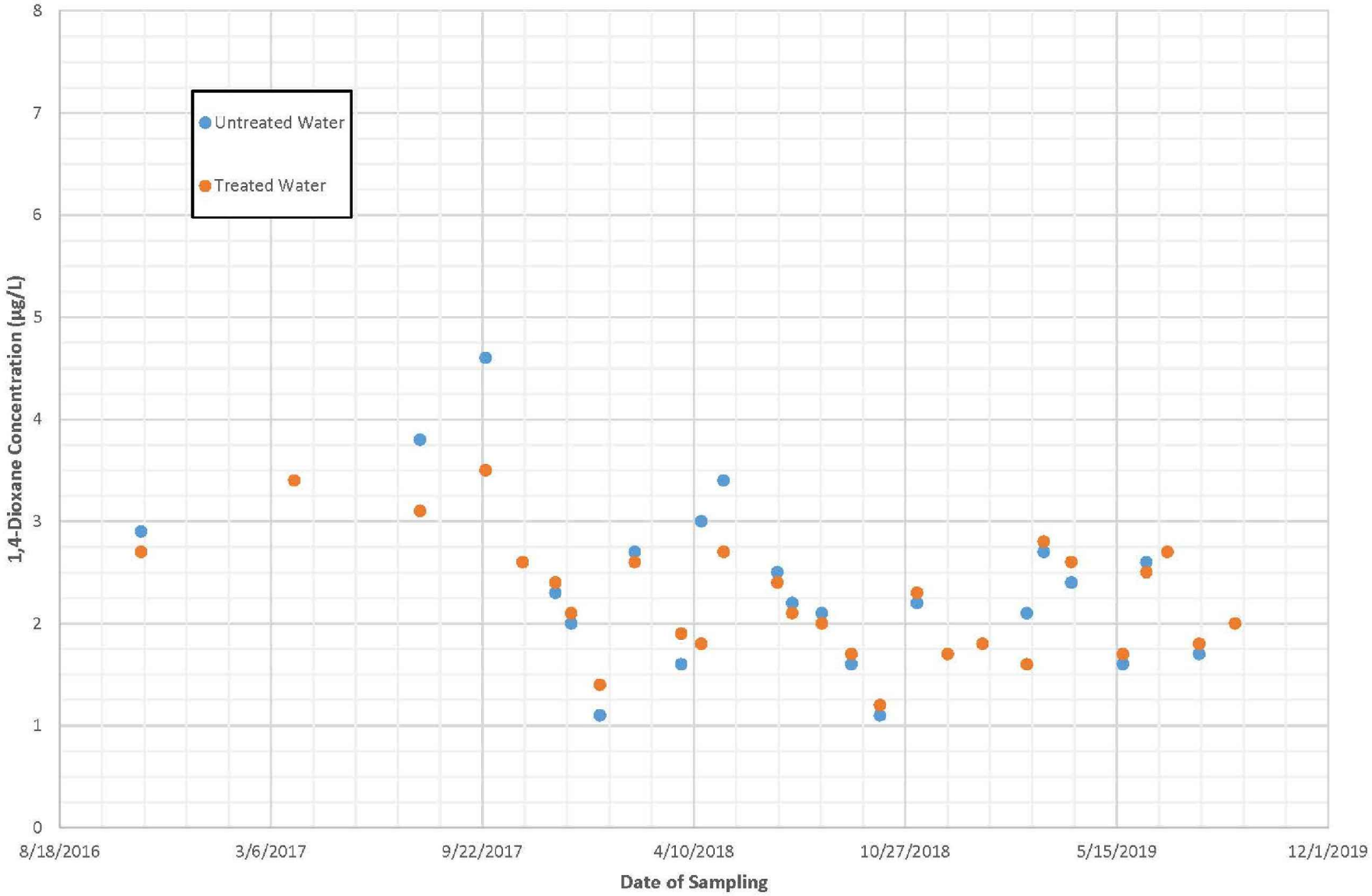

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WSP USA Inc.
13530 DULLES TECHNOLOGY DR
SUITE 300
HERNDON, VA 20171
TEL: +1 703.709.6500

Figure 3

1227 OLD CAMP MEADE ROAD
CONCENTRATION vs TIME PLOT
1,4–DIOXANE

FORMER KOP–FLEX FACILITY
HANOVER, MARYLAND

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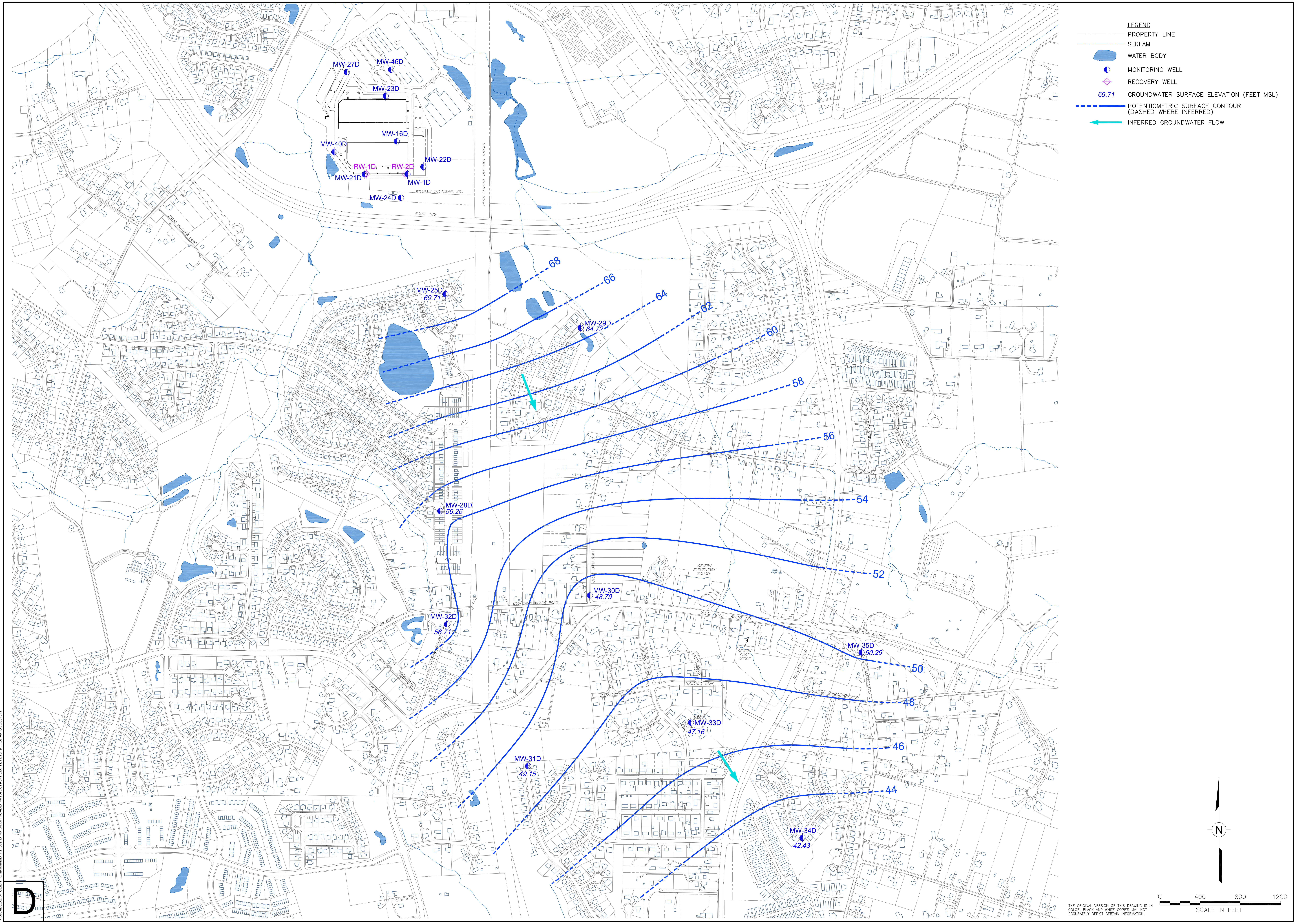
DWG Name: 314V1545.011–038



REVISIONS

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POTENTIOMETRIC SURFACE CONTOUR MAP CONFINED PORTION OF THE LOWER PATAPSCO AQUIFER
AUGUST 2019

FORMER KOP–FLEX FACILITY SITE
HANOVER, MARYLAND

PREPARED FOR
EMERSUB 16 LLC
ST. LOUIS, MISSOURI

WSP USA Inc.
13530 DULLES TECHNOLOGY DR, SUITE 300
HERNDON, VA 20171
TEL: +1 703.709.6500

FIGURE 4

Drawing Number
314V1545.011–042

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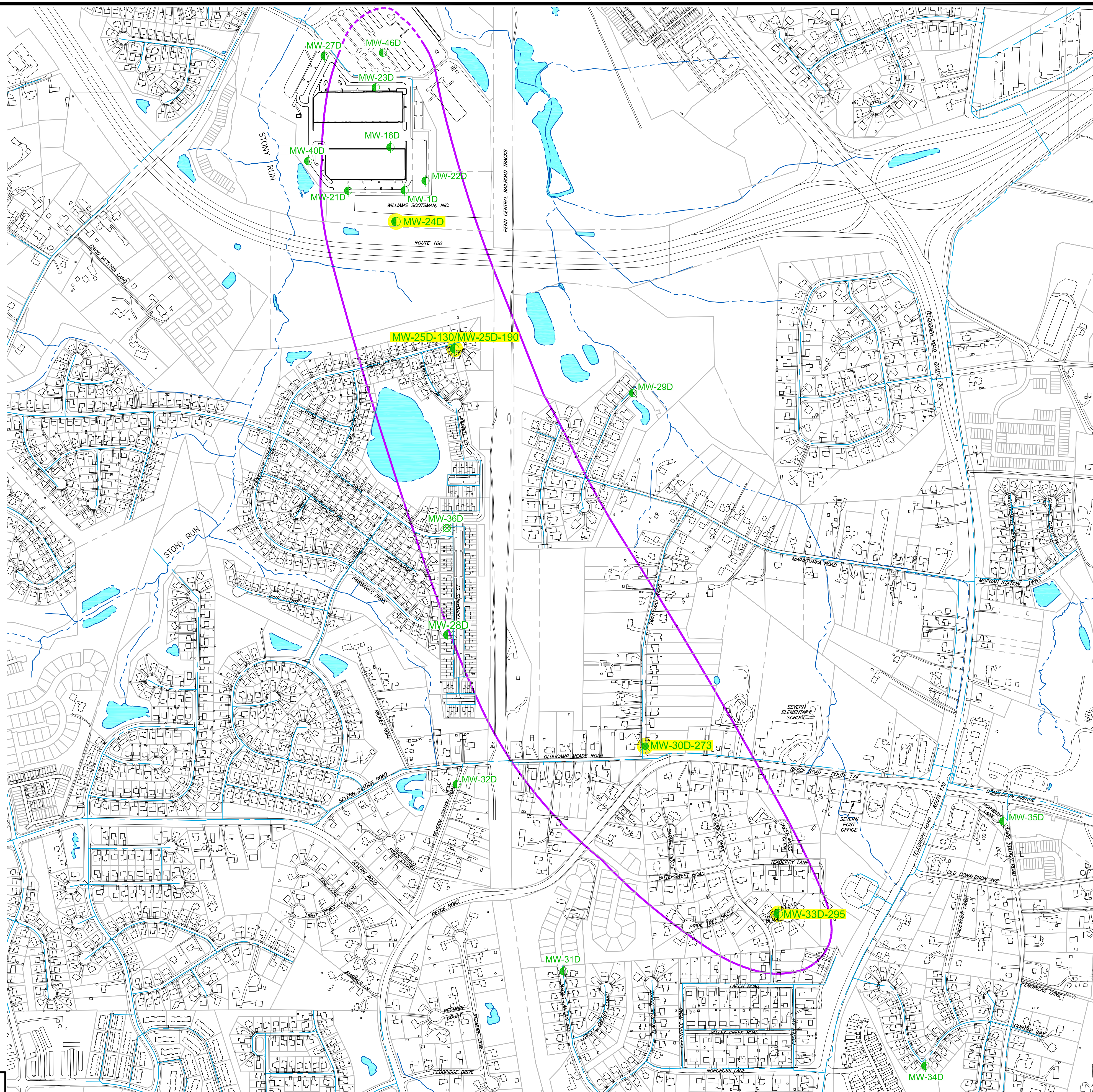

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LEGEND

- PROPERTY LINE
- WATER MAIN
- STREAM
- WATER BODY
- CONFINED LOWER PATAPSCO AQUIFER MONITORING WELL
- PATUXENT AQUIFER MONITORING WELLS
- CONFINED LOWER PATAPSCO AQUIFER AND PATUXENT AQUIFER MONITORING WELLS
- EXTENT OF AFFECTED GROUNDWATER
- WELL SELECTED FOR MNA SAMPLING

N

0 800 1600

SCALE IN FEET

REFERENCE:
PARCEL INFORMATION OBTAINED FROM ANNE ARUNDEL COUNTY, DEPARTMENT OF PUBLIC WORKS http://gis-world2.aacounty.org/DPWcounter/countermap.html

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FORMER KOP-FLEX FACILITY
HANOVER, MARYLAND
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Figure 5

MNA SAMPLE LOCATIONS

WSP USA Inc.
13530 DULLES TECHNOLOGY DR
SUITE 300
HERNDON, VA 20171
TEL: +1 703.709.6500

B

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TABLES

Summary Table of Laboratory Results
Potable Well Samples
1227 Old Camp Meade Road

		Parameter Units MCL	Acetone µg/l 550 (a)	Bromoform µg/l 80 (a)	Carbon Disulfide µg/l 100 (a)	Chloroform µg/l 80 (a)	1,1-Dichloroethane µg/l 90 (a)	1,1-Dichloroethylene µg/l 7	Methyl Tert Butyl Ether µg/l 20 (a)	Toluene µg/l 1,000	1,1,1-Trichloroethane µg/l 200	Tetrachloroethylene µg/l 5	Trichloroethylene µg/l 5	1,4-Dioxane µg/l 4.6 (b)
Address	**Sample Type**	**Date**												
1227 Old Camp	Pre-Treatment	2/13/2013	5 U	0.5 U	0.18 J	0.5 U	0.5 U	0.55	0.25 J	0.18 J	0.091 J	0.5 U	0.5 U	2.0 U
	Post-Treatment	2/13/2013	5 U	0.5 U	0.5 U	0.2 J	0.5 U	0.5 U	0.5 U	0.5 U	0.081 J	0.5 U	0.5 U	2.0 U
Meade Rd	Pre-Treatment	7/9/2013	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.11 J	0.5 U	0.5 U	2.3
Well Depth: 300 ft.	Pre-Treatment	2/12/2014	5 U	0.5 U	0.5 U	0.5 U	0.15 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.0 U
	Pre-Treatment	5/29/2014	5 U	0.5 U	0.5 U	0.5 U	0.051 J	1.3	0.5 U	0.5 U	0.15 J	0.5 U	0.5 U	2.0 U
	Post-Treatment	5/29/2014	5 U	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U	0.5 U	0.15 J	0.5 U	0.5 U	2.0 U
	Pre-Treatment	9/12/2014	5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.0	0.5 U	0.5 U	0.21 J	0.5 U	0.5 U	2.0 U
	Post-Treatment	9/12/2014	5 U	0.28 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.18 J	0.5 U	0.5 U	2.0 U
	Pre-Treatment	12/8/2014	0.99 J	0.5 U	0.5 U	0.5 U	0.5 U	0.43 J	0.5 U	0.5 U	0.20 J	0.5 U	0.5 U	2.0 U
	Post-Treatment	12/8/2014	5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.4	0.5 U	0.5 U	0.24 J	0.5 U	0.5 U	2.0 U
	Pre-Treatment	11/3/2016	5 U	0.5 U	0.5 U	0.5 U	0.19 J	8.8	0.5 U	0.5 U	0.48 J	0.5 U	0.5 U	2.9
	Post-Treatment	11/3/2016	5 U	0.5 U	0.5 U	0.095 J	0.16 J	0.5 U	0.5 U	0.5 U	0.42 J	0.5 U	0.5 U	2.7
	Post-Treatment	3/28/2017	5 U	0.5 U	0.5 U	0.5 U	0.17 J	0.5 U	0.5 U	0.5 U	0.41 J	0.5 U	0.5 U	3.4
	Pre-Treatment	7/25/2017	5 U	0.5 U	0.5 U	0.5 U	0.15 J	6.7	0.5 U	0.5 U	0.33 J	0.5 U	0.5 U	3.8
	Post-Treatment	7/25/2017	5 U	0.55	0.5 U	0.5 U	0.19 J	0.5 U	0.5 U	0.5 U	0.42 J	0.5 U	0.5 U	3.1
	Pre-Treatment	9/25/2017	5 U	0.5 U	0.5 U	0.5 U	0.18 J	7.8	0.5 U	0.5 U	0.41 J	0.5 U	0.5 U	4.6
	Post-Treatment	9/25/2017	5 U	0.5 U	0.5 U	0.5 U	0.15 J	1.7	0.5 U	0.5 U	0.37 J	0.5 U	0.5 U	3.5
	Pre-Treatment	10/30/2017	5 U	0.5 U	0.5 U	0.5 U	0.24 J	11.5	0.5 U	0.5 U	0.5	0.5 U	0.5 U	2.6
	Post-Treatment	10/30/2017	5 U	0.5 U	0.5 U	0.5 U	0.23 J	0.5 U	0.5 U	0.5 U	0.53	0.5 U	0.5 U	2.6
	Pre-Treatment	11/30/2017	5 U	0.5 U	0.5 U	0.5 U	0.16 J	6.0	0.5 U	0.5 U	0.3 J	0.5 U	0.5 U	2.3
	Post-Treatment	11/30/2017	5 U	0.5 U	0.5 U	0.5 U	0.17 J	1.9	0.5 U	0.5 U	0.34 J	0.5 U	0.5 U	2.4
	Pre-Treatment	12/15/2017	5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.0	0.5 U	0.5 U	0.36 J	0.5 U	0.5 U	2.0
	Post-Treatment	12/15/2017	5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.8	0.5 U	0.5 U	0.39 J	0.5 U	0.5 U	2.1
	Pre-Treatment	1/11/2018	5 U	0.5 U	0.5 U	0.5 U	0.15 J	5.3	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	1.1
	Post-Treatment	1/11/2018	5 U	0.5 U	0.5 U	0.5 U	0.14 J	1.5	0.5 U	0.5 U	0.32 J	0.5 U	0.5 U	1.4
	Pre-Treatment	2/13/2018	5 U	0.5 U	0.5 U	0.5 U	0.16 J	9.5	0.5 U	0.5 U	0.44 J	0.5 U	0.5 U	2.7
	Post-Treatment	2/13/2018	5 U	0.5 U	0.5 U	0.5 U	0.16 J	0.39 J	0.5 U	0.5 U	0.38 J	0.5 U	0.5 U	2.6
	Pre-Treatment	3/29/2018	5 U	0.5 U	0.5 U	0.5 U	0.14 J	7.5	0.5 U	0.5 U	0.35 J	0.5 U	0.5 U	1.6
	Post-Treatment	3/29/2018	5 U	0.5 U	0.5 U	0.5 U	0.14 J	3.1	0.5 U	0.5 U	0.34 J	0.5 U	0.5 U	1.9
	Pre-Treatment	4/17/2018	5 U	0.5 U	0.5 U	0.5 U	0.18 J	8.8	0.5 U	0.5 U	0.45 J	0.5 U	0.5 U	3.0
	Post-Treatment	4/17/2018	5 U	0.5 U	0.5 U	0.5 U	0.15 J	2.6	0.5 U	0.5 U	0.37 J	0.5 U	0.5 U	1.8
	Pre-Treatment	5/8/2018	5 U	0.5 U	0.5 U	0.5 U	0.18 J	8.7	0.5 U	0.5 U	0.48 J	0.5 U	0.5 U	3.4
	Post-Treatment	5/8/2018	5 U	0.5 U	0.5 U	0.5 U	0.17 J	0.5 U	0.5 U	0.5 U	0.42 J	0.5 U	0.5 U	2.7
	Pre-Treatment	6/28/2018	1.5 J	0.5 U	0.5 U	0.5 U	0.5 U	5.6	0.5 U	0.5 U	0.28 J	0.5 U	0.5 U	2.5
	Post-Treatment	6/28/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.28 J	0.5 U	0.5 U	2.4
	Pre-Treatment	7/12/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	5.2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.2
	Post-Treatment	7/12/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.1
	Pre-Treatment	8/9/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.0	0.5 U	0.5 U	0.26 J	0.5 U	0.5 U	2.1
	Post-Treatment	8/9/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.0	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	2.0
	Pre-Treatment	9/6/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.9	0.5 U	0.5 U	0.28 J	0.5 U	0.5 U	1.6
	Post-Treatment	9/6/2018	2.8 J	0.5 U	0.5 U	0.5 U	0.5 U	3.5	0.5 U	0.5 U	0.33 J	0.5 U	0.5 U	1.7

Summary Table of Laboratory Results
Potable Well Samples
1227 Old Camp Meade Road

	Parameter	Acetone	Bromoform	Carbon Disulfide	Chloroform	1,1-Dichloroethane	1,1-Dichloroethylene	Methyl Tert Butyl Ether	Toluene	1,1,1-Trichloroethane	Tetrachloroethylene	Trichloroethylene	1,4-Dioxane
	Units	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
	MCL	550 (a)	80 (a)	100 (a)	80 (a)	90 (a)	7	20 (a)	1,000	200	5	5	4.6 (b)
Sample Type	**Date**												
Pre-Treatment	10/3/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.3	0.5 U	0.5 U	0.50 U	0.5 U	0.5 U	1.1
Post-Treatment	10/3/2018	5 U	0.51	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.50 U	0.5 U	0.5 U	1.2
Pre-Treatment	11/7/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	5.2	0.5 U	0.5 U	0.24 J	0.5 U	0.5 U	2.2
Post-Treatment	11/7/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.7	0.5 U	0.5 U	0.25 J	0.5 U	0.5 U	2.3
Pre-Treatment	12/6/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.9	0.5 U	0.5 U	0.22 J	0.5 U	0.5 U	1.7
Post-Treatment	12/6/2018	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.68	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	1.7
Pre-Treatment	1/8/2019	--	0.5 U	0.5 U	0.5 U	0.5 U	6.2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.8
Post-Treatment	1/8/2019	--	0.5 U	0.5 U	0.5 U	0.5 U	3.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.8
Pre-Treatment	2/19/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	6.7	0.5 U	0.5 U	0.28 J	0.5 U	0.5 U	2.1
Post-Treatment	2/19/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.32 J	0.5 U	0.5 U	1.6
Pre-Treatment	3/7/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	7.1	0.5 U	0.5 U	0.28 J	0.5 U	0.5 U	2.7
Post-Treatment	3/7/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.57	0.5 U	0.5 U	0.30 J	0.5 U	0.5 U	2.8
Pre-Treatment	4/2/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	5.1	0.5 U	0.5 U	0.23 J	0.5 U	0.5 U	2.4
Post-Treatment	4/2/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.56	0.5 U	0.5 U	0.25 J	0.5 U	0.5 U	2.6
Pre-Treatment	5/21/2019	3.1 J	0.5 U	0.5 U	0.5 U	0.5 U	6.4	0.5 U	0.5 U	0.26 J	0.5 U	0.5 U	1.6
Post-Treatment	5/21/2019	2.5 J	0.5 U	0.5 U	0.5 U	0.5 U	0.76	0.5 U	0.5 U	0.14 J	0.5 U	0.5 U	1.7
Pre-Treatment	6/12/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	5.7	0.5 U	0.5 U	0.23 J	0.5 U	0.5 U	2.6
Post-Treatment	6/12/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.25 J	0.5 U	0.5 U	2.5
Pre-Treatment	7/2/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.7
Post-Treatment	7/2/2019	5 U	0.38 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.24 J	0.5 U	0.5 U	2.7
Pre-Treatment	8/1/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.4	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.7
Post-Treatment	8/1/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.22 J	0.5 U	0.5 U	1.8
Pre-Treatment	9/4/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	4.8	0.5 U	0.5 U	0.25 J	0.5 U	0.5 U	2.0
Post-Treatment	9/4/2019	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.27 J	0.5 U	0.5 U	2.0

(a) Maryland Department of Environment Action Level
(b) Maryland Risk Based Action Level

Notes:
MCL = US Environmental Protection Agency Maximum Contaminant Level
U = Undetected, value reported is the laboratory reporting limit
J = Indicates an estimated value between method detection limit and reporting limit
-- = Not analyzed

Table 2

Historical Groundwater Level Data (2017 to Present)
Offsite Area
Former Kop-Flex Facility Site
Hanover, Maryland

Well ID	Zone	TOC elevation (feet MSL)	5/1/2017		8/31/2017		11/14/2017		2/13/2018		5/31/2018	
			Depth to Water	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*
MW-25	Shallow	130.6	14.02	116.58	14.09	116.51	14.6	116.00	14.56	116.04	13.10	117.50
MW-28	Shallow	150.5	27.4	123.10	27.2	123.30	27.22	123.28	27.48	123.02	27.42	123.08
MW-45	Shallow	126.7	13.67	113.05	NM	--	NM	--	NM	--	12.98	113.74
MW-24D	Confined LPA	129.1	48.35	80.75	48.35	80.75	51.99	77.11	NM	--	50.94	78.16
MW-25D-130	Confined LPA	130.5	53.80	76.70	61.38	69.12	58.46	72.04	58.31	72.19	58.23	72.27
MW-25D-192	Confined LPA	130.5	53.11	77.39	60.36	70.14	58.71	71.79	57.49	73.01	57.40	73.10
MW-28D	Confined LPA	150.5	82.72	67.78	94.55	55.95	89.03	61.47	67.37	83.13	88.75	61.75
MW-29D	Confined LPA	131.9	NM	--	NM	--	NM	--	NM	--	64.94	66.98
MW-30D-273	Confined LPA	153.5	NM	--	NM	--	NM	--	NM	--	98.66	54.88
MW-31D	Confined LPA	162.5	100.24	62.26	115.67	46.83	107.21	55.29	106.29	56.21	106.80	55.70
MW-32D	Confined LPA	156.1	NM	--	NM	--	NM	--	NM	--	97.90	58.24
MW-33D-235	Confined LPA	178.6	117.26	61.34	133.39	45.21	124.55	54.05	123.79	54.81	124.00	54.60
MW-33D-295	Confined LPA	178.3	117.03	61.27	133.14	45.16	124.36	53.94	123.60	54.70	123.83	54.47
MW-34D	Confined LPA	183.9	NM	--	NM	--	NM	--	NM	--	132.70	51.21
MW-35D	Confined LPA	177.8	117.28	60.52	133.55	44.25	125.59	52.21	124.02	53.78	124.27	53.53
MW-46D	Confined LPA	124.8	NM	--	NM	--	NM	--	NM	--	37.37	87.43
MW-30D-413	Patuxent	153.1	NM	--	NM	--	NM	--	NM	--	138.10	15.03
MW-36D	Patuxent	158.7	NM	--	NM	--	NM	--	NM	--	141.75	16.96

Notes:
NM = no measurement taken at the well
TOC = top of casing
LPA = Lower Patapsco Aquifer
MSL = mean sea level
a/ Measurement is not included due to an error during recordation in the field.
b/ Well decommissioned on August 6, 2019.

Table 2

Historical Groundwater Level Data (2017 to Present)
Offsite Area
Former Kop-Flex Facility Site
Hanover, Maryland

Well ID	Zone	TOC elevation (feet MSL)	8/23/2018		11/8/2018		2/19/2019		5/22/2019		8/6/2019	
			Depth to Water	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*	*Depth to Water*	*Groundwater Elevation*
MW-25	Shallow	130.6	NM	--	11.84	118.76	11.75	118.85	NM	--	(b)	--
MW-28	Shallow	150.5	NM	--	24.33	126.17	23.30	127.20	NM	--	(b)	--
MW-45	Shallow	126.7	NM	--	12.00	114.72	11.98	114.74	11.75	114.97	NM	
MW-24D	Confined LPA	129.1	NM	--	50.72	78.38	48.92	80.18	49.67	79.43	52.37	76.73
MW-25D-130	Confined LPA	130.5	59.53	70.97	58.75	71.75	54.96	75.54	56.23	74.27	60.79	69.71
MW-25D-192	Confined LPA	130.5	58.69	71.81	57.63	72.87	54.20	76.30	55.45	75.05	60.37	70.13
MW-28D	Confined LPA	150.5	90.98	59.52	88.30	62.20	84.78	65.72	86.96	63.54	94.24	56.26
MW-29D	Confined LPA	131.9	66.56	65.36	65.03	66.89	60.64	71.28	62.36	69.56	67.20	64.72
MW-30D-273	Confined LPA	153.5	100.70	52.84	98.14	55.40	93.10	60.44	95.74	57.80	104.75	48.79
MW-31D	Confined LPA	162.5	109.95	52.55	106.27	56.23	102.47	60.03	104.91	57.59	113.35	49.15
MW-32D	Confined LPA	156.1	100.65	55.49	98.97	57.17	93.79	62.35	97.02	59.12	99.43	56.71
MW-33D-235	Confined LPA	178.6	127.52	51.08	125.14	53.46	119.35	59.25	121.72	56.88	132.76	45.84
MW-33D-295	Confined LPA	178.3	127.34	50.96	125.69	52.61	119.10	59.20	-- (a)	--	131.14	47.16
MW-34D	Confined LPA	183.9	136.42	47.49	131.76	52.15	127.40	56.51	129.93	53.98	141.48	42.43
MW-35D	Confined LPA	177.8	128.19	49.61	123.64	54.16	119.28	58.52	121.65	56.15	127.51	50.29
MW-46D	Confined LPA	124.8	NM	--	32.68	92.12	NM	--	35.47	89.33	38.40	86.40
MW-30D-413	Patuxent	153.1	143.75	9.38	140.62	12.51	130.73	22.40	137.25	15.88	145.27	7.86
MW-36D	Patuxent	158.7	146.32	12.39	143.85	14.86	134.83	23.88	141.3	17.41	147.65	11.06

Notes:
NM = no measurement taken at the well
TOC = top of casing
LPA = Lower Patapsco Aquifer
MSL = mean sea level
a/ Measurement is not included due to an error during r
b/ Well decommissioned on August 6, 2019.

ENCLOSURE A – LABORATORY ANALYTICAL REPORTS FOR RESIDENTIAL WELL SAMPLES (1227 OLD CAMP MEADE ROAD)

JULY 2019

The results set forth herein are provided by SGS North America Inc.

e-Hardcopy 2.0
Automated Report

Technical Report for

WSP Environment & Energy

Kop-Flex, Hanover, VA

31401545.001

SGS Job Number: JC91133

Sampling Date: 07/02/19

Report to:

WSP
11190 Sunrise Valley Drive Suite 300
Reston, VA 20190
Eric.Johnson@WSPGroup.com; maria.kaplan@wsp.com

ATTN: Eric Johnson

Total number of pages in report: 42

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Mike Earp
General Manager

Client Service contact: Rocus Peters 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, FL, IL, IN, KS, KY, LA, MA, MD, ME, MN, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TX, UT, VA, WV, DoD ELAP (ANAB L2248)

Sections: 1 2 3 4 5

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SGS North America Inc.

Sample Summary

WSP Environment & Energy

Job No: JC91133

Kop-Flex, Hanover, VA
Project No: 31401545.001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
JC91133-1	07/02/19	11:20	SB	07/03/19	AQ	Ground Water	RW-12270CM-070219
JC91133-2	07/02/19	11:15	SB	07/03/19	AQ	Ground Water	RW-12270CM-070219-F
JC91133-3	07/02/19	11:20	SB	07/03/19	AQ	Trip Blank Water	TRIP BLANK

Summary of Hits

Job Number: JC91133
Account: WSP Environment & Energy
Project: Kop-Flex, Hanover, VA
Collected: 07/02/19

Lab Sample ID / Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
JC91133-1	**RW-12270CM-070219**					
1,1-Dichloroethylene [a]		4.5	0.50	0.19	ug/l	EPA 524.2 REV 4.1
1,4-Dioxane		2.7	0.40	0.095	ug/l	SW846 8260C BY SIM
JC91133-2	**RW-12270CM-070219-F**					
Bromoform [a]		0.38 J	0.50	0.27	ug/l	EPA 524.2 REV 4.1
Dibromochloromethane [a]		0.29 J	0.50	0.14	ug/l	EPA 524.2 REV 4.1
1,1,1-Trichloroethane [a]		0.24 J	0.50	0.22	ug/l	EPA 524.2 REV 4.1
1,4-Dioxane		2.7	0.40	0.095	ug/l	SW846 8260C BY SIM
JC91133-3	**TRIP BLANK**					

No hits reported in this sample.

(a) EPA 524.2 is not a certified method for non-potable water samples.

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	RW-12270CM-070219		
Lab Sample ID:	JC91133-1	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 [a]	1B120280.D	1	07/12/19 19:25	BK	n/a	n/a	V1B5807
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	5.0	2.5	ug/l	
78-93-3	2-Butanone	ND	5.0	0.43	ug/l	
71-43-2	Benzene	ND	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND	0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND	0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND	0.50	0.13	ug/l	
75-25-2	Bromoform	ND	0.50	0.27	ug/l	
74-83-9	Bromomethane	ND	0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND	0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND	0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND	0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND	0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND	0.50	0.080	ug/l	
67-66-3	Chloroform	ND	0.50	0.17	ug/l	
74-87-3	Chloromethane	ND	0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND	0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND	0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride	ND	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	4.5	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND	0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND	0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND	0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND	0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND	0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND	0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND	0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219		
Lab Sample ID:	JC91133-1	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND	0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND	2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND	0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND	0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND	2.0	0.22	ug/l	
91-20-3	Naphthalene	ND	0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND	0.50	0.066	ug/l	
100-42-5	Styrene	ND	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	0.50	0.23	ug/l	
108-88-3	Toluene	ND	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	0.50	0.15	ug/l	
	m,p-Xylene	ND	0.50	0.14	ug/l	
95-47-6	o-Xylene	ND	0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	95%		70-130%
460-00-4	4-Bromofluorobenzene	90%		70-130%

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219		
Lab Sample ID:	JC91133-1	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q

(a) EPA 524.2 is not a certified method for non-potable water samples.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219		
Lab Sample ID:	JC91133-1	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162546.D	1	07/10/19 11:20	RS	n/a	n/a	V3A7041
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	2.7	0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	125%		25-195%

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219-F		
Lab Sample ID:	JC91133-2	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 [a]	1B120281.D	1	07/12/19 19:56	BK	n/a	n/a	V1B5807
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	5.0	2.5	ug/l	
78-93-3	2-Butanone	ND	5.0	0.43	ug/l	
71-43-2	Benzene	ND	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND	0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND	0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND	0.50	0.13	ug/l	
75-25-2	Bromoform	0.38	0.50	0.27	ug/l	J
74-83-9	Bromomethane	ND	0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND	0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND	0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND	0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND	0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND	0.50	0.080	ug/l	
67-66-3	Chloroform	ND	0.50	0.17	ug/l	
74-87-3	Chloromethane	ND	0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND	0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND	0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride	ND	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND	0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND	0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND	0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	0.29	0.50	0.14	ug/l	J
74-95-3	Dibromomethane	ND	0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND	0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND	0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219-F		
Lab Sample ID:	JC91133-2	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND	0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND	2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND	0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND	0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND	2.0	0.22	ug/l	
91-20-3	Naphthalene	ND	0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND	0.50	0.066	ug/l	
100-42-5	Styrene	ND	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	0.24	0.50	0.22	ug/l	J
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	0.50	0.23	ug/l	
108-88-3	Toluene	ND	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	0.50	0.15	ug/l	
	m,p-Xylene	ND	0.50	0.14	ug/l	
95-47-6	o-Xylene	ND	0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	96%		70-130%
460-00-4	4-Bromofluorobenzene	88%		70-130%

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219-F		
Lab Sample ID:	JC91133-2	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q

(a) EPA 524.2 is not a certified method for non-potable water samples.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-070219-F		
Lab Sample ID:	JC91133-2	**Date Sampled:**	07/02/19
Matrix:	AQ - Ground Water	**Date Received:**	07/03/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162547.D	1	07/10/19 11:49	RS	n/a	n/a	V3A7041
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	2.7	0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	127%		25-195%

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JC91133-3	**Date Sampled:**	07/02/19
Matrix:	AQ - Trip Blank Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 [a]	1B120271.D	1	07/12/19 14:12	BK	n/a	n/a	V1B5807
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	5.0	2.5	ug/l	
78-93-3	2-Butanone	ND	5.0	0.43	ug/l	
71-43-2	Benzene	ND	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND	0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND	0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND	0.50	0.13	ug/l	
75-25-2	Bromoform	ND	0.50	0.27	ug/l	
74-83-9	Bromomethane	ND	0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND	0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND	0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND	0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND	0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND	0.50	0.080	ug/l	
67-66-3	Chloroform	ND	0.50	0.17	ug/l	
74-87-3	Chloromethane	ND	0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND	0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND	0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride	ND	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND	0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND	0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND	0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND	0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND	0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND	0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND	0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JC91133-3	**Date Sampled:**	07/02/19
Matrix:	AQ - Trip Blank Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND	0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND	2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND	0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND	0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND	2.0	0.22	ug/l	
91-20-3	Naphthalene	ND	0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND	0.50	0.066	ug/l	
100-42-5	Styrene	ND	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	0.50	0.23	ug/l	
108-88-3	Toluene	ND	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	0.50	0.15	ug/l	
	m,p-Xylene	ND	0.50	0.14	ug/l	
95-47-6	o-Xylene	ND	0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	97%		70-130%
460-00-4	4-Bromofluorobenzene	94%		70-130%

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JC91133-3	**Date Sampled:**	07/02/19
Matrix:	AQ - Trip Blank Water	**Date Received:**	07/03/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	RL	MDL	Units	Q

(a) EPA 524.2 is not a certified method for non-potable water samples.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JC91133-3	**Date Sampled:**	07/02/19
Matrix:	AQ - Trip Blank Water	**Date Received:**	07/03/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162545.D	1	07/10/19 10:51	RS	n/a	n/a	V3A7041
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	ND	0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	126%		25-195%

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

GW WTD

CHAIN-OF-CUSTODY RECORD FX# 1019 2801 5037 JC91133 Page 1 of 1

WSP | Parsons Brinckerhoff Office Address	13530 Dulles Technology Drive Suite 300 Herndon, VA
Project Name	KOP-Flex
Project Location	Hanover, MD
Project Number & Task	31401595.011/03
Sampler(s) Name(s)	Chris Cresap, Shannon Burke
WSP | Parsons Brinckerhoff Contact Name	Eric Johnson
WSP | Parsons Brinckerhoff Contact E-mail	eric.johnson@wspgroup.com
WSP | Parsons Brinckerhoff Contact Phone	703-709-6500
Sampler(s) Signature(s)	
Requested Analyses & Preservatives	VOCs (SW), 1,4-Dioxane (8260 SIM)
No.	004535
Laboratory Name & Location	SGS Accutest
Laboratory Project Manager	Rocus Peters
Requested Turn-Around-Time	[X] Standard [ ] 24 HR [ ] 48 HR [ ] 72 HR [ ] ___ HR

	Sample Identification	Matrix	Collection Start* Date	Collection Start* Time	Collection Stop* Date	Collection Stop* Time	Number of Containers	VOCs (SW)	1,4-Dioxane (8260 SIM)	Sample Comments
1	RW-1227CM-070219	GW	7/2/19		1120			X	X	
2	RW-1227CM-070219-F	GW	7/2/19		1115			X	X	
3	Trip Blank	AQ					4	X	X	V397

INITIAL ASESSMENT JA DM

LABEL VERIFICATION

Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Shipment Method	Tracking Number(s)
	7/2/19	1130	FedEx	7/2/19		FedEX	1019 2801 5087
Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Number of Packages	Custody Seal Number(s)
RC	7/3/19	9:30				1	05858

*Use stop time/date for composite and/or air samples; use only start time/date for all other samples.

Matrix: AQ = Aqueous, S = Soil, SE = Sediment, A = Air, W = Wipe, B = Bulk, O = Other (detail in comments)

4.1 4

JC91133: Chain of Custody
Page 1 of 2

SGS Sample Receipt Summary

Job Number: JC91133 **Client:** _____ **Project:** _____

Date / Time Received: 7/3/2019 9:30:00 AM **Delivery Method:** _____ **Airbill #'s:** _____

Cooler Temps (Raw Measured) °C: Cooler 1: (2.8);

Cooler Temps (Corrected) °C: Cooler 1: (2.5);

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	☑		☐	3. COC Present:	☑		☐
2. Custody Seals Intact:	☑		☐	4. Smpl Dates/Time OK	☑		☐

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	☑		☐
2. Cooler temp verification:	IR Gun		
3. Cooler media:	Ice (Bag)		
4. No. Coolers:	1		

Quality Control Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	☑		☐	☐
2. Trip Blank listed on COC:	☑		☐	☐
3. Samples preserved properly:	☑		☐	
4. VOCs headspace free:	☑		☐	☐

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	☑		☐
2. Container labeling complete:	☑		☐
3. Sample container label / COC agree:	☑		☐

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	☑		☐
2. All containers accounted for:	☑		☐
3. Condition of sample:	Intact		

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	☑		☐	
2. Bottles received for unspecified tests	☐		☑	
3. Sufficient volume recvd for analysis:	☑		☐	
4. Compositing instructions clear:	☐		☐	☑
5. Filtering instructions clear:	☐		☐	☑

Test Strip Lot #s: pH 1-12: 229517 pH 12+: 208717 Other: (Specify) _____ _____

Comments

SM089-03
Rev. Date 12/7/17

JC91133: Chain of Custody
Page 2 of 2

MS Volatiles

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

Method Blank Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5807-MB	1B120262.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	5.0	2.5	ug/l	
78-93-3	2-Butanone	ND	5.0	0.43	ug/l	
71-43-2	Benzene	ND	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND	0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND	0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND	0.50	0.13	ug/l	
75-25-2	Bromoform	ND	0.50	0.27	ug/l	
74-83-9	Bromomethane	ND	0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND	0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND	0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND	0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND	0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND	0.50	0.080	ug/l	
67-66-3	Chloroform	ND	0.50	0.17	ug/l	
74-87-3	Chloromethane	ND	0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND	0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND	0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride	ND	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND	0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND	0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND	0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND	0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND	0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND	0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND	0.50	0.14	ug/l	
95-50-1	o-Dichlorobenzene	ND	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	0.50	0.14	ug/l	

Method Blank Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5807-MB	1B120262.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	Result	RL	MDL	Units	Q
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.18	ug/l	
100-41-4	Ethylbenzene	ND	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND	0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND	2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND	0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND	0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND	2.0	0.22	ug/l	
91-20-3	Naphthalene	ND	0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND	0.50	0.066	ug/l	
100-42-5	Styrene	ND	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	0.50	0.23	ug/l	
108-88-3	Toluene	ND	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	0.50	0.15	ug/l	
	m,p-Xylene	ND	0.50	0.14	ug/l	
95-47-6	o-Xylene	ND	0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries		Limits
2199-69-1	1,2-Dichlorobenzene-d4	99%	70-130%
460-00-4	4-Bromofluorobenzene	99%	70-130%

Method Blank Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5807-MB	1B120262.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:**

JC91133-1, JC91133-2, JC91133-3

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
	system artifact	3.70	1.2	ug/l	J
1066-40-6	Silanol, trimethyl-	9.51	1	ug/l	JN
	Total TIC, Volatile		1	ug/l	J

Method Blank Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V3A7041-MB	3A162544.D	1	07/10/19	RS	n/a	n/a	V3A7041

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	Result	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	ND	0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries		Limits
17647-74-4	1,4-Dioxane-d8	112%	25-195%

Blank Spike Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5807-BS	1B120261.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
67-64-1	Acetone	20	19.2	96	70-130
78-93-3	2-Butanone	20	20.3	102	70-130
71-43-2	Benzene	5	4.9	98	70-130
108-86-1	Bromobenzene	5	4.9	98	70-130
74-97-5	Bromochloromethane	5	5.1	102	70-130
75-27-4	Bromodichloromethane	5	4.9	98	70-130
75-25-2	Bromoform	5	5.7	114	70-130
74-83-9	Bromomethane	5	5.0	100	70-130
104-51-8	n-Butylbenzene	5	5.0	100	70-130
135-98-8	sec-Butylbenzene	5	5.0	100	70-130
98-06-6	tert-Butylbenzene	5	5.0	100	70-130
75-15-0	Carbon disulfide	5	4.9	98	70-130
108-90-7	Chlorobenzene	5	4.7	94	70-130
75-00-3	Chloroethane	5	4.6	92	70-130
67-66-3	Chloroform	5	4.8	96	70-130
74-87-3	Chloromethane	5	4.6	92	70-130
95-49-8	o-Chlorotoluene	5	4.9	98	70-130
106-43-4	p-Chlorotoluene	5	4.7	94	70-130
56-23-5	Carbon tetrachloride	5	5.9	118	70-130
75-34-3	1,1-Dichloroethane	5	4.9	98	70-130
75-35-4	1,1-Dichloroethylene	5	5.1	102	70-130
563-58-6	1,1-Dichloropropene	5	5.0	100	70-130
96-12-8	1,2-Dibromo-3-chloropropane	5	5.1	102	70-130
106-93-4	1,2-Dibromoethane	5	4.8	96	70-130
107-06-2	1,2-Dichloroethane	5	4.9	98	70-130
78-87-5	1,2-Dichloropropane	5	4.7	94	70-130
142-28-9	1,3-Dichloropropane	5	4.5	90	70-130
594-20-7	2,2-Dichloropropane	5	5.4	108	70-130
124-48-1	Dibromochloromethane	5	5.0	100	70-130
74-95-3	Dibromomethane	5	4.8	96	70-130
75-71-8	Dichlorodifluoromethane	5	5.1	102	70-130
541-73-1	m-Dichlorobenzene	5	4.9	98	70-130
95-50-1	o-Dichlorobenzene	5	4.8	96	70-130
106-46-7	p-Dichlorobenzene	5	4.8	96	70-130
156-60-5	trans-1,2-Dichloroethylene	5	4.8	96	70-130
156-59-2	cis-1,2-Dichloroethylene	5	4.7	94	70-130

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5807-BS	1B120261.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
10061-01-5	cis-1,3-Dichloropropene	5	4.9	98	70-130
10061-02-6	trans-1,3-Dichloropropene	5	4.9	98	70-130
100-41-4	Ethylbenzene	5	4.7	94	70-130
87-68-3	Hexachlorobutadiene	5	5.2	104	70-130
591-78-6	2-Hexanone	20	18.2	91	70-130
98-82-8	Isopropylbenzene	5	4.8	96	70-130
99-87-6	p-Isopropyltoluene	5	5.0	100	70-130
75-09-2	Methylene chloride	5	4.8	96	70-130
1634-04-4	Methyl Tert Butyl Ether	5	4.9	98	70-130
108-10-1	4-Methyl-2-pentanone	20	18.8	94	70-130
91-20-3	Naphthalene	5	4.9	98	70-130
103-65-1	n-Propylbenzene	5	4.8	96	70-130
100-42-5	Styrene	5	4.7	94	70-130
630-20-6	1,1,1,2-Tetrachloroethane	5	5.1	102	70-130
71-55-6	1,1,1-Trichloroethane	5	5.3	106	70-130
79-34-5	1,1,2,2-Tetrachloroethane	5	4.7	94	70-130
79-00-5	1,1,2-Trichloroethane	5	4.7	94	70-130
87-61-6	1,2,3-Trichlorobenzene	5	4.9	98	70-130
96-18-4	1,2,3-Trichloropropane	5	4.8	96	70-130
120-82-1	1,2,4-Trichlorobenzene	5	4.9	98	70-130
95-63-6	1,2,4-Trimethylbenzene	5	4.9	98	70-130
108-67-8	1,3,5-Trimethylbenzene	5	4.9	98	70-130
127-18-4	Tetrachloroethylene	5	4.9	98	70-130
108-88-3	Toluene	5	4.8	96	70-130
79-01-6	Trichloroethylene	5	4.8	96	70-130
75-69-4	Trichlorofluoromethane	5	5.2	104	70-130
75-01-4	Vinyl chloride	5	4.9	98	70-130
	m,p-Xylene	10	9.5	95	70-130
95-47-6	o-Xylene	5	4.9	98	70-130
1330-20-7	Xylenes (total)	15	14.4	96	70-130

CAS No.	Surrogate Recoveries	BSP	Limits
2199-69-1	1,2-Dichlorobenzene-d4	103%	70-130%
460-00-4	4-Bromofluorobenzene	99%	70-130%

* = Outside of Control Limits.

Blank Spike/Blank Spike Duplicate Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V3A7041-BS	3A162542.D	1	07/10/19	RS	n/a	n/a	V3A7041
V3A7041-BSD	3A162543.D	1	07/10/19	RS	n/a	n/a	V3A7041

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	BSD ug/l	BSD %	RPD	Limits Rec/RPD
123-91-1	1,4-Dioxane	20	21.5	108	21.9	110	2	48-137/32

CAS No.	Surrogate Recoveries	BSP	BSD	Limits
17647-74-4	1,4-Dioxane-d8	110%	108%	25-195%

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91356-1MS	1B120269.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-1	1B120264.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-1	1B120266.D	10	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	JC91356-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
67-64-1	Acetone	ND		20	15.3	77	41-142
78-93-3	2-Butanone	ND		20	20.8	104	55-129
71-43-2	Benzene	ND		5	3.6	72	53-138
108-86-1	Bromobenzene	ND		5	3.7	74	54-138
74-97-5	Bromochloromethane	ND		5	3.7	74	55-140
75-27-4	Bromodichloromethane	ND		5	3.6	72	57-147
75-25-2	Bromoform	ND		5	4.4	88	47-137
74-83-9	Bromomethane	ND		5	5.2	104	40-162
104-51-8	n-Butylbenzene	ND		5	3.8	76	45-144
135-98-8	sec-Butylbenzene	ND		5	3.8	76	46-145
98-06-6	tert-Butylbenzene	ND		5	3.8	76	48-141
75-15-0	Carbon disulfide	ND		5	3.7	74	35-127
108-90-7	Chlorobenzene	ND		5	3.6	72	54-135
75-00-3	Chloroethane	ND		5	5.3	106	38-153
67-66-3	Chloroform	ND		5	3.4	68	57-151
74-87-3	Chloromethane	ND		5	4.6	92	39-165
95-49-8	o-Chlorotoluene	ND		5	3.7	74	55-142
106-43-4	p-Chlorotoluene	ND		5	3.6	72	55-139
56-23-5	Carbon tetrachloride	ND		5	4.6	92	49-170
75-34-3	1,1-Dichloroethane	ND		5	3.7	74	55-149
75-35-4	1,1-Dichloroethylene	ND		5	4.0	80	42-142
563-58-6	1,1-Dichloropropene	ND		5	3.9	78	46-151
96-12-8	1,2-Dibromo-3-chloropropane	ND		5	4.5	90	48-141
106-93-4	1,2-Dibromoethane	ND		5	3.8	76	57-135
107-06-2	1,2-Dichloroethane	ND		5	3.6	72	59-166
78-87-5	1,2-Dichloropropane	ND		5	3.5	70	53-142
142-28-9	1,3-Dichloropropane	ND		5	3.5	70	58-143
594-20-7	2,2-Dichloropropane	ND		5	4.0	80	38-165
124-48-1	Dibromochloromethane	ND		5	3.6	72	55-138
74-95-3	Dibromomethane	ND		5	3.6	72	61-144
75-71-8	Dichlorodifluoromethane	ND		5	5.8	116	23-172
541-73-1	m-Dichlorobenzene	ND		5	3.8	76	53-138
95-50-1	o-Dichlorobenzene	ND		5	3.8	76	54-140
106-46-7	p-Dichlorobenzene	ND		5	3.7	74	53-137
156-60-5	trans-1,2-Dichloroethylene	1.3		5	4.8	70	47-148
156-59-2	cis-1,2-Dichloroethylene	77.0	b	5	86.2	-14*	a 51-146

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91356-1MS	1B120269.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-1	1B120264.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-1	1B120266.D	10	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	JC91356-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
10061-01-5	cis-1,3-Dichloropropene	ND		5	3.5	70	51-136
10061-02-6	trans-1,3-Dichloropropene	ND		5	3.5	70	54-142
100-41-4	Ethylbenzene	ND		5	3.6	72	51-138
87-68-3	Hexachlorobutadiene	ND		5	4.1	82	40-154
591-78-6	2-Hexanone	ND		20	18.0	90	53-128
98-82-8	Isopropylbenzene	ND		5	3.7	74	49-139
99-87-6	p-Isopropyltoluene	ND		5	3.8	76	45-141
75-09-2	Methylene chloride	ND		5	3.6	72	54-137
1634-04-4	Methyl Tert Butyl Ether	ND		5	3.6	72	53-143
108-10-1	4-Methyl-2-pentanone	ND		20	16.9	85	58-127
91-20-3	Naphthalene	ND		5	4.1	82	44-140
103-65-1	n-Propylbenzene	ND		5	3.7	74	50-142
100-42-5	Styrene	ND		5	3.5	70	23-130
630-20-6	1,1,1,2-Tetrachloroethane	ND		5	3.8	76	57-144
71-55-6	1,1,1-Trichloroethane	ND		5	4.0	80	52-164
79-34-5	1,1,2,2-Tetrachloroethane	ND		5	4.3	86	58-138
79-00-5	1,1,2-Trichloroethane	ND		5	3.6	72	59-139
87-61-6	1,2,3-Trichlorobenzene	ND		5	3.9	78	47-141
96-18-4	1,2,3-Trichloropropane	ND		5	4.3	86	56-148
120-82-1	1,2,4-Trichlorobenzene	ND		5	3.7	74	46-137
95-63-6	1,2,4-Trimethylbenzene	ND		5	3.7	74	41-138
108-67-8	1,3,5-Trimethylbenzene	ND		5	3.7	74	45-138
127-18-4	Tetrachloroethylene	ND		5	3.8	76	45-145
108-88-3	Toluene	ND		5	3.6	72	52-134
79-01-6	Trichloroethylene	ND		5	3.7	74	54-143
75-69-4	Trichlorofluoromethane	ND		5	5.9	118	36-167
75-01-4	Vinyl chloride	10.5		5	15.4	98	35-162
	m,p-Xylene	ND		10	7.2	72	49-135
95-47-6	o-Xylene	ND		5	3.5	70	49-134
1330-20-7	Xylenes (total)	ND		15	10.8	72	50-134

CAS No.	Surrogate Recoveries	MS	JC91356-1	JC91356-1	Limits
2199-69-1	1,2-Dichlorobenzene-d4	100%	97%	97%	70-130%
460-00-4	4-Bromofluorobenzene	99%	95%	97%	70-130%

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91356-1MS	1B120269.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-1	1B120264.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-1	1B120266.D	10	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Result is from Run #2.

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91133-1MS	3A162550.D	1	07/10/19	RS	n/a	n/a	V3A7041
JC91133-1	3A162546.D	1	07/10/19	RS	n/a	n/a	V3A7041

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	JC91133-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
123-91-1	1,4-Dioxane	2.7		20	25.6	115	28-162

CAS No.	Surrogate Recoveries	MS	JC91133-1	Limits
17647-74-4	1,4-Dioxane-d8	117%	125%	25-195%

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91356-2DUP	1B120270.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-2	1B120265.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	JC91356-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
67-64-1	Acetone	ND		ND		nc	10
78-93-3	2-Butanone	ND		ND		nc	12
71-43-2	Benzene	ND		ND		nc	10
108-86-1	Bromobenzene	ND		ND		nc	10
74-97-5	Bromochloromethane	ND		ND		nc	10
75-27-4	Bromodichloromethane	ND		ND		nc	10
75-25-2	Bromoform	ND		ND		nc	10
74-83-9	Bromomethane	ND		ND		nc	10
104-51-8	n-Butylbenzene	ND		ND		nc	10
135-98-8	sec-Butylbenzene	ND		ND		nc	10
98-06-6	tert-Butylbenzene	ND		ND		nc	10
75-15-0	Carbon disulfide	ND		ND		nc	19
108-90-7	Chlorobenzene	ND		ND		nc	10
75-00-3	Chloroethane	ND		ND		nc	10
67-66-3	Chloroform	ND		ND		nc	12
74-87-3	Chloromethane	ND		ND		nc	10
95-49-8	o-Chlorotoluene	ND		ND		nc	10
106-43-4	p-Chlorotoluene	ND		ND		nc	10
56-23-5	Carbon tetrachloride	ND		ND		nc	10
75-34-3	1,1-Dichloroethane	ND		ND		nc	10
75-35-4	1,1-Dichloroethylene	ND		ND		nc	10
563-58-6	1,1-Dichloropropene	ND		ND		nc	10
96-12-8	1,2-Dibromo-3-chloropropane	ND		ND		nc	10
106-93-4	1,2-Dibromoethane	ND		ND		nc	10
107-06-2	1,2-Dichloroethane	ND		ND		nc	10
78-87-5	1,2-Dichloropropane	ND		ND		nc	10
142-28-9	1,3-Dichloropropane	ND		ND		nc	10
594-20-7	2,2-Dichloropropane	ND		ND		nc	10
124-48-1	Dibromochloromethane	ND		ND		nc	10
74-95-3	Dibromomethane	ND		ND		nc	10
75-71-8	Dichlorodifluoromethane	ND		ND		nc	10
541-73-1	m-Dichlorobenzene	ND		ND		nc	10
95-50-1	o-Dichlorobenzene	ND		ND		nc	10
106-46-7	p-Dichlorobenzene	ND		ND		nc	10
156-60-5	trans-1,2-Dichloroethylene	ND		ND		nc	10
156-59-2	cis-1,2-Dichloroethylene	1.9		1.7		11* [a]	10

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91356-2DUP	1B120270.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-2	1B120265.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	JC91356-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
10061-01-5	cis-1,3-Dichloropropene	ND		ND		nc	10
10061-02-6	trans-1,3-Dichloropropene	ND		ND		nc	10
100-41-4	Ethylbenzene	ND		ND		nc	10
87-68-3	Hexachlorobutadiene	ND		ND		nc	10
591-78-6	2-Hexanone	ND		ND		nc	10
98-82-8	Isopropylbenzene	ND		ND		nc	10
99-87-6	p-Isopropyltoluene	ND		ND		nc	10
75-09-2	Methylene chloride	ND		ND		nc	10
1634-04-4	Methyl Tert Butyl Ether	ND		ND		nc	10
108-10-1	4-Methyl-2-pentanone	ND		ND		nc	10
91-20-3	Naphthalene	ND		ND		nc	10
103-65-1	n-Propylbenzene	ND		ND		nc	10
100-42-5	Styrene	ND		ND		nc	10
630-20-6	1,1,1,2-Tetrachloroethane	ND		ND		nc	10
71-55-6	1,1,1-Trichloroethane	ND		ND		nc	10
79-34-5	1,1,2,2-Tetrachloroethane	ND		ND		nc	10
79-00-5	1,1,2-Trichloroethane	ND		ND		nc	10
87-61-6	1,2,3-Trichlorobenzene	ND		ND		nc	10
96-18-4	1,2,3-Trichloropropane	ND		ND		nc	10
120-82-1	1,2,4-Trichlorobenzene	ND		ND		nc	10
95-63-6	1,2,4-Trimethylbenzene	ND		ND		nc	10
108-67-8	1,3,5-Trimethylbenzene	ND		ND		nc	10
127-18-4	Tetrachloroethylene	ND		ND		nc	10
108-88-3	Toluene	ND		ND		nc	10
79-01-6	Trichloroethylene	ND		ND		nc	10
75-69-4	Trichlorofluoromethane	ND		ND		nc	10
75-01-4	Vinyl chloride	2.6		2.5		4	10
	m,p-Xylene	ND		ND		nc	10
95-47-6	o-Xylene	ND		ND		nc	10
1330-20-7	Xylenes (total)	ND		ND		nc	10

CAS No.	Surrogate Recoveries	DUP	JC91356-2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	98%	96%	70-130%
460-00-4	4-Bromofluorobenzene	95%	94%	70-130%

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91356-2DUP	1B120270.D	1	07/12/19	BK	n/a	n/a	V1B5807
JC91356-2	1B120265.D	1	07/12/19	BK	n/a	n/a	V1B5807

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC91133-1, JC91133-2, JC91133-3

(a) High RPD due to low concentration of hit

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC91133-2DUP	3A162552.D	1	07/10/19	RS	n/a	n/a	V3A7041
JC91133-2	3A162547.D	1	07/10/19	RS	n/a	n/a	V3A7041

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC91133-1, JC91133-2, JC91133-3

CAS No.	Compound	JC91133-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
123-91-1	1,4-Dioxane	2.7		2.5		8	48

CAS No.	Surrogate Recoveries	DUP	JC91133-2	Limits
17647-74-4	1,4-Dioxane-d8	120%	127%	25-195%

* = Outside of Control Limits.

Instrument Performance Check (BFB)

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V1B5806-BFB
Lab File ID: 1B120247.D
Instrument ID: GCMS1B
Injection Date: 07/11/19
Injection Time: 14:06

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	14.99 - 40.0% of mass 95	3424	20.0		Pass
75	30.0 - 80.0% of mass 95	8612	50.4		Pass
95	Base peak, 100% relative abundance	17100	100.0		Pass
96	5.0 - 9.0% of mass 95	1206	7.05		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	14298	83.6		Pass
175	5.0 - 9.0% of mass 174	1017	5.95	(7.11) [a]	Pass
176	95.0 - 101.0% of mass 174	13890	81.2	(97.1) [a]	Pass
177	5.0 - 9.0% of mass 176	989	5.78	(7.12) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V1B5806-IC5806	1B120248.D	07/11/19	14:38	00:32	Initial cal 0.2
V1B5806-IC5806	1B120249.D	07/11/19	15:09	01:03	Initial cal 0.5
V1B5806-IC5806	1B120250.D	07/11/19	15:40	01:34	Initial cal 1
V1B5806-IC5806	1B120251.D	07/11/19	16:11	02:05	Initial cal 2
V1B5806-IC5806	1B120252.D	07/11/19	16:43	02:37	Initial cal 5
V1B5806-ICC5806	1B120253.D	07/11/19	17:14	03:08	Initial cal 10
V1B5806-IC5806	1B120254.D	07/11/19	17:45	03:39	Initial cal 20
V1B5806-IC5806	1B120255.D	07/11/19	18:16	04:10	Initial cal 40
V1B5806-IC5806	1B120256.D	07/11/19	18:47	04:41	Initial cal 80
V1B5806-ICV5806	1B120259.D	07/11/19	20:20	06:14	Initial cal verification 10

Instrument Performance Check (BFB)

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V1B5807-BFB
Lab File ID: 1B120260.D
Instrument ID: GCMS1B
Injection Date: 07/12/19
Injection Time: 08:02

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	14.99 - 40.0% of mass 95	3727	20.3		Pass
75	30.0 - 80.0% of mass 95	9337	50.8		Pass
95	Base peak, 100% relative abundance	18382	100.0		Pass
96	5.0 - 9.0% of mass 95	1241	6.75		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	14062	76.5		Pass
175	5.0 - 9.0% of mass 174	1146	6.23	(8.15) [a]	Pass
176	95.0 - 101.0% of mass 174	13442	73.1	(95.6) [a]	Pass
177	5.0 - 9.0% of mass 176	939	5.11	(6.99) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V1B5807-CC5806	1B120261.D	07/12/19	08:51	00:49	Continuing cal 5
V1B5807-BS	1B120261.D	07/12/19	08:51	00:49	Blank Spike
V1B5807-MB	1B120262.D	07/12/19	09:28	01:26	Method Blank
ZZZZZZ	1B120263.D	07/12/19	10:04	02:02	(unrelated sample)
JC91356-1	1B120264.D	07/12/19	10:36	02:34	(used for QC only; not part of job JC91133)
JC91356-2	1B120265.D	07/12/19	11:07	03:05	(used for QC only; not part of job JC91133)
JC91356-1	1B120266.D	07/12/19	11:38	03:36	(used for QC only; not part of job JC91133)
ZZZZZZ	1B120267.D	07/12/19	12:09	04:07	(unrelated sample)
ZZZZZZ	1B120268.D	07/12/19	12:40	04:38	(unrelated sample)
JC91356-1MS	1B120269.D	07/12/19	13:10	05:08	Matrix Spike
JC91356-2DUP	1B120270.D	07/12/19	13:42	05:40	Duplicate
JC91133-3	1B120271.D	07/12/19	14:12	06:10	TRIP BLANK
ZZZZZZ	1B120272.D	07/12/19	15:18	07:16	(unrelated sample)
ZZZZZZ	1B120273.D	07/12/19	15:49	07:47	(unrelated sample)
ZZZZZZ	1B120274.D	07/12/19	16:20	08:18	(unrelated sample)
ZZZZZZ	1B120275.D	07/12/19	16:50	08:48	(unrelated sample)
ZZZZZZ	1B120276.D	07/12/19	17:21	09:19	(unrelated sample)
ZZZZZZ	1B120277.D	07/12/19	17:52	09:50	(unrelated sample)
ZZZZZZ	1B120278.D	07/12/19	18:23	10:21	(unrelated sample)
ZZZZZZ	1B120279.D	07/12/19	18:54	10:52	(unrelated sample)
JC91133-1	1B120280.D	07/12/19	19:25	11:23	RW-12270CM-070219
JC91133-2	1B120281.D	07/12/19	19:56	11:54	RW-12270CM-070219-F

Instrument Performance Check (BFB)

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V3A6923-BFB
Lab File ID: 3A160428.D
Instrument ID: GCMS3A
Injection Date: 07/18/18
Injection Time: 16:55

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	15.0 - 40.0% of mass 95	25408	20.8		Pass
75	30.0 - 60.0% of mass 95	62880	51.6		Pass
95	Base peak, 100% relative abundance	121864	100.0		Pass
96	5.0 - 9.0% of mass 95	8101	6.65		Pass
173	Less than 2.0% of mass 174	826	0.68	(0.81) [a]	Pass
174	50.0 - 120.0% of mass 95	102317	84.0		Pass
175	5.0 - 9.0% of mass 174	8168	6.70	(7.98) [a]	Pass
176	95.0 - 101.0% of mass 174	100370	82.4	(98.1) [a]	Pass
177	5.0 - 9.0% of mass 176	6691	5.49	(6.67) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V3A6923-IC6923	3A160429.D	07/18/18	17:26	00:31	Initial cal 0.25
V3A6923-IC6923	3A160430.D	07/18/18	17:52	00:57	Initial cal 0.4
V3A6923-IC6923	3A160431.D	07/18/18	18:18	01:23	Initial cal 1
V3A6923-IC6923	3A160432.D	07/18/18	18:43	01:48	Initial cal 2
V3A6923-IC6923	3A160433.D	07/18/18	19:09	02:14	Initial cal 5
V3A6923-ICC6923	3A160434.D	07/18/18	19:35	02:40	Initial cal 20
V3A6923-IC6923	3A160435.D	07/18/18	20:00	03:05	Initial cal 50
V3A6923-IC6923	3A160436.D	07/18/18	20:26	03:31	Initial cal 100
V3A6923-IC6923	3A160437.D	07/18/18	20:52	03:57	Initial cal 200
V3A6923-ICV6923	3A160443.D	07/18/18	23:25	06:30	Initial cal verification 20

Instrument Performance Check (BFB)

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample:	V3A7041-BFB	**Injection Date:**	07/10/19
Lab File ID:	3A162540.D	**Injection Time:**	08:14
Instrument ID:	GCMS3A		

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	15.0 - 40.0% of mass 95	15966	21.4		Pass
75	30.0 - 60.0% of mass 95	37369	50.0		Pass
95	Base peak, 100% relative abundance	74714	100.0		Pass
96	5.0 - 9.0% of mass 95	4946	6.62		Pass
173	Less than 2.0% of mass 174	330	0.44	(0.68) [a]	Pass
174	50.0 - 120.0% of mass 95	48760	65.3		Pass
175	5.0 - 9.0% of mass 174	4020	5.38	(8.24) [a]	Pass
176	95.0 - 101.0% of mass 174	47986	64.2	(98.4) [a]	Pass
177	5.0 - 9.0% of mass 176	3158	4.23	(6.58) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V3A7041-CC6923	3A162541.D	07/10/19	08:43	00:29	Continuing cal 5
V3A7041-BS	3A162542.D	07/10/19	09:14	01:00	Blank Spike
V3A7041-BSD	3A162543.D	07/10/19	09:42	01:28	Blank Spike Duplicate
V3A7041-MB	3A162544.D	07/10/19	10:19	02:05	Method Blank
JC91133-3	3A162545.D	07/10/19	10:51	02:37	TRIP BLANK
JC91133-1	3A162546.D	07/10/19	11:20	03:06	RW-12270CM-070219
JC91133-2	3A162547.D	07/10/19	11:49	03:35	RW-12270CM-070219-F
ZZZZZZ	3A162548.D	07/10/19	12:18	04:04	(unrelated sample)
ZZZZZZ	3A162549.D	07/10/19	12:47	04:33	(unrelated sample)
JC91133-1MS	3A162550.D	07/10/19	13:15	05:01	Matrix Spike
JC91133-2DUP	3A162552.D	07/10/19	14:13	05:59	Duplicate

Surrogate Recovery Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Method: EPA 524.2 REV 4.1 **Matrix:** AQ

Samples and QC shown here apply to the above method

Lab Sample ID	Lab File ID	S1	S2
JC91133-1	1B120280.D	95	90
JC91133-2	1B120281.D	96	88
JC91133-3	1B120271.D	97	94
JC91356-1MS	1B120269.D	100	99
JC91356-2DUP	1B120270.D	98	95
V1B5807-BS	1B120261.D	103	99
V1B5807-MB	1B120262.D	99	99

Surrogate Compounds	Recovery Limits
S1 = 1,2-Dichlorobenzene-d4	70-130%
S2 = 4-Bromofluorobenzene	70-130%

Surrogate Recovery Summary

Job Number: JC91133
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Method: SW846 8260C BY SIM **Matrix:** AQ

Samples and QC shown here apply to the above method

Lab Sample ID	Lab File ID	S1
JC91133-1	3A162546.D	125
JC91133-2	3A162547.D	127
JC91133-3	3A162545.D	126
JC91133-1MS	3A162550.D	117
JC91133-2DUP	3A162552.D	120
V3A7041-BS	3A162542.D	110
V3A7041-BSD	3A162543.D	108
V3A7041-MB	3A162544.D	112

Surrogate Compounds	Recovery Limits
S1 = 1,4-Dioxane-d8	25-195%

AUGUST 2019

The results set forth herein are provided by SGS North America Inc.

e-Hardcopy 2.0
Automated Report

Technical Report for

WSP Environment & Energy

Kop-Flex, Hanover, VA

31401545.001

SGS Job Number: JC92613

Sampling Date: 08/01/19

Report to:

WSP
11190 Sunrise Valley Drive Suite 300
Reston, VA 20190
Eric.Johnson@WSPGroup.com; maria.kaplan@wsp.com

ATTN: Eric Johnson

Total number of pages in report: 40

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Mike Earp
General Manager

Client Service contact: Rocus Peters 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, FL, IL, IN, KS, KY, LA, MA, MD, ME, MN, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TX, UT, VA, WV, DoD ELAP (ANAB L2248)

Sections: 1 2 3 4 5

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SGS North America Inc.

Sample Summary

WSP Environment & Energy

Job No: JC92613

Kop-Flex, Hanover, VA
Project No: 31401545.001

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
JC92613-1	08/01/19	10:15	CC	08/02/19	DW	Drinking Water	RW-12270CM-080119-F
JC92613-2	08/01/19	10:20	CC	08/02/19	DW	Drinking Water	RW-12270CM-080119
JC92613-3	08/01/19	10:20	CC	08/02/19	DW	Drinking Water TB	TB-080119

Summary of Hits

Job Number: JC92613
Account: WSP Environment & Energy
Project: Kop-Flex, Hanover, VA
Collected: 08/01/19

Lab Sample ID / Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
JC92613-1	**RW-12270CM-080119-F**					
1,1,1-Trichloroethane		0.22 J	0.50	0.22	ug/l	EPA 524.2 REV 4.1
1,4-Dioxane		1.8	0.40	0.095	ug/l	SW846 8260C BY SIM
JC92613-2	**RW-12270CM-080119**					
1,1-Dichloroethylene		4.4	0.50	0.19	ug/l	EPA 524.2 REV 4.1
1,4-Dioxane		1.7	0.40	0.095	ug/l	SW846 8260C BY SIM
JC92613-3	**TB-080119**					
Acetone		4.1 J	5.0	2.5	ug/l	EPA 524.2 REV 4.1

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	RW-12270CM-080119-F		
Lab Sample ID:	JC92613-1	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	1B120445.D	1	08/06/19 12:03	BK	n/a	n/a	V1B5821
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
67-64-1	Acetone	ND		5.0	2.5	ug/l	
78-93-3	2-Butanone	ND		5.0	0.43	ug/l	
71-43-2	Benzene	ND	5.0	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND		0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND		0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND		0.50	0.13	ug/l	
75-25-2	Bromoform [a]	ND		0.50	0.27	ug/l	
74-83-9	Bromomethane	ND		0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND		0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND		0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND		0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND		0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	100	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND		0.50	0.080	ug/l	
67-66-3	Chloroform	ND		0.50	0.17	ug/l	
74-87-3	Chloromethane	ND		0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND		0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND		0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride [a]	ND	5.0	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND		0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	7.0	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND		0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.20	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.050	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	5.0	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	5.0	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND		0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND		0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND		0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND		0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND		0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND		0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119-F		
Lab Sample ID:	JC92613-1	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	600	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	75	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	100	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	70	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND		0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND		0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	700	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND		0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND		2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND		0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND		0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	5.0	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND		0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND		2.0	0.22	ug/l	
91-20-3	Naphthalene	ND		0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND		0.50	0.066	ug/l	
100-42-5	Styrene	ND	100	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND		0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	0.22	200	0.50	0.22	ug/l	J
79-34-5	1,1,2,2-Tetrachloroethane	ND		0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	5.0	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND		0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND		0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	70	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND		0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND		0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	5.0	0.50	0.23	ug/l	
108-88-3	Toluene	ND	1000	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	5.0	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND		1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	2.0	0.50	0.15	ug/l	
	m,p-Xylene	ND		0.50	0.14	ug/l	
95-47-6	o-Xylene	ND		0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	10000	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	98%		70-130%
460-00-4	4-Bromofluorobenzene	89%		70-130%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119-F		
Lab Sample ID:	JC92613-1	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q

(a) Associated CCV outside of control limits high, sample was ND. This compound in BS is outside in house QC criteria bias high.

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119-F		
Lab Sample ID:	JC92613-1	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162820.D	1	08/08/19 12:54	RS	n/a	n/a	V3A7051
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	1.8		0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	98%		25-195%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119		
Lab Sample ID:	JC92613-2	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	1B120446.D	1	08/06/19 12:34	BK	n/a	n/a	V1B5821
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
67-64-1	Acetone	ND		5.0	2.5	ug/l	
78-93-3	2-Butanone	ND		5.0	0.43	ug/l	
71-43-2	Benzene	ND	5.0	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND		0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND		0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND		0.50	0.13	ug/l	
75-25-2	Bromoform [a]	ND		0.50	0.27	ug/l	
74-83-9	Bromomethane	ND		0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND		0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND		0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND		0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND		0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	100	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND		0.50	0.080	ug/l	
67-66-3	Chloroform	ND		0.50	0.17	ug/l	
74-87-3	Chloromethane	ND		0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND		0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND		0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride [a]	ND	5.0	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND		0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	4.4	7.0	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND		0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.20	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.050	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	5.0	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	5.0	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND		0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND		0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND		0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND		0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND		0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND		0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119		
Lab Sample ID:	JC92613-2	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	600	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	75	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	100	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	70	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND		0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND		0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	700	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND		0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND		2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND		0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND		0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	5.0	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND		0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND		2.0	0.22	ug/l	
91-20-3	Naphthalene	ND		0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND		0.50	0.066	ug/l	
100-42-5	Styrene	ND	100	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND		0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	200	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND		0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	5.0	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND		0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND		0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	70	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND		0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND		0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	5.0	0.50	0.23	ug/l	
108-88-3	Toluene	ND	1000	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	5.0	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND		1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	2.0	0.50	0.15	ug/l	
	m,p-Xylene	ND		0.50	0.14	ug/l	
95-47-6	o-Xylene	ND		0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	10000	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	100%		70-130%
460-00-4	4-Bromofluorobenzene	88%		70-130%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119		
Lab Sample ID:	JC92613-2	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q

(a) Associated CCV outside of control limits high, sample was ND. This compound in BS is outside in house QC criteria bias high.

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-080119		
Lab Sample ID:	JC92613-2	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water	**Date Received:**	08/02/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162821.D	1	08/08/19 13:23	RS	n/a	n/a	V3A7051
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	1.7		0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	95%		25-195%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-080119		
Lab Sample ID:	JC92613-3	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water TB	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	1B120444.D	1	08/06/19 11:32	BK	n/a	n/a	V1B5821
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
67-64-1	Acetone	4.1		5.0	2.5	ug/l	J
78-93-3	2-Butanone	ND		5.0	0.43	ug/l	
71-43-2	Benzene	ND	5.0	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND		0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND		0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND		0.50	0.13	ug/l	
75-25-2	Bromoform [a]	ND		0.50	0.27	ug/l	
74-83-9	Bromomethane	ND		0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND		0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND		0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND		0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND		0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	100	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND		0.50	0.080	ug/l	
67-66-3	Chloroform	ND		0.50	0.17	ug/l	
74-87-3	Chloromethane	ND		0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND		0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND		0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride [a]	ND	5.0	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND		0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	7.0	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND		0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.20	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.050	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	5.0	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	5.0	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND		0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND		0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND		0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND		0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND		0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND		0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-080119		
Lab Sample ID:	JC92613-3	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water TB	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	600	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	75	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	100	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	70	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND		0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND		0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	700	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND		0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND		2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND		0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND		0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	5.0	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND		0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND		2.0	0.22	ug/l	
91-20-3	Naphthalene	ND		0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND		0.50	0.066	ug/l	
100-42-5	Styrene	ND	100	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND		0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	200	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND		0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	5.0	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND		0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND		0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	70	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND		0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND		0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	5.0	0.50	0.23	ug/l	
108-88-3	Toluene	ND	1000	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	5.0	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND		1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	2.0	0.50	0.15	ug/l	
	m,p-Xylene	ND		0.50	0.14	ug/l	
95-47-6	o-Xylene	ND		0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	10000	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	98%		70-130%
460-00-4	4-Bromofluorobenzene	90%		70-130%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-080119		
Lab Sample ID:	JC92613-3	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water TB	**Date Received:**	08/02/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q

(a) Associated CCV outside of control limits high, sample was ND. This compound in BS is outside in house QC criteria bias high.

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-080119		
Lab Sample ID:	JC92613-3	**Date Sampled:**	08/01/19
Matrix:	DW - Drinking Water TB	**Date Received:**	08/02/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162822.D	1	08/08/19 13:52	RS	n/a	n/a	V3A7051
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	ND		0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	86%		25-195%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

DW JC92613

CHAIN-OF-CUSTODY RECORD FX Tracking #: 7888 3665 2427 Page ___ of ___

WSP | Parsons Brinckerhoff Office Address	13530 Dulles Technology Dr. Suite 300 Herndon, VA
Project Name	Kop-Flex
Project Location	Hanover, MD
Project Number & Task	31401515011-03
WSP | Parsons Brinckerhoff Contact Name	Chris Cresci
WSP | Parsons Brinckerhoff Contact E-mail	Chris.Cresci @wspgroup.com
WSP | Parsons Brinckerhoff Contact Phone	703-709-6500
Sampler(s) Name(s)	Chris Cresci, Shannon Burke
Sampler(s) Signature(s)	

Requested Analyses & Preservatives

Sample Identification	Matrix	Collection Start* Date	Collection Start* Time	Collection Stop* Date	Collection Stop* Time	Number of Containers	VOCs (5035)	1,4 Dioxane (8260SIM)								Sample Comments
1 RW-1270CM-080119-F	DW	8/1/19		1015		6	X	X							VOA	Cooler temp: 1.6°C
2 RW-1270CM-080119	DW	8/1/19		1020		6	X	X							VOA	Thermal ID: IR-7 IP
3 TB-080119						4	X	X								

Bottle #: SW-113818-1144

INITIAL ASESSMENT 12 2B

LABEL VERIFICATION

Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Shipment Method	Tracking Number(s)
	8/1/19		Fed ex				
Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Number of Packages	Custody Seal Number(s)
Fedex	8/2/19	9:30	SFG				

*Use stop time/date for composite and/or air samples; use only start time/date for all other samples.

Matrix: AQ = Aqueous, S = Soil, SE = Sediment, A = Air, W = Wipe, B = Bulk, O = Other (detail in comments)

No. 004536 WSP | PARSONS BRINCKERHOFF

Laboratory Name & Location: SGS Accutest

Laboratory Project Manager: Rocus Peters

Requested Turn-Around-Time: [X] Standard [ ] 24 HR [ ] 48 HR [ ] 72 HR [ ] ___ HR

SGS Sample Receipt Summary

Job Number: JC92613 **Client:** _____ **Project:** _____

Date / Time Received: 8/2/2019 9:30:00 AM **Delivery Method:** _____ **Airbill #'s:** _____

Cooler Temps (Raw Measured) °C: Cooler 1: (1.6);

Cooler Temps (Corrected) °C: Cooler 1: (1.5);

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	☑		☐	3. COC Present:	☑		☐
2. Custody Seals Intact:	☑		☐	4. Smpl Dates/Time OK	☑		☐

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	☑		☐
2. Cooler temp verification:	IR Gun		
3. Cooler media:	Ice (Bag)		
4. No. Coolers:	1		

Quality Control Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	☑		☐	☐
2. Trip Blank listed on COC:	☑		☐	☐
3. Samples preserved properly:	☑		☐	
4. VOCs headspace free:	☑		☐	☐

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	☑		☐
2. Container labeling complete:	☑		☐
3. Sample container label / COC agree:	☑		☐

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	☑		☐
2. All containers accounted for:	☑		☐
3. Condition of sample:	Intact		

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	☑		☐	
2. Bottles received for unspecified tests	☐		☑	
3. Sufficient volume recvd for analysis:	☑		☐	
4. Compositing instructions clear:	☐		☐	☑
5. Filtering instructions clear:	☐		☐	☑

Test Strip Lot #s: pH 1-12: 229517 pH 12+: 208717 Other: (Specify) _____ _____

Comments

SM089-03
Rev. Date 12/7/17

JC92613: Chain of Custody
Page 2 of 2

MS Volatiles

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

Method Blank Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5821-MB	1B120443.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	5.0	2.5	ug/l	
78-93-3	2-Butanone	ND	5.0	0.43	ug/l	
71-43-2	Benzene	ND	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND	0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND	0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND	0.50	0.13	ug/l	
75-25-2	Bromoform	ND	0.50	0.27	ug/l	
74-83-9	Bromomethane	ND	0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND	0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND	0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND	0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND	0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND	0.50	0.080	ug/l	
67-66-3	Chloroform	ND	0.50	0.17	ug/l	
74-87-3	Chloromethane	ND	0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND	0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND	0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride	ND	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND	0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND	0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND	0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND	0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND	0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND	0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND	0.50	0.14	ug/l	
95-50-1	o-Dichlorobenzene	ND	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	0.50	0.14	ug/l	

Method Blank Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5821-MB	1B120443.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	Result	RL	MDL	Units	Q
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.18	ug/l	
100-41-4	Ethylbenzene	ND	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND	0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND	2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND	0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND	0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND	2.0	0.22	ug/l	
91-20-3	Naphthalene	ND	0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND	0.50	0.066	ug/l	
100-42-5	Styrene	ND	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	0.50	0.23	ug/l	
108-88-3	Toluene	ND	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	0.50	0.15	ug/l	
	m,p-Xylene	ND	0.50	0.14	ug/l	
95-47-6	o-Xylene	ND	0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries		Limits
2199-69-1	1,2-Dichlorobenzene-d4	98%	70-130%
460-00-4	4-Bromofluorobenzene	90%	70-130%

Method Blank Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V3A7051-MB	3A162816.D	1	08/08/19	RS	n/a	n/a	V3A7051

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	Result	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	ND	0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries		Limits
17647-74-4	1,4-Dioxane-d8	79%	25-195%

Blank Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5821-BS	1B120442.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
67-64-1	Acetone	20	16.5	83	70-130
78-93-3	2-Butanone	20	16.8	84	70-130
71-43-2	Benzene	5	5.1	102	70-130
108-86-1	Bromobenzene	5	5.1	102	70-130
74-97-5	Bromochloromethane	5	5.4	108	70-130
75-27-4	Bromodichloromethane	5	5.4	108	70-130
75-25-2	Bromoform	5	6.6	132* [a]	70-130
74-83-9	Bromomethane	5	5.9	118	70-130
104-51-8	n-Butylbenzene	5	4.6	92	70-130
135-98-8	sec-Butylbenzene	5	4.8	96	70-130
98-06-6	tert-Butylbenzene	5	4.6	92	70-130
75-15-0	Carbon disulfide	5	5.4	108	70-130
108-90-7	Chlorobenzene	5	5.0	100	70-130
75-00-3	Chloroethane	5	5.4	108	70-130
67-66-3	Chloroform	5	5.0	100	70-130
74-87-3	Chloromethane	5	5.4	108	70-130
95-49-8	o-Chlorotoluene	5	4.9	98	70-130
106-43-4	p-Chlorotoluene	5	4.7	94	70-130
56-23-5	Carbon tetrachloride	5	6.9	138* [a]	70-130
75-34-3	1,1-Dichloroethane	5	5.0	100	70-130
75-35-4	1,1-Dichloroethylene	5	4.9	98	70-130
563-58-6	1,1-Dichloropropene	5	5.1	102	70-130
96-12-8	1,2-Dibromo-3-chloropropane	5	4.5	90	70-130
106-93-4	1,2-Dibromoethane	5	4.8	96	70-130
107-06-2	1,2-Dichloroethane	5	5.0	100	70-130
78-87-5	1,2-Dichloropropane	5	5.0	100	70-130
142-28-9	1,3-Dichloropropane	5	4.9	98	70-130
594-20-7	2,2-Dichloropropane	5	6.0	120	70-130
124-48-1	Dibromochloromethane	5	5.7	114	70-130
74-95-3	Dibromomethane	5	5.1	102	70-130
75-71-8	Dichlorodifluoromethane	5	6.5	130	70-130
541-73-1	m-Dichlorobenzene	5	5.0	100	70-130
95-50-1	o-Dichlorobenzene	5	4.9	98	70-130
106-46-7	p-Dichlorobenzene	5	4.8	96	70-130
156-60-5	trans-1,2-Dichloroethylene	5	5.0	100	70-130
156-59-2	cis-1,2-Dichloroethylene	5	4.9	98	70-130

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5821-BS	1B120442.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
10061-01-5	cis-1,3-Dichloropropene	5	4.8	96	70-130
10061-02-6	trans-1,3-Dichloropropene	5	5.1	102	70-130
100-41-4	Ethylbenzene	5	4.8	96	70-130
87-68-3	Hexachlorobutadiene	5	5.3	106	70-130
591-78-6	2-Hexanone	20	16.8	84	70-130
98-82-8	Isopropylbenzene	5	4.6	92	70-130
99-87-6	p-Isopropyltoluene	5	4.6	92	70-130
75-09-2	Methylene chloride	5	5.3	106	70-130
1634-04-4	Methyl Tert Butyl Ether	5	4.6	92	70-130
108-10-1	4-Methyl-2-pentanone	20	17.4	87	70-130
91-20-3	Naphthalene	5	4.1	82	70-130
103-65-1	n-Propylbenzene	5	4.8	96	70-130
100-42-5	Styrene	5	4.5	90	70-130
630-20-6	1,1,1,2-Tetrachloroethane	5	5.6	112	70-130
71-55-6	1,1,1-Trichloroethane	5	5.5	110	70-130
79-34-5	1,1,2,2-Tetrachloroethane	5	4.8	96	70-130
79-00-5	1,1,2-Trichloroethane	5	4.9	98	70-130
87-61-6	1,2,3-Trichlorobenzene	5	4.5	90	70-130
96-18-4	1,2,3-Trichloropropane	5	4.9	98	70-130
120-82-1	1,2,4-Trichlorobenzene	5	4.5	90	70-130
95-63-6	1,2,4-Trimethylbenzene	5	4.7	94	70-130
108-67-8	1,3,5-Trimethylbenzene	5	4.8	96	70-130
127-18-4	Tetrachloroethylene	5	4.8	96	70-130
108-88-3	Toluene	5	4.7	94	70-130
79-01-6	Trichloroethylene	5	4.8	96	70-130
75-69-4	Trichlorofluoromethane	5	6.2	124	70-130
75-01-4	Vinyl chloride	5	6.0	120	70-130
	m,p-Xylene	10	9.6	96	70-130
95-47-6	o-Xylene	5	4.7	94	70-130
1330-20-7	Xylenes (total)	15	14.3	95	70-130

CAS No.	Surrogate Recoveries	BSP	Limits
2199-69-1	1,2-Dichlorobenzene-d4	103%	70-130%
460-00-4	4-Bromofluorobenzene	97%	70-130%

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5821-BS	1B120442.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

(a) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V3A7051-BS	3A162815.D	1	08/08/19	RS	n/a	n/a	V3A7051

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
123-91-1	1,4-Dioxane	20	16.1	81	48-137

CAS No.	Surrogate Recoveries	BSP	Limits
17647-74-4	1,4-Dioxane-d8	82%	25-195%

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC92636-1MS	1B120457.D	1	08/06/19	BK	n/a	n/a	V1B5821
JC92636-1	1B120456.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	JC92636-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
67-64-1	Acetone	ND		20	12.9	65	41-142
78-93-3	2-Butanone	ND		20	13.3	67	55-129
71-43-2	Benzene	ND		5	4.0	80	53-138
108-86-1	Bromobenzene	ND		5	3.9	78	54-138
74-97-5	Bromochloromethane	ND		5	4.2	84	55-140
75-27-4	Bromodichloromethane	ND		5	4.1	82	57-147
75-25-2	Bromoform	ND		5	5.2	104	47-137
74-83-9	Bromomethane	ND		5	6.0	120	40-162
104-51-8	n-Butylbenzene	ND		5	3.2	64	45-144
135-98-8	sec-Butylbenzene	ND		5	3.5	70	46-145
98-06-6	tert-Butylbenzene	ND		5	3.3	66	48-141
75-15-0	Carbon disulfide	ND		5	4.3	86	35-127
108-90-7	Chlorobenzene	ND		5	3.7	74	54-135
75-00-3	Chloroethane	ND		5	5.7	114	38-153
67-66-3	Chloroform	ND		5	3.9	78	57-151
74-87-3	Chloromethane	ND		5	5.6	112	39-165
95-49-8	o-Chlorotoluene	ND		5	3.5	70	55-142
106-43-4	p-Chlorotoluene	ND		5	3.5	70	55-139
56-23-5	Carbon tetrachloride	ND		5	5.5	110	49-170
75-34-3	1,1-Dichloroethane	ND		5	4.0	80	55-149
75-35-4	1,1-Dichloroethylene	ND		5	3.8	76	42-142
563-58-6	1,1-Dichloropropene	ND		5	3.8	76	46-151
96-12-8	1,2-Dibromo-3-chloropropane	ND		5	4.3	86	48-141
106-93-4	1,2-Dibromoethane	ND		5	3.8	76	57-135
107-06-2	1,2-Dichloroethane	ND		5	3.9	78	59-166
78-87-5	1,2-Dichloropropane	ND		5	3.8	76	53-142
142-28-9	1,3-Dichloropropane	ND		5	3.8	76	58-143
594-20-7	2,2-Dichloropropane	ND		5	4.5	90	38-165
124-48-1	Dibromochloromethane	ND		5	4.4	88	55-138
74-95-3	Dibromomethane	ND		5	4.0	80	61-144
75-71-8	Dichlorodifluoromethane	ND		5	6.6	132	23-172
541-73-1	m-Dichlorobenzene	ND		5	3.9	78	53-138
95-50-1	o-Dichlorobenzene	ND		5	3.9	78	54-140
106-46-7	p-Dichlorobenzene	ND		5	3.7	74	53-137
156-60-5	trans-1,2-Dichloroethylene	ND		5	3.9	78	47-148
156-59-2	cis-1,2-Dichloroethylene	ND		5	3.9	78	51-146

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC92636-1MS	1B120457.D	1	08/06/19	BK	n/a	n/a	V1B5821
JC92636-1	1B120456.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	JC92636-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
10061-01-5	cis-1,3-Dichloropropene	ND		5	3.5	70	51-136
10061-02-6	trans-1,3-Dichloropropene	ND		5	3.7	74	54-142
100-41-4	Ethylbenzene	ND		5	3.5	70	51-138
87-68-3	Hexachlorobutadiene	ND		5	4.1	82	40-154
591-78-6	2-Hexanone	ND		20	14.2	71	53-128
98-82-8	Isopropylbenzene	ND		5	3.3	66	49-139
99-87-6	p-Isopropyltoluene	ND		5	3.3	66	45-141
75-09-2	Methylene chloride	ND		5	4.2	84	54-137
1634-04-4	Methyl Tert Butyl Ether	ND		5	3.4	68	53-143
108-10-1	4-Methyl-2-pentanone	ND		20	14.1	71	58-127
91-20-3	Naphthalene	ND		5	3.2	64	44-140
103-65-1	n-Propylbenzene	ND		5	3.4	68	50-142
100-42-5	Styrene	ND		5	3.1	62	23-130
630-20-6	1,1,1,2-Tetrachloroethane	ND		5	4.4	88	57-144
71-55-6	1,1,1-Trichloroethane	ND		5	4.4	88	52-164
79-34-5	1,1,2,2-Tetrachloroethane	ND		5	4.2	84	58-138
79-00-5	1,1,2-Trichloroethane	ND		5	4.0	80	59-139
87-61-6	1,2,3-Trichlorobenzene	ND		5	3.5	70	47-141
96-18-4	1,2,3-Trichloropropane	ND		5	4.3	86	56-148
120-82-1	1,2,4-Trichlorobenzene	ND		5	3.4	68	46-137
95-63-6	1,2,4-Trimethylbenzene	ND		5	3.4	68	41-138
108-67-8	1,3,5-Trimethylbenzene	ND		5	3.5	70	45-138
127-18-4	Tetrachloroethylene	ND		5	3.8	76	45-145
108-88-3	Toluene	ND		5	3.6	72	52-134
79-01-6	Trichloroethylene	ND		5	3.9	78	54-143
75-69-4	Trichlorofluoromethane	ND		5	6.4	128	36-167
75-01-4	Vinyl chloride	ND		5	6.1	122	35-162
	m,p-Xylene	ND		10	6.9	69	49-135
95-47-6	o-Xylene	ND		5	3.4	68	49-134
1330-20-7	Xylenes (total)	ND		15	10.3	69	50-134

CAS No.	Surrogate Recoveries	MS	JC92636-1	Limits
2199-69-1	1,2-Dichlorobenzene-d4	103%	97%	70-130%
460-00-4	4-Bromofluorobenzene	94%	87%	70-130%

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC92810-2MS	3A162823.D	1	08/08/19	RS	n/a	n/a	V3A7051
JC92810-2	3A162817.D	1	08/08/19	RS	n/a	n/a	V3A7051

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	JC92810-2 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
123-91-1	1,4-Dioxane	ND		20	17.1	86	28-162

CAS No.	Surrogate Recoveries	MS	JC92810-2	Limits
17647-74-4	1,4-Dioxane-d8	93%	85%	25-195%

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC92613-2DUP	1B120450.D	1	08/06/19	BK	n/a	n/a	V1B5821
JC92613-2	1B120446.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	JC92613-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
67-64-1	Acetone	ND		ND		nc	10
78-93-3	2-Butanone	ND		ND		nc	12
71-43-2	Benzene	ND		ND		nc	10
108-86-1	Bromobenzene	ND		ND		nc	10
74-97-5	Bromochloromethane	ND		ND		nc	10
75-27-4	Bromodichloromethane	ND		ND		nc	10
75-25-2	Bromoform	ND		ND		nc	10
74-83-9	Bromomethane	ND		ND		nc	10
104-51-8	n-Butylbenzene	ND		ND		nc	10
135-98-8	sec-Butylbenzene	ND		ND		nc	10
98-06-6	tert-Butylbenzene	ND		ND		nc	10
75-15-0	Carbon disulfide	ND		ND		nc	19
108-90-7	Chlorobenzene	ND		ND		nc	10
75-00-3	Chloroethane	ND		ND		nc	10
67-66-3	Chloroform	ND		ND		nc	12
74-87-3	Chloromethane	ND		ND		nc	10
95-49-8	o-Chlorotoluene	ND		ND		nc	10
106-43-4	p-Chlorotoluene	ND		ND		nc	10
56-23-5	Carbon tetrachloride	ND		ND		nc	10
75-34-3	1,1-Dichloroethane	ND		ND		nc	10
75-35-4	1,1-Dichloroethylene	4.4		4.1		7	10
563-58-6	1,1-Dichloropropene	ND		ND		nc	10
96-12-8	1,2-Dibromo-3-chloropropane	ND		ND		nc	10
106-93-4	1,2-Dibromoethane	ND		ND		nc	10
107-06-2	1,2-Dichloroethane	ND		ND		nc	10
78-87-5	1,2-Dichloropropane	ND		ND		nc	10
142-28-9	1,3-Dichloropropane	ND		ND		nc	10
594-20-7	2,2-Dichloropropane	ND		ND		nc	10
124-48-1	Dibromochloromethane	ND		ND		nc	10
74-95-3	Dibromomethane	ND		ND		nc	10
75-71-8	Dichlorodifluoromethane	ND		ND		nc	10
541-73-1	m-Dichlorobenzene	ND		ND		nc	10
95-50-1	o-Dichlorobenzene	ND		ND		nc	10
106-46-7	p-Dichlorobenzene	ND		ND		nc	10
156-60-5	trans-1,2-Dichloroethylene	ND		ND		nc	10
156-59-2	cis-1,2-Dichloroethylene	ND		ND		nc	10

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC92613-2DUP	1B120450.D	1	08/06/19	BK	n/a	n/a	V1B5821
JC92613-2	1B120446.D	1	08/06/19	BK	n/a	n/a	V1B5821

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	JC92613-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
10061-01-5	cis-1,3-Dichloropropene	ND		ND		nc	10
10061-02-6	trans-1,3-Dichloropropene	ND		ND		nc	10
100-41-4	Ethylbenzene	ND		ND		nc	10
87-68-3	Hexachlorobutadiene	ND		ND		nc	10
591-78-6	2-Hexanone	ND		ND		nc	10
98-82-8	Isopropylbenzene	ND		ND		nc	10
99-87-6	p-Isopropyltoluene	ND		ND		nc	10
75-09-2	Methylene chloride	ND		ND		nc	10
1634-04-4	Methyl Tert Butyl Ether	ND		ND		nc	10
108-10-1	4-Methyl-2-pentanone	ND		ND		nc	10
91-20-3	Naphthalene	ND		ND		nc	10
103-65-1	n-Propylbenzene	ND		ND		nc	10
100-42-5	Styrene	ND		ND		nc	10
630-20-6	1,1,1,2-Tetrachloroethane	ND		ND		nc	10
71-55-6	1,1,1-Trichloroethane	ND		ND		nc	10
79-34-5	1,1,2,2-Tetrachloroethane	ND		ND		nc	10
79-00-5	1,1,2-Trichloroethane	ND		ND		nc	10
87-61-6	1,2,3-Trichlorobenzene	ND		ND		nc	10
96-18-4	1,2,3-Trichloropropane	ND		ND		nc	10
120-82-1	1,2,4-Trichlorobenzene	ND		ND		nc	10
95-63-6	1,2,4-Trimethylbenzene	ND		ND		nc	10
108-67-8	1,3,5-Trimethylbenzene	ND		ND		nc	10
127-18-4	Tetrachloroethylene	ND		ND		nc	10
108-88-3	Toluene	ND		ND		nc	10
79-01-6	Trichloroethylene	ND		ND		nc	10
75-69-4	Trichlorofluoromethane	ND		ND		nc	10
75-01-4	Vinyl chloride	ND		ND		nc	10
	m,p-Xylene	ND		ND		nc	10
95-47-6	o-Xylene	ND		ND		nc	10
1330-20-7	Xylenes (total)	ND		ND		nc	10

CAS No.	Surrogate Recoveries	DUP	JC92613-2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	101%	100%	70-130%
460-00-4	4-Bromofluorobenzene	90%	88%	70-130%

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC92810-3DUP	3A162824.D	1	08/08/19	RS	n/a	n/a	V3A7051
JC92810-3	3A162818.D	1	08/08/19	RS	n/a	n/a	V3A7051

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC92613-1, JC92613-2, JC92613-3

CAS No.	Compound	JC92810-3 ug/l	Q	DUP ug/l	Q	RPD	Limits
123-91-1	1,4-Dioxane	10.4		11.6		11	48

CAS No.	Surrogate Recoveries	DUP	JC92810-3	Limits
17647-74-4	1,4-Dioxane-d8	101%	93%	25-195%

* = Outside of Control Limits.

Instrument Performance Check (BFB)

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V1B5806-BFB
Lab File ID: 1B120247.D
Instrument ID: GCMS1B
Injection Date: 07/11/19
Injection Time: 14:06

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	14.99 - 40.0% of mass 95	3424	20.0		Pass
75	30.0 - 80.0% of mass 95	8612	50.4		Pass
95	Base peak, 100% relative abundance	17100	100.0		Pass
96	5.0 - 9.0% of mass 95	1206	7.05		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	14298	83.6		Pass
175	5.0 - 9.0% of mass 174	1017	5.95	(7.11) [a]	Pass
176	95.0 - 101.0% of mass 174	13890	81.2	(97.1) [a]	Pass
177	5.0 - 9.0% of mass 176	989	5.78	(7.12) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V1B5806-IC5806	1B120248.D	07/11/19	14:38	00:32	Initial cal 0.2
V1B5806-IC5806	1B120249.D	07/11/19	15:09	01:03	Initial cal 0.5
V1B5806-IC5806	1B120250.D	07/11/19	15:40	01:34	Initial cal 1
V1B5806-IC5806	1B120251.D	07/11/19	16:11	02:05	Initial cal 2
V1B5806-IC5806	1B120252.D	07/11/19	16:43	02:37	Initial cal 5
V1B5806-ICC5806	1B120253.D	07/11/19	17:14	03:08	Initial cal 10
V1B5806-IC5806	1B120254.D	07/11/19	17:45	03:39	Initial cal 20
V1B5806-IC5806	1B120255.D	07/11/19	18:16	04:10	Initial cal 40
V1B5806-IC5806	1B120256.D	07/11/19	18:47	04:41	Initial cal 80
V1B5806-ICV5806	1B120259.D	07/11/19	20:20	06:14	Initial cal verification 10

Instrument Performance Check (BFB)

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V1B5821-BFB
Lab File ID: 1B120440.D
Instrument ID: GCMS1B
Injection Date: 08/06/19
Injection Time: 08:58

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	14.99 - 40.0% of mass 95	2964	19.4		Pass
75	30.0 - 80.0% of mass 95	7774	50.8		Pass
95	Base peak, 100% relative abundance	15295	100.0		Pass
96	5.0 - 9.0% of mass 95	1105	7.22		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	12681	82.9		Pass
175	5.0 - 9.0% of mass 174	923	6.03	(7.28) [a]	Pass
176	95.0 - 101.0% of mass 174	12306	80.5	(97.0) [a]	Pass
177	5.0 - 9.0% of mass 176	842	5.51	(6.84) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V1B5821-CC5806	1B120441.D	08/06/19	09:56	00:58	Continuing cal 10
V1B5821-BS	1B120442.D	08/06/19	10:28	01:30	Blank Spike
V1B5821-MB	1B120443.D	08/06/19	10:59	02:01	Method Blank
JC92613-3	1B120444.D	08/06/19	11:32	02:34	TB-080119
JC92613-1	1B120445.D	08/06/19	12:03	03:05	RW-12270CM-080119-F
JC92613-2	1B120446.D	08/06/19	12:34	03:36	RW-12270CM-080119
ZZZZZZ	1B120447.D	08/06/19	13:06	04:08	(unrelated sample)
ZZZZZZ	1B120448.D	08/06/19	13:37	04:39	(unrelated sample)
JC92613-2DUP	1B120450.D	08/06/19	14:39	05:41	Duplicate
ZZZZZZ	1B120451.D	08/06/19	15:10	06:12	(unrelated sample)
ZZZZZZ	1B120452.D	08/06/19	15:41	06:43	(unrelated sample)
ZZZZZZ	1B120453.D	08/06/19	16:12	07:14	(unrelated sample)
ZZZZZZ	1B120454.D	08/06/19	16:44	07:46	(unrelated sample)
ZZZZZZ	1B120455.D	08/06/19	17:15	08:17	(unrelated sample)
JC92636-1	1B120456.D	08/06/19	17:46	08:48	(used for QC only; not part of job JC92613)
JC92636-1MS	1B120457.D	08/06/19	18:17	09:19	Matrix Spike
ZZZZZZ	1B120458.D	08/06/19	18:48	09:50	(unrelated sample)
ZZZZZZ	1B120459.D	08/06/19	19:20	10:22	(unrelated sample)

Instrument Performance Check (BFB)

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample:	V3A6923-BFB	**Injection Date:**	07/18/18
Lab File ID:	3A160428.D	**Injection Time:**	16:55
Instrument ID:	GCMS3A		

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	15.0 - 40.0% of mass 95	25408	20.8		Pass
75	30.0 - 60.0% of mass 95	62880	51.6		Pass
95	Base peak, 100% relative abundance	121864	100.0		Pass
96	5.0 - 9.0% of mass 95	8101	6.65		Pass
173	Less than 2.0% of mass 174	826	0.68	(0.81) [a]	Pass
174	50.0 - 120.0% of mass 95	102317	84.0		Pass
175	5.0 - 9.0% of mass 174	8168	6.70	(7.98) [a]	Pass
176	95.0 - 101.0% of mass 174	100370	82.4	(98.1) [a]	Pass
177	5.0 - 9.0% of mass 176	6691	5.49	(6.67) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V3A6923-IC6923	3A160429.D	07/18/18	17:26	00:31	Initial cal 0.25
V3A6923-IC6923	3A160430.D	07/18/18	17:52	00:57	Initial cal 0.4
V3A6923-IC6923	3A160431.D	07/18/18	18:18	01:23	Initial cal 1
V3A6923-IC6923	3A160432.D	07/18/18	18:43	01:48	Initial cal 2
V3A6923-IC6923	3A160433.D	07/18/18	19:09	02:14	Initial cal 5
V3A6923-ICC6923	3A160434.D	07/18/18	19:35	02:40	Initial cal 20
V3A6923-IC6923	3A160435.D	07/18/18	20:00	03:05	Initial cal 50
V3A6923-IC6923	3A160436.D	07/18/18	20:26	03:31	Initial cal 100
V3A6923-IC6923	3A160437.D	07/18/18	20:52	03:57	Initial cal 200
V3A6923-ICV6923	3A160443.D	07/18/18	23:25	06:30	Initial cal verification 20

Instrument Performance Check (BFB)

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V3A7051-BFB
Lab File ID: 3A162812.D
Instrument ID: GCMS3A
Injection Date: 08/08/19
Injection Time: 08:29

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	15.0 - 40.0% of mass 95	22544	19.9		Pass
75	30.0 - 60.0% of mass 95	56321	49.8		Pass
95	Base peak, 100% relative abundance	113093	100.0		Pass
96	5.0 - 9.0% of mass 95	7593	6.71		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	77330	68.4		Pass
175	5.0 - 9.0% of mass 174	6172	5.46	(7.98) [a]	Pass
176	95.0 - 101.0% of mass 174	74546	65.9	(96.4) [a]	Pass
177	5.0 - 9.0% of mass 176	5219	4.61	(7.00) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V3A7051-CC6923	3A162814.D	08/08/19	09:37	01:08	Continuing cal 5
V3A7051-BS	3A162815.D	08/08/19	10:06	01:37	Blank Spike
V3A7051-MB	3A162816.D	08/08/19	10:54	02:25	Method Blank
JC92810-2	3A162817.D	08/08/19	11:27	02:58	(used for QC only; not part of job JC92613)
JC92810-3	3A162818.D	08/08/19	11:56	03:27	(used for QC only; not part of job JC92613)
ZZZZZZ	3A162819.D	08/08/19	12:25	03:56	(unrelated sample)
JC92613-1	3A162820.D	08/08/19	12:54	04:25	RW-12270CM-080119-F
JC92613-2	3A162821.D	08/08/19	13:23	04:54	RW-12270CM-080119
JC92613-3	3A162822.D	08/08/19	13:52	05:23	TB-080119
JC92810-2MS	3A162823.D	08/08/19	14:21	05:52	Matrix Spike
JC92810-3DUP	3A162824.D	08/08/19	14:50	06:21	Duplicate
ZZZZZZ	3A162825.D	08/08/19	15:19	06:50	(unrelated sample)
ZZZZZZ	3A162826.D	08/08/19	15:48	07:19	(unrelated sample)
ZZZZZZ	3A162827.D	08/08/19	16:17	07:48	(unrelated sample)
ZZZZZZ	3A162828.D	08/08/19	16:46	08:17	(unrelated sample)
ZZZZZZ	3A162829.D	08/08/19	17:14	08:45	(unrelated sample)
ZZZZZZ	3A162830.D	08/08/19	17:43	09:14	(unrelated sample)
ZZZZZZ	3A162831.D	08/08/19	18:12	09:43	(unrelated sample)
ZZZZZZ	3A162832.D	08/08/19	18:41	10:12	(unrelated sample)
ZZZZZZ	3A162833.D	08/08/19	19:10	10:41	(unrelated sample)

Surrogate Recovery Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Method: EPA 524.2 REV 4.1 **Matrix:** AQ

Samples and QC shown here apply to the above method

Lab Sample ID	Lab File ID	S1	S2
JC92613-1	1B120445.D	98	89
JC92613-2	1B120446.D	100	88
JC92613-3	1B120444.D	98	90
JC92613-2DUP	1B120450.D	101	90
JC92636-1MS	1B120457.D	103	94
V1B5821-BS	1B120442.D	103	97
V1B5821-MB	1B120443.D	98	90

Surrogate Compounds	Recovery Limits
S1 = 1,2-Dichlorobenzene-d4	70-130%
S2 = 4-Bromofluorobenzene	70-130%

Surrogate Recovery Summary

Job Number: JC92613
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Method: SW846 8260C BY SIM **Matrix:** AQ

Samples and QC shown here apply to the above method

Lab Sample ID	Lab File ID	S1
JC92613-1	3A162820.D	98
JC92613-2	3A162821.D	95
JC92613-3	3A162822.D	86
JC92810-2MS	3A162823.D	93
JC92810-3DUP	3A162824.D	101
V3A7051-BS	3A162815.D	82
V3A7051-MB	3A162816.D	79

Surrogate Compounds	Recovery Limits
S1 = 1,4-Dioxane-d8	25-195%

SEPTEMBER 2019

The results set forth herein are provided by SGS North America Inc.

e-Hardcopy 2.0
Automated Report

Technical Report for

WSP Environment & Energy

Kop-Flex, Hanover, VA

31401545.011-02

SGS Job Number: JC94420

Sampling Date: 09/04/19

Report to:

WSP
11190 Sunrise Valley Drive Suite 300
Reston, VA 20190
eric.johnson@wspgroup.com; maria.kaplan@wsp.com;
Chris.Cresci@wspgroup.com
ATTN: Eric Johnson

Total number of pages in report: **41**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Mike Earp
General Manager

Client Service contact: Tammy McCloskey 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, FL, IL, IN, KS, KY, LA, MA, MD, ME, MN, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TX, UT, VA, WV, DoD ELAP (ANAB L2248)

Sections: 1 2 3 4 5

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SGS North America Inc.

Sample Summary

WSP Environment & Energy

Job No: JC94420

Kop-Flex, Hanover, VA
Project No: 31401545.011-02

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
JC94420-1	09/04/19	10:55	CC	09/05/19	DW	Drinking Water	RW-12270CM-090419-F
JC94420-2	09/04/19	11:00	CC	09/05/19	DW	Drinking Water	RW-12270CM-090419-
JC94420-3	09/04/19	11:00	CC	09/05/19	DW	Drinking Water TB	TB-090419

This report contains results reported as ND = Not detected. The following applies:
Organics ND = Not detected above the MDL

Summary of Hits

Job Number: JC94420
Account: WSP Environment & Energy
Project: Kop-Flex, Hanover, VA
Collected: 09/04/19

Lab Sample ID / Analyte	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
JC94420-1	**RW-12270CM-090419-F**					
1,1,1-Trichloroethane		0.27 J	0.50	0.22	ug/l	EPA 524.2 REV 4.1
1,4-Dioxane		2.0	0.40	0.095	ug/l	SW846 8260C BY SIM
JC94420-2	**RW-12270CM-090419-**					
1,1-Dichloroethylene		4.8	0.50	0.19	ug/l	EPA 524.2 REV 4.1
1,1,1-Trichloroethane		0.25 J	0.50	0.22	ug/l	EPA 524.2 REV 4.1
1,4-Dioxane		2.0	0.40	0.095	ug/l	SW846 8260C BY SIM
JC94420-3	**TB-090419**					

No hits reported in this sample.

Sample Results

Report of Analysis

Report of Analysis

Client Sample ID:	RW-12270CM-090419-F		
Lab Sample ID:	JC94420-1	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	1B120860.D	1	09/10/19 13:11	BK	n/a	n/a	V1B5843
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
67-64-1	Acetone	ND		5.0	2.5	ug/l	
78-93-3	2-Butanone	ND		5.0	0.43	ug/l	
71-43-2	Benzene	ND	5.0	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND		0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND		0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND		0.50	0.13	ug/l	
75-25-2	Bromoform	ND		0.50	0.27	ug/l	
74-83-9	Bromomethane	ND		0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND		0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND		0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND		0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND		0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	100	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND		0.50	0.080	ug/l	
67-66-3	Chloroform	ND		0.50	0.17	ug/l	
74-87-3	Chloromethane	ND		0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND		0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND		0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride [a]	ND	5.0	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND		0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	7.0	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND		0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.20	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.050	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	5.0	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	5.0	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND		0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND		0.50	0.31	ug/l	
124-48-1	Dibromochloromethane [b]	ND		0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND		0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane [b]	ND		0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND		0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-F		
Lab Sample ID:	JC94420-1	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	600	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	75	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	100	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	70	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND		0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND		0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	700	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND		0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND		2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND		0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND		0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	5.0	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND		0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND		2.0	0.22	ug/l	
91-20-3	Naphthalene	ND		0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND		0.50	0.066	ug/l	
100-42-5	Styrene	ND	100	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND		0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	0.27	200	0.50	0.22	ug/l	J
79-34-5	1,1,2,2-Tetrachloroethane	ND		0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	5.0	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND		0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND		0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	70	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND		0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND		0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	5.0	0.50	0.23	ug/l	
108-88-3	Toluene	ND	1000	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	5.0	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane [b]	ND		1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	2.0	0.50	0.15	ug/l	
	m,p-Xylene	ND		0.50	0.14	ug/l	
95-47-6	o-Xylene	ND		0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	10000	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	98%		70-130%
460-00-4	4-Bromofluorobenzene	90%		70-130%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-F		
Lab Sample ID:	JC94420-1	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q

(a) Associated CCV and BS outside of control limits high, sample was ND.
(b) Associated CCV outside of control limits high, sample was ND.

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-F		
Lab Sample ID:	JC94420-1	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162955.D	1	09/11/19 14:47	RS	n/a	n/a	V3A7059
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	2.0		0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	94%		25-195%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-		
Lab Sample ID:	JC94420-2	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	1B120861.D	1	09/10/19 13:42	BK	n/a	n/a	V1B5843
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
67-64-1	Acetone	ND		5.0	2.5	ug/l	
78-93-3	2-Butanone	ND		5.0	0.43	ug/l	
71-43-2	Benzene	ND	5.0	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND		0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND		0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND		0.50	0.13	ug/l	
75-25-2	Bromoform	ND		0.50	0.27	ug/l	
74-83-9	Bromomethane	ND		0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND		0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND		0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND		0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND		0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	100	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND		0.50	0.080	ug/l	
67-66-3	Chloroform	ND		0.50	0.17	ug/l	
74-87-3	Chloromethane	ND		0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND		0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND		0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride [a]	ND	5.0	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND		0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	4.8	7.0	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND		0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.20	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.050	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	5.0	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	5.0	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND		0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND		0.50	0.31	ug/l	
124-48-1	Dibromochloromethane [b]	ND		0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND		0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane [b]	ND		0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND		0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-		
Lab Sample ID:	JC94420-2	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	600	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	75	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	100	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	70	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND		0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND		0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	700	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND		0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND		2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND		0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND		0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	5.0	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND		0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND		2.0	0.22	ug/l	
91-20-3	Naphthalene	ND		0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND		0.50	0.066	ug/l	
100-42-5	Styrene	ND	100	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND		0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	0.25	200	0.50	0.22	ug/l	J
79-34-5	1,1,2,2-Tetrachloroethane	ND		0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	5.0	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND		0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND		0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	70	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND		0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND		0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	5.0	0.50	0.23	ug/l	
108-88-3	Toluene	ND	1000	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	5.0	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane [b]	ND		1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	2.0	0.50	0.15	ug/l	
	m,p-Xylene	ND		0.50	0.14	ug/l	
95-47-6	o-Xylene	ND		0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	10000	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	95%		70-130%
460-00-4	4-Bromofluorobenzene	87%		70-130%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-		
Lab Sample ID:	JC94420-2	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q

(a) Associated CCV and BS outside of control limits high, sample was ND.
(b) Associated CCV outside of control limits high, sample was ND.

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	RW-12270CM-090419-		
Lab Sample ID:	JC94420-2	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water	**Date Received:**	09/05/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162956.D	1	09/11/19 15:16	RS	n/a	n/a	V3A7059
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	2.0		0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	95%		25-195%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-090419		
Lab Sample ID:	JC94420-3	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water TB	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	1B120865.D	1	09/10/19 15:47	BK	n/a	n/a	V1B5843
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
67-64-1	Acetone	ND		5.0	2.5	ug/l	
78-93-3	2-Butanone	ND		5.0	0.43	ug/l	
71-43-2	Benzene	ND	5.0	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND		0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND		0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND		0.50	0.13	ug/l	
75-25-2	Bromoform	ND		0.50	0.27	ug/l	
74-83-9	Bromomethane	ND		0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND		0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND		0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND		0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND		0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	100	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND		0.50	0.080	ug/l	
67-66-3	Chloroform	ND		0.50	0.17	ug/l	
74-87-3	Chloromethane	ND		0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND		0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND		0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride [a]	ND	5.0	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND		0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	7.0	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND		0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.20	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.050	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	5.0	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	5.0	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND		0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND		0.50	0.31	ug/l	
124-48-1	Dibromochloromethane [b]	ND		0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND		0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane [b]	ND		0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND		0.50	0.14	ug/l	

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-090419		
Lab Sample ID:	JC94420-3	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water TB	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
95-50-1	o-Dichlorobenzene	ND	600	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	75	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	100	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	70	0.50	0.14	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND		0.50	0.18	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND		0.50	0.16	ug/l	
100-41-4	Ethylbenzene	ND	700	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND		0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND		2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND		0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND		0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	5.0	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND		0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND		2.0	0.22	ug/l	
91-20-3	Naphthalene	ND		0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND		0.50	0.066	ug/l	
100-42-5	Styrene	ND	100	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND		0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	200	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND		0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	5.0	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND		0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND		0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	70	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND		0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND		0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	5.0	0.50	0.23	ug/l	
108-88-3	Toluene	ND	1000	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	5.0	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane [b]	ND		1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	2.0	0.50	0.15	ug/l	
	m,p-Xylene	ND		0.50	0.14	ug/l	
95-47-6	o-Xylene	ND		0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	10000	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	102%		70-130%
460-00-4	4-Bromofluorobenzene	90%		70-130%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-090419		
Lab Sample ID:	JC94420-3	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water TB	**Date Received:**	09/05/19
Method:	EPA 524.2 REV 4.1	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

VOA List

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q

(a) Associated CCV and BS outside of control limits high, sample was ND.
(b) Associated CCV outside of control limits high, sample was ND.

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TB-090419		
Lab Sample ID:	JC94420-3	**Date Sampled:**	09/04/19
Matrix:	DW - Drinking Water TB	**Date Received:**	09/05/19
Method:	SW846 8260C BY SIM	**Percent Solids:**	n/a
Project:	Kop-Flex, Hanover, VA		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3A162954.D	1	09/11/19 14:18	RS	n/a	n/a	V3A7059
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	MCL	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	ND		0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17647-74-4	1,4-Dioxane-d8	98%		25-195%

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 141)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

DW, WTB

CHAIN-OF-CUSTODY RECORD

KDI-082119-119

Page 1 of 1

WSP | Parsons Brinckerhoff Office Address	13530 Dulles Technology Dr. Suite [illegible] Herndon, VA
Project Name	Kop-Flex
WSP | Parsons Brinckerhoff Contact Name	Chris Cresci
Project Location	Hanover, MD
WSP | Parsons Brinckerhoff Contact E-mail	Chris.Cresci @wspgroup.com
Project Number & Task	31401545.011-02
WSP | Parsons Brinckerhoff Contact Phone	703-709-6500
Sampler(s) Name(s)	Chris Cresci, Shannon Burke
Sampler(s) Signature(s)	[signature]

No. 004542 WSP PARSONS BRINCKERHOFF

Laboratory Name & Location: SGS Accutest

Laboratory Project Manager: Tammy McCloskey

Requested Turn-Around-Time: ☒ Standard ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ ___ HR

Requested Analyses & Preservatives: VOCs 524; 1,4 Dioxane 8260 SIM; JC94420

	Sample Identification	Matrix	Collection Start* Date	Collection Start* Time	Collection Stop* Date	Collection Stop* Time	Number of Containers	VOCs 524	1,4 Dioxane 8260 SIM	Sample Comments
1	RW-1227OCM-090419-FD	DW	9/4/19	1055			6	X	X	
2	RW-1227OCM-090419-	DW	9/4/19	1100			6	X	X	
3	TB-090419						4	X	X	V878

INITIAL ASSESSMENT 3A

LABEL VERIFICATION ______

3.8°C IP IR-1

Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Shipment Method	Tracking Number(s)
[signature]	9/4/19	1115	[signature]			FedEx	1019 2803 9018

Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Number of Packages	Custody Seal Number(s)
[signature]	9/5/19	1030	[signature]	9/5/19	1030	1	

*Use stop time/date for composite and/or air samples; use only start time/date for all other samples.

Matrix: AQ = Aqueous, S = Soil, SE = Sediment, A = Air, W = Wipe, B = Bulk, O = Other (detail in comments)

JC94420: Chain of Custody

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4.1

4

SGS Sample Receipt Summary

Job Number: JC94420 **Client:** WSP **Project:** KOP-FLEX, HANOVER, VA

Date / Time Received: 9/5/2019 10:30:00 AM **Delivery Method:** **Airbill #'s:**

Cooler Temps (Raw Measured) °C: Cooler 1: (3.8);

Cooler Temps (Corrected) °C: Cooler 1: (3.7);

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	☑		☐	3. COC Present:	☑		☐
2. Custody Seals Intact:	☑		☐	4. Smpl Dates/Time OK	☑		☐

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	☑		☐
2. Cooler temp verification:	IR Gun		
3. Cooler media:	Ice (Bag)		
4. No. Coolers:	1		

Quality Control Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	☑		☐	☐
2. Trip Blank listed on COC:	☑		☐	☐
3. Samples preserved properly:	☑		☐	
4. VOCs headspace free:	☑		☐	☐

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	☑		☐
2. Container labeling complete:	☑		☐
3. Sample container label / COC agree:	☑		☐

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	☑		☐
2. All containers accounted for:	☑		☐
3. Condition of sample:	Intact		

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	☑		☐	
2. Bottles received for unspecified tests	☐		☑	
3. Sufficient volume recvd for analysis:	☑		☐	
4. Compositing instructions clear:	☐		☐	☑
5. Filtering instructions clear:	☐		☐	☑

Test Strip Lot #s: pH 1-12: 229517 pH 12+: 208717 Other: (Specify)

Comments

SM089-03
Rev. Date 12/7/17

JC94420: Chain of Custody
Page 2 of 2

MS Volatiles

QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

Method Blank Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5843-MB	1B120856.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	5.0	2.5	ug/l	
78-93-3	2-Butanone	ND	5.0	0.43	ug/l	
71-43-2	Benzene	ND	0.50	0.16	ug/l	
108-86-1	Bromobenzene	ND	0.50	0.12	ug/l	
74-97-5	Bromochloromethane	ND	0.50	0.17	ug/l	
75-27-4	Bromodichloromethane	ND	0.50	0.13	ug/l	
75-25-2	Bromoform	ND	0.50	0.27	ug/l	
74-83-9	Bromomethane	ND	0.50	0.18	ug/l	
104-51-8	n-Butylbenzene	ND	0.50	0.068	ug/l	
135-98-8	sec-Butylbenzene	ND	0.50	0.43	ug/l	
98-06-6	tert-Butylbenzene	ND	0.50	0.057	ug/l	
75-15-0	Carbon disulfide	ND	0.50	0.18	ug/l	
108-90-7	Chlorobenzene	ND	0.50	0.093	ug/l	
75-00-3	Chloroethane	ND	0.50	0.080	ug/l	
67-66-3	Chloroform	ND	0.50	0.17	ug/l	
74-87-3	Chloromethane	ND	0.50	0.13	ug/l	
95-49-8	o-Chlorotoluene	ND	0.50	0.098	ug/l	
106-43-4	p-Chlorotoluene	ND	0.50	0.075	ug/l	
56-23-5	Carbon tetrachloride	ND	0.50	0.24	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.50	0.22	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.50	0.19	ug/l	
563-58-6	1,1-Dichloropropene	ND	0.50	0.14	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.14	ug/l	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.50	0.18	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.50	0.19	ug/l	
142-28-9	1,3-Dichloropropane	ND	0.50	0.17	ug/l	
594-20-7	2,2-Dichloropropane	ND	0.50	0.31	ug/l	
124-48-1	Dibromochloromethane	ND	0.50	0.14	ug/l	
74-95-3	Dibromomethane	ND	0.50	0.23	ug/l	
75-71-8	Dichlorodifluoromethane	ND	0.50	0.40	ug/l	
541-73-1	m-Dichlorobenzene	ND	0.50	0.14	ug/l	
95-50-1	o-Dichlorobenzene	ND	0.50	0.14	ug/l	
106-46-7	p-Dichlorobenzene	ND	0.50	0.10	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.50	0.21	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	0.50	0.14	ug/l	

Method Blank Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5843-MB	1B120856.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	Result	RL	MDL	Units	Q
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.18	ug/l	
100-41-4	Ethylbenzene	ND	0.50	0.076	ug/l	
87-68-3	Hexachlorobutadiene	ND	0.50	0.13	ug/l	
591-78-6	2-Hexanone	ND	2.0	0.24	ug/l	
98-82-8	Isopropylbenzene	ND	0.50	0.054	ug/l	
99-87-6	p-Isopropyltoluene	ND	0.50	0.43	ug/l	
75-09-2	Methylene chloride	ND	0.50	0.37	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	0.50	0.11	ug/l	
108-10-1	4-Methyl-2-pentanone	ND	2.0	0.22	ug/l	
91-20-3	Naphthalene	ND	0.50	0.28	ug/l	
103-65-1	n-Propylbenzene	ND	0.50	0.066	ug/l	
100-42-5	Styrene	ND	0.50	0.069	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	0.50	0.20	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.22	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.13	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.19	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	0.50	0.091	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	0.50	0.13	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.055	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.40	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.057	ug/l	
127-18-4	Tetrachloroethylene	ND	0.50	0.23	ug/l	
108-88-3	Toluene	ND	0.50	0.11	ug/l	
79-01-6	Trichloroethylene	ND	0.50	0.20	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.0	0.19	ug/l	
75-01-4	Vinyl chloride	ND	0.50	0.15	ug/l	
	m,p-Xylene	ND	0.50	0.14	ug/l	
95-47-6	o-Xylene	ND	0.50	0.076	ug/l	
1330-20-7	Xylenes (total)	ND	0.50	0.076	ug/l	

CAS No.	Surrogate Recoveries		Limits
2199-69-1	1,2-Dichlorobenzene-d4	100%	70-130%
460-00-4	4-Bromofluorobenzene	90%	70-130%

Method Blank Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5843-MB	1B120856.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:**

JC94420-1, JC94420-2, JC94420-3

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
	system artifact	3.66	.87	ug/l	J
	Total TIC, Volatile		0	ug/l	

Method Blank Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V3A7059-MB	3A162945.D	1	09/11/19	RS	n/a	n/a	V3A7059

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	Result	RL	MDL	Units	Q
123-91-1	1,4-Dioxane	ND	0.40	0.095	ug/l	

CAS No.	Surrogate Recoveries		Limits
17647-74-4	1,4-Dioxane-d8	113%	25-195%

Blank Spike Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5843-BS	1B120855.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
67-64-1	Acetone	20	15.8	79	70-130
78-93-3	2-Butanone	20	15.1	76	70-130
71-43-2	Benzene	5	4.4	88	70-130
108-86-1	Bromobenzene	5	4.4	88	70-130
74-97-5	Bromochloromethane	5	4.9	98	70-130
75-27-4	Bromodichloromethane	5	4.9	98	70-130
75-25-2	Bromoform	5	5.7	114	70-130
74-83-9	Bromomethane	5	5.2	104	70-130
104-51-8	n-Butylbenzene	5	4.1	82	70-130
135-98-8	sec-Butylbenzene	5	4.2	84	70-130
98-06-6	tert-Butylbenzene	5	4.0	80	70-130
75-15-0	Carbon disulfide	5	4.9	98	70-130
108-90-7	Chlorobenzene	5	4.3	86	70-130
75-00-3	Chloroethane	5	5.4	108	70-130
67-66-3	Chloroform	5	4.5	90	70-130
74-87-3	Chloromethane	5	5.0	100	70-130
95-49-8	o-Chlorotoluene	5	4.2	84	70-130
106-43-4	p-Chlorotoluene	5	4.2	84	70-130
56-23-5	Carbon tetrachloride	5	8.0	160* [a]	70-130
75-34-3	1,1-Dichloroethane	5	4.6	92	70-130
75-35-4	1,1-Dichloroethylene	5	4.3	86	70-130
563-58-6	1,1-Dichloropropene	5	4.3	86	70-130
96-12-8	1,2-Dibromo-3-chloropropane	5	4.5	90	70-130
106-93-4	1,2-Dibromoethane	5	4.3	86	70-130
107-06-2	1,2-Dichloroethane	5	4.3	86	70-130
78-87-5	1,2-Dichloropropane	5	4.4	88	70-130
142-28-9	1,3-Dichloropropane	5	4.3	86	70-130
594-20-7	2,2-Dichloropropane	5	4.8	96	70-130
124-48-1	Dibromochloromethane	5	5.6	112	70-130
74-95-3	Dibromomethane	5	4.6	92	70-130
75-71-8	Dichlorodifluoromethane	5	5.5	110	70-130
541-73-1	m-Dichlorobenzene	5	4.5	90	70-130
95-50-1	o-Dichlorobenzene	5	4.6	92	70-130
106-46-7	p-Dichlorobenzene	5	4.4	88	70-130
156-60-5	trans-1,2-Dichloroethylene	5	4.6	92	70-130
156-59-2	cis-1,2-Dichloroethylene	5	4.4	88	70-130

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5843-BS	1B120855.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
10061-01-5	cis-1,3-Dichloropropene	5	4.0	80	70-130
10061-02-6	trans-1,3-Dichloropropene	5	4.4	88	70-130
100-41-4	Ethylbenzene	5	4.1	82	70-130
87-68-3	Hexachlorobutadiene	5	4.9	98	70-130
591-78-6	2-Hexanone	20	15.1	76	70-130
98-82-8	Isopropylbenzene	5	3.9	78	70-130
99-87-6	p-Isopropyltoluene	5	4.0	80	70-130
75-09-2	Methylene chloride	5	4.7	94	70-130
1634-04-4	Methyl Tert Butyl Ether	5	4.0	80	70-130
108-10-1	4-Methyl-2-pentanone	20	15.4	77	70-130
91-20-3	Naphthalene	5	3.9	78	70-130
103-65-1	n-Propylbenzene	5	4.1	82	70-130
100-42-5	Styrene	5	3.7	74	70-130
630-20-6	1,1,1,2-Tetrachloroethane	5	5.2	104	70-130
71-55-6	1,1,1-Trichloroethane	5	5.0	100	70-130
79-34-5	1,1,2,2-Tetrachloroethane	5	4.6	92	70-130
79-00-5	1,1,2-Trichloroethane	5	4.5	90	70-130
87-61-6	1,2,3-Trichlorobenzene	5	4.4	88	70-130
96-18-4	1,2,3-Trichloropropane	5	4.6	92	70-130
120-82-1	1,2,4-Trichlorobenzene	5	4.4	88	70-130
95-63-6	1,2,4-Trimethylbenzene	5	4.1	82	70-130
108-67-8	1,3,5-Trimethylbenzene	5	4.1	82	70-130
127-18-4	Tetrachloroethylene	5	4.0	80	70-130
108-88-3	Toluene	5	4.0	80	70-130
79-01-6	Trichloroethylene	5	4.1	82	70-130
75-69-4	Trichlorofluoromethane	5	5.5	110	70-130
75-01-4	Vinyl chloride	5	5.4	108	70-130
	m,p-Xylene	10	8.1	81	70-130
95-47-6	o-Xylene	5	4.0	80	70-130
1330-20-7	Xylenes (total)	15	12.1	81	70-130

CAS No.	Surrogate Recoveries	BSP	Limits
2199-69-1	1,2-Dichlorobenzene-d4	108%	70-130%
460-00-4	4-Bromofluorobenzene	97%	70-130%

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V1B5843-BS	1B120855.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

(a) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

Blank Spike Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
V3A7059-BS	3A162944.D	1	09/11/19	RS	n/a	n/a	V3A7059

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	Spike ug/l	BSP ug/l	BSP %	Limits
123-91-1	1,4-Dioxane	20	19.7	99	48-137

CAS No.	Surrogate Recoveries	BSP	Limits
17647-74-4	1,4-Dioxane-d8	104%	25-195%

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC94579-1MS	1B120867.D	1	09/10/19	BK	n/a	n/a	V1B5843
JC94579-1	1B120862.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	JC94579-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
67-64-1	Acetone	14.0		20	26.0	60	41-142
78-93-3	2-Butanone	5.8		20	20.2	72	55-129
71-43-2	Benzene	ND		5	4.0	80	53-138
108-86-1	Bromobenzene	ND		5	4.1	82	54-138
74-97-5	Bromochloromethane	ND		5	4.4	88	55-140
75-27-4	Bromodichloromethane	ND		5	4.3	86	57-147
75-25-2	Bromoform	ND		5	5.7	114	47-137
74-83-9	Bromomethane	ND		5	5.3	106	40-162
104-51-8	n-Butylbenzene	ND		5	3.6	72	45-144
135-98-8	sec-Butylbenzene	ND		5	3.7	74	46-145
98-06-6	tert-Butylbenzene	ND		5	3.5	70	48-141
75-15-0	Carbon disulfide	ND		5	4.4	88	35-127
108-90-7	Chlorobenzene	ND		5	3.9	78	54-135
75-00-3	Chloroethane	ND		5	5.4	108	38-153
67-66-3	Chloroform	ND		5	3.9	78	57-151
74-87-3	Chloromethane	ND		5	5.4	108	39-165
95-49-8	o-Chlorotoluene	ND		5	3.8	76	55-142
106-43-4	p-Chlorotoluene	ND		5	3.8	76	55-139
56-23-5	Carbon tetrachloride	ND		5	7.5	150	49-170
75-34-3	1,1-Dichloroethane	ND		5	4.4	88	55-149
75-35-4	1,1-Dichloroethylene	ND		5	4.1	82	42-142
563-58-6	1,1-Dichloropropene	ND		5	3.9	78	46-151
96-12-8	1,2-Dibromo-3-chloropropane	ND		5	4.6	92	48-141
106-93-4	1,2-Dibromoethane	ND		5	4.0	80	57-135
107-06-2	1,2-Dichloroethane	0.35	J	5	4.1	75	59-166
78-87-5	1,2-Dichloropropane	ND		5	4.0	80	53-142
142-28-9	1,3-Dichloropropane	ND		5	4.1	82	58-143
594-20-7	2,2-Dichloropropane	ND		5	4.5	90	38-165
124-48-1	Dibromochloromethane	ND		5	5.1	102	55-138
74-95-3	Dibromomethane	ND		5	4.0	80	61-144
75-71-8	Dichlorodifluoromethane	ND		5	5.7	114	23-172
541-73-1	m-Dichlorobenzene	ND		5	4.2	84	53-138
95-50-1	o-Dichlorobenzene	ND		5	4.3	86	54-140
106-46-7	p-Dichlorobenzene	ND		5	4.0	80	53-137
156-60-5	trans-1,2-Dichloroethylene	ND		5	4.3	86	47-148
156-59-2	cis-1,2-Dichloroethylene	ND		5	4.2	84	51-146

* = Outside of Control Limits.

Matrix Spike Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC94579-1MS	1B120867.D	1	09/10/19	BK	n/a	n/a	V1B5843
JC94579-1	1B120862.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	JC94579-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Limits
10061-01-5	cis-1,3-Dichloropropene	ND		5	3.6	72	51-136
10061-02-6	trans-1,3-Dichloropropene	ND		5	3.9	78	54-142
100-41-4	Ethylbenzene	ND		5	3.6	72	51-138
87-68-3	Hexachlorobutadiene	ND		5	4.3	86	40-154
591-78-6	2-Hexanone	ND		20	15.7	79	53-128
98-82-8	Isopropylbenzene	ND		5	3.5	70	49-139
99-87-6	p-Isopropyltoluene	ND		5	3.6	72	45-141
75-09-2	Methylene chloride	ND		5	4.2	84	54-137
1634-04-4	Methyl Tert Butyl Ether	6.5		5	10.3	76	53-143
108-10-1	4-Methyl-2-pentanone	ND		20	16.0	80	58-127
91-20-3	Naphthalene	ND		5	3.6	72	44-140
103-65-1	n-Propylbenzene	ND		5	3.6	72	50-142
100-42-5	Styrene	ND		5	3.3	66	23-130
630-20-6	1,1,1,2-Tetrachloroethane	ND		5	4.8	96	57-144
71-55-6	1,1,1-Trichloroethane	ND		5	4.7	94	52-164
79-34-5	1,1,2,2-Tetrachloroethane	ND		5	4.8	96	58-138
79-00-5	1,1,2-Trichloroethane	ND		5	4.1	82	59-139
87-61-6	1,2,3-Trichlorobenzene	ND		5	3.9	78	47-141
96-18-4	1,2,3-Trichloropropane	ND		5	4.8	96	56-148
120-82-1	1,2,4-Trichlorobenzene	ND		5	3.8	76	46-137
95-63-6	1,2,4-Trimethylbenzene	ND		5	3.6	72	41-138
108-67-8	1,3,5-Trimethylbenzene	ND		5	3.6	72	45-138
127-18-4	Tetrachloroethylene	ND		5	3.8	76	45-145
108-88-3	Toluene	ND		5	3.7	74	52-134
79-01-6	Trichloroethylene	0.47	J	5	4.2	75	54-143
75-69-4	Trichlorofluoromethane	ND		5	5.6	112	36-167
75-01-4	Vinyl chloride	ND		5	5.6	112	35-162
	m,p-Xylene	ND		10	7.2	72	49-135
95-47-6	o-Xylene	ND		5	3.5	70	49-134
1330-20-7	Xylenes (total)	ND		15	10.7	71	50-134

CAS No.	Surrogate Recoveries	MS	JC94579-1	Limits
2199-69-1	1,2-Dichlorobenzene-d4	105%	98%	70-130%
460-00-4	4-Bromofluorobenzene	93%	88%	70-130%

* = Outside of Control Limits.

Matrix Spike/Matrix Spike Duplicate Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC94534-1MS	3A162949.D	1	09/11/19	RS	n/a	n/a	V3A7059
JC94534-1MSD	3A162950.D	1	09/11/19	RS	n/a	n/a	V3A7059
JC94534-1	3A162946.D	1	09/11/19	RS	n/a	n/a	V3A7059

The QC reported here applies to the following samples: **Method:** SW846 8260C BY SIM

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	JC94534-1 ug/l	Q	Spike ug/l	MS ug/l	MS %	Spike ug/l	MSD ug/l	MSD %	RPD	Limits Rec/RPD
123-91-1	1,4-Dioxane	12.2		20	27.8	78	20	26.8	73	4	28-162/64

CAS No.	Surrogate Recoveries	MS	MSD	JC94534-1	Limits
17647-74-4	1,4-Dioxane-d8	104%	97%	130%	25-195%

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC94420-2DUP	1B120864.D	1	09/10/19	BK	n/a	n/a	V1B5843
JC94420-2	1B120861.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	JC94420-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
67-64-1	Acetone	ND		ND		nc	10
78-93-3	2-Butanone	ND		ND		nc	12
71-43-2	Benzene	ND		ND		nc	10
108-86-1	Bromobenzene	ND		ND		nc	10
74-97-5	Bromochloromethane	ND		ND		nc	10
75-27-4	Bromodichloromethane	ND		ND		nc	10
75-25-2	Bromoform	ND		ND		nc	10
74-83-9	Bromomethane	ND		ND		nc	10
104-51-8	n-Butylbenzene	ND		ND		nc	10
135-98-8	sec-Butylbenzene	ND		ND		nc	10
98-06-6	tert-Butylbenzene	ND		ND		nc	10
75-15-0	Carbon disulfide	ND		ND		nc	19
108-90-7	Chlorobenzene	ND		ND		nc	10
75-00-3	Chloroethane	ND		ND		nc	10
67-66-3	Chloroform	ND		ND		nc	12
74-87-3	Chloromethane	ND		ND		nc	10
95-49-8	o-Chlorotoluene	ND		ND		nc	10
106-43-4	p-Chlorotoluene	ND		ND		nc	10
56-23-5	Carbon tetrachloride	ND		ND		nc	10
75-34-3	1,1-Dichloroethane	ND		ND		nc	10
75-35-4	1,1-Dichloroethylene	4.8		5.4		12* [a]	10
563-58-6	1,1-Dichloropropene	ND		ND		nc	10
96-12-8	1,2-Dibromo-3-chloropropane	ND		ND		nc	10
106-93-4	1,2-Dibromoethane	ND		ND		nc	10
107-06-2	1,2-Dichloroethane	ND		ND		nc	10
78-87-5	1,2-Dichloropropane	ND		ND		nc	10
142-28-9	1,3-Dichloropropane	ND		ND		nc	10
594-20-7	2,2-Dichloropropane	ND		ND		nc	10
124-48-1	Dibromochloromethane	ND		ND		nc	10
74-95-3	Dibromomethane	ND		ND		nc	10
75-71-8	Dichlorodifluoromethane	ND		ND		nc	10
541-73-1	m-Dichlorobenzene	ND		ND		nc	10
95-50-1	o-Dichlorobenzene	ND		ND		nc	10
106-46-7	p-Dichlorobenzene	ND		ND		nc	10
156-60-5	trans-1,2-Dichloroethylene	ND		ND		nc	10
156-59-2	cis-1,2-Dichloroethylene	ND		ND		nc	10

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC94420-2DUP	1B120864.D	1	09/10/19	BK	n/a	n/a	V1B5843
JC94420-2	1B120861.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

CAS No.	Compound	JC94420-2 ug/l	Q	DUP ug/l	Q	RPD	Limits
10061-01-5	cis-1,3-Dichloropropene	ND		ND		nc	10
10061-02-6	trans-1,3-Dichloropropene	ND		ND		nc	10
100-41-4	Ethylbenzene	ND		ND		nc	10
87-68-3	Hexachlorobutadiene	ND		ND		nc	10
591-78-6	2-Hexanone	ND		ND		nc	10
98-82-8	Isopropylbenzene	ND		ND		nc	10
99-87-6	p-Isopropyltoluene	ND		ND		nc	10
75-09-2	Methylene chloride	ND		ND		nc	10
1634-04-4	Methyl Tert Butyl Ether	ND		ND		nc	10
108-10-1	4-Methyl-2-pentanone	ND		ND		nc	10
91-20-3	Naphthalene	ND		ND		nc	10
103-65-1	n-Propylbenzene	ND		ND		nc	10
100-42-5	Styrene	ND		ND		nc	10
630-20-6	1,1,1,2-Tetrachloroethane	ND		ND		nc	10
71-55-6	1,1,1-Trichloroethane	0.25	J	0.27	J	8	10
79-34-5	1,1,2,2-Tetrachloroethane	ND		ND		nc	10
79-00-5	1,1,2-Trichloroethane	ND		ND		nc	10
87-61-6	1,2,3-Trichlorobenzene	ND		ND		nc	10
96-18-4	1,2,3-Trichloropropane	ND		ND		nc	10
120-82-1	1,2,4-Trichlorobenzene	ND		ND		nc	10
95-63-6	1,2,4-Trimethylbenzene	ND		ND		nc	10
108-67-8	1,3,5-Trimethylbenzene	ND		ND		nc	10
127-18-4	Tetrachloroethylene	ND		ND		nc	10
108-88-3	Toluene	ND		ND		nc	10
79-01-6	Trichloroethylene	ND		ND		nc	10
75-69-4	Trichlorofluoromethane	ND		ND		nc	10
75-01-4	Vinyl chloride	ND		ND		nc	10
	m,p-Xylene	ND		ND		nc	10
95-47-6	o-Xylene	ND		ND		nc	10
1330-20-7	Xylenes (total)	ND		ND		nc	10

CAS No.	Surrogate Recoveries	DUP	JC94420-2	Limits
2199-69-1	1,2-Dichlorobenzene-d4	98%	95%	70-130%
460-00-4	4-Bromofluorobenzene	90%	87%	70-130%

* = Outside of Control Limits.

Duplicate Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
JC94420-2DUP	1B120864.D	1	09/10/19	BK	n/a	n/a	V1B5843
JC94420-2	1B120861.D	1	09/10/19	BK	n/a	n/a	V1B5843

The QC reported here applies to the following samples: **Method:** EPA 524.2 REV 4.1

JC94420-1, JC94420-2, JC94420-3

(a) Outside control limits due to vial differences.

* = Outside of Control Limits.

Instrument Performance Check (BFB)

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample:	V1B5833-BFB	**Injection Date:**	08/28/19
Lab File ID:	1B120680.D	**Injection Time:**	08:16
Instrument ID:	GCMS1B		

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	14.99 - 40.0% of mass 95	3560	18.7		Pass
75	30.0 - 80.0% of mass 95	9191	48.4		Pass
95	Base peak, 100% relative abundance	18987	100.0		Pass
96	5.0 - 9.0% of mass 95	1311	6.90		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	15820	83.3		Pass
175	5.0 - 9.0% of mass 174	1151	6.06	(7.28) [a]	Pass
176	95.0 - 101.0% of mass 174	15180	79.9	(96.0) [a]	Pass
177	5.0 - 9.0% of mass 176	967	5.09	(6.37) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V1B5833-IC5833	1B120681.D	08/28/19	09:46	01:30	Initial cal 0.2
V1B5833-IC5833	1B120682.D	08/28/19	10:18	02:02	Initial cal 0.5
V1B5833-IC5833	1B120683.D	08/28/19	10:49	02:33	Initial cal 1
V1B5833-IC5833	1B120684.D	08/28/19	11:20	03:04	Initial cal 2
V1B5833-IC5833	1B120685.D	08/28/19	11:51	03:35	Initial cal 5
V1B5833-ICC5833	1B120686.D	08/28/19	12:22	04:06	Initial cal 10
V1B5833-IC5833	1B120687.D	08/28/19	13:42	05:26	Initial cal 20
V1B5833-IC5833	1B120688.D	08/28/19	14:12	05:56	Initial cal 40
V1B5833-IC5833	1B120689.D	08/28/19	14:44	06:28	Initial cal 80
V1B5833-ICV5833	1B120691.D	08/28/19	15:49	07:33	Initial cal verification 10

Instrument Performance Check (BFB)

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V1B5843-BFB
Lab File ID: 1B120853.D
Instrument ID: GCMS1B
Injection Date: 09/10/19
Injection Time: 09:06

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	14.99 - 40.0% of mass 95	2583	17.8		Pass
75	30.0 - 80.0% of mass 95	6953	47.9		Pass
95	Base peak, 100% relative abundance	14513	100.0		Pass
96	5.0 - 9.0% of mass 95	1014	6.99		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	12283	84.6		Pass
175	5.0 - 9.0% of mass 174	901	6.21	(7.34) [a]	Pass
176	95.0 - 101.0% of mass 174	11756	81.0	(95.7) [a]	Pass
177	5.0 - 9.0% of mass 176	832	5.73	(7.08) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V1B5843-CC5833	1B120854.D	09/10/19	09:47	00:41	Continuing cal 10
V1B5843-BS	1B120855.D	09/10/19	10:25	01:19	Blank Spike
V1B5843-MB	1B120856.D	09/10/19	11:06	02:00	Method Blank
ZZZZZZ	1B120857.D	09/10/19	11:37	02:31	(unrelated sample)
ZZZZZZ	1B120858.D	09/10/19	12:08	03:02	(unrelated sample)
ZZZZZZ	1B120859.D	09/10/19	12:40	03:34	(unrelated sample)
JC94420-1	1B120860.D	09/10/19	13:11	04:05	RW-12270CM-090419-F
JC94420-2	1B120861.D	09/10/19	13:42	04:36	RW-12270CM-090419-
JC94579-1	1B120862.D	09/10/19	14:13	05:07	(used for QC only; not part of job JC94420)
JC94420-2DUP	1B120864.D	09/10/19	15:15	06:09	Duplicate
JC94420-3	1B120865.D	09/10/19	15:47	06:41	TB-090419
ZZZZZZ	1B120866.D	09/10/19	16:18	07:12	(unrelated sample)
JC94579-1MS	1B120867.D	09/10/19	16:49	07:43	Matrix Spike
ZZZZZZ	1B120868.D	09/10/19	17:19	08:13	(unrelated sample)
ZZZZZZ	1B120869.D	09/10/19	17:50	08:44	(unrelated sample)
ZZZZZZ	1B120870.D	09/10/19	18:21	09:15	(unrelated sample)
ZZZZZZ	1B120871.D	09/10/19	18:53	09:47	(unrelated sample)
ZZZZZZ	1B120872.D	09/10/19	19:24	10:18	(unrelated sample)

Instrument Performance Check (BFB)

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample:	V3A6923-BFB	**Injection Date:**	07/18/18
Lab File ID:	3A160428.D	**Injection Time:**	16:55
Instrument ID:	GCMS3A		

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	15.0 - 40.0% of mass 95	25408	20.8		Pass
75	30.0 - 60.0% of mass 95	62880	51.6		Pass
95	Base peak, 100% relative abundance	121864	100.0		Pass
96	5.0 - 9.0% of mass 95	8101	6.65		Pass
173	Less than 2.0% of mass 174	826	0.68	(0.81) [a]	Pass
174	50.0 - 120.0% of mass 95	102317	84.0		Pass
175	5.0 - 9.0% of mass 174	8168	6.70	(7.98) [a]	Pass
176	95.0 - 101.0% of mass 174	100370	82.4	(98.1) [a]	Pass
177	5.0 - 9.0% of mass 176	6691	5.49	(6.67) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V3A6923-IC6923	3A160429.D	07/18/18	17:26	00:31	Initial cal 0.25
V3A6923-IC6923	3A160430.D	07/18/18	17:52	00:57	Initial cal 0.4
V3A6923-IC6923	3A160431.D	07/18/18	18:18	01:23	Initial cal 1
V3A6923-IC6923	3A160432.D	07/18/18	18:43	01:48	Initial cal 2
V3A6923-IC6923	3A160433.D	07/18/18	19:09	02:14	Initial cal 5
V3A6923-ICC6923	3A160434.D	07/18/18	19:35	02:40	Initial cal 20
V3A6923-IC6923	3A160435.D	07/18/18	20:00	03:05	Initial cal 50
V3A6923-IC6923	3A160436.D	07/18/18	20:26	03:31	Initial cal 100
V3A6923-IC6923	3A160437.D	07/18/18	20:52	03:57	Initial cal 200
V3A6923-ICV6923	3A160443.D	07/18/18	23:25	06:30	Initial cal verification 20

Instrument Performance Check (BFB)

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Sample: V3A7059-BFB
Lab File ID: 3A162941.D
Instrument ID: GCMS3A
Injection Date: 09/11/19
Injection Time: 07:33

m/e	Ion Abundance Criteria	Raw Abundance	% Relative Abundance		Pass/Fail
50	15.0 - 40.0% of mass 95	20125	20.1		Pass
75	30.0 - 60.0% of mass 95	50768	50.8		Pass
95	Base peak, 100% relative abundance	99880	100.0		Pass
96	5.0 - 9.0% of mass 95	6629	6.64		Pass
173	Less than 2.0% of mass 174	0	0.00	(0.00) [a]	Pass
174	50.0 - 120.0% of mass 95	69194	69.3		Pass
175	5.0 - 9.0% of mass 174	5438	5.44	(7.86) [a]	Pass
176	95.0 - 101.0% of mass 174	67768	67.8	(97.9) [a]	Pass
177	5.0 - 9.0% of mass 176	4632	4.64	(6.84) [b]	Pass

(a) Value is % of mass 174
(b) Value is % of mass 176

This check applies to the following Samples, MS, MSD, Blanks, and Standards:

Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed	Hours Lapsed	Client Sample ID
V3A7059-CC6923	3A162943.D	09/11/19	08:56	01:23	Continuing cal 5
V3A7059-BS	3A162944.D	09/11/19	09:25	01:52	Blank Spike
V3A7059-MB	3A162945.D	09/11/19	09:54	02:21	Method Blank
JC94534-1	3A162946.D	09/11/19	10:26	02:53	(used for QC only; not part of job JC94420)
ZZZZZZ	3A162947.D	09/11/19	10:55	03:22	(unrelated sample)
ZZZZZZ	3A162948.D	09/11/19	11:25	03:52	(unrelated sample)
JC94534-1MS	3A162949.D	09/11/19	11:54	04:21	Matrix Spike
JC94534-1MSD	3A162950.D	09/11/19	12:23	04:50	Matrix Spike Duplicate
ZZZZZZ	3A162952.D	09/11/19	13:20	05:47	(unrelated sample)
ZZZZZZ	3A162953.D	09/11/19	13:49	06:16	(unrelated sample)
JC94420-3	3A162954.D	09/11/19	14:18	06:45	TB-090419
JC94420-1	3A162955.D	09/11/19	14:47	07:14	RW-12270CM-090419-F
JC94420-2	3A162956.D	09/11/19	15:16	07:43	RW-12270CM-090419-
ZZZZZZ	3A162957.D	09/11/19	15:44	08:11	(unrelated sample)
ZZZZZZ	3A162958.D	09/11/19	16:13	08:40	(unrelated sample)
ZZZZZZ	3A162959.D	09/11/19	16:42	09:09	(unrelated sample)
ZZZZZZ	3A162960.D	09/11/19	17:12	09:39	(unrelated sample)
ZZZZZZ	3A162961.D	09/11/19	17:41	10:08	(unrelated sample)

Surrogate Recovery Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Method: EPA 524.2 REV 4.1 **Matrix:** AQ

Samples and QC shown here apply to the above method

Lab Sample ID	Lab File ID	S1	S2
JC94420-1	1B120860.D	98	90
JC94420-2	1B120861.D	95	87
JC94420-3	1B120865.D	102	90
JC94420-2DUP	1B120864.D	98	90
JC94579-1MS	1B120867.D	105	93
V1B5843-BS	1B120855.D	108	97
V1B5843-MB	1B120856.D	100	90

Surrogate Compounds	Recovery Limits
S1 = 1,2-Dichlorobenzene-d4	70-130%
S2 = 4-Bromofluorobenzene	70-130%

Surrogate Recovery Summary

Job Number: JC94420
Account: ESCVAR WSP Environment & Energy
Project: Kop-Flex, Hanover, VA

Method: SW846 8260C BY SIM **Matrix:** AQ

Samples and QC shown here apply to the above method

Lab Sample ID	Lab File ID	S1
JC94420-1	3A162955.D	94
JC94420-2	3A162956.D	95
JC94420-3	3A162954.D	98
JC94534-1MS	3A162949.D	104
JC94534-1MSD	3A162950.D	97
V3A7059-BS	3A162944.D	104
V3A7059-MB	3A162945.D	113

Surrogate Compounds	Recovery Limits
S1 = 1,4-Dioxane-d8	25-195%

ENCLOSURE B – WELL ABANDONMENT REPORTS

A-ZONE
ENVIRONMENTAL SERVICES

August 23, 2019

Brian Chew
Supervisor, Well Construction and Groundwater Quality Program
Anne Arundel County Health Department
3 Harry S. Truman Pkwy.
Annapolis, MD 21401

Re: Well Abandonment Reports

Dear Mr. Chew:

Enclosed please find 2 completed Water Well Abandonment-Sealing Report Forms and two well tags for a site on Fairbanks Drive.

If you have any questions or need any additional information, please do not hesitate to contact me at 304-724-6458 or csealander@a-zoneenvironmental.com.

Sincerely,

Christina J. Sealander

Christina J. Sealander
Office Manager

MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER MANAGEMENT ADMINISTRATION
1800 Washington Blvd., Baltimore, Maryland 21230 (410) 537-3784

WATER WELL ABANDONMENT-SEALING REPORT FORM

MW-28B

SUBMIT COPIES OF COMPLETED FORM TO:
* COUNTY ENVIRONMENTAL AGENCY (contact MDE, WMA if address needed)
* WELL OWNER
* MDE, WATER MANAGEMENT ADMINISTRATION, WELL PROGRAM

DATE WELL ABANDONED: 8-6-19 (month/day/year)

* PERMIT NUMBER OF ABANDONED WELL (if any) AA-13-0685

* PERMIT NUMBER OF REPLACEMENT WELL: ____

* PERSON ABANDONING WELL: Jesse Morgan WELL DRILLER'S LICENSE NUMBER: 106
CIRCLE: MWD / MSD / MGD

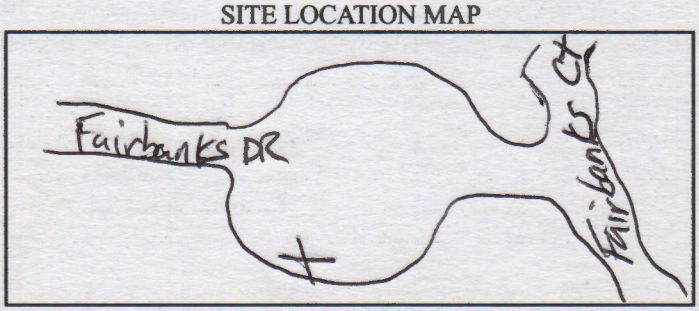
* OWNER'S NAME: Anne Arundel Co

* WELL LOCATION:
COUNTY: Anne Arundel Co
NEAREST TOWN: Hanover
TAX MAP ____ BLOCK ____ PARCEL ____
SUBDIVISION: ____
SECTION: ____ LOT: ____
STREET ADDRESS: Fairbanks DR

LATITUDE 39.139851

LONGITUDE 76.698855

SITE LOCATION MAP



LOG OF SEALING MATERIAL

MATERIAL	FEET	
	FROM	TO
Portland Cement	45	0
VOLUME OF MATERIAL USED		
11 Gal		

* TYPE OF WELL BEING ABANDONED:
✓ DRILLED ____ JETTED
____ BORED ____ HAND DUG
____ OTHER (specify) ____

* USE CODE:
____ DOMESTIC ____ MUNICIPAL/PUBLIC
____ IRRIGATION ____ INDUSTRIAL
✓ TEST/OBSERVATION ____ GEOTHERMAL

* TYPE OF CASING:
____ STEEL ✓ PLASTIC
____ CONCRETE ____ OTHER (specify)
____

SIZE OF CASING: 2.5 INCHES IN DIAMETER

DEPTH OF WELL: 45 FEET DEEP

WAS ANY CASING REMOVED? ✓ YES ____ NO
If yes, length removed, in feet: 45

WAS CASING RIPPED OR PERFORATED? N/A YES X NO

Pursuant to § 10-624 of the State Govt. Article of the Maryland Code, personal info requested on this form is used in processing this form pursuant to COMAR 26.04.04. Failure to provide the info may result in this form not being processed. You have the right to inspect, amend, or correct this form. The Maryland Department of the Environment is subject to the Maryland Public Information Act. This form may be made available on the Internet via MDE's website and is subject to inspection or copying, in whole or in part, by the public and other governmental agencies, if not protected by federal or State Law.

[signature] MGD106 (MWD) / MSD / MGS 8/23/19
SIGNATURE-MASTER WELL DRILLER OR SUPERVISING SANITARIAN LICENSE# CIRCLE ONE DATE

ORIGINAL

MARYLAND DEPARTMENT OF THE ENVIRONMENT, WATER MANAGEMENT ADMINISTRATION
1800 Washington Blvd., Baltimore, Maryland 21230 (410) 537-3784

WATER WELL ABANDONMENT-SEALING REPORT FORM

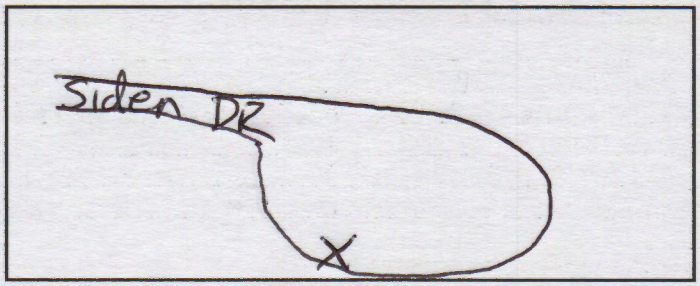
MW-25C

SUBMIT COPIES OF COMPLETED FORM TO:
* COUNTY ENVIRONMENTAL AGENCY (contact MDE, WMA if address needed)
* WELL OWNER
* MDE, WATER MANAGEMENT ADMINISTRATION, WELL PROGRAM

DATE WELL ABANDONED: 8-6-19 (month/day/year)

* PERMIT NUMBER OF ABANDONED WELL (if any) AA-13-0684
* PERMIT NUMBER OF REPLACEMENT WELL: ____ — ____
* PERSON ABANDONING WELL: Jesse Morgan WELL DRILLER'S LICENSE NUMBER: 106
CIRCLE: MWD / MSD / MGD
* OWNER'S NAME: Anne Arundel Co
* WELL LOCATION:
COUNTY: Anne Arundel Co
NEAREST TOWN: Hanover
TAX MAP ____ BLOCK ____ PARCEL ____
SUBDIVISION: ____
SECTION: ____ LOT: ____
STREET ADDRESS: ~~Fairbanks~~ → Siden DR
LATITUDE 39.145758
LONGITUDE 76.698633

SITE LOCATION MAP



LOG OF SEALING MATERIAL

MATERIAL	FEET	
	FROM	TO
Portland Cement	40	0
VOLUME OF MATERIAL USED		
10 Gal		

* TYPE OF WELL BEING ABANDONED:
✓ DRILLED ____ JETTED
____ BORED ____ HAND DUG
____ OTHER (specify) ____

* USE CODE:
____ DOMESTIC ____ MUNICIPAL/PUBLIC
____ IRRIGATION ____ INDUSTRIAL
✓ TEST/OBSERVATION ____ GEOTHERMAL

* TYPE OF CASING:
____ STEEL ✓ PLASTIC
____ CONCRETE ____ OTHER (specify)
____

SIZE OF CASING: 2.5 INCHES IN DIAMETER

DEPTH OF WELL: 40 FEET DEEP

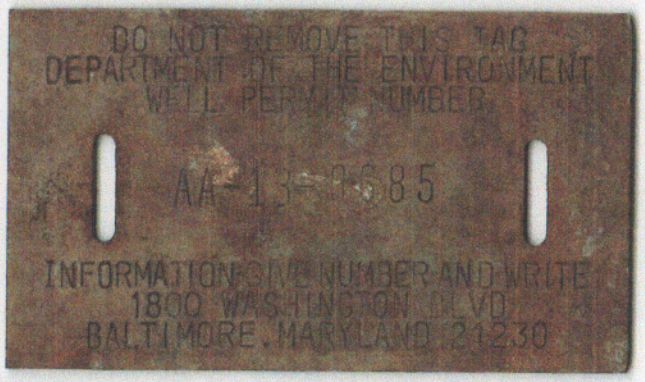
WAS ANY CASING REMOVED? ____ YES ✓ NO
If yes, length removed, in feet: ____

WAS CASING RIPPED OR PERFORATED? ✓ YES ____ NO

Pursuant to § 10-624 of the State Govt. Article of the Maryland Code, personal info requested on this form is used in processing this form pursuant to COMAR 26.04.04. Failure to provide the info may result in this form not being processed. You have the right to inspect, amend, or correct this form. The Maryland Department of the Environment is subject to the Maryland Public Information Act. This form may be made available on the Internet via MDE's website and is subject to inspection or copying, in whole or in part, by the public and other governmental agencies, if not protected by federal or State Law.

[signature] MGD106 MWD / MSD / MGS 8/23/19
SIGNATURE-MASTER WELL DRILLER OR SUPERVISING SANITARIAN LICENSE# CIRCLE ONE DATE

ORIGINAL


DO NOT REMOVE THIS TAG
DEPARTMENT OF THE ENVIRONMENT
WELL PERMIT NUMBER
AA-13-0685
INFORMATION GIVE NUMBER AND WRITE
1800 WASHINGTON BLVD
BALTIMORE, MARYLAND 21230


AA-13-0684


MW-338
MW-25C
40DTB

ENCLOSURE C – ^{14}C ASSAY METHOD FOR DETERMINING CONSTITUENT DEGRADATION RATES IN GROUNDWATER

Groundwater
Monitoring&Remediation

Quantification of TCE Co-Oxidation in Groundwater Using a ^{14}C–Assay

by James C. Mills IV, John T. Wilson, Barbara H. Wilson, Todd H. Wiedemeier, and David L. Freedman

Abstract

Bacteria that degrade natural organic matter in groundwater contain oxygenase enzymes that can co-oxidize trichloroethene (TCE). This degradation pathway is promising for large dilute plumes, but its evaluation is limited because the density of the bacteria with oxygenase enzymes has not been correlated to field scale rates of degradation. A ^{14}C–TCE assay was developed to determine pseudo first-order rate constants for the aerobic co-oxidation of TCE in groundwater. The assay involved incubating ^{14}C–TCE in samples of groundwater contained in 160 mL serum bottles, and monitoring the accumulation of radiolabel in degradation products. A first-order rate constant for co-oxidation was extracted from the rate of accumulation of ^{14}C in products, accounting for volumetric changes in the serum bottles due to sampling and subsequent changes to the distribution of TCE between the aqueous and gaseous phases. Of the groundwater samples evaluated from 19 wells at five sites, eight samples at three sites had ^{14}C product accumulation rates that exceeded the accumulation rate in filter-sterilized groundwater controls. First-order rate constants ranged from 2.65 to 0.0066 $year^{-1}$, which is equivalent to half-lives of 0.26 to 105 years. Groundwater samples from a few of the wells in which co-oxidation occurred had volatile organic contaminants in addition to TCE; their presence may have induced the oxygenase enzymes that are needed for TCE co-oxidation. $^{14}CO_2$ represented ~37% to 97% of the ^{14}C products that accumulated; the balance of the products was soluble and non-volatile.

Introduction

Monitored natural attenuation (MNA) is a remediation strategy that considers the total contributions of natural biotic and abiotic processes, such as biodegradation, sorption, dilution, and volatilization, among others, that lead to contaminant remediation over time (Wiedemeier et al. 1999). Biodegradation is a key component of MNA that relies on indigenous microbes capable of degrading contaminants, including chlorinated solvents, without active engineering intervention (National Research Council 2000; Illman and Alvarez 2009). Trichloroethene (TCE) is a chlorinated solvent of interest because of human health issues, prevalence of contamination, and regulation of TCE contaminated sites (Alvarez and Illman 2006; Löffler et al. 2013). TCE biodegradation occurs through anaerobic reductive dechlorination or aerobic co-oxidation pathways (Arp 1995). Methods to document the rate of in-situ reductive dechlorination of TCE, as well as the quantity of microbes and enzymes involved, are well established (Sherwood Lollar et al. 2000; Bradley 2003; Morrill et al. 2005; Alvarez and Illman 2006; Ritalahti et al. 2006; Illman and Alvarez 2009; Löffler et al. 2013). Nevertheless, methods to measure the rate of in-situ co-oxidation are less well developed. One approach relies on changes in TCE concentrations along a flowpath (Sturchio et al. 1998; Sorenson et al. 2000; Kirtland et al. 2003). However, this method is restricted to sites with concentrations that are high enough to accurately quantify changes; the flowpath is well defined; and/or tracers are present that permit adjustments for dispersion and adsorption. The need exists for methods to estimate in-situ rates of co-oxidation that are applicable to sites that are not as well characterized.

Aerobic co-oxidation of TCE is mediated by many (but not all) mono- and dioxygenase enzymes (http://eawag-bbd.ethz.ch/tce/tce_map.html). Growth on a wide variety of substrates induces expression of oxygenases, including many aromatics, alkanes, and alkenes (Alvarez-Cohen and Speitel Jr 2001). Reaction of TCE with oxygenases results in a variety of products, including CO, CO_2, formate, glyoxylate, dichloroacetate, and oxalate (Arp et al. 2001). However, unlike the products of reductive dechlorination, these are not unique to TCE degradation and therefore it is not possible to demonstrate the rate and occurrence of co-oxidation by measuring these compounds in-situ.

MNA requires rigorous documentation to provide evidence that the contaminants are degrading to regulatory limits. The Environmental Protection Agency's (EPA) Office of Solid Waste and Emergency Response Directive 9200.4-17 identified three lines of evidence to demonstrate MNA, including historical groundwater and/or soil chemistry data (primary), hydrogeological and geochemical data (secondary), and field or microcosm studies (tertiary) (EPA 1999). Tools exist that can assist in providing tertiary evidence for MNA to document the aerobic co-oxidation of TCE. Molecular tools to document the presence of oxygenases

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capable of degrading TCE are commercially available, including qPCR assays for soluble methane monooxygenase, ring hydroxylating toluene monooxygenase, and ethene monooxygenase (Baldwin et al. 2003; Paszczynski et al. 2011; Wiedemeier et al. 2017). It is also possible to test for the expression of these enzymes by quantification of the associated mRNA. Enzyme activity probes (EAPs) are also available to quantify the presence of oxygenase enzymes. EAPs serve as alternate substrates for TCE cometabolizing enzymes. An assay has been developed for four aromatic oxygenases (Keener et al. 1998, 2001; Miller et al. 2002; Clingenpeel et al. 2005), and soluble methane monooxygenase (Miller et al. 2002). The non-fluorescent EAPs are transformed by the enzymes into a quantifiable fluorescent signal upon reaction, thus providing direct evidence of cometabolic enzyme activity.

While quantifying the presence of enzymes capable of co-oxidation is important, it is not sufficient to conclusively establish that biodegradation is occurring, and if so, at what rate. Application of MNA to large, dilute plumes of TCE has been limited because the numbers of bacteria in groundwater that have the oxygenase enzymes has not been directly correlated to field scale rates of degradation (Wiedemeier et al. 2017). Because determining field scale rates for co-oxidation of TCE using concentration data is problematic (Wiedemeier et al. 2017), a more robust method of measuring rates is needed. The objective of this research was to develop an assay based on use of ^{14}C–labeled TCE. Quantification of biodegradation using ^{14}C–labeled compounds has been in use for decades, and numerous studies have employed ^{14}C–TCE. Nevertheless, an assay specifically targeting co-oxidation of TCE at low concentrations is needed to determine the low rates of degradation that may occur in dilute plumes. The assay developed in this study was applied to groundwater samples from five contaminated sites in the US. By measuring the accumulation of ^{14}C–labeled products from ^{14}C–TCE co-oxidation in the laboratory, it was possible to measure first-order rate constants that equate to half-lives in excess of 50 years.

Materials and Methods

Site Locations and Sample Collection

Groundwater samples were collected from five sites known to have TCE contamination: the former Twin Cities Army Ammunition Plant (TCAAP) in Shoreview, Minnesota; the former Plattsburgh Air Force Base (AFB) in Plattsburgh, New York; the former Hopewell Precision facility in Hopewell Junction, New York; the Tooele Army Depot near Tooele, Utah; and Hill AFB near Ogden, Utah. Additional site information and characterization is available in Wiedemeier et al. (2016, 2017). Details on TCE concentrations and the presence of other volatile organic compounds (VOCs) at the sites are presented in Appendix S1, Supporting Information.

Groundwater samples were obtained from 19 wells. At four of the sites, four wells were sampled; at Hill AFB, it was feasible to sample only three wells. Triplicate samples (100 mL) were collected from each well in sterile 160 mL borosilicate glass serum bottles (Wheaton®, Millville, New Jersey) and immediately sealed with polytetrafluoroethylene (PTFE)-faced gray butyl rubber septa (Sun-Sri™, Rockwood, Tennessee; 20 mm, 0.130 butyl) and aluminum crimp caps. The bottles were labeled and weighted (± 0.01 g) before field sample collection. Additional groundwater was collected from each well to be used for preparing filter-sterilized controls (see below). Samples were shipped overnight on ice to Clemson University.

Chemicals

^{14}C–TCE (1.0 mCi) was custom-synthesized by Moravek Biochemicals, Inc. (Brea, California) and dissolved in acetonitrile. The specific activity was 60.2 mCi/mmol and the reported radiochemical purity was 97.2%. A stock solution was prepared in a clear 65 mL bottle by adding the ^{14}C–TCE/acetonitrile solution to ~60 mL of TCE (ACS grade) saturated distilled deionized (DDI) water (~8.6 µmol TCE/mL), in order to reduce the specific activity of the ^{14}C–TCE and minimize radiolysis of the TCE to produce radio-labeled degradation products. The bottle was sealed with a Mininert valve and stored at 10 °C.

ScintiSafe™ Plus 50% Cocktail (Fisher Scientific, Pittsburgh, Pennsylvania) was used in liquid scintillation counting. NaOH (ACS grade) pellets were obtained from VWR (Randor, Pennsylvania). Barium hydroxide octahydrate (97%) was obtained from Alfa Aesar. Additional details on preparation of the ^{14}C–TCE stock solution and chemicals used are found in Appendix S2.

^{14}C–TCE Purification and Addition

To facilitate detection of low levels of ^{14}C–labeled TCE degradation products, it was necessary to remove ^{14}C–labeled impurities before adding it to the serum bottles. The label in the impurities would count along with the TCE transformation product in the assay and create a high background. The bacteria that express oxygenase enzymes might be affected by the acetonitrile in the stock solution. Gas chromatography (HP 5890 Series II) was used for this purpose (Darlington et al. 2008). An aliquot of the stock solution (50 µL) was injected onto a stainless-steel column packed with 1% SP-1000 on 60/80 Carbopack-B (Supelco). The end of the column was connected to a four-port valve in the gas chromatograph (GC) oven. The valve was positioned so that the flow exited the oven through stainless-steel tubing rather than routing to the flame ionization detector (FID). The tubing terminated with a sterile needle, through which the purified ^{14}C–TCE was injected at a predetermined residence time into the serum bottles (Appendix S3). Prior to injecting the purified ^{14}C–TCE, 50 mL of headspace was withdrawn with a gas-tight syringe to compensate for the gas being added, so that the headspace was not over pressurized.

High-purity N_2 served as the carrier gas (33.5 mL/min). The temperature program was 60 °C for 2 min, increase at 20 °C/min to 150 °C, increase at 10 to 200 °C and hold for 28.5 min. The elution time for TCE was 9.6 to 11.1 min. The extended hold time at 200 °C was designed to ensure that impurities did not accumulate on the column. The average amount of ^{14}C–TCE added to the serum bottles was 0.382 ± 0.021 µCi. The amount gradually decreased over approximately 4 months of testing, likely due to diffusive losses from the stock solution.

The use of a second column in series with the first was tested to determine if additional purification was achievable. However, the single and dual column approaches were equivalent. Appendix S4 provides further details on removal of impurities during addition of ^{14}C–TCE to groundwater samples.

Time Zero Preparations and Measurements

Immediately upon receipt at Clemson University, the bottles were warmed to room temperature (22 ± 2 °C), quiescently in the dark, for approximately 24 h before addition of ^{14}C–TCE. The mass of bottles was recorded (±0.01 g) to determine the amount of water in each bottle. Groundwater samples were collected in triplicate serum bottles from each well. For each site, two wells were sampled per day, on consecutive days. When the first set of samples was prepared, triplicate DDI water controls were also prepared. During subsequent testing, it became apparent that filter-sterilized groundwater (FSGW) was a better indicator of background activity; 0.2 µm, 47 mm filters (Whatman™; Millipore Sigma, St. Louis, Missouri) were used to prepare the FSGW controls.

After adding gas containing the purified ^{14}C–TCE to the headspace, the bottles were immediately inverted to reduce diffusional losses and placed on an orbital shaker table (98 ± 2 RPM) for approximately 1 h to facilitate establishment of equilibrium between the headspace and liquid phases. Headspace samples were then evaluated for VOCs and oxygen. Addition of ^{14}C–TCE resulted in an average time zero TCE level of 0.262 ± 0.031 µmol per bottle, or an aqueous phase concentration of 282 ± 0.034 µg/L when taking into account partitioning between the headspace and liquid phases (Gossett 1987).

Time zero monitoring for ^{14}C involved direct headspace and liquid counts. Direct sample counts were used to quantify the total amount of radioactive material in each bottle. Headspace samples (0.5 mL gas) were removed using a gas-tight syringe. Samples (0.5 mL gas, 0.1 mL liquid) were injected immediately into 20 mL borosilicate glass scintillation vials (Fisherbrand™; Fisher Scientific) each containing 15 mL of liquid scintillation cocktail (LSC). A hole (2.38 mm) was drilled in the polypropylene scintillation cap and a PTFE-faced gray butyl rubber septum was placed inside the cap to minimize any losses of ^{14}C from volatilization. The total amount of ^{14}C present per bottle was determined (based on disintegrations per minute [dpm]) using the equation:

$$C_{tot,o} = \frac{S_l}{V_{l,s}} \cdot V_{l,b} + \frac{S_h}{V_{g,s}} \cdot V_{g,b} \quad (1)$$

where $C_{tot,o}$ = total ^{14}C in a serum bottle at the beginning of the assay (dpm/bottle); S_l = ^{14}C in liquid sample (dpm/sample); $V_{l,s}$ = volume of liquid sample (typically 0.1 mL); and $V_{l,b}$ = initial volume of liquid in a serum bottle (~100 mL); S_h = ^{14}C in a headspace sample (dpm/sample); $V_{g,s}$ = volume of headspace sample (typically 0.5 mL); $V_{g,b}$ = volume of headspace in a serum bottle (160 mL – $V_{l,b}$).

To determine the accumulation of radio-labeled degradation products, a sample of water was collected from the serum bottle and the ^{14}C–TCE was sparged out of the sample with a stream of N_2. Sparging removed VOCs, principally ^{14}C–TCE, so that any radioactivity remaining in the vial consisted of non-volatile transformation products and not residual ^{14}C–TCE. Then scintillation counting was used to determine the accumulation of transformation products in the sparged sample.

Prior to removing a liquid sample from a serum bottle for sparging, approximately 3 mL of room air was injected. The liquid sample (3.0 mL) was then withdrawn and added to a scintillation vial. Approximately 12 µL of 8 M NaOH was added to raise the pH above 10.5, thereby ensuring retention of $^{14}CO_2$ in the aqueous phase as carbonate. The pH of the sample was confirmed qualitatively using a pH strip (BDH® VWR Analytical, pH 7.0–14.0, gradation of 0.5 units; VWR). The alkaline liquid sample was sparged with N_2 (550 ± 50 mL/min) for 30 min. The adequacy of this approach to remove ^{14}C–TCE was confirmed (Appendix S5). The vials were tilted on a 30° angle to facilitate contact between the N_2 and liquid. Following sparging, 15 mL of LSC was added to the vials, which were then incubated quiescently in the dark at room temperature for approximately 24 h before counting.

Monitoring and ^{14}C Product Distribution

Samples were removed seven or eight times over a period of 40 to 46 days. At each sampling event, headspace and liquid samples were counted to determine the total ^{14}C remaining and a headspace sample was used to measure O_2. Accumulation of ^{14}C labeled product in the aqueous phase was determined in 3.0 mL liquid samples, as described above. An overview of the sampling sequence is provided in Appendix S6.

On the final day of incubation, routine measurements were made (i.e., ^{14}C remaining in the headspace and liquid, O_2 in the headspace, and ^{14}C products in a 3.0 mL liquid sample). VOCs in the headspace were also analyzed. If the accumulation of ^{14}C products relative to the DDI or FSGW controls was statistically significant at 95% confidence, the distribution of products was evaluated for CO_2 and soluble, non-strippable residue (NSR). The amount of $^{14}CO_2$ was obtained by precipitation of radiolabel from the alkaline sparge water with barium hydroxide. To do so, a 10-mL sample of water from the serum bottle was added to a 15-mL sterile, polypropylene centrifuge tube (VWR®). Approximately 50 µL of 8 M NaOH was injected to raise the pH above 10.5. The samples were sparged with N_2 (550 ± 50 mL/min) for approximately 30 min, then 3.0 mL of the alkaline solution was withdrawn and added to 15 mL of LSC; this replicated the analysis performed with only a 3.0 mL liquid sample. Next, 1.35 g of $Ba(OH)_2 \cdot 8H_2O$ was added to the remaining 7.0 mL of the sparged, alkaline liquid in the centrifuge tubes and vigorously mixed using a constant speed vortex mixer. The tubes were centrifuged for 20 min (2700 rpm). An aliquot of the centrate (2.0 mL), that is, the water remaining in the centrifuge tube, was withdrawn and added to 15 mL of LSC. The LSC vials were incubated quiescently in the dark for approximately 24 h before counting. The centrate was presumed to contain ^{14}C products other than $^{14}CO_2$, since $^{14}CO_2$ formed a barium carbonate precipitate. The composition of the soluble

products (NSR) was not investigated any further. A second method was used to determine CO_2 and NSR, involving acidic sparging; details and results of this method are found in Appendix S7; a step-by-step procedure is also available (Mills IV 2017).

Analysis of VOCs and Oxygen

The total amount of TCE present in a serum bottle was quantified by injection of a headspace sample (0.5 mL) onto a GC (HP 5890 Series II) equipped with a stainless-steel column packed with 1% SP-1000 on 60/80 Carbopack B (Supelco; Millipore Sigma) and FID (Gossett 1987). Other VOCs present in the groundwater were also detected but were not identified. Acetonitrile, a component of the ^{14}C–TCE stock solution, was not detected in any of the serum bottles. The absence of acetonitrile was confirmed from day 0 GC chromatograms recorded for every serum bottle. It is important to note that even if acetonitrile was present in the serum bottles following GC purification, there is no evidence in the literature that suggests acetonitrile can serve as a primary substrate for TCE co-oxidation (Alvarez-Cohen and Speitel Jr 2001). VOCs were checked after the TCE was injected into the bottles, not prior to the addition.

Oxygen was measured in headspace samples (0.5 mL) on a GC equipped with a thermal conductivity detector and a stainless-steel column packed with 100/120 Carbosieve S-II support (Supelco). The flow rate was approximately 50.5 ± 0.2 mL/min with N_2 gas as the carrier and reference gas. An isothermal temperature program (105 °C, 4 min) was used. After 40 to 46 days of incubation, the average O_2 level in the groundwater bottles was 12.0 ± 0.28%; the lowest level observed was 7.50%. This was considered adequate to avoid any limitation on co-oxidation of TCE, and as a result, none of the groundwater bottles received additional O_2. There was no correlation between the occurrence of TCE co-oxidation and oxygen consumption, since oxygen was present in excess of the demand for TCE and other organic compounds.

Positive Controls and Sample Handling Effects

The ^{14}C assay was validated using water from a seep at the Twin Lakes Recreation Area on Lake Hartwell near Pendleton, SC and a culture of the propanotrophic bacterium ENV487 (courtesy of Dr. Robert Stefan at CB&I, Inc.). ENV487 was used because propanotrophs are known to cometabolize TCE (Chang and Alvarez-Cohen 1995; Frascari et al. 2003). It was grown to a density of ~5.3×10^{10} cell/mL on propane gas and oxygen in basal salts medium (BSM), as previously described (Rodriguez 2016). Following growth on propane and oxygen, dilutions (25%, 2.5%, 0.25%, and 0.025%) were prepared with BSM in 160 mL serum bottles and ^{14}C–TCE was added. Another bottle with only BSM was prepared as a negative control.

The seep at Twin Lakes discharges into an area with a high level of organic debris. It was selected because of its proximity to the laboratory and to evaluate the potential for co-oxidation of TCE in a sample with no known previous contamination by TCE or other chlorinated organic compounds. Samples from the seep area were added to serum bottles and immediately capped in the field using the same methodology described for collection of the groundwater samples. Upon arrival at Clemson University, ^{14}C–TCE was added. Triplicate DDI water controls were prepared at the same time.

The ENV487 propanotrophic culture was also used to evaluate the effect of sample handling and storage, that is, what was the effect of cooling the samples to 4 °C and storing them for ~20 h prior to measuring the accumulation of ^{14}C products. Three conditions were used to test the effects of temperature, each in triplicate: (1) ambient room temperature; (2) storage on ice for 24 h, then warming for 2.5 h; and (3) storage on ice for 24 h, then warming for 24 h; the latter most closely resembles how the groundwater samples were handled. ^{14}C–TCE was added following the respective temperature treatments. A 0.25% dilution of ENV487 from a culture of ~5.3×10^{10} cell/mL was selected based on initial results from the positive control test mentioned above. The bottles were monitored for accumulation of ^{14}C products for 40 days.

First-Order Modeling

The background level of TCE in the groundwater (Appendix S1) plus the TCE added along with ^{14}C–TCE resulted in an initial TCE concentration (0.282 ± 0.034 mg/L) that was below the half saturation constant (typically >1 mg/L) for a significant number of bacteria that cometabolize TCE (Alvarez-Cohen and Speitel Jr 2001; Wiedemeier et al. 2017). Consequently, first-order kinetics were utilized to represent the rate of TCE degradation. However, the number of cells present in each bottle was not determined and the rate constants developed through this modeling process could not be normalized to the amount of biomass. Therefore, an assumption of the model is that the amount of biomass is at steady-state, which is analogous to pseudo first-order reaction kinetics (Schmidt et al. 1985).

The accumulation of ^{14}C products over time was used to determine the pseudo first-order rate constant for TCE transformation (k), by fitting experimental data to a mass balance model for ^{14}C in the microcosms. Rate constants were determined by fitting measured ^{14}C product accumulation data to the following equation:

$$\Delta C_i = C_{l,i-1,a} - C_{l,i-1,a}\left(e^{-k\Delta t}\right) \quad (2)$$

where ΔC_i = the increase in ^{14}C products over the i^{th} interval between sampling events ($i = 0$ to 8 or 9, representing the number of sampling events); $C_{l,i,a}$ = concentration of ^{14}C products in the aqueous phase after removing the liquid and headspace samples, that is, the beginning of the i^{th} interval; and Δt is the time between sampling events. It was assumed that ΔC_i was zero at $i = 0$ (i.e., there was no accumulation of ^{14}C products at time zero).

Rate constants were determined using MATLAB by minimizing the sum of squared errors between the prediction and the ^{14}C product data over time. Triplicate bottles were fit simultaneously to obtain a single value for k (i.e., as opposed to determining k for each bottle and then taking the average). Calculations were performed in two stages, with the first stage corresponding to the initial conditions and the second stage to all subsequent data points.

The value of k was iterated in the MATLAB script until a minimum value was obtained for the sum of squared errors determined as the squared difference between the experimental and estimated ^{14}C product values. The MATLAB function used for the iterative approach was *lsqcurvefit*, which is a nonlinear curve-fitting solver function that uses the trust-region-reflective algorithm. Confidence intervals (CI) (95%) were determined using the MATLAB function *nlparci* with the Jacobian matrix and residual vector determined from *lsqcurvefit*. Details and the full set of equations used are in Appendix S8.

A Student's *t*-test was used to determine if the rate constant for a groundwater sample was statistically different from the FSGW control ($\alpha = 0.05$). If it was, a net k value was calculated by subtracting the FSGW rate. The CI for the net rate was determined by propagation of error using the standard deviations.

Liquid Scintillation Counting

Beta radiation was quantified using a Wallac 1220 Quantulus (PerkinElmer, Inc, Waltham, Massachusetts) liquid scintillation counter, which is an ultra-low-level spectrometer. The counter was connected to a desktop computer equipped with proprietary WinQ software (PerkinElmer, Inc.). The ^{14}C (high-energy beta) configuration in WinQ was used and windows 1 and 2 (used to detect beta radiation) were expanded to 5–700 and 1–700, respectively. All samples were counted for 15 min with the external standard quench parameter selected for quench correction. The quench efficiency curve was determined using prepared ^{14}C standards (Beckman Instruments Inc., Brea, California; quenched carbon-14 standards set) with a counting time of 15 min. Direct headspace and liquid ^{14}C samples were counted within 3 h of the sampling event. The sparged alkaline liquid samples were incubated quiescently in the dark for approximately 24 h before counting to reduce chemilumenscence arising from the high pH of the 3-mL sample mixed with the LSC.

Results and Discussion

Positive Controls

There was a statistically significant rate of ^{14}C product accumulation in the propanotrophic cultures compared to the BSM controls (Appendix S9). The pseudo first-order rate constant and associated 95% CI for the lowest dilution (0.025%) was $1.77 \times 10^{-1} \pm 3.01 \times 10^{-2}$ year^{-1}, which gives a half-life of 3.9 years (95% CI = 3.3 to 4.7 years). There was no statistically significant ($\alpha = 0.05$) increase in ^{14}C products in the BSM control.

There was a statistically significant ($\alpha = 0.05$) rate of ^{14}C product accumulation in seep samples from the Twin Lakes Recreation Area, resulting in a pseudo first-order rate constant of $5.00 \times 10^{-2} \pm 1.62 \times 10^{-2}$ year^{-1}. There was also a statistically significant ($\alpha = 0.05$) increase in the DDI water controls (filter-sterilized controls were not run), at a pseudo first-order rate of $2.61 \times 10^{-2} \pm 5.86 \times 10^{-3}$ year^{-1}. The net rate was $2.39 \times 10^{-2} \pm 1.67 \times 10^{-2}$ year^{-1}, yielding a half-life of 29 years (95% CI = 17 to 96 years). These results confirmed that the assay can detect co-oxidation rates that are meaningful in the context of MNA.

The effect of storage conditions on the rate of ^{14}C product accumulation was evaluated (Appendix S10). There was no significant difference in rates for the treatment that was never cooled to 4 °C and the treatment that was held at 4 °C for 2.5 h before being warmed to room temperature. The treatment that was held at 4 °C for 24 h before being warmed to room temperature behaved differently; this was most pronounced after day 4, as the ^{14}C product accumulation rate slowed noticeably. However, when only the first 5 days of data were considered, there were no statistically significant ($\alpha = 0.05$) differences among the first-order rate constants.

These results suggest that the conditions under which the groundwater samples were handled (i.e., shipment and storage on ice overnight, followed by warming to room temperature overnight) may have decreased the reaction rate. Consequently, the rates reported are likely conservative. It is difficult to envision a different approach to handling the samples, since they need to be shipped to a laboratory to perform the ^{14}C–TCE assay.

Groundwater Samples

Representative results for ^{14}C product accumulation in three of the groundwater samples are shown in Figure 1,

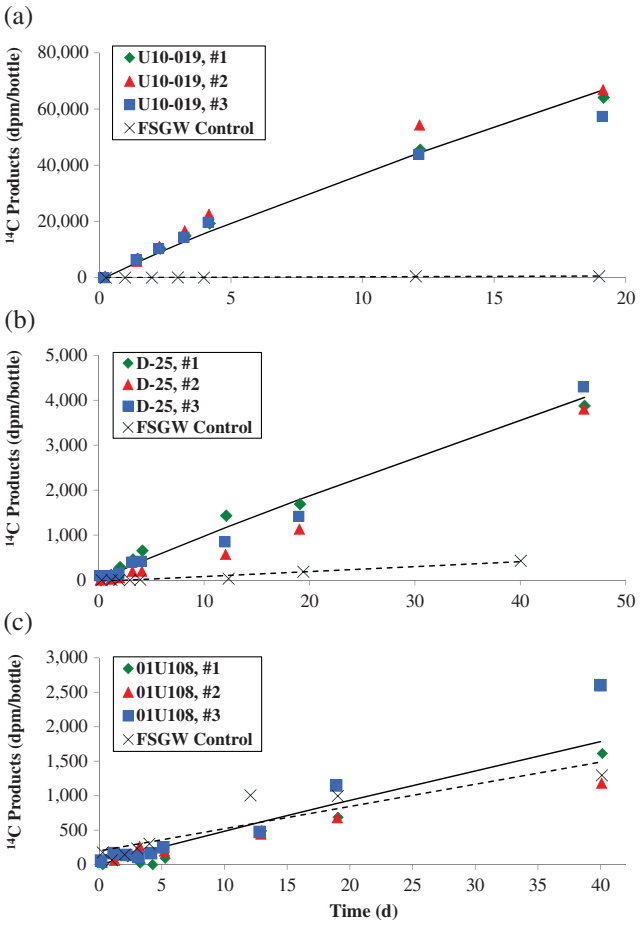

Figure 1. The solid line represents the experimental model fit used to determine k. The dashed line represents the fit to the FSGW controls. The experimental data only capture several locations, including (a) Hill AFB, (b) Tooele Army Depot, and (c) TCAAP.

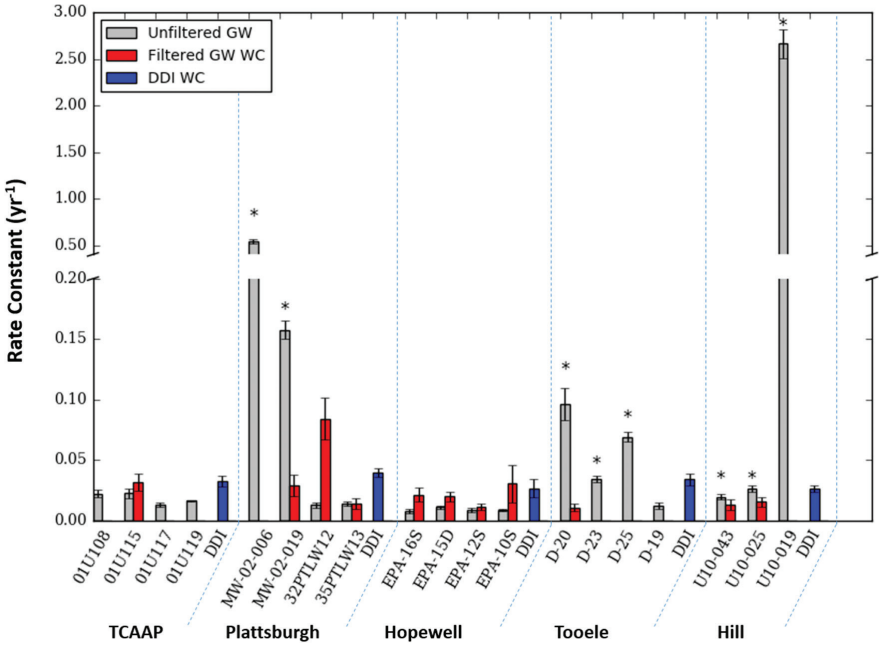

Figure 2. Average pseudo first-order rate constants for experimental groundwater samples (gray), FSGW controls (red), and DDI water controls (blue). Error bars represent the 95% CI. Asterisks indicate the groundwater samples that were statistically significant compared with their respective FSGW controls.

along with the corresponding FSGW controls; results for all of the samples are available in Mills IV (2017). The bottles presented in Figure 1 span a range of results, that is, a sample with a comparatively high rate constant ($k = 2.65\,\text{year}^{-1}$; Figure 1a); a sample with a relatively low rate constant ($k = 0.059\,\text{year}^{-1}$; Figure 1b); and a sample for which there was no statistically significant difference between the groundwater and FSGW control (Figure 1c).

Overall results for the rate constants are shown in Figure 2. Two of the four samples from Plattsburgh, three of four for Tooele, and three of three from Hill AFB had statistically significant rates at 95% CI. None of the samples from TCAAP or Hopewell were statistically significant. Table 1 presents the statistically significant net rates and half-lives.

The rate constants determined in this study, 0.0066 to $2.65\,\text{year}^{-1}$, are conservative compared to literature values. The co-oxidation of TCE in the presence of primary substrates has been extensively studied using pure and mixed cultures (Alvarez-Cohen and Speitel Jr 2001; Field and Sierra-Alvarez 2004). First-order rate constants range from 1.72×10^3 to $2.16 \times 10^6\,\text{year}^{-1}$ (Folsom et al. 1990; Alvarez-Cohen and McCarty 1991; Oldenhuis et al. 1991; Landa et al. 1994; Chang and Alvarez-Cohen 1996; Shurtliff et al. 1996; Kelly et al. 2000). In addition, a review article summarized laboratory and in-situ first-order rate constants for the aerobic co-oxidation of TCE, ranging from 8.76 to $6.02 \times 10^2\,\text{year}^{-1}$ (Suarez and Rifai 1999). The higher literature values are likely a consequence of the treatment conditions. In this study, only groundwater was used, which contains fewer organisms than samples containing groundwater and soil samples or inoculum from pure or mixed cultures grown in BSM.

The goodness of fit of the model to the data is indicated by the relatively small 95% CI. For several of the groundwater samples, the model overpredicted at the final data points (~day 40). This may have been a consequence of the

Table 1

Net Pseudo First-Order Rate Constants and Half-Lives Based on Groundwater Samples and FSGW Controls

Site Location	Well	Groundwater k (year^{-1})	Control k (year^{-1})	Net k (year^{-1})	$t_{1/2}$ (year)
Plattsburgh	MW-02-006[1]	0.540 ± 0.024	0.029 ± 0.009	0.511 ± 0.042	1.4 ± (1.3, 1.5)
Plattsburgh	MW-02-019	0.158 ± 0.007	0.029 ± 0.009	0.129 ± 0.014	5.4 ± (4.8, 6.1)
Tooele	D-20	0.096 ± 0.013	0.011 ± 0.003	0.085 ± 0.013	8.1 ± (7.0, 9.6)
Tooele	D-23[1]	0.035 ± 0.003	0.011 ± 0.003	0.024 ± 0.004	29 ± (25, 35)
Tooele	D-25[1]	0.069 ± 0.004	0.011 ± 0.003	0.059 ± 0.005	12 ± (11, 13)
Hill	U10-043	0.020 ± 0.002	0.013 ± 0.004	0.0066 ± 0.0047	105 ± (62, 364)
Hill	U10-025	0.026 ± 0.002	0.015 ± 0.004	0.011 ± 0.004	62 ± (44, 104)
Hill	U10-019[1]	2.667 ± 0.153	0.015 ± 0.004	2.652 ± 0.138	0.3 ± (0.2, 0.3)

[1]Denotes that the groundwater used in the FSGW control came from a different well. The FSGW controls used to determine net rates are found in Figure 2.

microbes running out of the cell resources needed to sustain the oxygenases (e.g., reducing power), and/or a cumulative toxicity effect caused by reactive byproducts from TCE co-oxidation (Alvarez-Cohen and Speitel Jr 2001). In other bottles, the model overpredicted early on; the lag in product accumulation may have reflected a lag in activity in response to the low temperature used during shipment.

Initially, only DDI water controls were used to assess background levels of ^{14}C product accumulation. Given the high purity of the ^{14}C–TCE added to the bottles, no accumulation was expected. However, statistically significant rates were observed, at an overall average of $3.15\times10^{-2}\pm4.82\times10^{-3}$ year^{-1}. A possible reason for degradation of ^{14}C–TCE in the DDI controls was the radiolysis of water molecules, which occurs when the energy emitted from the radioactive material results in formation of free radicals that degrade the radioactive material itself (Lappin and Temple 2006; Heys et al. 2009). The DDI water lacks any compounds other than TCE that could quench the radicals. In contrast, there was no accumulation of ^{14}C products in the BSM controls. BSM contains bicarbonate buffer and organics (nitriloacetic acid, to chelate metals) that are effective in scavenging free radicals (Crittenden et al. 2012).

The overall average rate of ^{14}C product accumulation in the FSGW controls was $1.96\times10^{-2}\pm5.02\times10^{-3}$ ye ar^{-1}, after removing one FSGW control (32PTLW12) that was an outlier (Figure 2), as demonstrated in Appendix S11. This was significantly lower than in the DDI controls ($p<0.02$). There are some exceptions, including the FSGW bottles from 32PTLW12 and EPA-10S (Figure 2). Nevertheless, the overall rate constants for FSGW controls were lower than for DDI water. The groundwater likely contained compounds (including carbonates) that quenched the free radicals formed during release of energy from decay of the ^{14}C–TCE.

Use of the FSGW controls made it possible to improve the sensitivity of the assay, allowing for detection of TCE co-oxidation at rates even lower than what was measured in the preliminary samples from Twin Lakes Recreation Area. This was of consequence for water samples from wells U10-043 and U10-025 at Hill and D-23 at Tooele. Rate constants for these groundwater samples are not statistically different from the DDI controls but they are different from the FSGW controls at 95% CI. It should be noted that not all of the groundwater samples had accompanying FSGW controls because the FSGW samples were tested as an afterthought, once the greater extent of autoradiolysis in the DDI water controls was established. Therefore, there was insufficient additional groundwater to run FSGW controls for each well. For future applications of this assay, use of FSGW controls is recommended instead of DDI water controls.

$^{14}CO_2$ + ^{14}C–NSR and VOCs

For the eight groundwater samples that exhibited statistically significant accumulation of ^{14}C products, additional testing was performed at the end of the monitoring period to determine the percentage of $^{14}CO_2$ and ^{14}C–NSR that formed. Based on barium precipitation, $^{14}CO_2$ ranged from 37% to 97%, with the balance consisting of ^{14}C–NSR (Figure 3). Similar results were obtained based on the difference between alkaline and acidic sparging (Appendix S7); there was no significant difference in the two analyses (Student's paired *t*-test, $p=0.39$). In samples from the propanotrophic culture, $^{14}CO_2$ increased with increasing cell density. Since this is a mixed culture, presumably members of the community were able to mineralize the products from the initial monooxygenase reaction.

The composition of the NSR was not evaluated, but likely included products that form from abiotic hydrolysis of the product from an oxygenase attack on TCE, including glyoxylate, oxalate, formate, and trichloroacetic acid (Newman and Wackett 1991, 1995; Li and Wackett 1992; Arp 1995; Arp et al. 2001; Whittaker et al. 2013). In mixed cultures, these compounds are further oxidized. Apparently, the groundwater samples and propanotrophic culture did not contain the appropriate community of microbes, or they

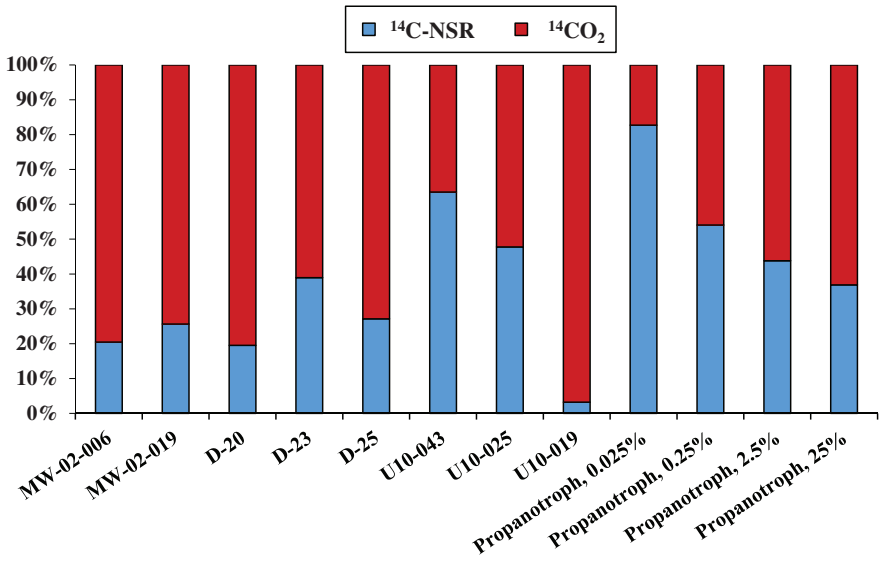

Figure 3. Characterization of the ^{14}C–labeled products measured at the end of the incubation period, based on the percentage of products recovered as $^{14}CO_2$ and ^{14}C–NSR. Only samples with statistically significant net rate constants were evaluated.

were not present in sufficient numbers, to achieve complete mineralization.

VOCs were evaluated at time zero and at the end of the incubation period. Plattsburgh MW-02-006 had the highest number of non-TCE peaks (nine). The peaks decreased or disappeared by the end of the incubation period. Groundwater from this well had the second highest rate constant (Figure 2, Table 1). Groundwater from Plattsburgh MW-02-009 had two appreciable non-TCE peaks and this groundwater also had a statistically significant rate constant. In groundwater samples from the two Plattsburgh wells with no significant accumulation of ^{14}C products, VOCs other than TCE were not detected, suggesting that VOCs played a role in co-oxidation at this site. Nevertheless, VOCs other than TCE were not detected in the other six groundwater samples with statistically significant rates. Two relatively minor non-TCE VOCs were detected in one of the groundwater samples from Hopewell (EPA-16S), although none of the Hopewell samples had statistically significant rates.

The results provided compelling evidence for co-oxidation of TCE in eight of the 19 groundwater samples tested. It is not yet known what drove the process. Use of TCE as a sole carbon and energy source has not been reported, despite many years of searching. For co-oxidation to occur, cells must be present that have oxygenase enzymes and/or they are consuming primary substrate that results in expression of oxygenases. A wide variety of primary substrates support co-oxidation of TCE (Alvarez-Cohen and Speitel Jr 2001). VOCs in the Plattsburgh and Hill samples may have fulfilled this role, although VOCs other than TCE were not detected in samples from Toole (Table S1 in Appendix S1). Methane and ethene, which both support co-oxidation of TCE, were absent. Most of the VOCs eluted after TCE, which is when aromatic compounds appear. However, they were not identified. In other samples, co-oxidation occurred without any VOCs present, suggesting that some other primary substrate was available. This might include aromatic compounds found in humic acids and other components of natural organic matter found in groundwater. Humic acids have been shown to act as a primary substrate in the co-oxidation of other organic compounds (Tang et al. 2017). However, the use of natural organic matter as a primary substrate to support co-oxidation of TCE has not been demonstrated. Additional research is needed to determine the primary substrates that sustain naturally occurring co-oxidation of TCE in groundwater.

An addition to the assay that is worthy of consideration is use of negative controls, that is, for samples that test positive for apparent cometabolic activity, additional samples could be subjected to treatments that inhibit aerobic cometabolism. This includes incubation of the samples in the absence of oxygen, as well as use of inhibitors that target oxygenases (e.g., acetylene, 1-pentyne, and phenylacetylene). Negative controls could further support the conclusion that the degradation activity was a consequence of aerobic cometabolism.

There was a reasonable agreement between the rate constants for co-oxidation of TCE and the abundance of bacteria that reacted to EAPs for oxygenase enzymes or had DNA that was amplified by qPCR probes for oxygenase enzymes. Primary data on the abundance to total bacteria and bacteria reacting to EAPs for oxygenase enzymes, and the abundance of DNA that is amplified by primers for oxygenase enzymes, are available in Wiedemeier et al. (2017). A manuscript describing the association between the rate constants and the microbial markers is in preparation.

Extrapolation of Laboratory Rate Constants to Field Scale Plumes

Geochemical gradients in contaminated aquifers can be sharp (Meckenstock et al. 2015). As a result, the screened interval of a monitoring well can supply groundwater with dissolved oxygen where aerobic co-oxidation is plausible and groundwater that is devoid of oxygen where aerobic co-oxidation cannot occur. If a significant portion of the TCE is in groundwater that is devoid of oxygen, it is not appropriate to use the rate constant from the ^{14}C assay for aerobic co-oxidation to describe the behavior of the field scale plume. If the co-oxidation process is carried out by bacteria located at the interface between the aerobic groundwater and anaerobic groundwater, it is possible that the rate constant is controlled by mass transfer processes for dissolved oxygen from the aerobic portions of the aquifer and a primary substrate from the anaerobic portion of the plume (Meckenstock et al. 2015). In either case, the rate constant from the laboratory ^{14}C assay would not describe the field scale plume.

The groundwater sampled from wells U10-019 at Hill AFB, and wells MW-02-006 and MW-02-019 at the former Plattsburgh AFB has the highest rate constants for TCE co-oxidation (Table 1). The water from these wells also had detectable concentrations of Iron (II) (Table S2 in Appendix S1), indicating that some of the flow to the wells was water that was devoid of dissolved oxygen. It would not be appropriate to use the rate constants from the ^{14}C assay to predict the behavior of TCE in these plumes, unless or until it can be shown that the TCE is associated with groundwater that has oxygen available for aerobic co-oxidation, and that the substrate for co-oxidation is uniformly distributed in the contaminated plume.

Conclusions

The ^{14}C–TCE assay allowed for quantification of pseudo first-order rate constants in groundwater samples from 8 of the 19 wells evaluated, at rates ranging from 0.0066 to 2.65 $year^{-1}$. This translates to half-lives of 0.26 to 105 years. In groundwater from the other 11 wells, the rate of ^{14}C product accumulation was not statistically different from the FSGW controls at 95% CI, so that no rate is reported. Although only a single GC column was used for purification of the ^{14}C–TCE, the level of impurities delivered to the serum bottles was sufficiently low to allow for detection of a half-life as long as 105 years. As a means to reduce cost and improve turn-around times for the assay, it may be possible to shorten the duration of the assay to less than 5 days. A shorter assay duration would also mitigate the effect of deviating from native conditions.

It is important to note that pseudo first-order rate constants that were extracted in this study are site specific. Because the constants are not normalized, they should not be applied to

model other sites. The ^{14}C assay is offered as a well-documented procedure that uses a short-term laboratory study done with groundwater samples from a site to provide a rate constant for TCE co-oxidation in a groundwater plume at the site. The rate constant can provide a second line of evidence for natural attenuation at sites where MNA is under consideration as a remedy or a component of a remedy for the site.

The protocol developed for this study may be used to determine if aerobic cometabolism contributes to natural attenuation of TCE. This is especially relevant when monitoring data indicate TCE is attenuating at a higher rate than can be explained by dilution alone, yet a mechanism to explain these observations is lacking. It is conceivable that the assay may yield false negatives, due to lower rates of activity in the laboratory versus the field caused by factors such as sample handling and the absence of soil (and therefore a lower level of microbes) as part of the assay. However, the assay was able to detect activity corresponding to half-lives in excess of 100 years, corresponding to low first order rates of cometabolism.

Use of ^{14}C–TCE poses challenges. The assay is limited to laboratories that can safely handle radioactive material and the cost for custom-synthesized material is appreciable. Nevertheless, use of ^{14}C provides definitive evidence for the occurrence of biotic activity via the accumulation of labeled products. Furthermore, use of ^{14}C–TCE allows for measurement of rates in a reasonable time-frame that are considerably lower than what is feasible using unlabeled TCE. While compound specific isotope analysis avoids some of the challenges posed by using ^{14}C–TCE, it is difficult to establish enrichment of $\delta^{13}C$-TCE in dilute plumes at low rates of cometabolism.

$^{14}CO_2$ constituted most of the ^{14}C product quantified, followed by ^{14}C–NSR. This indicated that the groundwater samples that exhibited co-oxidation of TCE contained microbes with the ability to mineralize most of the products formed from the initial oxygenase attack on the compound within the short period of time that was available in the assay. Although the composition of the NSR was not evaluated in this study, procedures to evaluate the NSR are well established (Darlington et al. 2008).

Supporting Information

The following supporting information is available for this article:

Appendix S1. Concentration of TCE, presence of other VOCs, concentrations of dissolved oxygen and iron (II), and pH at site locations.

Appendix S2. Preparation of the ^{14}C–TCE stock solution and other chemicals.

Appendix S3. Method for adding ^{14}C–TCE to groundwater samples.

Appendix S4. Impurities in the ^{14}C–TCE Stock Solution.

Appendix S5. Sparging to remove residual ^{14}C–TCE in alkaline 3.0 mL samples.

Appendix S6. Experimental sampling procedure.

Appendix S7. Acid sparging method to determine $^{14}CO_2$ and ^{14}C–NSR.

Appendix S8. Protocol for determining *k*.

Appendix S9. Results for positive controls.

Appendix S10. Effect of storage conditions on the rate of ^{14}C product accumulation.

Appendix S11. Outlier identification for the FSGW controls.

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Biographical Sketches

James C. Mills IV, *M.S., Department of Environmental Engineering and Earth Sciences, Clemson, SC 29634; Present address: Geosyntec Consultants, 13101 Telecom Dr #120, Temple Terrace, FL 33637; jcmills@g.clemson.edu*

John T. Wilson, *Ph.D., Cornell University, Principal Scientist with the Scissortail Environmental Solutions LLC, Ada, OK 74821; john@scissortailenv.com*

Barbara H. Wilson, *M.S., M.P.H., University of Oklahoma, Managing Member and Scientist with the Scissortail Environmental Solutions LLC, Ada, OK 74821; barbara@scissortailenv.com*

Todd H. Wiedemeier, *Deceased.*

David L. Freedman, *Ph.D., corresponding author, Cornell University, Professor and Department Chair, Department of Environmental Engineering and Earth Sciences, Clemson University, Clemson, SC 29634; dfreedm@clemson.edu*