Semi-Annual Groundwater Sampling and Analysis Report

Prepared for

Cherokee County Closed Landfill
Marble, North Carolina

February, 2006

Permit Number: 20-01
MESCO Project Number: G06006.0

Completed on August 17, 2006

Municipal Services Engineering Company, P.A.
Garner, NC Boone, NC

Municipal Engineering Services Company, P.A.
Garner, Boone and Morehead City, North Carolina

OPERATION/CONSTRUCTION MANAGERS

Municipal Services

CIVIL/SANITARY ENGINEERS

Engineering Company, P.A.

August 30, 2006

Mr. Ethan Brown
Solid Waste Section
Division of Waste Management
North Carolina Department of Environment and Natural Resources
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Re: Groundwater Sampling and Analysis
Cherokee County Closed Sanitary Landfill
Permit No. 20-01
MESCO Project No. G06006.0

Dear Mr. Brown:

The Cherokee County Closed Sanitary Landfill located in Marble NC was sampled and analyzed by Pace Analytical Services, Inc. (PACE) of Asheville, North Carolina, on February 22, 2006. The monitoring plan for the closed MSWLF consists of downgradient wells MW-1, MW-3, MW-4R, MW-5, MW-6, MW-6R, MW-7, and background wells MW-2 and MW-2R. Residential supply wells for all of the neighboring properties labeled as Rathbone, Van Buskirk (Haney), Pendergrass, and Solesbee. The surface water sampling point along the Valley river upstream of the facility named SW-1. The down stream surface monitoring locations SW-2 and SW-4 were sampled concurrently and were reported with the Subtitle D Landfill report previously submitted on August 17, 2006. Water samples were obtained from all of the monitoring locations during this event. The samples were analyzed for the complete set of Appendix I constituents as well as for the specific Appendix II compounds previously detected which included only the semi-volatile compound naphthalene within MW-6.

All detected constituents were analyzed for regulatory exceedance with reference to North Carolina Groundwater NCGW2L Standards. The results are shown in the enclosed tables titled "Exceedance Scan". The laboratory continues to analyze the samples utilizing a more stringent detection limit than recommended by the Section therefore several more metals are shown as detected than otherwise would be. Therefore the data was "filtered" with all metal concentrations found below the Sections recommended PQL were treated as ND for the separate "Exceedance Scan" only. The number of detected metals after removing those below the recommended limits decreased 57% from 75 to 32. The raw laboratory data has been left unaltered. The following table (Table 1) summarizes those metal constituents that exceeded the Standard.

Table 1. Exceedance Summary (Metals)

Well	Lead	Chromium	Nickel	Zinc
MW-2	x		x	
MW-2R	x	x	x	x
MW-3	x			
MW-6R	x			

x = concentration greater than NCGW2L Standard

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Inorganic constituents (Metals) continue to be detected within all of the monitoring sites when utilizing the more stringent PQL's the laboratory employs. The youngest wells MW-2R, and MW-6R as well as the background wells MW-2 and MW-2R continue to contain the highest number and concentration of metals. All of the metals were found within there historical range during this event. The origination of the total metals is likely natural which is elevated due to the culmination of turbidity and HCL which is utilized as a preservative. With further well development and adequate purging prior to sampling a decrease in total metals would be expected.

Volatile Organic Compounds (VOCs) were detected within downgradient monitoring wells MW-1, MW-5, MW-66, and the water supply well for the Rathbone residence. Table 2 illustrates the monitoring wells that were found to contain VOCs above the MCL during this sampling event.

Table 2. Exceedance Summary (VOCs)

Well	1,4-Dichlorobenzene
MW-1	x
MW-5	x
MW-6	x

x = concentration greater than NCGW2L Standard

The purgeable aromatic 1,4-dichlorobenzene was the only VOC detected above the Standard during the latest sampling event. However, none of the VOC concentrations were found outside of the historical identifiable range and an increasing trend is not evident.

A water sample obtained from background well MW-2 was free of all VOC detections for the second consecutive event. VOC concentrations in this area have been decreasing during the latest sampling events indicating that natural attenuation is ongoing.

The residential supply well that serves the Rathbone residence, located west of MW-6R, was found to contain a premier VOC. The Rathbone supply well contained a slight concentration of the trihalomethane chloroform well below both the drinking and groundwater standards. Mr. Rathbone was interviewed and it was discovered that he recently had his well disinfected with chlorine. Therefore the presence of chloroform is very likely a byproduct of the chlorination process and not attributed to leachate originating from the closed landfill.

Municipal Engineering Services Company, P.A. (MESCO) completed the enclosed potentiometric map with groundwater elevations on the day of sampling, flow rates and direction. Time Series graphs for MW-1, MW-4R, MW-5, and MW-6 are also included. The closed landfill is scheduled to be sampled concurrently with the Subtitle D landfill in August 2006. During the next sampling event all monitoring locations will be sampled for the Appendix I list and MW-6 will also continue to be analyzed for naphthalene. If you have any questions or comments regarding this report, please contact me at (919) 772-5393 or by email at jpfohl@mesco.com.

Sincerely,
MUNICIPAL ENGINEERING SERVICES CO., P.A.

Jonathan Pfohl
Environmental Specialist

Enclosures
cc: Mr. Robert Allen
Cherokee County

Exceedance Scan (Unfiltered based upon lab using MDL values NOT the Section's recommended PQL)
Cherokee County Closed Landfill

Well ID	Parameter Name[1]	Sample Date	Result	Unit	PQL[2]	NCGW2L[3]	Exceedance
MW-1	Copper	02/22/2006	0.0082	mg/l	0.0020	1	
MW-1	Vanadium	02/22/2006	0.009	mg/l	0.0050		
MW-1	Lead	02/22/2006	0.0068	mg/l	0.0050	0.015	
MW-1	Nickel	02/22/2006	0.017	mg/l	0.0050	0.1	
MW-1	Barium	02/22/2006	0.091	mg/l	0.0050	2	
MW-1	Chromium	02/22/2006	0.008	mg/l	0.0020	0.05	
MW-1	Zinc	02/22/2006	0.032	mg/l	0.010	1.05	
MW-1	Cobalt	02/22/2006	0.036	mg/l	0.0050		
MW-2	**Lead**	**02/22/2006**	**0.038**	**mg/l**	**0.0050**	**0.015**	**0.023**
MW-2	Chromium	02/22/2006	0.018	mg/l	0.0020	0.05	
MW-2	Cobalt	02/22/2006	0.16	mg/l	0.0050		
MW-2	Copper	02/22/2006	0.046	mg/l	0.0020	1	
MW-2	Beryllium	02/22/2006	0.0046	mg/l	0.0010		
MW-2	Vanadium	02/22/2006	0.019	mg/l	0.0050		
MW-2	Barium	02/22/2006	0.4	mg/l	0.0050	2	
MW-2	Zinc	02/22/2006	0.37	mg/l	0.010	1.05	
MW-2	**Nickel**	**02/22/2006**	**0.15**	**mg/l**	**0.0050**	**0.1**	**0.05**
MW-2R	**Zinc**	**02/22/2006**	**1.2**	**mg/l**	**0.010**	**1.05**	**0.15**
MW-2R	Vanadium	02/22/2006	0.096	mg/l	0.0050		
MW-2R	**Chromium**	**02/22/2006**	**0.18**	**mg/l**	**0.0020**	**0.05**	**0.13**
MW-2R	Cobalt	02/22/2006	0.15	mg/l	0.0050		
MW-2R	Tin	02/22/2006	0.0058	mg/l	0.0050		
MW-2R	**Nickel**	**02/22/2006**	**0.69**	**mg/l**	**0.0050**	**0.1**	**0.59**
MW-2R	**Lead**	**02/22/2006**	**0.072**	**mg/l**	**0.0050**	**0.015**	**0.057**
MW-2R	Copper	02/22/2006	0.18	mg/l	0.0020	1	
MW-2R	Thallium	02/22/2006	0.012	mg/l	0.010		
MW-2R	Arsenic	02/22/2006	0.014	mg/l	0.0050	0.05	
MW-2R	Barium	02/22/2006	0.73	mg/l	0.0050	2	
MW-2R	Beryllium	02/22/2006	0.011	mg/l	0.0010		
MW-3	Copper	02/22/2006	0.011	mg/l	0.0020	1	
MW-3	Nickel	02/22/2006	0.015	mg/l	0.0050	0.1	
MW-3	Cobalt	02/22/2006	0.045	mg/l	0.0050		
MW-3	**Lead**	**02/22/2006**	**0.019**	**mg/l**	**0.0050**	**0.015**	**0.004**
MW-3	Zinc	02/22/2006	0.17	mg/l	0.010	1.05	
MW-3	Chromium	02/22/2006	0.02	mg/l	0.0020	0.05	
MW-3	Barium	02/22/2006	0.17	mg/l	0.0050	2	
MW-4R	Zinc	02/22/2006	0.092	mg/l	0.010	1.05	
MW-4R	Barium	02/22/2006	0.062	mg/l	0.0050	2	
MW-4R	Cobalt	02/22/2006	0.015	mg/l	0.0050		
MW-5	Vanadium	02/22/2006	0.0054	mg/l	0.0050		
MW-5	Barium	02/22/2006	0.052	mg/l	0.0050	2	
MW-5	Zinc	02/22/2006	0.036	mg/l	0.010	1.05	
MW-5	Chromium	02/22/2006	0.0068	mg/l	0.0020	0.05	
MW-5	Nickel	02/22/2006	0.012	mg/l	0.0050	0.1	
MW-6	Nickel	02/22/2006	0.02	mg/l	0.0050	0.1	
MW-6	Selenium	02/22/2006	0.0057	mg/l	0.0050	0.05	
MW-6	Cobalt	02/22/2006	0.023	mg/l	0.0050		
MW-6	Barium	02/22/2006	0.17	mg/l	0.0050	2	
MW-6	Vanadium	02/22/2006	0.015	mg/l	0.0050		
MW-6	Beryllium	02/22/2006	0.002	mg/l	0.0010		

MW-6	Chromium	02/22/2006	0.013	mg/l	0.0020	0.05	
MW-6	Zinc	02/22/2006	0.055	mg/l	0.010	1.05	
MW-6	Lead	02/22/2006	0.012	mg/l	0.0050	0.015	
MW-6	Copper	02/22/2006	0.013	mg/l	0.0020	1	
MW-6R	Beryllium	02/22/2006	0.0037	mg/l	0.0010		
MW-6R	Zinc	02/22/2006	0.065	mg/l	0.010	1.05	
MW-6R	Nickel	02/22/2006	0.015	mg/l	0.0050	0.1	
MW-6R	Vanadium	02/22/2006	0.016	mg/l	0.0050		
MW-6R	Chromium	02/22/2006	0.016	mg/l	0.0020	0.05	
MW-6R	Copper	02/22/2006	0.028	mg/l	0.0020	1	
MW-6R	Barium	02/22/2006	0.54	mg/l	0.0050	2	
MW-6R	**Lead**	**02/22/2006**	**0.028**	**mg/l**	**0.0050**	**0.015**	**0.013**
MW-6R	Cobalt	02/22/2006	0.0077	mg/l	0.0050		
MW-7	Zinc	02/22/2006	0.013	mg/l	0.010	1.05	
MW-7	Barium	02/22/2006	0.087	mg/l	0.0050	2	
MW-7	Cobalt	02/22/2006	0.071	mg/l	0.0050		
Pendergrass	Barium	02/22/2006	0.0075	mg/l	0.0050	2	
Pendergrass	Copper	02/22/2006	0.053	mg/l	0.0020	1	
Pendergrass	Zinc	02/22/2006	0.032	mg/l	0.010	1.05	
Rathbone	Zinc	02/22/2006	0.015	mg/l	0.010	1.05	
Rathbone	Copper	02/22/2006	0.0085	mg/l	0.0020	1	
Solesbee	Barium	02/22/2006	0.0064	mg/l	0.0050	2	
SW-1	Zinc	02/22/2006	0.012	mg/l	0.010	1.05	
Van Buskirk (Haney)	Zinc	02/22/2006	0.018	mg/l	0.010	1.05	
Van Buskirk (Haney)	Barium	02/22/2006	0.029	mg/l	0.0050	2	
Van Buskirk (Haney)	Copper	02/22/2006	0.0084	mg/l	0.0020	1	
MW-1	Chlorobenzene	02/22/2006	6.2	ug/l	5.0	50	
MW-1	**1,4-Dichlorobenzene**	**02/22/2006**	**11**	**ug/l**	**5.0**	**1.4**	**9.6**
MW-5	**1,4-Dichlorobenzene**	**02/22/2006**	**9.3**	**ug/l**	**5.0**	**1.4**	**7.9**
MW-5	Chlorobenzene	02/22/2006	6.3	ug/l	5.0	50	
MW-6	Chlorobenzene	02/22/2006	13	ug/l	5.0	50	
MW-6	Naphthalene	02/22/2006	14	ug/l	5.0	21	
MW-6	**1,4-Dichlorobenzene**	**02/22/2006**	**21**	**ug/l**	**5.0**	**1.4**	**19.6**
Rathbone	Chloroform	02/22/2006	15	ug/l	5.0	70	

[1] Table only contains detected constituents.

[2] PQL = Practical Quantitation Limit

[3] NCGW2L = North Carolina Ground Water 2L Standard

Exceedance Scan (Filtered based upon Section's recommended PQL)
Cherokee County Closed Landfill

Well ID	Parameter Name[1]	Sample Date	Result	Unit	PQL[2]	NCGW2L[3]	Exceedance
MW-1	Cobalt	02/22/2006	0.036	mg/l	0.0050		
MW-2	Beryllium	02/22/2006	0.0046	mg/l	0.0010		
MW-2	Chromium	02/22/2006	0.018	mg/l	0.0020	0.05	
MW-2	Cobalt	02/22/2006	0.16	mg/l	0.0050		
MW-2	**Lead**	**02/22/2006**	**0.038**	**mg/l**	**0.0050**	**0.015**	**0.023**
MW-2	**Nickel**	**02/22/2006**	**0.15**	**mg/l**	**0.0050**	**0.1**	**0.05**
MW-2	Zinc	02/22/2006	0.37	mg/l	0.010	1.05	
MW-2R	Arsenic	02/22/2006	0.014	mg/l	0.0050	0.05	
MW-2R	Barium	02/22/2006	0.73	mg/l	0.0050	2	
MW-2R	Beryllium	02/22/2006	0.011	mg/l	0.0010		
MW-2R	**Chromium**	**02/22/2006**	**0.18**	**mg/l**	**0.0020**	**0.05**	**0.13**
MW-2R	Cobalt	02/22/2006	0.15	mg/l	0.0050		
MW-2R	**Lead**	**02/22/2006**	**0.072**	**mg/l**	**0.0050**	**0.015**	**0.057**
MW-2R	**Nickel**	**02/22/2006**	**0.69**	**mg/l**	**0.0050**	**0.1**	**0.59**
MW-2R	Thallium	02/22/2006	0.012	mg/l	0.010		
MW-2R	Tin	02/22/2006	0.0058	mg/l	0.0050		
MW-2R	**Zinc**	**02/22/2006**	**1.2**	**mg/l**	**0.010**	**1.05**	**0.15**
MW-3	Chromium	02/22/2006	0.02	mg/l	0.0020	0.05	
MW-3	Cobalt	02/22/2006	0.045	mg/l	0.0050		
MW-3	**Lead**	**02/22/2006**	**0.019**	**mg/l**	**0.0050**	**0.015**	**0.004**
MW-3	Zinc	02/22/2006	0.17	mg/l	0.010	1.05	
MW-4R	Cobalt	02/22/2006	0.015	mg/l	0.0050		
MW-4R	Zinc	02/22/2006	0.092	mg/l	0.010	1.05	
MW-6	Chromium	02/22/2006	0.013	mg/l	0.0020	0.05	
MW-6	Cobalt	02/22/2006	0.023	mg/l	0.0050		
MW-6	Lead	02/22/2006	0.012	mg/l	0.0050	0.015	
MW-6	Zinc	02/22/2006	0.055	mg/l	0.010	1.05	
MW-6R	Barium	02/22/2006	0.54	mg/l	0.0050	2	
MW-6R	Beryllium	02/22/2006	0.0037	mg/l	0.0010		
MW-6R	Chromium	02/22/2006	0.016	mg/l	0.0020	0.05	
MW-6R	**Lead**	**02/22/2006**	**0.028**	**mg/l**	**0.0050**	**0.015**	**0.013**
MW-6R	Zinc	02/22/2006	0.065	mg/l	0.010	1.05	
MW-7	Cobalt	02/22/2006	0.071	mg/l	0.0050		
MW-1	**1,4-Dichlorobenzene**	**02/22/2006**	**11**	**ug/l**	**5.0**	**1.4**	**9.6**
MW-1	Chlorobenzene	02/22/2006	6.2	ug/l	5.0	50	
MW-5	**1,4-Dichlorobenzene**	**02/22/2006**	**9.3**	**ug/l**	**5.0**	**1.4**	**7.9**
MW-5	Chlorobenzene	02/22/2006	6.3	ug/l	5.0	50	
MW-6	**1,4-Dichlorobenzene**	**02/22/2006**	**21**	**ug/l**	**5.0**	**1.4**	**19.6**
MW-6	Chlorobenzene	02/22/2006	13	ug/l	5.0	50	
MW-6	Naphthalene	02/22/2006	14	ug/l	5.0	21	
Rathbone	Chloroform	02/22/2006	15	ug/l	5.0	70	

[1] Table only contains detected constituents.
[2] PQL = Practical Quantitation Limit
[3] NCGW2L = North Carolina Ground Water 2L Standard

Hydrologic Properties at Monitoring Well Locations
Cherokee County Closed Landfill

Monitoring Well	Hydraulic Conductivity (cm/sec)	Effective Porosity (%)	Hydraulic Gradient	Flow Rate (ft/yr)	Flow Direction	Water Table Depth (ft)	Water Table Elev. (ft)
MW-1	5.50E-04	15%	0.01	40.0	N41W	2.9	1638.98
MW-2	4.40E-04	15%	0.06	182.7	N57W	23	1694.97
MW-2R	n/a	n/a	n/a	n/a	N57W	9.18	1697.44
MW-3	1.50E-03	15%	0.06	609.1	N50W	4.53	1684.04
MW-4R	3.50E-04	15%	0.06	143.2	N45W	5.6	1641.59
MW-5	1.20E-04	20%	0.06	36.4	N51W	3.68	1640.93
MW-6	5.10E-05	15%	0.06	21.6	N63W	30.23	1657.72
MW-6R	n/a	n/a	n/a	n/a	N63W	9.47	1656.34
MW-7	2.90E-04	5%	0.03	192.6	N20W	3.82	1643.03

NOTE: Data for conductivities and effective porosity obtained from GAI Consultants' Water Sampling Report

Hydrologic Gradient taken from the February 22, 2006 sampling event.

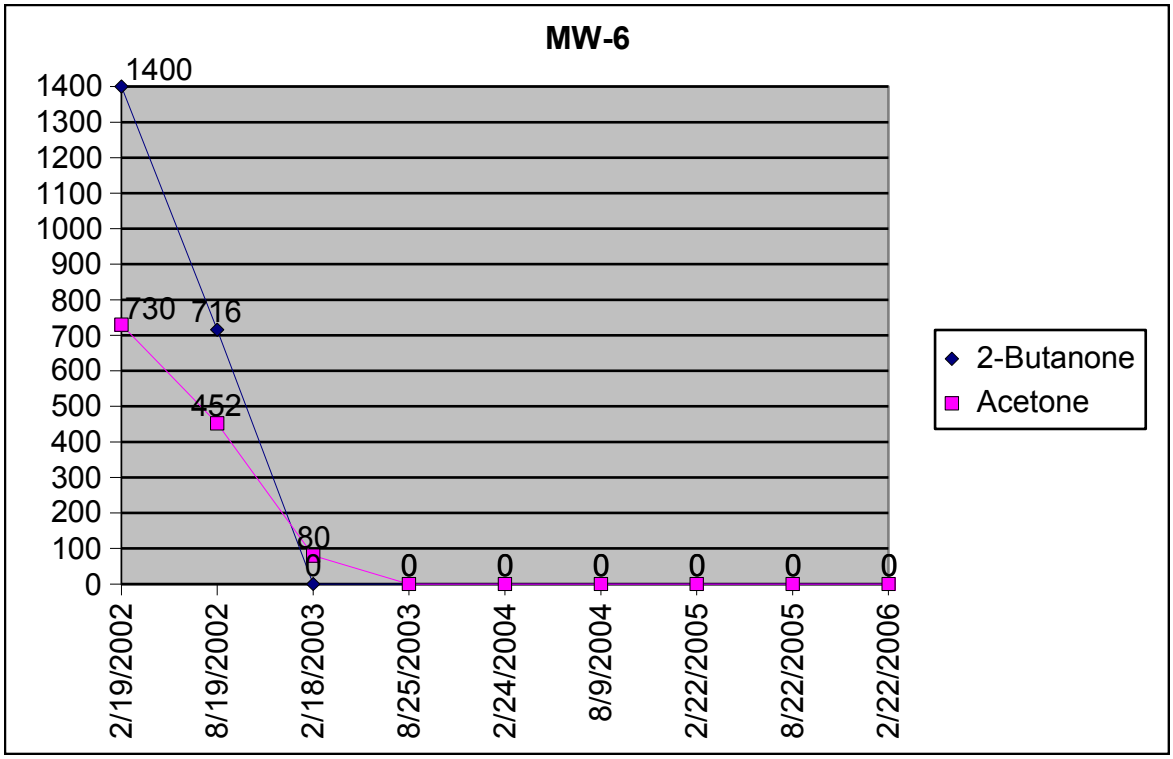
Flow rate (Q) is defined by the equation:

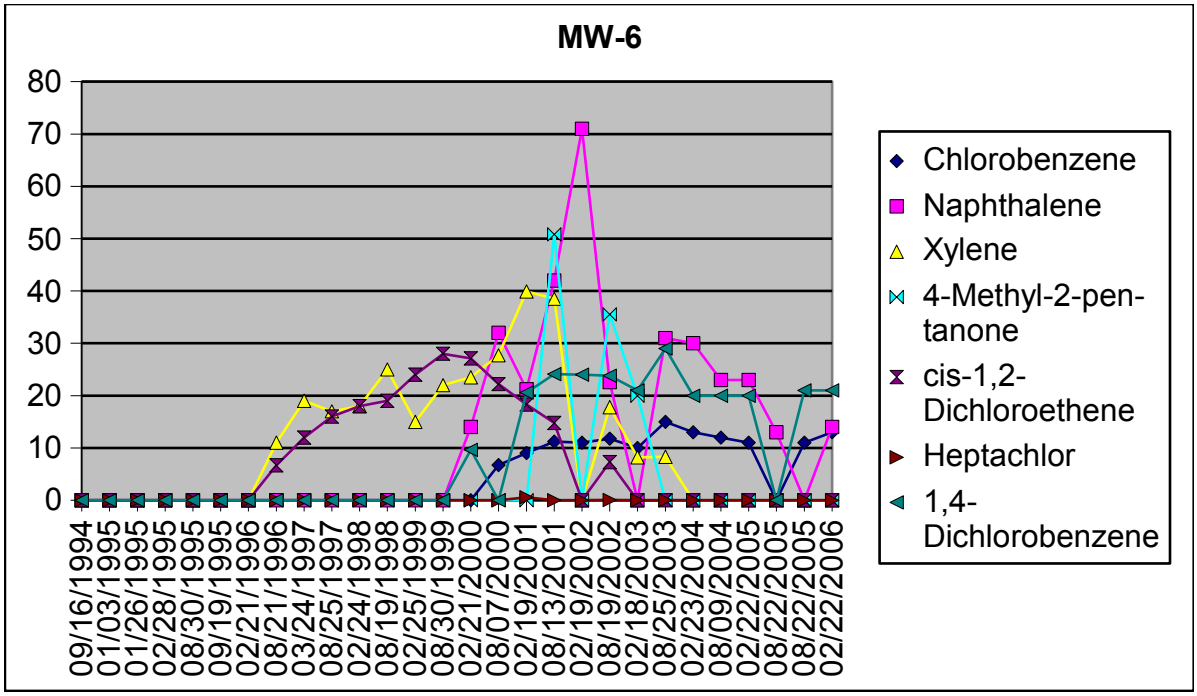
where

$$Q = -\frac{K}{n_e} \cdot \frac{dh}{dl}$$

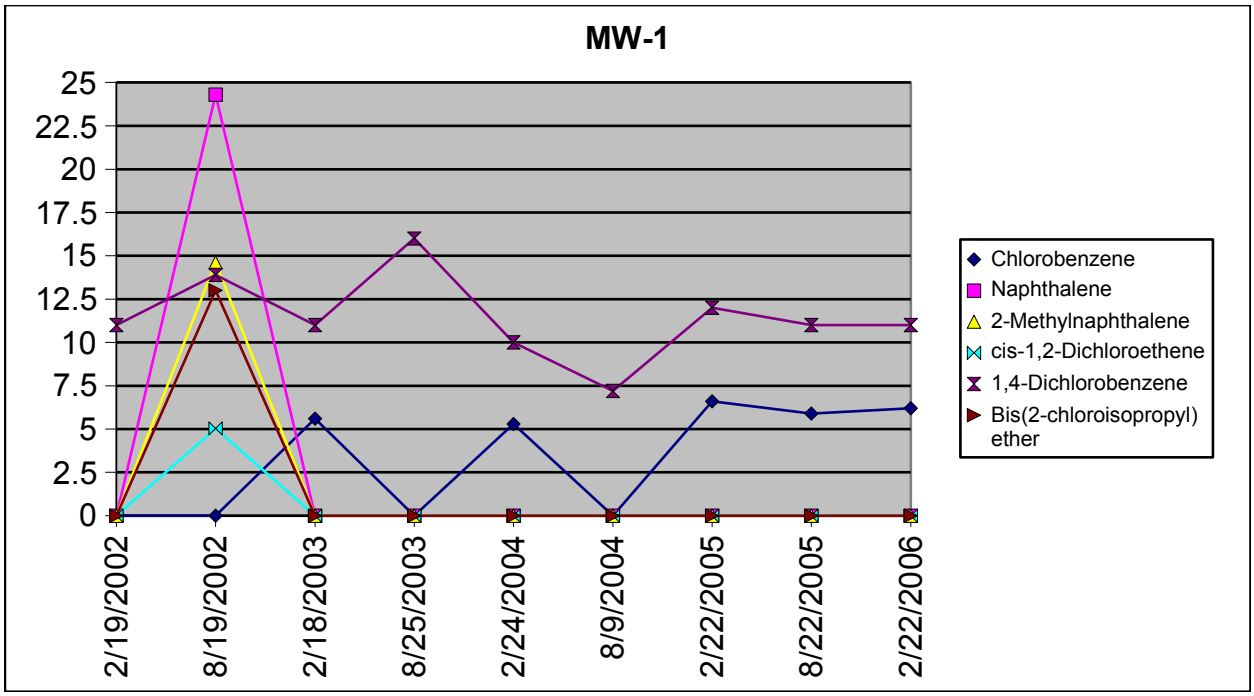
K = hydraulic conductivity
ne = effective porosity
dh = head difference
dl = horizontal distance

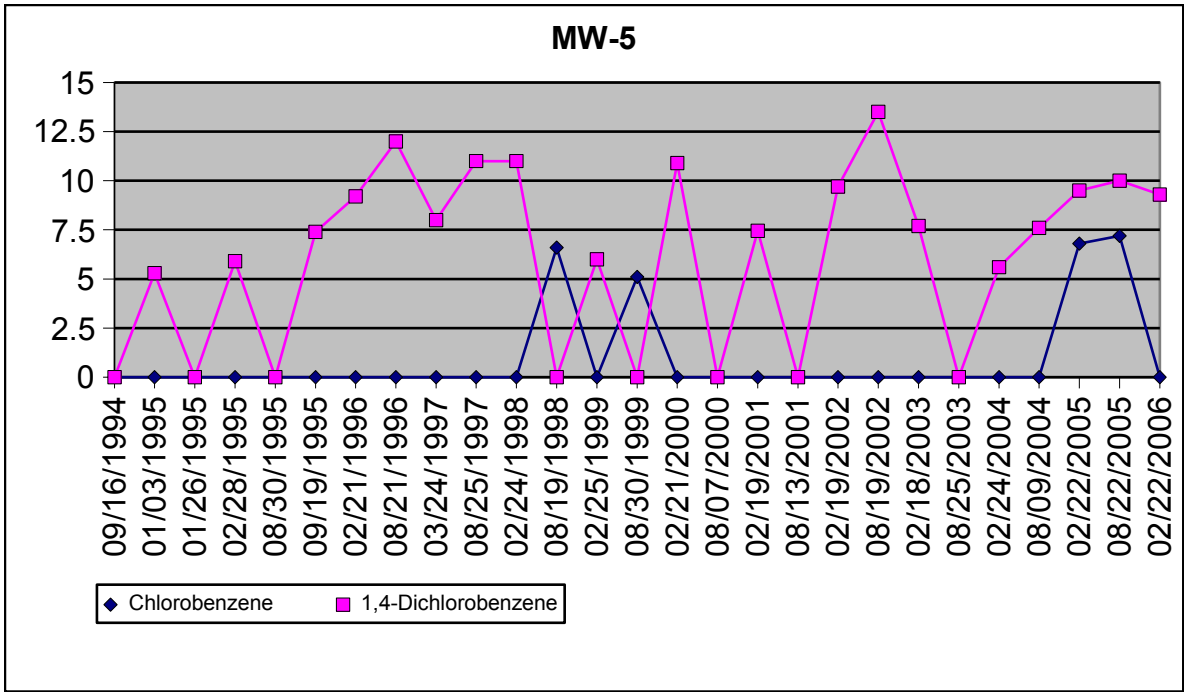
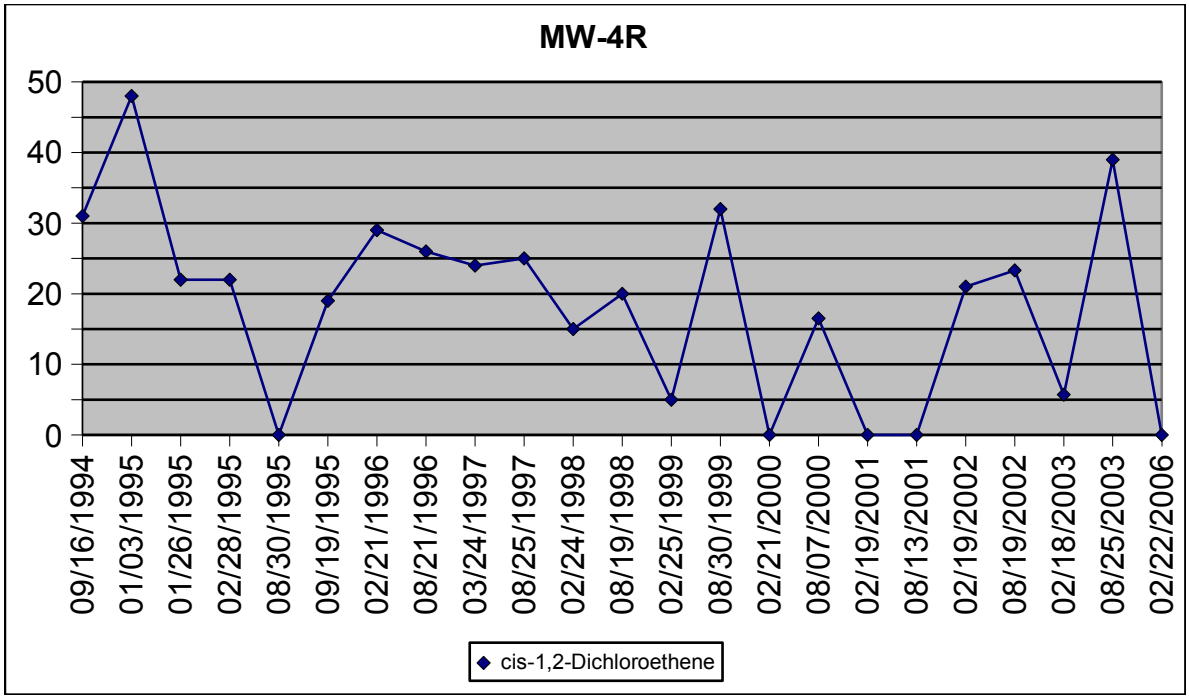
Time Series Plots for Select VOC Constituents (MW-6)
Cherokee County Closed Landfill





Time Series Plots for Select VOC Constituents (MW-1)
Cherokee County Closed Landfill



	2/19/02	8/19/02	2/18/03	8/25/03	2/24/04	8/9/04	2/22/05	8/22/05	2/22/06
Chlorobenzene	ND	ND	5.6	ND	5.3	ND	6.6	5.9	6.2
Naphthalene	ND	**24.3**	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	14.6	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	5.04	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	11	13.9	11	16	10	7.2	**12**	**11**	**11**
Bis(2-chloroisopropyl) ether	ND	13	ND	ND	ND	ND	ND	ND	ND

Time Series Plots for Select VOC Constituents (MW-4R & MW-5)
Cherokee County Closed Landfill