2016 Annual Monitoring Report for RCRA Waste Disposal Vault

Montague, Michigan
MID 006014906

Glenn Springs Holdings, Inc.

GHD | 2055 Niagara Falls Boulevard Niagara Falls New York 14304 USA
009970 | Report No 44 | February 2017

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1. Introduction

The following report describes the operations, maintenance, and monitoring (OM&M) activities for 2016 at the Resource Conservation and Recovery Act (RCRA) waste disposal vault (Vault) constructed at the Occidental Chemical Corporation (OCC) Site in Montague, Michigan (Site). In 1982 (revised in 2004), OCC implemented a Groundwater Quality Assessment Plan (GQAP) approved by the Michigan Department of Environmental Quality (MDEQ) for the groundwater beneath the Site (location is presented on Figure 1.1.). Glenn Springs Holdings, Inc. (GSH) is managing the corrective measures for OCC. Both GSH and OCC are wholly-owned subsidiaries of Occidental Petroleum Corporation. The GQAP consists of sampling, analysis, and statistical evaluation of both upgradient and downgradient groundwater wells installed at the Site to meet the requirements of the 30-year, post-closure groundwater monitoring plan developed and approved in accordance with 40 CFR Part 265 by the United States Environmental Protection Agency (USEPA) in 1982. The original groundwater wells and their subsequent replacements installed under the consent judgment between the State of Michigan and OCC, which resulted in the construction of the Vault, are used in the GQAP.

The monitoring network consists of 15 monitoring wells and 1 leachate sump. The monitoring wells consist of 3 upgradient wells (UG-1, UG-2, and UG-3) and 12 downgradient wells and 1 leachate sump (DG-1, DG-2U, DG-2L, DG-3, DG-4, DG-4A, DG-5U, DG-5L, DG-6U, DG-6L, DG-7U, DG-7L, and LS-1).

Modifications to the monitoring network have been made over time as described below. Originally, to sample above and below a clay layer in the lacustrine sand, the monitoring wells DG-5, DG-6, and DG-7 contained a double pump-packer system with a long-screened interval. This system allowed two depth specific samples to be taken from each of these wells. These two samples were distinguished by adding a U for the upper and an L for the lower sample to the well name (e.g., DG-6U and DG-6L). The original monitoring well DG-2 was equipped with inflatable packers; however, due to clogging by iron bacteria, DG-2 was replaced by a two-well cluster at the same location. Consistent with the original labeling, the two new wells were identified as DG-2U and DG-2L. After a confirmed statistical increase of chloroform in monitoring well DG-4, two additional wells were installed. One new well was placed north of the landfill directly upgradient of DG-4 and designated UG-3. The second new well, DG-4A, was placed adjacent to DG-4 and screened near the surface of the water table. In August 2003, new well clusters were installed to replace the packer equipped wells (DG-5, DG-6, and DG-7). Consistent with the original labeling, the six new wells were identified as DG-5U/5L, DG-6U/6L, and DG-7U/7L. At that time, all the sampling pumps and ancillary equipment were replaced with QED Well Wizard bladder pumps, to allow the use of low-flow purging and sampling techniques. These wells meet the requirements of 40 CFR 265 Subpart F groundwater monitoring.

The Vault contains hazardous wastes from the former Hooker Chemical facility previously located at the Site. Approximately 970,500 tons of waste, containing varying amounts of eight identified organic compounds (chloroform, carbon tetrachloride, trichloroethylene, perchloroethylene, hexachlorobutadiene, hexachlorocyclopentadiene, octachlorocyclopentene, and

hexachlorobenzene), were placed in the Vault. In addition, 15,200 tons of waste containing the heavy metal constituents of cadmium, chromium, and lead were also placed in the regulated unit.

This 2016 Annual Monitoring Report (AMR) presents:

1. An evaluation of the groundwater elevation and flow direction beneath the Vault
2. A summary of the analytical data collected semiannually in March and September 2016
3. A statistical analysis of the 2016 analytical data

The AMR was prepared by GHD on behalf of GSH.

2. Hydraulic Monitoring

Prior to the collection of groundwater samples, groundwater level measurements were taken in all monitoring wells. The 2016 water level data are summarized in Table 2.1.

The groundwater contours for March 30, 2016 and September 15, 2016 are shown on Figures 2.1 and 2.2, respectively. The pattern of flow on both figures is essentially the same. Examination of the figures shows that groundwater flow is in a southerly direction, consistent with historic results. The groundwater elevations also show that in 2016, seasonal water table fluctuations were less than 3.5 feet.

3. Groundwater Monitoring Program

3.1 Program Requirements

The groundwater quality assessment program for the Site requires sampling and analysis of 3 upgradient monitoring wells (UG-1, UG-2, and UG-3), 12 downgradient monitoring wells (DG-1 through DG-7), 1 leachate sump monitoring well (LS-1) (also downgradient of the Vault and directly downgradient of the leachate collection sump), and the leachate collection sump. The locations of the monitoring wells and the collection sump are shown on Figures 2.1 and 2.2.

This component of the monitoring program has been established to track the groundwater quality. To accomplish this, a monitoring program has been implemented to demonstrate that the upgradient wells remain upgradient, that the downgradient wells remain downgradient, and that the parameter concentrations in the downgradient wells remain consistent relative to their background concentrations in accordance with the approved GQAP dated September 2004. The MDNRE requires that GSH test the groundwater for the eight organic compounds (including volatile organic compounds [VOCs] and semi-volatile organic compounds [SVOCs]) and the three heavy metals listed in Section 1.0 of this report. These 11 parameters are measured semiannually. Other parameters establishing groundwater quality (chloride, iron, manganese, phenols, sodium, and sulfate) are measured annually. The sample from the leachate collection sump is analyzed for the same eight organic compounds and three heavy metals in groundwater that are analyzed semiannually.

Monitoring methods are outlined in the GQAP.

3.2 Work Performed

Semiannual chemical data for 2016 have been compiled for this AMR. GSH personnel collected all groundwater samples for chemical analysis during March 28 to 29, 2016 and September 12 to 14, 2016. Samples from the leachate sump were also collected on April 29 and October 28, 2016, also by GSH personnel. Groundwater sampling and analysis was performed in accordance with the procedures and analytical methods described in the approved GQAP and in the low-flow purging and sampling protocol of the "Groundwater Monitoring Plan for the Occidental Chemical Corporation Site in Montague, Michigan" (Earth Tech, January 2002). The 2016 groundwater analytical data are presented in Table 3.1. Samples were collected and analyzed from all upgradient wells, downgradient wells, and the leachate collection sump for the parameters listed above.

All samples were submitted to TriMatrix Laboratories, Inc. (TriMatrix), located in Grand Rapids, Michigan, and were analyzed as per the methods listed in the following table:

Table 3.1 Analytical Methods

Parameter	Analytical Method
VOCs	SW 8260B
SVOCs	SW 8121
Metals	SW 6020
Chloride	SM 4500-CL E
Phenols	SW 9065
Sulfate	EPA 375.2

Prior to sample collection, each monitoring well was purged using a dedicated bladder pump. Low-flow purging protocols were followed. During purging, stabilization parameters were measured at 5-minute intervals using a YSI 556 meter connected to a flow-through cell. The following stabilization parameters were monitored: pH, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential. Stabilization parameters were measured and recorded in the field. A summary of the final field stabilization parameters is presented in Table 3.2. Groundwater samples were collected once stabilization was achieved.

Samples were collected, handled, and documented in accordance with the GQAP. Appropriate sample volumes, container types, preservation procedures, and maximum holding times for the Site-specific analytical parameters were followed. Chain of custody protocol was strictly adhered to during all phases of sample collection, transport, and delivery to the analytical laboratory for analysis.

During 2016, the following maintenance activities were completed on the leachate collection system in order to maintain optimal operation:

- Replaced two blown fuses at the main transformers for the Leachate Collection System
- Rebuilt and repaired leachate building sump pump circuitry
- Inspected and cleaned drainage pipe

3.3 Results

The downgradient groundwater sample results discussed below are presented in Table 3.1. The upgradient sample results are discussed in Section 4.

3.3.1 March 2016 Event

No VOCs or SVOCs were detected in the vault monitoring well investigative samples or blanks from the March 2016 sampling event.

Cadmium and lead were not detected in any of the investigative samples.

Iron was detected in 3 of 12 downgradient samples collected as well as the equipment blank and 1 of 3 upgradient samples, and manganese was detected in 1 of 12 downgradient samples collected.

Sodium, chloride, and sulfate were detected in all 15 monitoring well samples submitted for analysis.

Total phenolics were not detected in any of the investigative samples.

3.3.2 September 2016 Event

No VOCs or SVOCs were detected in the investigative samples from the September 2016 sampling event.

Cadmium and lead were not detected in any of the monitoring well investigative samples; however, lead was detected in the equipment blank.

Total chromium was detected in 1 of 12 downgradient samples collected. Iron was detected in 1 of 12 downgradient samples collected as well as the equipment blank. Manganese was detected in 1 of the 12 downgradient samples but not in the equipment blank.

Sodium, chloride, and sulfate were detected in all 15 monitoring well samples submitted for analysis.

Total phenolics were not analyzed during the September 2016 monitoring event as only annual sampling of this parameter is required and samples were collected during the March 2016 event.

3.3.3 Leachate Sump

Eight out of the eight Site-specific VOCs and SVOCs were detected in the investigative samples from the leachate sump in April 2016 and eight out of eight Site-specific VOCs and SVOCs were detected in the October 2016 event.

No metals were detected in either leachate sump investigative sample in 2016, with the exception of one lead detection in the October 2016 investigative sample.

4. Statistical Comparisons vs. Upgradient Conditions

4.1 Introduction

The GQAP requires the statistical evaluation of the analytical data comparing parameter concentrations in groundwater collected in downgradient wells vs. concentrations in upgradient wells during monitoring activities for the Vault. Statistical procedures were originally specified in the January 1998 revision to the Sampling and Analysis Plan (SAP) (EarthTech, 1998). Subsequently, MDNRE requested that the original evaluation procedure (Cochran's Approximation to the Behren's-Fisher Student's t-test [CABFStt]) be replaced by the use of upper prediction limits (UPLs) in a letter dated May 28, 2003. Since that time, GSH worked cooperatively with MDNRE to develop a revised Statistical Evaluation Procedure (SEP) for the Site. A SEP revision entitled "Statistical Evaluation Procedure - Final" was submitted to MDNRE in November 2007, and approval for this was received from MDNRE in December 2007. This final SEP was applied in evaluating groundwater monitoring data at the Site.

Statistical comparisons of parameter concentrations in groundwater samples collected at downgradient wells versus upgradient wells in 2016 were performed according to the final SEP. Following the SEP methodology, individual sample results from downgradient monitoring wells collected during current sampling events are screened against UPLs generated using historical data from upgradient monitoring wells. The upgradient UPLs used are calculated from groundwater data collected since 2000 for cadmium, from 2004 to 2008 for lead, and since 2004 for total chromium. If any downgradient data from the current sampling event are found to be above the UPLs, then verification resampling is required as specified in Section 3.0 of the SEP.

4.2 2016 SEP Results

Evaluations of the March and September 2016 groundwater monitoring data using the methodology specified in the final SEP are presented in Appendix A. Based on the statistical analyses performed, observed concentrations of cadmium and total chromium were consistent with upgradient conditions represented by the UPLs calculated from historic upgradient data collected up to the end of the previous year (2013). Observed lead concentrations were consistent with upgradient conditions represented by the UPLs calculated from historic upgradient data collected up to the end of 2008.

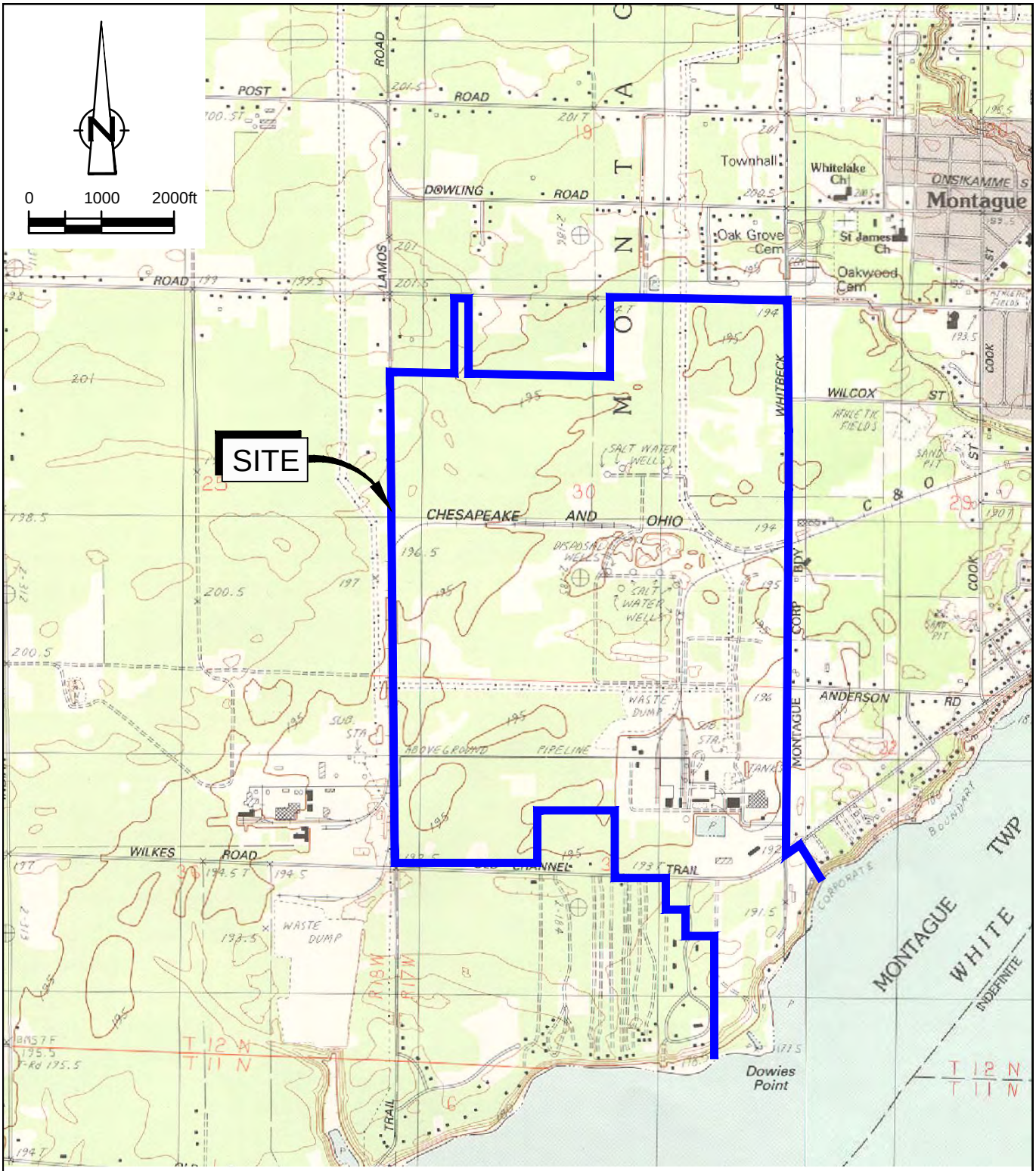
A change in laboratories to TriMatrix in 2009 resulted in the elevated reporting limits for lead from 2009 through 2016. TriMatrix reported the quantitation limit for lead (1.0 microgram per liter [µg/L]) as the reporting limit. This was performed in accordance with their contractual requirement. However, the previous laboratory (H2M) reported lower lead values using the method detection limit (less than 1.0 µg/L) as the reporting limit. In 2016, all three upgradient lead results were non-detect reported at the quantitation limit (1.0 µg/L). The use of quantitation limits (1.0 µg/L) resulted in an elevated detection limit for lead in 2016 when compared to the reported method detection limit in previous years (prior to 2009, less than 1.0 µg/L).

The 2009 through 2013 lead data are ambiguous compared to those obtained in previous years. Therefore, the 2009 through 2016 data were not used to update the UPLs. Since the reported non-detect value (1.0 µg/L) is greater than previous detected values, it is not possible to assess

whether lead concentrations have changed in the upgradient groundwater monitoring locations. Therefore, the 2008 UPL for lead was maintained for the assessment of the 2016 Vault groundwater monitoring data. The 2008 lead data will be retained until additional detected lead concentrations in upgradient wells are observed.

There were no concentrations of cadmium, total chromium, or lead present in groundwater collected from downgradient monitoring wells above the upgradient UPLs during the March and September 2016 events. Therefore, no additional action is required.

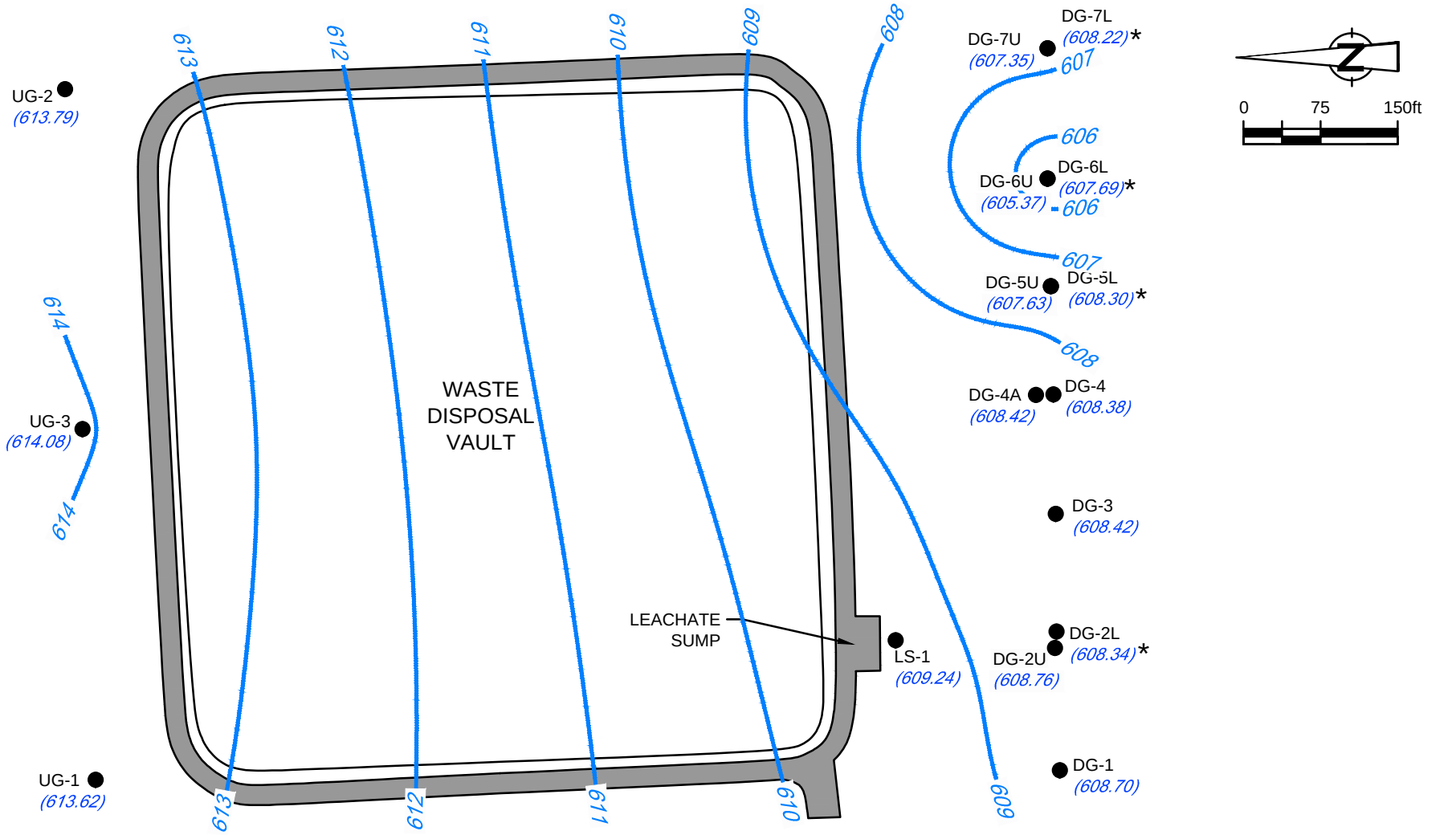
Upgradient UPLs are updated on an annual basis after verifying that current groundwater conditions in upgradient wells are consistent with historic conditions. This is done to account for possible changes in regional background conditions unrelated to operation and maintenance of the RCRA Vault. This current versus historical upgradient conditions comparison is accomplished using group-based statistical tests (as specified in Section 3.0 of the SEP) in which the six data points from the current year (three upgradient wells multiplied by two monitoring events) are tested against the historical data from the previous year back to 2000 for cadmium and back to 2004 for total chromium and lead. If no change in regional conditions is noted, the current year's upgradient data are added to the historical data set and the upgradient data UPLs updated. The final SEP specifies that if a change in regional conditions is noted, further statistical methodology would need to be developed and proposed to MDNRE to accommodate this. Comparison of the 2016 upgradient data found that the data was consistent with historic conditions for cadmium and total chromium, and as a result, the 2016 data was added to the background data set to update the calculated upgradient UPLs. The UPL for lead was not updated because the 2016 results had elevated detection limits. The updated UPLs are given in Table 4.1 and were used in assessing the 2016 semiannual groundwater monitoring data for the vault.



SOURCE: USGS QUADRANGLE MAPS;
MONTAGUE, FLOWER CREEK, AND MICHIGAN 1983

figure 1.1

SITE LOCATION
GLENN SPRINGS HOLDINGS, INC.
Montague, Michigan



LEGEND

UG-1	MONITORING WELL
(612.75)	GROUNDWATER ELEVATION (ft AMSL)
612	GROUNDWATER CONTOUR (ft AMSL)
*	NOT USED FOR CONTOURING

figure 2.1

GROUNDWATER CONTOURS
MARCH 30, 2016
GLENN SPRINGS HOLDINGS, INC.
Montague, Michigan

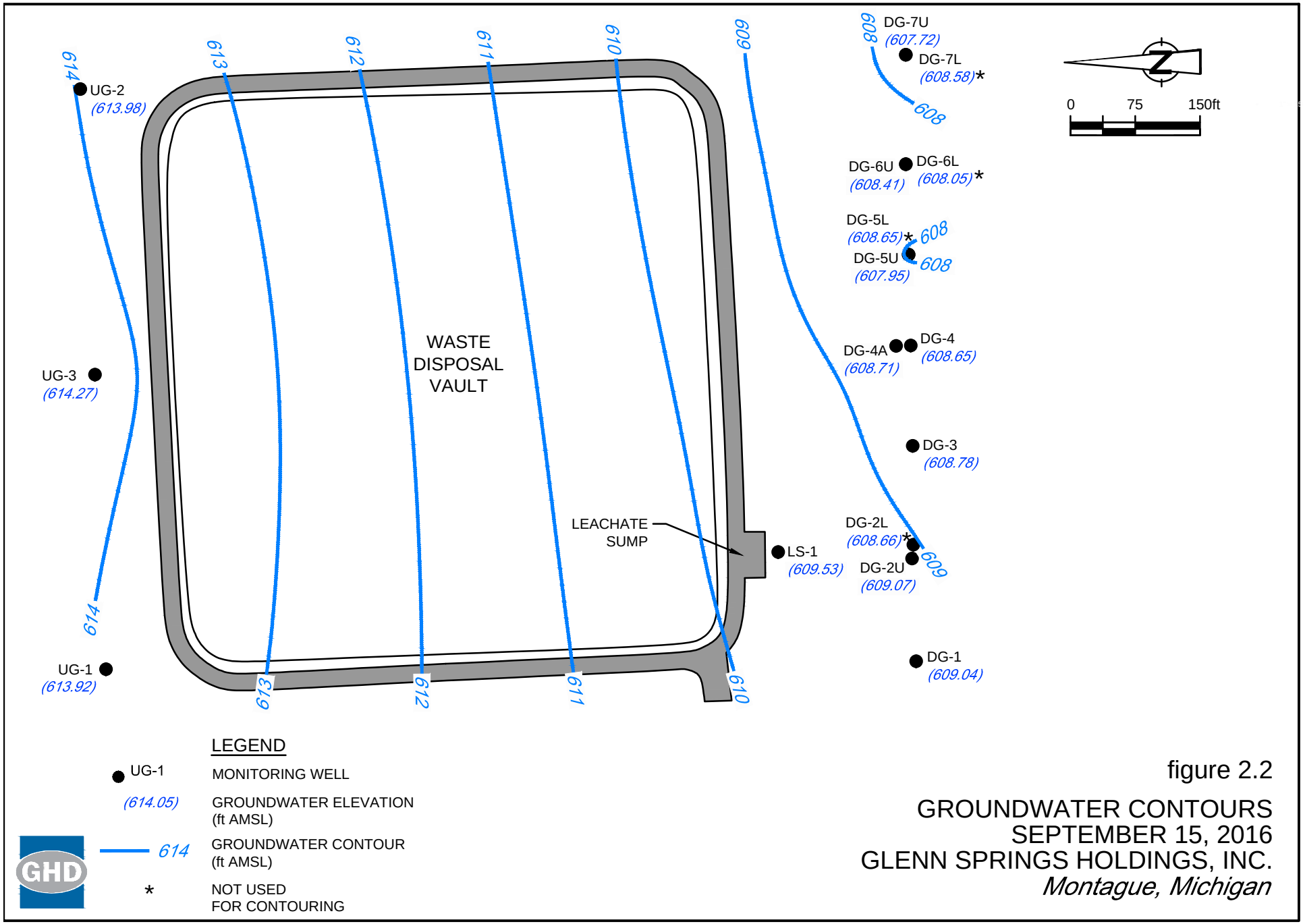


figure 2.2

GROUNDWATER CONTOURS
SEPTEMBER 15, 2016
GLENN SPRINGS HOLDINGS, INC.
Montague, Michigan

09970-D23101(044)GN-WA003 FEB 15, 2017

Table 2.1

Water Level Depths and Elevations - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

Well I.D.	Reference Elevation (Feet AMSL)	March 30, 2016		September 15, 2016	
		Depth to Water (Feet)	Elevation (Feet AMSL)	Depth to Water (Feet)	Elevation (Feet AMSL)
UG-1	645.70	32.08	613.62	31.78	613.92
UG-2	640.55	26.76	613.79	26.57	613.98
UG-3	640.22	26.14	614.08	25.95	614.27
DG-1	641.23	32.53	608.70	32.19	609.04
DG-2L	641.69	32.93	608.76	32.62	609.07
DG-2U	641.44	33.10	608.34	32.78	608.66
DG-3	639.23	30.81	608.42	30.45	608.78
DG-4	639.06	30.68	608.38	30.41	608.65
DG-4A	638.17	29.75	608.42	29.46	608.71
DG-5L	639.42	31.79	607.63	31.47	607.95
DG-5U	639.72	31.42	608.30	31.07	608.65
DG-6L	639.56	34.19	605.37	31.15	608.41
DG-6U	639.30	31.61	607.69	31.25	608.05
DG-7L	638.27	30.92	607.35	30.55	607.72
DG-7U	638.66	30.44	608.22	30.08	608.58
LS-1	639.34	30.10	609.24	29.81	609.53

Notes:

AMSL - Above Mean Sea Level

Table 3.1

Analytical Results Summary - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

		Downgradient Monitoring Wells						
Sample Location:		**DG-1**		**DG-2L**		**DG-2U**		
Sample ID:		**WG-9970-032916-JCB-DG1**	**WG-9970-091416-JCB-DG1**	**WG-9970-032816-JCB-DG2L**	**WG-9970-091316-JCB-DG2L**	**WG-9970-032816-JCB-DG2U**	**WG-9970-032816-JCB-Dup1**	**WG-9970-091316-JCB-DG2U**
Sample Date:		**3/29/2016**	**9/14/2016**	**3/28/2016**	**9/13/2016**	**3/28/2016**	**3/28/2016 (Duplicate)**	**9/13/2016**
Parameters	**Units**							
Volatile Organic Compounds								
Carbon tetrachloride	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform (Trichloromethane)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Semi-volatile Organic Compounds								
Hexachlorobenzene	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.011 U	0.011 U	0.010 U
Hexachlorobutadiene	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.011 U	0.011 U	0.010 U
Hexachlorocyclopentadiene	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.011 U	0.011 U	0.010 U
Octachlorocyclopentene	µg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.011 U	0.011 U	0.010 U
Metals								
Cadmium (dissolved)	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chromium (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Iron (dissolved)	µg/L	10 U	20 U	21	60	11	10 U	20 U
Lead (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Manganese (dissolved)	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Sodium (dissolved)	µg/L	1900	2000	3100	3200	1300	1200	1300
General Chemistry								
Chloride	µg/L	4500	5800	5200	4500	1800	1500	1400
Phenolics (Total Recoverable)	µg/L	50.0 U	-	50.0 U	-	50.0 U	50.0 U	-
Sulfate	µg/L	15000	16000	14000	13000	16000	16000	13000

Notes:

U - Parameter not detected at detection limit specified
\- - Not analyzed
[ ] - Parameter detected

Table 3.1

Analytical Results Summary - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

		Downgradient Monitoring Wells (continued)							
Sample Location:		**DG-3**		**DG-4**		**DG-4A**		**DG-5L**	
Sample ID:		**WG-9970-032816-JCB-DG3**	**WG-9970-091316-JCB-DG3**	**WG-9970-032816-JCB-DG4**	**WG-9970-091316-JCB-DG4**	**WG-9970-032816-JCB-DG4A**	**WG-9970-091316-JCB-DG4A**	**WG-9970-032916-JCB-DG5L**	**WG-9970-091416-JCB-DG5L**
Sample Date:		**3/28/2016**	**9/13/2016**	**3/28/2016**	**9/13/2016**	**3/28/2016**	**9/13/2016**	**3/29/2016**	**9/14/2016**
Parameters	**Units**								
Volatile Organic Compounds									
Carbon tetrachloride	µg/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
Chloroform (Trichloromethane)	µg/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
Tetrachloroethene	µg/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
Trichloroethene	µg/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
Semi-volatile Organic Compounds									
Hexachlorobenzene	µg/L	0.011 U	0.011 U	0.012 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U
Hexachlorobutadiene	µg/L	0.011 U	0.011 U	0.012 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U
Hexachlorocyclopentadiene	µg/L	0.011 U	0.011 U	0.012 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U
Octachlorocyclopentene	µg/L	0.011 U	0.011 U	0.012 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U
Metals									
Cadmium (dissolved)	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chromium (dissolved)	µg/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
Iron (dissolved)	µg/L	10 U	20 U	10 U	20 U	10 U	20 U	10 U	20 U
Lead (dissolved)	µg/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
Manganese (dissolved)	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Sodium (dissolved)	µg/L	4600	4500	1700	2200	1400	2200	5500	6300
General Chemistry									
Chloride	µg/L	6900	7400	2000	2400	1400	1600	12000	12000
Phenolics (Total Recoverable)	µg/L	50.0 U	-	50.0 U	-	50.0 U	-	50.0 U	-
Sulfate	µg/L	14000	14000	17000	27000	15000	48000	19000	19000

Notes:

U - Parameter not detected at detection limit specified
\- - Not analyzed
[ ] - Parameter detected

Table 3.1

Analytical Results Summary - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

		Downgradient Monitoring Wells (continued)						
Sample Location:		**DG-5U**		**DG-6L**			**DG-6U**	
Sample ID:		**WG-9970-032916-JCB-DG5U**	**WG-9970-091316-JCB-DG5U**	**WG-9970-032916-JCB-DG6L**	**WG-9970-091416-JCB-DG6L**	**WG-9970-091416-JCB-DUP2**	**WG-9970-032916-JCB-DG6U**	**WG-9970-091416-JCB-DG6U**
Sample Date:		**3/29/2016**	**9/13/2016**	**3/29/2016**	**9/14/2016**	**9/14/2016 (Duplicate)**	**3/29/2016**	**9/14/2016**
Parameters	**Units**							
Volatile Organic Compounds								
Carbon tetrachloride	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform (Trichloromethane)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Semi-volatile Organic Compounds								
Hexachlorobenzene	µg/L	0.010 U	0.010 U	0.011 U	0.010 U	0.010 U	0.011 U	0.010 U
Hexachlorobutadiene	µg/L	0.010 U	0.010 U	0.011 U	0.010 U	0.010 U	0.011 U	0.010 U
Hexachlorocyclopentadiene	µg/L	0.010 U	0.010 U	0.011 U	0.010 U	0.010 U	0.011 U	0.010 U
Octachlorocyclopentene	µg/L	0.010 U	0.010 U	0.011 U	0.010 U	0.010 U	0.011 U	0.010 U
Metals								
Cadmium (dissolved)	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chromium (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Iron (dissolved)	µg/L	10 U	20 U	10 U	20 U	20 U	10 U	20 U
Lead (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Manganese (dissolved)	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Sodium (dissolved)	µg/L	2600	2700	12000	13000	13000	8800	8600
General Chemistry								
Chloride	µg/L	3400	3700	22000	22000	21000	18000	16000
Phenolics (Total Recoverable)	µg/L	50.0 U	-	50.0 U	-	-	50.0 U	-
Sulfate	µg/L	14000	14000	21000	21000	21000	22000	20000

Notes:

U - Parameter not detected at detection limit specified
\- - Not analyzed
[ ] - Parameter detected

Table 3.1

Analytical Results Summary - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

		Downgradient Monitoring Wells (continued)						
Sample Location:		DG-7L		DG-7U		UG-1		
Sample ID:		WG-9970-032916-JCB-DG7L	WG-9970-091416-JCB-DG7L	WG-9970-032916-JCB-DG7U	WG-9970-091416-JCB-DG7U	WG-9970-032816-JCB-UG1	WG-9970-032816-JCB-Dup2	WG-9970-091316-JCB-UG1
Sample Date:		3/29/2016	9/14/2016	3/29/2016	9/14/2016	3/28/2016	3/28/2016 (Duplicate)	9/13/2016
Parameters	**Units**							
Volatile Organic Compounds								
Carbon tetrachloride	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform (Trichloromethane)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Semi-volatile Organic Compounds								
Hexachlorobenzene	µg/L	0.011 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U	0.010 U
Hexachlorobutadiene	µg/L	0.011 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U	0.010 U
Hexachlorocyclopentadiene	µg/L	0.011 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U	0.010 U
Octachlorocyclopentene	µg/L	0.011 U	0.010 U	0.011 U	0.010 U	0.010 U	0.010 U	0.010 U
Metals								
Cadmium (dissolved)	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chromium (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.1	1.0 U	1.0 U	1.0 U
Iron (dissolved)	µg/L	15	20 U	10 U	20 U	10 U	10 U	20 U
Lead (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Manganese (dissolved)	µg/L	12	12	10 U	10 U	10 U	10 U	10 U
Sodium (dissolved)	µg/L	6400	6600	7200	7800	1300	1200	1300
General Chemistry								
Chloride	µg/L	11000	11000	15000	15000	1400	1300	1600
Phenolics (Total Recoverable)	µg/L	50.0 U	-	50.0 U	-	50.0 U	50.0 U	-
Sulfate	µg/L	26000	26000	15000	17000	13000	13000	13000

Notes:

U - Parameter not detected at detection limit specified
\- - Not analyzed
[ ] - Parameter detected

Table 3.1

Analytical Results Summary - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

		Upgradient Monitoring Wells						
Sample Location:		UG-2			UG-3		LS-1	
Sample ID:		WG-9970-032816-JCB-UG2	WG-9970-091216-JCB-UG2	WG-9970-091216-JCB-DUP1	WG-9970-032816-JCB-UG3	WG-9970-091216-JCB-UG3	WG-9970-032916-JCB-LS1	WG-9970-091416-JCB-LS1
Sample Date:		3/28/2016	9/12/2016	9/12/2016 (Duplicate)	3/28/2016	9/12/2016	3/29/2016	9/14/2016
Parameters	**Units**							
Volatile Organic Compounds								
Carbon tetrachloride	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform (Trichloromethane)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Semi-volatile Organic Compounds								
Hexachlorobenzene	µg/L	0.012 U	0.012 U	0.011 U	0.011 U	0.010 U	0.011 U	0.011 U
Hexachlorobutadiene	µg/L	0.012 U	0.012 U	0.011 U	0.011 U	0.010 U	0.011 U	0.011 U
Hexachlorocyclopentadiene	µg/L	0.012 U	0.012 U	0.011 U	0.011 U	0.010 U	0.011 U	0.011 U
Octachlorocyclopentene	µg/L	0.012 U	0.012 U	0.011 U	0.011 U	0.010 U	0.011 U	0.011 U
Metals								
Cadmium (dissolved)	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chromium (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Iron (dissolved)	µg/L	16	20 U	20 U	10 U	20 U	10 U	20 U
Lead (dissolved)	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Manganese (dissolved)	µg/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Sodium (dissolved)	µg/L	990	1200	1300	990	1100	1500	1400
General Chemistry								
Chloride	µg/L	1600	1700	1500	1300	1400	1500	1400
Phenolics (Total Recoverable)	µg/L	50.0 U	-	-	50.0 U	-	50.0 U	-
Sulfate	µg/L	18000	21000	21000	10000	10000	18000	13000

Notes:

U - Parameter not detected at detection limit specified
\- - Not analyzed
[ ] - Parameter detected

Table 3.1

Analytical Results Summary - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

	Sample Location:	Leachate Sump	Leachate Sump	Equipment Blank	
	Sample ID:	LS-9970-BFB-042916	LS-9970-BFB-102816	WG-9970-050316-JCB-Dup3	WG-9970-091416-JCB-DUP3
	Sample Date:	4/29/2016	10/28/2016	5/3/2016	9/14/2016
Parameters	**Units**				
Volatile Organic Compounds					
Carbon tetrachloride	µg/L	3.2	2.6	1.0 U	1.0 U
Chloroform (Trichloromethane)	µg/L	26	20	1.0 U	1.0 U
Tetrachloroethene	µg/L	58	48	1.0 U	1.0 U
Trichloroethene	µg/L	1.2	1.1	1.0 U	1.0 U
Semi-volatile Organic Compounds					
Hexachlorobenzene	µg/L	0.58	2.1	0.011 U	0.010 U
Hexachlorobutadiene	µg/L	3.3	4.6	0.011 U	0.010 U
Hexachlorocyclopentadiene	µg/L	5.1	20	0.011 U	0.010 U
Octachlorocyclopentene	µg/L	4.5	84	0.011 U	0.010 U
Metals					
Cadmium (dissolved)	µg/L	1.0 U	1.0 U	-	0.20 U
Chromium (dissolved)	µg/L	5.0 U	5.0 U	-	1.0 U
Iron (dissolved)	µg/L			-	81
Lead (dissolved)	µg/L	5.0 U	7.4	-	18
Manganese (dissolved)	µg/L	-	-	-	10 U
Sodium (dissolved)	µg/L	-	-	-	500 U
General Chemistry					
Chloride	µg/L	-	-	1000	1000 U
Phenolics (Total Recoverable)	µg/L	-	-	-	-
Sulfate	µg/L	-	-	-	5.0 U

Notes:

U - Parameter not detected at detection limit specified
\- - Not analyzed
[ ] - Parameter detected

Table 3.2

Water Quality Field Parameter Results - 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

March 28 through 29, 2016

Well I.D.	Temperature (°Celsius)	Specific Conductivity mS/cm	Dissolved Oxygen (mg/L)	pH (s.u.)	Oxidation Reduction Potential (mV)
UG-1	8.50	0.138	0.13	6.65	-33.80
UG-2	6.00	0.207	8.76	6.60	-6.70
UG-3	8.21	0.133	5.27	7.15	-9.40
LS-1	9.67	0.241	5.22	6.65	88.90
DG-1	8.96	0.198	3.40	7.01	196.60
DG-2U	9.21	0.305	7.27	7.06	31.40
DG-2L	8.95	0.183	6.18	7.12	-8.40
DG-3	8.56	0.213	6.19	7.49	3.20
DG-4	8.33	0.276	6.20	7.16	13.40
DG-4A	8.35	0.301	6.11	7.24	19.00
DG-5U	8.40	0.186	3.70	7.65	132.20
DG-5L	8.63	0.230	0.95	7.64	127.60
DG-6U	9.16	0.261	1.16	6.72	181.70
DG-6L	9.23	0.281	1.09	7.41	149.20
DG-7U	9.01	0.247	2.78	6.80	190.10
DG-7L	9.28	0.232	0.45	7.04	166.00

September 12 through 14, 2016

Well I.D.	Temperature (°Celsius)	Specific Conductivity mS/cm	Dissolved Oxygen (mg/L)	pH (s.u.)	Oxidation Reduction Potential (mV)
UG-1	10.37	0.157	11.64	6.17	215.20
UG-2	14.74	0.290	14.13	7.00	-369.60
UG-3	11.91	0.145	9.22	6.24	-371.20
LS-1	11.81	0.236	9.04	6.54	214.80
DG-1	11.13	0.209	4.99	7.52	184.70
DG-2U	11.20	0.299	11.35	6.79	215.10
DG-2L	10.65	0.196	10.20	7.08	213.10
DG-3	10.20	0.225	9.89	7.16	212.20
DG-4	10.11	0.287	9.97	6.52	215.30
DG-4A	10.45	0.400	11.28	6.64	213.60
DG-5U	10.06	0.199	8.98	7.31	211.10
DG-5L	9.60	0.232	1.74	5.94	176.60
DG-6U	9.71	0.259	3.08	7.09	178.80
DG-6L	9.73	0.279	2.11	6.41	176.70
DG-7U	9.63	0.249	4.33	7.39	186.00
DG-7L	9.80	0.230	0.60	7.21	156.50

Notes:

s.u. - Standard Unit
mS/cm - Millisiemens per centimeter
mg/L - Milligram per liter
mV - Millivolt

Table 4.1

Upgradient Upper Prediction Limit (UPL) Update with Data through 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

Upgradient Well Name	Sampling Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-1	17-Oct-2000	ND (0.2)	--	--
UG-1	16-Dec-2000	ND (0.2)	--	--
UG-1	22-Jan-2001	ND (0.2)	--	--
UG-1	2-May-2001	ND (0.2)	--	--
UG-1	1-Nov-2001	ND (0.2)	--	--
UG-1	18-Apr-2002	0.3	--	--
UG-1	14-Oct-2002	ND (0.2)	--	--
UG-1	21-Apr-2003	0.2 U	--	--
UG-1	14-Oct-2003	0.2 U	--	--
UG-1	19-Apr-2004	0.13 U	1.6 B	1
UG-1	13-Sep-2004	0.13 B	0.60 B	0.082 U
UG-1	30-Mar-2005	0.13 U	1.2 B	0.12 B
UG-1	20-Sep-2005	0.15 U	0.15 U	0.058 U
UG-1	22-Mar-2006	0.073 U	*	0.50 B
UG-1	19-Sep-2006	0.11 U	2.1	3.7
UG-1	27-Mar-2007	0.086 U	3.8	0.2
UG-1	24-Sep-2007	0.14 U	1.2	0.18
UG-1	11-Mar-2008	0.090 U	1.5	0.12
UG-1	4-Aug-2008	0.14 U	0.12 U	0.12
UG-1	24-Mar-2009	0.20 U	1.0 U	--
UG-1	20-Oct-2009	0.20 U	1.3	--
UG-1	2-Apr-2010	0.20 U	1.0 U	--
UG-1	28-Sep-2010	0.20 U	1.1	--
UG-1	20-Apr-2011	0.20 U	1.0	--
UG-1	16-Sep-2011	0.20 U	1.0 U	--
UG-1	26-Mar-2012	0.20 U	1.0 U	--
UG-1	25-Sep-2012	0.20 U	1.0 U	--
UG-1	27-Mar-2013	0.20 U	1.0 U	--
UG-1	25-Sep-2013	0.20 U	1.0 U	--
UG-1	21-Apr-2014	0.20 U	1.0 U	--
UG-1	5-Aug-2014	0.20 U	1.0 U	--
UG-1	30-Mar-2015	0.20 U	1.0 U	--
UG-1	24-Sep-2015	0.20 U	1.0 U	--
UG-1	28-Mar-2016	0.2 U/0.2 U	1.0 U/1.0 U	--
UG-1	13-Sep-2016	0.20 U	1.0 U	--
UG-2	17-Oct-2000	ND (0.2)	--	--
UG-2	16-Dec-2000	ND (0.2)	--	--
UG-2	22-Jan-2001	ND (0.2)	--	--
UG-2	2-May-2001	ND (0.2)	--	--
UG-2	30-Oct-2001	ND (0.2)	--	--
UG-2	19-Apr-2002	0.3	--	--
UG-2	14-Oct-2002	ND (0.2)	--	--
UG-2	21-Apr-2003	0.2 U/0.2 U	--	--
UG-2	14-Oct-2003	0.2 U	--	--
UG-2	19-Apr-2004	0.13 U	1.4 B	0.91 B
UG-2	13-Sep-2004	0.11 U	0.58 B	0.19 B
UG-2	30-Mar-2005	0.13 U	1.2 B	0.15 B
UG-2	20-Sep-2005	0.15 U	0.15 U	0.058 U
UG-2	22-Mar-2006	0.073 U	*	0.48 B
UG-2	19-Sep-2006	0.11 U	1.4	0.61
UG-2	27-Mar-2007	0.086 U	3.2	0.33
UG-2	24-Sep-2007	0.14 U	0.94	0.18
UG-2	11-Mar-2008	0.1	0.96	0.1

Upgradient Upper Prediction Limit (UPL) Update with Data through 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

Upgradient Well Name	Sampling Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-2	4-Aug-2008	0.14 U	0.12 U	0.053 U
UG-2	24-Mar-2009	0.20 U	1.0 U	--
UG-2	20-Oct-2009	0.20 U	1.2	--
UG-2	2-Apr-2010	0.20 U	1.0 U	--
UG-2	28-Sep-2010	0.20 U	0.86 J	--
UG-2	20-Apr-2011	0.20 U	1.0	--
UG-2	16-Sep-2011	0.20 U	1.0 U	--
UG-2	26-Mar-2012	0.20 U	1.0 U	--
UG-2	25-Sep-2012	0.20 U	1.0 U	--
UG-2	27-Mar-2013	0.20 U	1.0 U	--
UG-2	25-Sep-2013	0.20 U	1.0 U	--
UG-2	21-Apr-2014	0.20 U	1.0 U	--
UG-2	4-Aug-2014	0.20 U	1.0 U	--
UG-2	30-Mar-2015	0.20 U	1.0 U	--
UG-2	27-Sep-2015	0.20 U	1.0 U	--
UG-2	28-Mar-2016	0.20 U	1.0 U	--
UG-2	13-Sep-2016	0.2 U/0.2 U	1.0 U/1.0 U	--
UG-3	17-Oct-2000	ND (0.2)	--	--
UG-3	16-Dec-2000	ND (0.2)	--	--
UG-3	22-Jan-2001	ND (0.2)	--	--
UG-3	2-May-2001	ND (0.2)	--	--
UG-3	1-Nov-2001	ND (0.2)	--	--
UG-3	18-Apr-2002	ND (0.2)	--	--
UG-3	14-Oct-2002	ND (0.2)	--	--
UG-3	21-Apr-2003	0.2 U	--	--
UG-3	14-Oct-2003	0.2 U	--	--
UG-3	19-Apr-2004	0.13 U	1.5 B	0.96 B
UG-3	13-Sep-2004	0.11 U/0.12 B	0.43 B/0.60 B	0.082 U/0.082 U
UG-3	30-Mar-2005	0.13 U	1.4 B	0.16 B
UG-3	20-Sep-2005	0.15 U	0.20 B	0.058 U
UG-3	22-Mar-2006	0.073 U	*	0.40 B
UG-3	19-Sep-2006	0.11 U	1.8	0.86
UG-3	27-Mar-2007	0.086 U	4	0.22
UG-3	24-Sep-2007	0.14 U	1	0.17
UG-3	11-Mar-2008	0.090 U/0.090 U	1.6/1.5	0.14/0.12
UG-3	4-Aug-2008	0.14 U	0.12 U	0.053 U
UG-3	24-Mar-2009	0.20 U	1.0 U	--
UG-3	20-Oct-2009	0.20 U	1.1	--
UG-3	2-Apr-2010	0.20 U	1.0 U	--
UG-3	28-Sep-2010	--	0.65 J	--
UG-3	20-Apr-2011	0.20 U/0.20 U	1.0 U/1.0 U	--
UG-3	16-Sep-2011	0.20 U	1.0 U	--
UG-3	26-Mar-2012	0.20 U	1.0 U	--
UG-3	25-Sep-2012	0.20 U	1.0 U	--
UG-3	27-Mar-2013	0.20 U	1.0 U	--
UG-3	25-Sep-2013	0.20 U	1.0 U	--
UG-3	21-Apr-2014	0.20 U	1.0 U	--
UG-3	4-Aug-2014	0.20 U	1.0 U	--
UG-3	30-Mar-2015	0.20 U	1.0 U	--
UG-3	24-Sep-2015	0.20 U	1.0 U	--
UG-3	28-Mar-2016	0.20 U	1.0 U	--
UG-3	13-Sep-2016	0.20 U	1.0 U	--

Table 4.1

Upgradient Upper Prediction Limit (UPL) Update with Data through 2016
Vault Well Sampling
Glenn Springs Holdings, Inc.
Montague, Michigan

Upgradient Well Name	Sampling Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
Number of Samples:		104	75	30
Percent of Non-Detects:		95%	60%	23%
Number of Detects:		4	30	23
Data Distribution:		Not Normal	Not Normal	Lognormal
UPL Method:		Parametric UPL	Non-Parametric UPL	Parametric UPL
Number of Future Samples for UPL:		2	2	2
Upgradient UPL:		**0.3**	**4.0**	**2.54****

Notes:

ND (0.2) or 0.2 U	- Parameter not detected at detection limit specified
B or J	- The analyte concentration detected is an estimated value below the reporting limit
--	- Value was a non-detect with elevated detection limit, and has, therefore, been excluded from UPL calculations
*	- Chromium was detected in equipment and field blanks during laboratory analysis, which resulted in elevated detection limits. These data were not included in the UPL calculations, since they are not considered representative of conditions at the Site.
**	- UPL was calculated using log-transformed data, and the result has been transformed back to original scale
UPL	- Upper prediction limit

Appendices

Appendix A
Statistical Evaluation of 2016 Groundwater Monitoring Data

Memorandum

February 08, 2017

To:	Dennis Hoyt, Samantha Sasnow	Ref. No.:	009970
From:	Wesley Dyck; Daniela Araujo/wg/31		

Subject: **Statistical Evaluation of September 2016 Groundwater Monitoring Data RCRA Waste Disposal Vault - Former Occidental Chemical Corporation Montague, Michigan**

1. Introduction

Groundwater samples were collected from downgradient and upgradient wells during the March and September 2016 monitoring events for the RCRA waste disposal vault at the Former Occidental Chemical Corporation facility in Montague, Michigan (Site). The cadmium, chromium, and lead concentration data were subjected to statistical analysis according to the final Statistical Evaluation Procedure (SEP) outlined in a memo prepared by Conestoga-Rovers & Associates (CRA) dated November 20, 2007, and approved by the Michigan Department of Environmental Quality (MDEQ) on December 17, 2007. The March and September 2016 data have been used to update upgradient background values for the Site, and the downgradient well data (analyte conditions in groundwater) have been compared to those updated values.

2. Statistical Evaluation

Statistical Method

According to the SEP, individual sample results from downgradient monitoring wells collected during the latest sampling event will be screened against Upper Prediction Limits (UPLs) generated using historical data from upgradient monitoring wells. Upgradient UPLs are updated on an annual basis following the final monitoring event of a calendar year (see Section 3.0 of the SEP). Since the September sampling was the final monitoring event for 2016, the annual UPL update is required. The annual update of upgradient UPLs checks for changes in regional background conditions by comparing the current year's upgradient data to historical upgradient data using group-based statistical tests. If no change in regional conditions is noted, the current year's upgradient data are incorporated into the historical data set and the upgradient UPLs recalculated. If a change in regional conditions were to be noted, then further methodology would be developed and proposed to the MDEQ.

This memo addresses two items: first, the upgradient UPLs are updated considering the 2016 data from upgradient wells UG-1, UG-2 and UG-3; and second, the September 2016 monitoring data for downgradient locations are compared against the updated upgradient UPLs. If any downgradient data from the current sampling event are found to be above the UPLs, then verification re-sampling would be required, as specified in Section 3.0 of the SEP.

Data Used for Analysis

Current groundwater monitoring activities at the Site collect and analyze cadmium, chromium and lead on a semi-annual basis, which are subject to upgradient UPL comparisons.

The following wells are currently included in the monitoring program:

UG-1 (upgradient)	DG-1	DG-3	DG-5L	DG-6U
UG-2 (upgradient)	DG-2L	DG-4	DG-5U	DG-7L
UG-3 (upgradient)	DG-2U	DG-4A	DG-6L	DG-7U

As well, a leachate sump monitoring well (LS-1) is included in sampling activities, which is grouped with the downgradient wells for evaluation purposes.

It was noted in the 2002 Annual Monitoring Report (CRA, 2003) that a change in the contract analytical laboratory occurred in 2000, which resulted in lower detection limits and a greater frequency of detected analyte concentrations in both upgradient and downgradient wells. To ensure that comparable data are evaluated, downgradient vs. upgradient comparisons are carried out excluding data collected prior to 2000. A second change in laboratories in 2004 resulted in a further improvement in the reporting limits for chromium and lead. This laboratory more frequently reported concentrations below the reporting limit as estimated values, which resulted in more detected concentrations of chromium and lead in the monitoring record between 2004-2008. Therefore, the reported concentrations for samples collected since 2004 are used for the upgradient UPL calculations for chromium. However, a further change in analytical laboratory in 2009 resulted in quantitation limits being reported instead of method detection limits, elevating the reported detection limit for lead and resulting in all non-detect data in upgradient wells since that time. Since the 2009+ lead data are ambiguous compared to those obtained between 2004-2008 (i.e., it is unknown how a non-detect at a higher detection limit compares to lower concentration detected values), the ongoing lead data (2009+) are not considered in updating the background lead value, unless a future detected result above the new quantitation limits (1 µg/L [micrograms per Litre]) is observed.

As directed by the SEP, for the purposes of the statistical procedures, any field duplicate results are averaged prior to performing calculations. Any laboratory QA/QC duplicate results are not considered.

3. Results

3.1 Updating Upgradient UPLs with 2016 Data

Since September was the final monitoring event for 2016, the upgradient UPL update process outlined in Section 3.3 of the SEP was undertaken prior to performing downgradient vs. upgradient comparisons for the September data.

The upgradient well data were first subjected to group-comparison tests as outlined in Section 3.3 of the SEP. The selection of a suitable test is based on the data distribution and percentage of non-detects. If both historical and current data are found to be normally distributed (or normal via a data transformation, e.g., lognormally distributed) and have no more than 50 percent non-detects, the Student *t*-test is used. If

either or both historical and current data are found to be neither normally nor lognormally distributed or contain more than 50 percent non-detects, then non-parametric tests are used (i.e., the Wilcoxon Rank Sum (WRS) test and the Quantile test).

To perform the upgradient group-comparison tests, data from the three upgradient wells were pooled and organized into two groups: historical (2000-2015) and recent (the current year including 2016 March and September data). Test results are provided in Attachment A and summarized below.

Parameter	Wilcoxon Rank Sum Test			Quantile Test
	Statistic (U)	Probability	Conclusion	Conclusion
Cadmium	300	0.725	No significant difference	No significant difference
Chromium	273	0.109	No significant difference	No significant difference
Lead	--	--	Not tested	Not tested

The recent data set for cadmium consisted entirely of non-detects, and therefore non-parametric tests (WRS and Quantile tests) were used to compare the recent and historical groups. The 2016 data were compared to the historical data and found not to be significantly different at a 95 percent confidence level and the Quantile test found no differences at the 0.5, 0.75 and 0.9 quantiles. The 2016 cadmium data were added to the upgradient data set, and the UPL recalculated (see Table 1).

The recent data set for chromium consisted entirely of non-detects (Table A-1); therefore, non-parametric tests were used to compare the recent and historical groups (i.e., WRS and Quantile tests). The WRS test was not significant and the Quantile test found no differences at the 0.5, 0.75 and 0.9 quantiles. Therefore the current (2016) data were added to the upgradient data set and the UPL recalculated (see Table 1).

As noted above, a change in laboratories has resulted in high detection limits reported for lead since 2009 than during the 2004-2008 period, during which lower detected values were reported. The recent upgradient data in all three upgradient wells were non-detects at the current detection limit (see Table A-1), which do not provide useful information on current lead concentrations. Therefore, it is not possible to assess whether lead concentrations have changed in upgradient groundwater over the past year, and the 2016 upgradient lead data have not been considered for addition to the UPL calculations. Instead, the previous UTL (2.5 μg/L) based on the 2004-2008 lead data will be retained until any additional detected lead concentrations in upgradient wells are observed.

In summary, based on the conclusions of the group comparison tests discussed above, the 2016 concentrations of cadmium and chromium in upgradient wells have been added to the respective upgradient data sets, and the associated UPLs recalculated. The 2016 lead data, being non-detects with higher quantitation limits than reported historically, have not been used to update the upgradient UPL for lead, and the value originally calculated at the end of 2008 has been retained. The resulting UPLs are presented in Table 1, which are available for use evaluating analyte concentrations at downgradient wells. Due to the type of statistical procedures employed (i.e., non-parametric methods), no changes in the numeric values for the upgradient UPLs occurred during this update.

3.2 Comparison of Downgradient Well Data vs. Upgradient UPLs for September 2016 Monitoring Event:

The September 2016 monitoring data from all wells are presented in Table 2. The upgradient UPLs (from Table 1) are also presented, for comparison purposes.

Cadmium was not detected in any groundwater samples collected during the September 2016 sampling event. Chromium was present at detectable concentrations in 1 of 12 downgradient wells, at a concentration consistent with historical upgradient conditions (i.e., below the upgradient UPL), but not detected in the leachate sump monitoring well or in any of the three upgradient wells. Lead was not detected in any downgradient or upgradient well or in the leachate sump during the September 2016 sampling event.

In all cases, the September 2016 monitoring data are below the calculated upgradient UPLs. Therefore, it is concluded that cadmium, chromium and lead concentrations found in the downgradient monitoring locations during September 2016 are consistent with upgradient conditions, indicating no evidence of any new release from the RCRA vault.

4. Conclusions

Based on the statistical analyses performed, all concentrations of monitored inorganic analytes in September 2016 were found to be consistent with upgradient conditions represented by the calculated upgradient UPLs. Regular monitoring may continue with no additional follow-up action required.

5. References

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Upgradient Upper Prediction Limit (UPL) Update with Data through 2016
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sampling Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-1	17-Oct-2000	ND (0.2)	--	--
UG-1	16-Dec-2000	ND (0.2)	--	--
UG-1	22-Jan-2001	ND (0.2)	--	--
UG-1	2-May-2001	ND (0.2)	--	--
UG-1	1-Nov-2001	ND (0.2)	--	--
UG-1	18-Apr-2002	0.3	--	--
UG-1	14-Oct-2002	ND (0.2)	--	--
UG-1	21-Apr-2003	0.2 U	--	--
UG-1	14-Oct-2003	0.2 U	--	--
UG-1	19-Apr-2004	0.13 U	1.6 B	1
UG-1	13-Sep-2004	0.13 B	0.60 B	0.082 U
UG-1	30-Mar-2005	0.13 U	1.2 B	0.12 B
UG-1	20-Sep-2005	0.15 U	0.15 U	0.058 U
UG-1	22-Mar-2006	0.073 U	*	0.50 B
UG-1	19-Sep-2006	0.11 U	2.1	3.7
UG-1	27-Mar-2007	0.086 U	3.8	0.2
UG-1	24-Sep-2007	0.14 U	1.2	0.18
UG-1	11-Mar-2008	0.090 U	1.5	0.12
UG-1	4-Aug-2008	0.14 U	0.12 U	0.12
UG-1	24-Mar-2009	0.20 U	1.0 U	--
UG-1	20-Oct-2009	0.20 U	1.3	--
UG-1	2-Apr-2010	0.20 U	1.0 U	--
UG-1	28-Sep-2010	0.20 U	1.1	--
UG-1	20-Apr-2011	0.20 U	1	--
UG-1	16-Sep-2011	0.20 U	1.0 U	--
UG-1	26-Mar-2012	0.20 U	1.0 U	--
UG-1	25-Sep-2012	0.20 U	1.0 U	--
UG-1	27-Mar-2013	0.20 U	1.0 U	--
UG-1	25-Sep-2013	0.20 U	1.0 U	--
UG-1	30-Mar-2015	0.20 U	1.0 U	--
UG-1	5-Aug-2014	0.20 U	1.0 U	--
UG-1	30-Mar-2015	0.20 U	1.0 U	--
UG-1	24-Sep-2015	0.20 U	1.0 U	--
UG-1	28-Mar-2016	0.20 U /0.20 U	1.0 U /1.0 U	--
UG-1	13-Sep-2016	0.20 U	1.0 U	--
UG-2	17-Oct-2000	ND (0.2)	--	--
UG-2	16-Dec-2000	ND (0.2)	--	--
UG-2	22-Jan-2001	ND (0.2)	--	--
UG-2	2-May-2001	ND (0.2)	--	--

Upgradient Upper Prediction Limit (UPL) Update with Data through 2016
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sampling Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-2	30-Oct-2001	ND (0.2)	--	--
UG-2	19-Apr-2002	0.3	--	--
UG-2	14-Oct-2002	ND (0.2)	--	--
UG-2	21-Apr-2003	0.2 U/0.2 U	--	--
UG-2	14-Oct-2003	0.2 U	--	--
UG-2	19-Apr-2004	0.13 U	1.4 B	0.91 B
UG-2	13-Sep-2004	0.11 U	0.58 B	0.19 B
UG-2	30-Mar-2005	0.13 U	1.2 B	0.15 B
UG-2	20-Sep-2005	0.15 U	0.15 U	0.058 U
UG-2	22-Mar-2006	0.073 U	*	0.48 B
UG-2	19-Sep-2006	0.11 U	1.4	0.61
UG-2	27-Mar-2007	0.086 U	3.2	0.33
UG-2	24-Sep-2007	0.14 U	0.94	0.18
UG-2	11-Mar-2008	0.1	0.96	0.1
UG-2	4-Aug-2008	0.14 U	0.12 U	0.053 U
UG-2	24-Mar-2009	0.20 U	1.0 U	--
UG-2	20-Oct-2009	0.20 U	1.2	--
UG-2	2-Apr-2010	0.20 U	1.0 U	--
UG-2	28-Sep-2010	0.20 U	0.86 J	--
UG-2	20-Apr-2011	0.20 U	1.0	--
UG-2	16-Sep-2011	0.20 U	1.0 U	--
UG-2	26-Mar-2012	0.20 U	1.0 U	--
UG-2	25-Sep-2012	0.20 U	1.0 U	--
UG-2	27-Mar-2013	0.20 U	1.0 U	--
UG-2	25-Sep-2013	0.20 U	1.0 U	--
UG-2	21-Apr-2014	0.20 U	1.0 U	--
UG-2	5-Aug-2014	0.20 U	1.0 U	--
UG-2	30-Mar-2015	0.20 U	1.0 U	--
UG-2	24-Sep-2015	0.20 U	1.0 U	--
UG-2	28-Mar-2016	0.20 U	1.0 U	--
UG-2	13-Sep-2016	0.20 U /0.20 U	1.0 U /1.0 U	--
UG-3	17-Oct-2000	ND (0.2)	--	--
UG-3	16-Dec-2000	ND (0.2)	--	--
UG-3	22-Jan-2001	ND (0.2)	--	--
UG-3	2-May-2001	ND (0.2)	--	--
UG-3	1-Nov-2001	ND (0.2)	--	--
UG-3	18-Apr-2002	ND (0.2)	--	--
UG-3	14-Oct-2002	ND (0.2)	--	--
UG-3	21-Apr-2003	0.2 U	--	--
UG-3	14-Oct-2003	0.2 U	--	--
UG-3	19-Apr-2004	0.13 U	1.5 B	0.96 B
UG-3	13-Sep-2004	0.11 U/0.12 B	0.43 B/0.60 B	0.082 U/0.082 U

Table 1

Upgradient Upper Prediction Limit (UPL) Update with Data through 2016
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sampling Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-3	30-Mar-2005	0.13 U	1.4 B	0.16 B
UG-3	20-Sep-2005	0.15 U	0.20 B	0.058 U
UG-3	22-Mar-2006	0.073 U	*	0.40 B
UG-3	19-Sep-2006	0.11 U	1.8	0.86
UG-3	27-Mar-2007	0.086 U	4	0.22
UG-3	24-Sep-2007	0.14 U	1	0.17
UG-3	11-Mar-2008	0.090 U/0.090 U	1.6/1.5	0.14/0.12
UG-3	4-Aug-2008	0.14 U	0.12 U	0.053 U
UG-3	24-Mar-2009	0.20 U	1.0 U	--
UG-3	20-Oct-2009	0.20 U	1.1	--
UG-3	2-Apr-2010	0.20 U	1.0 U	--
UG-3	28-Sep-2010	--	0.65 J	--
UG-3	20-Apr-2011	0.20 U/0.20 U	1.0 U/1.0 U	--
UG-3	16-Sep-2011	0.20 U	1.0 U	--
UG-3	26-Mar-2012	0.20 U	1.0 U	--
UG-3	25-Sep-2012	0.20 U	1.0 U	--
UG-3	27-Mar-2013	0.20 U	1.0 U	--
UG-3	25-Sep-2013	0.20 U	1.0 U	--
UG-3	21-Apr-2014	0.20 U	1.0 U	--
UG-3	5-Aug-2014	0.20 U	1.0 U	--
UG-3	30-Mar-2015	0.20 U	1.0 U	--
UG-3	24-Sep-2015	0.20 U	1.0 U	--
UG-3	28-Mar-2016	0.20 U	1.0 U	--
UG-3	13-Sep-2016	0.20 U	1.0 U	--
Number of Samples:		104	75	30
Percent of Non-Detects:		95%	60%	23%
Number of Detects:		4	30	23
Data Distribution:		Not Normal	Not Normal	Lognormal
UPL Method:		Parametric UPL	Non-Parametric UPL	Parametric UPL
Number of Future Samples for UPL:		2	2	2
Upgradient UPL:		**0.3**	**4.0**	**2.54****

Notes:

ND (0.2) or 0.2 U - Parameter not detected at detection limit specified.
B or J - The analyte concentration detected is an estimated value below the reporting limit.
-- Value was a non-detect with elevated detection limit, and has therefore been excluded from UPL calculations.
* Chromium was detected in equipment and field blanks during laboratory analysis which resulted in elevated detection limits. These data were not included in the UPL calculations, since they are not considered representative of conditions at the site.
** UPL was calculated using log-transformed data and the result has been transformed back to original scale.

Table 2

Comparison of Analyte Concentrations in Downgradient Well Groundwater vs. Upgradient Conditions
September 2016 Event
Former Occidental Chemical Corporation Facility
Montague, Michigan

	Cadmium		Chromium Total		Lead	
Number of Upgradient (UG) Samples:	**104**		**75**		**30**	
Percent Non-Detect in UG Samples:	**95%**		**60%**		**23%**	
UPL Method:	**Parametric UPL**		**Non-Parametric UPL**		**Parametric UPL**	
Upgradient UPL[(1)] 2000-2016 (µg/L):	**0.3**		**4.0**		**2.5**	
	September-16 Result (µg/L)	**Conclusion**	**September-16 Result (µg/L)**	**Conclusion**	**September-15 Result (µg/L)**	**Conclusion**
Upgradient Monitoring Well:						
UG-1	0.20 U	--	1.0 U	--	1.0 U	--
UG-2	0.20 U /0.20 U	--	1.0 U /1.0 U	--	1.0 U /1.0 U	--
UG-3	0.20 U	--	1.0 U	--	1.0 U	--
Downgradient Monitoring Location:						
DG-1	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-2L	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-2U	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-3	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-4	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-4A	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-5L	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-5U	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-6L	0.20 U /0.20 U	Non-Detect	1.0 U /1.0 U	Non-Detect	1.0 U /1.0 U	Non-Detect
DG-6U	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-7L	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect
DG-7U	0.20 U	Non-Detect	1.1	Consistent with UG	1.0 U	Non-Detect
LS-1[(2)]	0.20 U	Non-Detect	1.0 U	Non-Detect	1.0 U	Non-Detect

Notes:

[(1)] UPL - Upper Prediction Limit for the next 2 future samples with 95 percent confidence, based on upgradient data collected from 2000-2016.

[(2)] Leachate sump, grouped with downgradient wells.

0.20 U - Parameter not detected at detection limit specified.

0.20U/0.20 U - Field duplicate results.

J - The analyte concentration detected is an estimated value below the reporting limit.

Non-Detect - Analytes not detected are not subjected to statistical testing (but nonetheless are all below the upgradient UPL).

Consistent with UG - The concentration observed during the current monitoring event was not above the upgradient UPL, and is therefore consistent with upgradient conditions.

Attachment A
Statistical Output for Inter-Group Comparisons Prior to Upgradient UPL Updates

Attachment A

A.1) Non-parametric WRS and Quantile tests for cadmium in upgradient wells (current March and September 2016 vs. historical 2000-2015 data).

WRS test Output:

>NPAR

>KRUSKAL RESULT * GROUP$
Data for the following results were selected according to:
ANALYTE$="Cadmium"

Categorical values encountered during processing are:
GROUP$ (2 levels)
historical, recent

Kruskal-Wallis One-Way Analysis of Variance for 98 cases
Dependent variable is RESULT
Grouping variable is GROUP$

Group	Count	Rank Sum
historical	91	5151.000
recent	6	309.000

Mann-Whitney U test statistic = 300.000
Probability is 0.725
Chi-square approximation = 0.124 with 1 df

Conclusion: No significant difference

Quantile Test Results:

m=98 (historical data)
n=6 (recent data)

	0.5 Quantile		*0.75 Quantile*		*0.9 Quantile*	
	Upper Tail	*Lower Tail*	*Upper Tail*	*Lower Tail*	*Upper Tail*	*Lower Tail*
C	52	52	26	26	11	11
s	3	3	1	1	0	0
μ	3	3	2	2	1	1
σ	1.19	1.19	1.03	1.03	0.73	0.73
z'	-0.42	-0.42	-1.21	-0.97	-2.09	-1.54
Z (two-tailed test)	1.96	1.96	1.96	1.96	1.96	1.96
conclusion	No significant difference		No significant difference		No significant difference	

Overall Conclusion: No significant difference

A.2) Non-parametric WRS and Quantile tests for chromium in upgradient wells (current March and September 2016 vs. historical 2000-2015 data).

WRS test Output:

>NPAR

>KRUSKAL RESULT * GROUP$
Data for the following results were selected according to:
ANALYTE$="Chromium"

Categorical values encountered during processing are:
GROUP$ (2 levels)
historical, recent

Kruskal-Wallis One-Way Analysis of Variance for 69 cases
Dependent variable is RESULT
Grouping variable is GROUP$

Group	Count	Rank Sum
historical	69	2688.000
recent	6	162.000

Mann-Whitney U test statistic = 273.000
Probability is 0.109
Chi-square approximation = 2.568 with 1 df

Conclusion: No significant difference

Quantile Test Results:

m=69 (historical data)
n=6 (recent data)

	0.5 Quantile		*0.75 Quantile*		*0.9 Quantile*	
	Upper Tail	*Lower Tail*	*Upper Tail*	*Lower Tail*	*Upper Tail*	*Lower Tail*
c	37	37	19	19	8	8
s	2	4	0	2	0	1
μ	3	3	2	2	1	1
σ	1.18	1.18	1.03	1.03	0.73	0.73
z'	-1.23	0.46	-1.96	-0.02	-1.56	-0.19
Z (two-tailed test)	1.96	1.96	1.96	1.96	1.96	1.96
conclusion	No significant difference		No significant difference		No significant difference	

Overall Conclusion: No significant difference

A.3) Lead in upgradient wells (current March and September 2016 vs. historical 2004-2015 data).

Due to the current (2016) data set consisting exclusively of non-detect results with higher detection limits (above previous detected values), no statistical group tests were possible (*i.e.*, any comparison would be ambiguous). The 2016 lead data have not been used to update the upgradient UPL.

Upgradient Historical Data (2000-2015) and Current Data (2016) Group Comparison Test Results
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sample Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
		Historical Data	Historical Data	Historical Data
UG-1	17-Oct-2000	ND (0.2)	--	--
UG-1	16-Dec-2000	ND (0.2)	--	--
UG-1	22-Jan-2001	ND (0.2)	--	--
UG-1	2-May-2001	ND (0.2)	--	--
UG-1	1-Nov-2001	ND (0.2)	--	--
UG-1	18-Apr-2002	0.3	--	--
UG-1	14-Oct-2002	ND (0.2)	--	--
UG-1	21-Apr-2003	0.2 U	--	--
UG-1	14-Oct-2003	0.2 U	--	--
UG-1	19-Apr-2004	0.13 U	1.6 B	1
UG-1	13-Sep-2004	0.13 B	0.60 B	0.082 U
UG-1	30-Mar-2005	0.13 U	1.2 B	0.12 B
UG-1	20-Sep-2005	0.15 U	0.15 U	0.058 U
UG-1	22-Mar-2006	0.073 U	*	0.50 B
UG-1	19-Sep-2006	0.11 U	2.1	3.7
UG-1	27-Mar-2007	0.086 U	3.8	0.2
UG-1	24-Sep-2007	0.14 U	1.2	0.18
UG-1	11-Mar-2008	0.090 U	1.5	0.12
UG-1	4-Aug-2008	0.14 U	0.12 U	0.12
UG-1	24-Mar-2009	0.20 U	1.0 U	--
UG-1	20-Oct-2009	0.20 U	1.3	--
UG-1	2-Apr-2010	0.20 U	1.0 U	--
UG-1	28-Sep-2010	0.20 U	1.1	--
UG-1	20-Apr-2011	0.20 U	1	--
UG-1	16-Sep-2011	0.20 U	1.0 U	--
UG-1	26-Mar-2012	0.20 U	1.0 U	--
UG-1	25-Sep-2012	0.20 U	1.0 U	--
UG-1	27-Mar-2013	0.20 U	1.0 U	--
UG-1	23-Sep-2013	0.20 U	1.0 U	--
UG-1	21-Apr-2014	0.20 U	1.0 U	--
UG-1	5-Aug-2014	0.20 U	1.0 U	--
UG-1	30-Mar-2015	0.20 U	1.0 U	--
UG-1	24-Sep-2015	0.20 U	1.0 U	--
UG-2	17-Oct-2000	ND (0.2)	--	--
UG-2	16-Dec-2000	ND (0.2)	--	--
UG-2	22-Jan-2001	ND (0.2)	--	--
UG-2	2-May-2001	ND (0.2)	--	--

Upgradient Historical Data (2000-2015) and Current Data (2016) Group Comparison Test Results
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sample Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-2	30-Oct-2001	ND (0.2)	--	--
UG-2	19-Apr-2002	0.3	--	--
UG-2	14-Oct-2002	ND (0.2)	--	--
UG-2	21-Apr-2003	0.2 U/0.2 U	--	--
UG-2	14-Oct-2003	0.2 U	--	--
UG-2	19-Apr-2004	0.13 U	1.4 B	0.91 B
UG-2	13-Sep-2004	0.11 U	0.58 B	0.19 B
UG-2	30-Mar-2005	0.13 U	1.2 B	0.15 B
UG-2	20-Sep-2005	0.15 U	0.15 U	0.058 U
UG-2	22-Mar-2006	0.073 U	*	0.48 B
UG-2	19-Sep-2006	0.11 U	1.4	0.61
UG-2	27-Mar-2007	0.086 U	3.2	0.33
UG-2	24-Sep-2007	0.14 U	0.94	0.18
UG-2	11-Mar-2008	0.1	0.96	0.1
UG-2	4-Aug-2008	0.14 U	0.12 U	0.053 U
UG-2	24-Mar-2009	0.20 U	1.0 U	--
UG-2	20-Oct-2009	0.20 U	1.2	--
UG-2	2-Apr-2010	0.20 U	1.0 U	--
UG-2	28-Sep-2010	0.20 U	0.86 J	--
UG-2	20-Apr-2011	0.20 U	1	--
UG-2	16-Sep-2011	0.20 U	1.0 U	--
UG-2	26-Mar-2012	0.20 U	1.0 U	--
UG-2	25-Sep-2012	0.20 U	1.0 U	--
UG-2	27-Mar-2013	0.20 U	1.0 U	--
UG-2	23-Sep-2013	0.20 U	1.0 U	--
UG-2	21-Apr-2014	0.20 U	1.0 U	--
UG-2	5-Aug-2014	0.20 U	1.0 U	--
UG-2	30-Mar-2015	0.20 U	1.0 U	--
UG-2	24-Sep-2015	0.20 U	1.0 U	--
UG-3	17-Oct-2000	ND (0.2)	--	--
UG-3	16-Dec-2000	ND (0.2)	--	--
UG-3	22-Jan-2001	ND (0.2)	--	--
UG-3	2-May-2001	ND (0.2)	--	--
UG-3	1-Nov-2001	ND (0.2)	--	--
UG-3	18-Apr-2002	ND (0.2)	--	--
UG-3	14-Oct-2002	ND (0.2)	--	--
UG-3	21-Apr-2003	0.2 U	--	--

Upgradient Historical Data (2000-2015) and Current Data (2016) Group Comparison Test Results
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sample Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
UG-3	14-Oct-2003	0.2 U	--	--
UG-3	19-Apr-2004	0.13 U	1.5 B	0.96 B
UG-3	13-Sep-2004	0.11 U/0.12 B	0.43 B/0.60 B	0.082 U/0.082 U
UG-3	30-Mar-2005	0.13 U	1.4 B	0.16 B
UG-3	20-Sep-2005	0.15 U	0.20 B	0.058 U
UG-3	22-Mar-2006	0.073 U	*	0.40 B
UG-3	19-Sep-2006	0.11 U	1.8	0.86
UG-3	27-Mar-2007	0.086 U	4	0.22
UG-3	24-Sep-2007	0.14 U	1	0.17
UG-3	11-Mar-2008	0.090 U/0.090 U	1.6/1.5	0.14/0.12
UG-3	4-Aug-2008	0.14 U	0.12 U	0.053 U
UG-3	24-Mar-2009	0.20 U	1.0 U	--
UG-3	20-Oct-2009	0.20 U	1.1	--
UG-3	2-Apr-2010	0.20 U	1.0 U	--
UG-3	28-Sep-2010	--	0.65 J	--
UG-3	20-Apr-2011	0.20 U/0.20 U	1.0 U/1.0 U	--
UG-3	16-Sep-2011	0.20 U	1.0 U	--
UG-3	26-Mar-2012	0.20 U	1.0 U	--
UG-3	25-Sep-2012	0.20 U	1.0 U	--
UG-3	27-Mar-2013	0.20 U	1.0 U	--
UG-3	23-Sep-2013	0.20 U	1.0 U	--
UG-3	21-Apr-2014	0.20 U	1.0 U	--
UG-3	5-Aug-2014	0.20 U	1.0 U	--
UG-3	30-Mar-2015	0.20 U	1.0 U	--
UG-3	24-Sep-2015	0.20 U	1.0 U	--
	Statistics:			
	Historical Data			
Number of samples:		98	69	30
Percent of Non-Detects		95%	57%	23%
Number of Detects:		4	30	23
Shapiro-Wilk W test:		N/A	N/A	0.52
Shapiro-Wilk W test (log):		N/A	N/A	0.95
Critical W for 0.05 probability:		N/A	N/A	0.93
Distribution:		N/A	N/A	Lognormal

Upgradient Historical Data (2000-2015) and Current Data (2016) Group Comparison Test Results
Former Occidental Chemical Corporation Facility
Montague, Michigan

Upgradient Well Name	Sample Date	Cadmium Concentration (µg/L)	Chromium Total Concentration (µg/L)	Lead Concentration (µg/L)
		Current Data	**Current Data**	**Current Data**
UG-1	28-Mar-2016	0.20 U /0.20 U	1.0 U /1.0 U	1.0 U /1.0 U
UG-1	13-Sep-2016	0.20 U	1.0 U	1.0 U
UG-2	28-Mar-2016	0.20 U	1.0 U	1.0 U
UG-2	13-Sep-2016	0.20 U /0.20 U	1.0 U /1.0 U	1.0 U /1.0 U
UG-3	28-Mar-2016	0.20 U	1.0 U	1.0 U
UG-3	13-Sep-2016	0.20 U	1.0 U	1.0 U
	Statistics:			
	Current Data			
Number of samples:		6	6	6
Percent of Non-Detects		100%	100%	100%
Number of Detects:		0	0	0
Shapiro-Wilk W test:		N/A	N/A	N/A
Shapiro-Wilk W test (log):		N/A	N/A	N/A
Critical W for 0.05 probability:		N/A	N/A	N/A
Distribution:		N/A	N/A	N/A
Group Comparison Test:		NSD	NSD	**Not tested** [(1)]

Notes:

ND (0.2) or 0.2 U - Parameter not detected at detection limit specified.
B or J - The analyte concentration detected is an estimated value below the reporting limit.
-- Value is a non-detect with elevated detection limit, and has therefore been excluded from UPL calculations.
* Chromium was detected in equipment and field blanks during laboratory analysis which resulted in elevated detection limits. These data were not included in the UPL calculations since they are not considered representatives of conditions at the site.
NSD - No statistically significant difference between the two groups.
(1) Due to current (2016) data consisting exclusively of non-detect results with higher detection limits (above previous detected values), no statistical testing was performed.

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