Technical Memorandum

Environmental
Resources
Management

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Subject: Northeast Plume Remediation Progress Report

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Introduction

The northeast plume remediation program was designed to enhance the reductive dechlorination processes within the northeast part of the shallow aquifer at the former Johnson Controls Facility at 1007 South 12th Street in Watertown, Wisconsin (the Site). The Northeast Ground Water Plume Remediation Work Plan [Work Plan (February 2007)] outlined a program to implement bio-enhancement using emulsified oil substrate (EOS) to promote ground water remediation at the Site. The program was designed to establish a trend of decreasing volatile organic compound (VOC) concentrations and accelerate the timetable for obtaining site closure.

The northeast plume is defined by multiple sample results from monitoring wells B-14, B-15, B-16 (abandoned), MW-12S, and MW-34S. Samples from these wells have contained VOCs in concentrations exceeding enforcement standards.

Enhanced Biological Treatment

Natural attenuation occurs through complex reactions catalyzed by microorganisms naturally residing in the aquifer. Favorable conditions within the aquifer can enhance these reactions, thereby accelerating the rate of attenuation. Emulsified oil substrate is a soybean-based material that, when injected into the aquifer, can enhance dechlorination by:

- Providing nutrients that encourage microorganism growth;
- Consuming oxygen and producing hydrogen during degradation. The hydrogen is in turn used as an electron donor by microorganisms,

- Residing in the aquifer for a long period of time [(up to three years) source: eosremediation.com].

EOS has a slightly higher viscosity than water allowing it to move through the aquifer during injection. However, EOS is designed to adsorb to the aquifer material and does not continue to migrate with ground water.

Two phases of the bio-augmentation treatment have been completed for the northeast plume. The pilot test (Phase I) was performed over a limited area of the plume to evaluate injection coverage and dosage requirements. The pilot test results were used to guide subsequent injection activities. The full-scale treatment (Phase II) consisted of "hot-spot" EOS injection and downgradient monitoring. Figure 1, attached, shows monitoring point and injection point locations for both phases of EOS treatment.

Phase I: Pilot Test Injection

The pilot test was conducted over a limited area in the northern part of the plume. This area was selected because natural attenuation is less advanced, allowing an increased rate of dechlorination to be more easily detected.

Preparation and Design

Preparation and design activities for the EOS pilot test were conducted as described in the Work Plan. Eight monitoring points were installed in April 2007 to monitor ground water quality within the injection area. These monitoring points, designated MP-01 through MP-08, were constructed of 2-inch schedule 40 PVC screened from the water table to the top of the gray till (approximately 5-20 feet).

Emulsified Oil Substrate (EOS) Injection

The pilot EOS injection was performed between May 1 and May 3, 2007. Injection was accomplished by pumping EOS solution directly through hollow, direct-push rods. The 1.25-inch diameter rods were advanced to the top of the gray till (approximately 15-20 feet BGS) as determined by ERM geologists. A total of 20 injection points (IP-01 through IP-19) were advanced at an average spacing of 10 feet cross gradient by 20 feet downgradient. The direct-push rods were lifted in two foot increments while EOS solution was injected simultaneously into multiple points at a low pressure (less than 10

psi). A Dosatron pump was used to control the concentration of the EOS solution. Initially a dilution factor of 10 parts water to 1 part EOS (10:1) was selected for the pilot test injection; however, the dilution was eventually reduced to 5:1 based on variations in formation permeability and resulting injection rates. Potable water was injected after the EOS solution to reach the 10:1 dilution. Approximately 300 gallons of EOS solution was distributed between the 19 injection points during the pilot test. The injection volume data for the EOS pilot test are listed in Table 1.

Results

The depth interval from 8 to 12 feet below ground surface (bgs) accepted the majority of the EOS solution at each injection point. Focused injection below 12 feet was impractical due to lower soil permeability. The EOS solution was detected visually in monitoring points MP-01 through MP-05 within several hours of injection into adjacent injection points. Therefore, the injection point spacing of 10 ft cross-gradient (east-west) by 20 feet downgradient (north-south) was determined to be appropriate for the full-scale injection. Post pilot test ground water monitoring showed and increasing trend of dissolved methane, indicating an increase in biological activity.

Phase II: Full-Scale Injection

Beginning on August 20th, 2007, ERM performed the Phase II "hot-spot" EOS injection. The design was based on technical observations made during the Phase I activities and results of water quality monitoring.

Emulsified Oil Substrate (EOS) Injection

The EOS solution was injected directly into the impacted aquifer using two different processes. Injection using direct-push technology was performed east of the facility driveway according to the procedures for the pilot test described above. West of the facility driveway, attempted injection through points IP-43 through IP-48 was not successful using the direct-push approach due to low permeability and associated pressures exceeding 15 psi. A gravity feed approach was employed over a period of several days to avoid these issues.

Direct-Push Injection

EOS solution was injected into the shallow aquifer between August 20 and August 29, 2007. The injection points for the full-scale treatment were advanced using 1.25-inch diameter direct-push rods. Direct-push technology was utilized for points IP-20 through IP-42 and IP-49 through IP-54, east of the facility driveway. Approximately 3,300 gallons of EOS was distributed between the injection points east of the driveway. Injection rates varied between 0.16 and 1.0 gallons per minute (gpm) depending on the location. Distribution of the EOS was favored towards soil horizons with higher permeability. Based on the dose rate, approximately 114 gallons of 5:1 dilute EOS solution was injected into each point east of the driveway. The EOS solution was then 'chased' with potable water to reach a 10:1 dilution. The volume of EOS injected at each point is summarized in Table 2.

During the EOS injection process, ERM employed a down-hole water quality probe to measure pH, conductivity, dissolved oxygen, and oxidation reduction potential in monitoring points MP-01 through MP-08. Additionally, ERM visually inspected samples of water drawn from the monitoring points for the presence of EOS (whitish cast or milky appearance).

Gravity Feed Injection

ERM evaluated injection pressure requirements west of the facility driveway by installing and testing a 2-inch diameter PVC well screened from 8 to 18 feet (IP-47). Pressure testing was conducted by connecting a ball-valve, flow meter, and pressure gage assembly to a PVC pipe to control fluid flow and pressure. Potable water was injected into IP-47 while monitoring flow rates and corresponding pressures. A total of 63.4 gallons of water was injected into IP-47 during the pressure test. Results from the pressure test indicated that a pressure of 4.0 psi or less would be appropriate for the injection of EOS solution.

Nine additional 2-inch diameter PVC wells (IP-43, IP45, IP-47, and IP-55 through IP-60) screened from 8 to 18 feet were installed west of and within the facility driveway to facilitate EOS addition to the shallow aquifer. The EOS solution was delivered to the shallow zone under a gravity-controlled flow rate and pressure. Gravity feed injection began on September 13, 2007 and was completed on November 29, 2007. A polyethylene tank filled with EOS solution was placed above the top-of-casing elevation at each well. A hose connected the tank to the wellhead using water tight PVC pipe connections. The tank valve was then opened, allowing EOS solution to

gravity flow into the well. This process was used at nine injection wells: six on the west side of the facility driveway (IP-43, IP-45, IP-47, IP-58, IP-59, and IP-60) and three within the driveway (IP-55, IP-56, IP-57). A full tank (approximately 250 gallons) of 5:1 dilute EOS solution was injected into each well. The volume of EOS injected at each injection point is summarized in Table 2. Flow rates into each point were not calculated; however, flow was estimated to be 0.1 gallons per minute or less. At some points, several days were required to complete the gravity feed process.

Post-Injection Monitoring

Beginning on September 13, 2007, monitoring wells MP-01, MP-05, MP-06, MP-07, MP-08, MW-34S, MW-12S, B-14, and B-15 were monitored for dissolved gases (ethene, ethane, and methane). A bi-weekly monitoring program continued for six weeks to monitor dissolved gas concentrations within the treatment area. After this six week period, ERM performed monthly monitoring for dissolved gases and/or VOCs. Dissolved gas and VOC samples were analyzed by Test America of Watertown, Wisconsin according to analytical methods RSK 175 and SW 8260B, respectively. At several monitoring points, ground water acquired a dark gray color and strong sewer-like odor, both indications that enhanced biodegradation is occurring within the aquifer.

Post-Injection Monitoring Results

ERM has completed eight months of post injection monitoring within the northeast plume. Dissolved gas and VOC concentrations are summarized on Tables 3 and 4, respectively. Monitoring results for samples taken prior to the full-scale injection were tabulated with post- injection results to demonstrate the effectiveness of the treatment process. The primary constituents of concern included: 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (cis-1,2-DCE); tetrachloroethene (PCE); trans-1,2-dichloroenthene (trans-1,2-DCE); trichloroethene (TCE); and vinyl chloride (VC).

Ground Water Contamination Trends

ERM calculated VOC mass by dividing the constituent concentration by the constituent molecular weight and reported the mass in units of micromoles per liter (umol/L). The sum of VOC mass at each monitoring point and for each sampling event is shown in Table 4.

The VOC and dissolved gas concentrations detected in samples collected from the monitoring points show the following temporal trends. Methane and VOC data are illustrated graphically in Figures 2 through 5.

- Volatile Organic Compounds
    - Reductions in VOC mass occurred in MP-01, MW-02, MP-04, MW-34S, MW-12S, B-15, MP-06, MP-07 and MP-08. Mass reduction ranged from 15% in MP-07 to 99% in MP-05.

- Increases in VOC mass occurred in B-14. It is likely that this increase is due in part to movement of VOC mass within the treatment area but is expected that over time, VOC mass will be reduced in this area. Reduction is slower west of the driveway due to lower permeabilities
- Overall, TCE and cis-1,2-DCE have exhibited a decreasing trend. Vinyl chloride concentrations have showed initial increases followed by decreases indicating that the transformation from chlorinated pecies to lower chlorinated species is occurring.

- Dissolved Gases
  - The concentrations of ethene and ethane in monitoring wells B-14, B-15, MW-12S, and MW-34S and monitoring points MP-01, MP-06, MP-07 and MP-08 have been generally stable since the full-scale injection.
  - Monitoring point MP-05 has exhibited an increasing trend in ethene and ethane concentrations since April 2007.
  - Methane concentrations in monitoring points MP-01, MP-05, and MP-06 and monitoring well B-15 have increased since the full-scale injection.
  - MP-07 and MW-34S have exhibited generally stable methane concentrations since the full-scale injection.
  - Methane concentrations detected in MP-08, MW-12S, and B-14 have been below detection limits since April 2007.

Conclusions

Physical characteristics (appearance, odor) of the ground water and elevated dissolved gas concentrations indicate that enhanced biodegradation of the northeast plume is occurring. The concentration trends appear as anticipated with variations in local soil permeability and contaminant desorption. In general, the trend plots show an initial decrease in TCE with a corresponding increase in cis-1,2-DCE. As time progressed, TCE and cis-1,2-DCE have decreased. Vinyl chloride has shown mixed response as the dechlorination transformation occurs. Although the May 2008 monitoring data show increases in TCE at B-14, decreases in other locations indicate that given enough time the TCE in B-14 will also decrease. Overall, the VOC mass of

primary volatile organic constituents (TCE, cis-1,2-DCE and Vinyl Chloride) has decreased, further demonstrating the effectiveness of the enhanced biodegradation. ERM recommends continued monitoring of the northeast plume area to determine whether additional treatment of the northeast plume will be required.

Tables

Tables

Table 1: Injection Volumes
Northeast Plume Pilot Test
Former Johnson Controls Facility
Watertown, Wisconsin

Injection Point Number	Solution Water/EOS	Total Gallons
01	10:1	~20
02	10:1	~20
03	10:1	~20
04	10:1	~20
05	5:1	60
06	5:1	180
07	5:1	120
08	5:1	120
09	5:1	60
10	5:1	60
11	5:1	120
12	5:1	180
13	5:1	180
14	5:1	120
15	5:1	180
16	5:1	180
17	5:1	180
18	5:1	90
19	5:1	90
	Total	2,000

Pilot test conducted May 1 - 3, 2007

Table 2: Injection Volumes
Northeast Plume Full-Scale Injection
Former Johnson Controls Facility
Watertown, Wisconsin

Injection Point Number	Injection Dates	Solution Water/EOS	Injection Rate (gal/min)	EOS-Total (gallons)	Water-Total (gallons)
20	8/20/07-8/21/07	5:1	0.69	57.7	13.4
21	8/20/07-8/21/07	5:1	0.91	88.5	9.5
22	8/21/07	5:1	0.58	120.3	68.8
23	8/21/07	5:1	0.56	49.9	8.3
24	8/21/07	5:1	0.16	15.7	-
25	8/21/07	5:1	0.84	131.2	100
26	8/21/07-8/23/07	5:1	0.48	130	100
27	8/21/07	5:1	0.65	130	100
28	8/21/07	5:1	0.79	129.3	101.3
29	8/21/07-8/22/07	5:1	0.38	125.7	100
30	8/21/07-8/22/07	5:1	0.91	132.2	100
31	8/21/07-8/22/07	5:1	0.43	124.8	13.5
32	8/21/07-8/22/07	5:1	0.35	113	119
33	8/22/07	5:1	1.00	130	100
34	8/22/07-8/23/07	5:1	0.54	88.8	75
35	8/22/07	5:1	0.40	136	100
36	8/22/07-8/23/07	5:1	0.24	112.7	100
37	8/22/07	5:1	0.38	130.2	100.1
38	8/22/07	5:1	0.48	139.7	102.2
39	8/22/07-8/23/07	5:1	0.51	130.2	100
40	8/23/07	5:1	0.58	130	100
41	8/23/07	5:1	0.32	33.5	-
42	8/23/07	5:1	0.76	58.6	-
43	8/24/07	5:1	0.16	19.8	-
43	9/17/2007-9/20/07	5:1	Gravity Feed	250	-
44	8/24/07	5:1	0.16	7.6	-
45	8/24/07	5:1	0.10	5.5	-
45	9/13/2007-9/17/07	5:1	Gravity Feed	250	-
46	8/24/07	5:1	0.17	9.7	-
47	8/24/07	5:1	0.16	7.8	-
47	9/20/2007-10/11/07	5:1	Gravity Feed	250	-
48	8/24/07	5:1	0.26	15.3	-
49	8/28/07	5:1	0.35	160.2	120
50	8/28/07	5:1	0.56	142.9	108
51	8/28/07	5:1	0.46	140.4	110.2
52	8/28/07	5:1	0.36	140.4	109.9
53	8/28/07-8/29/07	5:1	0.46	120	100
54	8/28/07-8/29/07	5:1	0.35	140	43.7
55	10/16/07-10/23/07	5:1	Gravity Feed	250	-
56	10/23/07-10/30/07	5:1	Gravity Feed	234	-
57	11/20/2007-11/29/07	5:1	Gravity Feed	180	-
58	10/23/07-10/30/07	5:1	Gravity Feed	270	-
59	10/23/07-10/30/07, 11/20/07-11/29/07	5:1	Gravity Feed	267	200
60	10/16/07-10/23/07	5:1	Gravity Feed	267	-
			Total	5,566	2,203

Table 3: Dissolved Gas Monitoring Results
Northeast Ground Water Plume
Former Johnson Controls Facility
Watertown, Wisconsin

Sample Number	MP-01									MP-05								
Event	Pre Injection Monitoring			Post Injection Monitoring						Pre Injection Monitoring			Post Injection Monitoring					
Date	27-Apr-07	7-Jun-07	5-Jul-07	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08	27-Apr-07	7-Jun-07	5-Jul-07	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08
Dissolved Gases	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Ethane	<14	<14	<14	**73**	**72**	**57**	<14	**99**	**109**	<14	<14	**44**	**74**	**80**	**64**	<14	**222**	<14.0
Ethene	**28**	**31**	<11	**181**	**137**	**98**	**127**	**139**	**105**	**128**	**187**	**92**	**477**	**644**	**740**	**958**	**732**	**13**
Methane	**294**	**370**	**393**	**2,520**	**2,280**	**2,350**	**2,790**	**4,820**	**863**	**290**	**487**	**692**	**4,840**	**5,900**	**6,840**	**4,920**	**11,600**	<15.0
Total	322	401	393	2,774	2,489	2,505	2,917	5,058	1,077	418	674	828	5,391	6,624	7,644	5,878	12,554	13

Sample Number	MP-06						MP-07						MP-08					
Event	Post Injection Monitoring						Post Injection Monitoring						Post Injection Monitoring -					
Date	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08
Dissolved Gases	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Ethane	<14.0	<14.0	<14.0	<14.0	**21**	**58**	**400**	**498**	**357**	**401**	**321**	**58**	<14.0	<14.0	<14.0	<14.0	<14.0	<14.0
Ethene	**13**	**39**	**43**	**58**	**36**	**53**	**240**	**276**	**189**	**189**	**74**	**53**	**31**	**23**	**54**	**168**	**16**	**13**
Methane	**629**	**1,310**	**1,070**	**2,630**	**1,140**	**3,940**	**3,660**	**3,850**	**2,710**	**3,480**	**3,570**	**3,940**	<15.0	<15.0	**7,100**	**372**	**34**	**16**
Total	642	1,349	1,113	2,688	1,197	4,052	4,300	4,624	3,256	4,070	3,965	4,052	31	23	7,154	540	50	29

Sample Number	B-14						B-15					
Event	Post Injection Monitoring						Post Injection Monitoring					
Date	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08
Dissolved Gases	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Ethane	<14.0	<14.0	<14.0	<14.0	<14.0	<14.0	**54**	**48**	**85**	<14.0	**78**	**82**
Ethene	**12**	**13**	<11.0	<11.0	**12**	**13**	**28**	**25**	<11.0	**44**	**44**	**52**
Methane	<15.0	<15.0	<15.0	<15.0	<15.0	<15.0	**2,190**	**2,050**	**3,310**	**3,150**	**4,640**	**4,470**
Total	12	13	0	0	12	13	2,272	2,123	3,395	3,194	4,762	4,604

Sample Number	MW-34S						MW-12S					
Event	Post Injection Monitoring						Post Injection Monitoring					
Date	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08	13-Sep-07	27-Sep-07	11-Oct-07	20-Dec-07	22-Jan-08	28-Feb-08
Dissolved Gases	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Ethane	<14.0	<14.0	**21**	<14.0	**19**	<14.0	<14.0	<14.0	<14.0	<14.0	<14.0	<14.0
Ethene	**37**	**20**	**44**	**46**	**35**	**29**	**12**	**12**	<11.0	<11.0	**12**	**125**
Methane	**169**	<15.0	**407**	**388**	**314**	**178**	<15.0	<15.0	<15.0	<15.0	<15.0	<15.0
Total	206	20	472	434	368	207	12	12	0	0	12	125

Key

ug/L = micrograms per liter

Bold values indicate concentrations above the laboratory detection limit

Table 4: Volatile Organic Compound Monitoring Results
Northeast Ground Water Plume
Former Johnson Controls Facility
Watertown, Wisconsin

Sample Number		MP-01			MP-02			MP-03					MP-04			MP-05				
Injection Event		Pre Pilot	Post Pilot; Pre Full-Scale	Post Full-Scale	Pre Pilot	Post Pilot; Pre Full-Scale	Post Full-Scale	Pre Pilot	Post Pilot; Pre Full-Scale	Post Full-Scale			Pre Pilot	Post Pilot; Pre Full-Scale	Post Full-Scale	Pre Pilot	Post Pilot; Pre Full-Scale	Post Full-Scale		
Sample Date		27-Apr-07	31-Jul-07	26-Nov-07	27-Apr-07	31-Jul-07	26-Nov-07	27-Apr-07	31-Jul-07	26-Nov-07	28-Feb-08	2-May-08	27-Apr-07	31-Jul-07	26-Nov-07	27-Apr-07	31-Jul-07	26-Nov-07	28-Feb-08	2-May-08
Volatile Organic Compounds	ES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Benzene	5	0.2 U	2.0 U	2.0 U	0.2 U	2.0 U	4.0 U	1.3	40 U	64 U	40 U	32 U	4.0 U	40 U	4.0 U	4.0 U	8.0 U	16 U	0.2 U	0.2 U
Chloroform	6	0.2 U	2.0 U	2.0 U	0.48	2.0 U	4.0 U	0.2 U	40 U	64 U	40 U	32 U	4.0 U	40 U	4.0 U	4.0 U	8.0 U	16 U	0.2 U	0.2 U
1,1-Dichloroethane	850	0.64	5.0 U	5.0 U	1	5.0 U	10 U	61	120	160 U	100 U	90	10 U	100 U	10 U	10 U	20 U	40 U	3.6	2.5
1,1-Dichloroethene	7	2.8	5.0 U	5.0 U	18	6.3	10 U	63	130	160 U	100 U	80 U	25	100 U	10 U	10 U	20 U	40 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	750	2,100	550	4,300	4,500	1,000	8,700	26,000	29,000	15,000	11,000	9,000	12,000	1,500	3,000	5,600	6,300	45	13
trans-1,2-Dichloroethene	100	6.2	15	5.0 U	29	47	10 U	92	250	210	120	80 U	62	100 U	45	22	40	72	12	0.5 U
Isopropylbenzene	NA	0.2 U	2.0 U	2.0 U	0.37	2.0 U	4.0 U	0.31	40 U	64 U	40 U	32 U	4.0 U	40 U	4.0 U	4.0 U	8.0 U	16 U	0.2 U	0.2 U
Tetrachlorethene	5	5.3	5.0 U	5.0 U	3.4	5.0 U	10 U	28	100 U	160 U	100 U	80 U	10 U	100 U	10 U	10 U	20 U	40 U	0.5 U	0.5 U
Toluene	1	0.2 U	2.0 U	2.0 U	0.62	2.0 U	4.0 U	2.4	40 U	64 U	40 U	32 U	4.0 U	40 U	4.0 U	4.0 U	8.0 U	16 U	0.67	0.72
1,1,1-Trichloroethane	200	0.5 U	5.0 U	5.0 U	2.2	5.0 U	10 U	90	140	210	100 U	80 U	10 U	100 U	100 U	10 U	20 U	40 U	0.5 U	0.5 U
Trichloroethene	5	220	310	20	880	110	160	14,000	10,000	9,100	7,600	5,100	2,000	360	1,000	250	280	2,000	0.2 U	0.31
Vinyl Choride	0.2	86	200	160	590	3200	520	1,400	810	2,600	3,100	1,500	1,000	1300	780	800	760	2,400	37	14
Total Xylenes	10	0.5 U	5.0 U	5.0 U	0.56	5.0 U	10 U	1.3	100 U	160 U	100 U	80 U	10 U	100 U	10 U	10 U	20 U	40 U	0.5 U	0.71
Total VOC Mass (umol/L)[1]		11	27	8	61	99	20	222	363	414	263	177	125	147	36	46	72	119	1	0.4

Sample Number		B-14					MW-12S		MW-34S				B-15				MP-06		MP-07		MP-08	
Injection Event		Pre Pilot	Post Pilot; Pre Full-Scale	Post Full-Scale			Pre Pilot	Post Full-Scale	Pre Pilot	Post Full-Scle			Pre Pilot	Post Full-Scle			Pre Pilot	Post Full-Scale	Pre Pilot	Post Full-Scale	Pre Pilot	Post Full-Scale
Sample Date		4-Dec-06	12-Jul-07	29-Nov-07	28-Feb-08	2-May-08	4-Dec-06	26-Nov-07	4-Dec-06	26-Nov-07	28-Feb-08	2-May-08	27-Apr-07	20-Dec-07	28-Feb-08	2-May-08	26-Jun-07	26-Nov-07	26-Jun-07	26-Nov-07	26-Jun-07	26-Nov-07
Volatile Organic Compounds	ES	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Benzene	5	6.4 U	0.2 U	4.0 U	5.0 U	6.4 U	0.2 U	0.2 U	0.4 U	1.6 U	0.2 U	0.2 U	4.0 U	2.0 U	2.0 U	2.0 U	4.0 U	0.4 U	4.0 U	8.0 U	4.0 U	4.0 U
Chloroform	6	6.4 U	0.2 U	4.0 U	5.0 U	6.4 U	0.2 U	0.2 U	0.4 U	1.6 U	0.2 U	0.2 U	4.0 U	2.0 U	2.0 U	2.0 U	4.0 U	0.4 U	4.0 U	8.0 U	4.0 U	4.0 U
1,1-Dichloroethane	850	16 U	0.5 U	10 U	12 U	16 U	0.5 U	0.5 U	1.0 U	4.0 U	1	0.5 U	10 U	5.0 U	5.0 U	5.0 U	10 U	2.6	10 U	20 U	16	10 U
1,1-Dichloroethene	7	16 U	2.8	10 U	12 U	16 U	0.5 U	0.5 U	1.0 U	4.0 U	0.5 U	0.5 U	10 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	10 U	20 U	10 U	10 U
cis-1,2-Dichloroethene	70	130	840	55	110	150	4.0	0.9	93	420	130	29	1,000	980	630	370	350	110	3,400	2,900	3,800	1,300
trans-1,2-Dichloroethene	100	16 U	2.8	10 U	12 U	16 U	0.5 U	0.5 U	1.6	4.0 U	2	0.5 U	12	11	10	5.0 U	10 U	3.6	31	29	36	15
Isopropylbenzene	NA	6.4 U	0.2 U	4.0 U	5.0 U	6.4 U	0.2 U	0.2 U	0.4 U	1.6 U	0.2 U	0.2 U	4.0 U	2.0 U	2.0 U	2.0 U	4.0 U	0.4 U	4.0 U	8.0 U	4.0 U	4.0 U
Tetrachlorethene	5	16 U	0.5 U	10 U	12 U	16 U	0.5 U	0.5 U	1.0 U	4.0 U	0.5 U	0.5 U	10 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	10 U	20 U	10 U	10 U
Toluene	1	6.4 U	0.20	4.0 U	5.0 U	6.4 U	0.2 U	0.2 U	0.4 U	1.6 U	0.2 U	0.2 U	4.0 U	2.0 U	2.0 U	2.0 U	4.0 U	0.4 U	4.0 U	8.0 U	4.0 U	4.0 U
1,1,1-Trichloroethane	200	16 U	0.5 U	10 U	12 U	16 U	0.5 U	0.5 U	1.0 U	4.0 U	0.5 U	0.5 U	10 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	10 U	20 U	10 U	10 U
Trichloroethene	5	1,800	1,500	1,400	1,900	2,200	90	16	0.4 U	4.8	0.2 U	0.2 U	16	9.3	6.5	3.5	20	19	4.0	8.0 U	65	14
Vinyl Choride	0.2	6.4 U	2.5	4.0 U	5.0 U	6.4 U	0.2 U	0.2 U	14	72	28	6.2	110	74	60	23	74	13	330	310	750	160
Total Xylenes	10	16 U	0.5 U	10 U	12 U	16 U	0.5 U	0.5 U	1.0 U	4.0 U	0.5 U	0.5 U	10 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	10 U	20 U	10 U	10 U
Total VOC Mass, umol/L[1]		15	20	11	16	18	1	0.1	1	6	2	0.4	12	11	8	4	5	2	41	35	52	16

KEY

Bold values indicate an exceedence of the WDNR Enforcement Standard (ES)

ES = Enforcement Standard

NA = Not applicable

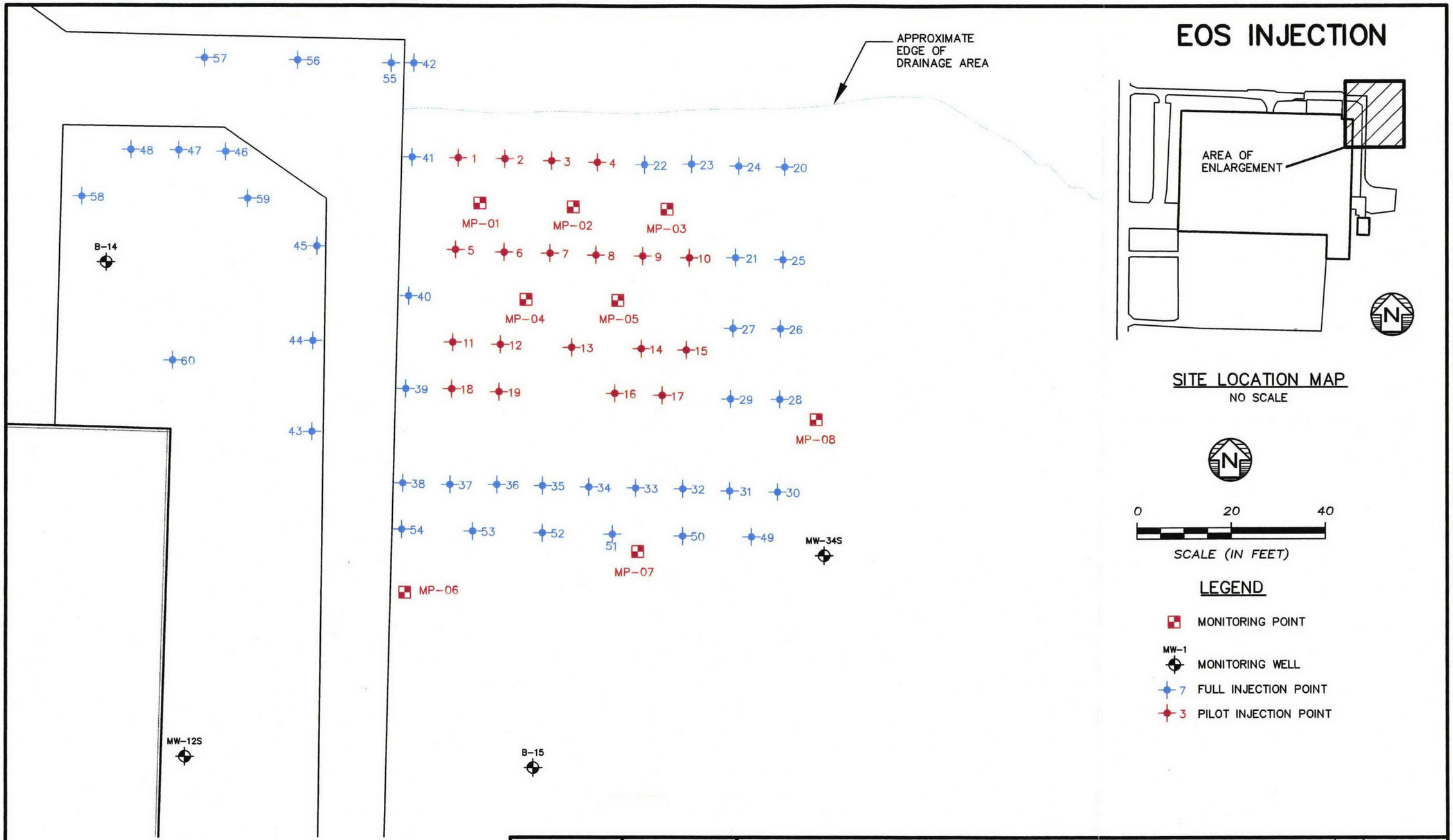
U = Constituent not detected above the reported value.

NOTES

1 VOC Mass calculated by dividing the constituent concentration by the constituent molecular weight.

Figures

EOS INJECTION



Drawn By DWS	ERM	FORMER JOHNSON CONTROLS FACILITY	CHK'D BK
CADD Review RMK		WATERTOWN, WISCONSIN	0055277
Date Drawn/Rev'd 10/5/2006		Environmental Resources Management	FIGURE 2

R:\CADD\Cintl-L\Johnson Controls\Watertown\Kappen-Brian\0055277\0055277-02_recover.dwg, FIGURE 2, 1/29/2008 1:45:05 PM, RMK - HOLLAND

Figure 2
Dissolved Methane Concentrations in Ground Water
Northeast Ground Water Plume
Former Johnson Controls Facility
Watertown, Wisconsin

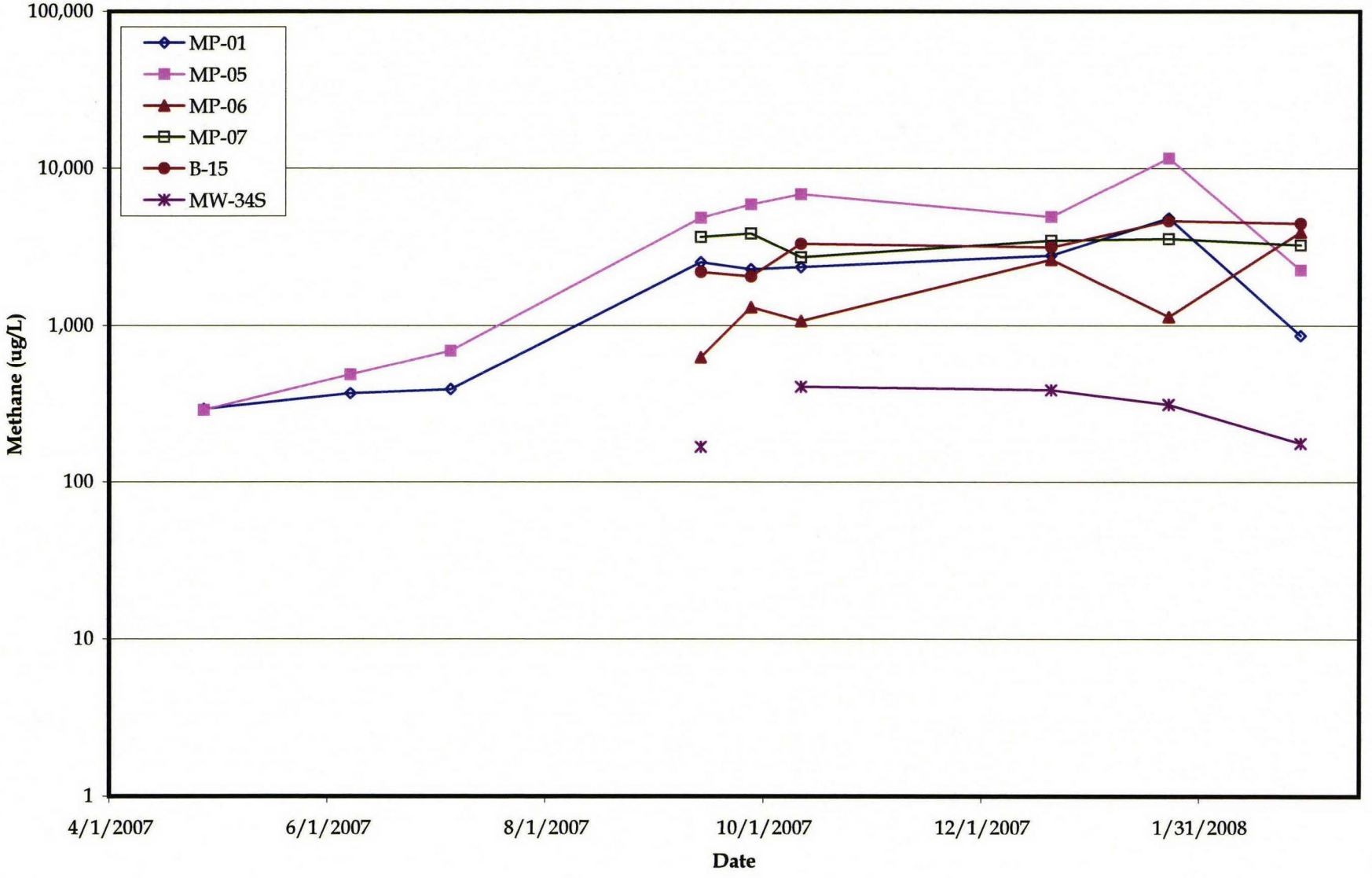


Figure 3
Trichloroethene Concentrations in Ground Water
Northeast Ground Water Plume
Former Johnson Controls Facility
Watertown, Wisconsin

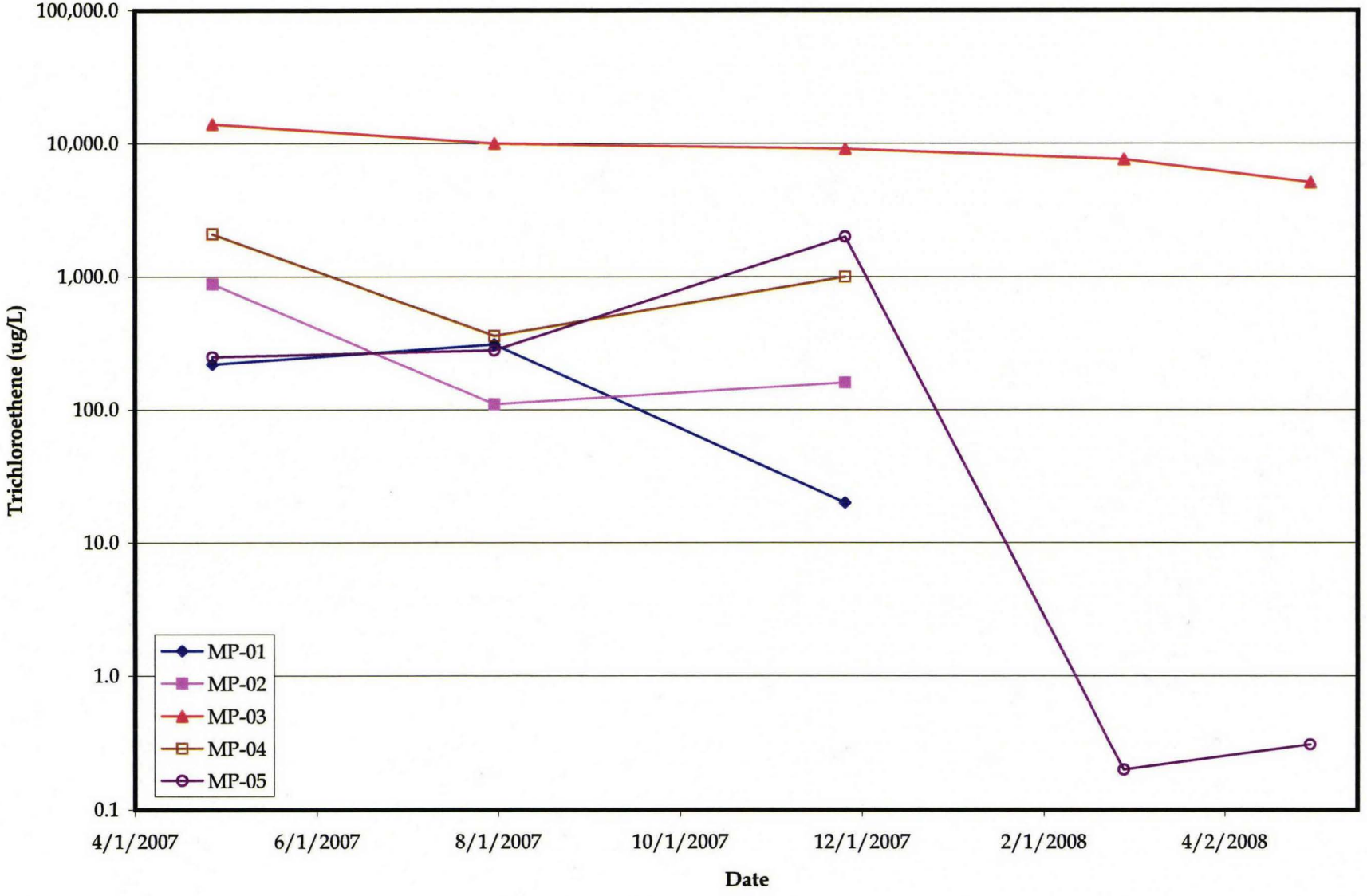


Figure 4
cis-1,2-Dichloroethene Concentrations in Ground Water
Northeast Ground Water Plume
Former Johnson Controls Facility
Watertown, Wisconsin

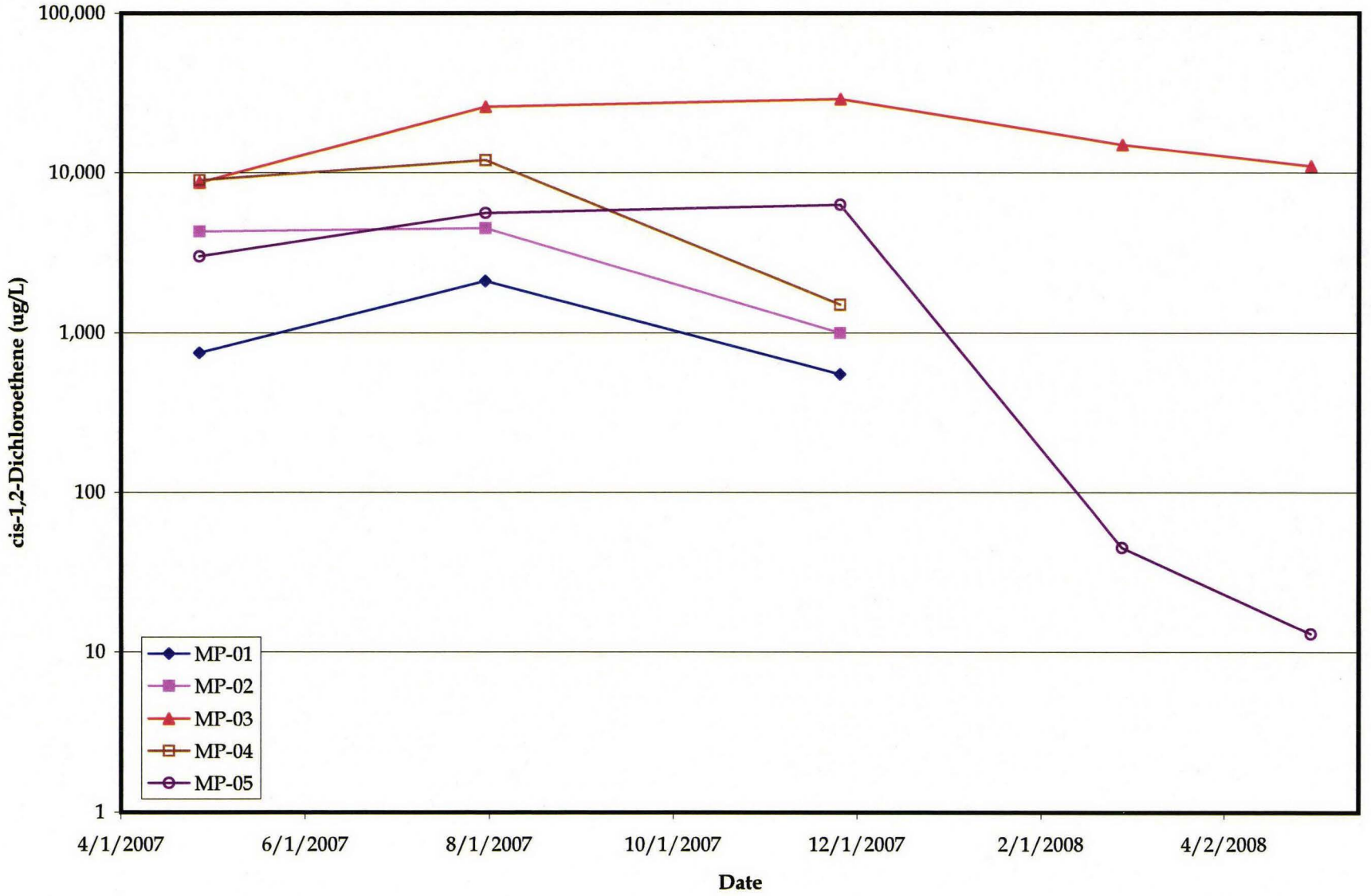
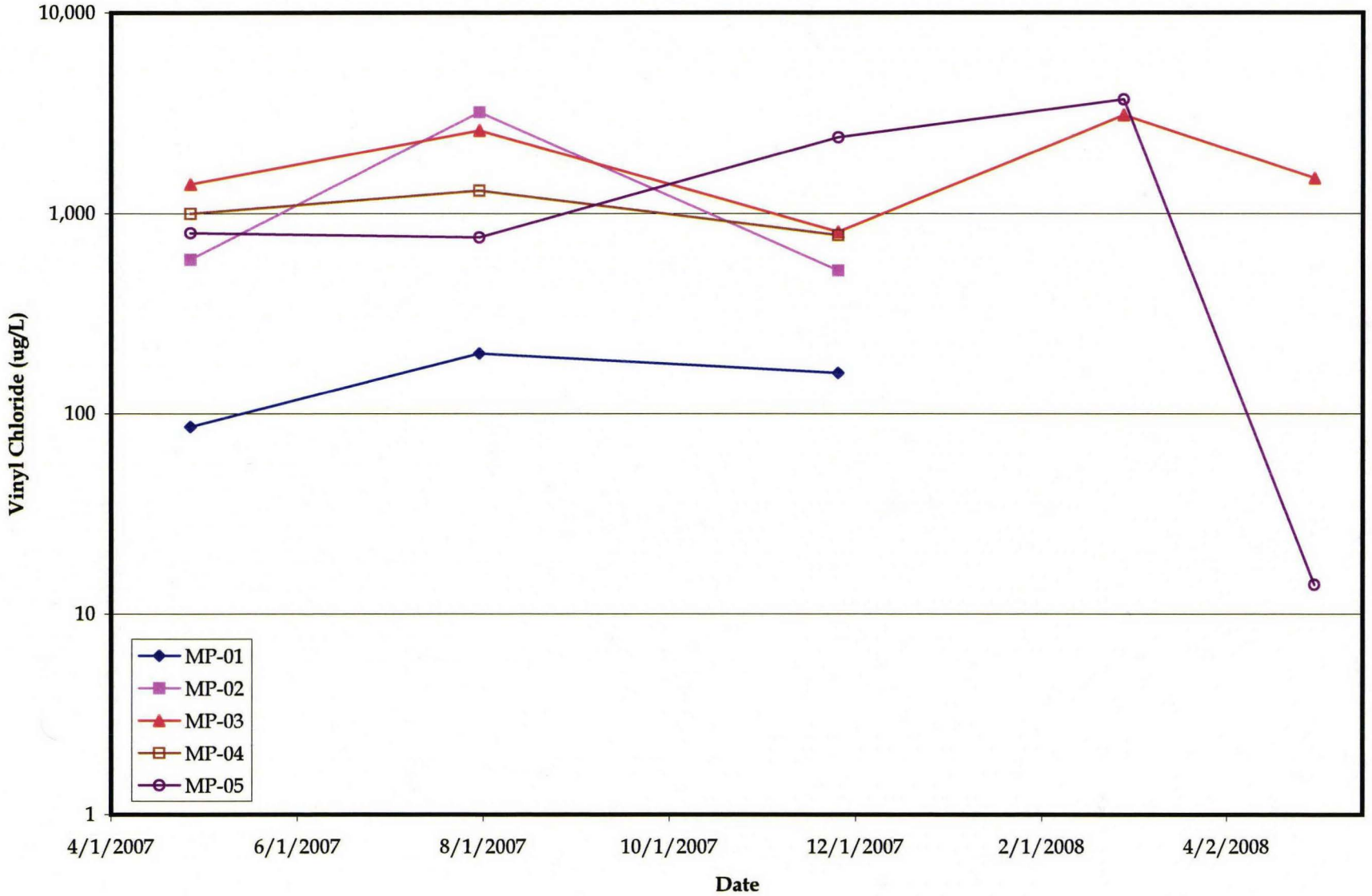



Figure 5
Vinyl Chloride Concentrations in Ground Water
Northeast Ground Water Plume
Former Johnson Controls Facility
Watertown, Wisconsin