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Environmental Management

February 22, 2016

Mr. Gerold Noyes, P.E.
Vermont Department of Environmental Conservation
Waste Management Division
1 National Life Drive – Davis 1
Montpelier, VT 05620-3704

RE: 2015 Annual Monitoring Report
Wheatley Site, Brookfield, Vermont (Site #94-1693)

Dear Gerold:

Waite-Heindel Environmental Management (WHEM) is pleased to present the *2015 Annual Monitoring Report* for the Wheatley Site in Brookfield, Vermont. A digital copy (*.PDF) has been placed on the VT DEC ftp site. The report provides details and results of the October 2015 (4th Quarter) sampling event. This report has been prepared in accordance with the requirements and conditions described in the *State of Vermont Contract for Personal Services* EC13-04.

Do not hesitate to contact us if you have any questions about the report or the work conducted. Please contact Chandler Noyes at cnoyes@waiteenv.com or myself at mwaite@waiteenv.com.

Sincerely,

Miles E. Waite, Ph.D., P.G
Senior Hydrogeologist

Chandler E. Noyes
Staff Geologist

Enclosure

2015 ANNUAL MONITORING REPORT

for the

WHEATLEY SITE
BROOKFIELD, VERMONT

VT DEC Site #77-0087

February 22, 2016

Prepared for:

STATE OF VERMONT
Vermont Department of Environmental Conservation
Waste Management Division
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1.0 INTRODUCTION

The following *2015 Annual Monitoring Report* for the Wheatley Site in Brookfield, Vermont (see attached Site Location Map in Appendix A) was prepared by Waite-Heindel Environmental Management, LLC (WHEM) for the Vermont Department of Environmental Conservation (VT DEC). This report has been completed in accordance WHEM's contract with State of Vermont (contract EC13-04) for environmental monitoring.

This report includes discussion of the results of groundwater monitoring conducted by WHEM during 2015. Monitoring locations were at the Wheatley Farm Site, currently a residential property occupied by Mr. James Moorcroft. Work conducted during 2015 and covered in this report include:

- Monitoring of four (4) groundwater monitoring wells during October 2015.

While the collection of indoor air samples from the Moorcroft residence has traditionally been a task conducted at this site during October, this protocol was changed during 2012 due to site business practices and lack of cooperation from the owner.

Monitoring is conducted in accordance with WHEM's *Work Plan for Environmental Monitoring* ("Work Plan") [1], with the *Field/Lab Coordination Memorandum for Water Monitoring* ("FLCM-Water") [2], and the *Field/Lab Coordination Memorandum for Air Monitoring* ("FLCM-Air") [3].

2.0 GROUNDWATER SAMPLING

Groundwater monitoring was conducted by WHEM on October 15, 2015. The following four (4) monitoring wells were monitored: MW-S1, MW-S2, MW-PL1 and MW-PL2. All monitoring well locations are shown in the Site Plan in Appendix A. Monitoring well MW-S2 was observed to be destroyed. The steel well guard had been knocked down, and the PVC well casing was damaged beyond repair, likely by horses that occupy the field. Former monitoring well MW-S3, which was damaged beyond repair in 2010, is no longer part of the monitoring routine. Without MW-S3 and MW-S2, there are now only three wells remaining for monitoring.

2.1 Groundwater Level Measurement

Prior to sampling on October 15, 2015, the water level in each monitoring well was measured with a water level probe. None of the wells were observed to be dry. Depth to groundwater of the remaining three wells ranged from 5.01 to 18.98 ft below top-of-casing (ft btoc).

Using top-of-casing elevation data, the measurements were converted into groundwater elevations. Elevation data from October 2015 are shown with historical measurements in Table 1.1 in Appendix B. Compared to the previous round of measurements in October 2014, the water table elevation increased in the PL-series wells (by an average of 0.55 ft), and also

increased in the remaining S-series well (MW-S1) by 0.30 ft. The water table elevation in MW-PL2 remains on the low end of the range of historical measurements.

Groundwater elevations were also plotted to develop a groundwater elevation map (see Groundwater Elevation Map – October 2015 in Appendix A). As this map shows, the general direction of overburden groundwater flow was toward the west, or toward the Second Branch of the White River. The lateral hydraulic gradient between well MW-PL2 and MW-S1 was 0.011 ft/ft, or 0.8%. The 2015 groundwater flow direction and gradient is typical for this Site.

2.2 Groundwater Sample Collection

Monitoring wells were purged and sampled using low-flow methodology. This involved utilizing a peristaltic pump (Geotech Geopump II) connected to dedicated, high-density polyethylene (HDPE) tubing within each well that extended to a pre-specified intake depth. The dedicated HDPE tubing was connected to disposable silicone tubing that ran through the head of the peristaltic pump; new silicone tubing was used for each well purged. The purge rate, as specified by site protocols, was 200 milliliters/minute (ml/min). The purge rate was reduced at well MW-S1 to 160 ml/min to reduce well drawdown and sample turbidity. The purge rate at well MW-PL2 typically has to be reduced to allow for stabilization of parameters, so a lower initial purge rate was used (120 ml/min), which was then slightly increased after the first measurement (to 150 ml/min). Purge rates, purge volumes, and pump intake depths are shown in the field water collection sheets provided in Appendix C. During the purging process, the water level was monitored using a water level probe (Solinst) with a 0.25-inch probe, and geochemical parameters were measured using a calibrated YSI 556 multi-parameter water quality meter with a flow cell connected to the outlet of the peristaltic pump. The following field geochemical parameters were monitored: dissolved oxygen, specific conductance, temperature, pH, turbidity, and redox potential. The water quality meter was calibrated in the morning prior to sampling; between each sample, the flow cell was rinsed with a mixture of methanol and de-ionized water, and the probes were rinsed with de-ionized water.

Wells were allowed to purge until geochemical parameters stabilized, as specified by site protocols. Upon stabilization, the silicone tubing was disconnected from the water meter. Samples were then collected directly from the outlet of the peristaltic pump. Parameter measurements and sample times are shown in the field sheets in Appendix C. Stabilized parameter measurements are shown with recent historical data (2008 to present) in Tables 1.2 through 1.7.

All samples were delivered by WHEM to TestAmerica Laboratory (TA) of South Burlington, Vermont for analysis of volatile organic compounds via EPA Method 8260B. Results for PCE, TCE, cis-1,2-DCE and trans-1,2-DCE are discussed below.

Sampling proceeded as per protocol, and there were no deviations from the Work Plan or the FLCM-Water other than reducing the purge rate at MW-S1, and starting with a lower initial purge rate at MW-PL2.

2.3 Purgewater Management

All purgewater generated during this event was containerized in 5-gallon pails with watertight caps and transported by WHEM to the UniFirst Plant site in Williamstown, Vermont, where the water was added into the groundwater treatment system. This was accomplished by pouring the purgewater into a sump located in the treatment shed that is connected to the activated carbon treatment train. This protocol was introduced in 2012, and will be followed on all future monitoring events, with no further disposal of purgewater on the ground as done previously.

2.4 Discussion of Results

Validated laboratory analytical results are summarized in Table 2.0 in Appendix B. Full copies of the laboratory report and the data validation package are presented in the Data Validation Report [4]. Following is a detailed discussion of field and laboratory results.

2.4.1 Field Geochemical Parameters

Field geochemical parameter measurements are summarized in Tables 1.2 through 1.7 in Appendix B. Based on a comparison to historical water quality parameters (2002-2014), the following observations can be made from the October 2015 data:

- **Dissolved oxygen** readings were all within the range of historical measurements with no anomalies or clear trends.
- **Specific conductance** readings were all within the range of historical measurements, increasing from 2014 readings, with no anomalies or clear trends.
- **pH** readings were all within the range of historical measurements. In MW-PL2, pH recorded a more typical value, after an unusually low value in October 2014.
- **Turbidity** readings were generally lower than historical measurements for MW-S1 and MW-PL2, however turbidity in MW-PL1 increased to its highest value to date.
- **Redox (ORP)** readings were lower in all three remaining wells compared to the October 2014 results. ORP in MW-S1 was measured to be negative as is typical for this well, after it had its only positive value during the previous sampling event. ORP in both MW-PL1 and MW-PL2 was the lowest to date. The cause of this decrease in ORP is unknown at this time.

2.4.2 Analytical Results

The analytical results from October 2015 indicate the following:

- **MW-PL1**: the target compound PCE was reported at a concentration of 2.7 micrograms per liter (ug/L). TCE was estimated at a trace concentration of 0.32 ug/L, below the method detection limit. No other target compounds were reported above detection limits.
- **MW-PL2**: no target compounds were reported above detection limits.
- **MW-S1**: no target compounds were reported above detection limits.

During the 2011 monitoring event, PCE was detected (5.1 ug/L) in MW-PL1 just above the Vermont Groundwater Enforcement Standard (VGES) of 5.0 ug/L for the first time since

monitoring had begun. Since that spike, contaminant concentrations have decreased to more typical levels (2.0-3.0 ug/L), as observed in this well since 2005. PCE concentrations in MW-PL1 reported between 1997 and the present are shown in the graph presented in Appendix B, and are indicative of an increasing concentration trend between 2005-2012 as compared to data from 1999-2004. It should be noted that PCE has never been reported in any of the three other monitoring wells at this Site.

2.4.3 QA/QC Samples

As part of the quality assurance/quality control (QA/QC) program, WHEM collected a field duplicate sample during the October 2015 sampling event. A duplicate "MW-PLX" was collected in conjunction with MW-PL1. These samples were analyzed by TA using the same method (EPA Method 8260B). PCE was detected in both samples at comparable concentrations (2.7 ug/L in MW-PL1, 2.8 ug/L in "MW-PLX") at over twice the method detection limit, indicating acceptable sample parity. Trace TCE was estimated in both compounds, but below the method detection limit in both cases.

WHEM also collected a trip blank (TB-5) and a field blank (FB-6) during the October 2015 sampling event. No target compounds were reported in either of these samples, indicating that there were no spurious influences on sample quality.

2.5 Discussion of Data Validation

The laboratory data from the October 2015 groundwater sampling event were validated by Phoenix Chemistry Services, an independent data validator. The validation was performed in accordance with Tier III guidelines as described by the USEPA Region I. Details are presented in the Data Validation Report [4] which is provided in Appendix D.

Results for target volatile organic compounds in groundwater collected from the Site during October 2015 were determined to be valid as reported for all samples. While there were qualifications for non-target compounds (acetone and bromomethane), these issues did not directly affect the validity of the groundwater data.

2.6 Recommendations

Based on the above information, overburden groundwater within a portion of the Site continues to show evidence of low levels of dissolved PCE. Given this condition, WHEM recommends continuing the groundwater monitoring program as specified in the Work Plan and FLCM-Water with a reduced monitoring well network that includes MW-PL1, MW-PL2, and MW-S1. Due to its destruction, monitoring well MW-S2 should be formally abandoned by filling in any remaining well bore void with bentonite clay. The next sampling event is scheduled for October 2016.

3.0 INDOOR AIR SAMPLING

Indoor air sampling is no longer part of the monitoring protocol for this Site. Historical air sampling data are provided in Table 3 in Appendix B.

4.0 REFERENCES

1. Waite-Heindel Environmental Management, LLC, *Work Plan for Environmental Monitoring at the UniFirst Plant Site, Williamstown, Vermont, Wheatley Farm Site, Brookfield, Vermont, Bressett Site, Randolph, Vermont*, July 11, 2013.

2. Phoenix Chemistry Services, *Field/Lab Coordination Memorandum for Water Monitoring, UniFirst Plant Site, Williamstown, Vermont, Wheatley Farm Site, Brookfield, Vermont, Bressett Site, Randolph, Vermont*, June 4, 2013.

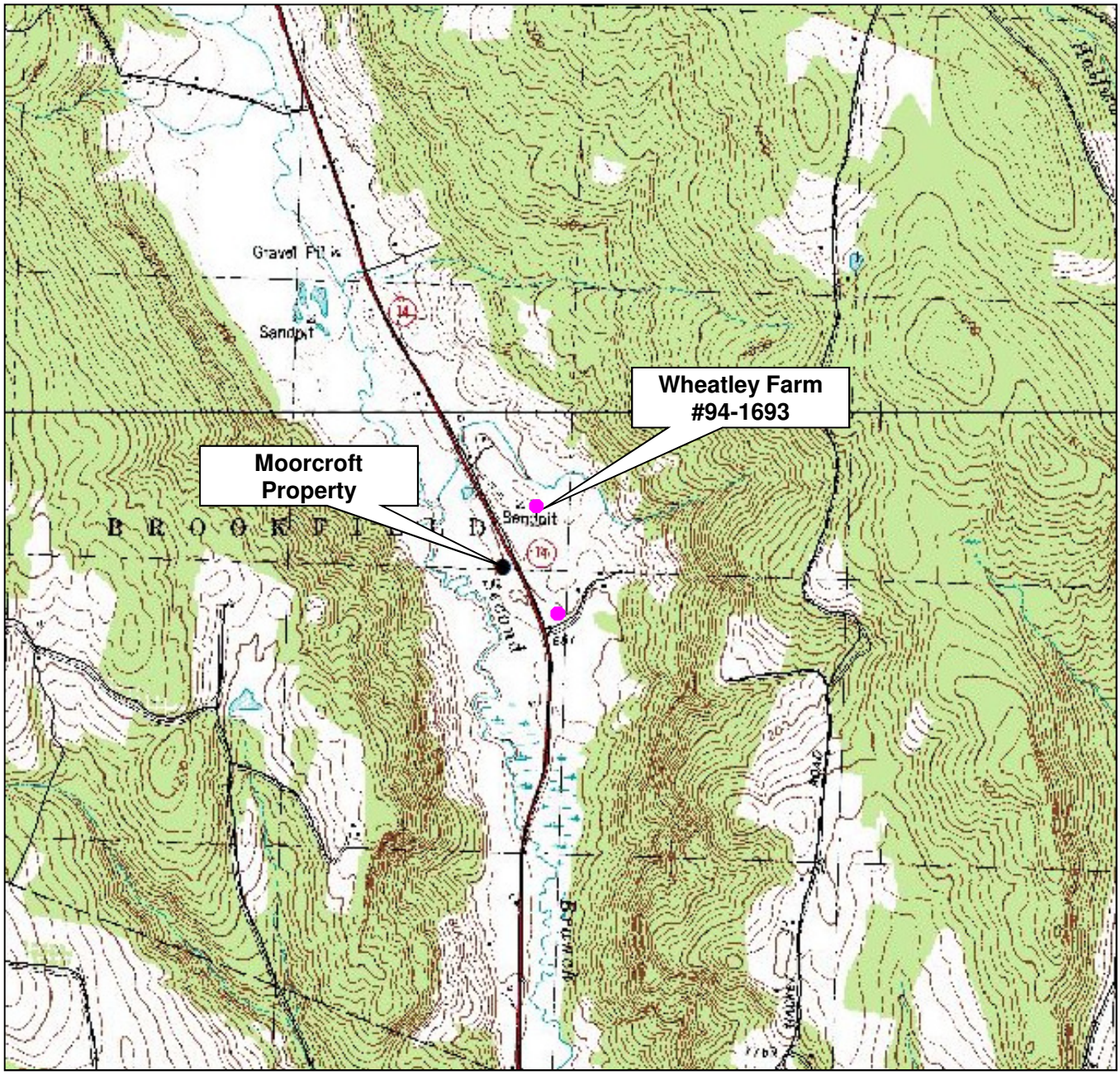
3. Phoenix Chemistry Services, *Field/Lab Coordination Memorandum for Air Monitoring, UniFirst Plant Site, Williamstown, Vermont, Wheatley Farm Site, Brookfield, Vermont, Bressett Site, Randolph, Vermont*, December 22, 2007.

4. Phoenix Chemistry Services, *Data Validation for the UniFirst Project, Bressett, Wheatley and UniFirst Sites, Randolph, Brookfield, and Williamstown, VT, Volatile Organics in Water Samples, Sample Delivery Group Nos. BRES61, UNIF54, and WHEA21, January 14, 2016.*

5. State of Vermont, Agency of Natural Resources, Department of Environmental Conservation, *Chapter 12, Groundwater Protection Rule and Strategy*, February, 2005.

APPENDIX A:

FIGURES



LEGEND

- Site
- State-Listed Hazardous Waste Site

N

Map Source: *USGS Mapping 7.5 Minute Quadrangles: Brookfield (1983), Randolph Ctr (1983)*

Data Source *Vermont DEC databases, updated 2006.*

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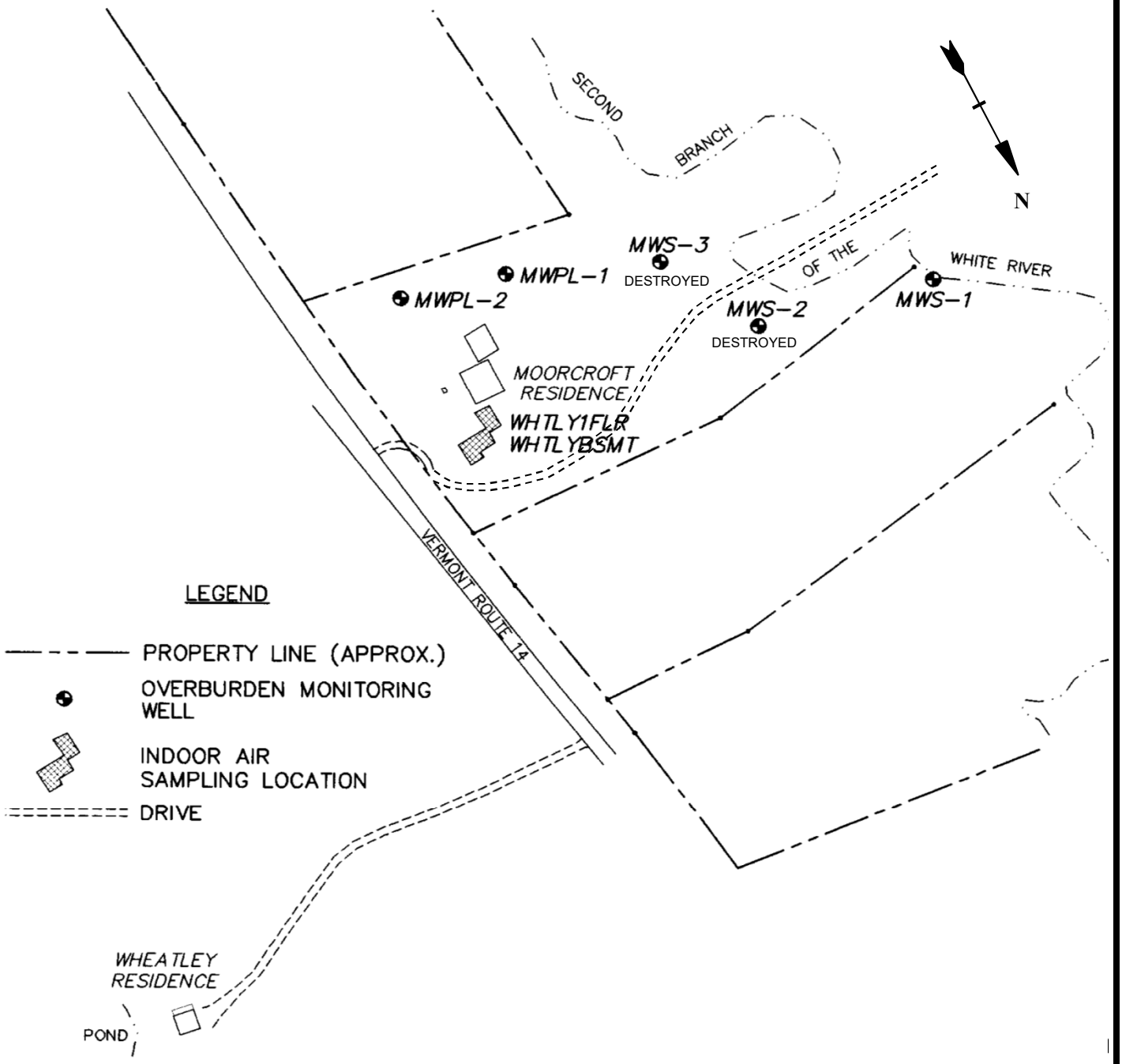
SITE LOCATION MAP

Wheatley Site / Moorcroft Residence

Brookfield, Vermont

Date: 12/15/12	Drawing No. 1	Scale: 1:24,000	By: MEW



Notes:
This map is a copy of the Site Plan (April 1999) prepared Tighe & Bond, Inc., and has information provided by The Johnson Co.
Map has been annotated by WHEM.
All locations approximate

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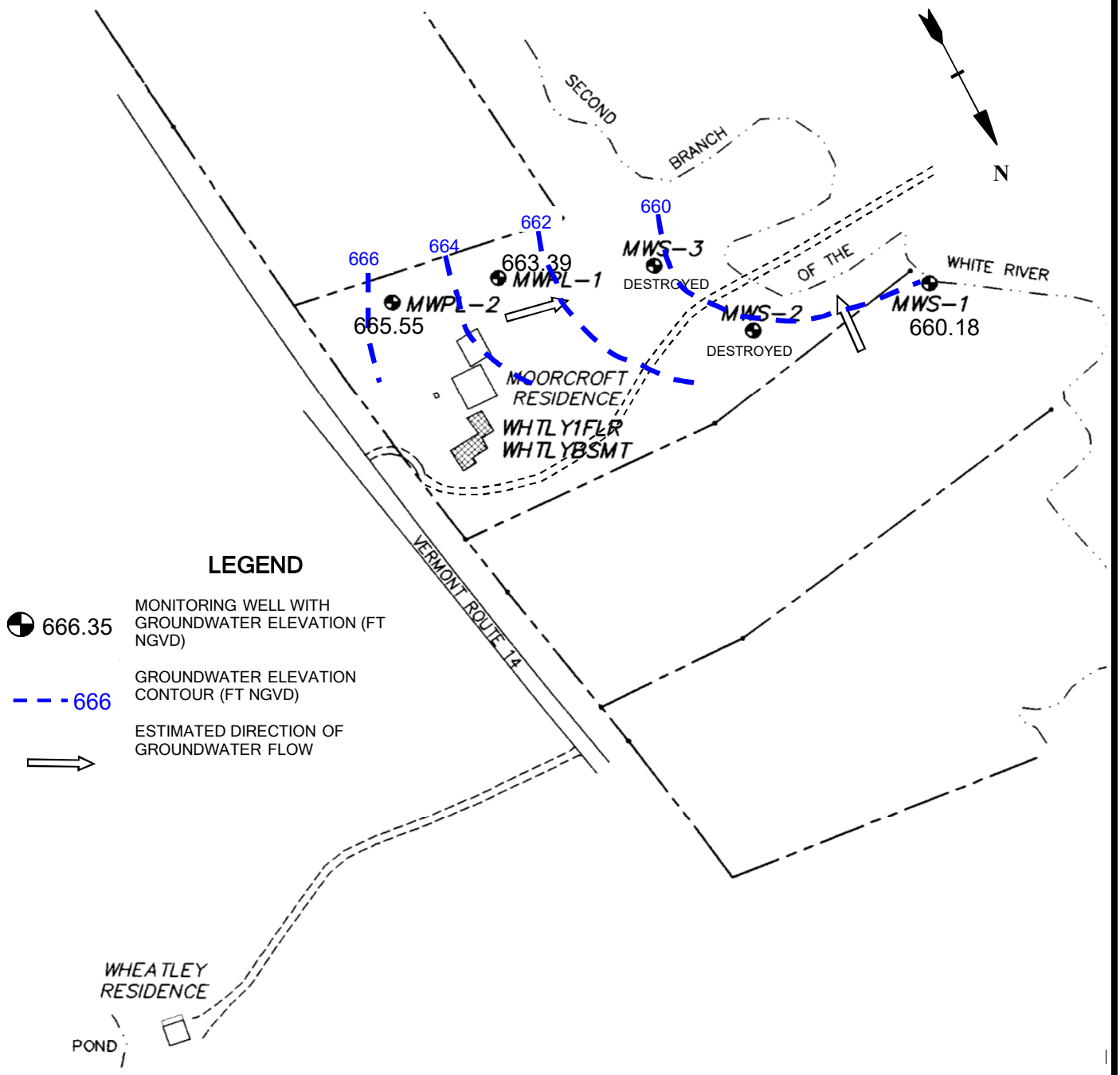
SITE PLAN

Wheatley Farm / Moorcroft Property

Brookfield, Vermont

Date: 02/01/16	Drawing No. 2	Scale: 1" = 200'	By: MEW



Notes:
This map is a copy of the Site Plan (April 1999) prepared Tighe & Bond, Inc., and has information provided by The Johnson Co.
Map has been modified by WHEM.
All locations approximate

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GROUNDWATER ELEVATION CONTOUR MAP

Oct-15

Wheatley Farm / Moorcroft Property

Brookfield, Vermont

Date: 02/01/16	Drawing No. 3	Scale: 1" = 200'	By: MEW

APPENDIX B:

TABLES AND GRAPHS

TABLE 1.1
Groundwater Elevation Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	FT	660.35	659.62	660.68	660.21	660.22	659.55	659.88	660.18
MW-S2	Monitoring Well	FT	660.32	659.30	660.46	659.89	660.02	658.94	659.36	Destroyed
MW-S3	Monitoring Well	FT	661.83	WELL DESTROYED						
MW-PL1	Monitoring Well	FT	663.81	662.26	664.07	663.88	663.41	663.05	662.93	663.39
MW-PL2	Monitoring Well	FT	666.91	666.24	666.59	667.22	665.48	665.84	664.91	665.55

Notes:
-All elevations in feet above NGVD; "NGVD" = National Geodetic Vertical Datum (1988).
-"Dry" = well dry during monitoring event; "NA" =not available; "NS" = not sampled.

TABLE 1.2
Dissolved Oxygen Field Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	mg/L	0.00	0.00	3.42	3.94	0.00	0.98	0.82	0.44
MW-S2	Monitoring Well	mg/L	1.51	0.00	3.89	3.81	0.00	0.31	0.86	Destroyed
MW-S3	Monitoring Well	mg/L	0.00	WELL DESTROYED						
MW-PL1	Monitoring Well	mg/L	1.75	2.45	4.79	6.19	2.35	2.30	2.65	2.82
MW-PL2	Monitoring Well	mg/L	8.17	9.55	7.28	9.89	6.37	6.67	5.44	1.59

Notes:
-"Dry" = well dry during monitoring event; "NA" = not available; "NS = not sampled.
-Data from 2002-2003 collected by Tighe & Bond and reported in "2002 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2003) and "2003 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2004).

TABLE 1.3
Specific Conductance Field Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	us/cm	319	518	401	528	348	332	353	453
MW-S2	Monitoring Well	us/cm	222	346	255	310	238	188	198	Destroyed
MW-S3	Monitoring Well	us/cm	273	WELL DESTROYED						
MW-PL1	Monitoring Well	us/cm	448	744	574	749	460	425	437	542
MW-PL2	Monitoring Well	us/cm	376	661	528	750	523	336	489	520

Notes:
- All conductivity meaurements in microsiemens per centimeter (us/cm).
-"Dry" = well dry during monitoring event; "NA" = not available; "NS = not sampled..
-Data from 2002-2003 collected by Tighe & Bond and reported in "2002 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2003) and "2003 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2004).

TABLE 1.4
Temperature Field Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	deg C	15.3	14.3	9.8	10.6	12.5	13.45	13.49	15.60
MW-S2	Monitoring Well	deg C	15.6	14.2	10.6	12.8	13.8	13.28	10.73	Destroyed
MW-S3	Monitoring Well	deg C	11.3	WELL DESTROYED						
MW-PL1	Monitoring Well	deg C	10.1	10.0	8.5	9.6	10.5	10.22	9.59	10.79
MW-PL2	Monitoring Well	deg C	10.7	9.8	9.2	9.2	11.3	10.10	9.28	9.74

Notes:
- All temperature measurements in degrees Celsius (deg C).
-"Dry" = well dry during monitoring event; "NA" = not available; "NS = not sampled.
-Data from 2002-2003 collected by Tighe & Bond and reported in "2002 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2003) and "2003 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2004).

TABLE 1.5
pH Field Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	unitless	NA	7.96	6.92	7.32	8.11	7.68	7.77	7.89
MW-S2	Monitoring Well	unitless	NA	6.71	6.00	6.66	6.46	6.20	6.38	Destroyed
MW-S3	Monitoring Well	unitless	NA	WELL DESTROYED						
MW-PL1	Monitoring Well	unitless	NA	6.31	6.10	6.20	7.50	7.22	6.95	7.27
MW-PL2	Monitoring Well	unitless	NA	6.43	6.20	6.59	7.32	7.12	6.09	6.99

Notes:
-"Dry" = well dry during monitoring event; "NA" = not available; "NS = not sampled.
-Data from 2002-2003 collected by Tighe & Bond and reported in "2002 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2003) and "2003 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2004).

TABLE 1.6
Turbidity Field Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	NTU	71.2	11.4	NA	119	10.8	2.3	17.9	9.97
MW-S2	Monitoring Well	NTU	0.0	0.0	NA	52.4	0.0	1.1	5.2	Destroyed
MW-S3	Monitoring Well	NTU	2.9	WELL DESTROYED						
MW-PL1	Monitoring Well	NTU	0.0	1.2	NA	44.3	0.0	11.2	19.8	79.4
MW-PL2	Monitoring Well	NTU	0.0	3.2	NA	80.7	2.5	2.8	13.8	2.2

Notes:
-All turbidity measurements in nephelometric turbidity units (NTU).
-"Dry" = well dry during monitoring event; "NA" = not available; "NS = not sampled.
-Data from 2002-2003 collected by Tighe & Bond and reported in "2002 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2003) and "2003 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2004).

TABLE 1.7
Redox Potential Field Measurements: 2008 - 2015
Wheatley Site, Brookfield, Vermont

Location	Type	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	Monitoring Well	mV	-182	-173	-187	-197	-112	-103	28	-98.8
MW-S2	Monitoring Well	mV	-50	-68	-62	-115	-26	-16	-5	Destroyed
MW-S3	Monitoring Well	mV	-205	WELL DESTROYED						
MW-PL1	Monitoring Well	mV	101	155	158	148	169	122	247	79.4
MW-PL2	Monitoring Well	mV	112	153	170	148	175	127	309	65

Notes:
-All redox potential measurements in millivolts (mV).
-"Dry" = well dry during monitoring event; "NA" = not available; "NS = not sampled.
-Data from 2002-2003 collected by Tighe & Bond and reported in "2002 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2003) and "2003 Monitoring Report Summary, Wheatley Farm Site" (March 12, 2004).

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TABLE 2.0
MONITORING WELL RESULTS: 2008-2015
Wheatley Farm Site, Brookfield

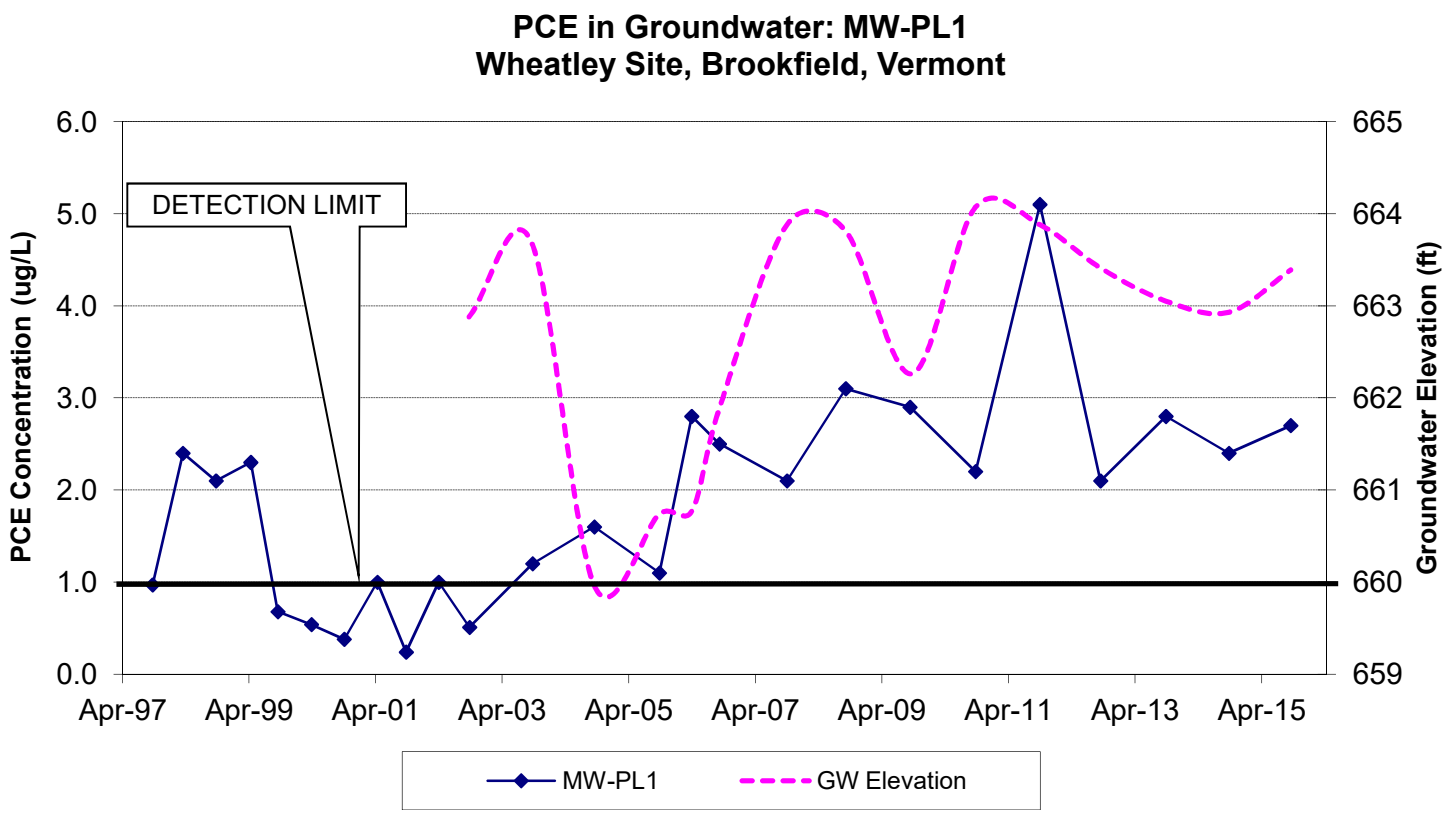
Location	Parameter Method 8260	Groundwater Enforcement Standard	Units	Oct-08	Oct-09	Oct-10	Oct-11	Oct-12	Oct-13	Oct-14	Oct-15
MW-S1	**PCE**	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	TCE	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	cis-1,2-DCE	**70.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	trans-1,2-DCE	**100.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
MW-S2	**PCE**	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	DESTROYED
	TCE	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
	cis-1,2-DCE	**70.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
	trans-1,2-DCE	**100.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	
MW-S3	**PCE**	**5.0**	ug/L	1.0 U	DESTROYED						
	TCE	**5.0**	ug/L	1.0 U							
	cis-1,2-DCE	**70.0**	ug/L	1.0 U							
	trans-1,2-DCE	**100.0**	ug/L	1.0 U							
MW-PL1	**PCE**	**5.0**	ug/L	**3.1**	**2.9**	**2.2**	**5.1**	**2.1**	**2.8**	**2.4**	**2.7**
	TCE	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	0.47 J	0.19 J	0.34 J	0.32 J	0.32 J
	cis-1,2-DCE	**70.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	trans-1,2-DCE	**100.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
MW-PL2	**PCE**	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	TCE	**5.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	cis-1,2-DCE	**70.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
	trans-1,2-DCE	**100.0**	ug/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

Notes:
- "PCE" = tetrachlorethene; "TCE" = tricholorethene; "DCE" = dichloroethene.
-"U" = not detected above listed quantitation limit; "J" = reported concentration is an estimated value; "UJ" = reported quantitation limit is an estimated value.
-"Dry" = well dry during monitoring event; "NA" = not available.
- Data entered from the data validation report for each sampling event.
- Shaded cells indicate that the reported concentration is in excess of the Enforcement Standard.
- Groundwater Enforcement Standards referenced from Table 1, Chapter 12 - Groundwater Protection Rule and Strategey, February 2005.

TABLE 3.0
HISTORICAL INDOOR AIR QUALITY RESULTS
Wheatley Farm Site, Brookfield, Vermont

Owner	Location	Parameter Method T-014A	Guidance Level	Units	Jul-01	Jan-02	Jul-02	Oct-03	Oct-04	Oct-05	Oct-06	Oct-07	Oct-08	Oct-09	Oct-10
Moorcroft	WHTLY1FLR	Tetrachloroethene	0.08	ppbv	0.42 U	**0.09** J	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	**0.022**	**0.100**
		Trichloroethene	0.09	ppbv	0.42 U	0.27 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	**0.96**	NS	**2.0**	**0.012**
		cis-1,2-Dichloroethene		ppbv	0.42 U	0.27 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	0.010 U	0.000 U
		trans-1,2-Dichloroethene	15.6	ppbv	0.42 U	0.27 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	**0.014**	**0.043**
	WHTLYBSMT	Tetrachloroethene	0.08	ppbv	**4.8**	0.32 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	**0.020**	0.010 U
		Trichloroethene	0.09	ppbv	0.47 U	0.32 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	**0.017**	0.010 U
		cis-1,2-Dichloroethene		ppbv	0.47 U	0.32 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	0.010 U	0.010 U
		trans-1,2-Dichloroethene	15.6	ppbv	0.47 U	0.32 U	0.5 U	NS	0.5 U	0.2 U	0.2 U	0.010 U	NS	**0.028**	**0.017**

Notes:
-"U" = not detected above listed quantitation limit; "J" = reported concentration is an estimated value; "UJ" = reported quantitation limit is an estimated value; "R" = the data are unusable (analyte may or may not be present).
-"NS" = Not Sampled (house unoccupied or access not obtained).
-Bold values are reported above quantitation limit; shaded cells are in excess of the guidance level.
-Guidance levels for tetrachloroethene and trichloroethene is Target Indoor Air concentration (converted to ppbv) from Table C.7 of VT ANR Investigation and Remediation of Contaminated Properties Procedure, April 2012.
-Guidance level for trans-1,2,-dichloroethene is based on the EPA Regional Screening Level (RLS) for residential indoor air (April 2012). There is no EPA RSL for cis-1,2-dichloroethene.



Note:
1) Concentrations shown below the detection limit are estimated (J).

APPENDIX C:

FIELD DATA SHEETS

Waite - Heindel
Environmental Management

UNIFIRST
FIELD WATER COLLECTION SHEET

SAMPLING LOCATION	MW-S1			Pump Intake Depth	9.5'
Date	10/15/2015			Pump Type	peri
Sampler	CP/CW			Well Diameter	2"
Weather	cloudy 50's			Well Depth	12.52
Water Type	(gw)	sw	supply	Initial Depth to Water	5.01
Sampling Method	bailer	(low flow)	grab	Traditional Purge Vol. / Rate	200

LOW FLOW PURGING DATA

Time	DTW (ft btp)	Purge Rate (ml/min)	Temp. (deg C)	Specific Cond. (ms/m) / (us/cm)	pH	ORP (mv)	DO (mg/L)	Turbidity (NTU)		Notes
			within 3%	within 3%	1 pH unit	10 mv	within 10%	within 10%		
1205	6.35	200	15.65	446	8.09	29.1	3.96	35.63		
1208	6.52	↓	15.59	445	8.07	-26.8	1.49	40.03		
1211	6.61		15.64	444	8.05	-57.6	0.93	32.97		
1214	6.64		15.60	445	8.04	-74.9	0.90	22.61		
1217	6.72		15.60	↓	8.02	-76.0	0.56	15.50		
1220	6.74		15.62	447	8.00	-87.1	0.51	11.56		
1223	6.74		15.68	↓	7.97	-91.9	0.46	11.65		
1226	↓		15.73	451	7.92	-100.1	0.45	9.75		
1229		↓	15.60	453	7.89	-98.8	0.44	9.97		

SAMPLE COLLECTION

	Purge Volume	Temp.	Specific Cond.	pH	ORP	DO	Turbidity		
Final Measurements:	2.0 gal	15.60	453	7.89	-98.8	0.44	9.97		

Sample Description	Label	Type Container	# Container	Preservative	Analysis Method	Collection Time	COC #
Sample	MW-S1	40 ml	3	HCl	8260	1231	
Additional							
Additional							
Field Duplicate							
MS/MSD	MW-S1	"	4	"	"	"	
Field Blank							

General Notes:

WEM Project #110320012

VT DEC Site #

Waite-Heindel
Environmental Management

UNIFIRST
FIELD WATER COLLECTION SHEET

SAMPLING LOCATION	MW-PL2	Pump Intake Depth	20'
Date	10/15/15	Pump Type	Peri
Sampler	CP/LN	Well Diameter	3/4"
Weather	Sunny, 60's	Well Depth	20.52
Water Type	(gw) sw supply	Initial Depth to Water	18.98
Sampling Method	bailer (low flow) grab	Traditional Purge Vol. / Rate	75 ml/m

LOW FLOW PURGING DATA

Time	DTW (ft btp)	Purge Rate (ml/min)	Temp. (deg C)	Specific Cond. (ms/m) / (us/cm)	pH	ORP (mv)	DO (mg/L)	Turbidity (NTU)		Notes
			within 3%	within 3%	1 pH unit	10 mv	within 10%	within 10%		
1410	19.21	100	10.42	524	7.37	61.8	6.17	633		
1415	19.19	150	10.06	521	7.10	60.4	1.60	7.[illegible]		↑
1418	19.23	↑	9.88	522	7.04	60.5	1.60	4.90		
1421			9.75	521	7.00	62.2	1.64	4.02		
1424	↓	↓	9.74	520	6.99	65.0	1.59	2.70		

SAMPLE COLLECTION	Purge Volume	Temp.	Specific Cond.	pH	ORP	DO	Turbidity		
Final Measurements:	1 vol	9.74	520	6.99	65.0	1.59	2.70		

Sample Description	Label	Type Container	# Container	Preservative	Analysis Method	Collection Time	COC #
Sample	MW-PL2	40ml	3	HCl	8260	1426	
Additional							
Additional							
Field Duplicate							
MS/MSD							
Field Blank							

General Notes:

WEM Project #110320012

VT DEC Site #

Waite-Heindel
Environmental Management

UNIFIRST
FIELD WATER COLLECTION SHEET

SAMPLING LOCATION	MW-PL1			Pump Intake Depth	16.5
Date				Pump Type	peri
Sampler				Well Diameter	3/4"
Weather				Well Depth	17.33
Water Type	gw	sw	supply	Initial Depth to Water	13.12
Sampling Method	bailer	low flow	grab	Traditional Purge Vol. / Rate	100 ml/min

LOW FLOW PURGING DATA

Time	DTW (ft btp)	Purge Rate (ml/min)	Temp. (deg C)	Specific Cond. (ms/m) / (us/cm)	pH	ORP (mv)	DO (mg/L)	Turbidity (NTU)		Notes
			within 3%	within 3%	1 pH unit	10 mv	within 10%	within 10%		
1442	13.12	200	12.87	540	7.54	82.5	7.00	261.3		200 ml/min
1445	↓	↓	10.81	537	7.43	84.4	3.72	148.1		
1448			10.85	539	7.38	83.6	3.16	45.24		
1451			10.82	540	7.30	82.1	2.97	29.07		clearing
1454			10.79	541	7.29	80.6	2.86	11.02		
1457			↓	542	7.27	79.4	2.82	5.51		stable

SAMPLE COLLECTION	Purge Volume	Temp.	Specific Cond.	pH	ORP	DO	Turbidity		
Final Measurements:	1.25	10.75	542	7.27	79.4	2.82	5.51		

Sample Description	Label	Type Container	# Container	Preservative	Analysis Method	Collection Time	COC #	
Sample	MW-PL1	40ml	3	HCl	8260	1459		
Additional								
Additional								
Field Duplicate	MW-PLX	40ml	3	HCl	8260	"1445"		
MS/MSD								
Field Blank	FB-6	40ml	2	"	"	1520		

General Notes: TB-5 placed in cooler @ 1510

WEM Project #110320012

VT DEC Site #

APPENDIX D:

DATA VALIDATION REPORT

Phoenix Chemistry Services

January 14, 2016

Mr. Gerold Noyes
VT Department of Environmental Conservation
Waste Management and Prevention Division
1 National Life Drive - Davis 1
Montpelier, VT 05620-3704

Reference #s: 2015-1120 -001

Dear Gerold,

Attached please find the results of the data validation of Sample Delivery Group (SDG) Nos. BRES61, UNIF54, and WHEA21 from the Environmental Monitoring work at the Bressett Site, in Randolph, the UniFirst Site in Williamstown, and the Wheatley Farm Site in Brookfield, VT. The water samples in these SDGs were collected on October 12-15, 2015. The laboratory analyses were performed by TestAmerica Burlington (formerly STL Burlington) of South Burlington, VT.

The data packages were received on November 20, 2015, and questions concerning the electronic deliverables were resolved on January 14, 2016. The validation has been performed by Phoenix Chemistry Services, to the extent possible according to the Tier III guidelines as defined by USEPA Region I, as presented in "Region I EPA-NE Data Validation Manual and Functional Guidelines for Evaluating Environmental Analyses", December, 1996. The EPA's National Functional Guidelines for Organic Data Review (EPA 540/R-99/008, October, 1999), and the Field/Laboratory Coordination Memorandum for Water Monitoring (FLCM), June 25, 2013 were also considered during the evaluation, and professional judgment was applied as necessary and appropriate. Data qualifiers have been applied in the final validation report as necessary and appropriate, in accordance with these guidelines.

Five analyses were appropriately submitted by the laboratory to provide additional information. There are three dilution and two re-analyses in this group. In the spreadsheet files these results have been marked as rejected; since the validator chose alternate submissions for these results, they are not included in the calculation of completed results as rejections, but were simply treated as disregarded during validation. Consequently, these results are not included in the Data Summary Table for this sample set.

Electronic copies of these reports are being submitted to Waite Environmental Management and TestAmerica Burlington, as well as to your attention. The year-end quality assurance summary report for air and water analyses will follow shortly.

Thank you for this opportunity to provide data validation services to the Waste Management Division. We look forward to continuing to work with you. If there are any questions or concerns about the material in this report, please do not hesitate to contact me for help and clarification.

Sincerely,

Deborah H. Gaynor, Ph.D.
Principal, Phoenix Chemistry Services

DATA VALIDATION

FOR

UniFirst Project
Bressett, Wheatley, and UniFirst Sites
Randolph, Brookfield, and Williamstown, VT

ORGANIC ANALYSIS DATA
Volatile Organics in Water Samples

Sample Delivery Group Nos. BRES61, UNIF54, and WHEA21

Chemical Analyses Performed by:

TestAmerica Burlington
30 Community Drive Dr. Suite 11
South Burlington, VT 05403

FOR

Mr. Gerold Noyes
Department of Environmental Conservation
Waste Management and Prevention Division
1 National Life Dr – Davis 1
Montpelier, VT 05620-3704

Data Validation Report by:

Phoenix Chemistry Services
126 Covered Bridge Rd.
N. Ferrisburgh, VT 05473
(802)-233-2473

January 14, 2016

EXECUTIVE SUMMARY

Phoenix Chemistry Services (Phoenix) has completed the validation of the volatile organics analysis data prepared by TestAmerica Burlington (formerly STL Burlington) for 38 groundwater samples, 8 potable water samples, 1 performance evaluation (PE) sample, 6 field blanks (FB), and 5 trip blanks (TB) from the Bressett Site in Randolph, VT, the UniFirst Site in Williamstown, VT, and the Wheatley Farm site in Brookfield, VT. The laboratory reported the data under Sample Delivery Group (SDG) Nos. BRES61, UNIF54, and WHEA21 which were submitted as three data packages received by Phoenix on November 20, 2015. These SDGs include the following samples:

Table 1. Sample Identifications

Sample Identifier	Laboratory ID
Method 8260B	
SDG No. BRES61	
BRW-3	200-30193-5
BRW-2	200-30193-6
BRW-1	200-30193-7
TB-2	200-30218-1
MW-103D	200-30218-2
MW-104S	200-30218-3
MW-104D	200-30218-4
MW-102D	200-30218-5
MW-102S	200-30218-6
MW-101S	200-30218-7
MW-101DR	200-30218-8
MW-Z	200-30218-9
MW-4S	200-30218-10
MW-4D	200-30218-11
MW-3S	200-30218-12
MW-3D	200-30218-13
FB-3	200-30218-14
SDG No. UNIF54	
MW-25884	200-30193-8
BRW-Z	200-30193-9
FB-2	200-30193-10
TB-3	200-30270-1
FB-4	200-30270-2
SS-2	200-30270-3
SS-5	200-30270-4
SEEP-1A	200-30270-5
W-SEEP	200-30270-6
SS-Z	200-30270-7
SP-3MW	200-30270-8
SP-4	200-30270-9
PZ-102	200-30270-10

Sample Identifier	Laboratory ID
PZ-101	200-30270-11
W-19	200-30270-12
W-25	200-30270-13
MW-50	200-30270-14
MW-E	200-30270-15
W-1	200-30270-16
W-20	200-30270-17
MW-D	200-30270-18
W-Z	200-30270-19
SDG No. WHEA21	
TB-5	200-30268-1
FB-6	200-30268-2
MW-PL2	200-30268-3
MW-S1	200-30268-4
MW-S2	200-30268-5
MW-PL1	200-30268-6
MW-PLX	200-30268-1
Method 524.2	
SDG No. BRES61	
TB-1	200-30193-1
SHIELDS	200-30193-2
WELL Z	200-30193-3
FB-1	200-30193-4
SDG No. UNIF54	
TB-4	200-30259-39
FB-5	200-30259-40
WP-5	200-30259-41
WP-7	200-30259-42
WP-8	200-30259-43
WP-13	200-30259-44
WP-23	200-30259-45
WP-3	200-30259-46
WP-Z	200-30259-47

Sample MW-103RD was originally identified as MW-103D on the Chain of Custody received on October 13, 2015. This well has been renamed MW-103RD to identify it as a re-drilled well. The correct identifier has been used throughout this report and in the validated spreadsheet files, and the sampler has been reminded to use the correct identifier. Samples WP-2 and MW-D were originally logged in with incorrect identifiers due to poor legibility on sample bottle labels and the chain of custody documents. The validator requested corrections immediately upon receipt of the sample receipt logs, and the laboratory corrected these prior to analysis. The laboratory used the collection time to confirm the sample identified on the chain of custody as MW-102D but labeled as MW-104D; three bottles labeled as MW-104D had a collection time that corresponded to the time listed for MW-104D on the chain of custody. The laboratory requested clarification from the field sampler regarding the correct identifier for sample MW-102D

The laboratory appropriately logged in storage (holding) blanks with each set of samples, by day of receipt and matrix (potable and non-potable waters). However, the sample identifier (ID) used for holding blanks is always VHBLK01. Where it is necessary to refer to these storage blanks in this report, the laboratory identifier has been appended to the sample identifier to create a unique ID.

Findings of the validation effort resulted in the following qualifications of sample results:

- Results for all analytes in MW-3D, FB-3, BRW-Z, MW-D, and W-Z were qualified as estimated (J, UJ). The dilution analyses MW-101DRDL, MW-ZDL, and MW-3SDL, and the reanalyses MW-4SRE and MW-4DRE were disregarded for the remainder of the validation effort.

- Results for acetone in the Method 8260B analyses of samples SS-5, SEEP-1A, W-SEEP, SS-Z, SP-3MW, SP-4, PZ-102, PZ-101, W-19, W-25, MW-50, MW-E, W-20, W-1, MW-D, W-Z, TB-5, FB-6, MW-S1, MW-PLX, MW-PL2, and MW-PL1 were qualified as estimated (UJ).

- Results for vinyl chloride in BRW-1, BRW-3, MW-102D, MW-102S, MW-101S, MW-101DR, MW-Z, MW-3S, MW-4S, MW-4D, and MW-25884 (range: 0.23 – 0.30 ug/L) were qualified as less than the quantitation limit (U). Results for chloroform in WP-5, WP-7, and WP-13 (range: 0.09 – 0.14 ug/L) were qualified as less than the quantitation limit (U). Contaminants reported in field blanks (trip blanks and field blanks) are not qualified.

- Results for trichloroethene, 1,2-dichloropropane, bromodichloromethane, cis-1,3-dichloropropene, 4-methyl-2-pentanone, toluene, trans-1,3-dichlroopropene, 1,1,2-trichlorethane, tetrachloroethene, 2-hexanone, and dibromochloromethane in WP-7 were qualified as estimated (J, UJ).

- Results for bromomethane in TB-1, SHIELDS, WELL-Z, and FB-1 and for chloromethane in TB-2, MW-103RD, MW-104S, MW-104D, FB-3, MW-3D, and BRW-2were qualified as estimated (UJ).

- Results for bromomethane in WP-8, MW-4S, and MW-S1 were qualified as estimated (UJ).

- All results in MW-103RD were qualified as estimated (UJ).

- Results for tetrachloroethene above the established calibration range in MW-101DR, MW-Z, and MW-3S were qualified as estimated (J).

- The laboratory appropriately applied "J" qualifiers to the sample Form I's when the concentration of an analyte was less than the sample-specific PQL. The validator did not remove these qualifiers.

- All laboratory-specific qualifiers, such as the asterisk (*), have been removed by the validator.

The Overall Evaluation of Data (Section XVI) summarizes the validation results. The validation findings and conclusions for each analytical parameter are detailed in the remaining sections

of this report.

Documentation problems observed in the data packages are described in Section XVII.

This validation report shall be considered part of the data packages for all future distributions of the volatiles (8260B and 524.2) analysis data.

INTRODUCTION

Analyses were performed according to SW-846 Method 8260B Low Level, as documented in TestAmerica SOP BR-MV-006r11, and SDWA Method 524.2 Rev. 4.1, as documented in TestAmerica SOP BR-MV-005r11, and in accordance with requirements in the Field/Laboratory Coordination Memorandum for Water Monitoring (FLCM), June 25, 2013. The target compound list for the Method 8260B analyses was limited to the OLM03.1 CLP target compound list, and the target compound list for Method 524.2 was limited to the OLM03.1 CLP target compound list plus methyl-*tert*-butyl ether (MTBE).

Tentative identification of non-target analyte peaks (i.e., tentatively identified compounds, or TICs) was not requested for these analyses.

Phoenix Chemistry Services' validation was performed in conformance with Tier III guidelines as defined by USEPA Region in the "Region I EPA-NE Data Validation Manual: The Data Quality System", (12/96 Revision). To maintain consistency with previous work at these sites, the data were evaluated in accordance with the "Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses", December 1996. EPA's National Functional Guidelines for Organic Data Review (EPA 540/R-99/008, October, 1999) were also considered during the evaluation, and professional judgment was applied as necessary and appropriate.

The data validation process evaluates data on a technical basis for chemical analyses conducted under the CLP or other well-defined methods. Contract compliance is evaluated only in specific situations. Issues pertaining to contractual compliance are noted where applicable. It is assumed that the data package is presented in accordance with the CLP (CLP-like or SW-846) requirements. It is also assumed that the data package represents the best efforts of the laboratory and has already been subjected to adequate and sufficient quality review prior to submission for validation. In instances where SW-846 or other specific methods have been used for the analyses, the validation effort is modified to acknowledge the differences in methodology while maintaining the goals and quality objectives of the CLP.

Results of sample analyses are reported by the laboratory as either qualified or unqualified; various qualifier codes are used by the laboratory to denote specific information regarding the analytical results. During the validation process, laboratory data are verified against all available supporting documentation. Based on this evaluation, qualifier codes may be added, deleted, or modified by the data validator. Raw data is examined in detail to check calculations, compound identification, and/or transcription errors. Validated results are either qualified or unqualified; if results are unqualified, this means that the reported values may be used without reservation. Final validated results are annotated with the following codes, as defined in the EPA Region I Functional Guidelines:

U - The analyte was analyzed for, but was not detected. The associated numerical value is the sample quantitation limit. The sample quantitation limit accounts for sample specific dilution factors and percent solids corrections or sample sizes that deviate from those required by the method.

J - The associated numerical value is an estimated quantity.

UJ - The analyte was analyzed for, but was not detected. The sample quantitation limit is

an estimated quantity.

R - The data are unusable (analyte may or may not be present). Resampling and reanalysis is necessary for verification. The R replaces the numerical value or sample quantitation limit. In some instances (e.g., a dilution) a result may be indicated as "rejected" to avoid confusion when a more quantitatively accurate result is available.

EB, TB, BB - An analyte that was identified in an aqueous equipment (field) blank, trip blank, or bottle blank that was used to assess field contamination associated with soil/sediment samples. These qualifiers are to be applied to soil/sediment sample results only.

These codes are assigned during the validation process and are based on the data review of the results. They are recorded in the Data Summary Table contained in Attachment A and the spreadsheet summary files (Attachment B, submitted electronically) of this validation report.

All data users should note two facts. First, **the "R" qualifier means that the laboratory-reported value is completely unusable.** The analysis is invalid due to significant quality control problems, and provides no information as to whether the compound is present or not. Rejected values should not appear on data tables because they have no useful purpose under any circumstances. Second, **no analyte concentration is guaranteed to be accurate even if all associated quality control is acceptable.** While strict quality control conformance provides well-defined confidence in the reported results, any analytical result will always contain some error.

The user is also cautioned that the validation effort is based on the materials provided by the laboratory. Software manipulation, resulting in misleading raw data printouts, cannot be routinely detected during validation; unless otherwise stated in the report, these kinds of issues are outside the scope of this review.

Detailed Findings of Measurement Error Associated with the Analytical Analysis

I. Preservation and Technical Holding Times (Sample Integrity)

The samples for volatiles analysis in SDG Nos. BRES61, UNIF54, and WHEA21 were collected on October 12-15, 2015. All volatiles analyses were performed within the acceptable holding times for preserved water samples (14 days from collection), as required by Region 1with the following exceptions:

- Samples MW-3D and FB-3 were analyzed on the 17th day following collection (three days out of the technical holding time) along with their associated storage (holding) blank, VHBLK0130218-15;
- BRW-Z was analyzed 4 days out of holding time; and
- MW-D and W-Z, which were analyzed one day out of holding time.

Additionally, reanalyses of MW-4S, its matrix spike and duplicate, and MW-4D for suspected carryover were performed on day 15 following collection (one day out of holding time). Dilution analyses for samples MW-101DR, MW-Z, and MW-3S were also performed one day out of holding time.

The pH of the samples was measured at the time of screening, and is recorded in the Sample Preparation sections of the data packages and noted in the Case Narrative. Vial preservation with hydrochloric acid is noted by the field sampler in all field sheets. The pH of the vial analyzed is also measured immediately following analysis. All recorded sample pH values were <2 with the exception of MW-103RD, which had a screen vial pH >2. The laboratory noted this, and analyzed the remaining sample bottle within its 7-day holding time, on Oct. 20, 2015.

Due to analysis 15-18 days following sample collection, results for all analytes in MW-3D, FB-3, BRW-Z, MW-D, and W-Z were qualified as estimated (J, UJ). Results for all analytes in the dilution analyses MW-101DRDL, MW-ZDL, and MW-3SDL, and reanalyses MW-4SRE and MW-4DRE warrant qualification as estimated (J, UJ); however, since only small differences (all losses) in concentration for detected analytes were determined in the analyses out of holding time, it is the professional judgment of the data validator that the initial analyses within holding time are preferable, and these dilution and re-analyses were disregarded for the remainder of the validation effort. Qualifications of results in the original sample analyses, based on the reasons for the reanalyses and dilution analyses of these samples, are applied and discussed later in this report.

The cooler temperatures on receipt at the laboratory were checked and documented in the data packages, and were 4.9, 4.5, 2.3, 4.5, and 2.3 ^{o}C, which are within the acceptance range of 4 ^{o}C ±2 ^{o}C, and one cooler received a few hours after sample collection at 10.1 ^{o}C, which is acceptable, since the cooling process had started.

The field data sheets and Chain of Custody incorrectly identified sample MW-103RD as MW-103D. This well has been renamed to MW-103RD to identify that it was re-drilled. The correct identifier has been used throughout this report and in the validated spreadsheet files. The field sampler has been reminded to correctly identify the sample for this well in future sampling efforts.

II. GC/MS Instrument Performance Check (Tuning)

The samples were analyzed on a single GC/MS system identified as instrument CHL. The tuning of this instrument was demonstrated with analysis of 4-bromofluorobenzene (BFB); tunes were analyzed for each shift (12-hour period) during which the samples or associated standards were analyzed. All nine (9) BFB tunes were correctly calculated, within acceptance limits, and are reported accurately on the Form V summaries in the data packages.

III. Initial Calibration (IC)

One IC (10/20/15) was performed in support of the Method 8260B sample analyses, and one IC (10/23/15) was performed in support of the Method 524.2 sample analyses reported in these data packages. Documentation of all individual IC standards was present in the data packages and relative response factor (RRF) as well as percent relative standard deviation (%RSD) values appear to be correctly calculated and accurately reported on the Form VI summaries. The validator was unable to exactly replicate the calculation of the RRFs and consequently the %RSD values for the Method 8260B analyses; the differences are small (at most a few hundredths of the values) but seem to be too large for rounding to be the source of the problem. The laboratory has been asked for an explanation. No problems were encountered with replication of the Method 524.2 calculations.

The Method 8260B IC was performed at six concentration levels (0.827, 1.88, 4.80, 24.8, 50.0, and 100.1 parts per billion [ppb]) for these analyses; the ketones were calibrated at 4.14, 9.42, 24.0, 124, 250, and 501 ppb, and a small sub-set of the analytes were also analyzed at a seventh concentration level (0.405 ppb) but reported with the same reporting limit. The Method 524.2 IC was performed at five concentration levels (0.476, 2,10, 20, and 30 ppb); the ketones were calibrated at 2.38, 10, 50, 100, and 150 ppb.

Manual integrations were performed on some target compounds in the ICs, CCs, spiked analyses and field samples within this data set. Both the automated and manually integrated ion chromatograms were present within the data packages, and all manual integrations were identified with the analyst's name, the date, and the reason for the change, and all appear acceptable.

All % RSDs for both ICs were below the maximum limit (30%) specified by Region I, and all RRF's were above the 0.05 minimum technical criterion, with the following exception for the Method 524.2 IC:

Table 2. Initial Calibration Exceedances

Instrument	IC	Average RRF
		2-butanone
CHL (524.2)	10/23/15	0.0230

Pursuant to the Region I validation document, results for 2-butanone in all samples analyzed by Method 524.2 in this data set warranted rejection (R) based on the low average RRF achieved. However, 2-butanone was spiked at a concentration of 10 µg/L (twice the reporting limit) in the matrix spikes, matrix spike duplicates, laboratory control samples, and laboratory control sample duplicates for Method 524.2 in this data set, and acceptable recoveries for this compound were achieved in these analyses. Therefore, results for 2-butanone were not qualified on the basis of the low RRFs in the associated IC on this instrument.

An ICV was analyzed immediately after each IC, as required, and recoveries were correctly calculated and accurately reported as percent differences (%D) in the data packages. All percent differences in the ICVs were within laboratory established control limits (±25 %D for Method 8260B and ±30 %D for Method 524.2), and Region 1 limits (±25 %D) for continuing calibrations.

IV. Continuing Calibration (CC)

Six continuing calibration (CC) standards were analyzed in support of the Method 8260B sample analyses, and one CC standard was analyzed in support of the Method 524.2 sample analyses reported in this data set. Documentation of the CC standards was present in the data packages and RRF as well as percent difference (%D) values were correctly calculated and accurately reported on the Form VII summaries within the data packages, although the same minor discrepancies noted for the Method 8260B IC calculations were also encountered.

The maximum limit for %D in the CC standard allowed by Region 1 is ±25%, and the laboratory's Method 8260B acceptance criteria is ±20 %D. All %D results were below these limits for the CC standards analyzed by Method 8260B with the following exceptions:

- acetone exhibited a -40.3, -32.2, -36.9, and -21.1 %D in the CC standards analyzed on 10/27/15 at 15:05, on 10/28/15 at 9:30 and at 17:45, and on 10/30/15 at 08:51;
- 2-butanone exhibited a -22.7 %D in the CC analyzed on 10/27/15 at 15:05; and
- bromomethane exhibited a -23.0 %D in the CC analyzed on 10/30/15 at 8:51.

All RRFs were above the 0.05 minimum criterion in all CC standards for Method 8260B.

All %D results were below ±25% for the CC standards analyzed by Method 524.2; the laboratory's acceptance criteria is ±30 %D.

All RRFs for Method 524.2 CC standards were above the 0.05 minimum criterion with the exception of 2-butanone (0.0216) in the CC standard analyzed on 10/29/15.

On the basis of the unacceptable %D values outside the criteria established by Region 1 in the associated CC standards, results for acetone in samples SS-5, SEEP-1A, W-SEEP, SS-Z, SP-3MW, SP-4, PZ-102, PZ-101, W-19, W-25, MW-50, MW-E, W-20, W-1, MW-D, W-Z, TB-5, FB-6, MW-S1, MW-PLX, MW-PL2, and MW-PL1 were qualified as estimated (UJ). On the basis of the unacceptable %D value in the associated CC standards, results for bromomethane in samples FB-3, BRW-2, and MW-3D warrant qualification as estimated (UJ); however, these values are within the Region 1 criteria, so no qualifications were applied. For the reasons discussed in Section III, no results for 2-butanone were qualified on the basis of the low RRFs in the associated ICs and CC.

It should be noted that negative % difference values will result in a low bias for positive detects, and a positive % difference will result in a high bias for positive detects.

V. Blanks

Results for seven (7) water-matrix laboratory method blanks (MBs) were reported in support of the Method 8260B and results for one water-matrix MB were reported in support of the Method 524.2 sample analyses. No target compounds were detected in any MB for either method with the following exceptions:

Table 3. Method Blank (MB) Detections

Method Blank ID	Analyte	Concentration (ug/L)	Reporting limit (ug/L)	Action limit (ug/L)
Method 8260B				
MB 200-95910	vinyl chloride	0.265	1.0	1.3
MB-200-96105	methylene chloride	0.24	1.0	see VHBLK0130193-44

Five trip blanks (TBs) were reported in these SDGs; three for Method 8260B analysis and two for Method 524.2 analysis. No target compounds were detected in any TB in this sample set with a single exception:

- chloromethane was detected at 0.12 ug/L in TB-1 by Method 524.2 analysis (action limit: see VHBLK0130259-48).

It should be noted that this trip blank was in a cooler with both potable and non-potable samples, and therefore was properly analyzed by Method 524.2.

Six field blanks (FBs) were reported in these SDGs; four were analyzed by Method 8260B and two by Method 524.2. No target analytes were detected in any FB with the following exceptions:

Table 4. Field Blank (FB) Detections

Field Blank ID (Method)	Analyte	Concentration (ug/L)	Reporting limit (ug/L)	Action limit (ug/L)
FB-2 (8260B)	vinyl chloride	0.268	1.0	See MB 200-95910
FB-5 (524.2)	chloroform	0.125	0.5	see discussion below

Seven holding (storage) blanks (HBs) were reported in these SDGs; five were stored with non-potable aqueous and solid samples and analyzed by Method 8260B, and two were stored with potable water samples and analyzed by Method 524.2. No target analytes were detected in any HB for either method with the following exceptions:

Table 5. Holding Blank (HB) Detections

Field Blank ID	Analyte	Concentration (ug/L)	Reporting limit (ug/L)	Action limit (ug/L)
Method 8260B				
VHBLK0130193-12	vinyl chloride	0.25	1.0	See MB 200-95910
VHBLK0130193-13	vinyl chloride	0.25	1.0	See MB 200-95910
Method 524.2				
VHBLK0130193-44	methylene chloride	0.41	0.5	4.1
VHBLK0130259-48	chloromethane	0.25	0.5	1.2

It should also be noted that a false positive for chloroform at 0.34 ug/L was reported in the performance evaluation (PES) sample (Method 524.2) analyzed at 100%, and reported at 0.27 ug/L in a 50% analysis of this sample; chloroform was also reported at slightly lower concentrations in several field samples in this analytical window. It should also be noted that because methylene chloride is recognized as common laboratory contaminant, its action limit is ten times the highest amount found in associated blanks.

On the basis of laboratory contamination exhibited in method and storage blanks, results for vinyl chloride in BRW-1, BRW-3, MW-102D, MW-102S, MW-101S, MW-101DR, MW-Z, MW-3S, MW-4S, MW-4D, and MW-25884 (range: 0.23 – 0.30 ug/L) were qualified as less than the quantitation limit (U). Since methylene chloride was not reported in any associated field sample analyzed by Method 8260B, and chloromethane was not reported in any associated field sample analyzed by Method 524.2, no results for methylene chloride or chloromethane required qualification on the basis of laboratory contamination as evidenced by MB 96105 (Method 8260B) or VHBLK0130259-48 (Method 524.2). On the basis of laboratory contamination as evidenced by the false positive in the PES analysis, results for chloroform in WP-5, WP-7, and WP-13 (range: 0.09 – 0.14 ug/L) were qualified as less than the quantitation limit (U). Contaminants reported in field blanks (trip blanks and field blanks) are not qualified.

VI. Surrogate Compounds

Percent recoveries (%R) for all surrogate compounds in Method 8260B were correctly calculated, accurately reported on the Form II summaries within the data packages, and were within acceptance limits for all sample analyses, with the exception that samples LCS 200-96179, LCSD 200-96179, and the dilution analyses of samples MW-101DR and MW-Z were not fortified with the surrogate standard solution due to analytical error. Since almost all other spiked analytes and the internal standards were recovered within acceptance criteria in the LCS and LCSD analyses, these analyses were otherwise demonstrably within control; the dilution analyses exhibited good comparability to the undiluted analyses; and surrogate recoveries were within acceptance criteria in all other analyses within the analytical batch; therefore, on the basis of professional judgment, no qualifications were applied due to the failure to spike these four analyses with surrogate standards. However, the analytical carelessness exhibited in the failure to spike these four samples, and the failure to note this occurrence and immediately rectify it with appropriate reanalyses, is unacceptable.

Surrogate recoveries were reported for Method 524.2 analysis in the internal standard summary reports in the "Organic Sample Data" sections of the data packages. The laboratory SOP includes four surrogate compounds, and these were present in all sample analyses; however, they were reported in the same manner as internal standard compounds (on the Form VIII).

The surrogate compounds in the Method 524.2 sample analyses were evaluated from the Form VIII area responses using the acceptance criteria established by the laboratory SOP (±50 % of the area response in the associated continuing calibration standard). The laboratory SOP also defines recovery criteria relative to the associated initial calibration (±50 % of the ion area for that analyte in the IC; it is not specified in the SOP whether that is average area or from the mid-point of the initial calibration).

All surrogate recoveries in samples analyzed by Method 524.2 were correctly calculated, accurately reported on the Form VIII summaries within the data packages, and were within acceptance limits for all sample analyses, with the exception of sample WP-7, which exhibited a very low recovery

(12.4%) for surrogate toluene-d_8. The validator examined the raw data for the analysis, and could find no evidence of a matrix effect.

On the basis of the unacceptably low recovery for surrogate toluene-d_8, results for trichloroethene, 1,2-dichloropropane, dichlorobromomethane, cis-1,3-dichloropropene, 4-methyl-2-pentanone, toluene, trans-1,3-dichlroopropene, 1,1,2-trichlorethane, tetrachloroethene, 2-hexanone, and dibromochloromethane in WP-7 were qualified as estimated (J, UJ).

VII. Internal Standards (IS)

All IS areas and retention times (RT) were within the established QC limits for all reported sample analyses in these data packages for both 8260B and 524.2 analysis.

VIII. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Samples MW-4S, SS-5, W-1, and MW-S1 were used for the Method 8260B MS/MSD analyses in this data set, and samples WP-8 and SHIELDS were used for the Method 524.2 MS/MSD analyses. The spiking solution for Method 8260B contained all target compounds at 0.827 µg/L (except for the ketones at 4.14 µg/L), which is at the concentration of the low standard of the IC, although it is significantly below the actual reporting limit used for this method (1 ug/L). The spiking solution for Method 524.2 contained all target compounds at 2 ug/L (10 ug/L for the ketones) , which is four times the reporting limit. The Field-Laboratory Coordination Memorandum (FLCM) for this project requires that the spiking solution for both methods use a base concentration of 1 ug/L (ketones at five ug/L). Percent recoveries (%R) and relative percent differences (%RPD) between paired recoveries were correctly calculated and accurately reported on the Form III summaries for the spiked analytes.

All recoveries were acceptable (range 60 – 125 %R; overall laboratory-established control limits: 15 – 200 %R; Region 1 limits 60 – 140 %R) and reproducible (range: 0 - 30%; limit 30% RPD), with the following exceptions:

Table 6. Matrix Spike/Matrix Spike Duplicate Exceedances

Parent Sample	Analyte	Native Conc. (ug/L)	% R (MS)	% R (MSD)	Laboratory Limits (%R)	% RPD
WP-8	bromomethane	0.26	61	a	70 - 130	**31**
MW-4S	vinyl chloride	nd	62	73	80 – 130	a
	bromomethane	nd	**58**	**58**	60 - 120	a
	cis-1,3-dichloropropene	nd	a	76	80 – 125	a
	trans-1,3-dichloropropene	nd	a	72	80 – 125	a
	tetrachloroethene	2.2	a	**57**	80-120	a
	2-hexanone	nd	a	73	75-150	a
	dibromochloromethane	nd	a	76	80-125	a
	ethylbenzene	nd	a	79	80-125	a
	o-xylene	nd	a	77	80-120	a
	styrene	nd	a	77	80-120	a
	bromoform	nd	a	75	80-120	a
SS-5	chloromethane	nd	64	a	65-120	a

Parent Sample	Analyte	Native Conc. (ug/L)	% R (MS)	% R (MSD)	Laboratory Limits (%R)	% RPD
	cis-1,2-dichloroethene	0.95	71	79	80-125	a
	trans-1,2-dichloroethene	nd	78	a	80-120	a
W-1	trichloroethene	5.1	125	a	75-120	a
	tetrachloroethene	23	138	**171**	80-120	a
MW-S1	chloromethane	nd	62	63	65-120	a
	bromomethane	nd	**56**	**42**	60-120	a

nd = not detected a = acceptable
Results exceeding both laboratory and Region I limits are shown in **boldface**.

Since the Method 8260B samples were spiked at a concentration less than four times the native concentration for tetrachloroethene in samples W-1 and MW-4S, no qualifications were necessary on the basis of the unacceptable recoveries of this compound in the associated MS and/or MSD analyses outside the Region 1 acceptance limits. No qualifications were deemed necessary for recoveries of the analytes shown outside laboratory-established limits but within Region 1 limits in the MS and/or MSD analyses of samples WP-8, MW-4S, SS-5, W-1, and MW-S1.

On the basis of the unacceptable precision between the associated MS and MSD analyses, results for bromomethane in WP-8 were qualified as estimated (UJ). On the basis of the unacceptably low recoveries below the lower Region 1 limit of bromomethane in the MS and MSD analyses of MW-4S and MW-S1, results for bromomethane in MW-4S and MW-S1 were qualified as estimated (UJ).

All analytes were spiked into the MS/MSD analyses; therefore non-spiked target compounds could not be evaluated against the parent samples to evaluate laboratory precision.

IX. Field Duplicates

SDG Nos. BRES61, UNIF54, and WHEA21 contained five groundwater field duplicate pairs for Method 8260B and two drinking water field duplicate pairs analyzed by Method 524.2, which were identified by the field sampler as follows:

Table 7. Field Duplicate Identifications

Field Sample	Field Duplicate
Method 8260B	
MW-101DR	MW-Z
MW-25884	BRW-Z
MW-D	W-Z
W-SEEP	SS-Z
MW-PL1	MW-PLX
Method 524.2	
SHIELDS	WELL-Z
WP-3	WP-Z

Tetrachloroethene, trichloroethene, and cis-1,2-dichloroethen were detected at greater than twice the quantitation limit in MW-101DR, MW-D, and W-Z by Method 8260B, and tetrachloroethene was detected at greater than twice the quantitation limit in MW-PL1 and MW-PLX. Trichloroethene was detected at greater than twice the quantitation limit in WP-3 and WP-Z by Method 524.2.

Trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, and vinyl chloride were reported below the quantitation limit in one or both of samples MW-25884 and BRW-Z; trans-1,2-dichloroethene and vinyl chloride were reported below the quantitation limit in MW-101DR and MW-Z; trichloroethene was detected below the quantitation limit in MW-PL1 and MW-PLX; trans-1,2-dichloroethene was detected below the quantitation limit in MW-D and W-Z; and carbon disulfide and cis-1,2-dichloroethene were detected below the quantitation limit in WP-3 and WP-Z. No target analytes were detected in samples SHIELDS, WELL-Z, W-SEEP, and SS-Z and no other target compounds greater than 2 times the quantitation limit were detected in these samples, so precision could not be evaluated for any other analytes in these field duplicate pairs.

The original analyses of samples MW-101DR and MW-Z resulted in detection of tetrachloroethene outside the linear calibration range of the instrument, and these samples were reanalyzed at a dilution to bring tetrachloroethene within the calibrated linear range. However, these analyses were performed outside of holding time, and all detected analytes exhibited lower concentrations in the dilution analyses. As discussed previously, these dilution analyses were disregarded for the validation effort. Sample BRW-Z was also analyzed outside of holding time, but since this analysis was the only one performed, it had to be used.

Precision in the field duplicate pairs MW-25884 and BRW-Z, MW-C and W-Z, MW-PL1 and MW-PLX, SEEP-1A and SS-Z, MW-101S and MW-Z, WP-3 and WP-Z, and SHIELDS and WELL-Z was acceptable (less than 30 % RPD) for all target analytes greater than 2 times the quantitation limit.

X. Sensitivity Check

The aqueous MDL and verification studies submitted for Method 8260B were performed in October, 2014, which is approximately one year prior to these analyses. The Limit of Quantitation (LOQ) values are verified on a quarterly basis, and checked during on-site assessments performed by NELAP and Department of Defense assessors. All project analytes in this study had calculated MDL values below the method quantitation limits and verified, acceptable LOQ values.

The aqueous MDL and the verification studies for Method 524.2 submitted for this project were completed on 4/2/15, which is within one year prior to the sample analyses in this data set. All analytes had calculated and verified MDLs below the method quantitation limits in these MDL studies.

Current verification studies have not been requested for either method. All of the laboratory control samples and the MS and MSD analyses analyzed with the samples for Method 8260B were spiked below 1 µg/L (ketones at 4 µg/L), and at 2 ug/L (ketones at 10 ug/L) for Method 524.2. Recoveries within or above Region 1 acceptance criteria (60 – 140 %R) were obtained for all target analytes in all spiked analyses (except as noted). In addition, the low standard of the initial calibrations for both methods supports the reporting limit for the sample analyses.

On the basis of acceptable recoveries in low-concentration laboratory control samples, and the low standard of the initial calibrations at the reporting limit, sensitivity for both methods was deemed acceptable for the purposes of this monitoring program.

XI. Performance Evaluation (PE) Samples/Accuracy Check

Five zero blind PE samples (commonly known as laboratory control sample, LCS) and

duplicate (LCSD) pairs were prepared and analyzed by the laboratory at 0.827 µg/L (ketones at 4.14 ug/L) in support of the Method 8260B sample analyses, and two LCS and LCSD pairs were prepared and analyzed at 2 ug/L (ketones at 10 ug/L) in support of the Method 524.2 sample analyses in this data set. Laboratory established control limits are 15 – 200 %R (overall) for Method 8260B, and 70 - 130 %R for every analyte for Method 524.2; the Region 1 control limits are 60 – 140 %R. The laboratory limit of 30 %RPD is shown on the Form III summaries for Method 8260B analyses, and a 20 %RPD limit is shown on the Form III summaries for the Method 524.2 paired analyses; the Region 1 limit for paired aqueous analyses is 30 %RPD.

Percent recoveries were correctly calculated and accurately reported on Form III summaries in the data packages, and were acceptable (68 – 132 %R for Method 8260B, and 84 - 123 %R for Method 524.2) and reproducible (0 - 22 %RPD across both methods) with the following exceptions:

Table 8. LCS/LCSD Exceedances

Batch ID (date)	Analyte	LCS %R	LCSD %R	Laboratory Limits (%R)	% RPD
Method 524.2					
200-95962 (10/23/15)	bromomethane	61	a	70 - 130	**31**
Method 8260B					
200-95765 (10/20/15)	chloromethane	138	a	65 - 120	**43**
	bromomethane	**174**	**159**	65 - 120	a
	carbon disulfide	127	a	80 - 120	a
200-95910 (10/22/15)	bromomethane	123	a	65 - 120	a
	methylene chloride	121	a	80 - 120	a
200-96141 (10/28/15)	chloroethane	a	131	80 - 130	a
200-96179 (10/28/15)	bromomethane	a	123	60 - 120	a
200-96256 (10/30/15)	chloromethane	60	a	65 - 120	**43**

a = acceptable
Results exceeding both laboratory and Region I limits are shown in **boldface**.

No reanalysis was performed for the recoveries outside the acceptance limits in any of the LCS/LCSD pairs. For Method 524.2, since the reported recoveries were within Region 1 limits, no results were qualified for the recovery slightly below the lower laboratory control limits in the LCS analysis on 10/23/15, and for Method 8260B, no results were qualified for the recoveries slightly above laboratory control limits in the LCS or LCSD analyses on 10/20/15, 10/22/15, and 10/28/15, or for the recovery slightly below the laboratory lower control limit in the LCS analysis on 10/30/15.

Since bromomethane was not detected in associated samples, no results required qualification on the basis of recoveries above both laboratory and Region 1 limits in the associated LCS and/or LCSD analyses on 10/20/15 for Method 8260B.

On the basis of the unacceptable precision in the associated Method 524.2 LCS and LCSD sample analyses on 10/23/15, results for bromomethane in TB-1, SHIELDS, WELL-Z, and FB-1 were qualified as estimated (UJ). On the basis of unacceptable precision in the associated Method 8260B LCS and LCSD sample analyses on 10/20/15 and 10/30/15, results for chloromethane in TB-2, MW-103RD, MW-104S, MW-104D, FB-3, MW-3D, and BRW-2 were qualified as estimated (UJ).

One external single-blind PES sample for Method 524.2 was submitted with the samples in this sampling round. It was initially analyzed at a two-fold dilution on the basis of screening results. The analyst determined that the dilution was not necessary, and immediately reanalyzed the PES at

100%; however, this analysis was performed 7 minutes after the 12-hour analytical window ended. Since the mass calibration (instrument tuning) of the instruments used now is much more stable than for the instruments available when these methods were first written, analysis a few minutes after the 12-hour period may be considered acceptable by professional judgment if all other indicators of system performance are stable. However, the validator examined the results of both the diluted and undiluted analyses of the PES, and found insignificant differences in these results. Therefore, the 100% analysis outside the analytical 12-hour window was disregarded for the remainder of the validation. The laboratory should note that the 12-hour window is a method compliance issue, and that analyses outside of the window are non-compliant.

The results of the two-fold dilution of the PES are summarized in Appendix C. All spiked compounds were within the vendor's published QC Performance Acceptance Limits (three standard deviations). One target analyte not added by the vendor, chloroform, was reported in the analysis of the PES, at a concentration below the quantitation limit (0.34 ug/L). The method blank, as well as samples WP-5, WP-7, and WP-13, which were also analyzed in this analytical window all had positive detections for chloroform below this value. The validator believes the presence of chloroform in all these analyses as well as the false positive in the PES is due to laboratory contamination.

XII. Target Compound Identification

Reported target compounds were correctly identified with supporting spectra present for all samples in these data packages.

XIII. Compound Quantitation and Reported Quantitation Limits

Target compound quantitation and practical quantitation limits (PQLs) were accurately reported on the Form I summaries. Samples MW-D and W-Z were initially analyzed at a two-fold dilution on the basis of screen results, and due to analytical error, these analyses were performed just after midnight on the first day outside of the technical holding time. Reanalysis at 100% is not required by the FLCM for dilutions less than four-fold if the most concentrated analyte falls above one-half the highest calibration standard. Sample W-Z meets this criterion, but sample MW-D does not. A reanalysis of MW-D at 100% should have been performed to meet FLCM requirements, since tetrachloroethene was detected at 47.7 ug/L on-column, and the high standard is 100.1 ug/L on-column. All results in MW-D and W-Z were previously qualified for analysis outside the technical holding time.

Sample MW-103RD was received with a significant amount of sediment in the sample bottles. The laboratory transferred the aqueous layer above the sediment to a new sample bottle, but to completely fill the bottle and prevent the formation of an air pocket (head space) in the container, it was necessary to add laboratory reagent water also. This produced an effective dilution of 1.2-fold. All target analytes were non-detect in this analysis. The presence of sediment in the sample bottle, and the transfer and dilution process all present opportunities for loss of volatile components, and on the basis of professional judgment, all results in MW-103RD were qualified as estimated (UJ).

Samples MW-101DR, MW-Z, and MW-3S were initially analyzed at 100%, and tetrachloroethene was detected slightly above the established linear calibration range in these analyses. The samples were reanalyzed at a two-fold dilution to bring tetrachloroethene within the calibration range; however, all of these dilutions were accomplished one or two days outside of the technically

acceptable holding time, and samples MW-101DRDL and MW-ZDL were also not spiked with the surrogate standard solution. The validator examined all results, and found that vinyl chloride was present in all three initial analyses (although it was previously qualified as a laboratory contaminant in these analyses) but vinyl chloride was not detected in any dilution analyses; additionally, almost all other analytes exhibited decreases in reported concentrations. On the basis of professional judgment, the validator disregarded the dilution analyses MW-101DRDL, MW-ZDL, and MW-3SDL performed out of holding time as providing less accurate results than the original analyses. On the basis of results above the established calibration range, results for tetrachloroethene in MW-101DR, MW-Z, and MW-3S were qualified as estimated (J).

One or more manual integrations were performed on field samples and spiked analyses. The manual integrations appear to be correctly performed, are initialed by the analyst, and are accurately reported with the final area listed on the tabular report and the before and after ion chromatograms included in the data packages.

The laboratory appropriately applied "J" qualifiers to the sample Form I's when the concentration of an analyte was less than the sample-specific PQL. The validator did not remove these qualifiers.

The values that the validator has judged to be acceptable are presented in the "Validated_Value" column in the Data Summary Table in Attachment A and in the spreadsheet summary files submitted electronically as Attachment B. The final qualifiers based on the validation effort are presented in the "Validator_Qualifier" column in the Data Summary Table and in the spreadsheet summary files. All results, positive and non-detect, are listed in the these summaries, whether or not the value or qualifier was changed as a result of the validation; if a value or qualifier was changed, this is indicated by the "Y" (for yes) notation in the column "Validator_Change" in the Data Summary Table. Sample-specific (practical) quantitation limits (PQL) are given in the summaries.

All laboratory-specific qualifiers, such as the asterisk (*), have been removed by the validator. This is not noted as a validation change.

XIV. Tentatively Identified Compounds (TICs)

Evaluation of unidentified, non-target analyte peaks was not requested or performed for these samples.

XV. System Performance

The analytical systems appear to have been operating well at the time of these analyses based on the evaluation of the available raw data, with the exceptions noted above, and also with the exception of potential carryover. As required y the FLCM and good laboratory practices, analytical windows should be constructed so as to analyze from the least concentrated to the most concentrated samples to minimize the opportunity for carryover. Typically the laboratory only has screen results to make these decisions, but this project also provides extensive site history and predicts the expected relative sample concentrations. Using this information would prevent many of the reanalyses and analytical issues encountered with this sample set.

The analytical windows on 10/22/15 (SDG BRES61), 10/27/15 and 10/28/15 (UNIF54) exhibit improper sequencing of sample analyses. On 10/22/15, sample MW-101DR, which is known to be a moderate concentration well, and which screened as requiring a dilution, was analyzed prior to MW-Z, MW-4S, MW-4D, MW-3S, and the MS and MSD analyses of MW-4S. Screen results for MW-4S and MW-4D indicated that high concentrations of tetrachloroethene were not present in these samples. Both MW-101DR and MW-Z had detected results for tetrachloroethene above the linear calibration range, as predicted by screen results. An instrument blank following every expected high-concentration analysis would have prevented the need to reanalyze samples MW-4S, MW-4D, and the matrix spike analyses, all of which were performed outside of holding time. On 10/28/15, samples MW-D and W-Z, both of which had high screen results were analyzed sequentially. An instrument blank was analyzed after W-Z but should also have been analyzed between these analyses, and submitted with the data package to demonstrate instrument cleanliness. Since these were field duplicates, no qualifications in W-Z were necessary on the basis of possible or suspected carryover.

XVI. Overall Evaluation of Data

Results for volatile organic compounds were determined to be valid as reported for all samples in SDG Nos. BRES61, UNIF54, and WHEA21, with the following exceptions:

- Due to analysis 15-18 days following sample collection, results for all analytes in MW-3D, FB-3, BRW-Z, MW-D, and W-Z were qualified as estimated (J, UJ). Results for all analytes in the dilution analyses MW-101DRDL, MW-ZDL, and MW-3SDL, and reanalyses MW-4SRE and MW-4DRE warrant qualification as estimated (J, UJ); however, since only small differences (all losses) in concentration for detected analytes were determined in the analyses out of holding time, it is the professional judgment of the data validator that the initial analyses within holding time are preferable, and these dilution and re-analyses were disregarded for the remainder of the validation effort.

- On the basis of the unacceptable %D values outside the criteria established by Region 1 in the associated CC standards, results for acetone in the Method 8260B analyses of samples SS-5, SEEP-1A, W-SEEP, SS-Z, SP-3MW, SP-4, PZ-102, PZ-101, W-19, W-25, MW-50, MW-E, W-20, W-1, MW-D, W-Z, TB-5, FB-6, MW-S1, MW-PLX, MW-PL2, and MW-PL1 were qualified as estimated (UJ). On the basis of the unacceptable %D value in the associated CC standards, results for bromomethane in samples FB-3, BRW-2, and MW-3D warrant qualification as estimated (UJ); however, these values are within the Region 1 criteria, so no qualifications were applied.

- On the basis of laboratory contamination exhibited in method and storage blanks, results for vinyl chloride in BRW-1, BRW-3, MW-102D, MW-102S, MW-101S, MW-101DR, MW-Z, MW-3S, MW-4S, MW-4D, and MW-25884 (range: 0.23 – 0.30 ug/L) were qualified as less than the quantitation limit (U). Since methylene chloride was not reported in any associated field sample analyzed by Method 8260B, and chloromethane was not reported in any associated field sample analyzed by Method 524.2, no results for methylene chloride or chloromethane required qualification on the basis of laboratory contamination as evidenced by MB 96105 (Method 8260B) or VHBLK0130259-48 (Method 524.2). On the basis of laboratory contamination as evidenced by the false positive in the PES analysis, results for chloroform in WP-5, WP-7, and WP-13 (range: 0.09 – 0.14 ug/L) were qualified as less than the quantitation limit (U). Contaminants reported in field blanks (trip blanks and field blanks) are not qualified.

- On the basis of the unacceptably low recovery in WP-7 for surrogate toluene-d_8, results for trichloroethene, 1,2-dichloropropane, dichlorobromomethane, cis-1,3-dichloropropene, 4-methyl-2-pentanone, toluene, trans-1,3-dichlroopropene, 1,1,2-trichlorethane, tetrachloroethene, 2-hexanone, and dibromochloromethane in WP-7 were qualified as estimated (J, UJ).

- On the basis of the unacceptable precision in the associated Method 524.2 LCS and LCSD sample analyses on 10/23/15, results for bromomethane in TB-1, SHIELDS, WELL-Z, and FB-1 were qualified as estimated (UJ). On the basis of unacceptable precision in the associated Method 8260B LCS and LCSD sample analyses on 10/20/15 and 10/30/15, results for chloromethane in TB-2, MW-103RD, MW-104S, MW-104D, FB-3, MW-3D, and BRW-2 were qualified as estimated (UJ).

- On the basis of the unacceptable precision between the associated MS and MSD analyses, results for bromomethane in WP-8 were qualified as estimated (UJ).

- On the basis of the unacceptably low recoveries below the lower Region 1 limit of bromomethane in the MS and MSD analyses of MW-4S and MW-S1, results for bromomethane in MW-4S and MW-S1 were qualified as estimated (UJ).

- The presence of sediment in the sample bottle, and the transfer and dilution process all present opportunities for loss of volatile components, and on the basis of professional judgment, all results in MW-103RD were qualified as estimated (UJ).

- On the basis of professional judgment, the validator disregarded the dilution analyses MW-101DRDL, MW-ZDL, and MW-3SDL performed out of holding time as providing less accurate results than the original analyses.

- On the basis of results above the established calibration range, results for tetrachloroethene in MW-101DR, MW-Z, and MW-3S were qualified as estimated (J).

- The laboratory appropriately applied "J" qualifiers to the sample Form I's when the concentration of an analyte was less than the sample-specific PQL. The validator did not remove these qualifiers.

- All laboratory-specific qualifiers, such as the asterisk (*), have been removed by the validator.

Documentation problems observed in the data packages are described in Section XVII.

XVII. Documentation

Chain-of-custody (COC) and internal chain of custody (ICOC) records were present and completed accurately, with the following exceptions:

- The chain of custody document provided by email and available on the laboratory's customer file server for samples received on 10/15/15 and identified by the laboratory designation 200-30270 was not included in the data package for SDG No. UNIF54. It is

included in this report in Attachment D, and should be maintained with the data packages.

- Sample MW-103RD was originally identified as MW-103D on the Chain of Custody received on November 17, 2014. This well has been renamed MW-103RD to identify it as a re-drilled well. The correct identifier has been used throughout this report and in the EDD; sampler should also note that samples from this well have twice arrived at the laboratory exhibiting pH >2, so evaluation of sampling protocols for this well should be performed.

- Samples WP-2 and MW-D were originally logged in with incorrect identifiers due to poor legibility on sample bottle labels and the chain of custody documents. At the validator's request, the laboratory corrected these prior to analysis. The laboratory used the collection time to confirm the sample identified on the chain of custody as MW-102D but labeled as MW-104D; three bottles labeled as MW-104D had a collection time that corresponded to the time listed for MW-104D on the chain of custody. The laboratory requested clarification from the field sampler regarding the correct identifier for sample MW-102D

Data presentation was acceptable, with the following exceptions:

- The laboratory should note that analysis within the 12-hour window is a method compliance issue, and that any analyses outside of this method requirement are non-compliant.

- Samples LCS 200-96179, LCSD 200-96179, and the dilution analyses of samples MW-101DR and MW-Z were not fortified with the surrogate standard solution due to analytical error. The analytical carelessness exhibited in the failure to spike these four samples, and the failure to note this occurrence and immediately rectify it with appropriate reanalyses, is unacceptable.

- The spiking solution for Method 8260B contained all target compounds at 0.827 ug/L (except for the ketones at 4.14 ug/L), which is at the concentration of the low standard of the IC, although it is significantly below the actual reporting limit used for this method (1 ug/L). The spiking solution for Method 524.2 contained all target compounds at 2 ug/L (10 ug/L for the ketones), which is four times the reporting limit. The Field-Laboratory Coordination Memorandum (FLCM) for this project requires that the spiking solution for both methods use a base concentration of 1 ug/L (ketones at five ug/L).

- A reanalysis of MW-D at 100% should have been performed to meet FLCM requirements, since tetrachloroethene was detected at 47.7 ug/L on-column, and the high standard is 100.1 ug/L on-column.

- An instrument blank following every expected high-concentration analysis should be performed and submitted with the raw data as needed to demonstrate instrument cleanliness. Additionally, analytical windows should be constructed according to screen results and FLCM guidance.

This validation report should be considered <u>part of the data packages</u> for all future distributions of the volatiles (8260B and 524.2) analysis data.

ATTACHMENT A

DATA SUMMARY TABLE
SDG Nos. BRES61, UNIF54, and WHEA21
Volatile Organics in Water Samples