VIA ELECTRONIC MAIL

February 18, 2022

Karen A. Cahill
Division of Environmental Remediation
New York State Department of Environmental Conservation
Region 7
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Subject: MW-5-40 *In Situ* Remediation Status Report #1
Former Emerson Power Transmission, Ithaca, New York

Dear Karen:

On behalf of Emerson Electric Co., WSP USA Inc. has prepared this *In Situ* Remediation Status Report #1 (Status Report) for the remediation of groundwater in the area of monitoring well MW-5-40 located in Operable Unit 1 (OU-1) at the former Emerson Power Transmission (EPT) site in Ithaca, New York (Site; Figure 1). The *in situ* Remediation Work Plan (Work Plan) was implemented in accordance with the New York State Department of Environmental Conservation's (NYSDEC) conditional approval letter, dated November 5, 2020.

On March 18, 2018, NYSDEC requested that *in situ* treatment be considered to reduce elevated levels of chlorinated volatile organic compounds (CVOCs) remaining at monitoring well MW-5-40. In a letter dated April 25, 2019, WSP responded to this request and proposed completing a focused evaluation of MW-5-40. The *in situ* remediation fieldwork was completed between May 20 and May 22, 2021. Subsequently, groundwater samples were collected from the MW-5-40 area in June, August, and September to evaluate the i*n situ* Remediation progress. This Status Report provides a summary of the completed field activities, field observations, results of groundwater monitoring, and recommendations with respect to the *in situ* remediation work.

IN SITU REMEDIATION

The Work Plan recommended the use of *in situ* treatment to enhance the natural attenuation processes. The *in situ* treatment was completed over three days between May 20 and May 22, 2021. The implemented injection schedule is provided in Table 1. In summary, sodium lactate (60% by weight), a fermentable electron donor, nutrients (nitrogen and phosphorus), pH buffer (sodium bicarbonate), and a microbial augment containing DHC were diluted with deoxygenated potable water (i.e, using sodium ascorbate) and injected directly into MW-5-40. The Work Plan objectives were based on delivering amendment throughout the nearby fractured bedrock and achieving a fermentable carbon concentration of 1,500 mg/l and a DHC abundance of 1.00×10^7 cells per liter in that formation, at an injection rate between 0.5 and 5 gallons per minute (gpm). The average injection rate during the 3 days was 0.4 gpm, 0.1 gpm below the target injection rate. The dose of nutrients and buffer were based on ratios to the fermentable carbon. The total amendment fluid volume injected into the subsurface was approximately 451 gallons.

Amendments were mixed in several small batches and delivered through an inflatable packer installed in MW-5-40 at the water table under minimum pressure. The maximum injection pressure was limited to a maximum of 95 pounds per square inch. The

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groundwater extraction system was shut down approximately 1 week prior to commencement of the injection program and restarted approximately 4 weeks after completion of the injection program; the vapor extraction system remained in operation.

IN SITU REMEDIATION OBSERVATIONS

During injection, groundwater elevations and geochemical parameters were monitored in the nearby monitoring wells MW-5-25B, MW-5-100, MW-8B, MW-12C, MW-13C, MW-15C, MW-46-43C, and MW-46-72C. YSI EXO Multiparameter Water Quality Sondes were deployed in each of these monitoring wells to gather the appropriate information. In addition, Outfall 001 and Seeps 1 through 3 were monitored. These monitoring wells and locations were measured for elevation, dissolved oxygen, oxidation-reduction potential, total dissolved solids/specific conductance, pH, and temperature. In addition, discharge from Outfall 001 was monitored for pH, conductivity, and temperature before, during, and after injection, and Seeps 1 through 3 were observed for notable changes in flow.

During the MW-5-40 amendment delivery changes in groundwater evaluations and total dissolved solids/specific conductance were observed in MW-46-43C that directly correspond with the injection timeframes. Groundwater elevations and geochemical parameter changes were not observed in any other monitoring well locations, Outfall 001, or Seeps 1 through 3. The changes in groundwater elevations are shown in Figures 2A and 2B and total dissolved solids are shown in Figures 3A and 3B. In addition, precipitation rates were tracked between May 14 and May 28 to verify that rainfall did not impact changes in groundwater during the injection. The precipitation data is provided in Table 2.

GROUNDWATER MONITORING RESULTS

Groundwater samples were collected from the MW-5-40 area in June, August, and September to evaluate the i*n situ* treatment progress in the injection well. On June 22 and 23, 2021 CVOC samples and microbial data were collected, on August 25, 2021, an additional round of microbial data was collected, and on September 21 and 22, 2021 CVOC samples and general chemistry samples were collected. The historical CVOC data including the two recent sampling events are provided in Table 3, the microbial data are provided in Table 4, and the compound-specific isotope analysis (CSIA) and general chemistry data are provided in Table 5. Samples were mainly collected from the MW-5-40 monitoring well however since there were groundwater changes in MW-46-43C, CVOC and general chemistry samples were collected from this monitoring location.

DAUGHTER PRODUCTS

Each of the daughter products has been detected in groundwater samples collected from MW-5-40 (Table 3). The origin of these breakdown products can be confirmed to be biological by examining the accumulation of dichloroethene (DCE) isomers. When trichloroethene (TCE) is biodegraded reductively, it forms cis-1,2-dichloroethene (cis-DCE) and trans-1,2-dichloroethene (trans-DCE) at a ratio of greater than 4 to 1, while a proportionally lower cis-DCE concentration would indicate non-biological processes. On average, the cis isomer is present at 98% of the total DCE concentration (Table 3). The predominance of cis-DCE compared to trans-DCE provides strong evidence of the biological origin of the breakdown products as opposed to being a component of the original CVOC release.

In the MW-5-40 injection well, TCE decreased from 1,460 µg/L on March 24, 2021 (pre-in situ remediation) to 55 µg/L on June 23, 2021, and rebounded slightly to 287 µg/L on September 21, 2021. Cis-DCE decreased from 8,600 µg/L on March 24 to 8,370 µg/L on June 23 and increased to 10,900 µg/L on September 21. Trans-DCE decreased from 327 µg/L on March 24, decreased again to 158 µg/L on June 23, and then further decreased to 40 µg/L on September 21. Vinyl chloride (VC) increased from 1,280 µg/L on March 24 to 2,400 µg/L on June 23 and then decreased to 1,580 µg/L on September 21. The decreases in TCE and increases in daughter products that include cis-DCE and VC could suggest degradation of TCE to daughter products.

In MW-46-43C a delayed decrease of TCE and cis-DCE was observed from June 22, 2021 to September 22, 2021. On June 22 TCE was 3,600 µg/L, however TCE was non-detect on September 22. On June 22 cis-DCE was 18,300 µg/L and then on September 22 cis-DCE was 6,740 µg/L. In addition, on June 22 VC was 1,890 µg/L and then on September 22 VC was 13,400 µg/L, indicating biodegradation of TCE and daughter products to VC.

Additional CVOC data is needed to evaluate the long-term effectiveness of the *in situ* remediation. Quarterly monitoring of the MW-5-40 and MW-46-43C monitoring wells will be completed in accordance with the draft interim Site Management Plan.

MICROBIAL ANALYSIS

Bio-Trap® samplers, a colonization matrix for microbes, were deployed in MW-5-40 and analyzed for a broad spectrum of different microorganisms and key functional genes involved in a variety of pathways for CVOC degradation in December 2019 to establish a baseline. Since the implementation of the Work Plan, a more targeted approach was implemented to analyze different microorganisms and key functional genes specifically related to the selected in situ remedy. Samples were collected on June 22, 2021, and August 25, 2021, to evaluate the microorganisms and key functional genes. The results are provided in Table 4.

Overall, the *in situ* remediation stimulated microorganism growth between the baselines results and one-month post-injection. For example, *Dehalococcoides* (DHC) increased from 10^5 cells per bead to 10^6 cells per bead and *Desulfuromonas* spp. (DSB) increased from 10^4 cells per bead to 10^5 cells per bead. DHC and DSB are key functional genes for the complete reduction of TCE to ethene. When comparing the baseline to both the June 22 and August 25 results, the August 25 results suggest that microbial populations have generally decreased to the baseline concentrations.

One more round of microbial data will be collected to confirm that microbial activities returned to baseline concentrations.

COMPOUND SPECIFIC ISOTOPE ANALYSIS AND GENERAL CHEMISTRY

COMPOUND SPECIFIC ISOTOPE ANALYSIS

CSIA is a direct method of assessing degradation along any pathway. Elements such as carbon, hydrogen, oxygen, and chlorine have more than one stable isotopic form which, when incorporated into compounds, can be characterized to determine information about the compound's degree of degradation and its source. As a compound degrades, its isotopic compositions change along with a known pathway, and CSIA measures isotopic ratios in either the reactant or the product to identify the occurrence and potentially the extent of degradation. Physical mechanisms of natural attenuation (e.g., dilution and sorption) do not significantly affect the isotopic signature of residual contaminants. Information on the use and interpretation of CSIA data can be found in the 2009 EPA Guide for Assessing Biodegradation and Source Identification of Organic Groundwater Contaminants Using CSIA.

Samples for CSIA were collected during the baseline event in December 2019, June 22, 2021, and September 22, 2021, and are provided in Table 5. The isotopic signature of TCE in the sample collected from MW-5-40 in December 2019 (-32.47 ‰) is similar to the fractionation range of commercial-grade TCE (-27.37 ‰ to -31.57 ‰) as reported by Shouakar-Stash et al., (2003)[1]. The June 22 results indicate the TCE results were -26.6 ‰, just outside the commercial grade range, however the September 22 result was -29.5 ‰ which is still within the range of commercial-grade TCE.

One or two more quarters of CISA data will be collected from MW-5-40 to evaluate the isotopic trends in this monitoring well.

GENERAL CHEMISTRY

Samples for general chemistry were collected from MW-5-40 during the baseline event in December 2019 and September 22, 2021, and are provided in Table 5. In addition, since groundwater observations occurred in MW-46-43C general chemistry samples were collected from this location on September 22 to compare with MW-5-40 and evaluate longer-term trends.

When comparing the dissolved gases that include carbon dioxide, methane, ethane, and ethene; there were increases in dissolved gas concentrations for all the dissolved gases from the baseline sampling event in December 2019 to June 22 and September 22 (post-injection). The increase in ethane and ethene is a direct indication of complete dechlorination of TCE. In addition, the increased methane provides a measure of electron donor wastage, methanogenesis is typically the process that consumes the majority of electron

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[1] Shouakar-Stash et. al. 2003. Stable hydrogen, carbon, and chlorine isotope measurements of selected chlorinated organic solvents. Journal of Contaminant Hydrology, Volume 60, Issue 3-4, pp 211-228.

donor. Elevated methane is usually unavoidable under reducing conditions. Likewise, elevated dissolved gas concentrations were observed in MW-46-43C.

In addition, samples were collected for Volatile Fatty Acids (VFA) to evaluate if residual sodium lactate in the form of lactic acid was present in the injection well. Total Organic Carbon (TOC) was also measured in June and September to compare with December 2019 baseline results. The September 22, VFA and TOC data, suggests all of the electron donor that was injected has been consumed.

One more round of general chemistry data will be collected to confirm that subsurface conditions have returned to baseline conditions.

RECOMMENDATION AND CONCLUSION

WSP recommends continuing with quarterly groundwater samples for CVOCs and the modification of the sampling plan to include:

- One more quarter of microbial data
- One or two more rounds of CSIA data
- One more quarter of general chemistry data

In accordance with the Work Plan, the effectiveness of the remedy will be gauged by the establishment of conditions that promote degradation along the sequential reductive pathway and ultimately a reduction in CVOC mass. The indicator parameters are as follows:

- Generation of sequential reduction degradation products, including ethane and ethene
- Decreasing CVOC mass
- DHC populations greater than 10^{-4}cells per milliliter
- Detection of vinyl chloride reductase or BAV1 vinyl chloride reductase functional genes
- TOC concentrations elevated above baseline
- Measurable isotopic fractionation

WSP will prepare a one-year post-injection report that will evaluate the overall effectiveness of the in situ remediation with respect to the established conditions listed above.

Sincerely,

Scott Haitz
Vice President, National Practice Lead

Jeffrey Baker
Lead Consultant

JRB:SPH
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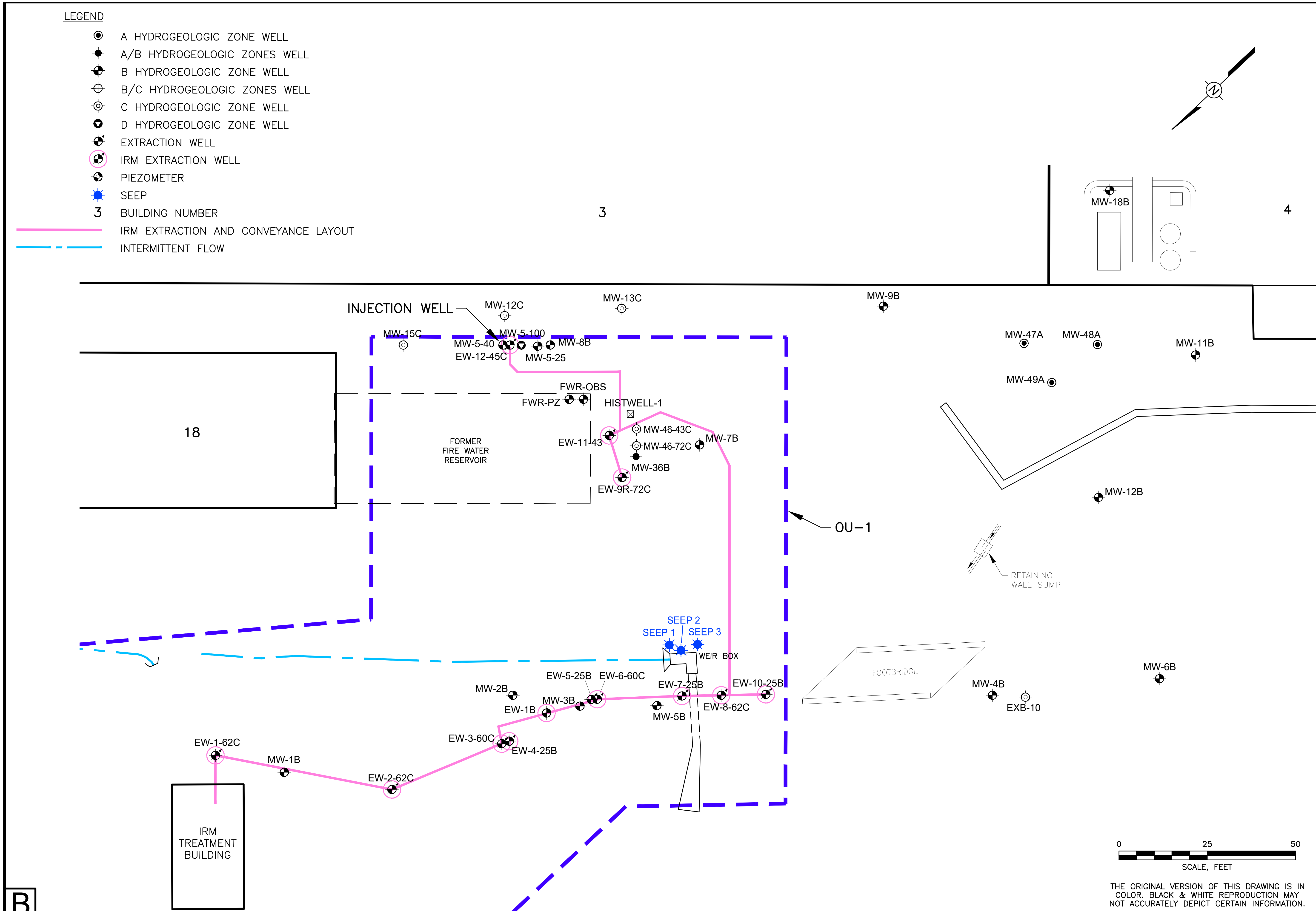
Encl.

cc: Stephen Clarke, Emerson (electronic copy)
Anthony Perretta, NYSDOH (electronic copy)

FIGURES



FORMER EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON
ST. LOUIS, MISSOURI

FIGURE 1

WELL AND PIEZOMETER LOCATIONS

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TEL: +1 412.604.1040

Drawn By: 08072020
Checked: 12022021
Approved:
Dwg Name: 314P1545.001-B22

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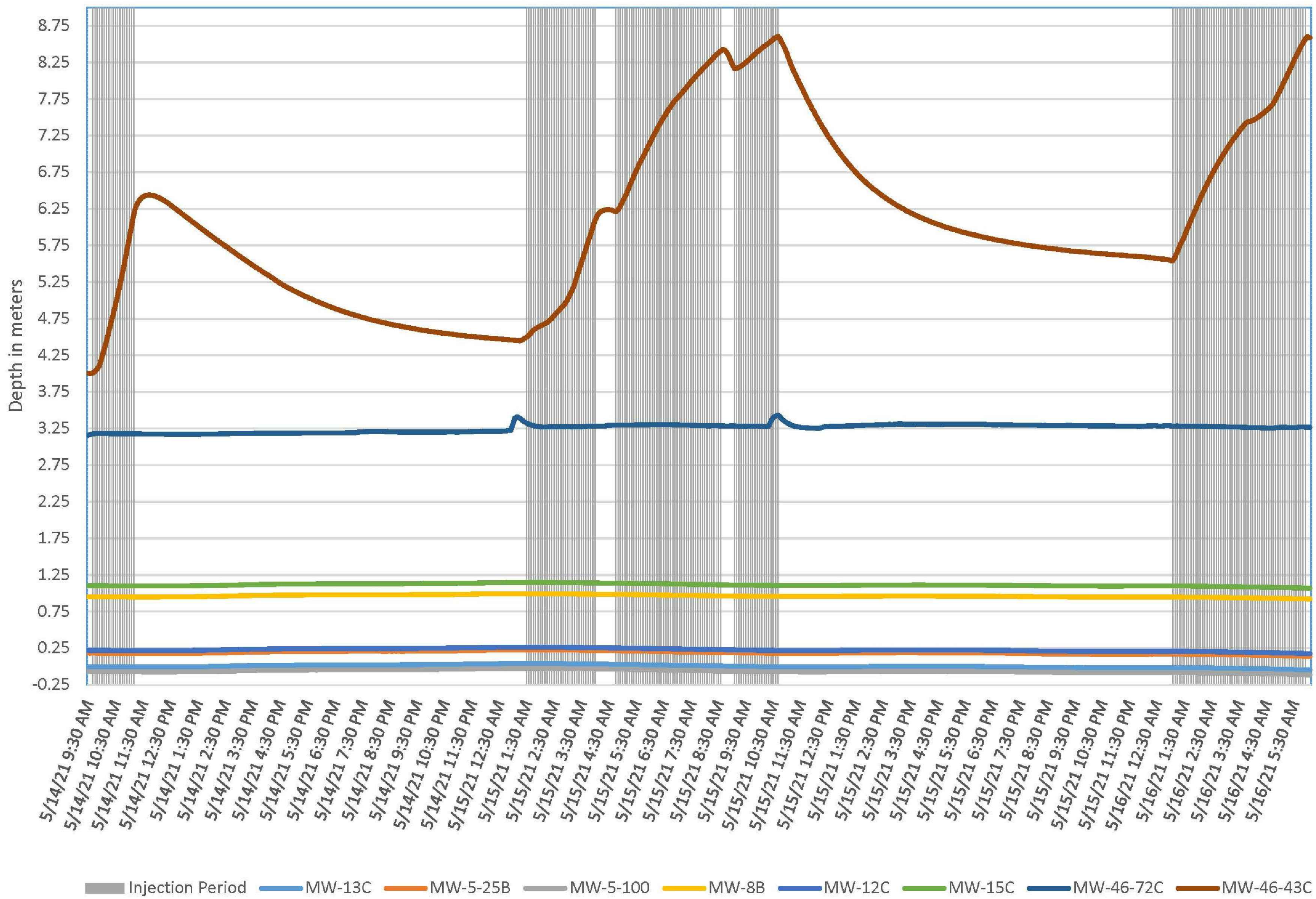

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FIGURE 2A

GROUNDWATER ELEVATIONS DURING INJECTIONS

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

Drawn By: EGC
Checked:
Approved: JRB 2/18/2022
DWG Name 314V1545.001–048

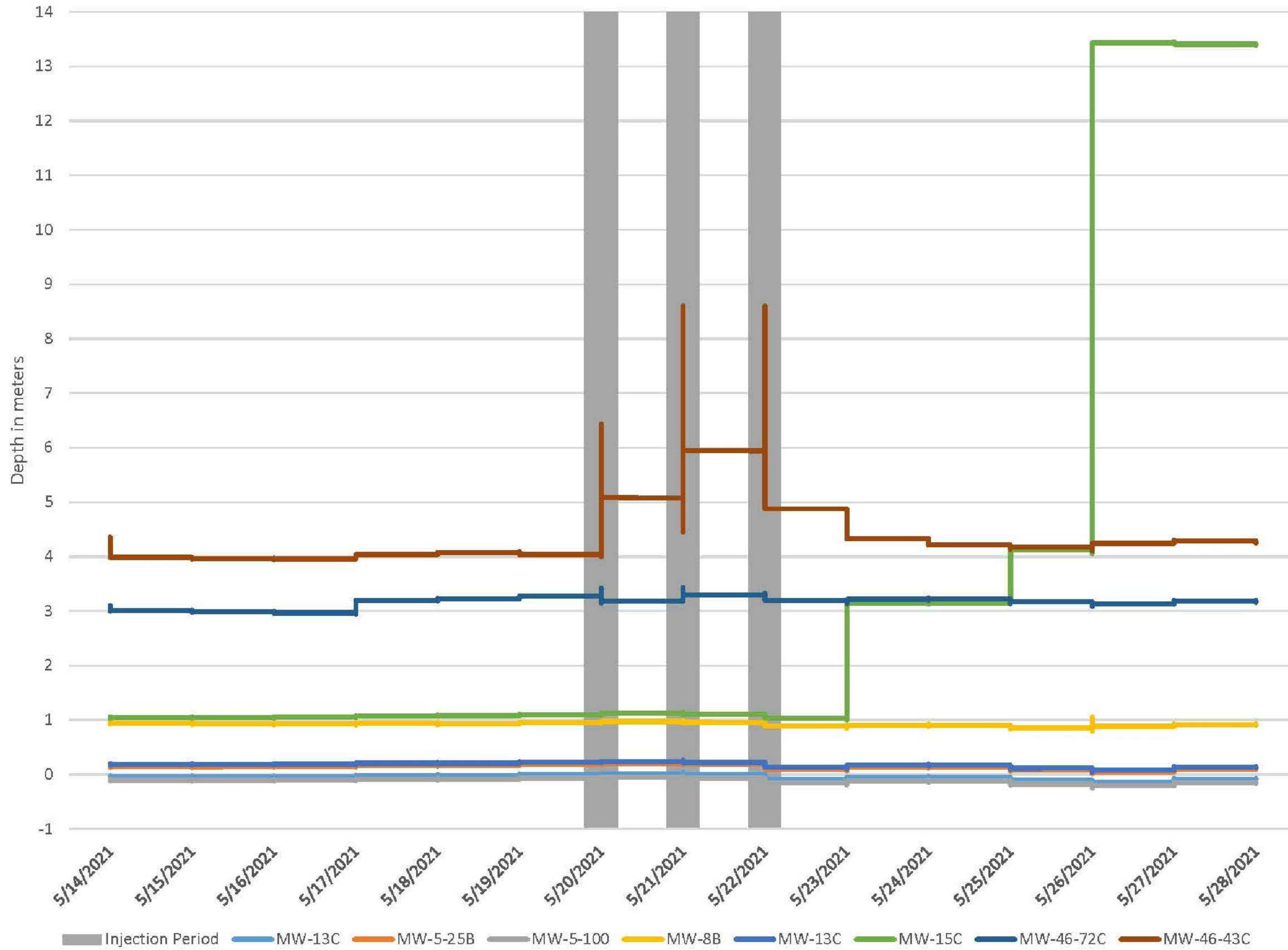

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FIGURE 2B

GROUNDWATER ELEVATIONS

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

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EMERSON POWER TRANSMISSION

Drawn By:	EGC
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Approved:	JRB 2/18/2022
DWG Name	314V1545.001–048

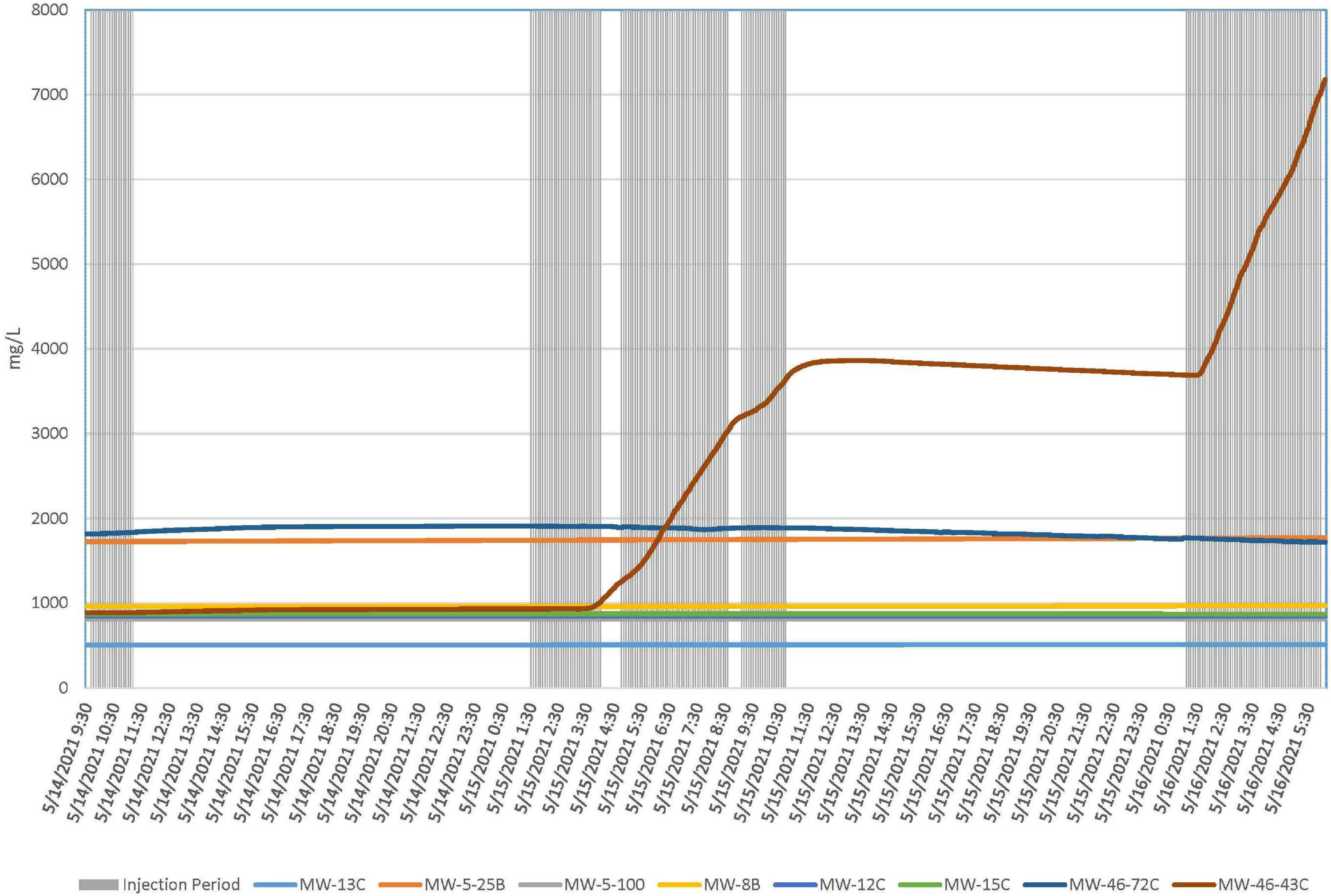

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FIGURE 3A

TOTAL DISSOLVED SOLIDS
DURING INJECTIONS

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

Drawn By: EGC

Checked:

Approved: JRB 2/18/2022

DWG Name 314V1545.001–048

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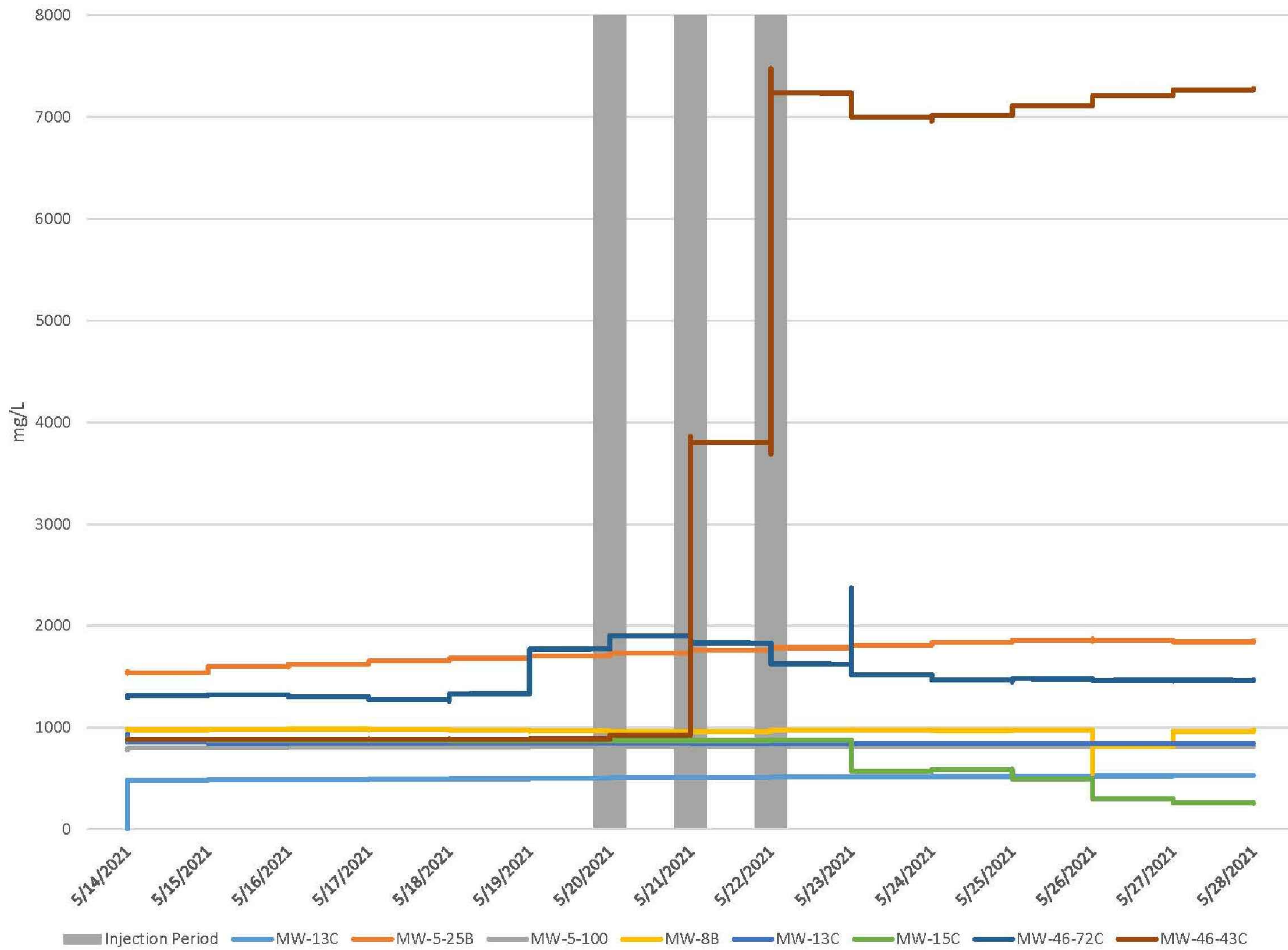

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FIGURE 3B

TOTAL DISSOLVED SOLIDS

EMERSON POWER TRANSMISSION
ITHACA, NEW YORK

PREPARED FOR
EMERSON POWER TRANSMISSION

Drawn By: EGC
Checked:
Approved: JRB 2/18/2022
DWG Name 314V1545.001–048

TABLES

Table 1

Injection Tracking Summary
***In Situ* Groundwater Remediation - MW-5-40**
Former Emerson Power Transmission Facility
Ithaca, New York

Date	Injection/Mix Batch (100 gal ea.)	Start Time	End Time	Duration (min)	*In Situ* Injection Amendments: Ammonium Sulfate (lbs)	Diammonium Phosphate (lbs)	Sodium Bicarbonate (lbs)	Terra Systems QRS™-SL (gal)	Terra Systems TSI-DC® (l)	Mix Water (gals)	Chase Water (gals)	Injection Parameters: Flowrate (gpm)	Packer Pressure (psi)	Injection Pressure (psi)	Packer Depth (ft btoc)	Notes
5/20/2021	1	16:15	17:50	95	4.3	0.7	4	6.6	0.75	66	-	0.7	150	90	28	Nitrogen leakage observed around packer; packer to to be reset 5/21 at higher pressure
	Day 1 SubTotal				**4.3**	**0.7**	**4**	**6.6**	**0.75**	**66**	-					
5/21/2021	1	8:10	9:10	60	0.8	0.1	0.7	1.6	0.25	12	-	0.2	175	95	30	Packer reset at lower fracture
	1	9:10	10:40	90	1.4	0.2	1.3	2.9	-	22	-	0.2	175	95	25	Packer reset at higher fracture
	2	11:25	15:15	230	6.5	1.0	6	6	0.75	100	-	0.4	175	95	25	
	3	15:42	17:20	98	3.3	0.5	3	3	-	25	-	0.3	175	95	25	
	3	17:20	--	--	9.8	1.5	9	9	-	75		--	0	0	25	Gravity delivery
	Day 2 SubTotal				**21.7**	**3.3**	**20**	**22.4**	**1**	**234**	-					
5/22/2021	4	7:43	12:36	293	13	2.0	12	11	1.25	100	5	0.3	175	95	25	5 gallons of chase water to fill casing added following completion of batch #4
	Day 3 SubTotal				**13**	**2.0**	**12**	**11**	**1.25**	**100**	5					
				Event Total	**39**	**6**	**36**	**40**	**3**	**400**	**5**					

Table 2

Precipitation Rates
Former Emerson Power Transmission
Ithaca, New York (a, b)

Date	Maximum Temperature	Minimum Temperature	Precipitation	Snowfall	Snow Depth
14-May	64	34	0	0	0
15-May	69	38	0	0	0
16-May	71	38	0	0	0
17-May	70	44	0.02	0	0
18-May	74	44	0	0	0
19-May	77	45	0	0	0
20-May	83	50	0	0	0
21-May	88	57	0	0	0
22-May	89	56	0	0	0
23-May	82	57	Trace	0	0
24-May	77	44	0	0	0
25-May	74	47	0	0	0
26-May	81	58	0.22	0	0
27-May	84	53	0.42	0	0
28-May	63	43	0	0	0
Sum			0.66	0	-

Data from https://www.nrcc.cornell.edu/wxstation/ithaca/ithaca.html

Table 3

Historical Groundwater Results
Former Emerson Power Transmission
Ithaca, New York (a, b)

Well ID	Sample Date	1,1-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	PCE	1,1,1-TCA	TCE	Vinyl Chloride	Total CVOCs (f)
Evaluation Criteria (c)		5	5	5	5	5	5	5	2	-
MW-5-40	4/1/09	1 U	22.0	12,000 D	92.0 DJ	2.0	1 U	11,000 D	510 D	23,626
	9/22/09	200 U	200 U	16,000	200 U	200 U	200 U	28,000 D	270	44,270
	4/7/10	1 U	23.2	13,400 D	177	3.6	1 U	6,540 D	390	20,534
	10/4/10	1 U	28.7	11,400	128	5.3	1 U	5,550	314	17,426
	3/25/11	1 U	5.7	18,000	111	2.7	1 U	6,390	774	25,283
	10/4/11	1 U	7.7 J	6,720 J	48.1 J	3.8	1 U	6,760 J	384 J	13,924
	3/28/12	1 U	11.2	10,200	89.1	4.0	1 U	6,600	314	17,218
	10/4/12	200 U	200 U	9,780	200 U	200 U	200 U	6,840	460	17,080
	4/3/13	1 U	21.6	8,470	149	2.5	1 U	4,050	452	13,145
	10/18/13	20 U	25.8	13,100	96.4	20.0 U	20 U	9,580	711	23,513
	3/27/14	50 U	50 U	10,900	101	50 U	50 U	6,080	657	17,738
	8/20/14	20 U	20 U	7,740	112	20 U	20 U	4,920	563 J	13,335
	3/11/15	0.58 J	20.2	6,820	151	3.0	1 U	2,320	565	9,880
	8/24/15	0.63 J	19.1	8,180	224	4.8	1 U	5,370	969	14,768
	4/12/16	20 U	17.7 J	12,700	237	20 U	20 U	1,550	1,140	15,645
	9/27/16	50 U	50 U	12,000 J	143	50 U	50 U	4,490	683	17,316
	3/28/17	25 U	22.5 J	12,300	192	25 U	25 U	4,430	505	17,450
	6/14/17	25 U	30.0	15,100	264	25 U	25 U	3,720	878	19,992
	9/26/17	100 U	47.3 J	19,000	284	100 U	100 U	4,600	939	24,870
	12/19/17	10 U	36.9	16,500	232	10 U	10 U	3,230	975	20,974
	3/20/18	50 U	29.6 J	15,400	270	50 U	50 U	2,500	1,190	19,390
	5/9/18	50 U	33.9 J	18,100	294	50 U	50 U	2,000	1,000	21,428
	8/29/18	50 U	50 U	16500	256	50 U	50 U	3,780	733	21,269
	12/12/18	50 U	50 U	13,600	176	50 U	50 U	2,630	909	17,315
	3/6/19	25 U	22.5 J	9,840	226	25 U	25 U	3,910	852	14,851
	6/19/19	0.75 J	27.1	11,400	247	1.8	1 U	3,040	979	15,696
	9/19/19	5 U	24.0	12,200	325	5 U	5 U	1,310	1,010	14,869
	12/10/19	25 U	25 U	4,640	18.6 J	25 U	25 U	49.8	164	4,872
	3/20/20	20 U	20.6	10,100	318	20 U	20 U	2,840	1,600	14,879
	5/14/20	20 U	20.6	9,130	233	20 U	20 U	2,790 J	884	13,058
	8/12/20	25 U	16.7 J	10,200	263	25 U	25 U	2,320	1,310	14,110
	12/17/20	10 U	6.9 J	3,760	133	10 U	10 U	1,020	1,150	6,070
	3/24/21	10 U	16.9	8,600	327	10 U	10 U	1,460	1,280	11,684
	6/23/21	20 U	21.1	8,370	158	20 U	20 U	54.6	2,400	11,004
	9/22/21	100 U	100 U	10,900	68.4	100 U	100 U	287	1,580	12,835
	% ND	91%	26%	0%	6%	71%	100%	0%	0%	0%
	Min D	0.58	5.7	3,760	18.6	1.8	NA	49.8	164	4,872
	Max D	0.75	47.3	19,000	327	5.3	NA	28,000	2,400	44,270
	Mean D	0.65	22.3	11,516	186.2	3.4	NA	4,629	842.7	17,180
	Trend	NA	NT - Stable	NT - Stable	Increasing	NA	NA	Decreasing	Increasing	Decreasing

Table 3

Historical Groundwater Results
Former Emerson Power Transmission
Ithaca, New York (a, b)

Well ID	Sample Date	1,1-DCA	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	PCE	1,1,1-TCA	TCE	Vinyl Chloride	Total CVOCs (f)
Evaluation Criteria (c)		5	5	5	5	5	5	5	2	-
MW-46-43C	*8/17/17*	50 U	50 U	***19,800***	***106***	50 U	50 U	***8,710***	***562***	29,178
	9/26/17	50 U	***30.3*** J	***17,900***	***112***	50 U	50 U	***7,900***	***589***	26,531
	12/19/17	25 U	***34.5***	***21,500***	***107***	25 U	25 U	***3,830***	***889***	26,361
	3/20/18	100 U	100 U	***16,200***	***96.5*** J	100 U	100 U	***8,470***	***987***	25,754
	5/8/18	50 U	***36.1*** J	***18,600***	***135***	50 U	50 U	***8,220***	***944***	27,935
	8/28/18	50 U	***41.1*** J	***29,700***	***173***	50 U	50 U	***9,900***	***1,260***	41,074
	12/12/18	100 U	100 U	***22,200***	***117***	100 U	100 U	***4,750***	***1,260***	28,327
	3/5/19	200 U	200 U	***24,200***	***155*** J	200 U	200 U	***6,720***	***1,250***	32,325
	6/19/19	25 U	***34.3***	***19,100***	***115***	25 U	25 U	***6,650***	***1,110***	27,009
	9/17/19	25 U	***52.8***	***25,700***	***148***	25 U	25 U	***5,140***	***1,740***	32,781
	12/10/19	50 U	***36.1*** J	***22,700***	***145***	50 U	50 U	***3,950***	***1,080***	27,911
	3/20/20	50 U	***38.1*** J	***22,300***	***136***	50 U	50 U	***5,340***	***1,490***	29,304
	5/13/20	100 UJ	100 UJ	***23,900***	***158*** J	100 UJ	100 UJ	***4,860*** J	***1,220*** J	30,138
	8/11/20	100 U	100 U	***25,200***	***143***	100 U	100 U	***4,140***	***1,650***	31,133
	12/17/20	50 U	***32.4*** J	***21,500***	***119***	50 U	50 U	***3,180***	***1,560***	26,391
	3/23/21	50 U	***37.7*** J	***25,200***	***115***	50 U	50 U	***4,370***	***1,590***	31,313
	6/22/21	25 UJ	***39.0*** J	***18,300*** J	***137*** J	25 UJ	25 UJ	***3,600*** J	***1,890*** J	23,966
	9/22/21	100 U	100 U	***6,740***	***85.1*** J	100 U	100 U	100 U	***13,400***	20,225
	% ND	*100%*	*38%*	*0%*	*0%*	*100%*	*100%*	*6%*	*0%*	*0%*
	Min D	*NA*	*30.3*	*6,740*	*85.1*	*NA*	*NA*	*3,180*	*562*	*20,225*
	Max D	*NA*	*52.8*	*29,700*	*173*	*NA*	*NA*	*9,900*	*1,890*	*41,074*
	Mean D	*NA*	*37.5*	*21,152*	*127.9*	*NA*	*NA*	*5,866*	*1,915*	*28,759*
	Trend	*NA*	*NT - Stable*	*NT - Stable*	*NT - Stable*	*NA*	*NA*	*Decreasing*	*Increasing*	*NT - Stable*

a/ Select constituents are presented above. For duplicate samples, the highest concentration of the duplicate and original sample is listed. When completing the Mann-Kendall trend test, all non-detects were set to a common value lower than any of the detected values.

b/ All results are reported in micrograms per liter (µg/l). DCA = dichloroethane; DCE = dichloroethene; PCE = tetrachloroethene; TCA = trichloroethane; TCE = trichloroethene; VOCs = volatile organics compounds; "%" = percent; ND = non-detect; min D = minimum detection; max D = maximum detection; NT = no trend; NT - Stable = No trend and the coefficient of variation is less than 1; NA = not applicable; ID = identification; U = analyte not detected above Reporting Limit; J = estimated concentration below the Reporting Limit and greater than or equal to the Method Detection Limit; D = concentration is from a secondary dilution analysis; UJ = non-detects with estimated quantitation limits due to failed quality control sample calibration(s) for that analyte; UR = The quality control associated with the analyte indicates uncertainty with the reported limits (spike/surrogate failed the recovery limits). **Bolded italic concentrations exceed**

c/ Evaluation criteria are the New York State Ambient Water Quality Standards or Guidance Values for Class GA groundwater provided in the New York State Department of Environmental Conservation Division of Water Technical and Operational Guidance Series (1.1.1), dated June 1998, and the April 2000 Addendum.

d/ Abandoned wells.

e/ EXB-2 has been converted to extraction well EW-12-45C.

f/ Total CVOCs only include the 8 site related CVOCS that include 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, PCE, 1,1,1-TCA, TCE, and vinyl chloride.

Table 4

***In Situ* Microbe Study**
Former Emerson Power Transmission
Ithaca, New York (a)

Sample ID:	MW-5-40	MW-5-40	MW-5-40	MW-5-40
Event:	Baseline	1st Round	2nd Round	2nd Round
Sample Date:	12/10/2019	6/22/2021	8/25/2021	9/22/2021
PLFA				
Total Biomass (cells/bead)	4.74E+05	-	6.95E+06	-
Firmicutes/TerBrSats (% total PLFA)	3.76%	-	9.50%	-
Proteobacteria/Monos (% total PLFA)	69.28%	-	49.99%	-
Anaerobic metal reducers/BrMonos (% total PLFA)	1.04%	-	16.69%	-
SRB/Actinomycetes/MidBrSats (% total PLFA)	0.53%	-	1.32%	-
General/Nsats (% total PLFA)	21.71%	-	22.31%	-
Eukaryotes/polyenoics (% total PLFA)	3.67%	-	0.19%	-
Slowed Growth (ratio cy/cis)	0.10	-	0.29	-
Decreased Permeability (ratio trans/cis)	0.21	-	0.14	-
CENSUS (cells/bead)				
Dehalococcoides (DHC)	1.28E+05	5.44E+06	-	3.04E+04
tceA Reductase (TCE)	2.38E+03	3.79E+05		1.81E+02
bvcA Reductase (BVC)	2.23E+04	3.24E+05		3.15E+03
vcrA Reductase (VCR)	2.22E+03	2.05E+05		3.20E+02
Dehalobacter (DHBt)	3.36E+04	1.02E+06		4.15E+04
Desulfuromonas (DSM)	1.69E+05	1.61E+05		4.97E+04
Sulfate Reducing Bacteria (APS)	3.61E+05	5.07E+06		1.55E+05
Dehalobacter DCM (DCM)	2.50E+02 U	1.67E+01 U		1.38E+03
Dehalobium chlorocoercia (DECO)	2.50E+02 U	2.37E+04		5.75E+02
Dehalogenimonas spp. (DHG)	2.50E+02 U	1.15E+05		2.50E+02 U
Desulfitobacterium spp. (DSB)	4.42E+04	5.68E+05		4.90E+04
Total Eubacteria (EBAC)	4.99E+07	1.94E+08		2.03E+07
Ethene Monooxygenase (EtnC)	3.21E+03	1.28E+03		9.42E+02
Epoxyalkane Transferase (EtnE)	2.50E+02 U	4.81E+03		4.36E+03
Methanogens (MGN)	7.05 E+01 J	1.42E+04		4.83E+02
PCE Reductase (PCE-1)	1.23E+04	5.14E+04		1.95E+03
PCE Reductase (PCE-2)	8.27E+04	1.07E+05		2.85E+04
Phenol Hydroxylase (PHE)	3.56E+04	1.19E+05		1.18E+05
Toluene Monooxygenase 2 (RDEG)	2.50E+02 U	9.88E+04		5.03E+02
Toluene Monooxygenase (RMO)	2.50E+02 U	2.12E+04		2.25E+04
Trichlorobenzene Dioxygenase (TCBO)	2.50E+02 U	1.12E+03		2.50E+02 U
Toluene Dioxygenase (TOD)	6.11E+03	1.67E+01 U		9.57E+03

a/ J = estimated gene copies below Practical Quantitation Limit (PQL) but above Lower Quantitation Limit (LQL);
U = not detected

Table 5

In Situ CSIA and General Chemistry Data
Former Emerson Power Transmission
Ithaca, New York (a)

Sample ID:	MW-5-40	MW-5-40	MW-5-40	MW-46-43C
Event:	Baseline	1st Period	2nd Period	2nd Period
Sample Date:	12/10/2019	6/22/2021	9/22/2021	9/22/2021
Dissolved Gases (µg/l)				
Carbon Dioxide	5,300	-	13,500	68,100
Methane	75	11,800	2,100	49
Ethane	0.54	18.7	12	22
Ethene	6.9	943	42	1,600
Volatile Fatty Acids (mg/l)				
Acetic Acid	4.6	-	5	86
Butyric Acid	1 U	-	0.58 U	2 J
Formic Acid	5 U	-	45	49
Hexanoic Acid	2 U	-	0.58 U	0.58 U
i-Hexanoic Acid	2 U	-	0.56 U	0.56 U
Lactic Acid	2 U	-	0.53 U	0.53 U
Pentanoic Acid	1 U	-	0.56 U	0.68 J
i-Pentanoic Acid	1 U	-	0.61 U	0.61 U
Propionic Acid	1 U	-	0.75 J	46
Pyruvic Acid	1 U	-	0.60 U	0.60 U
Compound Specific Isotope Analysis, δ(‰)				
cis-1,2-Dichloroethene	-26.44	-30.7	-30.00	-
trans-1,2-Dichloroethene	-40.73	-41.3 J	N/A	-
Trichloroethene	-32.47	-26.6 J	-29.50	-
Vinyl chloride	-46.64	-39.9	-51.20	-
Alkalinity (mg/l)				
Total ($CaCO_3$ pH 4.5)	336	-	170	452
TOC (mg/l)				
Total Organic Carbon	11	322	10	85

a/ µg/l = micrograms per liter; mg/l = miligrams per liter; δ(‰) = stable carbon isotope ratio of corresponding dissolved chlorinated solvent; U = not detected; ND = ratio not determined; J= Estimated concentration below PQL but above LQL
N/A = not analyzed due to concentration below detection limit

ENCLOSURE A

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SITE LOGIC Report

QuantArray®-Chlor Study

Contact: Erik Reinert

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Address: WSP USA Corp
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Fayetteville, NY, NY 13066

Email: erik.reinert@wsp.com

MI Identifier: 115SF

Report Date: 07/07/2021

Project: Former EPT Ithaca, 31401545.001 Task 5

Comments:

The QuantArray®-Chlor Approach

Quantification of *Dehalococcoides*, the only known bacterial group capable of complete reductive dechlorination of PCE and TCE to ethene, has become an indispensable component of assessment, remedy selection, and performance monitoring at sites impacted by chlorinated solvents. While undeniably a key group of halorespiring bacteria, *Dehalococcoides* are not the only bacteria of interest in the subsurface because reductive dechlorination is not the only potential biodegradation pathway operative at contaminated sites, and chlorinated ethenes are not always the primary contaminants of concern. The QuantArray®-Chlor not only includes a variety of halorespiring bacteria (*Dehalococcoides*, *Dehalobacter*, *Dehalogenimonas*, etc.) to assess the potential for reductive dechlorination of chloroethenes, chloroethanes, chlorobenzenes, chlorophenols, and chloroform, but also provides quantification of functional genes involved in aerobic (co)metabolic pathways for biodegradation of chlorinated solvents and even competing biological processes. Thus, the QuantArray®-Chlor will give site managers the ability to simultaneously yet economically evaluate the potential for biodegradation of a spectrum of common chlorinated contaminants through a multitude of anaerobic and aerobic (co) metabolic pathways to give a much more clear and comprehensive view of contaminant biodegradation.

The QuantArray®-Chlor is used to quantify specific microorganisms and functional genes to evaluate the following:

Anaerobic Reductive Dechlorination	Quantification of important halorespiring bacteria (e.g. *Dehalococcoides*, *Dehalobacter*, *Dehalogenimonas*, *Desulfitobacterium* spp.) and key functional genes (e.g. vinyl chloride reductases, TCE reductase, chloroform reductase) responsible for reductive dechlorination of a broad spectrum of chlorinated solvents.
Aerobic Cometabolism	Several different types of bacteria including methanotrophs and some toluene/phenol utilizing bacteria can co-oxidize TCE, DCE, and vinyl chloride. The QuantArray®-Chlor quantifies functional genes like soluble methane monooxygenase encoding enzymes capable of co-oxidation of chlorinated ethenes.
Aerobic (Co)metabolism of Vinyl Chloride	Ethene oxidizing bacteria are capable of cometabolism of vinyl chloride. In some cases, ethenotrophs can also utilize vinyl chloride as a growth supporting substrate. The QuantArray®-Chlor targets key functional genes in ethene metabolism.

How do QuantArrays® work?

The QuantArray®-Chlor in many respects is a hybrid technology combining the highly parallel detection of microarrays with the accurate and precise quantification provided by qPCR into a single platform. The key to highly parallel qPCR reactions is the nanoliter fluidics platform for low volume, solution phase qPCR reactions.

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How are QuantArray® results reported?

One of the primary advantages of the QuantArray®-Chlor is the simultaneous quantification of a broad spectrum of different microorganisms and key functional genes involved in a variety of pathways for chlorinated hydrocarbon biodegradation. However, highly parallel quantification combined with the various metabolic and cometabolic capabilities of different target organisms can complicate data presentation. Therefore, in addition to Summary Tables, QuantArray® results will be presented as Microbial Population Summary and Comparison Figures to aid in data interpretation and subsequent evaluation of site management activities.

Types of Tables and Figures:

Microbial Population Summary	Figure presenting the concentrations of QuantArray®-Chlor target populations (e.g. *Dehalococcoides*) and functional genes (e.g. vinyl chloride reductase) relative to typically observed values.
Summary Tables	Tables of target population concentrations grouped by biodegradation pathway and contaminant type.
Comparison Figures	Depending on the project, sample results can be presented to compare changes over time or examine differences in microbial populations along a transect of the dissolved plume.

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Results

Table 1: Summary of the QuantArray®-Chlor results obtained for sample MW-5-40.

Sample Name	MW-5-40
Sample Date	06/22/2021
Reductive Dechlorination	cells/mL
Dehalococcoides (DHC)	**5.44E+06**
tceA Reductase (TCE)	**3.79E+05**
BAV1 Vinyl Chloride Reductase (BVC)	**3.24E+05**
Vinyl Chloride Reductase (VCR)	**2.05E+05**
Dehalobacter spp. (DHBt)	**1.02E+06**
Dehalobacter DCM (DCM)	<1.67E+01
Dehalogenimonas spp. (DHG)	**1.15E+05**
cerA Reductase (CER)	**6.00E-01 (J)**
trans-1,2-DCE Reductase (TDR)	<1.67E+01
Desulfitobacterium spp. (DSB)	**5.68E+05**
Dehalobium chlorocoercia (DECO)	**2.37E+04**
Desulfuromonas spp. (DSM)	**1.61E+05**
PCE Reductase (PCE-1)	**5.14E+04**
PCE Reductase (PCE-2)	**1.07E+05**
Chloroform Reductase (CFR)	<1.67E+01
1,1 DCA Reductase (DCA)	<1.67E+01
1,2 DCA Reductase (DCAR)	<1.67E+01
Aerobic (Co)Metabolic	
Soluble Methane Monooxygenase (SMMO)	<1.67E+01
Toluene Dioxygenase (TOD)	<1.67E+01
Phenol Hydroxylase (PHE)	**1.19E+05**
Trichlorobenzene Dioxygenase (TCBO)	**1.12E+03**
Toluene Monooxygenase 2 (RDEG)	**9.88E+04**
Toluene Monooxygenase (RMO)	**2.12E+04**
Ethene Monooxygenase (EtnC)	**1.28E+03**
Epoxyalkane Transferase (EtnE)	**4.81E+03**
Dichloromethane Dehalogenase (DCMA)	<1.67E+01
Other	
Total Eubacteria (EBAC)	**1.94E+08**
Sulfate Reducing Bacteria (APS)	**5.07E+06**
Methanogens (MGN)	**1.42E+04**

Legend:
NA = Not Analyzed
NS = Not Sampled
J = Estimated Gene Copies Below PQL but Above LQL
I = Inhibited
< = Result Not Detected

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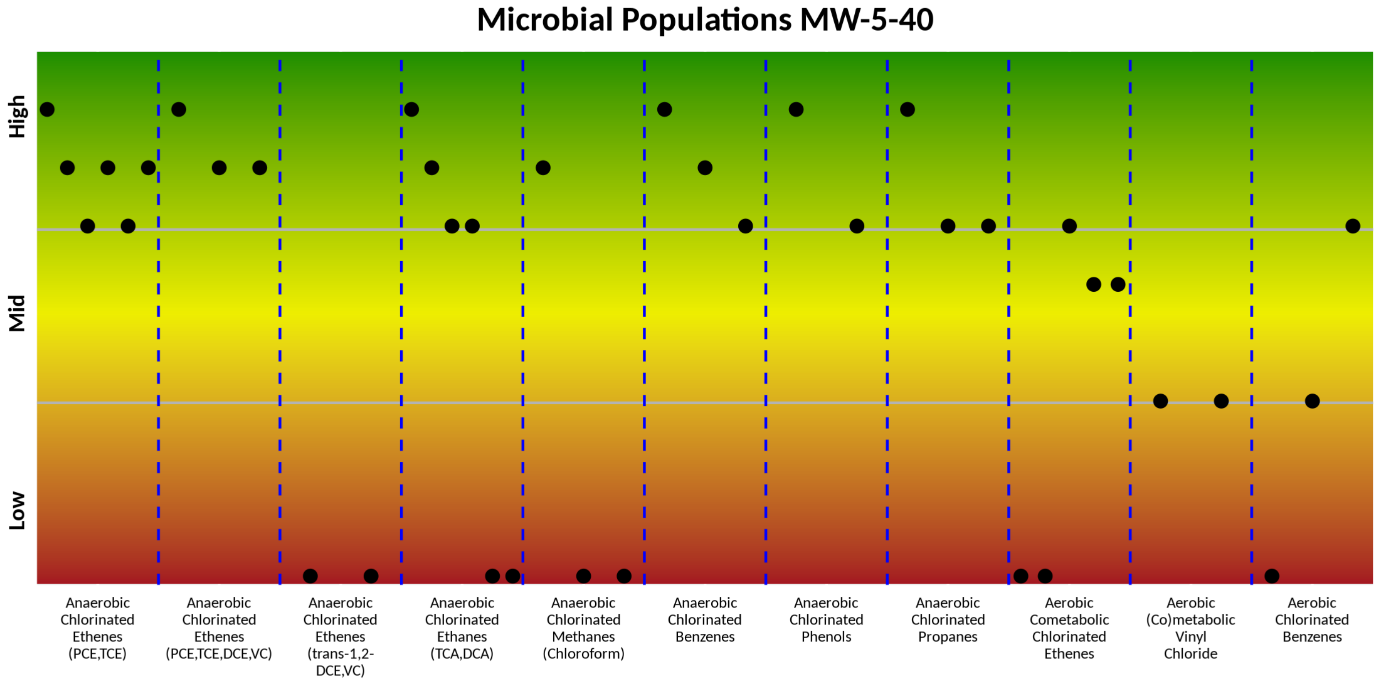

Figure 1: Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.

Anaerobic - Reductive Dechlorination or Dichloroelimination		Aerobic - (Co)metabolism	
Chlorinated Ethenes (PCE, TCE)	DHC, DHBt, DSB, DSM, PCE-1, PCE-2	Chlorinated Ethenes (TCE,DCE,VC)	sMMO, TOD, PHE, RDEG, RMO
Chlorinated Ethenes (PCE, TCE, DCE, VC)	DHC, BVC, VCR	(Co)metabolic Vinyl Chloride	etnC, etnE
Chlorinated Ethenes (trans-1,2-DCE, VC)	TDR, CER	Chlorinated Benzenes	TOD, TCBO, PHE
Chlorinated Ethanes (TCA and 1,2-DCA)	DHC, DHBt, DHG, DSB[1], DCA, DCAR		
Chlorinated Methanes (Chloroform)	DHBt, DCM, CFR		
Chlorinated Benzenes	DHC, DHBt[2], DECO		
Chlorinated Phenols	DHC, DSB		
Chlorinated Propanes	DHC, DHG, DSB[1]		

[1] *Desulfitobacterium dichloroeliminans* DCA1. [2] Implicated in reductive dechlorination of dichlorobenzene and potentially chlorobenzene.

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Table 2: Summary of the QuantArray®-Chlor results for microorganisms responsible for reductive dechlorination for samples MW-5-40.

Sample Name	MW-5-40
Sample Date	06/22/2021
Reductive Dechlorination	cells/mL
Dehalococcoides (DHC)	**5.44E+06**
tceA Reductase (TCE)	**3.79E+05**
BAV1 Vinyl Chloride Reductase (BVC)	**3.24E+05**
Vinyl Chloride Reductase (VCR)	**2.05E+05**
Dehalobacter spp. (DHBt)	**1.02E+06**
Dehalobacter DCM (DCM)	<1.67E+01
Dehalogenimonas spp. (DHG)	**1.15E+05**
Desulfitobacterium spp. (DSB)	**5.68E+05**
Dehalobium chlorocoercia (DECO)	**2.37E+04**
Desulfuromonas spp. (DSM)	**1.61E+05**

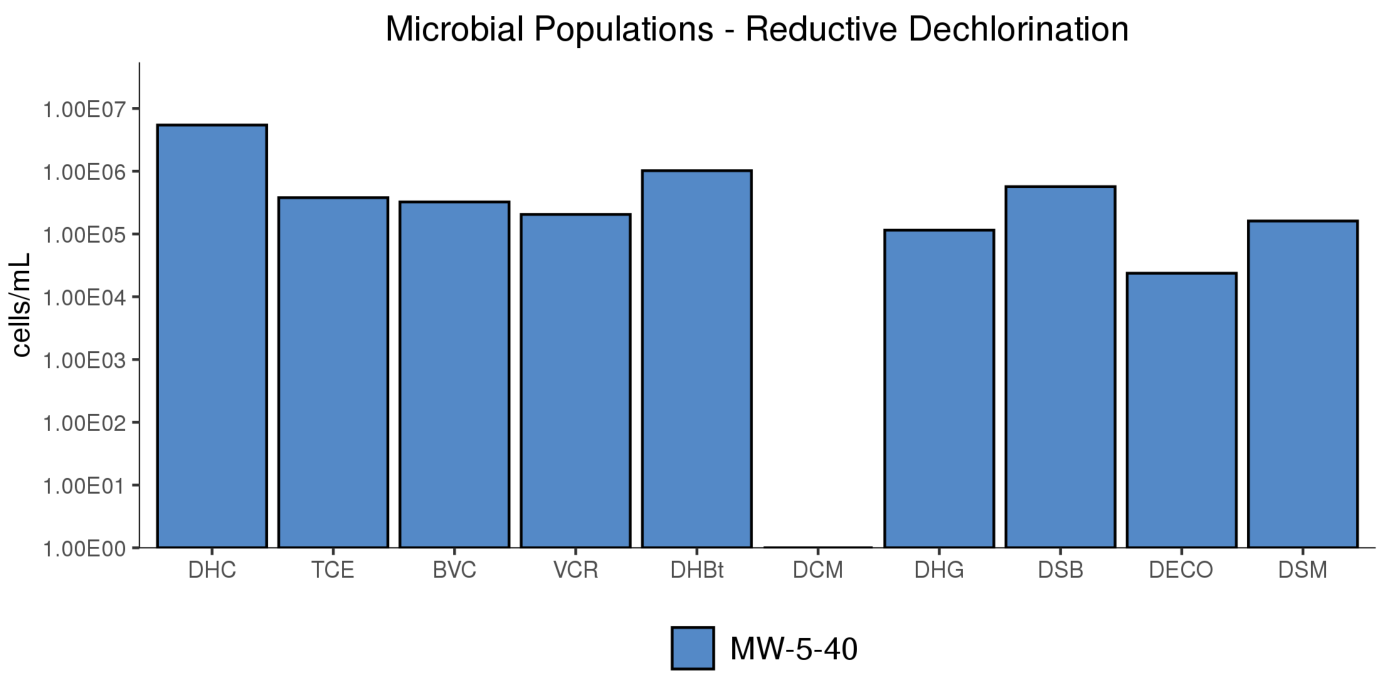

Figure 2: Comparison - microbial populations involved in reductive dechlorination.

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Table 3: Summary of the QuantArray®-Chlor results for microorganisms responsible for reductive dechlorination for samples MW-5-40.

Sample Name	**MW-5-40**
Sample Date	**06/22/2021**
Reductive Dechlorination	cells/mL
Chloroform Reductase (CFR)	<1.67E+01
1,1 DCA Reductase (DCA)	<1.67E+01
1,2 DCA Reductase (DCAR)	<1.67E+01
PCE Reductase (PCE-1)	**5.14E+04**
PCE Reductase (PCE-2)	**1.07E+05**
Dehalogenimonas trans-1,2-DCE Reductase (TDR)	<1.67E+01
Dehalogenimonas cerA Reductase (CER)	**6.00E-01 (J)**

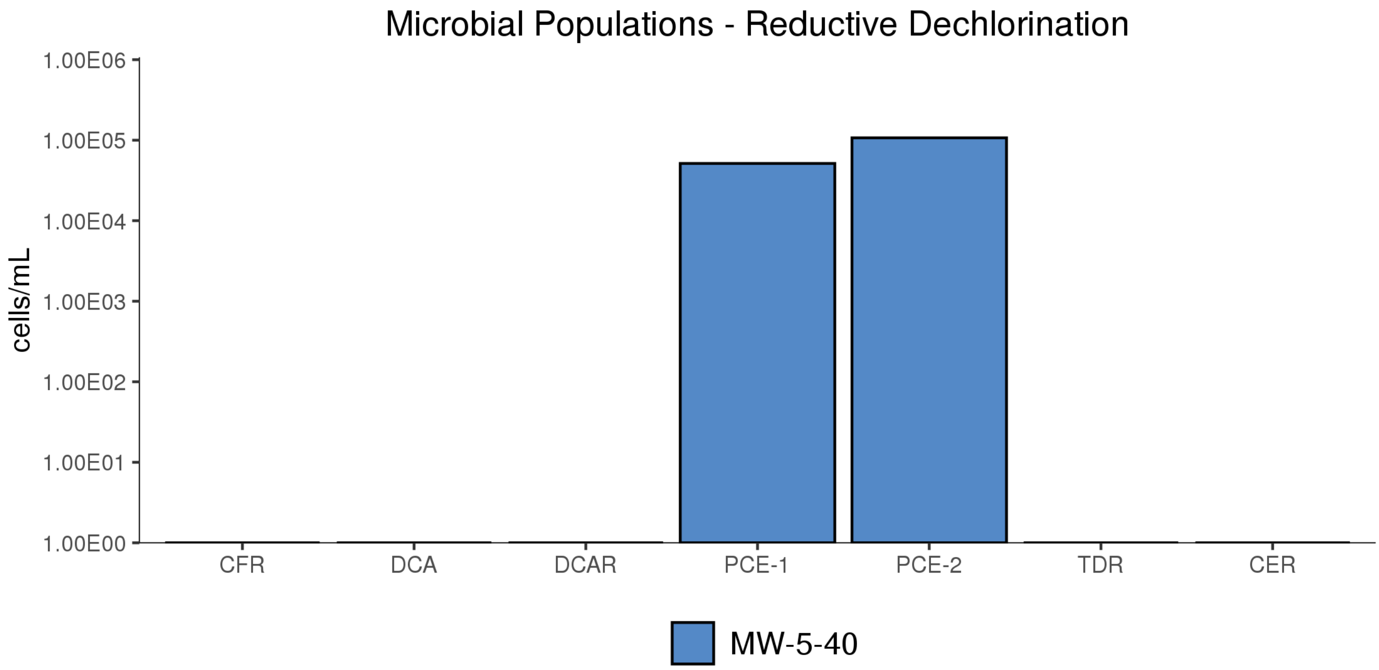

Figure 3: Comparison - microbial populations involved in reductive dechlorination.

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Table 4: Summary of the QuantArray®-Chlor results for microorganisms responsible for aerobic (co)metabolism for samples MW-5-40.

Sample Name	**MW-5-40**
Sample Date	**06/22/2021**
Aerobic (Co)Metabolic	cells/mL
Soluble Methane Monooxygenase (SMMO)	<1.67E+01
Toluene Dioxygenase (TOD)	<1.67E+01
Phenol Hydroxylase (PHE)	**1.19E+05**
Trichlorobenzene Dioxygenase (TCBO)	**1.12E+03**
Toluene Monooxygenase 2 (RDEG)	**9.88E+04**
Toluene Monooxygenase (RMO)	**2.12E+04**
Ethene Monooxygenase (EtnC)	**1.28E+03**
Epoxyalkane Transferase (EtnE)	**4.81E+03**
Dichloromethane Dehalogenase (DCMA)	<1.67E+01

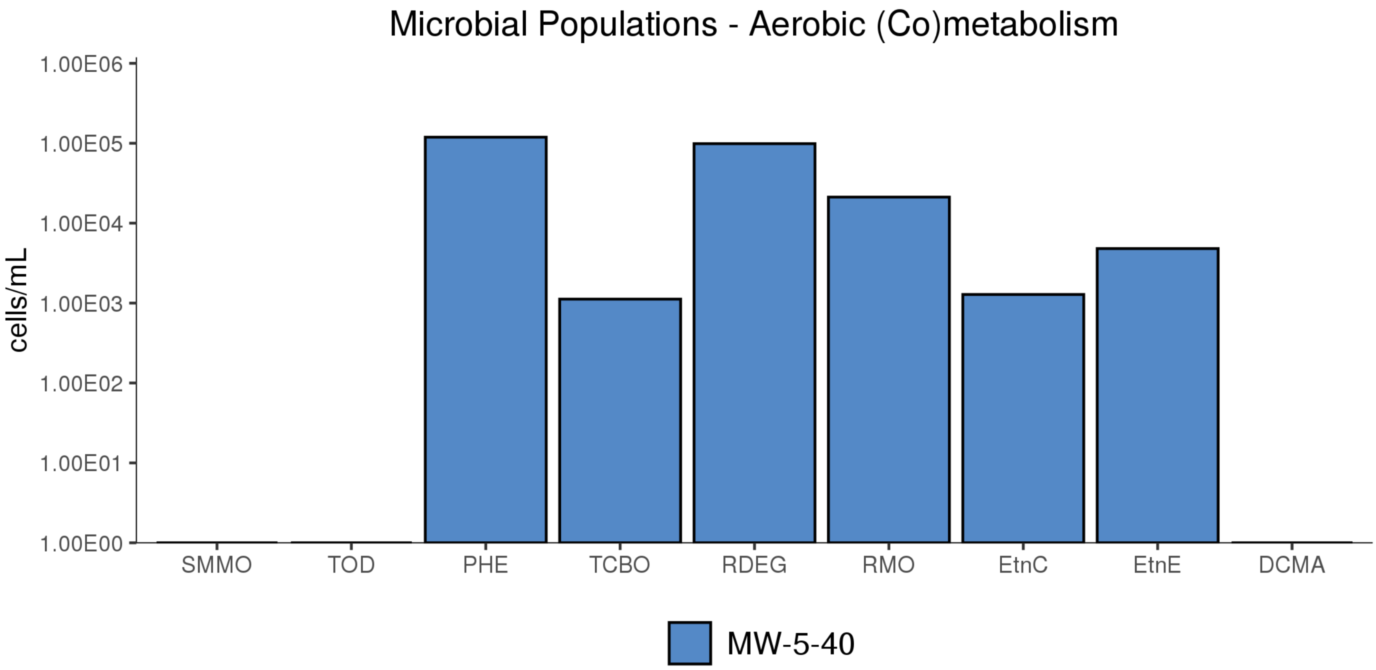

Figure 4: Comparison - microbial populations involved in aerobic (co)metabolism.

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Table 5: Summary of the QuantArray®-Chlor results for total bacteria and other populations for samples MW-5-40.

Sample Name	MW-5-40
Sample Date	06/22/2021
Other	cells/mL
Total Eubacteria (EBAC)	**1.94E+08**
Sulfate Reducing Bacteria (APS)	**5.07E+06**
Methanogens (MGN)	**1.42E+04**

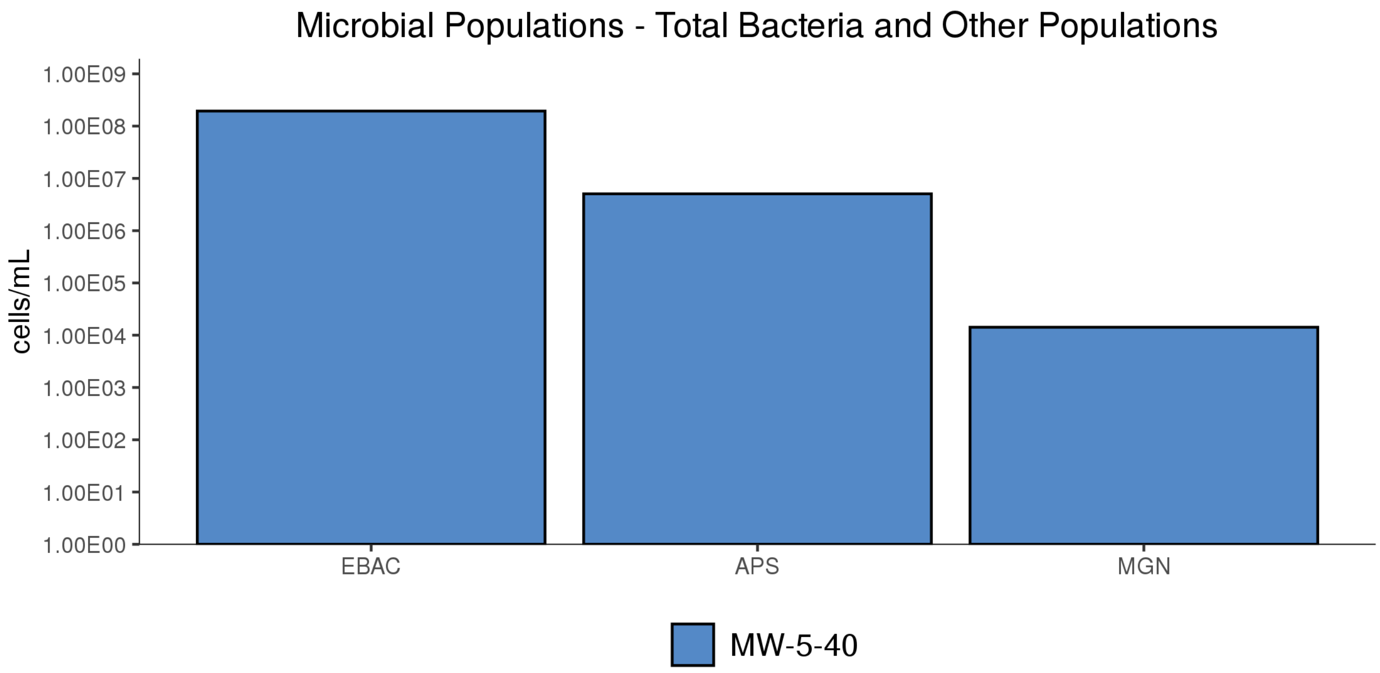

Figure 5: Comparison - microbial populations.

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Interpretation

The overall purpose of the QuantArray®-Chlor is to give site managers the ability to simultaneously yet economically evaluate the potential for biodegradation of a spectrum of common chlorinated contaminants through a multitude of anaerobic and aerobic (co)metabolic pathways in order to provide a clearer and more comprehensive view of contaminant biodegradation. The following discussion describes the interpretation of results in general terms and is meant to serve as a guide.

Reductive Dechlorination - Chlorinated Ethenes: While a number of bacterial cultures including *Dehalococcoides*, *Dehalobacter*, *Desulfitobacterium*, and *Desulfuromonas* spp. capable of utilizing PCE and TCE as growth-supporting electron acceptors have been isolated [1–5], *Dehalococcoides* may be the most important because they are the only bacterial group that has been isolated to date which is capable of complete reductive dechlorination of PCE to ethene [6]. In fact, the presence of *Dehalococcoides* has been associated with complete reductive dechlorination to ethene at sites across North America and Europe [7], and Lu et al. [8] have proposed using a *Dehalococcoides* concentration of 1×10^4 cells/mL as a screening criterion to identify sites where biological reductive dechlorination is predicted to proceed at "generally useful" rates.

At chlorinated ethene sites, any "stall" leading to the accumulation of daughter products, especially vinyl chloride, would be a substantial concern. While *Dehalococcoides* concentrations greater than 1×10^4 cells/mL correspond to ethene production and useful rates of dechlorination, the range of chlorinated ethenes degraded varies by strain within the *Dehalococcoides* genus [6, 9], and the presence of co-contaminants and competitors can have complex impacts on the halorespiring microbial community [10–15]. Therefore, QuantArray®-Chlor also provides quantification of a suite of reductive dehalogenase genes (PCE, TCE, BVC, VCR, CER, and TDR) to more definitively confirm the potential for reductive dechlorination of all chlorinated ethene compounds including vinyl chloride.

Perhaps most importantly, QuantArray®-Chlor quantifies TCE reductase (TCE) and both known vinyl chloride reductase genes (BVC, VCR) from *Dehalococcoides* to conclusively evaluate the potential for complete reductive dechlorination of chlorinated ethenes to nontoxic ethene [16–18]. In addition, the analysis also includes quantification of reductive dehalogenase genes from *Dehalogenimonas* spp. capable of reductive dechlorination of chlorinated ethenes. More specifically, these are the trans-1,2-DCE dehalogenase gene (TDR) from strain WBC-2 [19] and the vinyl chloride reductase gene (CER) from GP, the only known organisms other than *Dehalococcoides* capable of vinyl chloride reduction [20]. Finally, PCE reductase genes responsible for sequential reductive dechlorination of PCE to *cis*-DCE by *Sulfurospirillum* and *Geobacter* spp. are also quantified. In mixed cultures, evidence increasingly suggests that partial dechlorinators like *Sulfurospirillum* and *Geobacter* may be responsible for the majority of reductive dechlorination of PCE to TCE and *cis*-DCE while *Dehalococcoides* functions more as *cis*-DCE and vinyl chloride reducing specialists [10, 21].

Reductive Dechlorination - Chlorinated Ethanes: Under anaerobic conditions, chlorinated ethanes are susceptible to reductive dechlorination by several groups of halorespiring bacteria including *Dehalobacter*, *Dehalogenimonas*, and *Dehalococcoides*. While the reported range of chlorinated ethanes utilized varies by genus, species, and sometimes at the strain level, several general observations can be made regarding biodegradation pathways and daughter product formation. *Dehalobacter* spp. have been isolated that are capable of sequential reductive dechlorination of 1,1,1-TCA through 1,1-DCA to chloroethane [13]. Biodegradation of 1,1,2-TCA by several halorespiring bacteria including *Dehalobacter* and *Dehalogenimonas* spp. proceeds via dichloroelimination producing vinyl chloride [22–24]. Similarly, 1,2-DCA biodegradation by *Dehalobacter*, *Dehalogenimonas*, and *Dehalococcoides* occurs via dichloroelimination producing ethene. While not utilized by many *Desulfitobacterium* isolates, at least one strain, *Desulfitobacterium dichloroeliminans* strain DCA1, is also capable of dichloroelimination of 1,2-DCA [25]. The 1,2-dichloroethane reductive dehalogenase gene (DCAR) from members of *Desulfitobacterium* and *Dehalobacter* is known to dechlorinate 1,2-DCA to ethene, while the 1,1-dichloroethane reductive dehalogenase (DCA) targets the gene responsible for 1,1-DCA dechlorination in some strains of *Dehalobacter*. In addition to chloroform,chloroform reductase (CFR) has also been shown to be responsible for reductivedechlorination of 1,1,1-TCA [26].

Reductive Dechlorination - Chlorinated Methanes: Chloroform is a common co-contaminant at chlorinated solvent sites and can inhibit reductive dechlorination of chlorinated ethenes. Grostern et al. demonstrated that a *Dehalobacter* population was capable of reductive dechlorination of chloroform to produce dichloromethane [27]. The *cfrA* gene encodes the reductase which catalyzes this initial step in chloroform biodegradation [26]. Justicia-Leon et al. have since shown that dichloromethane can support growth of a distinct group of *Dehalobacter* strains via fermentation [28]. The *Dehalobacter* DCM assay targets the 16S rRNA gene of these strains.

Reductive Dechlorination - Chlorinated Benzenes: Chlorinated benzenes are an important class of industrial solvents and chemical intermediates in the production of drugs, dyes, herbicides, and insecticides. The physical-chemical properties of chlorinated benzenes as well as susceptibility to biodegradation are functions of their degree of chlorination and the positions of chlorine substituents. Under anaerobic conditions, reductive dechlorination of higher chlorinated benzenes including hexachlorobenzene (HCB),

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pentachlorobenzene (PeCB), tetrachlorobenzene (TeCB) isomers, and trichlorobenzene (TCB) isomers has been well documented [29], although biodegradation of individual compounds and isomers varies between isolates. For example, *Dehalococcoides* strain CBDB1 reductively dechlorinats HCB, PeCB, all three TeCB isomers, 1,2,3-TCB, and 1,2,4-TCB [9, 30]. *Dehalobium chlorocoercia* DF-1 has been shown to be capable of reductive dechlorination of HCB, PeCB, and 1,2,3,5-TeCB [31]. The dichlorobenzene (DCB) isomers and chlorobenzene (CB) were considered relatively recalcitrant under anaerobic conditions. However, new evidence has demonstrated reductive dechlorination of DCBs to CB and CB to benzene [32] with corresponding increases in concentrations of *Dehalobacter* spp. [33].

Reductive Dechlorination - Chlorinated Phenols: Pentachlorophenol (PCP) was one of the most widely used biocides in the U.S. and despite residential use restrictions, is still extensively used industrially as a wood preservative. Along with PCP, the tetrachlorophenol and trichlorophenol isomers were also used as fungicides in wood preserving formulations. 2,4-Dichlorophenol and 2,4,5-TCP were used as chemical intermediates in herbicide production (e.g. 2,4-D) and chlorophenols are known byproducts of chlorine bleaching in the pulp and paper industry. While the range of compounds utilized varies by strain, some *Dehalococcoides* isolates are capable of reductive dechlorination of PCP and other chlorinated phenols. For example, *Dehalococcoides* strain CBDB1 is capable of utilizing PCP, all three tetrachlorophenol (TeCP) congeners, all six trichlorophenol (TCP) congeners, and 2,3-dichlorophenol (2,3-DCP). PCP dechlorination by strain CBDB1 produces a mixture of 3,5-DCP, 3,4-DCP, 2,4-DCP, 3-CP, and 4-CP [34]. In the same study, however, *Dehalococcoides* strain 195 dechlorinated a more narrow spectrum of chlorophenols which included 2,3-DCP, 2,3,4-TCP, and 2,3,6-TCP, but no other TCPs or PCP. Similar to *Dehalococcoides*, some species and strains of *Desulfitobacterium* are capable of utilizing PCP and other chlorinated phenols. *Desulfitobacterium hafniense* PCP-1 is capable of reductive dechlorination of PCP to 3-CP [35]. However, the ability to biodegrade PCP is not universal among *Desulfitobacterium* isolates. *Desulfitobacterium* sp. strain PCE1 and *D. chlororespirans* strain Co23, for example, can utilize some TCP and DCP isomers, but not PCP for growth [2, 36].

Reductive Dechlorination - Chlorinated Propanes: *Dehalogenimonas* is a recently described bacterial genus of the phylum Chloroflexi which also includes the well-known chloroethene-respiring *Dehalococcoides* [23]. The *Dehalogenimonas* isolates characterized to date are also halorespiring bacteria, but utilize a rather unique range of chlorinated compounds as electron acceptors including chlorinated propanes (1,2,3-TCP and 1,2-DCP) and a variety of other vicinally chlorinated alkanes including 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, and 1,2-dichloroethane [23].

Aerobic - Chlorinated Ethene Cometabolism: Under aerobic conditions, several different types of bacteria including methane-oxidizing bacteria (methanotrophs), and many benzene, toluene, ethylbenzene, xylene, and (BTEX)-utilizing bacteria can cometabolize or co-oxidize TCE, DCE, and vinyl chloride [37]. In general, cometabolism of chlorinated ethenes is mediated by monooxygenase enzymes with "relaxed' specificity that oxidize a primary (growth supporting) substrate (*e.g.* methane) and co-oxidize the chlorinated compound (*e.g.*TCE). QuantArray®-Chlor provides quantification of a suite of genes encoding oxygenase enzymes capable of co-oxidation of chlorinated ethenes including soluble methane monooxygenase (sMMO). Soluble methane monooxygenases co-oxidize a broad range of chlorinated compounds [38–41] including TCE, *cis*-DCE, and vinyl chloride. Furthermore, soluble methane monooxygenases are generally believed to support greater rates of aerobic cometabolism [40]. QuantArray®-Chlor also quantifies aromatic oxygenase genes encoding ring hydroxylating toluene monooxygenase genes (RMO, RDEG), toluene dioxygenase (TOD) and phenol hydroxylases (PHE) capable of TCE co-oxidation [42–46]. TCE or a degradation product has been shown to induce expression of toluene monooxygenases in some laboratory studies [43, 47] raising the possibility of TCE cometabolism with an alternative (non-aromatic) growth substrate. Moreover, while a number of additional factors must be considered, recent research under ESTCP Project 201584 has shown positive correlations between concentrations of monooxygenase genes (soluble methane monooxygenase, ring hydroxylating monooxygenases, and phenol hydroxylase) and the rate of TCE degradation [48].

Aerobic - Chlorinated Ethane Cometabolism: While less widely studied than cometabolism of chlorinated ethenes, some chlorinated ethanes are also susceptible to co-oxidation. As mentioned previously, soluble methane monooxygenases (sMMO) exhibit very relaxed specificity. In laboratory studies, sMMO has been shown to co-oxidize a number of chlorinated ethanes including 1,1,1-TCA and 1,2-DCA [38, 40].

Aerobic - Vinyl Chloride Cometabolism: Beginning in the early 1990s, numerous microcosm studies demonstrated aerobic oxidation of vinyl chloride under MNA conditions without the addition of exogenous primary substrates. Since then, strains of

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Mycobacterium, *Nocardioides*, *Pseudomonas*, *Ochrobactrum*, and *Ralstonia* species have been isolated which are capable of aerobic growth on both ethene and vinyl chloride (see Mattes et al. [49] for a review). The initial steps in the pathway are the monooxygenase (*etn*ABCD) catalyzed conversion of ethene and vinyl chloride to their respective epoxyalkanes (epoxyethane and chlorooxirane), followed by epoxyalkane:CoM transferase (*etn*E) mediated conjugation and breaking of the epoxide [50].

Aerobic - Chlorinated Benzenes: In general, chlorobenzenes with four or less chlorine groups are susceptible to aerobic biodegradation and can serve as growth-supporting substrates. Toluene dioxygenase (TOD) has a relatively relaxed substrate specificity and mediates the incorporation of both atoms of oxygen into the aromatic ring of benzene and substituted benzenes (toluene and chlorobenzene). Comparison of TOD levels in background and source zone samples from a CB-impacted site suggested that CBs promoted growth of TOD-containing bacteria [51]. In addition, aerobic biodegradation of some trichlorobenzene and even tetrachlorobenzene isomers is initiated by a group of related trichlorobenzene dioxygenase genes (TCBO). Finally, phenol hydroxylases catalyze the continued oxidation and in some cases, the initial oxidation of a variety of monoaromatic compounds. In an independent study, significant increases in numbers of bacteria containing PHE genes corresponded to increases in biodegradation of DCB isomers [51].

Aerobic - Chlorinated Methanes: Many aerobic methylotrophic bacteria, belonging to diverse genera (*Hyphomicrobium*, *Methylobacterium*, *Methylophilus*, *Pseudomonas*, *Paracoccus*, and *Alibacter*) have been isolated which are capable of utilizing dichloromethane (DCM) as a growth substrate. The DCM metabolic pathway in methylotrophic bacteria is initiated by a dichloromethane dehalogenase (DCMA) gene. DCMA is responsible for aerobic biodegradation of dichloromethane by methylotrophs by first producing formaldehyde which is then further oxidized [52]. As discussed in previous sections, soluble methane monooxygenase (sMMO) exhibits relaxed specificity and co-oxidizes a broad spectrum of chlorinated hydrocarbons. In addition to chlorinated ethenes, sMMO has been shown to co-oxidize chloroform in laboratory studies [38, 41].

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Client:	Erik Reinert WSP USA Buildings Inc. 7000 E. Genessee Street Bldg D, 2nd Floor Fayetteville, NY, NY 13066	**Phone:**	315-374-1773
		Fax:	

Identifier: 115SF **Date Rec:** 06/23/2021 **Report Date:** 07/16/2021

Client Project #: 31401545.001 Task 5 **Client Project Name:** Former EPT Ithaca

Purchase Order #:

Test results provided for: CSIA

Reviewed By:

Ali. Faleghani

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CSIA

Client:	**WSP USA Buildings Inc.**	**MI Project Number:**	**115SF**
Project:	Former EPT Ithaca	Date Received:	06/23/2021

Sample Information

Client Sample ID:	**MW-5-40**
Sample Date:	06/22/2021
Analyst/Reviewer:	MW/AT

Carbon	Units	
$^{13}C/^{12}C$ 1,1-DCE (‰)	$\delta^{13}C$, VPDB (‰)	**NA**
$^{13}C/^{12}C$ cis-DCE (‰)	$\delta^{13}C$, VPDB (‰)	**-30.7**
$^{13}C/^{12}C$ PCE (‰)	$\delta^{13}C$, VPDB (‰)	**NA**
$^{13}C/^{12}C$ TCE (‰)	$\delta^{13}C$, VPDB (‰)	**-26.6 (J)**
$^{13}C/^{12}C$ Trans-DCE (‰)	$\delta^{13}C$, VPDB (‰)	**-41.3 (J)**
$^{13}C/^{12}C$ Vinyl Chloride (‰)	$\delta^{13}C$, VPDB (‰)	**-39.9**

Legend:
NA= Not Analyzed NS=Not Sampled J= Estimated concentration below PQL but above LQL ND= Not Detected

Quality Assurance/Quality Control Data

Samples Received **6/23/2021**

Component	Date Prepared	Date Analyzed	Arrival Temperature	Positive Control (‰ Std. Dev.)*	Blank
$^{13}C/^{12}C$ TCE (‰)	06/23/2021	07/15/2021	0 °C	0.5	Pass
$^{13}C/^{12}C$ cis-DCE (‰)	06/23/2021	07/15/2021	0 °C	0.4	Pass
$^{13}C/^{12}C$ Trans-DCE (‰)	06/23/2021	07/15/2021	0 °C	0.4	Pass
$^{13}C/^{12}C$ Vinyl Chloride (‰)	06/23/2021	07/15/2021	0 °C	0.1	Pass

* $\delta^{13}C$ positive control values are within +- 0.5‰ of true value.

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Identifier: 115SF **Date Rec:** 06/23/2021 **Report Date:** 07/16/2021

Client Project #: 31401545.001 Task 5 **Client Project Name:** Former EPT Ithaca

Purchase Order #:

Comments: 8260 results received from client on 7/14/2021. Based on VOC data, PCE was non-detect and 1,1-DCE was expected to be below CSIA detection limits after required dilutions; therefore, these targets were not analyzed (NA). Please note that TCE was detected but only in one replicate. Trans-DCE was standardized against a cis-DCE isotopic standard.

LELAP CERTIFICATE NUMBER: 01955
DOD-ELAP ACCREDITATION NUMBER: 74960

ANALYTICAL RESULTS

PERFORMED BY

Pace Analytical Gulf Coast
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Baton Rouge, LA 70820
(225) 769-4900

Report Date 07/07/2021

Report # 221062562

Project 31401545.001 Task 5

Samples Collected 6/22/21

Deliver To	***Additional Recipients***
Jeffrey Baker	Erik Reinert, WSP Environment & Energy
WSP Environment & Energy	Environmental Payable, WSP USA Corp
7000 East Genessee	
Building D, 2nd Floor	
Fayetteville, NY 13066	
724-882-7923	

Laboratory Endorsement

Sample analysis was performed in accordance with approved methodologies provided by the Environmental Protection Agency or other recognized agencies. The samples and their corresponding extracts will be maintained for a period of 30 days unless otherwise arranged. Following this retention period the samples will be disposed in accordance with Pace Gulf Coast's Standard Operating Procedures.

Common Abbreviations that may be Utilized in this Report

ND	Indicates the result was Not Detected at the specified reporting limit
NO	Indicates the sample did not ignite when preliminary test performed for EPA Method 1030
DO	Indicates the result was Diluted Out
MI	Indicates the result was subject to Matrix Interference
TNTC	Indicates the result was Too Numerous To Count
SUBC	Indicates the analysis was Sub-Contracted
FLD	Indicates the analysis was performed in the Field
DL	Detection Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
RE	Re-analysis
CF	HPLC or GC Confirmation
00:01	Reported as a time equivalent to 12:00 AM

Reporting Flags that may be Utilized in this Report

J or I	Indicates the result is between the MDL and LOQ
J	DOD flag on analyte in the parent sample for MS/MSD outside acceptance criteria
U	Indicates the compound was analyzed for but not detected
B or V	Indicates the analyte was detected in the associated Method Blank
Q	Indicates a non-compliant QC Result (See Q Flag Application Report)
*****	Indicates a non-compliant or not applicable QC recovery or RPD – see narrative
E	Organics **-** The result is estimated because it exceeded the instrument calibration range
E	Metals - % diference for the serial dilution is > 10%
L	Reporting Limits adjusted to meet risk-based limit.
P	RPD between primary and confirmation result is greater than 40
DL	Diluted analysis – when appended to Client Sample ID

Sample receipt at Pace Gulf Coast is documented through the attached chain of custody. In accordance with NELAC, this report shall be reproduced only in full and with the written permission of Pace Gulf Coast. The results contained within this report relate only to the samples reported. The documented results are presented within this report.

This report pertains only to the samples listed in the Report Sample Summary and should be retained as a permanent record thereof. The results contained within this report are intended for the use of the client. Any unauthorized use of the information contained in this report is prohibited.

I certify that this data package is in compliance with The NELAC Institute (TNI) Standard 2009 and terms and conditions of the contract and Statement of Work both technically and for completeness, for other than the conditions in the case narrative. Release of the data contained in this hardcopy data package and in the computer readable data submitted has been authorized by the Quality Assurance Manager or his/her designee, as verified by the following signature.

Estimated uncertainty of measurement is available upon request. This report is in compliance with the DOD QSM as specified in the contract if applicable.

Authorized Signature
Pace Gulf Coast Report 221062562

Certifications

Certification	Certification Number
DOD ELAP	74960
Alabama	01955
Arkansas	88-0655
Colorado	01955
Delaware	01955
Florida	E87854
Georgia	01955
Hawaii	01955
Idaho	01955
Illinois	200048
Indiana	01955
Kansas	E-10354
Kentucky	95
Louisiana	01955
Maryland	01955
Massachusetts	01955
Michigan	01955
Mississippi	01955
Missouri	01955
Montana	N/A
Nebraska	01955
New Mexico	01955
North Carolina	618
North Dakota	R-195
Oklahoma	9403
South Carolina	73006001
South Dakota	01955
Tennessee	01955
Texas	T104704178
Vermont	01955
Virginia	460215
Washington	C929
USDA Soil Permit	P330-16-00234

Case Narrative

Client: WSP Environmental & Energy **Report:** 221062562

Pace Analytical Gulf Coast received and analyzed the sample(s) listed on the Report Sample Summary page of this report. Receipt of the sample(s) is documented by the attached chain of custody. This applies only to the sample(s) listed in this report. No sample integrity or quality control exceptions were identified unless noted below.

No anomalies were found for the analyzed sample(s).

Sample Summary

Lab ID	Client ID	Matrix	Collect Date	Receive Date
22106256201	MW-5-40	Water	6/22/21 11:15	6/24/21 10:10
22106256202	TRIP BLANK	Water	6/22/21 00:01	6/24/21 10:10

Detect Summary

Results and Detection Limits are adjusted for dilution and moisture when applicable

SM 5310 B-2011

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22106256201	MW-5-40	Total Organic Carbon	mg/L	322	10	NA

EPA RSK175

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22106256201	MW-5-40	Ethane	ug/L	18.7	1	NA
22106256201	MW-5-40	Ethene	ug/L	943	1	NA
22106256201	MW-5-40	Methane	ug/L	11800	1	NA

Sample Results

MW-5-40	**Collect Date**	06/22/2021 11:15	**Lab ID**	22106256201
	Receive Date	06/24/2021 10:10	**Matrix**	Water

SM 5310 B-2011

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	10	07/01/21 16:23	715222	JGD	

CAS#	Parameter	Result	DL	LOQ	Units
C-012	**Total Organic Carbon**	**322**	**3.00**	**20.0**	**mg/L**

EPA RSK175

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	07/06/21 22:21	715522	AWE	

CAS#	Parameter	Result	DL	LOQ	Units
74-84-0	**Ethane**	**18.7**	**0.172**	**1.00**	**ug/L**
74-85-1	**Ethene**	**943**	**0.241**	**1.00**	**ug/L**
74-82-8	**Methane**	**11800**	**1.98**	**5.00**	**ug/L**

TRIP BLANK	**Collect Date**	06/22/2021 00:01	**Lab ID**	22106256202
	Receive Date	06/24/2021 10:10	**Matrix**	Water

SM 5310 B-2011

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	06/30/21 21:36	715123	JGD	

CAS#	Parameter	Result	DL	LOQ	Units
C-012	Total Organic Carbon	0.300U	0.300	2.00	mg/L

General Chemistry QC Summary

Analytical Batch 715123	Client ID Lab ID Sample Type Prep Date Analysis Date Matrix	MB715123 2207567 MB NA 06/30/21 20:44 Water		LCS715123 2207568 LCS NA 06/30/21 20:06 Water			
SM 5310 B-2011		Units Result	mg/L DL	Spike Added	Result	%R	Control Limits%R
Total Organic Carbon	C-012	0.300U	0.300	50.0	47.3	95	90 - 110

Analytical Batch 715222	Client ID Lab ID Sample Type Prep Date Analysis Date Matrix	MB715222 2208105 MB NA 07/01/21 15:56 Water		LCS715222 2208106 LCS NA 07/01/21 14:54 Water			
SM 5310 B-2011		Units Result	mg/L DL	Spike Added	Result	%R	Control Limits%R
Total Organic Carbon	C-012	0.300U	0.300	50.0	45.2	90	90 - 110

General Chromatography QC Summary

Analytical Batch 715522	Client ID	MB715522		LCS715522				LCSD715522				
	Lab ID	2209633		2209634				2209635				
	Sample Type	MB		LCS				LCSD				
	Prep Date	NA		NA				NA				
	Analysis Date	07/06/21 18:21		07/06/21 16:58				07/06/21 17:59				
	Matrix	Water		Water				Water				
EPA RSK175		Units Result	ug/L DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
Ethane	74-84-0	0.172U	0.172	97.1	85.2	88	70 - 130	97.1	91.7	94	7	30
Ethene	74-85-1	0.241U	0.241	120	99.9	83	70 - 130	120	109	91	9	30
Methane	74-82-8	1.98U	1.98	384	351	91	70 - 130	384	379	99	8	30

Pace Analytical®

CHAIN-OF-CUSTODY Analytical Request Document

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

LAB USE ONLY- Affix Workorder

Client ID: wsp-c - WSP Environmental & Energy
SDG: 221062562
PM: RWe

ALL SHADED

Company: WSP USA
Billing Information:
Address: 7600 E GENESEE FAYETTEVILLE
Report To: JEFF BAKER
Email To: JEFFREY.BAKER@WSP.COM
Copy To: ERIK.BEINERT@WSP.COM
Site Collection Info/Address:
Customer Project Name/Number: 31401545.001 /TASK 5
State: NY / County/City: 14850 / Time Zone Collected: [ ] PT [ ] MT [ ] CT [ ] ET
Phone:
Email:
Site/Facility ID #:
Compliance Monitoring? [ ] Yes [ ] No
Collected By (print): NATE WINSTON
Purchase Order #:
Quote #:
DW PWS ID #:
DW Location Code:
Collected By (signature):
Turnaround Date Required:
Immediately Packed on Ice: [ ] Yes [ ] No
Sample Disposal: [X] Dispose as appropriate [ ] Return [ ] Archive: ____ [ ] Hold: ____
Rush: [ ] Same Day [ ] Next Day [ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day (Expedite Charges Apply)
Field Filtered (if applicable): [ ] Yes [ ] No
Analysis: ____

Container Preservative Type **

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other ____

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Analyses

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start) Date	Time	Composite End Date	Time	Res Cl	# of Ctns	TOC 5310 C	Disolved Gases: Methane, ethane, ethene -3810/TASK IPS
MW-5-40	AQ/DW	G	6/22/21	1115	—	—		5	X	X
TRIP BLANK	—	—	—	—	—	—		2	X	

Lab Profile/Line:
Lab Sample Receipt Checklist:
Custody Seals Present/Intact Y N NA
Custody Signatures Present Y N NA
Collector Signature Present Y N NA
Bottles Intact Y N NA
Correct Bottles Y N NA
Sufficient Volume Y N NA
Samples Received on Ice Y N NA
VOA - Headspace Acceptable Y N NA
USDA Regulated Soils Y N NA
Samples in Holding Time Y N NA
Residual Chlorine Present Y N NA
Cl Strips: ____
Sample pH Acceptable Y N NA
pH Strips: ____
Sulfide Present Y N NA
Lead Acetate Strips: ____

LAB USE ONLY:
Lab Sample # / Comments:

Customer Remarks / Special Conditions / Possible Hazards:
Type of Ice Used: Wet Blue Dry None
Packing Material Used: 516717034381
Radchem sample(s) screened (<500 cpm): Y N NA
SHORT HOLDS PRESENT (<72 hours): Y N N/A
Lab Tracking #: 2673307
Samples received via: FEDEX UPS Client Courier Pace Courier

Lab Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#:
Cooler 1 Temp Upon Receipt: ____oC
Cooler 1 Therm Corr. Factor: ____oC
Cooler 1 Corrected Temp: ____oC
Comments:
1.5E34 22cpm
Trip Blank Received: Y N NA
HCL MeOH TSP Other

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:
[signature]	6/22/21 1115		
FedEx	6-24-21 1010	Lauren Heller	6-24-21 1010

MTJL LAB USE ONLY
Table #:
Acctnum:
Template:
Prelogin:
PM:
PB:

Non Conformance(s): YES / NO
Page: ____ of: ____

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SAMPLE RECEIVING CHECKLIST

* 2 2 1 0 6 2 5 6 2 *

SAMPLE DELIVERY GROUP 221062562	
Client **PM** RWe wsp-c - WSP Environmental & Energy	**Transport Method** FEDEX
Profile Number 284637	**Received By** McCune, Dodie N.
Line Item(s) 1 - water	**Receive Date(s)** 06/24/21

CHECKLIST	YES	NO
Samples received with proper thermal preservation?	☑	☐
Radioactivity is <1600 cpm? If no, record cpm value in notes section.	☑	☐
COC relinquished and complete (including sampleIDs, collect times, and sampler)?	☑	☐
All containers received in good condition and within hold time?	☑	☐
All sample labels and containers received match the chain of custody?	☑	☐
Preservative added to any containers?	☐	☑
If received, was headspace for VOC water containers < 6mm?	☑	☐
Samples collected in containers provided by Pace Gulf Coast?	☑	☐

COOLERS

Airbill Thermometer ID: E34	Temp °C
5167 1703 4381	1.5

DISCREPANCIES

None

LAB PRESERVATIONS

None

NOTES

Revision 1.6 Page 1 of 1

microbialinsights
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Fax: (865) 573-8133

Client: Jeffrey Baker
WSP USA Buildings Inc.
2202 N Westshore Blvd
Suite 300
Tampa, FL 33607

Phone: 724-882-9723

Fax:

Identifier: 090SH **Date Rec:** 08/26/2021 **Report Date:** 09/24/2021

Client Project #: 31401545.001 Task 5 **Client Project Name:** Former Emerson Power

Purchase Order #: 047QL

Test results provided for: PLFA

Reviewed By:

Kate Clark

MICROBIAL INSIGHTS, INC.

10515 Research Dr., Knoxville, TN 37932
Tel. (865) 573-8188 Fax. (865) 573-8133

PLFA

Client:	**WSP USA Buildings Inc.**	**MI Project Number:**	**090SH**
Project:	Former Emerson Power	Date Received:	08/26/2021

Sample Information

Sample Name:	**MW-5-40**
Sample Date:	08/25/2021
Sample Matrix:	Std. Bio-Trap
Analyst/Reviewer:	AT/KC

Biomass

Total Biomass (cells/mL)	**6.95E+06**

Community Structure (% total PLFA)

Firmicutes (TerBrSats)	**9.50**
Proteobacteria (Monos)	**49.99**
Anaerobic metal reducers (BrMonos)	**16.69**
SRB/Actinomycetes (MidBrSats)	**1.32**
General (Nsats)	**22.31**
Eukaryotes (polyenoics)	**0.19**

Physiological Status (Proteobacteria only)

Slowed Growth	**0.29**
Decreased Permeability	**0.14**

Legend:
NA = Not Analyzed NS = Not Sampled

MICROBIAL INSIGHTS, INC.

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Tel. (865) 573-8188 Fax. (865) 573-8133

PLFA

Client: **WSP USA Buildings Inc.**
Project: Former Emerson Power

MI Project Number: **090SH**
Date Received: 08/26/2021

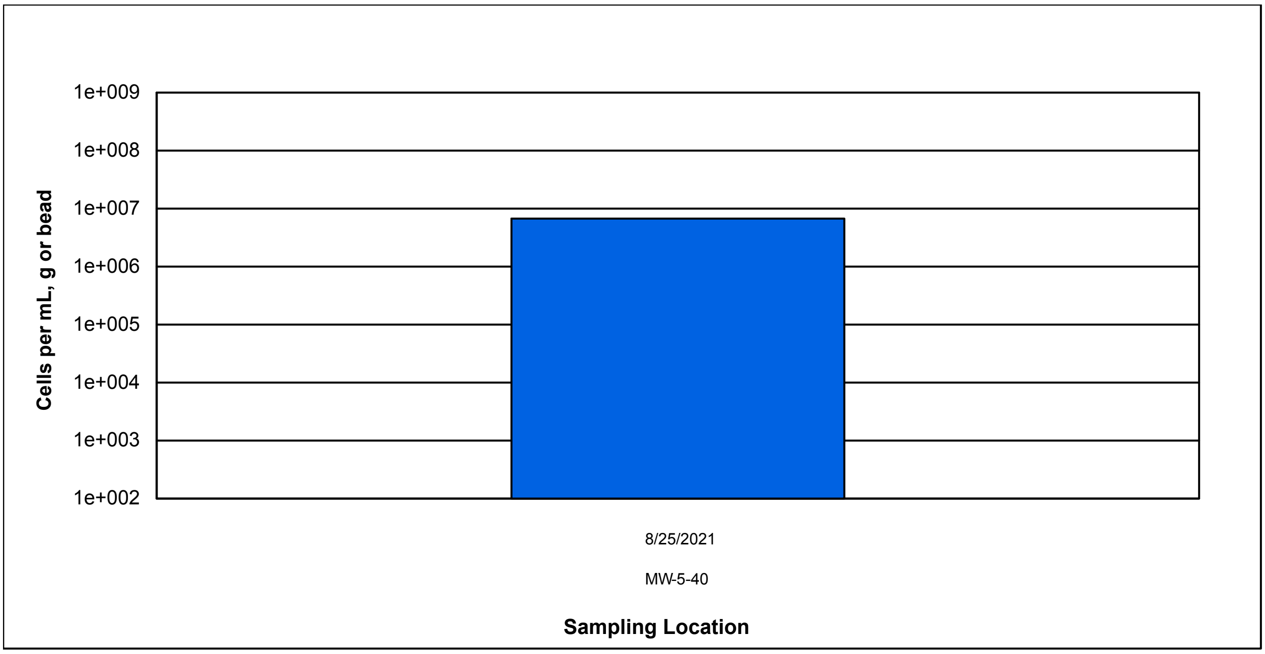

Figure 1. Biomass content is presented as a cell equivalent based on the total amount of phospholipid fatty acids (PLFA) extracted from a given sample. Total biomass is calculated based upon PLFA attributed to bacterial and eukaryotic biomass

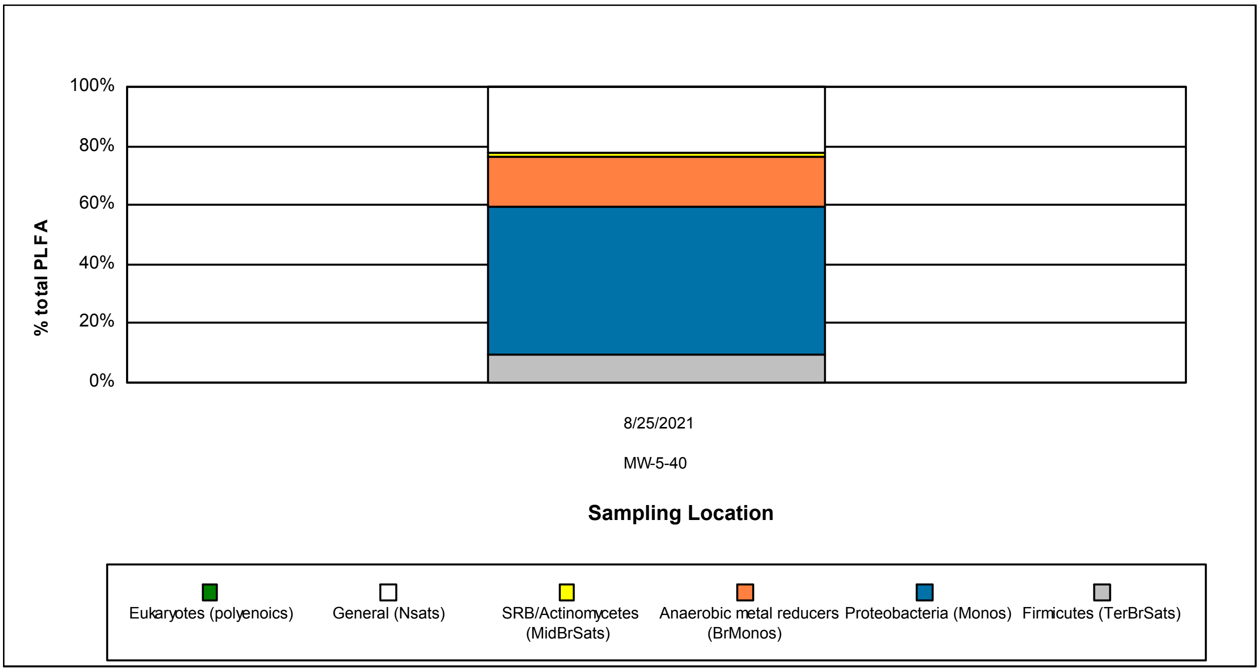

Figure 2. Relative percentages of total PLFA structural groups in the samples analyzed. Structural groups are assigned according to PLFA chemical structure, which is related to fatty acid biosynthesis.

Quality Assurance/Quality Control Data

Samples Received **8/26/2021**

Component	Date Prepared	Date Analyzed	Arrival Temperature	Positive Control	Extraction Blank	Negative Control
PLFA	08/26/2021	09/23/2021	23 °C	100%		non-detect

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SITE LOGIC Report

QuantArray®-Chlor Study

Contact: Jeffrey Baker

Phone: 724-882-9723

Address: WSP USA
2202 N West Shore Blvd
Suite 300
Tampa, FL 33607

Email: jeffrey.baker@wsp.com

MI Identifier: 122SI

Report Date: 10/07/2021

Project: Former EPT Ithaca, 31401545.001 Task 5

Comments:

The QuantArray®-Chlor Approach

Quantification of *Dehalococcoides*, the only known bacterial group capable of complete reductive dechlorination of PCE and TCE to ethene, has become an indispensable component of assessment, remedy selection, and performance monitoring at sites impacted by chlorinated solvents. While undeniably a key group of halorespiring bacteria, *Dehalococcoides* are not the only bacteria of interest in the subsurface because reductive dechlorination is not the only potential biodegradation pathway operative at contaminated sites, and chlorinated ethenes are not always the primary contaminants of concern. The QuantArray®-Chlor not only includes a variety of halorespiring bacteria (*Dehalococcoides*, *Dehalobacter*, *Dehalogenimonas*, etc.) to assess the potential for reductive dechlorination of chloroethenes, chloroethanes, chlorobenzenes, chlorophenols, and chloroform, but also provides quantification of functional genes involved in aerobic (co)metabolic pathways for biodegradation of chlorinated solvents and even competing biological processes. Thus, the QuantArray®-Chlor will give site managers the ability to simultaneously yet economically evaluate the potential for biodegradation of a spectrum of common chlorinated contaminants through a multitude of anaerobic and aerobic (co) metabolic pathways to give a much more clear and comprehensive view of contaminant biodegradation.

The QuantArray®-Chlor is used to quantify specific microorganisms and functional genes to evaluate the following:

Anaerobic Reductive Dechlorination	Quantification of important halorespiring bacteria (e.g. *Dehalococcoides*, *Dehalobacter*, *Dehalogenimonas*, *Desulfitobacterium* spp.) and key functional genes (e.g. vinyl chloride reductases, TCE reductase, chloroform reductase) responsible for reductive dechlorination of a broad spectrum of chlorinated solvents.
Aerobic Cometabolism	Several different types of bacteria including methanotrophs and some toluene/phenol utilizing bacteria can co-oxidize TCE, DCE, and vinyl chloride. The QuantArray®-Chlor quantifies functional genes like soluble methane monooxygenase encoding enzymes capable of co-oxidation of chlorinated ethenes.
Aerobic (Co)metabolism of Vinyl Chloride	Ethene oxidizing bacteria are capable of cometabolism of vinyl chloride. In some cases, ethenotrophs can also utilize vinyl chloride as a growth supporting substrate. The QuantArray®-Chlor targets key functional genes in ethene metabolism.

How do QuantArrays® work?

The QuantArray®-Chlor in many respects is a hybrid technology combining the highly parallel detection of microarrays with the accurate and precise quantification provided by qPCR into a single platform. The key to highly parallel qPCR reactions is the nanoliter fluidics platform for low volume, solution phase qPCR reactions.

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How are QuantArray® results reported?

One of the primary advantages of the QuantArray®-Chlor is the simultaneous quantification of a broad spectrum of different microorganisms and key functional genes involved in a variety of pathways for chlorinated hydrocarbon biodegradation. However, highly parallel quantification combined with the various metabolic and cometabolic capabilities of different target organisms can complicate data presentation. Therefore, in addition to Summary Tables, QuantArray® results will be presented as Microbial Population Summary and Comparison Figures to aid in data interpretation and subsequent evaluation of site management activities.

Types of Tables and Figures:

Microbial Population Summary	Figure presenting the concentrations of QuantArray®-Chlor target populations (e.g. *Dehalococcoides*) and functional genes (e.g. vinyl chloride reductase) relative to typically observed values.
Summary Tables	Tables of target population concentrations grouped by biodegradation pathway and contaminant type.
Comparison Figures	Depending on the project, sample results can be presented to compare changes over time or examine differences in microbial populations along a transect of the dissolved plume.

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Results

Table 1: Summary of the QuantArray®-Chlor results obtained for sample MW-5-40.

Sample Name	**MW-5-40**
Sample Date	**09/22/2021**
Reductive Dechlorination	cells/bead
Dehalococcoides (DHC)	**3.04E+04**
tceA Reductase (TCE)	**1.81E+02**
BAV1 Vinyl Chloride Reductase (BVC)	**3.15E+03**
Vinyl Chloride Reductase (VCR)	**3.20E+02**
Dehalobacter spp. (DHBt)	**4.15E+04**
Dehalobacter DCM (DCM)	**1.38E+03**
Dehalogenimonas spp. (DHG)	<2.50E+02
cerA Reductase (CER)	<2.50E+02
trans-1,2-DCE Reductase (TDR)	<2.50E+02
Desulfitobacterium spp. (DSB)	**4.90E+04**
Dehalobium chlorocoercia (DECO)	**5.75E+02**
Desulfuromonas spp. (DSM)	**4.97E+04**
PCE Reductase (PCE-1)	**1.95E+03**
PCE Reductase (PCE-2)	**2.85E+04**
Chloroform Reductase (CFR)	<2.50E+02
1,1 DCA Reductase (DCA)	<2.50E+02
1,2 DCA Reductase (DCAR)	<2.50E+02
Aerobic (Co)Metabolic	
Soluble Methane Monooxygenase (SMMO)	<2.50E+02
Toluene Dioxygenase (TOD)	**9.57E+03**
Phenol Hydroxylase (PHE)	**1.18E+05**
Trichlorobenzene Dioxygenase (TCBO)	<2.50E+02
Toluene Monooxygenase 2 (RDEG)	**5.03E+02**
Toluene Monooxygenase (RMO)	**2.25E+04**
Ethene Monooxygenase (EtnC)	**9.42E+02**
Epoxyalkane Transferase (EtnE)	**4.36E+03**
Dichloromethane Dehalogenase (DCMA)	<2.50E+02
Other	
Total Eubacteria (EBAC)	**2.03E+07**
Sulfate Reducing Bacteria (APS)	**1.55E+05**
Methanogens (MGN)	**4.83E+02**

Legend:
NA = Not Analyzed
NS = Not Sampled
J = Estimated Gene Copies Below PQL but Above LQL
I = Inhibited
< = Result Not Detected

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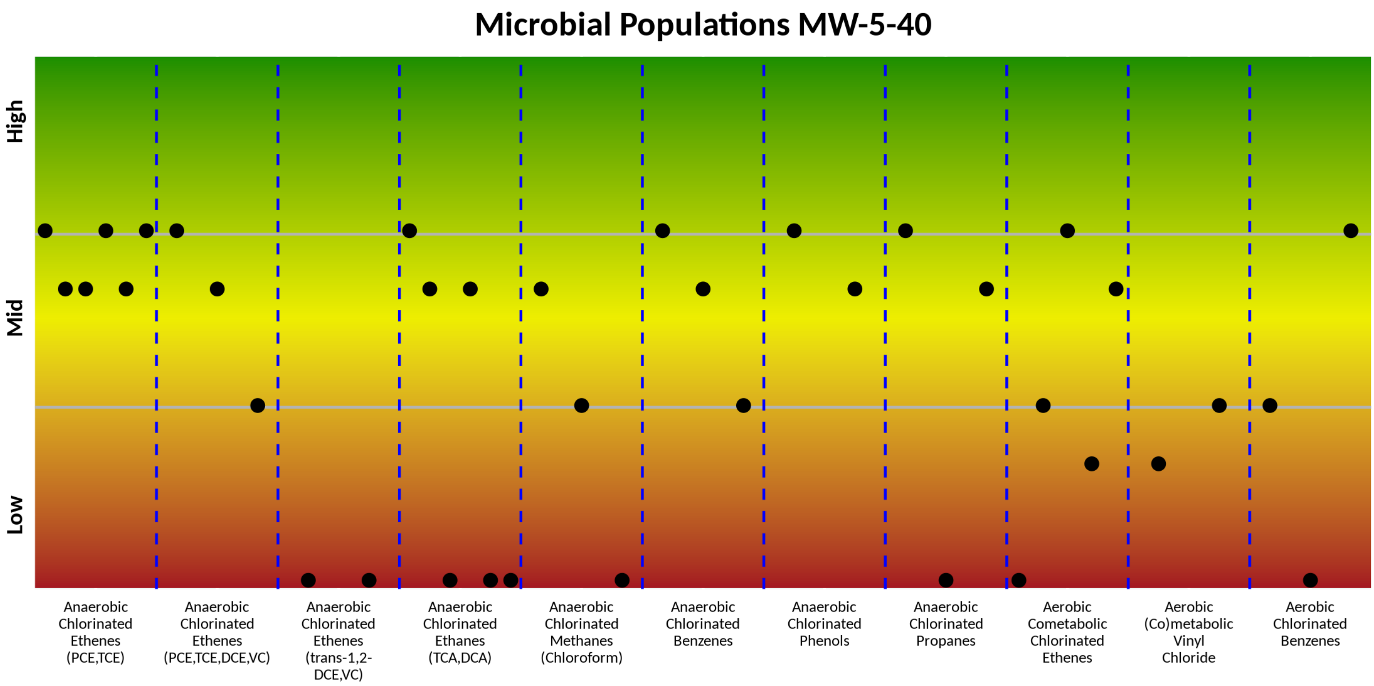

Figure 1: Microbial population summary to aid in evaluating potential pathways and biodegradation of specific contaminants.

Anaerobic - Reductive Dechlorination or Dichloroelimination		Aerobic - (Co)metabolism	
Chlorinated Ethenes (PCE, TCE)	DHC, DHBt, DSB, DSM, PCE-1, PCE-2	Chlorinated Ethenes (TCE,DCE,VC)	sMMO, TOD, PHE, RDEG, RMO
Chlorinated Ethenes (PCE, TCE, DCE, VC)	DHC, BVC, VCR	(Co)metabolic Vinyl Chloride	etnC, etnE
Chlorinated Ethenes (trans-1,2-DCE, VC)	TDR, CER	Chlorinated Benzenes	TOD, TCBO, PHE
Chlorinated Ethanes (TCA and 1,2-DCA)	DHC, DHBt, DHG, DSB[1], DCA, DCAR		
Chlorinated Methanes (Chloroform)	DHBt, DCM, CFR		
Chlorinated Benzenes	DHC, DHBt[2], DECO		
Chlorinated Phenols	DHC, DSB		
Chlorinated Propanes	DHC, DHG, DSB[1]		

[1] *Desulfitobacterium dichloroeliminans* DCA1. [2] Implicated in reductive dechlorination of dichlorobenzene and potentially chlorobenzene.

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Table 2: Summary of the QuantArray®-Chlor results for microorganisms responsible for reductive dechlorination for samples MW-5-40.

Sample Name	MW-5-40
Sample Date	09/22/2021
Reductive Dechlorination	cells/bead
Dehalococcoides (DHC)	**3.04E+04**
tceA Reductase (TCE)	**1.81E+02**
BAV1 Vinyl Chloride Reductase (BVC)	**3.15E+03**
Vinyl Chloride Reductase (VCR)	**3.20E+02**
Dehalobacter spp. (DHBt)	**4.15E+04**
Dehalobacter DCM (DCM)	**1.38E+03**
Dehalogenimonas spp. (DHG)	<2.50E+02
Desulfitobacterium spp. (DSB)	**4.90E+04**
Dehalobium chlorocoercia (DECO)	**5.75E+02**
Desulfuromonas spp. (DSM)	**4.97E+04**

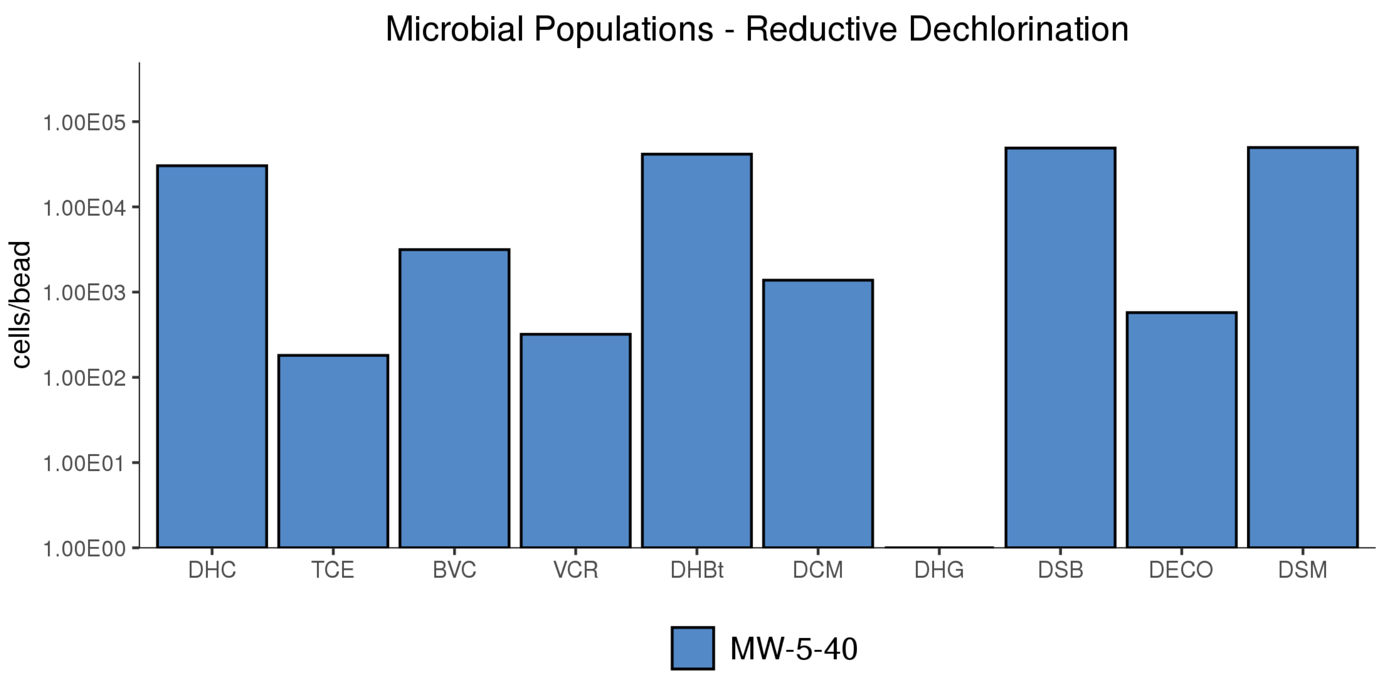

Figure 2: Comparison - microbial populations involved in reductive dechlorination.

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Fax: 865.573.8133
Web: www.microbe.com

Table 3: Summary of the QuantArray®-Chlor results for microorganisms responsible for reductive dechlorination for samples MW-5-40.

Sample Name	MW-5-40
Sample Date	09/22/2021
Reductive Dechlorination	cells/bead
Chloroform Reductase (CFR)	<2.50E+02
1,1 DCA Reductase (DCA)	<2.50E+02
1,2 DCA Reductase (DCAR)	<2.50E+02
PCE Reductase (PCE-1)	**1.95E+03**
PCE Reductase (PCE-2)	**2.85E+04**
Dehalogenimonas trans-1,2-DCE Reductase (TDR)	<2.50E+02
Dehalogenimonas cerA Reductase (CER)	<2.50E+02

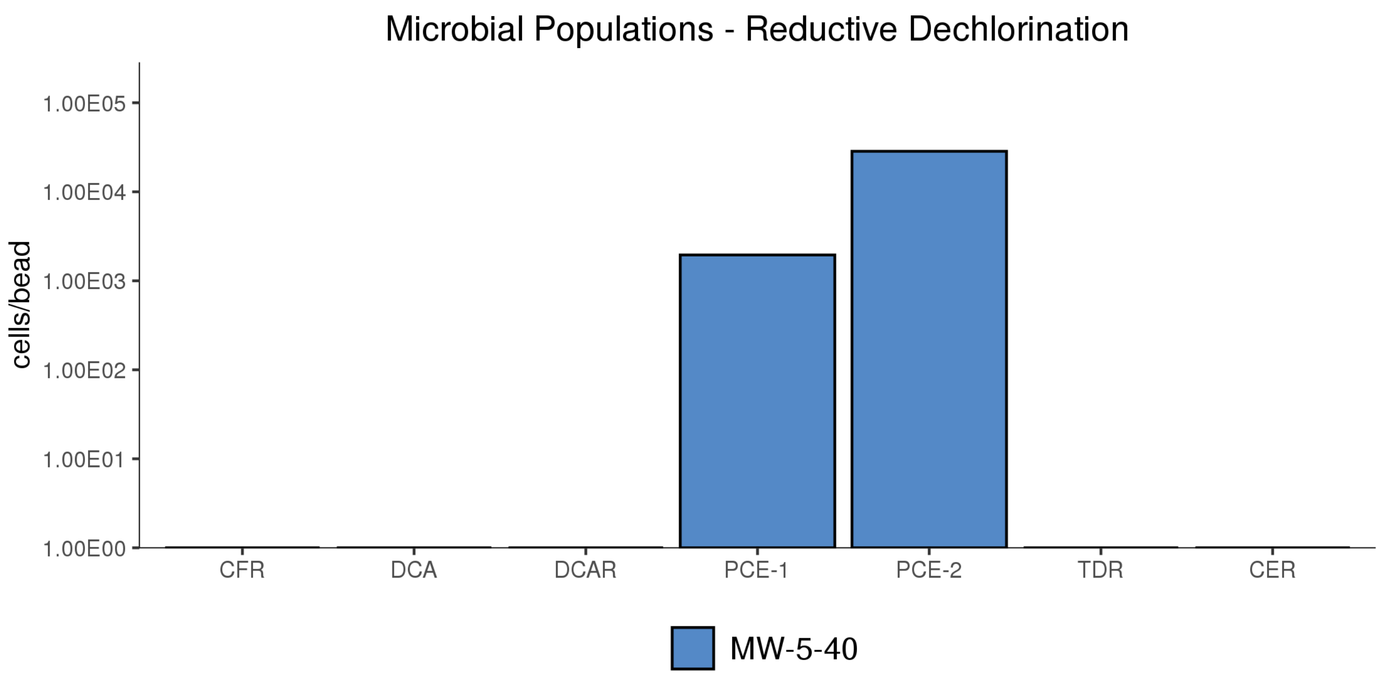

Figure 3: Comparison - microbial populations involved in reductive dechlorination.

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Table 4: Summary of the QuantArray®-Chlor results for microorganisms responsible for aerobic (co)metabolism for samples MW-5-40.

Sample Name	**MW-5-40**
Sample Date	**09/22/2021**
Aerobic (Co)Metabolic	cells/bead
Soluble Methane Monooxygenase (SMMO)	<2.50E+02
Toluene Dioxygenase (TOD)	**9.57E+03**
Phenol Hydroxylase (PHE)	**1.18E+05**
Trichlorobenzene Dioxygenase (TCBO)	<2.50E+02
Toluene Monooxygenase 2 (RDEG)	**5.03E+02**
Toluene Monooxygenase (RMO)	**2.25E+04**
Ethene Monooxygenase (EtnC)	**9.42E+02**
Epoxyalkane Transferase (EtnE)	**4.36E+03**
Dichloromethane Dehalogenase (DCMA)	<2.50E+02

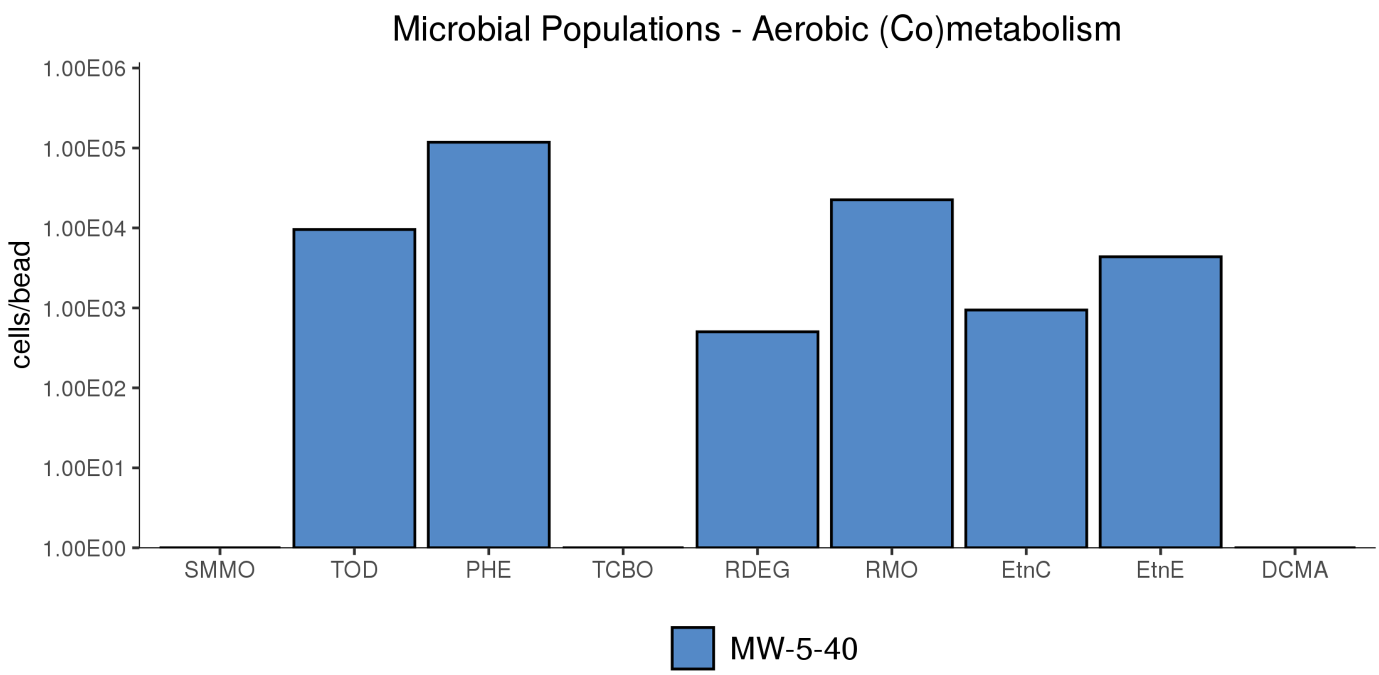

Figure 4: Comparison - microbial populations involved in aerobic (co)metabolism.

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Table 5: Summary of the QuantArray®-Chlor results for total bacteria and other populations for samples MW-5-40.

Sample Name	MW-5-40
Sample Date	09/22/2021
Other	cells/bead
Total Eubacteria (EBAC)	**2.03E+07**
Sulfate Reducing Bacteria (APS)	**1.55E+05**
Methanogens (MGN)	**4.83E+02**

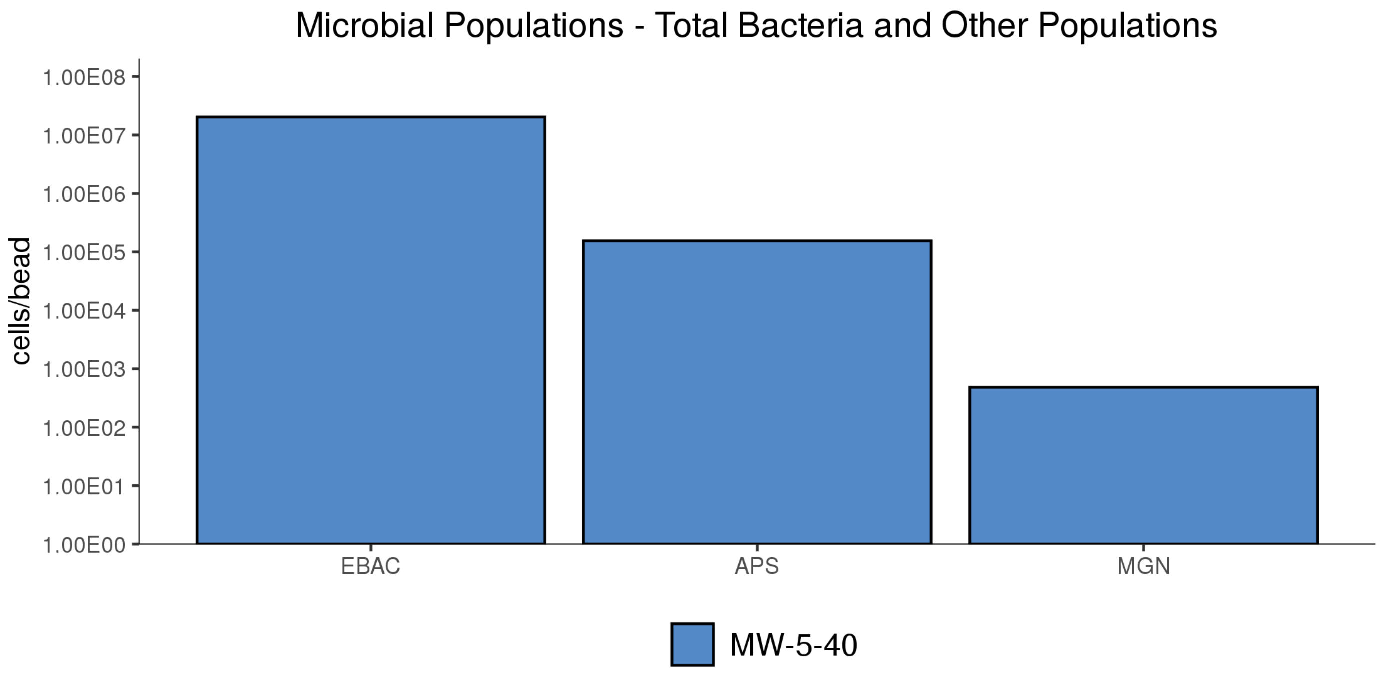

Figure 5: Comparison - microbial populations.

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Interpretation

The overall purpose of the QuantArray®-Chlor is to give site managers the ability to simultaneously yet economically evaluate the potential for biodegradation of a spectrum of common chlorinated contaminants through a multitude of anaerobic and aerobic (co)metabolic pathways in order to provide a clearer and more comprehensive view of contaminant biodegradation. The following discussion describes the interpretation of results in general terms and is meant to serve as a guide.

Reductive Dechlorination - Chlorinated Ethenes: While a number of bacterial cultures including *Dehalococcoides*, *Dehalobacter*, *Desulfitobacterium*, and *Desulfuromonas* spp. capable of utilizing PCE and TCE as growth-supporting electron acceptors have been isolated [1–5], *Dehalococcoides* may be the most important because they are the only bacterial group that has been isolated to date which is capable of complete reductive dechlorination of PCE to ethene [6]. In fact, the presence of *Dehalococcoides* has been associated with complete reductive dechlorination to ethene at sites across North America and Europe [7], and Lu et al. [8] have proposed using a *Dehalococcoides* concentration of 1×10^4 cells/mL as a screening criterion to identify sites where biological reductive dechlorination is predicted to proceed at "generally useful" rates.

At chlorinated ethene sites, any "stall" leading to the accumulation of daughter products, especially vinyl chloride, would be a substantial concern. While *Dehalococcoides* concentrations greater than 1×10^4 cells/mL correspond to ethene production and useful rates of dechlorination, the range of chlorinated ethenes degraded varies by strain within the *Dehalococcoides* genus [6, 9], and the presence of co-contaminants and competitors can have complex impacts on the halorespiring microbial community [10–15]. Therefore, QuantArray®-Chlor also provides quantification of a suite of reductive dehalogenase genes (PCE, TCE, BVC, VCR, CER, and TDR) to more definitively confirm the potential for reductive dechlorination of all chlorinated ethene compounds including vinyl chloride.

Perhaps most importantly, QuantArray®-Chlor quantifies TCE reductase (TCE) and both known vinyl chloride reductase genes (BVC, VCR) from *Dehalococcoides* to conclusively evaluate the potential for complete reductive dechlorination of chlorinated ethenes to non-toxic ethene [16–18]. In addition, the analysis also includes quantification of reductive dehalogenase genes from *Dehalogenimonas* spp. capable of reductive dechlorination of chlorinated ethenes. More specifically, these are the trans-1,2-DCE dehalogenase gene (TDR) from strain WBC-2 [19] and the vinyl chloride reductase gene (CER) from GP, the only known organisms other than *Dehalococcoides* capable of vinyl chloride reduction [20]. Finally, PCE reductase genes responsible for sequential reductive dechlorination of PCE to *cis*-DCE by *Sulfurospirillum* and *Geobacter* spp. are also quantified. In mixed cultures, evidence increasingly suggests that partial dechlorinators like *Sulfurospirillum* and *Geobacter* may be responsible for the majority of reductive dechlorination of PCE to TCE and *cis*-DCE while *Dehalococcoides* functions more as *cis*-DCE and vinyl chloride reducing specialists [10, 21].

Reductive Dechlorination - Chlorinated Ethanes: Under anaerobic conditions, chlorinated ethanes are susceptible to reductive dechlorination by several groups of halorespiring bacteria including *Dehalobacter*, *Dehalogenimonas*, and *Dehalococcoides*. While the reported range of chlorinated ethanes utilized varies by genus, species, and sometimes at the strain level, several general observations can be made regarding biodegradation pathways and daughter product formation. *Dehalobacter* spp. have been isolated that are capable of sequential reductive dechlorination of 1,1,1-TCA through 1,1-DCA to chloroethane [13]. Biodegradation of 1,1,2-TCA by several halorespiring bacteria including *Dehalobacter* and *Dehalogenimonas* spp. proceeds via dichloroelimination producing vinyl chloride [22–24]. Similarly, 1,2-DCA biodegradation by *Dehalobacter*, *Dehalogenimonas*, and *Dehalococcoides* occurs via dichloroelimination producing ethene. While not utilized by many *Desulfitobacterium* isolates, at least one strain, *Desulfitobacterium dichloroeliminans* strain DCA1, is also capable of dichloroelimination of 1,2-DCA [25]. The 1,2-dichloroethane reductive dehalogenase gene (DCAR) from members of *Desulfitobacterium* and *Dehalobacter* is known to dechlorinate 1,2-DCA to ethene, while the 1,1-dichloroethane reductive dehalogenase (DCA) targets the gene responsible for 1,1-DCA dechlorination in some strains of *Dehalobacter*. In addition to chloroform,chloroform reductase (CFR) has also been shown to be responsible for reductivedechlorination of 1,1,1-TCA [26].

Reductive Dechlorination - Chlorinated Methanes: Chloroform is a common co-contaminant at chlorinated solvent sites and can inhibit reductive dechlorination of chlorinated ethenes. Grostern et al. demonstrated that a *Dehalobacter* population was capable of reductive dechlorination of chloroform to produce dichloromethane [27]. The *cfrA* gene encodes the reductase which catalyzes this initial step in chloroform biodegradation [26]. Justicia-Leon et al. have since shown that dichloromethane can support growth of a distinct group of *Dehalobacter* strains via fermentation [28]. The *Dehalobacter* DCM assay targets the 16S rRNA gene of these strains.

Reductive Dechlorination - Chlorinated Benzenes: Chlorinated benzenes are an important class of industrial solvents and chemical intermediates in the production of drugs, dyes, herbicides, and insecticides. The physical-chemical properties of chlorinated benzenes as well as susceptibility to biodegradation are functions of their degree of chlorination and the positions of chlorine substituents. Under anaerobic conditions, reductive dechlorination of higher chlorinated benzenes including hexachlorobenzene (HCB),

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pentachlorobenzene (PeCB), tetrachlorobenzene (TeCB) isomers, and trichlorobenzene (TCB) isomers has been well documented [29], although biodegradation of individual compounds and isomers varies between isolates. For example, *Dehalococcoides* strain CBDB1 reductively dechlorinats HCB, PeCB, all three TeCB isomers, 1,2,3-TCB, and 1,2,4-TCB [9, 30]. *Dehalobium chlorocoercia* DF-1 has been shown to be capable of reductive dechlorination of HCB, PeCB, and 1,2,3,5-TeCB [31]. The dichlorobenzene (DCB) isomers and chlorobenzene (CB) were considered relatively recalcitrant under anaerobic conditions. However, new evidence has demonstrated reductive dechlorination of DCBs to CB and CB to benzene [32] with corresponding increases in concentrations of *Dehalobacter* spp. [33].

Reductive Dechlorination - Chlorinated Phenols: Pentachlorophenol (PCP) was one of the most widely used biocides in the U.S. and despite residential use restrictions, is still extensively used industrially as a wood preservative. Along with PCP, the tetrachlorophenol and trichlorophenol isomers were also used as fungicides in wood preserving formulations. 2,4-Dichlorophenol and 2,4,5-TCP were used as chemical intermediates in herbicide production (e.g. 2,4-D) and chlorophenols are known byproducts of chlorine bleaching in the pulp and paper industry. While the range of compounds utilized varies by strain, some *Dehalococcoides* isolates are capable of reductive dechlorination of PCP and other chlorinated phenols. For example, *Dehalococcoides* strain CBDB1 is capable of utilizing PCP, all three tetrachlorophenol (TeCP) congeners, all six trichlorophenol (TCP) congeners, and 2,3-dichlorophenol (2,3-DCP). PCP dechlorination by strain CBDB1 produces a mixture of 3,5-DCP, 3,4-DCP, 2,4-DCP, 3-CP, and 4-CP [34]. In the same study, however, *Dehalococcoides* strain 195 dechlorinated a more narrow spectrum of chlorophenols which included 2,3-DCP, 2,3,4-TCP, and 2,3,6-TCP, but no other TCPs or PCP. Similar to *Dehalococcoides*, some species and strains of *Desulfitobacterium* are capable of utilizing PCP and other chlorinated phenols. *Desulfitobacterium hafniense* PCP-1 is capable of reductive dechlorination of PCP to 3-CP [35]. However, the ability to biodegrade PCP is not universal among *Desulfitobacterium* isolates. *Desulfitobacterium* sp. strain PCE1 and *D. chlororespirans* strain Co23, for example, can utilize some TCP and DCP isomers, but not PCP for growth [2, 36].

Reductive Dechlorination - Chlorinated Propanes: *Dehalogenimonas* is a recently described bacterial genus of the phylum Chloroflexi which also includes the well-known chloroethene-respiring *Dehalococcoides* [23]. The *Dehalogenimonas* isolates characterized to date are also halorespiring bacteria, but utilize a rather unique range of chlorinated compounds as electron acceptors including chlorinated propanes (1,2,3-TCP and 1,2-DCP) and a variety of other vicinally chlorinated alkanes including 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, and 1,2-dichloroethane [23].

Aerobic - Chlorinated Ethene Cometabolism: Under aerobic conditions, several different types of bacteria including methane-oxidizing bacteria (methanotrophs), and many benzene, toluene, ethylbenzene, xylene, and (BTEX)-utilizing bacteria can cometabolize or co-oxidize TCE, DCE, and vinyl chloride [37]. In general, cometabolism of chlorinated ethenes is mediated by monooxygenase enzymes with "relaxed' specificity that oxidize a primary (growth supporting) substrate (*e.g.* methane) and co-oxidize the chlorinated compound (*e.g.*TCE). QuantArray®-Chlor provides quantification of a suite of genes encoding oxygenase enzymes capable of co-oxidation of chlorinated ethenes including soluble methane monooxygenase (sMMO). Soluble methane monooxygenases co-oxidize a broad range of chlorinated compounds [38–41] including TCE, *cis*-DCE, and vinyl chloride. Furthermore, soluble methane monooxygenases are generally believed to support greater rates of aerobic cometabolism [40]. QuantArray®-Chlor also quantifies aromatic oxygenase genes encoding ring hydroxylating toluene monooxygenase genes (RMO, RDEG), toluene dioxygenase (TOD) and phenol hydroxylases (PHE) capable of TCE co-oxidation [42–46]. TCE or a degradation product has been shown to induce expression of toluene monooxygenases in some laboratory studies [43, 47] raising the possibility of TCE cometabolism with an alternative (non-aromatic) growth substrate. Moreover, while a number of additional factors must be considered, recent research under ESTCP Project 201584 has shown positive correlations between concentrations of monooxygenase genes (soluble methane monooxygenase, ring hydroxylating monooxygenases, and phenol hydroxylase) and the rate of TCE degradation [48].

Aerobic - Chlorinated Ethane Cometabolism: While less widely studied than cometabolism of chlorinated ethenes, some chlorinated ethanes are also susceptible to co-oxidation. As mentioned previously, soluble methane monooxygenases (sMMO) exhibit very relaxed specificity. In laboratory studies, sMMO has been shown to co-oxidize a number of chlorinated ethanes including 1,1,1-TCA and 1,2-DCA [38, 40].

Aerobic - Vinyl Chloride Cometabolism: Beginning in the early 1990s, numerous microcosm studies demonstrated aerobic oxidation of vinyl chloride under MNA conditions without the addition of exogenous primary substrates. Since then, strains of

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Mycobacterium, *Nocardioides*, *Pseudomonas*, *Ochrobactrum*, and *Ralstonia* species have been isolated which are capable of aerobic growth on both ethene and vinyl chloride (see Mattes et al. [49] for a review). The initial steps in the pathway are the monooxygenase (*etn*ABCD) catalyzed conversion of ethene and vinyl chloride to their respective epoxyalkanes (epoxyethane and chlorooxirane), followed by epoxyalkane:CoM transferase (*etn*E) mediated conjugation and breaking of the epoxide [50].

Aerobic - Chlorinated Benzenes: In general, chlorobenzenes with four or less chlorine groups are susceptible to aerobic biodegradation and can serve as growth-supporting substrates. Toluene dioxygenase (TOD) has a relatively relaxed substrate specificity and mediates the incorporation of both atoms of oxygen into the aromatic ring of benzene and substituted benzenes (toluene and chlorobenzene). Comparison of TOD levels in background and source zone samples from a CB-impacted site suggested that CBs promoted growth of TOD-containing bacteria [51]. In addition, aerobic biodegradation of some trichlorobenzene and even tetrachlorobenzene isomers is initiated by a group of related trichlorobenzene dioxygenase genes (TCBO). Finally, phenol hydroxylases catalyze the continued oxidation and in some cases, the initial oxidation of a variety of monoaromatic compounds. In an independent study, significant increases in numbers of bacteria containing PHE genes corresponded to increases in biodegradation of DCB isomers [51].

Aerobic - Chlorinated Methanes: Many aerobic methylotrophic bacteria, belonging to diverse genera (*Hyphomicrobium*, *Methylobacterium*, *Methylophilus*, *Pseudomonas*, *Paracoccus*, and *Alibacter*) have been isolated which are capable of utilizing dichloromethane (DCM) as a growth substrate. The DCM metabolic pathway in methylotrophic bacteria is initiated by a dichloromethane dehalogenase (DCMA) gene. DCMA is responsible for aerobic biodegradation of dichloromethane by methylotrophs by first producing formaldehyde which is then further oxidized [52]. As discussed in previous sections, soluble methane monooxygenase (sMMO) exhibits relaxed specificity and co-oxidizes a broad spectrum of chlorinated hydrocarbons. In addition to chlorinated ethenes, sMMO has been shown to co-oxidize chloroform in laboratory studies [38, 41].

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microbial insights

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Client: Jeffrey Baker
WSP USA Buildings Inc.
2202 N West Shore Blvd
Suite 300
Tampa, FL 33607

Phone: 724-882-9723

Fax:

Identifier: 123SI **Date Rec:** 09/23/2021 **Report Date:** 11/01/2021

Client Project #: 31401545.001 - 05 **Client Project Name:** Former EPT Ithaca

Purchase Order #: 31401545.001-2021-2

Test results provided for: CSIA

Reviewed By:

MICROBIAL INSIGHTS, INC.

10515 Research Dr., Knoxville, TN 37932
Tel. (865) 573-8188 Fax. (865) 573-8133

CSIA

Client:	**WSP USA Buildings Inc.**	**MI Project Number:**	**123SI**
Project:	Former EPT Ithaca	Date Received:	09/23/2021

Sample Information

Client Sample ID:	**MW-5-40**
Sample Date:	09/22/2021
Analyst/Reviewer:	KK/KK

Carbon	Units	
$^{13}C/^{12}C$ 1,1-DCE (‰)	$\delta^{13}C$, VPDB (‰)	**NA**
$^{13}C/^{12}C$ cis-DCE (‰)	$\delta^{13}C$, VPDB (‰)	**-30.0**
$^{13}C/^{12}C$ PCE (‰)	$\delta^{13}C$, VPDB (‰)	**NA**
$^{13}C/^{12}C$ TCE (‰)	$\delta^{13}C$, VPDB (‰)	**-29.5 (J)**
$^{13}C/^{12}C$ Trans-DCE (‰)	$\delta^{13}C$, VPDB (‰)	**NA**
$^{13}C/^{12}C$ Vinyl Chloride (‰)	$\delta^{13}C$, VPDB (‰)	**-51.2 (J)**

Legend:

NA= Not Analyzed NS=Not Sampled J= Estimated concentration below PQL but above LQL ND= Not Detected

Quality Assurance/Quality Control Data

Samples Received **9/23/2021**

Component	Date Prepared	Date Analyzed	Arrival Temperature	Positive Control (‰ Std. Dev.)*	Blank
$^{13}C/^{12}C$ TCE (‰)	09/23/2021	10/16/2021	0 °C	0.5	Pass
$^{13}C/^{12}C$ cis-DCE (‰)	09/23/2021	10/16/2021	0 °C	0.1	Pass
$^{13}C/^{12}C$ Vinyl Chloride (‰)	09/23/2021	10/16/2021	0 °C	0.1	Pass

* $\delta^{13}C$ positive control values are within +- 0.5‰ of true value.

microbial insights
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Identifier: 123SI **Date Rec:** 09/23/2021 **Report Date:** 11/01/2021

Client Project #: 31401545.001 - 05 **Client Project Name:** Former EPT Ithaca

Purchase Order #: 31401545.001-2021-2

Comments: VOC data received from client on 10/13/2021. Values that were detected but below the LOQ are indicated with a “J”. Compounds expected to be below the CSIA limit of detection (LOD) after required dilutions were not analyzed (NA).

LELAP CERTIFICATE NUMBER: 01955
DOD-ELAP ACCREDITATION NUMBER: 74960

ANALYTICAL RESULTS

PERFORMED BY

Pace Analytical Gulf Coast
7979 Innovation Park Dr.
Baton Rouge, LA 70820
(225) 769-4900

Report Date 10/14/2021

Report # 221092452

Project Emersub 15 31401545.001 Task 5

Samples Collected 9/22/21

Deliver To	***Additional Recipients***
Jeffrey Baker WSP Environment & Energy 7000 East Genessee Building D, 2nd Floor Fayetteville, NY 13066 724-882-7923	Erik Reinert, WSP Environment & Energy Environmental Payable, WSP USA Corp

Revision 1

Laboratory Endorsement

Sample analysis was performed in accordance with approved methodologies provided by the Environmental Protection Agency or other recognized agencies. The samples and their corresponding extracts will be maintained for a period of 30 days unless otherwise arranged. Following this retention period the samples will be disposed in accordance with Pace Gulf Coast's Standard Operating Procedures.

Common Abbreviations that may be Utilized in this Report

ND	Indicates the result was Not Detected at the specified reporting limit
NO	Indicates the sample did not ignite when preliminary test performed for EPA Method 1030
DO	Indicates the result was Diluted Out
MI	Indicates the result was subject to Matrix Interference
TNTC	Indicates the result was Too Numerous To Count
SUBC	Indicates the analysis was Sub-Contracted
FLD	Indicates the analysis was performed in the Field
DL	Detection Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
RE	Re-analysis
CF	HPLC or GC Confirmation
00:01	Reported as a time equivalent to 12:00 AM

Reporting Flags that may be Utilized in this Report

J or I	Indicates the result is between the MDL and LOQ
J	DOD flag on analyte in the parent sample for MS/MSD outside acceptance criteria
U	Indicates the compound was analyzed for but not detected
B or V	Indicates the analyte was detected in the associated Method Blank
Q	Indicates a non-compliant QC Result (See Q Flag Application Report)
*****	Indicates a non-compliant or not applicable QC recovery or RPD – see narrative
E	Organics **-** The result is estimated because it exceeded the instrument calibration range
E	Metals - % diference for the serial dilution is > 10%
L	Reporting Limits adjusted to meet risk-based limit.
P	RPD between primary and confirmation result is greater than 40
DL	Diluted analysis – when appended to Client Sample ID

Sample receipt at Pace Gulf Coast is documented through the attached chain of custody. In accordance with NELAC, this report shall be reproduced only in full and with the written permission of Pace Gulf Coast. The results contained within this report relate only to the samples reported. The documented results are presented within this report.

This report pertains only to the samples listed in the Report Sample Summary and should be retained as a permanent record thereof. The results contained within this report are intended for the use of the client. Any unauthorized use of the information contained in this report is prohibited.

I certify that this data package is in compliance with The NELAC Institute (TNI) Standard 2009 and terms and conditions of the contract and Statement of Work both technically and for completeness, for other than the conditions in the case narrative. Release of the data contained in this hardcopy data package and in the computer readable data submitted has been authorized by the Quality Assurance Manager or his/her designee, as verified by the following signature.

Estimated uncertainty of measurement is available upon request. This report is in compliance with the DOD QSM as specified in the contract if applicable.

Authorized Signature
Pace Gulf Coast Report 221092452

Revision 1

Certifications

Certification	Certification Number
DOD ELAP	74960
Alabama	01955
Arkansas	88-0655
Colorado	01955
Delaware	01955
Florida	E87854
Georgia	01955
Hawaii	01955
Idaho	01955
Illinois	200048
Indiana	01955
Kansas	E-10354
Kentucky	95
Louisiana	01955
Maryland	01955
Massachusetts	01955
Michigan	01955
Mississippi	01955
Missouri	01955
Montana	N/A
Nebraska	01955
New Mexico	01955
North Carolina	618
North Dakota	R-195
Oklahoma	9403
South Carolina	73006001
South Dakota	01955
Tennessee	01955
Texas	T104704178
Vermont	01955
Virginia	460215
Washington	C929
USDA Soil Permit	P330-16-00234

Revision 1

Case Narrative

Client: WSP Environmental & Energy **Report:** 221092452

Pace Analytical Gulf Coast received and analyzed the sample(s) listed on the Report Sample Summary page of this report. Receipt of the sample(s) is documented by the attached chain of custody. This applies only to the sample(s) listed in this report. No sample integrity or quality control exceptions were identified unless noted below.

This report resubmitted on 10/14/21 to revise the client sample ID for sample 22109245201 (MW-5-40).

VOLATILES MASS SPECTROMETRY

In the EPA 8260C analysis for analytical batch 722728, the LCS and/or LCSD recoveries are above the upper control limit for Bromomethane. This analyte was not detected in the associated samples.

VOLATILES GAS CHROMATOGRAPHY

The RSK175 analysis was performed one day outside holding time. The sample was set up to run within holding time but an unexpected issue with the autosampler caused the run to stop mid-sequence. Maintenance was performed and the run was restarted the next morning.

Revision 1

Sample Summary

Lab ID	Client ID	Matrix	Collect Date	Receive Date
22109245201	MW-5-40	Water	9/22/21 10:42	9/23/21 11:20
22109245202	MW-46-43C	Water	9/22/21 13:52	9/23/21 11:20

Revision 1

Detect Summary

Results and Detection Limits are adjusted for dilution and moisture when applicable

AM23G

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22109245201	MW-5-40	Acetic Acid	mg/L	5.0	10	NA
22109245201	MW-5-40	Formic Acid	mg/L	45	10	NA
22109245201	MW-5-40	Propionic Acid	mg/L	0.75J	10	NA
22109245202	MW-46-43C	Acetic Acid	mg/L	86	10	NA
22109245202	MW-46-43C	Butyric Acid	mg/L	2.0J	10	NA
22109245202	MW-46-43C	Formic Acid	mg/L	49	10	NA
22109245202	MW-46-43C	Pentanoic Acid	mg/L	0.68J	10	NA
22109245202	MW-46-43C	Propionic Acid	mg/L	46	10	NA

SM 2320 B-2011

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22109245201	MW-5-40	Total Alkalinity	mg/L CaCO3	170	1	NA
22109245202	MW-46-43C	Total Alkalinity	mg/L CaCO3	452	1	NA

SM 5310 B-2011

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22109245201	MW-5-40	Total Organic Carbon	mg/L	10.0	1	NA
22109245202	MW-46-43C	Total Organic Carbon	mg/L	85.0	2	NA

EPA 8260C

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22109245201	MW-5-40	cis-1,2-Dichloroethene	ug/L	9660	100	NA
22109245201	MW-5-40	trans-1,2-Dichloroethene	ug/L	47.6J	100	NA
22109245201	MW-5-40	Trichloroethene	ug/L	294	100	NA
22109245201	MW-5-40	Vinyl chloride	ug/L	1650	100	NA
22109245202	MW-46-43C	cis-1,2-Dichloroethene	ug/L	6480	100	NA
22109245202	MW-46-43C	trans-1,2-Dichloroethene	ug/L	84.0J	100	NA
22109245202	MW-46-43C	Vinyl chloride	ug/L	15100	100	NA

EPA RSK175

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22109245201	MW-5-40	Ethane	ug/L	12	1	NA
22109245201	MW-5-40	Ethene	ug/L	42	1	NA
22109245201	MW-5-40	Methane	ug/L	2100	1	NA
22109245202	MW-46-43C	Ethane	ug/L	22	1	NA
22109245202	MW-46-43C	Ethene	ug/L	1600	1	NA
22109245202	MW-46-43C	Methane	ug/L	4900	1	NA

EPA RSK-175

Lab ID	Client ID	Parameter	Units	Result	Dil.	%Moist
22109245201	MW-5-40	Carbon Dioxide	ug/L	13500	1	NA

Revision 1

Detect Summary (Continued)

Results and Detection Limits are adjusted for dilution and moisture when applicable

EPA RSK-175						
Lab ID	**Client ID**	**Parameter**	**Units**	**Result**	**Dil.**	**%Moist**
22109245202	MW-46-43C	Carbon Dioxide	ug/L	68100	10	NA

Revision 1

Sample Results

MW-5-40	Collect Date	09/22/2021 10:42	Lab ID	22109245201
	Receive Date	09/23/2021 11:20	Matrix	Water

EPA 8260C

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	100	10/06/21 19:49	722728	SMS	

CAS#	Parameter	Result	DL	LOQ	Units
630-20-6	1,1,1,2-Tetrachloroethane	20.0U	20.0	100	ug/L
71-55-6	1,1,1-Trichloroethane	20.0U	20.0	100	ug/L
79-34-5	1,1,2,2-Tetrachloroethane	20.0U	20.0	100	ug/L
79-00-5	1,1,2-Trichloroethane	20.0U	20.0	100	ug/L
75-34-3	1,1-Dichloroethane	20.0U	20.0	100	ug/L
75-35-4	1,1-Dichloroethene	20.0U	20.0	100	ug/L
563-58-6	1,1-Dichloropropene	20.0U	20.0	100	ug/L
96-18-4	1,2,3-Trichloropropane	20.0U	20.0	100	ug/L
120-82-1	1,2,4-Trichlorobenzene	20.0U	20.0	100	ug/L
95-63-6	1,2,4-Trimethylbenzene	20.0U	20.0	100	ug/L
96-12-8	1,2-Dibromo-3-chloropropane	20.0U	20.0	100	ug/L
106-93-4	1,2-Dibromoethane	20.0U	20.0	100	ug/L
95-50-1	1,2-Dichlorobenzene	20.0U	20.0	100	ug/L
107-06-2	1,2-Dichloroethane	20.0U	20.0	100	ug/L
78-87-5	1,2-Dichloropropane	20.0U	20.0	100	ug/L
108-67-8	1,3,5-Trimethylbenzene	20.0U	20.0	100	ug/L
541-73-1	1,3-Dichlorobenzene	20.0U	20.0	100	ug/L
142-28-9	1,3-Dichloropropane	20.0U	20.0	100	ug/L
106-46-7	1,4-Dichlorobenzene	20.0U	20.0	100	ug/L
594-20-7	2,2-Dichloropropane	20.0U	20.0	100	ug/L
78-93-3	2-Butanone	20.0U	20.0	500	ug/L
110-75-8	2-Chloroethylvinyl ether	100U	100	500	ug/L
95-49-8	2-Chlorotoluene	20.0U	20.0	100	ug/L
591-78-6	2-Hexanone	50.0U	50.0	500	ug/L
106-43-4	4-Chlorotoluene	20.0U	20.0	100	ug/L
99-87-6	4-Isopropyltoluene	20.0U	20.0	100	ug/L
108-10-1	4-Methyl-2-pentanone	20.0U	20.0	500	ug/L
67-64-1	Acetone	50.0U	50.0	500	ug/L
107-02-8	Acrolein	250U	250	2500	ug/L
107-13-1	Acrylonitrile	100U	100	2500	ug/L
71-43-2	Benzene	20.0U	20.0	100	ug/L
108-86-1	Bromobenzene	20.0U	20.0	100	ug/L
74-97-5	Bromochloromethane	20.0U	20.0	100	ug/L
75-27-4	Bromodichloromethane	20.0U	20.0	100	ug/L
75-25-2	Bromoform	25.0U	25.0	100	ug/L
74-83-9	Bromomethane	50.0U	50.0	100	ug/L
75-15-0	Carbon disulfide	20.0U	20.0	100	ug/L
56-23-5	Carbon tetrachloride	25.0U	25.0	100	ug/L
108-90-7	Chlorobenzene	20.0U	20.0	100	ug/L
75-00-3	Chloroethane	25.0U	25.0	100	ug/L
67-66-3	Chloroform	20.0U	20.0	100	ug/L
74-87-3	Chloromethane	20.0U	20.0	100	ug/L
156-59-2	**cis-1,2-Dichloroethene**	**9660**	**20.0**	**100**	**ug/L**
10061-01-5	cis-1,3-Dichloropropene	20.0U	20.0	100	ug/L
124-48-1	Dibromochloromethane	20.0U	20.0	100	ug/L
74-95-3	Dibromomethane	25.0U	25.0	100	ug/L
75-71-8	Dichlorodifluoromethane	20.0U	20.0	100	ug/L
100-41-4	Ethylbenzene	20.0U	20.0	100	ug/L
87-68-3	Hexachlorobutadiene	50.0U	50.0	500	ug/L
98-82-8	Isopropylbenzene (Cumene)	20.0U	20.0	100	ug/L
m,p-Xylene	m,p-Xylene	20.0U	20.0	200	ug/L
74-88-4	Methyl iodide	50.0U	50.0	500	ug/L
75-09-2	Methylene chloride	20.0U	20.0	500	ug/L

Revision 1

Sample Results

MW-5-40	Collect Date	09/22/2021 10:42	Lab ID	22109245201
	Receive Date	09/23/2021 11:20	Matrix	Water

EPA 8260C (Continued)

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	100	10/06/21 19:49	722728	SMS	

CAS#	Parameter	Result	DL	LOQ	Units
91-20-3	Naphthalene	20.0U	20.0	500	ug/L
104-51-8	n-Butylbenzene	20.0U	20.0	100	ug/L
103-65-1	n-Propylbenzene	100U	100	500	ug/L
95-47-6	o-Xylene	20.0U	20.0	100	ug/L
135-98-8	sec-Butylbenzene	20.0U	20.0	100	ug/L
100-42-5	Styrene	20.0U	20.0	100	ug/L
1634-04-4	tert-Butyl methyl ether (MTBE)	20.0U	20.0	100	ug/L
98-06-6	tert-Butylbenzene	20.0U	20.0	100	ug/L
127-18-4	Tetrachloroethene	20.0U	20.0	100	ug/L
108-88-3	Toluene	20.0U	20.0	100	ug/L
156-60-5	**trans-1,2-Dichloroethene**	**47.6J**	**20.0**	**100**	**ug/L**
10061-02-6	trans-1,3-Dichloropropene	20.0U	20.0	100	ug/L
110-57-6	trans-1,4-Dichloro-2-butene	50.0U	50.0	500	ug/L
79-01-6	**Trichloroethene**	**294**	**20.0**	**100**	**ug/L**
75-69-4	Trichlorofluoromethane	20.0U	20.0	100	ug/L
76-13-1	Trichlorotrifluoroethane	20.0U	20.0	100	ug/L
108-05-4	Vinyl acetate	20.0U	20.0	100	ug/L
75-01-4	**Vinyl chloride**	**1650**	**20.0**	**100**	**ug/L**

CAS#	Surrogate	Conc. Spiked	Conc. Rec	Units	% Recovery	%Rec Limits
460-00-4	4-Bromofluorobenzene	5000	5010	ug/L	100	78 - 130
1868-53-7	Dibromofluoromethane	5000	5030	ug/L	101	77 - 127
2037-26-5	Toluene d8	5000	5300	ug/L	106	76 - 134
17060-07-0	1,2-Dichloroethane-d4	5000	4860	ug/L	97	71 - 127

EPA RSK-175

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	10/05/21 12:54	722588	BMR	

CAS#	Parameter	Result	DL	LOQ	Units
124-38-9	**Carbon Dioxide**	**13500**	**127**	**900**	**ug/L**

AM23G

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	10	10/06/21 03:31	722630	SLL2	

CAS#	Parameter	Result	DL	LOQ	Units
64-19-7	**Acetic Acid**	**5.0**	**1.2**	**5.0**	**mg/L**
107-92-6	Butyric Acid	0.58U	0.58	5.0	mg/L
64-18-6	**Formic Acid**	**45**	**0.55**	**5.0**	**mg/L**
142-62-1	Hexanoic Acid	0.58U	0.58	5.0	mg/L
646-07-1	i-Hexanoic Acid	0.56U	0.56	5.0	mg/L
503-74-2	i-Pentanoic Acid	0.61U	0.61	5.0	mg/L
50-21-5	Lactic Acid	0.53U	0.53	5.0	mg/L
109-52-4	Pentanoic Acid	0.56U	0.56	5.0	mg/L
79-09-4	**Propionic Acid**	**0.75J**	**0.53**	**5.0**	**mg/L**

Sample Results

MW-5-40	Collect Date	09/22/2021 10:42	Lab ID	22109245201
	Receive Date	09/23/2021 11:20	Matrix	Water

AM23G (Continued)

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	10	10/06/21 03:31	722630	SLL2	

CAS#	Parameter	Result	DL	LOQ	Units
127-17-3	Pyruvic Acid	0.60U	0.60	5.0	mg/L

SM 2320 B-2011

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	09/29/21 08:09	722125	RYC	

CAS#	Parameter	Result	DL	LOQ	Units
000000-00-5	**Total Alkalinity**	**170**	**0.26**	**1.0**	**mg/L CaCO3**

SM 5310 B-2011

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	09/28/21 12:51	721848	JGD	

CAS#	Parameter	Result	DL	LOQ	Units
C-012	**Total Organic Carbon**	**10.0**	**0.300**	**2.00**	**mg/L**

EPA RSK175

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	10/07/21 12:37	722697	AWE	

CAS#	Parameter	Result	DL	LOQ	Units
74-84-0	**Ethane**	**12**	**0.17**	**1.0**	**ug/L**
74-85-1	**Ethene**	**42**	**0.24**	**1.0**	**ug/L**
74-82-8	**Methane**	**2100**	**2.0**	**5.0**	**ug/L**

MW-46-43C	Collect Date	09/22/2021 13:52	Lab ID	22109245202
	Receive Date	09/23/2021 11:20	Matrix	Water

EPA 8260C

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	100	10/06/21 20:08	722728	SMS	

CAS#	Parameter	Result	DL	LOQ	Units
630-20-6	1,1,1,2-Tetrachloroethane	20.0U	20.0	100	ug/L
71-55-6	1,1,1-Trichloroethane	20.0U	20.0	100	ug/L
79-34-5	1,1,2,2-Tetrachloroethane	20.0U	20.0	100	ug/L

Revision 1

Sample Results

MW-46-43C	Collect Date	09/22/2021 13:52	Lab ID	22109245202
	Receive Date	09/23/2021 11:20	Matrix	Water

EPA 8260C (Continued)

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	100	10/06/21 20:08	722728	SMS	

CAS#	Parameter	Result	DL	LOQ	Units
79-00-5	1,1,2-Trichloroethane	20.0U	20.0	100	ug/L
75-34-3	1,1-Dichloroethane	20.0U	20.0	100	ug/L
75-35-4	1,1-Dichloroethene	20.0U	20.0	100	ug/L
563-58-6	1,1-Dichloropropene	20.0U	20.0	100	ug/L
96-18-4	1,2,3-Trichloropropane	20.0U	20.0	100	ug/L
120-82-1	1,2,4-Trichlorobenzene	20.0U	20.0	100	ug/L
95-63-6	1,2,4-Trimethylbenzene	20.0U	20.0	100	ug/L
96-12-8	1,2-Dibromo-3-chloropropane	20.0U	20.0	100	ug/L
106-93-4	1,2-Dibromoethane	20.0U	20.0	100	ug/L
95-50-1	1,2-Dichlorobenzene	20.0U	20.0	100	ug/L
107-06-2	1,2-Dichloroethane	20.0U	20.0	100	ug/L
78-87-5	1,2-Dichloropropane	20.0U	20.0	100	ug/L
108-67-8	1,3,5-Trimethylbenzene	20.0U	20.0	100	ug/L
541-73-1	1,3-Dichlorobenzene	20.0U	20.0	100	ug/L
142-28-9	1,3-Dichloropropane	20.0U	20.0	100	ug/L
106-46-7	1,4-Dichlorobenzene	20.0U	20.0	100	ug/L
594-20-7	2,2-Dichloropropane	20.0U	20.0	100	ug/L
78-93-3	2-Butanone	20.0U	20.0	500	ug/L
110-75-8	2-Chloroethylvinyl ether	100U	100	500	ug/L
95-49-8	2-Chlorotoluene	20.0U	20.0	100	ug/L
591-78-6	2-Hexanone	50.0U	50.0	500	ug/L
106-43-4	4-Chlorotoluene	20.0U	20.0	100	ug/L
99-87-6	4-Isopropyltoluene	20.0U	20.0	100	ug/L
108-10-1	4-Methyl-2-pentanone	20.0U	20.0	500	ug/L
67-64-1	Acetone	50.0U	50.0	500	ug/L
107-02-8	Acrolein	250U	250	2500	ug/L
107-13-1	Acrylonitrile	100U	100	2500	ug/L
71-43-2	Benzene	20.0U	20.0	100	ug/L
108-86-1	Bromobenzene	20.0U	20.0	100	ug/L
74-97-5	Bromochloromethane	20.0U	20.0	100	ug/L
75-27-4	Bromodichloromethane	20.0U	20.0	100	ug/L
75-25-2	Bromoform	25.0U	25.0	100	ug/L
74-83-9	Bromomethane	50.0U	50.0	100	ug/L
75-15-0	Carbon disulfide	20.0U	20.0	100	ug/L
56-23-5	Carbon tetrachloride	25.0U	25.0	100	ug/L
108-90-7	Chlorobenzene	20.0U	20.0	100	ug/L
75-00-3	Chloroethane	25.0U	25.0	100	ug/L
67-66-3	Chloroform	20.0U	20.0	100	ug/L
74-87-3	Chloromethane	20.0U	20.0	100	ug/L
156-59-2	**cis-1,2-Dichloroethene**	**6480**	**20.0**	**100**	**ug/L**
10061-01-5	cis-1,3-Dichloropropene	20.0U	20.0	100	ug/L
124-48-1	Dibromochloromethane	20.0U	20.0	100	ug/L
74-95-3	Dibromomethane	25.0U	25.0	100	ug/L
75-71-8	Dichlorodifluoromethane	20.0U	20.0	100	ug/L
100-41-4	Ethylbenzene	20.0U	20.0	100	ug/L
87-68-3	Hexachlorobutadiene	50.0U	50.0	500	ug/L
98-82-8	Isopropylbenzene (Cumene)	20.0U	20.0	100	ug/L
m,p-Xylene	m,p-Xylene	20.0U	20.0	200	ug/L
74-88-4	Methyl iodide	50.0U	50.0	500	ug/L
75-09-2	Methylene chloride	20.0U	20.0	500	ug/L
91-20-3	Naphthalene	20.0U	20.0	500	ug/L
104-51-8	n-Butylbenzene	20.0U	20.0	100	ug/L
103-65-1	n-Propylbenzene	100U	100	500	ug/L

Revision 1

Sample Results

MW-46-43C	**Collect Date**	09/22/2021 13:52	**Lab ID**	22109245202
	Receive Date	09/23/2021 11:20	**Matrix**	Water

EPA 8260C (Continued)

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	100	10/06/21 20:08	722728	SMS	

CAS#	Parameter	Result	DL	LOQ	Units
95-47-6	o-Xylene	20.0U	20.0	100	ug/L
135-98-8	sec-Butylbenzene	20.0U	20.0	100	ug/L
100-42-5	Styrene	20.0U	20.0	100	ug/L
1634-04-4	tert-Butyl methyl ether (MTBE)	20.0U	20.0	100	ug/L
98-06-6	tert-Butylbenzene	20.0U	20.0	100	ug/L
127-18-4	Tetrachloroethene	20.0U	20.0	100	ug/L
108-88-3	Toluene	20.0U	20.0	100	ug/L
156-60-5	**trans-1,2-Dichloroethene**	**84.0J**	**20.0**	**100**	**ug/L**
10061-02-6	trans-1,3-Dichloropropene	20.0U	20.0	100	ug/L
110-57-6	trans-1,4-Dichloro-2-butene	50.0U	50.0	500	ug/L
79-01-6	Trichloroethene	20.0U	20.0	100	ug/L
75-69-4	Trichlorofluoromethane	20.0U	20.0	100	ug/L
76-13-1	Trichlorotrifluoroethane	20.0U	20.0	100	ug/L
108-05-4	Vinyl acetate	20.0U	20.0	100	ug/L
75-01-4	**Vinyl chloride**	**15100**	**20.0**	**100**	**ug/L**

CAS#	Surrogate	Conc. Spiked	Conc. Rec	Units	% Recovery	%Rec Limits
460-00-4	4-Bromofluorobenzene	5000	5060	ug/L	101	78 - 130
1868-53-7	Dibromofluoromethane	5000	5080	ug/L	102	77 - 127
2037-26-5	Toluene d8	5000	5430	ug/L	109	76 - 134
17060-07-0	1,2-Dichloroethane-d4	5000	4900	ug/L	98	71 - 127

EPA RSK-175

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	10	10/05/21 13:20	722588	BMR	

CAS#	Parameter	Result	DL	LOQ	Units
124-38-9	**Carbon Dioxide**	**68100**	**1270**	**9000**	**ug/L**

AM23G

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	10	10/06/21 04:24	722630	SLL2	

CAS#	Parameter	Result	DL	LOQ	Units
64-19-7	**Acetic Acid**	**86**	**1.2**	**5.0**	**mg/L**
107-92-6	**Butyric Acid**	**2.0J**	**0.58**	**5.0**	**mg/L**
64-18-6	**Formic Acid**	**49**	**0.55**	**5.0**	**mg/L**
142-62-1	Hexanoic Acid	0.58U	0.58	5.0	mg/L
646-07-1	i-Hexanoic Acid	0.56U	0.56	5.0	mg/L
503-74-2	i-Pentanoic Acid	0.61U	0.61	5.0	mg/L
50-21-5	Lactic Acid	0.53U	0.53	5.0	mg/L
109-52-4	**Pentanoic Acid**	**0.68J**	**0.56**	**5.0**	**mg/L**
79-09-4	**Propionic Acid**	**46**	**0.53**	**5.0**	**mg/L**
127-17-3	Pyruvic Acid	0.60U	0.60	5.0	mg/L

Revision 1

Sample Results

MW-46-43C	**Collect Date**	09/22/2021 13:52	**Lab ID**	22109245202
	Receive Date	09/23/2021 11:20	**Matrix**	Water

SM 2320 B-2011

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	09/29/21 08:09	722125	RYC	

CAS#	Parameter	Result	DL	LOQ	Units
000000-00-5	**Total Alkalinity**	**452**	**0.26**	**1.0**	**mg/L CaCO3**

SM 5310 B-2011

*Results And limits are adjusted for dilution.

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	2	09/29/21 17:02	722133	JGD	

CAS#	Parameter	Result	DL	LOQ	Units
C-012	**Total Organic Carbon**	**85.0**	**0.600**	**4.00**	**mg/L**

EPA RSK175

Prep Date	Prep Batch	Prep Method	Dilution	Run Date	Run Batch	Analyst	%Moisture
NA	NA	NA	1	10/07/21 12:49	722697	AWE	

CAS#	Parameter	Result	DL	LOQ	Units
74-84-0	**Ethane**	**22**	**0.17**	**1.0**	**ug/L**
74-85-1	**Ethene**	**1600**	**0.24**	**1.0**	**ug/L**
74-82-8	**Methane**	**4900**	**2.0**	**5.0**	**ug/L**

GC/MS Volatiles QC Summary

Analytical Batch 722728	Client ID Lab ID Sample Type Prep Date Analysis Date Matrix	MB722728 2248809 MB NA 10/06/21 12:15 Water		LCS722728 2248810 LCS NA 10/06/21 10:39 Water				LCSD722728 2248811 LCSD NA 10/06/21 10:59 Water				
EPA 8260C		Units Result	ug/L DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
1,1,1,2-Tetrachloroethane	630-20-6	0.200U	0.200	50.0	42.0	84	75 - 124	50.0	43.2	86	3	30
1,1,1-Trichloroethane	71-55-6	0.200U	0.200	50.0	44.2	88	76 - 126	50.0	46.0	92	4	30
1,1,2,2-Tetrachloroethane	79-34-5	0.200U	0.200	50.0	37.8	76	70 - 122	50.0	39.6	79	5	30
1,1,2-Trichloroethane	79-00-5	0.200U	0.200	50.0	41.9	84	72 - 121	50.0	42.0	84	0	30
1,1-Dichloroethane	75-34-3	0.200U	0.200	50.0	40.0	80	74 - 127	50.0	41.0	82	2	30
1,1-Dichloroethene	75-35-4	0.200U	0.200	50.0	46.4	93	69 - 129	50.0	47.6	95	3	20
1,1-Dichloropropene	563-58-6	0.200U	0.200	50.0	44.8	90	72 - 131	50.0	46.2	92	3	30
1,2,3-Trichloropropane	96-18-4	0.200U	0.200	50.0	36.9	74	70 - 120	50.0	39.7	79	7	30
1,2,4-Trichlorobenzene	120-82-1	0.200U	0.200	50.0	40.9	82	61 - 135	50.0	41.6	83	2	30
1,2,4-Trimethylbenzene	95-63-6	0.200U	0.200	50.0	40.3	81	74 - 125	50.0	41.5	83	3	30
1,2-Dibromo-3-chloropropane	96-12-8	0.200U	0.200	50.0	35.8	72	57 - 121	50.0	40.0	80	11	30
1,2-Dibromoethane	106-93-4	0.200U	0.200	50.0	42.0	84	70 - 124	50.0	43.6	87	4	30
1,2-Dichlorobenzene	95-50-1	0.200U	0.200	50.0	39.3	79	71 - 126	50.0	39.3	79	0	30
1,2-Dichloroethane	107-06-2	0.200U	0.200	50.0	40.6	81	71 - 129	50.0	41.0	82	1	30
1,2-Dichloropropane	78-87-5	0.200U	0.200	50.0	43.1	86	72 - 128	50.0	42.8	86	1	30
1,3,5-Trimethylbenzene	108-67-8	0.200U	0.200	50.0	40.9	82	71 - 132	50.0	41.4	83	1	30
1,3-Dichlorobenzene	541-73-1	0.200U	0.200	50.0	40.6	81	74 - 126	50.0	40.5	81	0	30
1,3-Dichloropropane	142-28-9	0.200U	0.200	50.0	40.9	82	74 - 122	50.0	41.1	82	1	30
1,4-Dichlorobenzene	106-46-7	0.200U	0.200	50.0	41.2	82	72 - 122	50.0	40.9	82	1	30
2,2-Dichloropropane	594-20-7	0.200U	0.200	50.0	42.9	86	77 - 124	50.0	44.4	89	3	30
2-Butanone	78-93-3	0.200U	0.200	250	182	73	58 - 137	250	206	82	12	30
2-Chloroethylvinyl ether	110-75-8	1.00U	1.00	250	207	83	56 - 124	250	214	86	3	30
2-Chlorotoluene	95-49-8	0.200U	0.200	50.0	38.8	78	72 - 127	50.0	39.7	79	2	30
2-Hexanone	591-78-6	0.500U	0.500	250	190	76	50 - 135	250	211	84	10	30
4-Chlorotoluene	106-43-4	0.200U	0.200	50.0	38.7	77	75 - 126	50.0	39.3	79	2	30
4-Isopropyltoluene	99-87-6	0.200U	0.200	50.0	42.4	85	71 - 129	50.0	42.8	86	1	30
4-Methyl-2-pentanone	108-10-1	0.200U	0.200	250	194	78	57 - 132	250	217	87	11	30
Acetone	67-64-1	0.500U	0.500	250	198	79	44 - 156	250	218	87	10	30
Acrolein	107-02-8	2.50U	2.50	250	203	81	30 - 160	250	210	84	3	30
Acrylonitrile	107-13-1	1.00U	1.00	250	208	83	64 - 137	250	206	82	1	30
Benzene	71-43-2	0.200U	0.200	50.0	43.7	87	70 - 129	50.0	44.6	89	2	20
Bromobenzene	108-86-1	0.200U	0.200	50.0	36.8	74	71 - 120	50.0	36.9	74	0	30
Bromochloromethane	74-97-5	0.200U	0.200	50.0	45.0	90	76 - 130	50.0	44.2	88	2	30
Bromodichloromethane	75-27-4	0.200U	0.200	50.0	42.6	85	74 - 125	50.0	44.4	89	4	30
Bromoform	75-25-2	0.250U	0.250	50.0	45.2	90	64 - 122	50.0	46.5	93	3	30
Bromomethane	74-83-9	0.500U	0.500	50.0	72.5	**145***	47 - 138	50.0	72.8	**146***	0	30
Carbon disulfide	75-15-0	0.200U	0.200	50.0	43.7	87	69 - 136	50.0	45.4	91	4	30
Carbon tetrachloride	56-23-5	0.250U	0.250	50.0	45.1	90	76 - 128	50.0	46.9	94	4	30
Chlorobenzene	108-90-7	0.200U	0.200	50.0	44.0	88	74 - 123	50.0	45.0	90	2	20
Chloroethane	75-00-3	0.250U	0.250	50.0	44.9	90	62 - 141	50.0	48.6	97	8	30
Chloroform	67-66-3	0.200U	0.200	50.0	41.5	83	75 - 122	50.0	41.8	84	1	30
Chloromethane	74-87-3	0.200U	0.200	50.0	40.8	82	59 - 132	50.0	43.4	87	6	30
cis-1,2-Dichloroethene	156-59-2	0.200U	0.200	50.0	41.0	82	73 - 130	50.0	42.5	85	4	30
cis-1,3-Dichloropropene	10061-01-5	0.200U	0.200	50.0	43.8	88	71 - 132	50.0	43.5	87	1	30
Dibromochloromethane	124-48-1	0.200U	0.200	50.0	43.8	88	71 - 123	50.0	43.9	88	0	30
Dibromomethane	74-95-3	0.250U	0.250	50.0	44.1	88	72 - 129	50.0	44.7	89	1	30
Dichlorodifluoromethane	75-71-8	0.200U	0.200	50.0	44.1	88	58 - 140	50.0	46.3	93	5	30
Ethylbenzene	100-41-4	0.200U	0.200	50.0	44.3	89	74 - 126	50.0	45.5	91	3	30
Hexachlorobutadiene	87-68-3	0.500U	0.500	50.0	43.2	86	61 - 144	50.0	45.7	91	6	30
Isopropylbenzene (Cumene)	98-82-8	0.200U	0.200	50.0	45.9	92	71 - 125	50.0	47.3	95	3	30
m,p-Xylene	m,p-Xylene	0.200U	0.200	100	89.2	89	74 - 126	100	91.5	92	3	30
Methyl iodide	74-88-4	0.500U	0.500	50.0	63.2	126	57 - 141	50.0	57.2	114	10	30
Methylene chloride	75-09-2	0.200U	0.200	50.0	41.2	82	68 - 132	50.0	41.0	82	1	30
Naphthalene	91-20-3	0.200U	0.200	50.0	40.1	80	57 - 138	50.0	42.7	85	6	35
n-Butylbenzene	104-51-8	0.200U	0.200	50.0	43.1	86	69 - 134	50.0	44.5	89	3	30
n-Propylbenzene	103-65-1	1.00U	1.00	50.0	42.6	85	75 - 129	50.0	43.9	88	3	30
o-Xylene	95-47-6	0.200U	0.200	50.0	43.2	86	73 - 130	50.0	43.9	88	2	30
sec-Butylbenzene	135-98-8	0.200U	0.200	50.0	42.4	85	70 - 136	50.0	43.7	87	3	30

Revision 1

GC/MS Volatiles QC Summary

Analytical Batch 722728	Client ID	MB722728		LCS722728				LCSD722728				
	Lab ID	2248809		2248810				2248811				
	Sample Type	MB		LCS				LCSD				
	Prep Date	NA		NA				NA				
	Analysis Date	10/06/21 12:15		10/06/21 10:39				10/06/21 10:59				
	Matrix	Water		Water				Water				
EPA 8260C		Units Result	ug/L DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
Styrene	100-42-5	0.200U	0.200	50.0	43.8	88	71 - 127	50.0	44.3	89	1	30
tert-Butyl methyl ether (MTBE)	1634-04-4	0.200U	0.200	50.0	40.3	81	71 - 125	50.0	41.6	83	3	30
tert-Butylbenzene	98-06-6	0.200U	0.200	50.0	37.3	75	72 - 126	50.0	38.0	76	2	30
Tetrachloroethene	127-18-4	0.200U	0.200	50.0	44.3	89	68 - 128	50.0	46.8	94	5	30
Toluene	108-88-3	0.200U	0.200	50.0	43.7	87	72 - 120	50.0	44.6	89	2	20
trans-1,2-Dichloroethene	156-60-5	0.200U	0.200	50.0	40.4	81	69 - 132	50.0	42.6	85	5	30
trans-1,3-Dichloropropene	10061-02-6	0.200U	0.200	50.0	44.9	90	71 - 131	50.0	44.7	89	0	30
trans-1,4-Dichloro-2-butene	110-57-6	0.500U	0.500	50.0	37.8	76	56 - 132	50.0	40.8	82	8	30
Trichloroethene	79-01-6	0.200U	0.200	50.0	46.0	92	76 - 129	50.0	47.4	95	3	20
Trichlorofluoromethane	75-69-4	0.200U	0.200	50.0	43.0	86	72 - 136	50.0	47.4	95	10	30
Trichlorotrifluoroethane	76-13-1	0.200U	0.200	50.0	44.2	88	72 - 136	50.0	47.7	95	8	30
Vinyl acetate	108-05-4	0.200U	0.200	50.0	31.7	63	54 - 147	50.0	32.5	65	2	30
Vinyl chloride	75-01-4	0.200U	0.200	50.0	45.4	91	68 - 132	50.0	47.3	95	4	30
Surrogate												
1,2-Dichloroethane-d4	17060-07-0	49.1	98	50	45.2	90	71 - 127	50	45.7	91	NA	NA
4-Bromofluorobenzene	460-00-4	55	110	50	53.9	108	78 - 130	50	55.4	111	NA	NA
Dibromofluoromethane	1868-53-7	54.6	109	50	48.6	97	77 - 127	50	48.7	97	NA	NA
Toluene d8	2037-26-5	49.3	99	50	47.4	95	76 - 134	50	47.9	96	NA	NA

Revision 1

GC Volatiles QC Summary

Analytical Batch 722588	Client ID Lab ID Sample Type Prep Date Analysis Date Matrix	MB722588 2247987 MB NA 10/05/21 11:08 Water		LCS722588 2247988 LCS NA 10/05/21 11:14 Water				LCSD722588 2247989 LCSD NA 10/05/21 11:25 Water				
EPA RSK-175		Units Result	ug/L DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
Carbon Dioxide	124-38-9	127U	127	8700	9070	104	38 - 147	8700	9340	107	3	40

Revision 1

General Chemistry QC Summary

Analytical Batch 722125	Client ID	MB722125		LCS722125				LCSD722125				
	Lab ID	2244875		2244876				2244877				
	Sample Type	MB		LCS				LCSD				
	Prep Date	NA		NA				NA				
	Analysis Date	09/29/21 08:09		09/29/21 08:09				09/29/21 08:09				
	Matrix	Water		Water				Water				
SM 2320 B-2011		Units Result	mg/L CaCO3 DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
Total Alkalinity	000000-00-5	0.26U	0.26	200	197	98	90 - 110	200	197	98	0	11

Analytical Batch 722630	Client ID	MB722630		LCS722630				LCSD722630				
	Lab ID	2248216		2248217				2248218				
	Sample Type	MB		LCS				LCSD				
	Prep Date	NA		NA				NA				
	Analysis Date	10/05/21 21:17		10/05/21 20:23				10/06/21 07:04				
	Matrix	Water		Water				Water				
AM23G		Units Result	mg/L DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
Acetic Acid	64-19-7	0.12U	0.12	2.0	2.0	100	70 - 130	2.0	2.0	101	1	20
Butyric Acid	107-92-6	0.058U	0.058	2.0	2.0	102	70 - 130	2.0	2.1	104	2	20
Formic Acid	64-18-6	0.055U	0.055	2.0	1.9	97	70 - 130	2.0	1.9	96	1	20
Hexanoic Acid	142-62-1	0.058U	0.058	2.0	2.0	101	70 - 130	2.0	2.0	100	1	20
i-Hexanoic Acid	646-07-1	0.056U	0.056	2.0	2.1	105	70 - 130	2.0	2.1	104	1	20
i-Pentanoic Acid	503-74-2	0.061U	0.061	2.0	2.0	103	70 - 130	2.0	2.0	103	0	20
Lactic Acid	50-21-5	0.053U	0.053	2.0	2.2	109	70 - 130	2.0	2.2	108	1	20
Pentanoic Acid	109-52-4	0.056U	0.056	2.0	2.0	103	70 - 130	2.0	2.0	100	3	20
Propionic Acid	79-09-4	0.053U	0.053	2.0	2.1	103	70 - 130	2.0	2.1	105	2	20
Pyruvic Acid	127-17-3	0.060U	0.060	2.0	2.2	108	70 - 130	2.0	2.2	109	1	20

Analytical Batch 721848	Client ID	MB721848		LCS721848			
	Lab ID	2243263		2243264			
	Sample Type	MB		LCS			
	Prep Date	NA		NA			
	Analysis Date	09/27/21 15:53		09/27/21 14:48			
	Matrix	Water		Water			
SM 5310 B-2011		Units Result	mg/L DL	Spike Added	Result	%R	Control Limits%R
Total Organic Carbon	C-012	0.300U	0.300	50.0	47.8	96	90 - 110

Analytical Batch 722133	Client ID	MB722133		LCS722133			
	Lab ID	2244981		2244982			
	Sample Type	MB		LCS			
	Prep Date	NA		NA			
	Analysis Date	09/29/21 16:35		09/29/21 15:41			
	Matrix	Water		Water			
SM 5310 B-2011		Units Result	mg/L DL	Spike Added	Result	%R	Control Limits%R
Total Organic Carbon	C-012	0.300U	0.300	50.0	49.1	98	90 - 110

General Chromatography QC Summary

Analytical Batch 722697	Client ID	MB722697		LCS722697				LCSD722697				
	Lab ID	2248674		2248675				2248676				
	Sample Type	MB		LCS				LCSD				
	Prep Date	NA		NA				NA				
	Analysis Date	10/07/21 11:15		10/07/21 10:40				10/07/21 10:52				
	Matrix	Water		Water				Water				
EPA RSK175		Units Result	ug/L DL	Spike Added	Result	%R	Control Limits%R	Spike Added	Result	%R	RPD	RPD Limit
Ethane	74-84-0	0.17U	0.17	97	88	91	70 - 130	97	100	103	13	30
Ethene	74-85-1	0.24U	0.24	120	110	93	70 - 130	120	120	103	11	30
Methane	74-82-8	2.0U	2.0	380	370	95	70 - 130	380	400	105	10	30

Revision 1

WSP

Chain of Custody Form

WSP Office Address	7000 East Genesee Street, Building D, 2nd Floor
Project Name	Emersub 15, LLC
WSP Contact Name	~~Nathaniel Winston~~ JEFF BAKER
Project Location	Ithaca, NY
WSP Contact E-mail	JEFFREY.BAKER @wsp.com
Project Number & Task	31401545.001/Task 5
WSP Contact Phone	724-882-9723
Sampler(s) Name(s)	Nathaniel Winston
Sampler(s) Signature(s)	[signature]
No.	
Laboratory Name & Location	PACE, Baton Rouge
Laboratory Project Manager	
Requested Turn-Around-Time	[X] Standard [ ] 24 HR [ ] 48 HR [ ] 72 HR [ ] ___ HR

Requested Analyses & Preservatives

Sample Identification	Matrix	Collection Start* Date	Collection Start* Time	Collection Stop* Date	Collection Stop* Time	Number of Containers	Carbon Dioxide AM20GAX	Ethane, Ethene, Methane RSK175	Volatile Fatty Acids AM23G	Total Organic Carbon	Alkalinity	VOCs 8260B						Sample Comments
MW-5-40	AQ	—	—	9/22/21	1042	13	X	X	X	X	X	X						1
MW-46-43C	AQ	—	—	9/22/21	1352	13	X	X	X	X	X	X						2

Relinquished By (Signature)	Date	Time	Received By (Signature)	Date	Time	Shipment Method / Number of Packages
[signature]	9/22/21	1645				FedEx
FedEx	9/23/21	1120	[signature]	9/23/21	1120	

*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)

Client ID: wsp-c - WSP Environmental & Energy
SDG: 221092452
PM: RWe

4.0 E34 19 crm 5341 6451 7016

Revision 1

SAMPLE RECEIVING CHECKLIST

Pace Analytical®

SAMPLE DELIVERY GROUP	221092452
Client **PM** RWe wsp-c - WSP Environmental & Energy	**Transport Method** FEDEX
Profile Number 284637	**Received By** McCune, Dodie N.
Line Item(s) 1 - water	**Receive Date(s)** 09/23/21

CHECKLIST	YES	NO
Samples received with proper thermal preservation?	☑	☐
Radioactivity is <1600 cpm? If no, record cpm value in notes section.	☑	☐
COC relinquished and complete (including sampleIDs, collect times, and sampler)?	☑	☐
All containers received in good condition and within hold time?	☑	☐
All sample labels and containers received match the chain of custody?	☑	☐
Preservative added to any containers?	☐	☑
If received, was headspace for VOC water containers < 6mm?	☑	☐
Samples collected in containers provided by Pace Gulf Coast?	☑	☐

COOLERS

Airbill	Thermometer ID: E34	Temp °C
534164517016		4.0

DISCREPANCIES

None

LAB PRESERVATIONS

None

NOTES