ERM

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Memo

To	Tauren Beggs
From	David de Courcy-Bower and Carl Stay
Date	6 July 2023
Reference	0383990
Subject	Former Hamilton Industries Property, Two Rivers, Wisconsin BRRTS Activity #02-36-578316

Dear Mr. Beggs

This memorandum summarizes results of additional pre-design investigation (PDI) activities for the Central volatile organic compound (VOC) groundwater plume (Central Plume) at the former Hamilton Industries site (the "Site") in Two Rivers, Wisconsin. The planned additional PDI activities were presented in the August 30, 2022, Work Plan Addendum II (WP Addendum II) and based on the prior site investigation results that were presented in the April 21, 2021 Site Status Report and Remedial Action Options Evaluation (2021 RAOE). The primary focus of the additional PDI work was to collect soil and groundwater samples from the Central trichloroethene (TCE) Plume and perform laboratory bench-scale treatability testing for compatibility with chemical oxidation and zero-valent iron remediation technologies.

The Central Plume primarily consists of dissolved TCE with low concentrations of 1,4-Dioxane. Figure 1 provides a depiction of the dissolved phase TCE distribution based on monitoring well and vertical aquifer sample data. The pre-design sampling and bench scale testing activities focused on the Central Plume where TCE concentrations exceed the Chapter NR 140 Enforcement Standard. The highest measured concentration of TCE was 1,310 ug/l measured from the sample collected from VAS-34.

1. SITE BACKGROUND

Factors affecting the efficacy of potential in-situ treatment of the Central TCE Plume were presented in Section 6 of the 2021 RAOE - Site Conceptual Model (SCM). In particular, the varying aquifer matrix lithology, aquifer geochemistry (oxidative state), and aquifer matrix chemistry were recognized as having the greatest potential effects on an in-situ remedy. The following paragraphs describe these factors.

1.1 Varying Aquifer Matrix Lithology

The upland portion of the Central Plume resides in fine to medium sand that directly overlies silty clay till, while the downgradient portion of the plume resides in both fine to medium sand and an underlying fine sand and silt. The fine sand and silt are limited in extent forming an interval between the overlying sand and underlying silty clay. The fine to medium sand interval has a

relatively higher permeability than the silt; therefore, is more amenable to injection of liquid amendments for in-situ treatment.

Grain size analysis of materials from each of the aquifer matrix lithologies confirm the field descriptions made during advancement of the VAS borings. The upper fine – medium sand appears to be relatively well sorted, while the fine sand and silt interval is moderate to poorly sorted. Less well sorted deposits tend to be "tighter" and have lower injectivity due to the presence of a wide range of grain sizes available to fill in between coarser mineral grains.

1.2 Aquifer Geochemistry

The dissolved oxygen concentrations and ORP values measured in the sand and silt lithologies are indicative of moderate to strong oxidizing aquifer conditions while the values measured in deep wells screened in the underlying silty clay indicate moderate reducing conditions. This information indicates that a chemical oxidation treatment technology may be more readily implemented than one that relies on reducing environment. However, other factors that can adversely affect chemical oxidation will need to be considered during the remedy selection process.

1.3 Aquifer Matrix Chemistry

Laboratory analysis of total organic carbon for the fine to medium sand and the fine sand and silt intervals indicated that relatively high natural oxidant demand (1.1% in fine-med. sand; 2.78% in silt) might require higher oxidant injection volumes. According to Mickelson and Socha (Quaternary Geology of Calumet and Manitowoc Counties, Wisconsin, UW Extension Bulletin 108, 2017), the glacial and lake sediments that host the Central Plume contain an abundance of carbonate minerals (approximately 28 – 56 percent for till deposits of the Kewaunee Formation). Carbonate minerals can have a significant impact on some chemical oxidation chemistries such as sodium persulfate.

1.4 TCE Estimated Mass

The estimated mass of dissolved TCE contaminant and associated soil mass and volume within concentration iso-levels of 50 ug/l, 100 ug/l and 500 ug/l were determined using groundwater monitoring results collected in 2022 and CTech's Earth Volumetric Studio (EVS). The following table provides total estimated mass of Central Plume TCE within various iso-concentration levels:

Table 1. Central Plume Estimated TCE Mass

Concentration Iso-level	Estimated TCE Mass	Estimated Soil Volume
50 ug/l	0.314 kg	3.539E+05 cu. Ft.
100 ug/l	0.197 kg	1.411E+05 cu. Ft.
500 ug/l	0.017 kg	3.762E+03 cu. Ft.

1.5 Injectivity Testing

Injectivity tests were performed at monitoring wells MW-13S/D and MW-15S/D to determine the ability of the aquifer to receive injected water. Injectivity test results were reported in the RAOE report dated 21 April 2021. These tests concluded that injection of fluid into the shallow sandy aquifer is viable. Therefore, in-situ chemical oxidation, chemical reduction, and enhanced bioremediation are being considered as potential treatment technologies for the Central TCE Plume. All three require injection of substrates. Injection may be implemented using direct-push technology or permanent injection wells.

Chemical oxidation or reduction technologies have been proven to be effective at in-situ chlorinated VOC (CVOC) destruction across various hydrogeological environments. The choice of either oxidant or reductant can be influenced, in part, by whether the target aquifer is in an oxidizing (elevated dissolved oxygen, elevated oxidation-reduction potential) or reducing (low dissolved oxygen, low or negative oxidation-reduction potential) environment. Sample data indicate that the upper sand portion of the shallow aquifer in the Central Plume area is an oxidizing environment. Field observations indicate the presence of sufficient amounts of oxygen (dissolved oxygen generally greater than 5 mg/l) and elevated oxidation-reduction potential. The past site groundwater monitoring events have consistently indicated that the upper sand and silt portions of the aquifer are dominated by oxidizing conditions, whereas the deeper clay groundwater regimes are depleted in terms of dissolved oxygen and have a generally negative oxidation-reduction potential. The presence of elevated, naturally occurring organic carbon in the sand, silt, and clayey intervals indicated that bench studies would be beneficial in determining the potential chemical oxidant demand of the organic material and oxidant dosing requirements to enable CVOC treatment.

2. PRE-DESIGN ACTIVITIES (2022)

2.1 Soil Boring / Monitoring Well Installation

Six soil borings were advanced to collect soil samples from each of the three soil-matrix lithologies (sand, silt, and clay) for soil oxidant demand, base-buffering capacity, and zero valent iron (ZVI) treatability testing. The locations of the soil borings are shown on Figure 2 and listed in Table 1. Three of the soil borings (MW-27S, MW-28S, and MW-29I) were located in the upland portion and three (MW-30I, MW-21S, and SB-18) were located in the lower elevation, downgradient portion of the Central Plume, respectively. The silt interval was not encountered in the three upland area soil borings. A thin (2 – 3 ft. thick) silt interval was encountered in the three soil borings advanced in the lower portion of the Central Plume area.

Nine soil samples, three from each matrix lithology (sand, silt, clay), were submitted for oxidant demand testing. Formation water is not needed for the oxidant demand and base-buffering capacity testing. Three silt unit soil samples and three groundwater samples were collected from the lower plume area for the ZVI treatability study. Both soil and water samples from new monitoring wells MW-30I and MW-31I were paired for the ZVI bench testing. Since SB-18 was not converted into a monitoring well, a groundwater sample was obtained from the existing monitoring well MW-15I for the SB-18 ZVI bench test.

Five of the six soil borings were converted into remediation performance monitoring wells. The silt interval was not encountered in the upland portion of the Central Plume area, and three monitoring wells (MW-27S, MW-28S, and MW-29I) were completed in the shallow sand interval. The MW-30I well screen straddles the silt interval, while the MW-31S well screen covers the upper sand interval. Soil boring logs and monitoring well construction logs are provided as Appendix A.

Table 2. Summary of PDI Testing Soil and Groundwater Sample Locations

Sample Location	Soil Sample Interval	Well Screen Interval
MW-15I*	None	18 – 23’
SB/MW-27S	9 – 11’	10 – 20’
SB/MW-27S	23 – 25’	
SB/MW-28S	15 – 17’	7 – 17’
SB/MW-29I	18 – 20’	7 – 17’
SB/MW-30I***	10 – 12’	6 – 16’
SB/MW-30I***	15 – 17’	
SB/MW-31S***	7 – 9’	4 – 14’
SB/MW-31S***	13 – 15’	
SB-18**	10 – 12’	None
* Groundwater sample only for ZVI/EHC bench testing. ** Soil sample only for ZVI/EHC bench testing. *** Soil and groundwater sample for ZVI/EHC bench testing.		

3. BENCH TESTING

Nine soil samples for the oxidant demand and base buffering capacity testing were dispatched to Evonik’s PeroxyChem laboratory of Tonawanda, New York. Alkaline activated persulfate was the oxidant used for the oxidant demand testing. Three ZVI treatability soil and groundwater samples were sent to Resolution Partners, LLC (Resolution Partners) located in Madison, Wisconsin. The ZVI treatability samples were retained at the laboratory pending receipt of groundwater samples collected from the newly installed remediation performance monitoring wells. Shallow aquifer groundwater samples were collected from two of the lower Central TCE plume area, newly installed remedy performance monitoring wells and MW-15I for use in ZVI treatability testing.

3.1 Oxidant Demand and Base-Buffering Capacity Bench-Scale Testing

Results of oxidant demand and base-buffering capacity testing performed by Evonik are provided in Appendix B. Soil samples were submitted to Evonik’s laboratory located in Tonawanda, New York to perform bench-scale studies for sodium persulfate demand and base buffering capacity. ERM has considered injecting activated sodium persulfate into the aquifer surrounding and downgradient of well cluster MW-13S/D to oxidize the VOCs in the upland portion of the Central TCE contaminant plume. Possible methods for injecting the oxidant are described later in this report.

3.1.1 Persulfate Demand Test

Evonik's Klozur® activated persulfate is a strong oxidant capable of mineralizing a wide range of contaminants, including chlorinated solvents, petroleum hydrocarbons and polyaromatic hydrocarbons. Activation of the persulfate anion generates the sulfate radical, the primary species that drives the rapid destruction of the contaminants of concern. For purposes of this injection at the Site, activation of the persulfate anion will be accomplished using concentrated sodium hydroxide (NaOH) to elevate the pH to 10.5.

The Klozur® Persulfate demand test measured the loss of an initial amount of 15 g persulfate per kilogram of soil in the presence of soil, distilled water, and activator over a period of 48 and 168 hours. The consumption of Klozure after 48 and 168 hours is summarized on Table 2 of Appendix B. The average persulfate demand for the sand was 5.6 g/kg after 168 hours. The average persulfate demand for the silt was 8.87 g/kg and the average persulfate demand for the clay was 12.00 g/kg after 168 hours. The varying oxidant demand test results correspond to the relative higher TOC content of the finer grained lithologies.

3.1.2 Base Buffering Capacity

When high pH is chosen as a means of activation, a Base Buffering Capacity (BBC) test is performed. The goal of a BBC test is to determine the amount of NaOH needed to raise the pH of a soil to pH 10.5, which is necessary for Klozur persulfate activation. Evonik prepared the same soil interval samples as used in the persulfate demand test to determine the amount of base required to buffer the sample to a pH of 10.5. The results of the BBC test are also summarized in Table 2 of Appendix B. The average BBC for sand, silt and clay soils was 0.25, 0.48, and 0.58 g of 25% NaOH per kg dry soil, respectively.

3.2 Zero-Valent Iron Bench-Scale Testing

Results of Resolution Partner's testing are presented in Appendix C. Soil and groundwater samples were delivered to Resolution Partners for bench-scale testing of two types of ZVI amendments. The purpose of the zero-valent iron bench study was to determine the efficacy of ZVI to destroy recalcitrant CVOCs through reductive dechlorination, specifically TCE, at the Site. The following soil and groundwater samples were provided to Resolution Partners for treatability:

Table 3. ZVI Bench Testing Source Materials

Sample Id.	Soil Mass (kg)	Groundwater Volume (L)	Date Received
MW-15I-WG		2.0	8 Sept 2022
SB-18-SO-10-12	1.56		1 Sept 2022
MW-30I-WG		2.0	8 Sept 2022
SB-MW-30-SO-10-12	2.05		1 Sept 2022
MW-31I-WG		2.0	8 Sept 2022
SB-MW-31-SO-13-15	1.65		1 Sept 2022

The two selected reagents, Evonik SGW-EHC and Connelly ZVI GMA-M, were provided by Resolution Partners to test soil and groundwater collected from the above boring/well locations.

Resolution Partners prepared duplicate study trials, with each trial including 20 g of soil and 100 ml of groundwater (a 1:5 liquid to solids ratio based on mass). The trials were amended with the two abovementioned reagents at 0.3, 0.5, and 1.0 weight percent (wt.%) based on the soil mass. The samples were shaken to disaggregate the soil and mix the reagent with the soil. The trials were divided into two sets (by reagent type) and started on sequential days to facilitate analyses of 18 trials for each sampling event. Headspace sampling took place after 1, 7, 21 and 42 days of reaction time for a total of 108 analyses.

CVOC concentrations measured during the 42-day trial period are summarized in Table 3 of Appendix C, presented as µg/L for each trial, and includes the means of the replicate samples. Fractional changes are relative to baseline groundwater.

3.2.1 Baseline Analytical Results

Silt interval soil samples from SB-18, SB-30 and SB-31 were submitted by Resolution Partners to CTL Laboratories of Baraboo, WI for baseline soil analysis. The following table summarizes the soil analytical results reported by CTL.

Table 4. CT Labs Soil Analytical Summary

Parameter*	Units	SB-18 (10-12')	SB-30 (10-12')	SB-31 (13-15')
Percent Solids	%	79.98	79.92	79.49
1,2,4-Trimethylbenzene	ug/kg	30.4	26.4	22.7
TCE	ug/kg	<28	385	670
cDCE	ug/kg	<28	<26	419
tDCE	ug/kg	<27	<25	53.9
1,1-DCE	ug/kg	<22	<21	<21
VC	ug/kg	<28	<26	<26

*VOCs reported on a dry weight basis.
TCE = trichloroethene; cDCE = cis-1,2-dichloroethene; tDCE = trans- 1,2-dichloroethene; 1,1-DCE = 1,1-dichloroethene; VC = vinyl chloride.

Groundwater field parameters were measured for temperature, pH, specific conductivity, dissolved oxygen, and oxidation-reduction potential. The following table provides a summary of these field parameters. Samples were submitted to Pace Analytical of Green Bay, WI for analysis using USEPA Method 8260B. Results for TCE, cDCE, tDCE, 1,1-DCE and VC are also summarized on the following Table 5.

Table 5. Field Monitoring Parameters and Groundwater Monitoring Analytical Summary

Parameter	Units	MW-15I 09/07/2022 11:05	MW-30I 09/07/2022 13:50	MW-31S 09/07/2022 15:00
Temperature	deg. C	18.1	19.0	16.9
pH	Units	7.5	7.22	6.99
Specific Conductivity	uS/cm	1333	1232	914
Dissolved Oxygen	mg/l	1.79	2.11	0.43
Oxidation-Reduction Potential	mV	81.4	71.9	-151.4
TCE	ug/l	539	110	<0.32
cDCE	ug/l	12.6	1.3	1.6
tDCE	ug/l	<5.3	<0.53	0.62 J
1,1-DCE	ug/l	<5.8	<0.58	<0.58
VC	ug/l	<1.7	<0.17	0.64 J

TCE = trichloroethene; cDCE = cis-1,2-dichloroethene; tDCE = trans- 1,2-dichloroethene; 1,1-DCE = 1,1-dichloroethene.
CVOCs analyzed by Pace Analytical of Green Bay, WI.
RP also ran baseline analysis on the water samples submitted for the bench testing (Table 2 of Appendix C). The results were generally similar when compared to the results from Pace Labs.

In contrast to prior groundwater monitoring locations, the field ORP value (-151.4 mV) measured in the new MW-31S location was strongly negative. This measurement indicates the presence of a localized area with reducing conditions. The RP baseline groundwater analytical results from Table 2 of Appendix C also showed a negative ORP result (-52 mV) for the MW-31S location. The reducing conditions may be responsible for the presence of TCE daughter products in soil and water samples from that location (Tables 4 and 5). Additional field parameter measurements will be collected during the June 2023 groundwater sampling event to confirm the measured values over time.

It is notable that TCE and the other CVOC were not detected in the SB-18, silt interval soil sample at concentrations above the values presented in Table 4. Therefore, the CVOC contaminants detected during the ZVI bench testing were likely associated with the MW-15I water sample used with the SB-18 soil. Additionally, as presented in Table 5, TCE was not detected in the MW-31S groundwater sample that was used for the silt interval bench test from the MW-31S location. TCE is more available to react with the ZVI or EHC amendments when in the free water than if it is adsorbed into the soil matrix.

It is important to keep these variabilities in mind when reviewing the ZVI bench test results. As previously noted, there were varying baseline conditions between the test set-up for the three sample locations. The varying baseline soil CVOC concentrations provide different amounts of contaminant mass available to be released into the free water where the ZVI or EHC reductants can more readily react.

The three baseline conditions include:

1. No soil/elevated groundwater TCE concentrations (MW-15I/SB-18). In this case there is little or no soil contaminant mass to diffuse/replace the TCE treated and removed from the groundwater.

2. Elevated soil/elevated groundwater TCE concentrations (MW-30/SB-30). In this case soil contamination is readily available to replace the groundwater TCE as it is treated.

3. Elevated soil/no groundwater TCE concentrations (MW-31/SB-31). This case is similar to case 2, in that TCE can be replenished from the soil as the groundwater is treated. However, the groundwater TCE comes from the soil.

3.2.2 Results of Evonik SGW-EHC Testing

RP provided a discussion of the results of EHC bench-scale testing in the report included in Appendix C. The RP discussion and ERM's observations are summarized below.

The MW-15I/SB-18 sample composite contained predominantly TCE from the MW-15I groundwater sample because the baseline soil concentration was < 28 ug/Kg. When compared to the baseline water concentration, the addition of 0.3 and 0.5 wt.% EHC reduced concentrations by approximately 75 percent in 42 days. Increasing the dose to 1.0 wt.% produced an 87% reduction by day 42. The EHC produced cis-1,2-dichloroethene (cDCE) by day 42 at concentrations of approximately 160 ug/L. The low soil TCE mass, for the SB-18 tests provide insight into the ZVI and EHC reaction rates for a water contamination dominated scenario.

The MW-30I/SB-30 sample composite contained only TCE. The fractional changes show a nominal increase over the baseline concentration resulting from release of TCE from soil (385 ug/kg) that was used in the reactor. TCE concentrations showed only slight reductions from day 1 to day 42 for all three dosages of EHC. It appears that the TCE, soil back-diffusion rate is equal to or slightly greater than the water treatment rate. However, the actual soil TCE mass reduction is not known.

The MW-31I/SB-31 sample was reported to contain TCE, cDCE and trans-1,2-dichloroethene (tDCE) on day 1. As with MW-30I/SB-30, the presence of all were due to release of these compounds from the soil used in the reactors. The concentration trends for TCE, cDCE and tDCE were also inconsistent over the 42 days of observation. It is notable that TCE concentrations for all three EHC dosages, dropped to < 1 ug/L at 21 days. Thus, the rate of TCE, soil back-diffusion appears to be less than the water treatment rate.

On a micro-molar basis, EHC-amended reactors reduced the total micromoles of TCE of MW-15I/SB-18 and MW-30I/SB-30 by a maximum of 75 to 33 percent respectively by day 42, but there were no clear dose-response trends, and no daughter products were detected. The poorest overall reduction in moles of CVOCs were at MW-31I/SB-31 with a maximum mass reduction of 32 percent; again, with no clear dose-response trend. The MW-31I/SB-31 TCE mass reductions were offset by increases in daughter products cDCE, tDCE and chloroethene (CE). RP indicated that vinyl chloride was not detected during the testing.

3.2.3 Results of Connelly ZVI GMA-M Testing

ZVI-amended reactors reduced the total micromoles of TCE for samples MW-15I/SB-18 and MW-30I/SB-30 by a maximum of 89 to 22 percent respectively, by day 42. With increasing dose of ZVI, a slight improvement in reductions were apparent. No daughter products were detected in these two trial tests.

With ZVI amendment, reduction in moles of CVOCs in sample MW-31I/SB-31 spanned 40 to 62 percent with no dose-response trend. Although reductions in TCE were evident, cDCE and tDCE appeared to increase at intermediate times before decreasing by day 42. RP indicated that vinyl chloride was not detected during the testing.

Resolution Partners measured pH and ORP on day 66 after the trials were determined to be complete. The pH decreased slightly or stayed the same with the addition of EHC to the three reactors. EHC reduced the ORP by almost 400 mV for samples MW-15I/SB-18 and MW-30I/SB-30 with greater reductions at higher doses. Sample MW-31I/SB-31 began with a lower ORP (-57 mV) and saw a smaller decrease with the addition of the EHC to -148 mV. The addition of ZVI generally increased the pH to about 7.5 standard units (SU). The ORP decreased in MW-15I/SB-18 and MW-30I/SB-30 ZVI tests, but not as much as with the EHC. In ZVI test sample for MW-31I/SB-31, the ORP increased by about 20 mV.

4. CONCLUSIONS

Bench-scale testing was performed on soil and groundwater samples collected from the different soil lithologies that host the Central Plume. Nine soil samples were submitted to Evonik's laboratory for performance testing of the persulfate oxidant and the associated base buffering capacity. Evonik's KDT testing provided an indication of the minimum amount of oxidant required to overcome the demands of soil and groundwater contaminants, and other secondary species that may contribute to the consumption of the oxidant. Evonik's report included a recommendation to perform a field pilot demonstration to determine the effectiveness of Klozur® activated persulfate on contaminants of concern under actual field conditions.

Groundwater and soil samples MW-15I/SB-18, MW-30I/SB-30 and MW-31S/SB-31 were submitted to RP to test the ability for the amendments EHC and ZVI to reduce site CVOCs. The different soil and groundwater combinations enabled testing and evaluating three different plume conditions. The results for the SB-18/MW-15I combination clearly indicated that both ZVI and EHC reduced TCE concentrations in groundwater. The MW-30I/SB-31 and MW-31S/SB-31 combination tests demonstrated that TCE will likely desorb from the soil during both ZVI and EHC treatment. The rate of TCE, soil back-diffusion appeared to be less than the water treatment rate. The MW-31S/SB-31 test also suggested that conditions were favorable for reductive dichlorination as the daughter products cDCE and tDCE concentrations increased during the intermediate testing period. RP indicated that vinyl chloride was not detected during the testing.

The MW-15I/SB-18 tests showed that the greatest TCE concentration reductions occurred immediately after the initial mixing on day 1. With the exception of the 1% dose rate test, decreasing reductions were observed over the subsequent 7-, 14-, and 21-day test intervals.

The oxidant and ZVI bench testing confirmed that these reagents/substrates are potentially suitable for remediating the Central TCE Plume at the Site. The oxidant is likely the most effective technology for treating the upland, sand aquifer portion of the Central TCE Plume. Due to the increasing oxidant demand for the silt and clay lithologies, the ZVI or a combination of ZVI and possibly enhanced bioremediation may be more efficacious for the lower portion of the Central TCE Plume.

Field pilot testing is recommended for both the oxidizing and reducing amendments. A pilot test workplan will be prepared and submitted for WDNR review and approval.

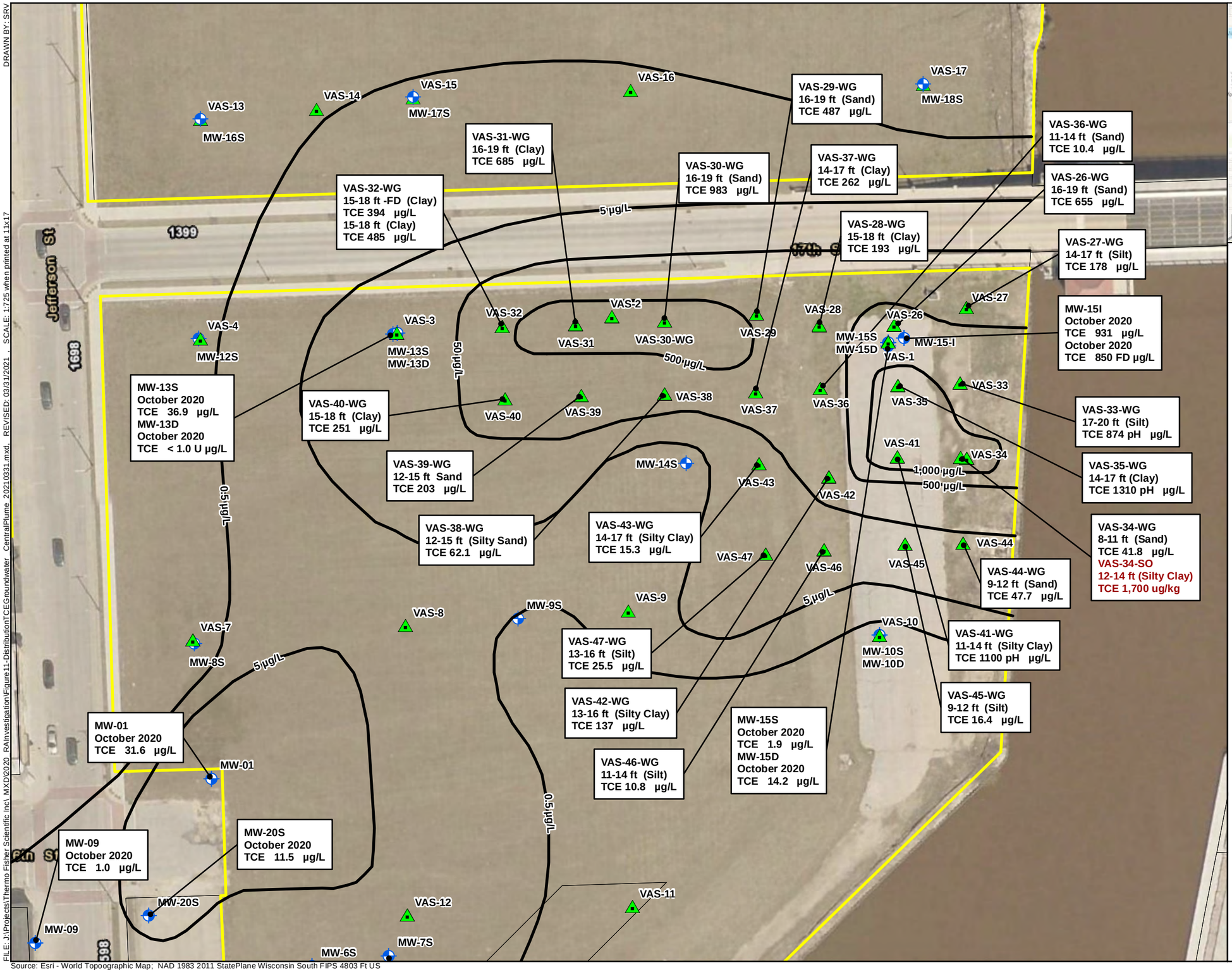
Carl B. Stay, P.E.
Technical Consultant

David de Courcy-Bower, P.E.
Partner

FIGURES

DRAWN BY: SRV

FILE: J:\Projects\Thermo Fisher Scientific Inc\ MXD\2020_RAInvestigation\Figure11-DistributionTCEGroundwater_CentralPlume_20210331.mxd, REVISED: 03/31/2021 , SCALE: 1:725 when printed at 11x17



Legend

- Monitoring Well Location
- Vertical Aquifer Boring
- TCE Contour (2020)
- Property Boundary (Approximate)
- Parcel Boundary

Notes:
- < = Compound not detected at concentrations above the laboratory method detection limit. The laboratory method detection limit is shown. If the method detection limit is not available, the reporting dection limit is shown (RDL).
- * Non-detect results are reported on a wet weight basis.
- Empty cells = Not analyzed
- N = Normal Environmental Sample
- FD = Field Duplicate Sample
- µg/L = micrograms per liter
- Ft = feet
- SO = Soil Sample
- WG = Groundwater Sample
- VAS = Vertical Aquifer Sample

Qualifiers - Organic:
- J = Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value (PACE)
- pH = Post-analysis pH measurement indicates insufficient VOA sample preservation.
- All analyses performed by PACE.

N

0 60 120
Feet

Figure 1
Distribution of TCE in Groundwater - Central Plume
Former Hamilton Industries
1316 18th Street
Two Rivers, Wisconsin

Environmental Resources Management
www.erm.com

Source: Esri - World Topographic Map; NAD 1983 2011 StatePlane Wisconsin South FIPS 4803 Ft US

Legend

- Soil Boring Location
- Monitoring Well Location (Quarterly)
- Monitoring Well Location (Annual)
- Monitoring Well Location (Discontinue)
- Well and Soil Boring Location used in PDI Testing
- Property Boundary (Approximate)
- Parcel Boundary

N

0 175 350

Feet

Figure 2
PDI Testing Location Map
Former Hamilton Industries
1316 18th Street
Two Rivers, Wisconsin

Environmental Resources Management
www.erm.com

Source: Esri - World Topoographic Map; NAD 1983 2011 StatePlane Wisconsin South FIPS 4803 Ft US

DRAWN BY: S. Vickery

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APPENDIX A
SOIL BORING/MONITORING WELL CONSTRUCTION LOGS

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-27S**
ERM PROJECT # 0383990
SHEET 1 OF 3

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792433.49
EASTING	2607434.88
ELEVATION	597.97 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1 hours*
Gals. Purged: *58*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
		SAND (SP-SC) well graded, subangular, fine to medium grained SAND; loose, trace clay, dry, dark brown		SP-SC	
2	595				
4					
6					
8	590				
10					
12					
	585				

WELL CONSTRUCTION
Casing Type: 6-inch Diameter Steel
Stickup
Bentonite Seal
Schedule 40 PVC Riser

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 10 ft
Depth to bottom of screen = 20 ft
Stick-up length = 1.99 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-27S**
ERM PROJECT # 0383990
SHEET 2 OF 3

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792433.49
EASTING	2607434.88
ELEVATION	597.97 ft

WELL CONSTRUCTION

	Riser	Screen
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Method: *Surge and Pump - mechanical*
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Gals. Purged: *58*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	WELL CONSTRUCTION
14		SAND (SP) poorly graded, subangular, medium grained SAND; loose, trace clay, wet, light brown		SP		20/40 Silica Sand; 0.010-slot Schedule 40 PVC Screen
16						
			17			
18	580	CLAY (CH) medium plasticity, dense, wet, light brown		CH		
20						
22						
	575					
24						

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 10 ft
Depth to bottom of screen = 20 ft
Stick-up length = 1.99 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-27S**
ERM PROJECT # 0383990
SHEET 3 OF 3

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792433.49
EASTING	2607434.88
ELEVATION	597.97 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1 hours*
Gals. Purged: *58*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	WELL CONSTRUCTION
		CLAY (CH) medium plasticity, dense, wet, light brown *(Continued)*		CH		
28	570		28			
30						
32						
	565					
34						
36						
38	560					

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 10 ft
Depth to bottom of screen = 20 ft
Stick-up length = 1.99 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-28S**
ERM PROJECT # 0383990
SHEET 1 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/29/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/29/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792439.9
EASTING	2607534.29
ELEVATION	595.59 ft

WELL CONSTRUCTION

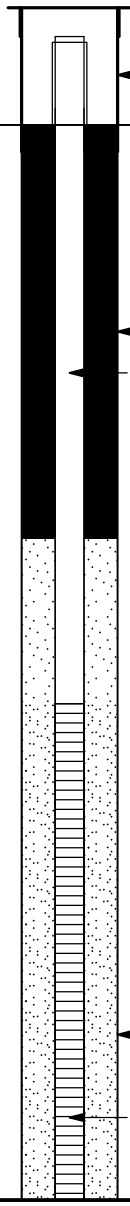
	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1 hours*
Gals. Purged: *57*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
	595	SAND (SW-SC) well graded, subangular, fine to medium grained SAND; loose, trace clay, dry, dark brown, [Wood pieces]		SW-SC	
2					
		SAND (SC) well graded, subangular, fine to medium grained SAND; loose, trace fine gravel, trace clay, dry, dark brown	3		
4				SC	
		SAND (SW-SC) well graded, subangular, fine to medium grained SAND; loose, trace clay, dry, light brown	5		
	590				
6				SW-SC	
8		SAND (SW-SC) poorly graded, subangular, fine grained SAND; loose, moist, yellowish orange	8		
				SW-SC	
10		SAND (SW-SC) well graded, subangular, fine to medium grained SAND; loose, trace silt, moist, light brown	10		
	585			SW-SC	
12		SAND (SW-SC) well graded, subangular, fine to medium grained SAND; loose, trace silt, wet, light brown	12	SW-SC	

WELL CONSTRUCTION



REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 7 ft
Depth to bottom of screen = 17 ft
Stick-up length = 1.80 ft

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-28S**
ERM PROJECT # 0383990
SHEET 2 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/29/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/29/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792439.9
EASTING	2607534.29
ELEVATION	595.59 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1 hours*
Gals. Purged: *57*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	WELL CONSTRUCTION
		SAND (SW-SC) well graded, subangular, fine to medium grained SAND; loose, trace silt, wet, light brown *(Continued)*				
14				SW-SC		
			15			
		FAT CLAY (CH) medium plasticity, dense, wet, light brown				
	580					
16						
				CH		
18						
20			20			
	575					
22						
24						
	570					

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 7 ft
Depth to bottom of screen = 17 ft
Stick-up length = 1.80 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-29I**
ERM PROJECT # 0383990
SHEET 1 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792416.48
EASTING	2607595.7
ELEVATION	593.45 ft

WELL CONSTRUCTION

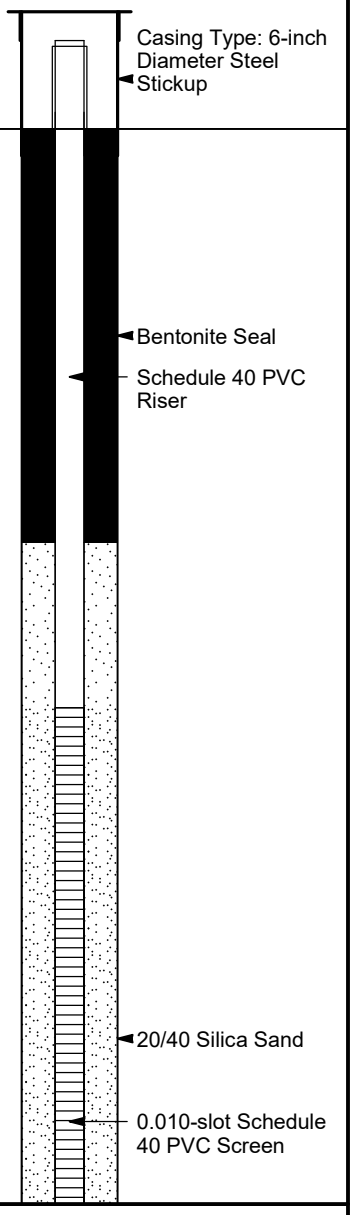
	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1 hours*
Gals. Purged: *60*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
		SAND (SP) poorly graded, rounded, fine to medium grained SAND; loose, dry, light brown			
2					
	590				
4					
6				SP	
8					
	585				
10					
			11		
		SAND (SP) poorly graded, rounded, fine to medium grained SAND; loose, wet, light brown			
12				SP	

WELL CONSTRUCTION



REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 7 ft
Depth to bottom of screen = 17 ft
Stick-up length = 2.42 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-29I**
ERM PROJECT # 0383990
SHEET 2 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792416.48
EASTING	2607595.7
ELEVATION	593.45 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1 hours*
Gals. Purged: *60*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	WELL CONSTRUCTION
14	580	SAND (SP) poorly graded, rounded, fine to medium grained SAND; loose, wet, light brown *(Continued)*		SP		
			14.5			
16		FAT CLAY (CH) medium plasticity, dense, wet, light brown		CH		
18	575					
20						
22						
24	570		24			

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 7 ft
Depth to bottom of screen = 17 ft
Stick-up length = 2.42 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-30I**
ERM PROJECT # 0383990
SHEET 1 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792367.1
EASTING	2607657.44
ELEVATION	587.72 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1.5 hours*
Gals. Purged: *65*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
		Dry, black, [Asphalt]			
		GRAVEL angular, medium grained GRAVEL; loose, some concrete, dry, light gray, [Gravel fill with concrete and debris]	0.5		
2	585	SAND (SP) poorly graded, rounded, fine to medium grained SAND; dry, light brown	2	SP	
4		SAND (SP) poorly graded, rounded, fine to medium grained SAND; wet, light brown	4.5	SP	
6					
8	580				
10		SILT (ML) non plastic, wet, light grayish brown	10	ML	
12	575				

WELL CONSTRUCTION
Casing Type: 6-inch Diameter Steel
Stickup
Bentonite Seal
Schedule 40 PVC Riser
20/40 Silica Sand
0.010-slot Schedule 40 PVC Screen

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 6 ft
Depth to bottom of screen = 16 ft
Stick-up length = 1.87 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-30I**
ERM PROJECT # 0383990
SHEET 2 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/30/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/30/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792367.1
EASTING	2607657.44
ELEVATION	587.72 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *1.5 hours*
Gals. Purged: *65*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	WELL CONSTRUCTION
14		FAT CLAY (CH) medium plasticity, dense, moist, light grayish brown				
16						
18	570			CH		
20						
22						
24	565		24			

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 6 ft
Depth to bottom of screen = 16 ft
Stick-up length = 1.87 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-31S**
ERM PROJECT # 0383990
SHEET 1 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/31/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/31/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792363.18
EASTING	2607709.01
ELEVATION	586.66 ft

WELL CONSTRUCTION

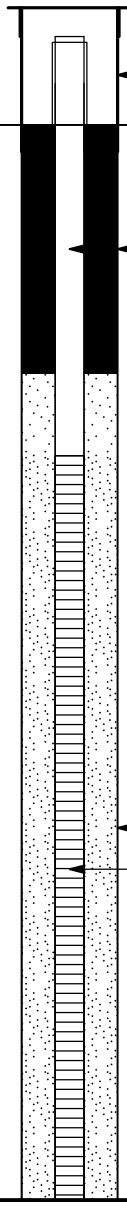
	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *0.5 hours*
Gals. Purged: *62*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
		Dry, dark reddish brown, [Organic rich topsoil]	0.5		
		CLAYEY SAND (SW-SC) well graded, subangular, fine to medium grained SAND; loose, trace gravel, dry, dark blackish brown, [Organic rich]		SW-SC	
2	585	SAND (SW) well graded, angular, fine to medium grained SAND; loose, trace gravel, moist, dark brown	2	SW	
4					
		SAND (SW) well graded, rounded, fine to medium grained SAND; loose, trace clay, wet, dark brown	5	SW	
6					
	580				
8		SAND (SP) poorly graded, rounded, medium to coarse grained SAND; loose, wet, brown	8	SP	
10					
	575				
12		SAND (SP) poorly graded, rounded, fine grained SAND; loose, wet, brown	12	SP	

WELL CONSTRUCTION



Casing Type: 6-inch Diameter Steel
Stickup
Schedule 40 PVC Riser
Bentonite Seal
20/40 Silica Sand
0.010-slot Schedule 40 PVC Screen

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 4 ft
Depth to bottom of screen = 14 ft
Stick-up length = 2.12 ft

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **MW-31S**
ERM PROJECT # 0383990
SHEET 2 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/31/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/31/2022

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Wisconsin South (US Feet))

NORTHING	792363.18
EASTING	2607709.01
ELEVATION	586.66 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Surge and Pump - mechanical*
Duration: *0.5 hours*
Gals. Purged: *62*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	WELL CONSTRUCTION
		SILT (ML) stiff, moist, grayish brown		ML		
14						
			15			
		FAT CLAY (CH) medium plasticity, dense, moist, light brown				
16						
	570			CH		
18						
20			20			
	565					
22						
24						

REMARKS:
BBC = Base Buffering Capacity Test; SOD = Soil Oxidant Demand with Klozur Persulfate

WELL INSTALLATION NOTES:
Depth to top of screen = 4 ft
Depth to bottom of screen = 14 ft
Stick-up length = 2.12 ft

WELL CONSTRUCTION GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 12/13/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **SB-18**
ERM PROJECT # 0383990
SHEET 1 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/31/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/31/2022
HORIZONTAL DATUM (NAD 1983 StatePlane Wisconsin South (US Feet))		BOREHOLE DEPTH	16 ft
NORTHING	792290.81	BOREHOLE DIAMETER	3.25 in
EASTING	2607666.51	DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM (NAVD 88 (US Feet)) ELEVATION	587.33 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLING DATA: SAMPLE TYPE	RECOVERY	PID (ppm) 10.6 eV Lamp	Observations / Remarks
		Dry, light brown							
		SAND (SP) poorly graded, subrounded, fine to medium grained SAND; loose, dry, light brown	0.5					0	
2	585			SP			60/60	0	
4								0	
		SAND (SP) poorly graded, subrounded, fine to medium grained SAND; loose, wet, light brown	5					0	
6				SP			36/36	0	
8	580	SAND (SP) poorly graded, subrounded, fine to medium grained SAND; loose, wet, light brown	8	SP				0	
10		SILT (ML) non plastic, stiff, moist, light brown	10	ML			36/48	0	SB-18-SO-10-12-20220831 [SOD & BBC] [(10-12ft)]
12	575	LEAN CLAY (CL) low plasticity, stiff, moist, light brown	12	CL			36/48	0	

REMARKS:

LAB ANALYSIS:

Auger Cuttings

Direct push geoprobe sample

BORING LOG GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 11/10/22

7311 W Greenfield Avenue
Milwaukee, WI 53214

PROJECT:
Thermo Fisher
Former Hamilton Industries

BORING # **SB-18**
ERM PROJECT # 0383990
SHEET 2 OF 2

DRILLING CONTRACTOR	Geoserve Inc. Woodstock, IL	ERM REPRESENTATIVE	Lauren Lande
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Milwaukee, WI
DRILLING METHOD	Direct Push	DATE: START	08/31/2022
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	08/31/2022
HORIZONTAL DATUM (NAD 1983 StatePlane Wisconsin South (US Feet))		BOREHOLE DEPTH	16 ft
NORTHING	792290.81	BOREHOLE DIAMETER	3.25 in
EASTING	2607666.51	DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM (NAVD 88 (US Feet)) ELEVATION	587.33 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLING DATA: SAMPLE TYPE	RECOVERY	PID (ppm) 10.6 eV Lamp	Observations / Remarks
		LEAN CLAY (CL) low plasticity, stiff, moist, light brown *(Continued)*							
14				CL			36/48	0	
								0	
16			16						End of soil boring at 16 feet [(16-16ft)]
	570								
18									
20									
22	565								
24									

REMARKS:

LAB ANALYSIS:

Auger Cuttings

Direct push geoprobe sample

BORING LOG GINT_TWORIVERS_2022-11.GPJ ERM DATA TEMPLATE.GDT 11/10/22

APPENDIX B

EVONIK BENCH SCALE TESTING

OXIDANT DEMAND AND BASE-BUFFERING CAPACITY

Klozur® Persulfate Demand Test and Base Buffering Capacity test

Client: **ERM**
7311 W Greenfield Ave., Milwaukee, WI 53214
John Roberts
Phone: 414-977-4710
Email: John.Roberts@erm.com

Performing Lab: Evonik
Tonawanda, New York, 14150

Date **September 28, 2022**

I. Background

Klozur® activated persulfate is a strong oxidant capable of mineralizing a wide range of contaminants, including chlorinated solvents, petroleum hydrocarbons, polyaromatic hydrocarbons, gasoline additives, pesticides, and many others. Activation of the persulfate anion generates the sulfate radical, the primary species that drives the rapid destruction of the contaminants of concern. Activation can be accomplished by several methods[1]: heat, transition metals, addition of hydrogen peroxide, or utilizing high pH. Choice of the activation method will depend on the contaminant of concern and site characteristics.

A chemical oxidant is not specific as to what it will oxidize. As a result, activated persulfate will not only mineralize the contaminant of concern, but a portion of the oxidant will be used in oxidizing soil organics, reduced metals, and organic species that are not of concern. In addition, activated persulfate will undergo auto-decomposition, which will be a function of temperature, concentration and activation method. The demand upon the activated persulfate from all of these components is captured in a coarse screening test termed, “Klozur Demand Test”. It is dependent upon the site characteristics, such as the organic content of the soil, the mineral loading, and soil type and collectively must be considered for estimating the magnitude of oxidant dosing during field application.

The Klozur® Persulfate KDT test measures the loss of persulfate in the presence of soil, groundwater and activator over a period of 48 and 168 hours.

[1] Evonik is the owner of licensee under various patents relating to the use of activation chemistries

The resulting KDT values can then be used as a guide to develop appropriate persulfate dosing for subsequent treatability testing and field applications.

When high pH is chosen as a means of activation, a Base Buffering Capacity (BBC) test is recommended. The goal of a BBC test is to determine the amount of sodium hydroxide (NaOH) needed to raise the pH of a soil to pH 10.5, which is necessary for Klozur persulfate activation. This report contains the results and observations from both a KDT and BBC test.

II. Sample Handling

Client Sample Identification

Site Identification: Two Rivers

Nine soil samples were received with a request to test them separately.

Soil Sample 1: SB-MW-27-SO-9-11-20220829
Soil Sample 2: SB-MW-27-SO-23-25-20220829
Soil Sample 3: SB-MW-28-SO-15-17-20220829
Soil Sample 4: SB-MW-29-SO-18-20-20220830
Soil Sample 5: SB-MW-30-SO-10-12-20220830
Soil Sample 6: SB-MW-30-SO-15-17-20220830
Soil Sample 7: SB-MW-31-SO-7-9-20220831
Soil Sample 8: SB-MW-31-SO-13-15-20220831
Soil Sample 9: SB-18-SO-10-12-20220831
GW ID: DI H2O

Handling Procedures

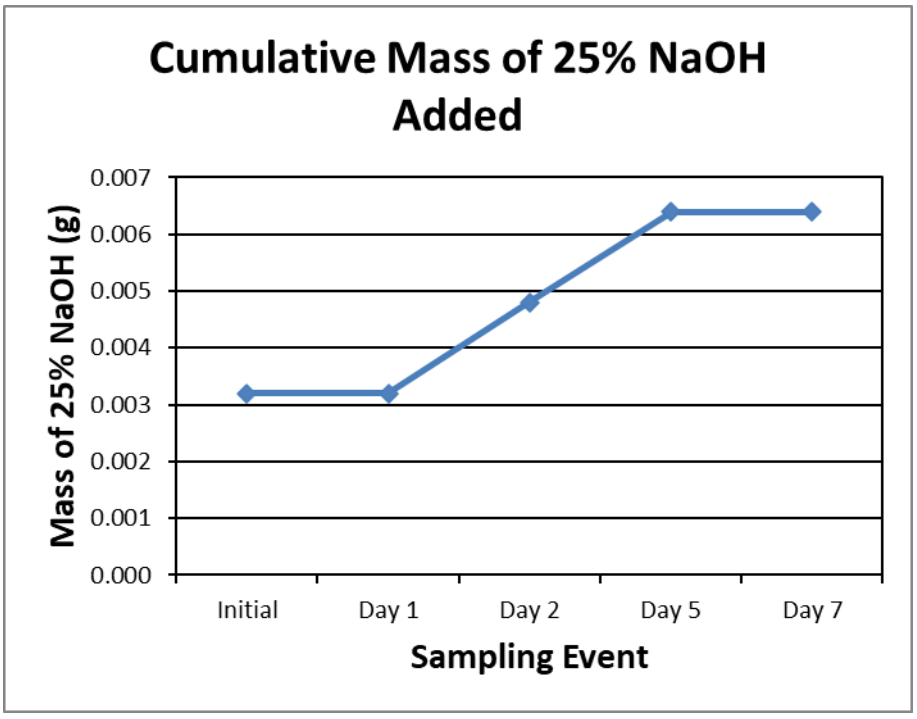
- The samples were received on September 2, 2022. Each soil was transferred into a stainless-steel bowl and mixed well.
  - Soil Sample 1 was a medium golden brown, semi-moist, medium sand with an earthy odor.
  - Soil Sample 2 was a medium grey-brown, semi-moist, sticky hard clay. No stones or odor were detected.
  - Soil Sample 3 was a medium grey-brown, semi-moist, sticky hard clay. No stones or odor were detected.
  - Soil Sample 4 was a medium grey-brown, semi-dry, sticky hard clay. No stones or odor were detected.
  - Soil Sample 5 was a medium grey-brown, very moist, silt / clay. No stones or odor were detected.
  - Soil Sample 6 was a medium grey-brown, semi-dry, sticky hard clay. No stones or odor were detected.
  - Soil Sample 7 was a dark brown, semi-moist, medium sand with some small stones. No odor was detected.

    - Soil Sample 8 was a medium brown, semi-moist, silt / clay. No stones or odor were detected.
    - Soil Sample 9 was a medium tan-brown, semi-moist, clay / silt. No stones or odor were detected.
- No groundwater was sent with the samples, so DI H2O was used for the study.
- The remaining soils were put into their original containers and stored at ambient lab temperature.
- On September 7, 2022, and September 13, 2022, the tubes were prepared according to the Evonik Tonawanda KDT protocol using the provided soils and DI H2O. Additional tubes were prepared according to Evonik Tonawanda BBC protocol using the provided soils and DI H2O.
- The experimental samples were stored at room temperature and each sample was inverted daily.
- The unused soil will be disposed of responsibly after about one month.

III. Results

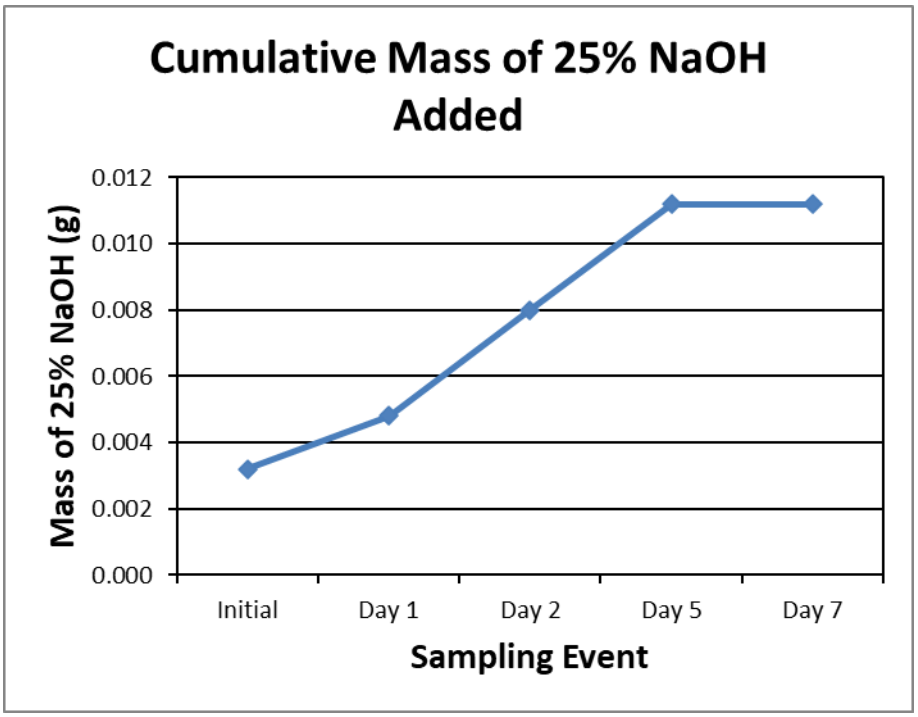
Sample 1 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-27-SO-9-11-20220829 GW: DI H2O	High pH 25% NaOH	10	30	15	12.67	0.93	1.51

Sample 1 ID	pH	Initial Dosing	7 days	Total mass of 25% NaOH added over 7 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-27-SO-9-11-20220829 GW: DI H2O	**Initial pH**	9.80	10.84	0.006	0.23
	Final pH	11.16	10.84		



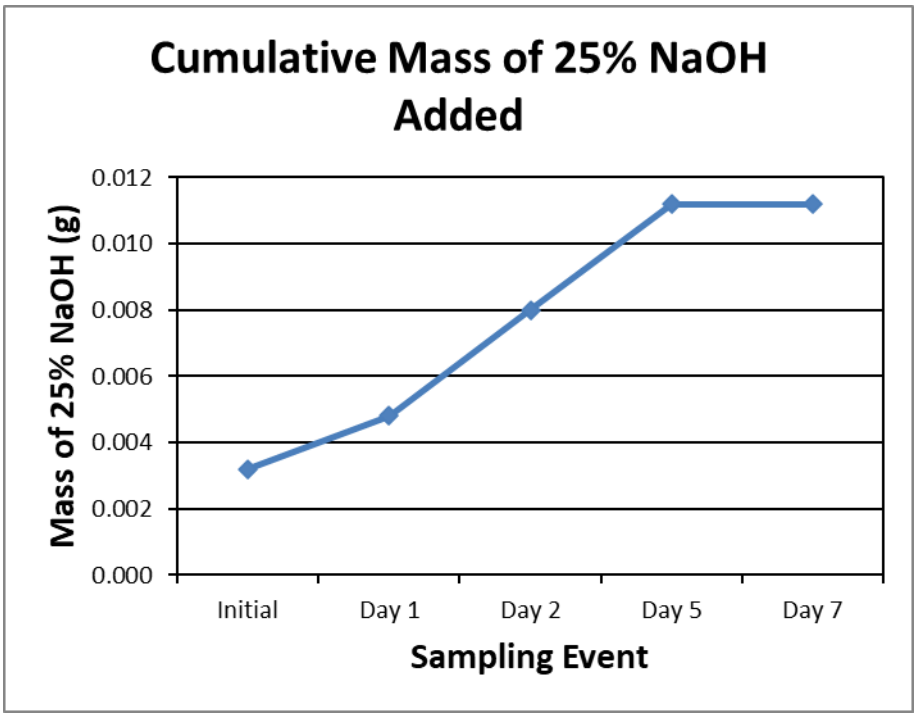
Sample 2 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-27-SO-23-25-20220829 GW: DI H2O	High pH 25% NaOH	10	30	15	12.67	7.14	12.36

Sample 2 ID	pH	Initial Dosing	7 days	Total mass of 25% NaOH added over 7 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-27-SO-23-25-20220829 GW: DI H2O	**Initial pH**	9.34	10.63	0.013	0.52
	Final pH	10.89	10.63		



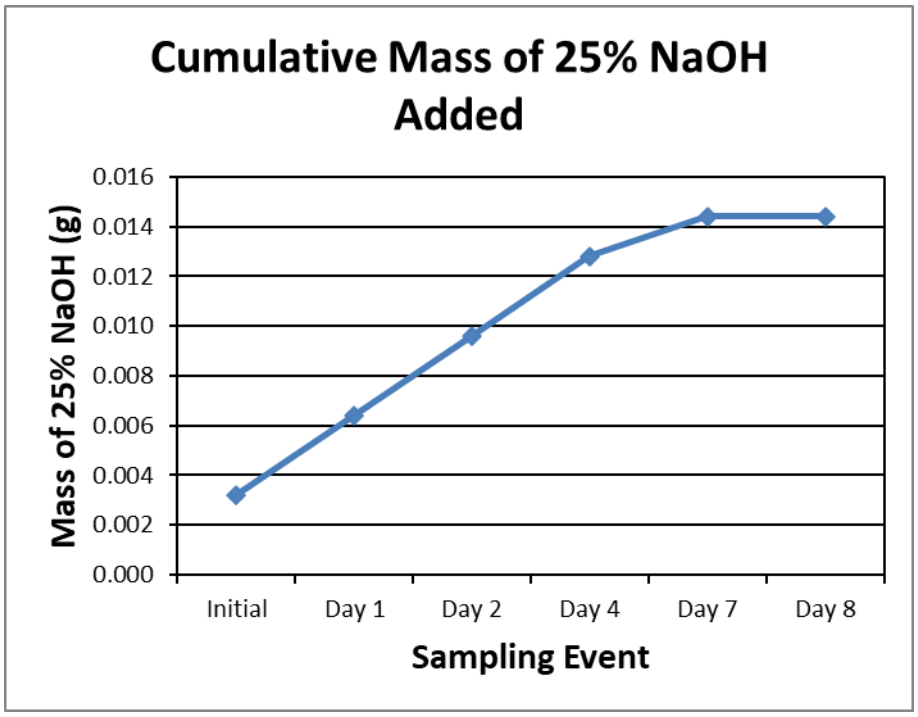
Sample 3 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-28-SO-15-17-20220829 GW: DI H2O	High pH 25% NaOH	10	30	15	12.66	7.22	12.02

Sample 3 ID	pH	Initial Dosing	7 days	Total mass of 25% NaOH added over 7 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-28-SO-15-17-20220829 GW: DI H2O	**Initial pH**	9.04	10.50	0.013	0.53
	Final pH	10.84	10.50		



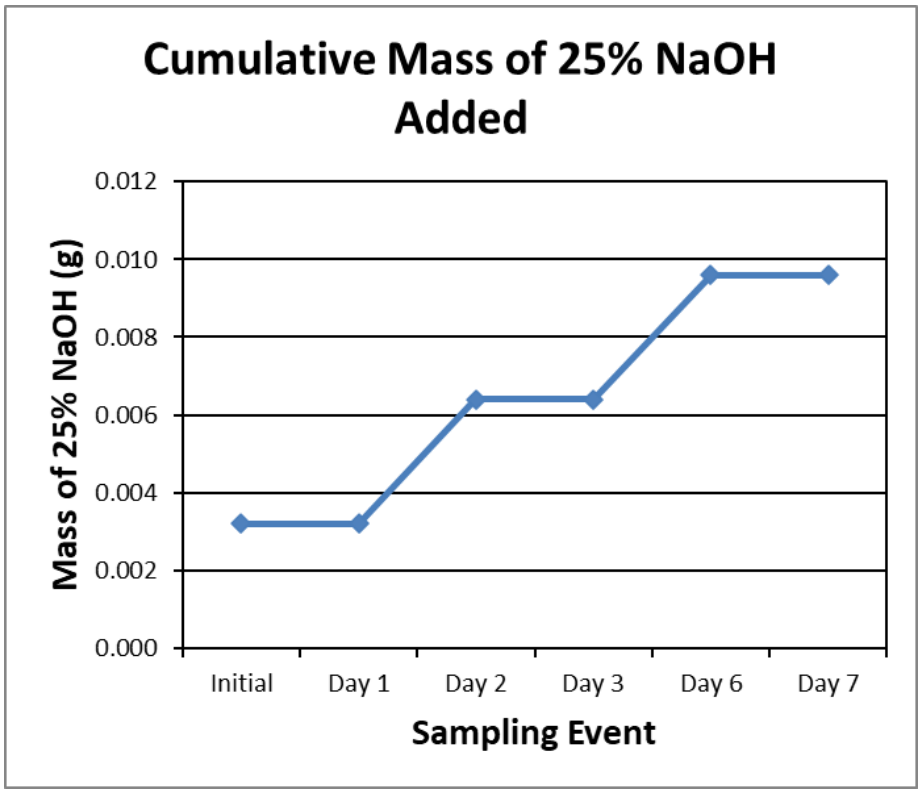
Sample 4 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-29-SO-18-20-20220830 GW: DI H2O	High pH 25% NaOH	10	30	15	12.64	7.24	12.47

Sample 4 ID	pH	Initial Dosing	8 days	Total mass of 25% NaOH added over 8 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-29-SO-18-20-20220830 GW: DI H2O	**Initial pH**	9.14	10.56	0.014	0.59
	Final pH	10.83	10.56		



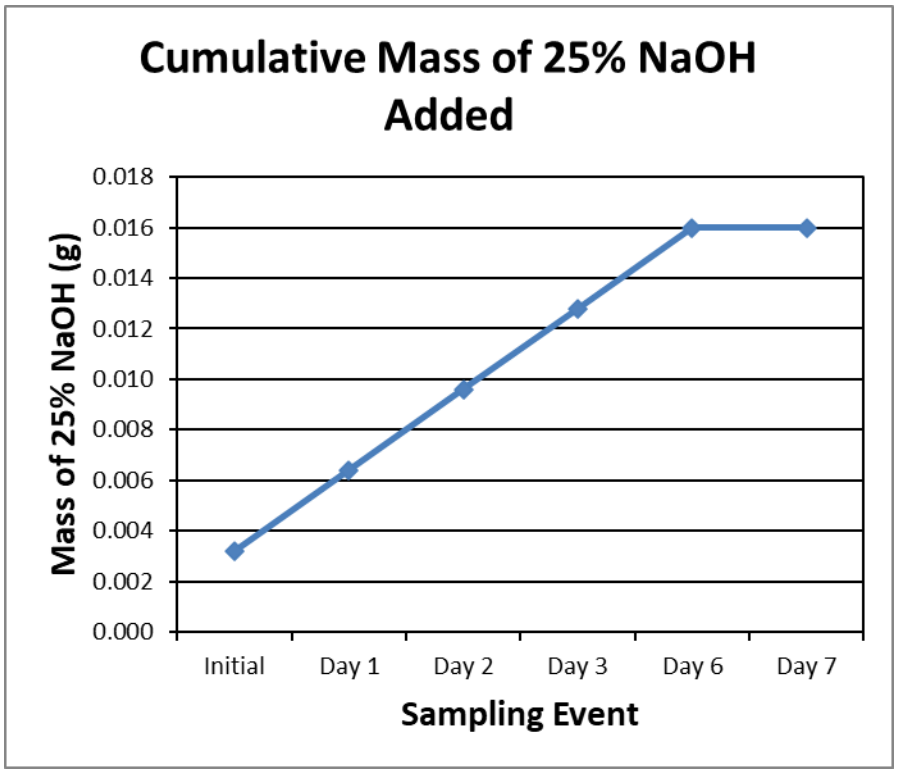
Sample 5 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-30-SO-10-12-20220830 GW: DI H2O	High pH 25% NaOH	10	30	15	12.54	3.49	7.17

Sample 5 ID	pH	Initial Dosing	8 days	Total mass of 25% NaOH added over 8 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-30-SO-10-12-20220830 GW: DI H2O	**Initial pH**	9.51	10.80	0.010	0.39
	Final pH	11.07	10.80		



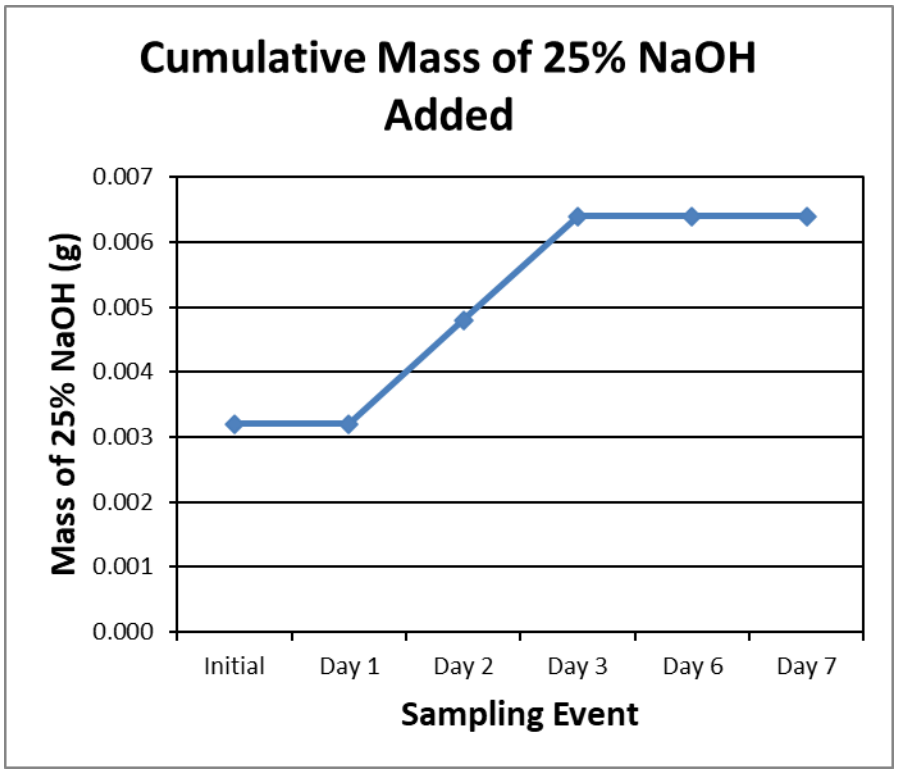
Sample 6 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-30-SO-15-17-20220830 GW: DI H2O	High pH 25% NaOH	10	30	15	12.58	6.39	11.13

Sample 6 ID	pH	Initial Dosing	8 days	Total mass of 25% NaOH added over 8 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-30-SO-15-17-20220830 GW: DI H2O	**Initial pH**	8.66	10.70	0.016	0.66
	Final pH	10.90	10.70		



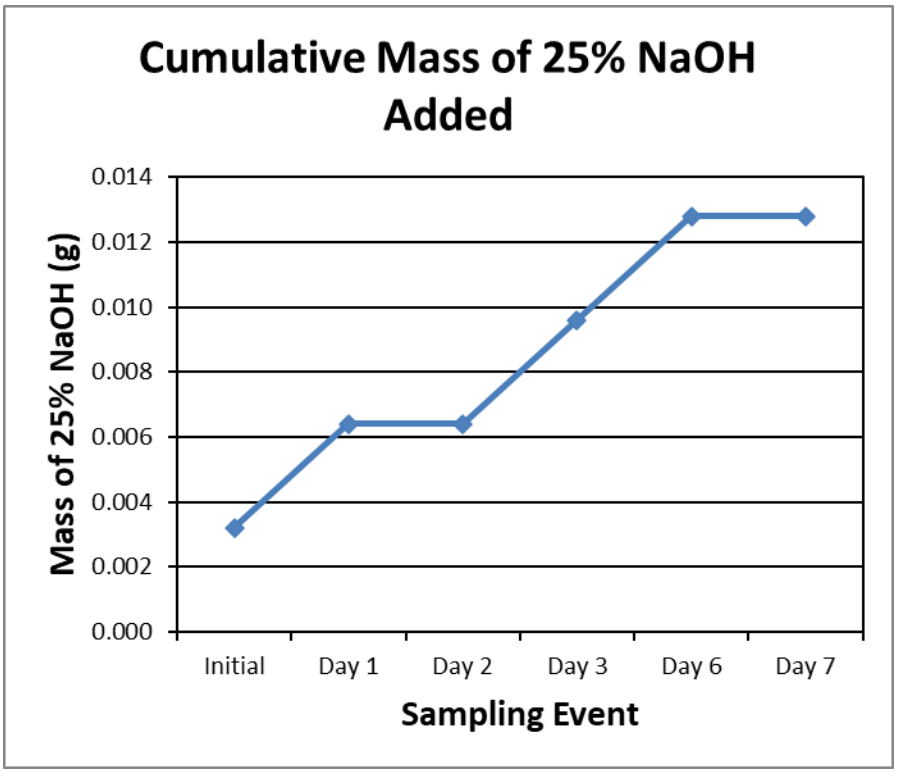
Sample 7 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-31-SO-7-9-20220831 GW: DI H2O	High pH 25% NaOH	10	30	15	12.62	5.56	9.68

Sample 7 ID	pH	Initial Dosing	8 days	Total mass of 25% NaOH added over 8 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-31-SO-7-9-20220831 GW: DI H2O	**Initial pH**	9.00	10.62	0.006	0.26
	Final pH	10.93	10.62		



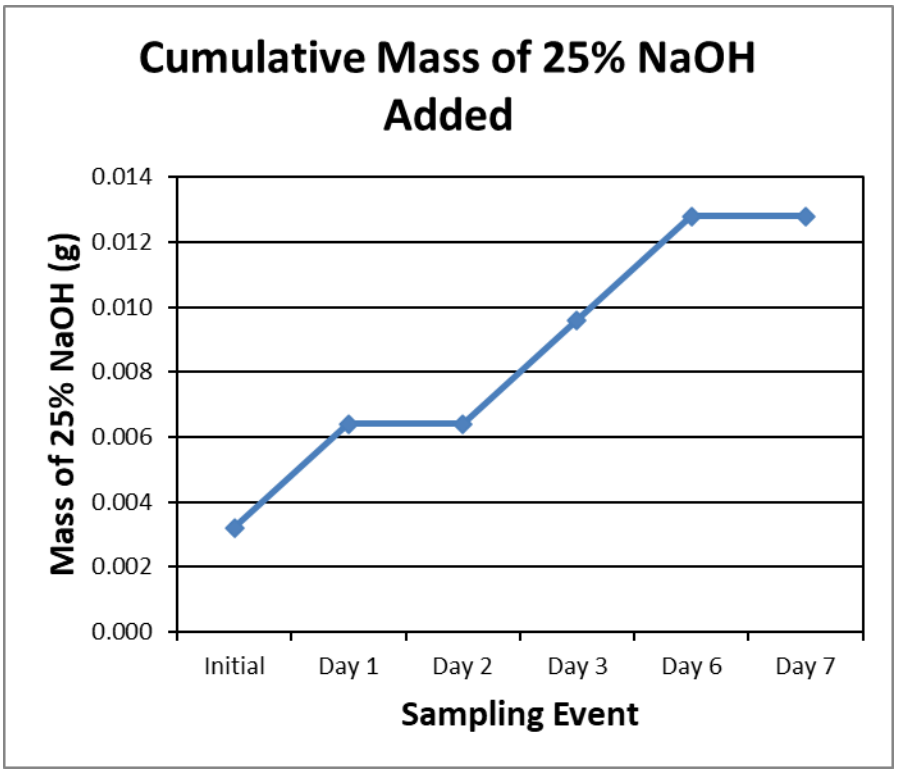
Sample 8 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-MW-31-SO-13-15-20220831 GW: DI H2O	High pH 25% NaOH	10	30	15	12.58	6.67	10.95

Sample 8 ID	pH	Initial Dosing	8 days	Total mass of 25% NaOH added over 8 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-MW-31-SO-13-15-20220831 GW: DI H2O	**Initial pH**	9.19	10.87	0.013	0.52
	Final pH	10.92	10.87		



Sample 9 ID	Trial Activator	Soil Wt. (g)	Water Vol. (mL)	Klozur Dosage (g/Kg Soil) t=0 hrs.	Slurry pH	Klozur Consumption (g persulfate / kg dry soil)	
						t=48hr	t=168 hr
Soil: SB-18-SO-10-12-20220831 GW: DI H2O	High pH 25% NaOH	10	30	15	12.51	4.72	

Sample 9 ID	pH	Initial Dosing	8 days	Total mass of 25% NaOH added over 8 days (g)	BBC (g 25% NaOH / kg dry soil)
Soil: SB-18-SO-10-12-20220831 GW: DI H2O	**Initial pH**	9.28	10.74	0.013	0.52
	Final pH	10.97	10.74		



IV. Conclusions

Table 1: Summary of the Klozur® Persulfate demand with high pH activation after 48 hours and 168 hours plus the BBC values for the provided soils and DI H2O.

Sample #	Soil Sample ID	Klozur Consumption (g persulfate / kg dry soil)		BBC (g 25% NaOH / kg dry soil)
		t=48hr	t=168 hr	
1	SB-MW-27-SO-9-11-20220829	0.93	1.51	0.23
2	SB-MW-27-SO-23-25-20220829	7.14	12.36	0.52
3	SB-MW-28-SO-15-17-20220829	7.22	12.02	0.53
4	SB-MW-29-SO-18-20-20220830	7.24	12.47	0.59
5	SB-MW-30-SO-10-12-20220830	3.49	7.17	0.39
6	SB-MW-30-SO-15-17-20220830	6.39	11.13	0.66
7	SB-MW-31-SO-7-9-20220831	5.56	9.68	0.26
8	SB-MW-31-SO-13-15-20220831	6.67	10.95	0.52
9	SB-18-SO-10-12-20220831	4.72	8.48	0.52

V. Photos from BBC test

Photo 1: Day 0, before initial dosing. From left to right: Sample 1 - SB-MW-27-SO-9-11-20220829 soil Tubes #1 & 2 and Sample 2 - SB-MW-27-SO-23-25-20220829 soil Tubes #1 & 2

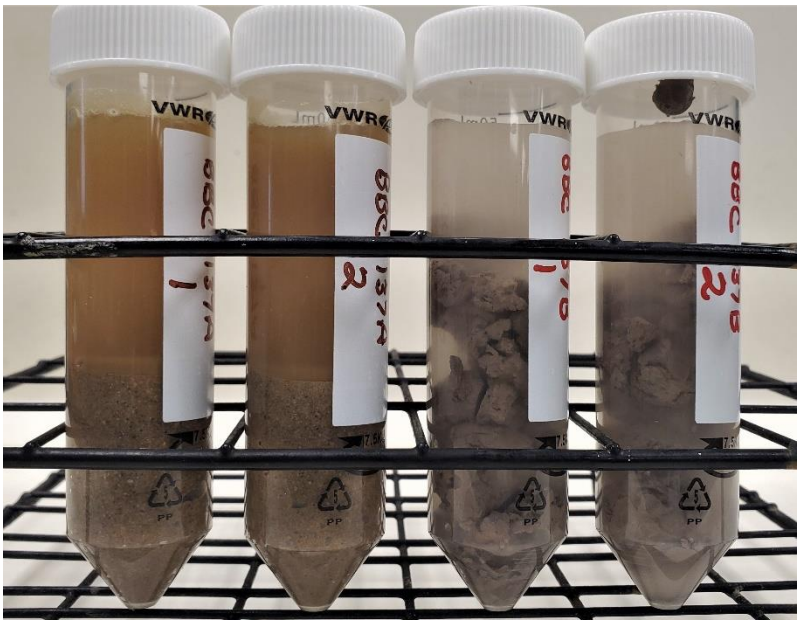


Photo 2: Day 0, before initial dosing. From left to right: Sample 3 - SB-MW-28-SO-15-17-20220829 soil Tubes #1 & 2 and Sample 4 - SB-MW-29-SO-18-20-20220830 soil Tubes #1 & 2

Photo 3: Day 0, before initial dosing. From left to right: Sample 5 - SB-MW-30-SO-10-12-20220830 soil Tubes #1 & 2 and Sample 6 - SB-MW-30-SO-15-17-20220830 soil Tubes #1 & 2

Photo 4: Day 0, before initial dosing. From left to right: Sample 7 - SB-MW-31-SO-7-9-20220831 soil Tubes #1 & 2 and Sample 8 - SB-MW-31-SO-13-15-20220831 soil Tubes #1 & 2

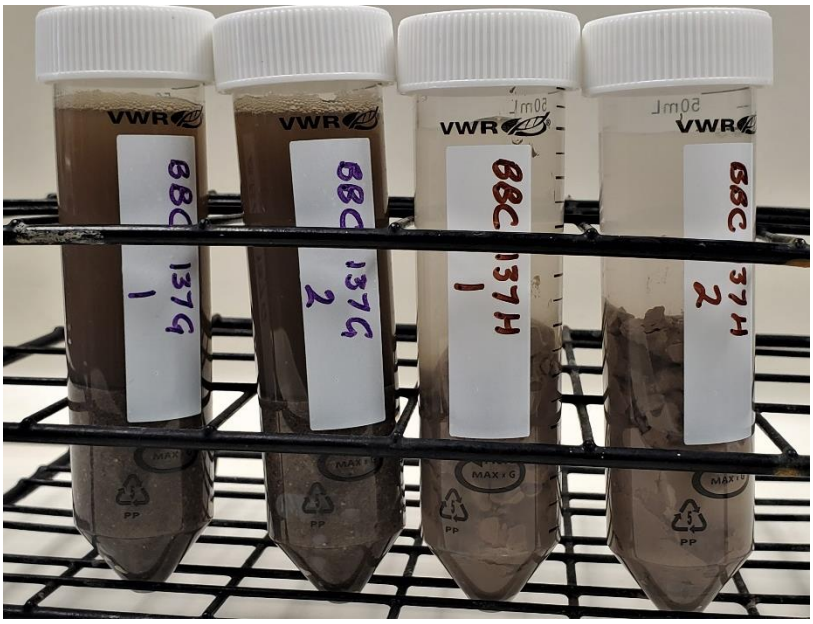


Photo 5: Day 0, before initial dosing. From left to right: Sample 9 - SB-18-SO-10-12-20220831 soil #1 & 2

Photo 6: Day 7. From left to right: Sample 1 - SB-MW-27-SO-9-11-20220829 soil Tubes #1 & 2 and Sample 2 - SB-MW-27-SO-23-25-20220829 soil Tubes #1 & 2

Photo 7: Day 7. From left to right: Sample 3 - SB-MW-28-SO-15-17-20220829 soil Tubes #1 & 2 and Sample 4 - SB-MW-29-SO-18-20-20220830 soil Tubes #1 & 2

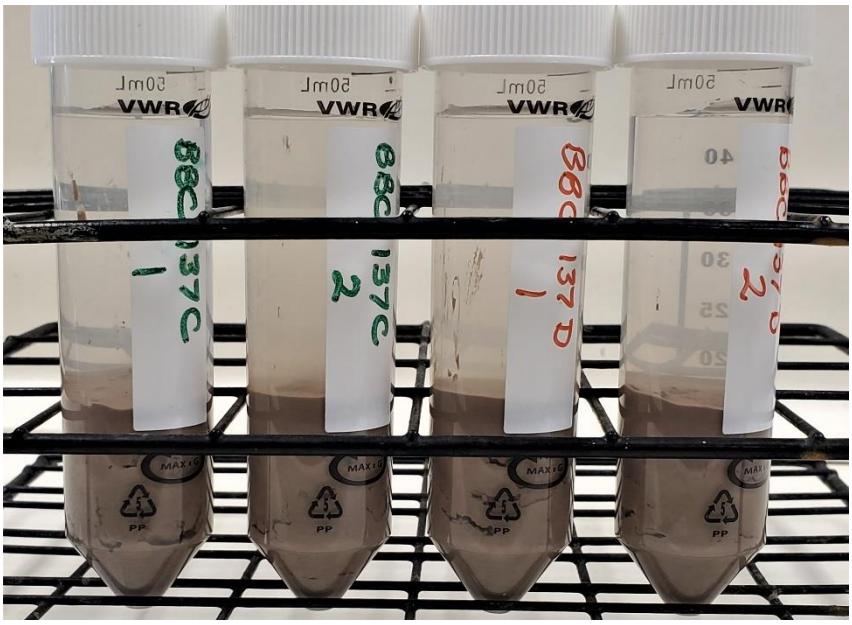


Photo 8: Day 7. From left to right: Sample 5 - SB-MW-30-SO-10-12-20220830 soil Tubes #1 & 2 and Sample 6 - SB-MW-30-SO-15-17-20220830 soil Tubes #1 & 2

Photo 9: Day 7. From left to right: Sample 7 - SB-MW-31-SO-7-9-20220831 soil Tubes #1 & 2 and Sample 8 - SB-MW-31-SO-13-15-20220831 soil Tubes #1 & 2

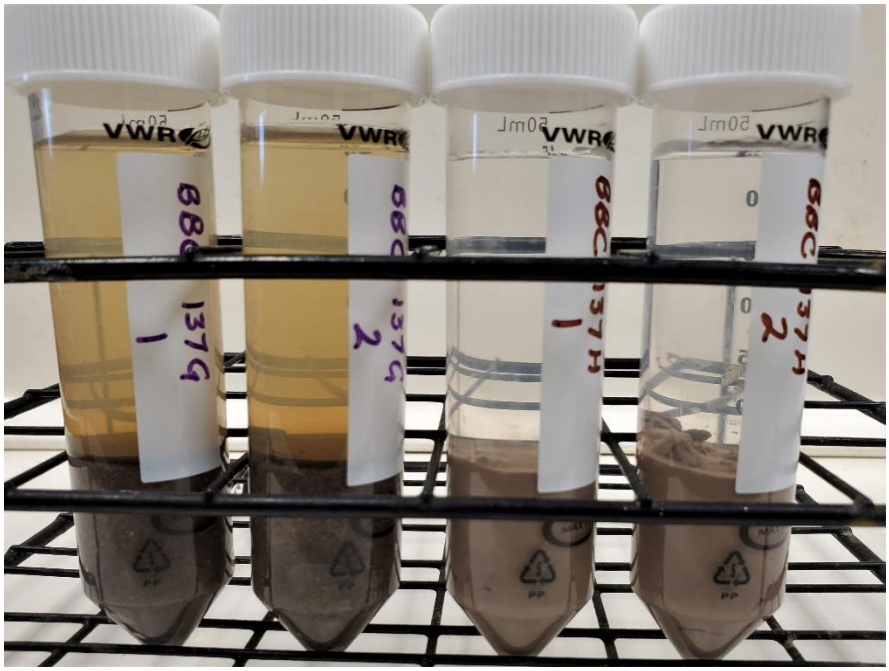
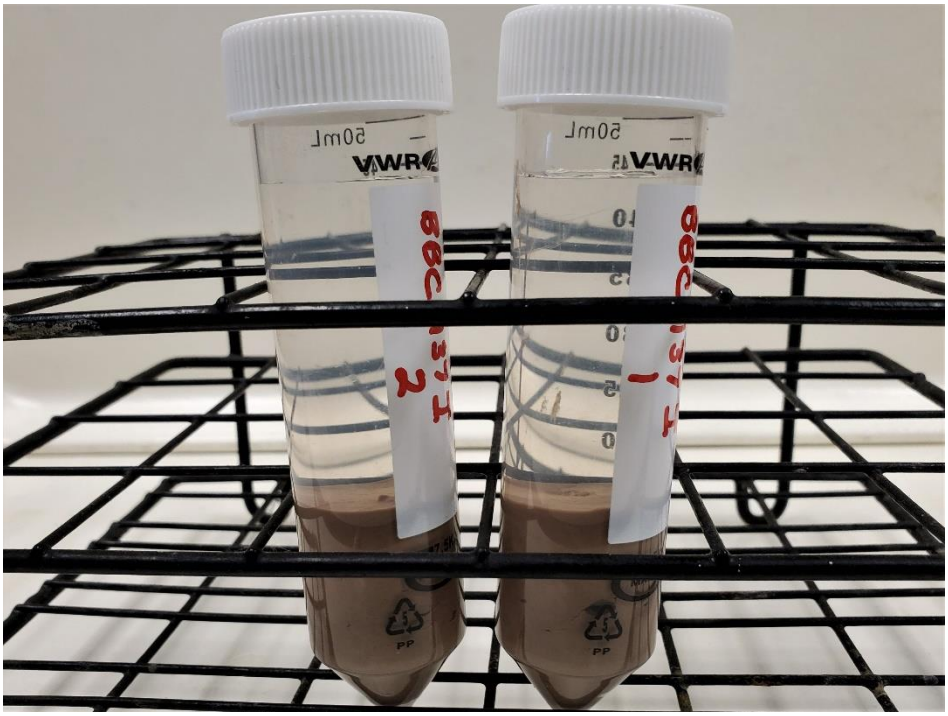


Photo 10: Day 7. From left to right: Sample 9 - SB-18-SO-10-12-20220831 soil #1 & 2



VI. Authorizing Signatures

This report contains the results as determined by Evonik laboratory protocol and are accurately represented herein.

Note: 1. Evonik recommends performing suitable treatability testing and field pilot demonstration to determine the effectiveness of Klozur® activated persulfate on the contaminants of concern. KDT testing provides only an indication of the minimum amount of oxidant required to overcome the demands of soil, groundwater and other secondary species that contribute to the usage of the oxidant. The KDT results do not imply a guarantee of efficacy of the activated persulfate in actual field situations. 2. ANY SUCH QUANTITY OR WARRANTY IS EXPRESSLY DISCLAIMED. Evonik Industries AG and Klozur are registered trademarks of Evonik Industries AG.

APPENDIX C

ReSolution Partners Bench Scale Testing

ERH and Zero Valent Iron

ReSolution Partners, LLC

Bench-Scale Evaluation of Zero-Valent Iron and EHC

Prepared for
ERM, Milwaukee, WI

15 May 2023 – revision 2

Introduction

ERM is evaluating the potential application of zero-valent iron (ZVI) for the destruction of chlorinated volatile organic compounds (CVOCs, specifically trichloroethene) at a site in Two Rivers, Wisconsin. ERM has requested a bench-scale evaluation of CVOC destruction using site-specific soil and groundwater samples, and ZVI or EHC.

Sample Requirements

ReSolution Partners, LLC (RP) received the following samples for the treatability study:

Sample Id.	Soil Mass (kg)	Groundwater Volume (L)	Date Received
MW-15I-WG		2.0	8 Sept 2022
SB-18-SO-10-12	1.56		1 Sept 2022
MW-30I-WG		2.0	8 Sept 2022
SB-MW-30-SO-10-12	2.05		1 Sept 2022
MW-31I-WG		2.0	8 Sept 2022
SB-MW-31-SO-13-15	1.65		1 Sept 2022

The targeted treatment zone is described as oxic, so no special sample handling measures were required. Samples were assumed to be adequately homogenized upon receipt and required no processing.

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Baseline Analyses

A representative aliquot of each soil sample will be prepared and shipped to CT Labs, Baraboo, WI for analyses of VOCs by USEPA Method 8260. A 5-day turn-around-time (TAT) was requested. The results are summarized in Table 1 and laboratory reports are provided in Attachment A. The VOC concentrations in the soil were highly variable with no chlorinated ethenes in SB-18, 385 µg/kg of trichloroethene (TCE) in SB-MW-30 and 1,140 µg/kg of TCE and 1,2-dchloroethenes (DCEs). All three samples contained 1,2,4-trimethylbenzene.

RP measured the pH, SEC, ORP and DO content of each of the three groundwater samples. RP also measure the concentrations of chlorinated ethenes using the RP in-house headspace screening procedure as described in Attachment B. The results are provided in Table 2. The groundwater samples from MW15I and -30I were both oxic with pH values slightly greater than 7 SU. The SEC was on the order of 1,000 µS/cm. Both samples contained TCE from 770 to 170 µg/L. No other chlorinated ethenes were detected. The groundwater from MW-31 differed from the other two samples; being suboxic with a pH less than 7 SU and a SEC of 760 µS/cm.

ZVI Treatability Study

The study trials were prepared in 125 mL bottles with Mininert caps as described in Attachment B. Each trial included 20 g of soil and 100 mL of groundwater (a 1:5 liquid to solids ratio based on mass) and amended as noted below, leaving ~15 mL of headspace. The trials were amended with Evonik SGW-EHC and Connelly ZVI GMA-M at 0.3, 0.5, and 1.0, wt.% based on the soil mass. Each trial was prepared in duplicate for a total of 36 trials. The samples were shaken to disaggregate the soil and mix the reagents with the soil. The trials were divided into two sets (by reagent type) and started on sequential days (26 September for the EHC and 27 September for the ZVI) to facilitate analyses of 18 trials for each sampling event. Headspace sampling took place after 1, 7, 21 and 42 days of reaction time for a total of 108 analyses. The VOC concentrations are summarized in Table 3, presented as µg/L for each trial, with the means of the replicate samples. Fractional changes are relative to baseline groundwater.

The MW-15I+SB-18 sample produced predominantly TCE. The addition of 0.3 and 0.5 wt.% EHC reduced concentrations by approximately 70 to 75 percent in 42 days. Increasing the dose to 1.0 wt.% produced an 87% reduction by day 42. The EHC

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produced 1,2-cis-dichloroethene (cDCE) by day 42 at concentrations on the order of 160 µg/L. ZVI additions produced comparable TCE concentration reductions for all three dosages; ending at ~86% reductions by day 42.

The MW-30I+SB30 sample contained only TCE. The fractional changes show a nominal increase over the baseline concentration as a result of release of TCE from soil with 385 µg/kg TCE that was used in the reactor. TCE concentrations showed only slight reductions from day 1 to 42 for all three dosages of EHC.

The MW-31I+SB-31 sample was reported to contain TCE, cDCE and trans-1,2-dichloroethene (tDCE) on day 1. As with MW-30I+SB30, the presence of these compounds were due to release from the soil used in the reactors. The concentration trends for TCE, cDCE and tDCE were inconsistent over the 42 days of observation.

Table 4 presents molar conversions of the mean concentrations to better identify potential sequential reductive dechlorination and track total CVOC destruction. To better reflect the potential release of VOCs from the soil in the starting concentrations for the reactors it was assumed that all the chlorinated compounds in the soil were desorbed into the aqueous phase. The results as micromoles in each reactor was also presented graphically on Figure 1a for the EHC-amended sample and Figure 1b for the ZVI-amended samples.

EHC-amended reactors reduced the total micromoles TCE of MW-15I+SB-18 and MW-30I+SB-30 by 50 to 75 percent and 16 to 33 percent by day 42, but there were no clear dose-response trends. No daughter products were detected. MW-31I+SB-31 saw the poorest overall reduction in moles of CVOCs at 4 to 18 percent; again, with no dose-response trend. Reductions in TCE were offset by increases in daughter products cDCE, cDCE and chloroethene (CE).

ZVI-amended reactors reduced the total micromoles TCE of MW-15I+SB-18 and MW-30I+SB-30 by 84 to 89 percent and 23 to 26 percent by day 42. There was a slight improvement in reductions with increasing dose. No daughter products were detected. MW-31I+SB-31 reduction in moles of CVOCs at 41 to 63 percent; with no dose-response trend. Reductions in TCE were evident, but cDCE and tDCE appeared to increase at intermediate times before decreasing by day 42.

Table 5 presents the pH and ORP measurements made on day 66 after the trials were determined by ERM to be complete. The pH decreased slightly or stayed the same with the addition of the EHC to the three reactors. EHC reduced the ORP by almost 400 mV

for samples MW-15I+SB-18 and MW-30I+SB-30 with greater reductions at higher doses. Sample MW-31I+SB-31 began with a lower ORP (-57 mV) and saw a smaller decrease with the addition of the EHC to -148 mV. The addition of ZVI generally increased the pH to on the order of 7.5 SU. The ORP decreased in MW-15I+SB-18 and MW-30I+SB-30 but not as much as with the EHC. In sample MW-15I+SB-18 and MW-30I+SB-30 the ORP increased by about 20 mV.

Summary

The performance of the two reagents is compared in the following table:

Sample	Dose (wt.%)	Change in total moles of cVOCs by day 42	
		EHC	ZVI
MW-15GW+SB-18SO	0.3	75	84
	0.5	50	85
	1.0	57	89
MW-30GW+SB-30SO	0.3	20	--
	0.5	33	26
	1.0	16	24
MW-31GW+SB-31SO	0.3	16	58
	0.5	4	63
	1.0	18	41

For samples MW-15GW+SB-18SO and MW-31GW+SB-31SO the ZVI clearly resulted in greater cVOC destruction without the formation of CE. The day 21 and 42 results suggest that the ZVI was still active at the close of the trials and additional destruction was likely. Sample MW-30GW+SB-30SO showed destruction of TCE was inhibited for both reagents. Alternatively, the higher TCE may reflect the fact that TCE may be more readily desorbed resulting in higher aqueous concentrations as the TCE is destroyed. Given that ERM reports the soil TOC to be on the order of 20,000 to 30,000 mg/kg, the lower K_{oc} for TCE (126 mL/g) may result in greater TCE desorption.

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ReSolution Partners, LLC

Table 1. Baseline soil analyses for chlorinated ethenes (detected compounds only).

Constituent (µg/kg)	SB-18	SB-MW-30	SB-MW-31
Trichloroethene	<28	**385**	**670**
cis-1,2-Dichloroethene	<28	<26	**419**
trans-1,2-Dichloroethene	<27	<25	**53.9**
1,2,4-trimethylbenzene	**30.4**	**26.4**	**22.7**

Table 2. Baseline groundwater analyses.

Sample Id.	RP Screening GC-PID (µg/L)						DO (mg/L)	ORP (mV)	pH	SEC (µS/cm)
	CE	1,1-DCE	t-DCE	c-DCE	TCE	PCE				
MW-15I-WG	<5	<1	<1	<1	**768**	<1	3.55	204	7.43	1090
MW-30I-WG	<5	<1	<1	<1	**173**	<1	2.79	221	7.27	982
MW-31I-WG	<5	<1	<1	<1	<1	<1	0.36	-52	6.85	762

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Table 3a. Treatment trials for all EHC replicates in µg/L with mean concentrations of replicates. Fractional changes are relative to baseline groundwater.

Sample Id.	Reagent	Dose (wt.%)	Reaction Time (d)	RP Screening GC-PID (µg/L)											
				t-DCE				c-DCE				TCE			
				Rep 1	Rep 2	Mean	Fractional Change	Rep 1	Rep 2	Mean	Fractional Change	Rep 1	Rep 2	Mean	Fractional Change
MW-15I-GW SB-18	Groundwater Baseline (ug/L)			1 Sample		<1	NA	1 Sample		<1	NA	1 Sample		768	NA
	Soil Baseline (ug/kg)			1 Sample		<27	NA	1 Sample		<28	NA	1 Sample		<28	NA
	EHC	0.3	1	<1	<1	<1	NA	28.1	<1	14.3	NA	476	508	492	-0.36
			7	<1	<1	<1	NA	<1	<1	<1	NA	330	334	332	-0.57
			21	<1	<1	<1	NA	<1	<1	<1	NA	257	212	235	-0.69
			42	<1	<1	<1	NA	<1	<1	<1	NA	211	176	194	-0.75
		0.5	1	<1	<1	<1	NA	<1	<1	<1	NA	591	530	561	-0.27
			7	<1	<1	<1	NA	<1	<1	<1	NA	341	339	340	-0.56
			21	<1	<1	<1	NA	<1	<1	<1	NA	226	231	229	-0.70
			42	<1	<1	<1	NA	<1 [c]	152	152	151	190	<1	190	-0.75
		1.0	1	<1	<1	<1	NA	<1	<1	<1	NA	530	518	524	-0.32
			7	<1	<1	<1	NA	<1	<1	<1	NA	347	338	343	-0.55
			21	<1	<1	<1	NA	<1	<1	<1	NA	240	265	253	-0.67
			42	<1	<1	<1	NA	171	<1	171	170	<1	204	102	-0.87
MW-30I-GW SB-30	Groundwater Baseline			1 Sample		<5	NA	1 Sample		<1	NA	1 Sample		173	NA
	Soil Baseline (ug/kg)			1 Sample		<26	NA	1 Sample		<25	NA	1 Sample		385	NA
	EHC	0.3	1	<1	<1	<1	NA	<1	<1	<1	NA	240	254	247	0.43
			7	<1	<1	<1	NA	<1	<1	<1	NA	242	240	241	0.39
			21	<1	<1	<1	NA	<1	<1	<1	NA	241	228	235	0.36
			42	<1	<1	<1	NA	<1	<1	<1	NA	222	198	210	0.21
		0.5	1	<1	<1	<1	NA	<1	<1	<1	NA	236	236	236	0.36
			7	<1	<1	<1	NA	<1	<1	<1	NA	242	257	250	0.44
			21	<1	<1	<1	NA	<1	<1	<1	NA	258	292	275	0.59
			42	<1	<1	<1	NA	<1	<1	<1	NA	176	172	174	0.01
		1.0	1	<1	<1	<1	NA	<1	<1	<1	NA	222	242	232	0.34
			7	<1	<1	<1	NA	<1	<1	<1	NA	250	240	245	0.42
			21	<1	<1	<1	NA	<1	<1	<1	NA	287	262	275	0.59
			42	<1	<1	<1	NA	<1	<1	<1	NA	217	221	219	0.27
MW-31I-GW SB-31	Groundwater Baseline			1 Sample		<5	NA	1 Sample		<1	NA	1 Sample		<1	NA
	Soil Baseline (ug/kg)			1 Sample		53.9	NA	1 Sample		419	NA	1 Sample		670	NA
	EHC	0.3	1	8.1	10.3	9.2	2.7	66.1	72.1	69.1	137	53.5	40.1	46.8	93
			7	12.6	17.9	15.3	5.1	89.9	121	105	210	68.5	68.3	68.4	136
			21	12.8	18.1	15.5	5.2	195	191	193	385	<1	<1	<1	0
			42 [a]	11.7	14.6	13.2	4.3	168	139	154	306	<1	<1	<1	0
		0.5	1	8.4	8.2	8.3	2.3	66.2	64.3	65.3	130	47.1	43.4	45.3	90
			7	16.2	15.9	16.1	5.4	111	110	111	220	77.0	70.0	73.5	146
			21	15.3	16.8	16.1	5.4	193	192	193	384	<1	<1	<1	0
			42 [b]	15.0	14.9	15.0	5.0	185	164	175	348	<1	<1	<1	0
		1.0	1	8.1	9.1	8.6	2.4	69.7	68.8	69.3	138	48.1	49.8	49.0	97
			7	15.3	17.3	16.3	5.5	102	115	109	216	77.1	85.1	81.1	161
			21	13.6	16.8	15.2	5.1	177	196	187	372	<1	<1	<1	0
			42	9.8	13.7	11.8	3.7	136	166	151	301	<1	<1	<1	0

Notes:
a. Chloroethene was also detected at <5 and 98.3 ug/L, mean of 45.9 ug/L
b. Chloroethene was also detected at 61.3 and 23.8 ug/L. mean of 42.5 ug/L
c. <1 value may be an outlier and not used in mean calculation

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Table 3b. Treatment trials for all ZVI replicates in µg/L with mean concentrations of replicates. Fractional changes are relative to baseline groundwater.

Sample Id.	Reagent	Dose (wt.%)	Reaction Time (d)	RP Screening GC-PID (µg/L)											
				t-DCE				c-DCE				TCE			
				Rep 1	Rep 2	Mean	Fractional Change	Rep 1	Rep 2	Mean	Fractional Change	Rep 1	Rep 2	Mean	Fractional Change
MW-15I-GW SB-18	Groundwater Baseline			1 Sample		<1	NA	1 Sample		<1	NA	1 Sample		768	NA
	Soil Baseline (ug/kg)			1 Sample		<27	NA	1 Sample		<28	NA	1 Sample		<28	NA
	ZVI GMA-M	0.3	1	<1	<1	<1	NA	<1	<1	<1	NA	493	462	478	-0.38
			7	<1	<1	<1	NA	<1	<1	<1	NA	301	309	305	-0.60
			21	<1	<1	<1	NA	<1	<1	<1	NA	181	152	167	-0.78
			42	<1	<1	<1	NA	<1	<1	<1	NA	120	124	122	-0.84
		0.5	1	<1	<1	<1	NA	<1	<1	<1	NA	493	473	483	-0.37
			7	<1	<1	<1	NA	<1	<1	<1	NA	318	284	301	-0.61
			21	<1	<1	<1	NA	<1	<1	<1	NA	166	157	162	-0.79
			42	<1	<1	<1	NA	<1	<1	<1	NA	116	115	116	-0.85
		1.0	1	<1	<1	<1	NA	<1	<1	<1	NA	505	446	476	-0.38
			7	<1	<1	<1	NA	<1	<1	<1	NA	303	291	297	-0.61
			21	<1	<1	<1	NA	<1	<1	<1	NA	128	137	133	-0.83
			42	<1	<1	<1	NA	<1	<1	<1	NA	94.0	86.3	90.2	-0.88
MW-30I-GW SB-30	Groundwater Baseline			1 Sample		<5	NA	1 Sample		<1	NA	1 Sample		173	NA
	Soil Baseline (ug/kg)			1 Sample		<26	NA	1 Sample		<25	NA	1 Sample		385	NA
	ZVI GMA-M	0.3	1	<1	<1	<1	NA	<1	<1	<1	NA	184	236	210	0.21
			7	<1	<1	<1	NA	<1	<1	<1	NA	203	375	289	0.67
			21	<1	<1	<1	NA	<1	<1	<1	NA	166	472	319	0.84
			42	<1	<1	<1	NA	<1	<1	<1	NA	154	653	404	1.33
		0.5	1	<1	<1	<1	NA	<1	<1	<1	NA	216	204	210	0.21
			7	<1	<1	<1	NA	<1	<1	<1	NA	273	235	254	0.47
			21	<1	<1	<1	NA	<1	<1	<1	NA	293	159	226	0.31
			42	<1	<1	<1	NA	<1	<1	<1	NA	287	99.2	193	0.12
		1.0	1	<1	<1	<1	NA	<1	<1	<1	NA	230	238	234	0.35
			7	<1	<1	<1	NA	<1	<1	<1	NA	261	292	277	0.60
			21	<1	<1	<1	NA	<1	<1	<1	NA	201	267	234	0.35
			42	<1	<1	<1	NA	<1	<1	<1	NA	149	248	199	0.15
MW-31I-GW SB-31	Groundwater Baseline			1 Sample		<5	NA	1 Sample		<1	NA	1 Sample		<1	Fractional
	Soil Baseline (ug/kg)			1 Sample		53.9	NA	1 Sample		419	NA	1 Sample		670	NA
	ZVI GMA-M	0.3	1	<1	6.7	3.6	0.4	35.5	42.8	39.2	77	28.3	27.2	27.8	NA
			7	8.4	11.7	10.1	3.0	74.3	94.2	84.3	168	54.8	48.5	51.7	102
			21	<1	7.8	4.2	NA	61.4	69.0	65.2	129	50.7	44.8	47.8	95
			42	<1	<1	<1	NA	58.1	41.6	49.9	99	41.6	45.5	43.6	86
		0.5	1	6.8	<1	3.7	0.5	59.4	28.2	43.8	87	33.0	19.5	26.3	52
			7	10.8	11.0	10.9	3.4	81.7	82.7	82.2	163	52.1	46.8	49.5	98
			21	5.9	7.5	6.7	1.7	60.8	71.8	66.3	132	43.8	43.2	43.5	86
			42	6.3	5.9	6.1	1.4	68.4	67	67.7	134	39.9	36.5	38.2	75.4
		1.0	1	8.8	8.8	8.8	2.5	67.3	63.7	65.5	130	32.4	37.0	34.7	68
			7	12.8	11.9	12.4	3.9	93.9	88.6	91.3	182	46.6	52.1	49.4	98
			21	9.2	8.9	9.1	2.6	88.9	78.2	83.6	166	41.6	44.5	43.1	85
			42	5.9	6.7	6.3	1.5	88.5	87.8	88.2	175	31.7	31.3	31.5	62

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Table 4a. EHC mean concentrations converted to micromoles per reactor.

Sample Id.	Reagent	Dose (wt.%)	Reaction Time (d)	Mean = RP Screening GC-PID (µg/L)					
				t-DCE		c-DCE		TCE	
				Mean [b]	umoles per Reactor [c]	Mean [b]	umoles per Reactor [c]	Mean [b]	umoles per Reactor [c]
MW-15I-GW SB-18	Groundwater Baseline (ug/L)			<1	0.00052	<1	0.00052	768	0.58
	Soil Baseline (ug/kg)			<27	0.0028	<28	0.0029	<28	0.0021
	Total Baseline Content [a]			NA	0.0033	NA	0.0034	NA	0.59
	EHC	0.3	1	<1	0.00052	14.3	0.015	492	0.37
			7	<1	0.00052	<1	0.00052	332	0.25
			21	<1	0.00052	<1	0.00052	235	0.18
			42	<1	0.00052	<1	0.00052	194	0.15
		0.5	1	<1	0.00052	<1	0.00052	561	0.43
			7	<1	0.00052	<1	0.00052	340	0.26
			21	<1	0.00052	<1	0.00052	229	0.17
			42	<1	0.00052	152	0.16	190	0.14
		1.0	1	<1	0.00052	<1	0.00052	524	0.40
			7	<1	0.00052	<1	0.00052	343	0.26
			21	<1	0.00052	<1	0.00052	253	0.19
			42	<1	0.00052	171	0.18	102	0.078
MW-30I-GW SB-30	Groundwater Baseline			<5	0.0026	<1	0.00052	173	0.13
	Soil Baseline (ug/kg)			<26	0.0027	<25	0.0026	385	0.059
	Total Baseline Content [a]			NA	0.0053	NA	0.0031	NA	0.19
	EHC	0.3	1	<1	0.00052	<1	0.00052	247	0.19
			7	<1	0.00052	<1	0.00052	241	0.18
			21	<1	0.00052	<1	0.00052	235	0.18
			42	<1	0.00052	<1	0.00052	210	0.16
		0.5	1	<1	0.00052	<1	0.00052	236	0.18
			7	<1	0.00052	<1	0.00052	250	0.19
			21	<1	0.00052	<1	0.00052	275	0.21
			42	<1	0.00052	<1	0.00052	174	0.13
		1.0	1	<1	0.00052	<1	0.00052	232	0.18
			7	<1	0.00052	<1	0.00052	245	0.19
			21	<1	0.00052	<1	0.00052	275	0.21
			42	<1	0.00052	<1	0.00052	219	0.17
MW-31I-GW SB-31	Groundwater Baseline			<5	0.0026	<1	0.00052	<1	0.00038
	Soil Baseline (ug/kg)			53.9	0.011	419	0.087	670	0.10
	Total Baseline Content [a]			NA	0.014	NA	0.087	NA	0.10
	EHC	0.3	1	9.2	0.0095	69.1	0.071	46.8	0.036
			7	15.3	0.016	105	0.11	68.4	0.052
			21	15.5	0.016	193	0.20	<1	0.00038
			42 [d]	13.2	0.014	154	0.16	<1	0.00038
		0.5	1	8.3	0.0086	65.3	0.067	45.3	0.034
			7	16.1	0.017	111	0.11	73.5	0.056
			21	16.1	0.017	193	0.20	<1	0.00038
			42 [e]	15.0	0.015	175	0.18	<1	0.00038
		1.0	1	8.6	0.0089	69.3	0.071	49.0	0.037
			7	16.3	0.017	109	0.11	81.1	0.062
			21	15.2	0.016	187	0.19	<1	0.00038
			42	11.8	0.012	151	0.16	<1	0.00038

Notes:
a.) Assumes that all of the CVOCs in the soil sample are potential available for desorption to aqueous phase.
b.) See Table 3 for individual observations.
c.) Assumes 0.100 L groundwater and 0.020 kg of soil in each reactor. One-half of nondetects used for means.
d. Chloroethene was also detected at <0.08 and 1.57 uM, mean of 0.73 uM
e.) Chloroethene was also detected at 0.98 and 0.38 uM, mean of 0.68 uM

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Table 4b. ZVI mean concentrations converted to micromoles per reactor.

Sample Id.	Reagent	Dose (wt.%)	Reaction Time (d)	Mean = RP Screening GC-PID (µg/L)					
				t-DCE		c-DCE		TCE	
				Mean [b]	umoles per Reactor [c]	Mean [b]	umoles per Reactor [c]	Mean [b]	umoles per Reactor [c]
MW-15I-GW SB-18	Groundwater Baseline (ug/L)			<1	0.00052	<1	0.00052	768	0.58
	Soil Baseline (ug/kg)			<27	0.0028	<28	0.0029	<28	0.0021
	Total Baseline Content [a]			NA	0.0033	NA	0.0034	NA	0.59
	ZVI GMA-M	0.3	1	<1	0.00052	<1	0.00052	478	0.36
			7	<1	0.00052	<1	0.00052	305	0.23
			21	<1	0.00052	<1	0.00052	167	0.13
			42	<1	0.00052	<1	0.00052	122	0.093
		0.5	1	<1	0.00052	<1	0.00052	483	0.37
			7	<1	0.00052	<1	0.00052	301	0.23
			21	<1	0.00052	<1	0.00052	162	0.12
			42	<1	0.00052	<1	0.00052	116	0.088
		1.0	1	<1	0.00052	<1	0.00052	476	0.36
			7	<1	0.00052	<1	0.00052	297	0.23
			21	<1	0.00052	<1	0.00052	133	0.10
			42	<1	0.00052	<1	0.00052	90	0.07
MW-30I-GW SB-30	Groundwater Baseline			<5	0.0026	<1	0.00052	173	0.13
	Soil Baseline (ug/kg)			<26	0.0027	<25	0.0026	385	0.059
	Total Baseline Content [a]			NA	0.0053	NA	0.0031	NA	0.19
	ZVI GMA-M	0.3	1	<1	0.00052	<1	0.00052	210	0.16
			7	<1	0.00052	<1	0.00052	289	0.22
			21	<1	0.00052	<1	0.00052	319	0.24
			42	<1	0.00052	<1	0.00052	404	0.31
		0.5	1	<1	0.00052	<1	0.00052	210	0.16
			7	<1	0.00052	<1	0.00052	254	0.19
			21	<1	0.00052	<1	0.00052	226	0.17
			42	<1	0.00052	<1	0.00052	193	0.15
		1.0	1	<1	0.00052	<1	0.00052	234	0.18
			7	<1	0.00052	<1	0.00052	277	0.21
			21	<1	0.00052	<1	0.00052	234	0.18
			42	<1	0.00052	<1	0.00052	199	0.15
MW-31I-GW SB-31	Groundwater Baseline			<5	0.0026	<1	0.00052	<1	0.00038
	Soil Baseline (ug/kg)			53.9	0.011	419	0.087	670	0.10
	Total Baseline Content [a]			NA	0.014	NA	0.087	NA	0.10
	ZVI GMA-M	0.3	1	3.6	0.0037	39.2	0.040	27.8	0.021
			7	10.1	0.010	84.3	0.087	51.7	0.039
			21	4.2	0.004	65.2	0.067	47.8	0.036
			42	0.5	0.00052	49.9	0.051	43.6	0.033
		0.5	1	3.7	0.0038	43.8	0.045	26.3	0.020
			7	10.9	0.011	82.2	0.085	49.5	0.038
			21	6.7	0.0069	66.3	0.068	43.5	0.00038
			42	6.1	0.0063	67.7	0.070	38.2	0.00038
		1.0	1	8.8	0.0091	65.5	0.068	34.7	0.026
			7	12.4	0.013	91.3	0.094	49.4	0.038
			21	9.1	0.0094	83.6	0.086	43.1	0.033
			42	6.3	0.0065	88.2	0.091	31.5	0.024

Notes:
a.) Assumes that all of the CVOCs in the soil sample are potential available for desorption to aqueous phase.
b.) See Table 3 for individual observations.
c.) Assumes 0.100 L groundwater and 0.020 kg of soil in each reactor. One-half of nondetects used for means.

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Table 5. pH and ORP measurements on day 66.

Sample Id.	Reagent	Dose (wt.%)	Reaction Time (d)	pH (SU)			ORP (mV)		
				Rep 1	Rep 2	Mean	Rep 1	Rep 2	Mean
MW-15I-GW SB-18	Groundwater Baseline			1 Sample		7.43	1 Sample		204
	EHC	0.3	66	6.99	6.78	6.89	-76	-47	-62
		0.5		6.83	6.87	6.85	-161	-199	-180
		1.0		6.68	6.73	6.71	-179	-171	-175
MW-30I-GW SB-30	Groundwater Baseline			1 Sample		7.27	1 Sample		221
	EHC	0.3	66	6.94	6.98	6.96	-130	-112	-121
		0.5		6.91	6.96	6.94	-164	-169	-167
		1.0		6.75	6.73	6.74	-188	-157	-173
MW-31I-GW SB-31	Groundwater Baseline			1 Sample		6.85	1 Sample		-52
	EHC	0.3	66	6.84	6.82	6.83	-175	-167	-171
		0.5		6.76	6.99	6.88	-152	-133	-143
		1.0		6.72	6.74	6.73	-145	-151	-148
MW-15I-GW SB-18	Groundwater Baseline			1 Sample		7.42	1 Sample		204
	ZVI	0.3	66	7.15	7.22	7.19	-99	-88	-94
		0.5		7.24	7.31	7.28	-69	-65	-67
		1.0		7.37	7.37	7.37	-63	-57	-60
MW-30I-GW SB-30	Groundwater Baseline			1 Sample		7.27	1 Sample		221
	ZVI	0.3	66	7.67	7.69	7.68	-55	-59	-57
		0.5		7.73	7.76	7.75	-55	-54	-55
		1.0		7.78	7.85	7.82	-51	-57	-54
MW-31I-GW SB-31	Groundwater Baseline			1 Sample		6.85	1 Sample		-52
	ZVI	0.3	66	7.23	7.24	7.24	-41	-34	-38
		0.5		7.23	7.31	7.27	-31	-29	-30
		1.0		7.44	7.45	7.45	-31	-34	-33

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Figure 1a. EHC-amended sample concentration trends on molar basis.

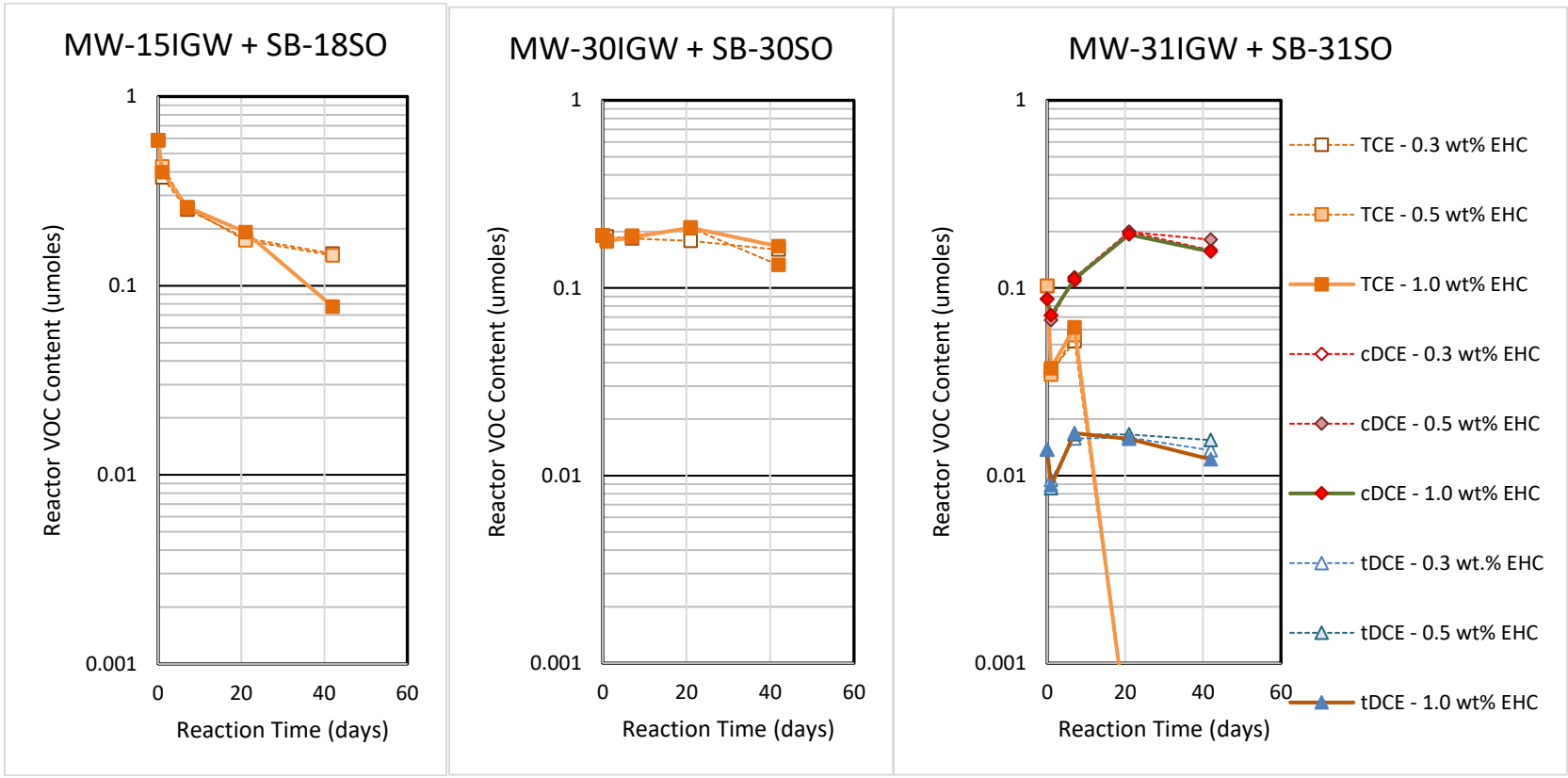
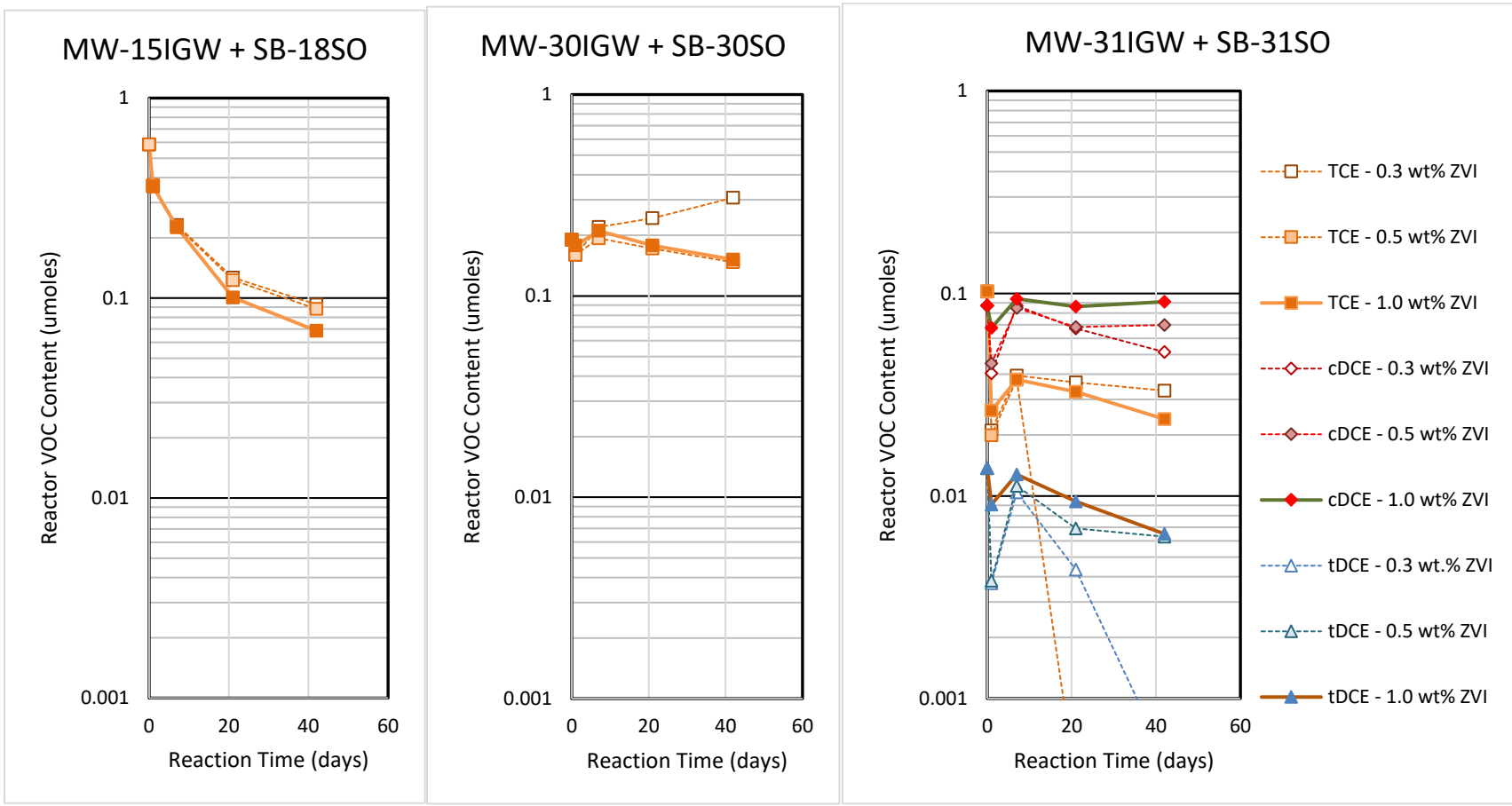


Figure 1b. ZVI-amended sample concentration trends on molar basis.



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ReSolution Partners, LLC

Attachment A

Baseline Soil Laboratory Report

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ANALYTICAL REPORT

RESOLUTION PARTNERS LLC
ANGELA HASSELL
967 JONATHON DR.
MADISON, WI 53713

Project Name: ERM-TWO RIVERS WI
Project Phase:
Contract #: 3364
Project #:
Folder #: 172129
Purchase Order #:

Arrival Temperature: 4.4
Report Date: 9/20/2022
Date Received: 9/13/2022
Reprint Date: 9/20/2022

CT LAB Sample#: 1233912 Sample Description: SB-18 Sampled: 9/12/2022 08:00

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Inorganic Results										
Solids, Percent	**79.98**	%			1			9/14/2022 13:45	BMS	EPA 8000C
Organic Results										
1,1,1,2-Tetrachloroethane	<16	ug/kg	16	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,1,1-Trichloroethane	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,1,2,2-Tetrachloroethane	<23	ug/kg	23	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,1,2-Trichloroethane	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,1-Dichloroethane	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,1-Dichloroethene	<22	ug/kg	22	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,1-Dichloropropene	<39	ug/kg	39	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2,3-Trichlorobenzene	<18	ug/kg	18	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2,3-Trichloropropane	<30	ug/kg	30	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2,4-Trichlorobenzene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2,4-Trimethylbenzene	**30.4**	ug/kg	18 *	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2-Dibromo-3-chloropropane	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2-Dibromoethane	<17	ug/kg	17	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233912 Sample Description: SB-18 Sampled: 9/12/2022 08:00

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
1,2-Dichlorobenzene	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2-Dichloroethane	<20	ug/kg	20	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,2-Dichloropropane	<24	ug/kg	24	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,3,5-Trichlorobenzene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,3,5-Trimethylbenzene	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,3-Dichlorobenzene	<13	ug/kg	13	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,3-Dichloropropane	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,4-Dichloro-2-butene	<19	ug/kg	19	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1,4-Dichlorobenzene	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
1-Chlorohexane	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
112Trichloro122trifluoroethane	<57	ug/kg	57	370	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
12Dichloro112trifluoroethane	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
2,2-Dichloropropane	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
2-Butanone	<260	ug/kg	260	1800	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
2-Chloroethyl vinyl ether	<100	ug/kg	100	330	1	Q	9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
2-Chlorotoluene	<15	ug/kg	15	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
2-Hexanone	<140	ug/kg	140	920	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
2-Nitropropane	<210	ug/kg	210	920	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
4-Chlorotoluene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
4-Methyl-2-pentanone	<280	ug/kg	280	1800	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Acetone	<230	ug/kg	230	920	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Benzene	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Bromobenzene	<15	ug/kg	15	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Bromochloromethane	<29	ug/kg	29	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Bromodichloromethane	<21	ug/kg	21	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233912 Sample Description: SB-18 Sampled: 9/12/2022 08:00

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Bromoform	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Bromomethane	<83	ug/kg	83	280	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Carbon disulfide	<54	ug/kg	54	370	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Carbon tetrachloride	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Chlorobenzene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Chloroethane	<78	ug/kg	78	370	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Chloroform	<30	ug/kg	30	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Chloromethane	<30	ug/kg	30	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
cis-1,2-Dichloroethene	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
cis-1,3-Dichloropropene	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Cyclohexane	<29	ug/kg	29	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Cyclohexanone	<400	ug/kg	400	1800	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Dibromochloromethane	<14	ug/kg	14	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Dibromomethane	<20	ug/kg	20	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Dichlorodifluoromethane	<29	ug/kg	29	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Dichlorofluoromethane	<36	ug/kg	36	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Diisopropyl ether	<23	ug/kg	23	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Ethyl acetate	<170	ug/kg	170	920	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Ethyl ether	<29	ug/kg	29	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Ethyl-tertiary butyl ether	<23	ug/kg	23	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Ethylbenzene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Hexachlorobutadiene	<18	ug/kg	18	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Hexane	<46	ug/kg	46	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Iodomethane	<100	ug/kg	100	350	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Isopropylbenzene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233912 Sample Description: SB-18 Sampled: 9/12/2022 08:00

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
m & p-Xylene	<23	ug/kg	23	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Methyl acetate	<37	ug/kg	37	130	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Methyl methacrylate	<18	ug/kg	18	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Methyl tert-butyl ether	<22	ug/kg	22	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Methylcyclohexane	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Methylene chloride	<39	ug/kg	39	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
n-Butylbenzene	<15	ug/kg	15	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
n-Propylbenzene	<15	ug/kg	15	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Naphthalene	<13	ug/kg	13	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
o-Xylene	<12	ug/kg	12	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
p-Isopropyltoluene	<15	ug/kg	15	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
sec-Butylbenzene	<13	ug/kg	13	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Styrene	<18	ug/kg	18	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
tert-Butyl alcohol	<1100	ug/kg	1100	4600	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
tert-Butylbenzene	<16	ug/kg	16	92	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Tertiary-amyl methyl ether	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Tetrachloroethene	<31	ug/kg	31	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Tetrahydrofuran	<290	ug/kg	290	1800	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Toluene	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
trans-1,2-Dichloroethene	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
trans-1,3-Dichloropropene	<24	ug/kg	24	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Trichloroethene	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Trichlorofluoromethane	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Vinyl Acetate	<190	ug/kg	190	920	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C
Vinyl chloride	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 10:50	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233913 Sample Description: SB-MW-30 Sampled: 9/12/2022 08:05

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Inorganic Results										
Solids, Percent	**79.92**	%			1			9/14/2022 13:45	BMS	EPA 8000C
Organic Results										
1,1,1,2-Tetrachloroethane	<15	ug/kg	15	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,1,1-Trichloroethane	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,1,2,2-Tetrachloroethane	<22	ug/kg	22	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,1,2-Trichloroethane	<24	ug/kg	24	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,1-Dichloroethane	<24	ug/kg	24	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,1-Dichloroethene	<21	ug/kg	21	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,1-Dichloropropene	<37	ug/kg	37	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2,3-Trichlorobenzene	<18	ug/kg	18	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2,3-Trichloropropane	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2,4-Trichlorobenzene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2,4-Trimethylbenzene	**26.4**	ug/kg	18	88	1	*	9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2-Dibromo-3-chloropropane	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2-Dibromoethane	<16	ug/kg	16	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2-Dichlorobenzene	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2-Dichloroethane	<19	ug/kg	19	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,2-Dichloropropane	<23	ug/kg	23	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,3,5-Trichlorobenzene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,3,5-Trimethylbenzene	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,3-Dichlorobenzene	<12	ug/kg	12	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,3-Dichloropropane	<24	ug/kg	24	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1,4-Dichloro-2-butene	<18	ug/kg	18	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233913 Sample Description: SB-MW-30 Sampled: 9/12/2022 08:05

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
1,4-Dichlorobenzene	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
1-Chlorohexane	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
112Trichloro122trifluoroethane	<54	ug/kg	54	350	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
12Dichloro112trifluoroethane	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
2,2-Dichloropropane	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
2-Butanone	<250	ug/kg	250	1800	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
2-Chloroethyl vinyl ether	<96	ug/kg	96	320	1	Q	9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
2-Chlorotoluene	<14	ug/kg	14	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
2-Hexanone	<130	ug/kg	130	880	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
2-Nitropropane	<200	ug/kg	200	880	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
4-Chlorotoluene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
4-Methyl-2-pentanone	<260	ug/kg	260	1800	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Acetone	<220	ug/kg	220	880	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Benzene	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Bromobenzene	<14	ug/kg	14	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Bromochloromethane	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Bromodichloromethane	<20	ug/kg	20	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Bromoform	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Bromomethane	<79	ug/kg	79	260	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Carbon disulfide	<52	ug/kg	52	350	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Carbon tetrachloride	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Chlorobenzene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Chloroethane	<74	ug/kg	74	350	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Chloroform	<28	ug/kg	28	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Chloromethane	<29	ug/kg	29	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233913 Sample Description: SB-MW-30 Sampled: 9/12/2022 08:05

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
cis-1,2-Dichloroethene	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
cis-1,3-Dichloropropene	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Cyclohexane	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Cyclohexanone	<380	ug/kg	380	1800	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Dibromochloromethane	<13	ug/kg	13	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Dibromomethane	<19	ug/kg	19	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Dichlorodifluoromethane	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Dichlorofluoromethane	<34	ug/kg	34	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Diisopropyl ether	<22	ug/kg	22	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Ethyl acetate	<160	ug/kg	160	880	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Ethyl ether	<27	ug/kg	27	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Ethyl-tertiary butyl ether	<22	ug/kg	22	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Ethylbenzene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Hexachlorobutadiene	<17	ug/kg	17	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Hexane	<44	ug/kg	44	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Iodomethane	<96	ug/kg	96	330	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Isopropylbenzene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
m & p-Xylene	<22	ug/kg	22	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Methyl acetate	<35	ug/kg	35	120	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Methyl methacrylate	<18	ug/kg	18	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Methyl tert-butyl ether	<21	ug/kg	21	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Methylcyclohexane	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Methylene chloride	<37	ug/kg	37	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
n-Butylbenzene	<14	ug/kg	14	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
n-Propylbenzene	<14	ug/kg	14	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233913 Sample Description: SB-MW-30 Sampled: 9/12/2022 08:05

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Naphthalene	<12	ug/kg	12	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
o-Xylene	<11	ug/kg	11	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
p-Isopropyltoluene	<14	ug/kg	14	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
sec-Butylbenzene	<12	ug/kg	12	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Styrene	<18	ug/kg	18	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
tert-Butyl alcohol	<1100	ug/kg	1100	4400	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
tert-Butylbenzene	<15	ug/kg	15	88	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Tertiary-amyl methyl ether	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Tetrachloroethene	<30	ug/kg	30	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Tetrahydrofuran	<270	ug/kg	270	1800	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Toluene	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
trans-1,2-Dichloroethene	<25	ug/kg	25	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
trans-1,3-Dichloropropene	<23	ug/kg	23	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Trichloroethene	**385**	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Trichlorofluoromethane	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Vinyl Acetate	<180	ug/kg	180	880	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C
Vinyl chloride	<26	ug/kg	26	180	1		9/15/2022 13:30	9/19/2022 11:18	RLD	EPA 8260C

CT LAB Sample#: 1233914 Sample Description: SB-MW-31 Sampled: 9/12/2022 08:10

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Inorganic Results										
Solids, Percent	**79.49**	%			1			9/14/2022 13:45	BMS	EPA 8000C
Organic Results										

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233914 Sample Description: SB-MW-31 Sampled: 9/12/2022 08:10

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
1,1,1,2-Tetrachloroethane	<15	ug/kg	15	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,1,1-Trichloroethane	<26	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,1,2,2-Tetrachloroethane	<21	ug/kg	21	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,1,2-Trichloroethane	<23	ug/kg	23	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,1-Dichloroethane	<23	ug/kg	23	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,1-Dichloroethene	<21	ug/kg	21	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,1-Dichloropropene	<36	ug/kg	36	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2,3-Trichlorobenzene	<17	ug/kg	17	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2,3-Trichloropropane	<27	ug/kg	27	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2,4-Trichlorobenzene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2,4-Trimethylbenzene	**22.7**	ug/kg	17 *	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2-Dibromo-3-chloropropane	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2-Dibromoethane	<15	ug/kg	15	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2-Dichlorobenzene	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2-Dichloroethane	<19	ug/kg	19	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,2-Dichloropropane	<22	ug/kg	22	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,3,5-Trichlorobenzene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,3,5-Trimethylbenzene	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,3-Dichlorobenzene	<12	ug/kg	12	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,3-Dichloropropane	<23	ug/kg	23	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,4-Dichloro-2-butene	<18	ug/kg	18	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1,4-Dichlorobenzene	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
1-Chlorohexane	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
112Trichloro122trifluoroethane	<53	ug/kg	53	340	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
12Dichloro112trifluoroethane	<24	ug/kg	24	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233914 Sample Description: SB-MW-31 Sampled: 9/12/2022 08:10

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
2,2-Dichloropropane	<26	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
2-Butanone	<240	ug/kg	240	1700	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
2-Chloroethyl vinyl ether	<94	ug/kg	94	310	1	Q	9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
2-Chlorotoluene	<14	ug/kg	14	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
2-Hexanone	<130	ug/kg	130	850	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
2-Nitropropane	<200	ug/kg	200	850	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
4-Chlorotoluene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
4-Methyl-2-pentanone	<260	ug/kg	260	1700	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Acetone	<210	ug/kg	210	850	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Benzene	<24	ug/kg	24	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Bromobenzene	<14	ug/kg	14	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Bromochloromethane	<26	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Bromodichloromethane	<20	ug/kg	20	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Bromoform	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Bromomethane	<77	ug/kg	77	260	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Carbon disulfide	<50	ug/kg	50	340	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Carbon tetrachloride	<24	ug/kg	24	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Chlorobenzene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Chloroethane	<73	ug/kg	73	340	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Chloroform	<27	ug/kg	27	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Chloromethane	<28	ug/kg	28	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
cis-1,2-Dichloroethene	**419**	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
cis-1,3-Dichloropropene	<25	ug/kg	25	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Cyclohexane	<26	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Cyclohexanone	<370	ug/kg	370	1700	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233914 Sample Description: SB-MW-31 Sampled: 9/12/2022 08:10

Analyte	Result	Units	LOD	LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Dibromochloromethane	<13	ug/kg	13	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Dibromomethane	<19	ug/kg	19	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Dichlorodifluoromethane	<26	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Dichlorofluoromethane	<33	ug/kg	33	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Diisopropyl ether	<21	ug/kg	21	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Ethyl acetate	<150	ug/kg	150	850	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Ethyl ether	<26	ug/kg	26	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Ethyl-tertiary butyl ether	<21	ug/kg	21	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Ethylbenzene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Hexachlorobutadiene	<16	ug/kg	16	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Hexane	<43	ug/kg	43	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Iodomethane	<94	ug/kg	94	320	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Isopropylbenzene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
m & p-Xylene	<21	ug/kg	21	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Methyl acetate		ug/kg	34	120	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Methyl methacrylate	<17	ug/kg	17	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Methyl tert-butyl ether	<21	ug/kg	21	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Methylcyclohexane	<25	ug/kg	25	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Methylene chloride	<36	ug/kg	36	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
n-Butylbenzene	<14	ug/kg	14	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
n-Propylbenzene	<14	ug/kg	14	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Naphthalene	<12	ug/kg	12	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
o-Xylene	<11	ug/kg	11	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
p-Isopropyltoluene	<14	ug/kg	14	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
sec-Butylbenzene	<12	ug/kg	12	85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

CT LAB Sample#: 1233914 Sample Description: SB-MW-31 Sampled: 9/12/2022 08:10

Analyte	Result	Units	LOD		LOQ	Dilution	Qualifier	Prep Date/Time	Analysis Date/Time	Analyst	Method
Styrene	<17	ug/kg	17		85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
tert-Butyl alcohol	<1000	ug/kg	1000		4300	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
tert-Butylbenzene	<15	ug/kg	15		85	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Tertiary-amyl methyl ether	<24	ug/kg	24		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Tetrachloroethene	<29	ug/kg	29		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Tetrahydrofuran	<260	ug/kg	260		1700	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Toluene	<24	ug/kg	24		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
trans-1,2-Dichloroethene	**53.9**	ug/kg	25	*	170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
trans-1,3-Dichloropropene	<22	ug/kg	22		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Trichloroethene	**670**	ug/kg	26		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Trichlorofluoromethane	<26	ug/kg	26		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Vinyl Acetate	<180	ug/kg	180		850	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C
Vinyl chloride	<26	ug/kg	26		170	1		9/15/2022 13:30	9/19/2022 11:45	RLD	EPA 8260C

Unless specifically stated to the contrary, soil/sediment/sludge sample results/LOD/LOQ/RLs were reported on a Dry Weight Basis

Notes regarding entire Chain of Custody:

Notes: * Indicates a value in between the LOD (limit of detection) and the LOQ (limit of quantitation). All LOD/LOQs are adjusted to reflect dilution and also any differences in the sample weight / volume as compared to standard amounts.

All samples were received intact and properly preserved unless otherwise noted. The results reported relate only to the samples tested. This report shall not be reproduced, except in full, without written approval of this laboratory. The Chain of Custody is attached.

Submitted by: Brett M. Szymanski
Project Manager
608-356-2760

QC Qualifiers

Code	Description
B	Analyte detected in the associated Method Blank.
C	Toxicity present in BOD sample.
D	Diluted Out.
E	Safe, No Total Coliform detected.
F	Unsafe, Total Coliform detected, no E. Coli detected.
G	Unsafe, Total Coliform detected and E. Coli detected.
H	Holding time exceeded.
I	Incubator temperature was outside acceptance limits during test period.
J	Estimated value.
L	Significant peaks were detected outside the chromatographic window.
M	Matrix spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
N	Insufficient BOD oxygen depletion.
O	Complete BOD oxygen depletion.
P	Concentration of analyte differs more than 40% between primary and confirmation analysis.
Q	Laboratory Control Sample outside acceptance limits.
R	See Narrative at end of report.
S	Surrogate standard recovery outside acceptance limits due to apparent matrix effects.
T	Sample received with improper preservation or temperature.
U	Analyte concentration was below detection limit.
V	Raised Quantitation or Reporting Limit due to limited sample amount or dilution for matrix background interference.
W	Sample amount received was below program minimum.
X	Analyte exceeded calibration range.
Y	Replicate/Duplicate precision outside acceptance limits.
Z	Specified calibration criteria was not met.

Current CT Laboratories Certifications

Wisconsin (WDNR) Chemistry ID# 157066030
Wisconsin (DATCP) Bacteriology ID# 289
Louisiana NELAP (primary) ID# 115843
Illinois NELAP Lab ID# 200073
Kansas NELAP Lab ID# E-10368
Virginia NELAP Lab ID# 460203
ISO/IEC 17025-2005 A2LA Cert # 3806.01
DoD-ELAP A2LA 3806.01

Rev. 02/2017

CHAIN OF CUSTODY

Company: ReSolution Partners LLC

Project Contact: Angela Hassell

Telephone: 608-669-1248

Project Name: ERM-Two Rivers WI

Project #:

Location:

Sampled By: Kevin Baker 608-669-6949

CT LABORATORIES
1230 Lange Court, Baraboo, WI 53913
608-356-2760 Fax 608-356-2766
www.ctlaboratories.com

Folder #: 172129

Company: RESOLUTION PARTNERS LL

Project: ERM-TWO RIVERS WI

Logged By: erc PM: BMS

Program:
QSM RCRA SDWA NPDES
Solid Waste Other _____

PO #

Report To:
EMAIL: ahassell@resolutionpartnersllc.net
brehm@resolutionpartnersllc.net
kbaker@resolutionpartnersllc.net
Company: 967 Jonathon Drive
Address: Madison, WI 53713

Invoice To: * Angela Hassell
EMAIL: ahassell@resolutionpartnersllc.net
Company: ReSolution Partners LLC
Address: 967 Jonathon Drive
Madison, WI 53713

*Party listed is responsible for payment of invoice as per CT Laboratories' terms and conditions

Client Special Instructions
* Add 0.19g for extra sample label.

Matrix:
GW - groundwater SW - surface water WW - wastewater DW - drinking water
S - soil/sediment SL - sludge A - air M - misc/waste

Turnaround Time
RUSH 5-day
Date Needed: _____
Rush analysis requires prior CT Laboratories' approval
Surcharges:
24 hr 200%
2-3 days 100%
4-9 days 50%

Collection Date	Collection Time	Matrix	Grab/ Comp	Sample #	Sample ID Description	Filtered? Y/N	ANALYSES REQUESTED: VOCs 8260C *	Total # Containers	Designated MS/MSD	CT Lab ID # (Lab use only)
							Fill in Spaces with Bottles per Test			
9/12/2022	800	SO			SB-18	N	x	3		123912
9/12/2022	805	SO			SB-MW-30	N	x	3		13
9/12/2022	810	SO			SB-MW-31	N	x	3		14

Relinquished By: Kevin Baker Date/Time 9/12/2022 0830

Received By: _____ Date/Time _____

Received By: Spee Dee Date/Time 9/13/22 1411

Received for Laboratory by: Ene Date/Time 9/13/22 1421

Lab Use Only
Ice Present (or) No
Temp 2.4 IR Gun 28
Cooler # XXX

ReSolution Partners, LLC

Attachment B

Screening-Level Gas Chromatograph (GC) Treatability Study Approach

Updated 20 August 2021

ReSolution Partners, LLC (RP) performs treatability studies for volatile organic compounds (VOCs) and gases listed in Table 1 using in-house methods with a GC. The following sections outline our treatability study approach.

Microcosm Setup

Duplicate reactors are prepared with site soil and/or groundwater in 40, 125, or 250 mL glass bottles with Mininert caps. Mininert caps allow for repeat sampling of the same microcosm over time. The Mininert caps have been found to maintain high VOC concentrations for extended periods of time (Attachment B).

Approximately 25 mL of headspace is made available in the microcosms for gas analysis with the GC. Immediately following sample addition, the bottles are tumbled for 1 hour to disaggregate soil and to mix in the reagents. Following the initial setup, reaction bottles are stored cap side down and inverted daily (Monday-Friday). This procedure has been demonstrated to reduce volatilization losses over time.

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GC Analysis

The concentration of volatile organic compounds (VOCs) in an aqueous sample is determined by analyzing the headspace gas above the sample in a closed container equipped with a Mininert cap. A specific volume of the headspace gas is injected into a Hewlett Packard 5890 Series II gas chromatograph (GC) equipped with a capillary column, a photoionization detector (PID) (used for analyzing chlorinated ethenes) and a flame ionization detector (FID) (used for analyzing chlorinated ethanes and aromatic petroleum constituents, e.g. BTEX).

The concentrations of solvents in the aqueous sample is determined against a standard curve, which is determined from the headspace of a series of four aqueous calibration standards with various concentrations spanning the instrument's operational range. A linear response with a correlation coefficient greater than 0.999 is considered an acceptable calibration. The calibration is verified using a check standard gas each day of measurement. The method is considered within calibration if the check standard result is within 20% of the manufacturer-certified concentration. The instrument response is proportional to concentration and injection volume. The solvent concentrations are reported as aqueous concentrations expressed as mass per liter of water.

The concentration of organic gaseous compounds (methane, acetylene, ethene, ethane and propane) in a gas sample (headspace) is determined by injecting a specific volume of the sample (from a container equipped with a Mininert cap) into a Hewlett Packard 5890 Series I GC equipped with a packed stainless-steel column and an FID. The standard curve is prepared from a series of four injections of a manufacturer-certified gas standard with various injection volumes spanning the instrument's operation range. A linear response with a correlation coefficient greater than 0.999 is considered an acceptable calibration. The same standard gas will be used as a check standard to verify the standard curve each day of measurement. The method is considered within calibration if the check standard result is within 20% of the manufacturer-certified concentration. The instrument response is proportional to concentration and injection volume. The constituent concentrations are expressed as mass per liter of air.

Reporting limit for most compounds in Table 1 is 1 ppb, with the exception of vinyl chloride (5 ppb).

With the use of Mininert caps, pH and ORP are typically measured at the final sampling interval. Additional aqueous analytes (e.g. sulfate, sulfide chloride) can also at this time

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subject to the limits of the test volumes. If pH, ORP or other measurements are required at multiple intervals, a separate series of sacrificial microcosms are setup for these analyses.

Table 1. Screening-Level GC-PID/FID Analytes

Chlorinated Ethenes Tetrachloroethene Trichloroethene cis-1,2-Dichloroethene trans-1,2-Dichloroethene 1,1-Dichloroethene Chloroethene	**Aromatic Hydrocarbons** Benzene Ethylbenzene Toluene m-Xylene o-Xylene p-Xylene 1,2,4-Trichlorobenzene 1,3,5-Trichlorobenzene 1,4-Dichlorobenzene Chlorobenzene
Chlorinated Ethanes 1,1,2-Trichloroethane 1,1,1-Trichloroethane 1,2-Dichloroethane 1,1-Dichloroethane Methylene chloride Chloroform	**Gases** Ethene Ethane Methane Acetylene Propane
Ketones Acetone	

VOC Retention Over Time with Mininert Caps

ReSolution Partners performed a series of tests comparing our standard Teflon-lined septum caps to Mininert valves for measuring VOCs and methane in time-series trials. The Mininert valve allows for repeated puncturing of the septum without recapping the jars, eliminating the need for multiple sacrificial containers per sample. If pH and ORP are to be measured at time selected time intervals, sacrificial jars would still be required. The following table summarizes the comparison of both caps using site soil and groundwater from a project in Brazil:

Analyte (µg/L)	Mininert Cap and Sacrificial Jars		Mininert Cap and Repeated Measurement of Sample Jar		Standard Teflon-lined Septum Cap and Sacrificial Jars	
	Day 0	Day 56	Day 0	Day 56	Day 0	Day 56
VC	3,460	1,960	3,730	2,430	1,490	2,170
t-DCE	<5	<5	<5	<5	<5	<5
c-DCE	<5	<5	<5	<5	<5	<5
TCE	2,150	1,840	2,300	1,940	2,190	1,930
PCE	15,100	13,300	15,700	14,100	14,500	13,900
Methane	15.1	17.4	18.9	16.5	16.4	21.0

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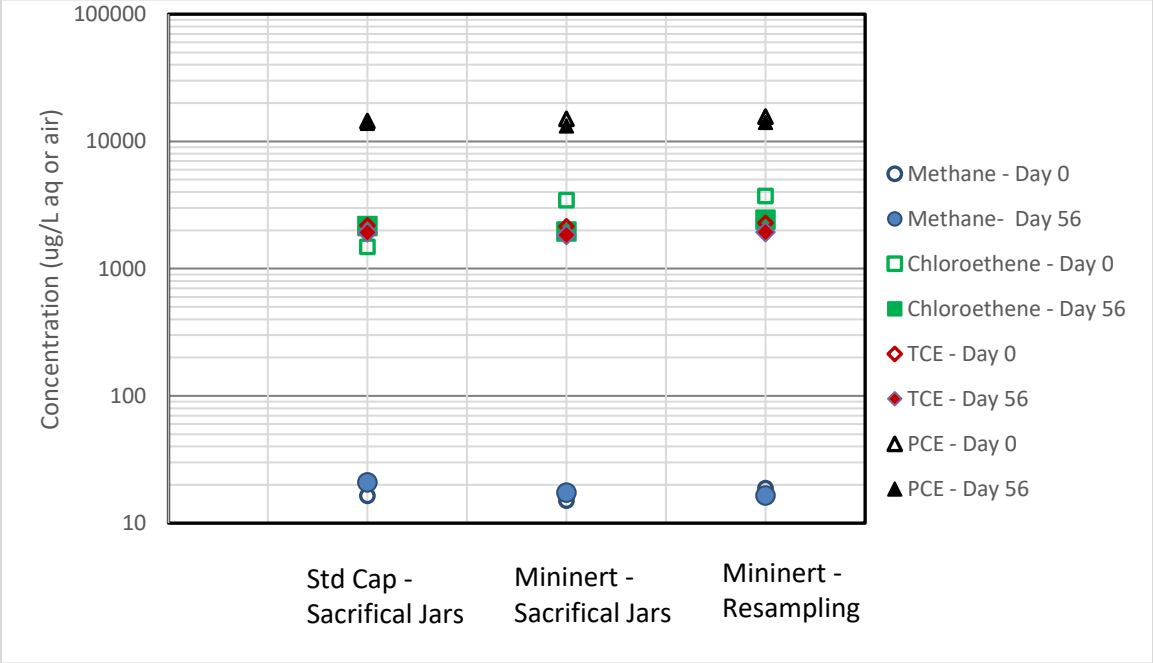
The Day 0 result for chloroethene with the standard cap may be an outlier when compared to all the other results (see attached figure).

The repeated measurements made through the Mininert cap were the highest for all 6 observations of chlorinated ethenes by 3 to 51 percent (comparing the Mininert reuse to the mean of the sacrificial jars). The methane results were 14 percent less and 20 percent more than the mean of the sacrificial jars. For most measurements, the absolute difference in concentrations is relatively small. If pH and ORP are not required the use of the Mininert caps may provide slightly better recoveries, but if pH and ORP are required, the potential decrease in VOC recovery is very small and acceptable for the evaluation of multiple reagents in treatment trials.



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