9606- MSWLF-1998

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Carrie Johnson

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Groundwater Sampling and Statistical Analysis

Prepared for

Wayne County Subtitle D Landfill
Dudley, North Carolina

August, 2004

Received
DEC 2004
Waste Management

MESCO Project Number: G04016.0

Completed on December 16, 2004

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

December 16, 2004

Mr. Larry Rose
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 Statistical Analysis
Wayne County Subtitle D Lined Landfill
MESCO Project No. G4016.0

Dear Mr. Rose:

Municipal Engineering Services Company, P.A. (MESCO) completed the statistical analysis for the Wayne County Subtitle D Lined phase 1 landfill located near Dudley, North Carolina. Although the phase 2 landfill monitoring wells were sampled in conjunction with the phase 1 they were not included in this statistical analyses since this is only the 2nd of 4 baseline sampling events. The purpose of these analyses is to determine, in comparison to background levels, statistical significance of constituents detected during the August 26, 2004 sampling event.

Environment I of Greenville, NC completed the Appendix I laboratory analyses. The results reveal only a few metal detections with no VOCs found. A preliminary data screening was conducted upon the metals detected in all monitoring locations. Detected metals with concentrations found below that of the background well MW-1 were eliminated and a statistical analysis was not conducted upon these wells. The statistical analyses was completed for the metals arsenic, chromium, lead, vanadium, and zinc.

Statistical Analysis Methodology

Metals

An inter-well statistical analysis was conducted upon metals detected during the August 2004 sampling event. Monitoring well MW-1 was defined as the background well, and an upper tolerance limit (UTL) with 95% coverage was computed for each detected constituent from the background data at a 95% confidence level. For each tested constituent, an appropriate statistical analysis method was selected based on the percentages of non-detects (%ND) in the historical background data. The following table (Table 1) summarizes the methods used for four different % ND ranges.

Table 1. Statistical Analysis Methods for Various %ND Ranges

%ND	Analysis Method	ND Substitution
%ND<15%	Parametric tolerance limit	1/2 ND
15%<%ND<50%	Parametric tolerance limit	Cohen or 1/2 ND
50%<%ND<90%	Non-parametric tolerance limit	1/2 ND
90%<%ND	Poisson tolerance limit	-

NOTE: For parametric tolerance interval, normality of the background data was checked by the Shapiro-Wilks normality test, as the method requires that the data be normally distributed.

PO Box 97, Garner, North Carolina 27529 (919) 772-5393
PO Box 828, Morehead City, NC 28557 (252) 726-9481 PO Box 349, Boone, North Carolina 28607 (828) 262-1767

A total of 5 metals were tested for statistical significance. For arsenic the Poisson tolerance limit with no ND substitution was used because the constituent has never been detected within the background (%ND was >90%). For the remaining metals the non-parametric tolerance limit with ½ ND substitution was utilized because the %ND was between 50% and 90% or the Poisson count exceeded the required 420.

Intrawell Analyses

Intrawell analysis was conducted only upon the constituent that was initially found to be statistically significant by interwell analysis. In general, intrawell analysis is conducted in order to differentiate true contamination from spatial variability. Shewhart-CUSUM control charts were generated for each of the triggered constituents to determine its baseline levels. Baseline levels in this context are defined as the background level derived from the data in a given downgradient well. Intrawell analyses through Shewhart-CUSUM control charts require a minimum of eight independent historical sampling events and a detection rate greater than 25% (%ND≤75%).

Results & Conclusions

Interwell analysis was performed upon all five inorganic constituents detected within the compliance wells. Historical data compiled for monitoring well MW-1 was used as the baseline. Data distributions were reviewed using time series and box and whiskers plots (enclosed charts). The only constituent found to be significantly higher than their background levels by interwell analysis was chromium within MW-2. However the results of the intrawell analysis formulated by Shewhart-CUSUM charts proved that chromium has not increased within MW-2.

The results of the statistical analysis performed upon the constituents detected during the this sampling event show no evidence of a leachate release from the Wayne County Subtitle D Landfill. The Wayne County Subtitle D Lined Landfill will continue detection monitoring and is scheduled to be sampled for the complete Appendix I list of constituents in February 2005. The results report and interwell and intrawell statistical analyses will be submitted to the section upon completion. Please contact me at (919) 772-5393 or by email at jpfohl@mesco.com should you have any questions or comments concerning this report.

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

Jonathan Pfohl
Environmental Specialist

Enclosures
cc: Mr. Lloyd Cook
Wayne County

Exceedance Scan
Wayne Co. Subtitle D Landfill, Phases 1 & 2

Well ID	Parameter Name [1]	Sample Date	Result	Unit	PQL [2]	MCL [3]	Exceedance
MW-1	Chromium, total	8/26/2004	0.033	mg/l	0.01	0.05	
MW-1	Vanadium	8/26/2004	0.061	mg/l	0.04	-	
MW-10	Chromium, total	8/26/2004	0.011	mg/l	0.01	0.05	
MW-2	**Chromium, total**	**8/26/2004**	**0.143**	**mg/l**	**0.01**	**0.05**	**0.093**
MW-2	Lead, total	8/26/2004	0.014	mg/l	0.01	0.015	
MW-2	Vanadium	8/26/2004	0.213	mg/l	0.04	-	
MW-4	Arsenic, total	8/26/2004	0.015	mg/l	0.01	0.05	
MW-4	Chromium, total	8/26/2004	0.014	mg/l	0.01	0.05	
MW-6	Chromium, total	8/26/2004	0.019	mg/l	0.01	0.05	
MW-7	Chromium, total	8/26/2004	0.011	mg/l	0.01	0.05	
MW-8	Chromium, total	8/26/2004	0.013	mg/l	0.01	0.05	
MW-8	Zinc, total	8/26/2004	0.063	mg/l	0.05	2.1	
MW-9	Chromium, total	8/26/2004	0.013	mg/l	0.01	0.05	
SW-4	Cadmium, total	8/25/2004	0.002	mg/l	0.001	0.005	
SW-5	Cadmium, total	8/25/2004	0.002	mg/l	0.001	0.005	
MW-12	Beryllium, total	8/26/2004	0.003	mg/l	0.002	-	
MW-12	**Lead, total**	**8/26/2004**	**0.037**	**mg/l**	**0.01**	**0.015**	**0.022**
MW-12	Zinc, total	8/26/2004	0.069	mg/l	0.05	2.1	
MW-13	Cadmium, total	8/26/2004	0.002	mg/l	0.001	0.005	
SW-4	Cadmium, total	8/25/2004	0.002	mg/l	0.001	0.005	
SW-5	Cadmium, total	8/25/2004	0.002	mg/l	0.001	0.005	
LEACHATE	Arsenic, total	8/26/2004	0.011	mg/l	0.01	0.05	
LEACHATE	Chromium, total	8/26/2004	0.022	mg/l	0.01	0.05	
LEACHATE	Sulfate, total	8/26/2004	6.6	mg/l		250	
LEACHATE	Zinc, total	8/26/2004	0.92	mg/l	0.05	2.1	
LEACHATE	**2-Butanone**	**8/26/2004**	**619**	**ug/l**	**100**	**170**	**449**
LEACHATE	Acetone	8/26/2004	169	ug/l	100	700	
LEACHATE	Toluene	8/26/2004	21.8	ug/l	5	1000	
LEACHATE	Xylene	8/26/2004	6.4	ug/l	5	530	

[1] Table only contains detected constituents.
[2] PQL = Practical Quantitation Limit
[3] MCL = Maximum Contaminant Level (North Carolina Groundwater Standard)

Statistical Analyses Summary

Inter-Well Analysis Summary
Wayne County Subtitle D Lined Landfill

Background Well: MW-1

Arsenic, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
100.00	-	Poisson tolerance interval	ND	17	ug/l

Well	Result	Significance
MW-4	15	no

Chromium, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
37.50	-	Non-Parametric Tolerance interval	1/2ND	108	ug/l

Well	Result	Significance
MW-2	143	yes

Lead, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
62.50	-	Non-Parametric Tolerance interval	1/2ND	76	ug/l

Well	Result	Significance
MW-2	14	no

Vanadium, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
43.75	-	Non-Parametric Tolerance interval	1/2ND	310	ug/l

Well	Result	Significance
MW-2	213	no

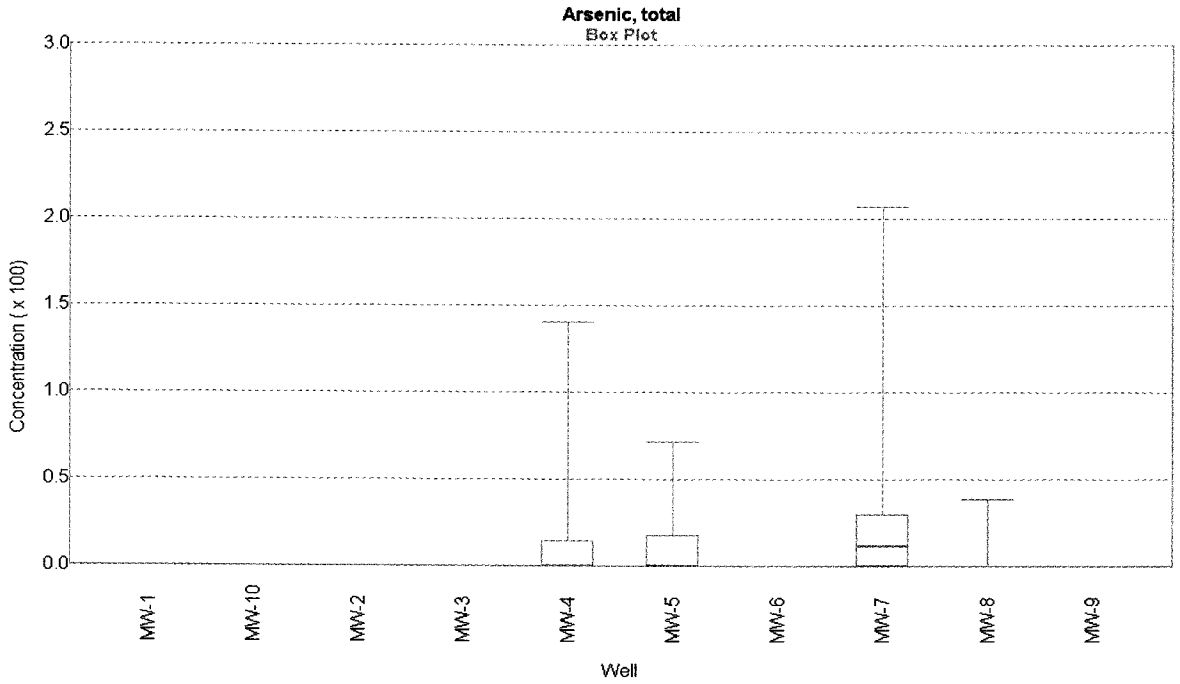
Zinc, total

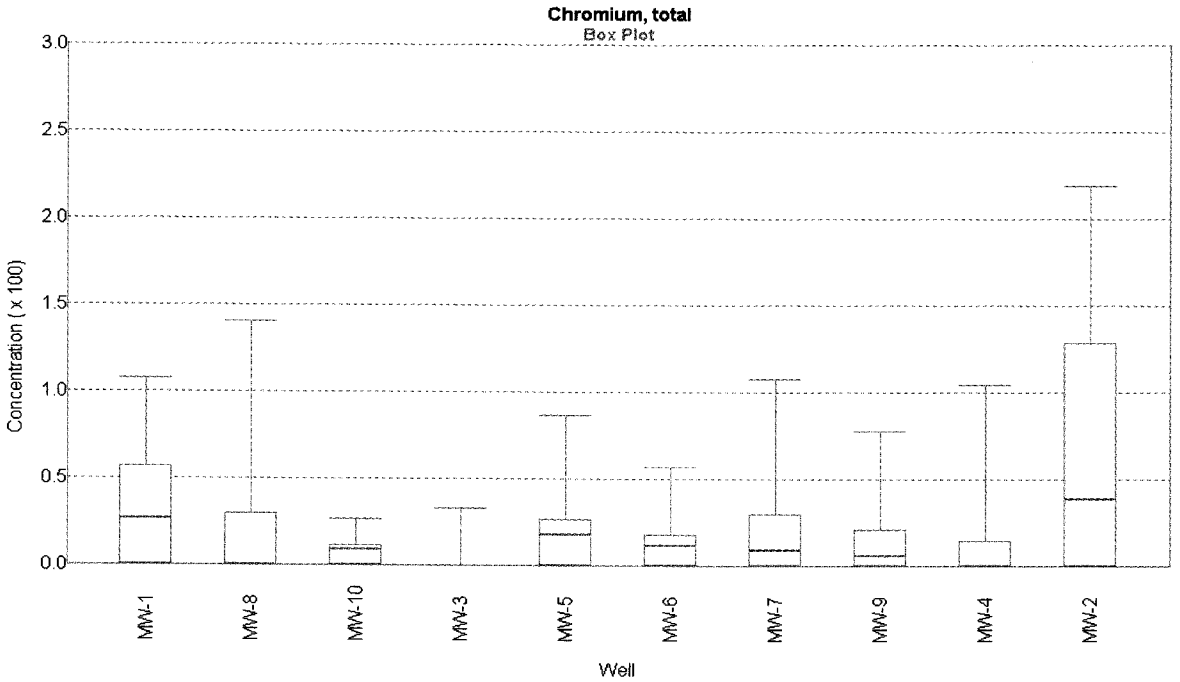
%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
93.75	-	Non-Parametric Tolerance interval	1/2ND	148	ug/l

Well	Result	Significance
MW-8	63	no

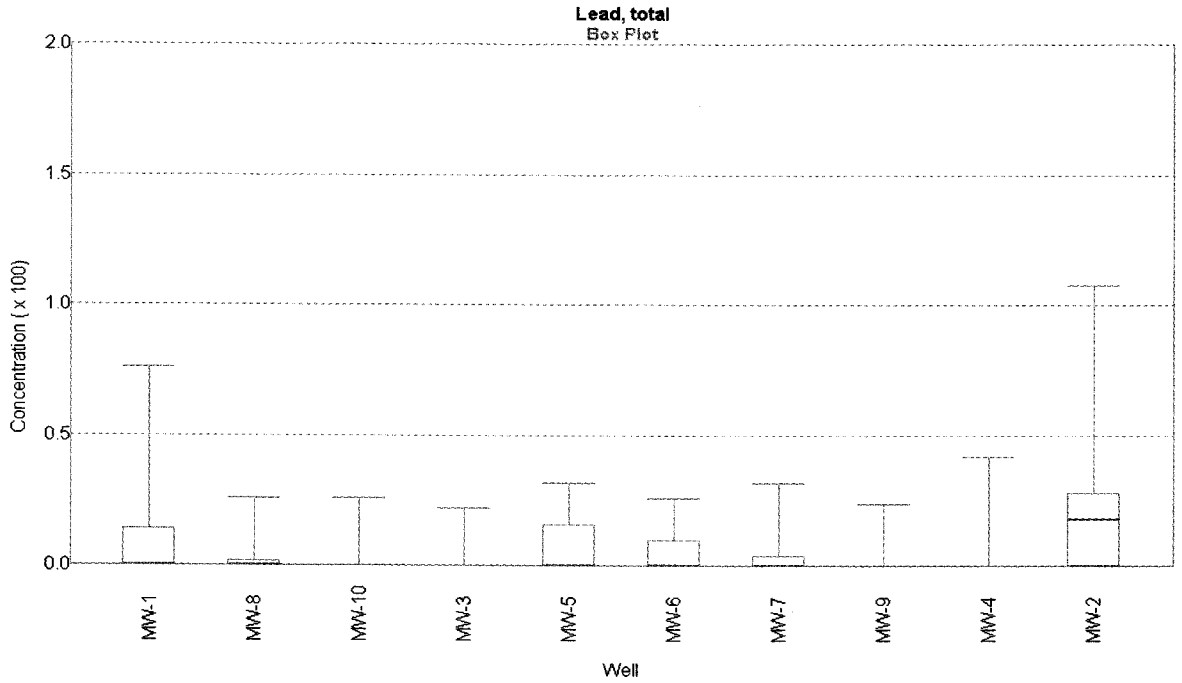
NOTE: Bold-faced monitoring points indicate detected levels exceed North Carolina Groundwater Standard.

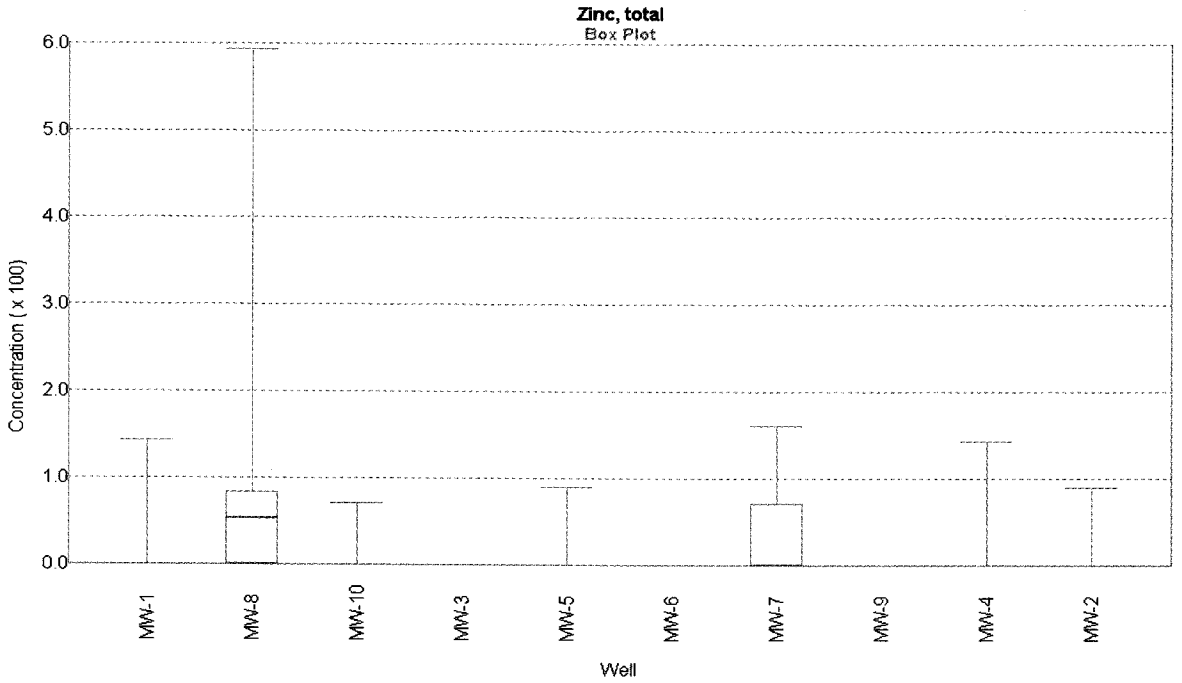
Box Plots for Select Constituents
Wayne County Subtitle D Lined Landfill



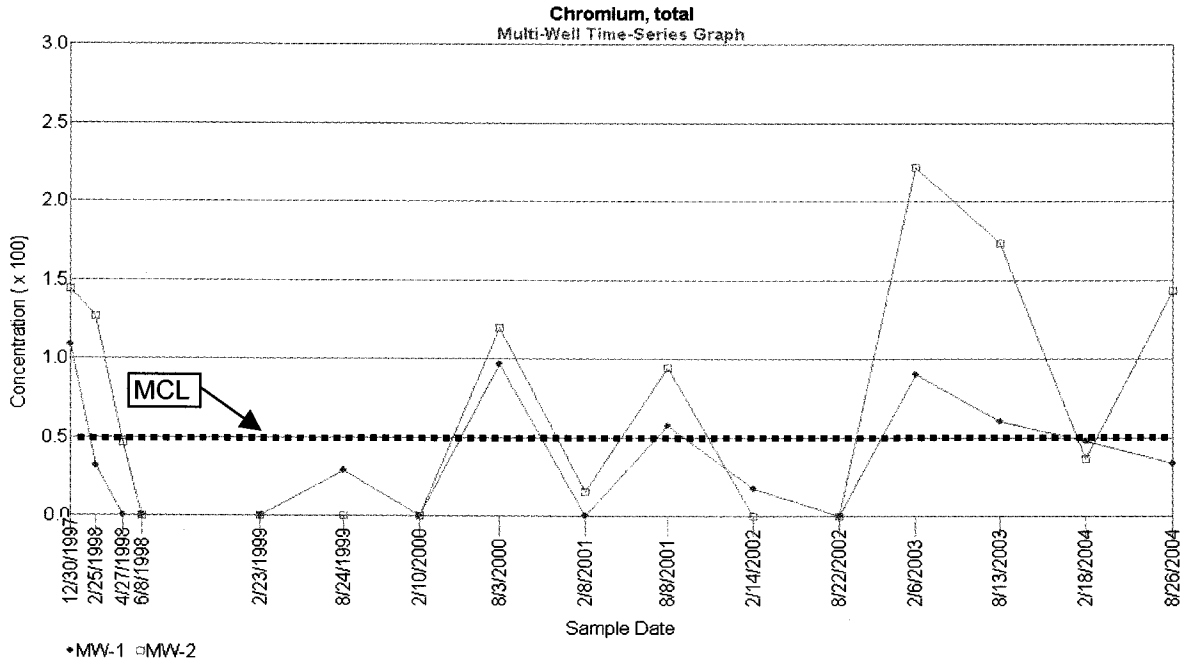


Box Plots for Select Constituents
Wayne County Subtitle D Lined Landfill

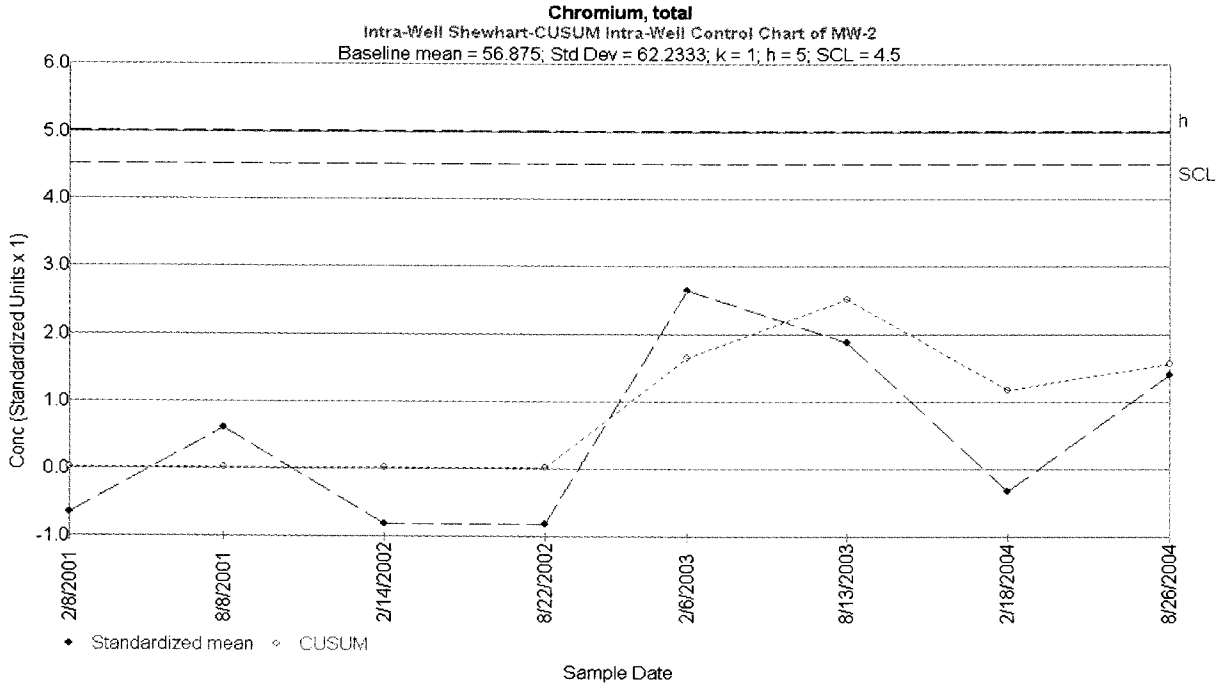




Time Series Plots for Select Constituents
Wayne County Subtitle D Lined Landfill



Shewhart-CUSUM charts for selected constituents
Wayne County Subtitle D Lined Landfill



Basic Statistics

Parameter: Arsenic, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

	Total Observations
162	
Total Non-Detects	139
Pooled Mean	9.99383
Pooled Std Dev	20.8947
Background Mean	5
Background Std Dev	0

Background Wells

There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	16	16	100	80

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	5	0	0	1120	70

Compliance Wells

There are 9 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-10	17	17	100	85
MW-2	16	16	100	80
MW-3	16	16	100	80
MW-4	16	11	68.75	292
MW-5	16	10	62.5	231
MW-6	16	16	100	80
MW-7	17	8	47.0588	454
MW-8	16	13	81.25	157
MW-9	16	16	100	80

Well	Mean	Std Dev	Dif From Bk	Std Err	Rank Sum	Rank Mean
MW-10	5	0	0	7.01864	1190	70
MW-2	5	0	0	7.12419	1120	70
MW-3	5	0	0	7.12419	1120	70
MW-4	18.25	34.6073	13.25	7.12419	1526	95.375
MW-5	14.4375	17.5764	9.4375	7.12419	1601	100.063
MW-6	5	0	0	7.12419	1120	70
MW-7	26.7059	48.2801	21.7059	7.01864	1918	112.824
MW-8	9.8125	11.0225	4.8125	7.12419	1368	85.5
MW-9	5	0	0	7.12419	1120	70

Analysis of Variance Statistics

SS Wells	8574.09
SS Total	70291

Kruskal-Wallis Statistics

Non-Detect Rank	70
Background Rank Sum	1120
Background Rank Mean	70
H Statistic	17.4312
H Adjusted for Ties	47.3255

Basic Statistics

Parameter: Beryllium, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

	Total Observations
162	
Total Non-Detects	152
Pooled Mean	1.23488
Pooled Std Dev	1.10917
Background Mean	1.13188
Background Std Dev	0.5275

Background Wells

There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	16	15	93.75	18.11

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	1.13188	0.5275	0	1302.5	81.4063

Compliance Wells

There are 9 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-10	17	17	100	17
MW-2	16	14	87.5	20.91
MW-3	16	16	100	16
MW-4	16	15	93.75	17
MW-5	16	16	100	16
MW-6	16	16	100	16
MW-7	17	13	76.4706	40.33
MW-8	16	14	87.5	22.7
MW-9	16	16	100	16

Well	Mean	Std Dev	Dif From Bk	Std Err	Rank Sum	Rank Mean
MW-10	1	0	-0.131875	0.368729	1300.5	76.5
MW-2	1.30688	0.992685	0.175	0.374274	1383	86.4375
MW-3	1	0	-0.131875	0.374274	1224	76.5
MW-4	1.0625	0.25	-0.069375	0.374274	1301.5	81.3438
MW-5	1	0	-0.131875	0.374274	1224	76.5
MW-6	1	0	-0.131875	0.374274	1224	76.5
MW-7	2.37235	2.85659	1.24048	0.368729	1633.5	96.0882
MW-8	1.41875	1.15136	0.286875	0.374274	1386	86.625
MW-9	1	0	-0.131875	0.374274	1224	76.5

Analysis of Variance Statistics

SS Wells	27.7331
SS Total	198.072

Kruskal-Wallis Statistics

Non-Detect Rank	76.5
Background Rank Sum	1302.5
Background Rank Mean	81.4063
H Statistic	2.93285
H Adjusted for Ties	16.8561

Basic Statistics

Parameter: Cadmium, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

	Total Observations
162	
Total Non-Detects	156
Pooled Mean	0.548765
Pooled Std Dev	0.280469
Background Mean	0.5
Background Std Dev	0

Background Wells

There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	16	16	100	8

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	0.5	0	0	1256	78.5

Compliance Wells

There are 9 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-10	17	17	100	8.5
MW-2	16	16	100	8
MW-3	16	16	100	8
MW-4	16	15	93.75	10.5
MW-5	16	15	93.75	8.6
MW-6	16	16	100	8
MW-7	17	16	94.1176	9
MW-8	16	14	87.5	10.8
MW-9	16	15	93.75	9.5

Well	Mean	Std Dev	Dif From Bk	Std Err	Rank Sum	Rank Mean
MW-10	0.5	0	0	0.0978337	1334.5	78.5
MW-2	0.5	0	0	0.0993049	1256	78.5
MW-3	0.5	0	0	0.0993049	1256	78.5
MW-4	0.65625	0.625	0.15625	0.0993049	1339.5	83.7188
MW-5	0.5375	0.15	0.0375	0.0993049	1335.5	83.4688
MW-6	0.5	0	0	0.0993049	1256	78.5
MW-7	0.529412	0.121268	0.0294118	0.0978337	1413	83.1176
MW-8	0.675	0.479583	0.175	0.0993049	1418	88.625
MW-9	0.59375	0.375	0.09375	0.0993049	1338.5	83.6563

Analysis of Variance Statistics

SS Wells	0.673209
SS Total	12.6648

Kruskal-Wallis Statistics

Non-Detect Rank	78.5
Background Rank Sum	1256
Background Rank Mean	78.5
H Statistic	0.818408
H Adjusted for Ties	7.64515

Basic Statistics

Parameter: Chromium, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

	Total Observations
162	
Total Non-Detects	78
Pooled Mean	25.8025
Pooled Std Dev	36.6929
Background Mean	37.3125
Background Std Dev	35.6234

Background Wells

There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	16	6	37.5	597

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	37.3125	35.6234	0	1584	99

Compliance Wells

There are 9 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-10	17	7	41.1765	190
MW-2	16	6	37.5	1147
MW-3	16	14	87.5	121
MW-4	16	9	56.25	382
MW-5	16	5	31.25	422
MW-6	16	7	43.75	258
MW-7	17	7	41.1765	372
MW-8	16	9	56.25	386
MW-9	16	8	50	305

Well	Mean	Std Dev	Dif From Bk	Std Err	Rank Sum	Rank Mean
MW-10	11.1765	7.11719	-26.136	11.6282	1209.5	71.1471
MW-2	71.6875	73.2072	34.375	11.803	1706	106.625
MW-3	7.5625	7.81425	-29.75	11.803	781	48.8125
MW-4	23.875	34.7867	-13.4375	11.803	1190.5	74.4063
MW-5	26.375	25.9329	-10.9375	11.803	1507.5	94.2188
MW-6	16.125	14.7417	-21.1875	11.803	1281.5	80.0938
MW-7	21.8824	26.3697	-15.4301	11.6282	1429.5	84.0882
MW-8	24.125	35.6069	-13.1875	11.803	1244.5	77.7813
MW-9	19.0625	20.9904	-18.25	11.803	1269	79.3125

Analysis of Variance Statistics

SS Wells	47362.7
SS Total	216766

Kruskal-Wallis Statistics

Non-Detect Rank	39.5
Background Rank Sum	1584
Background Rank Mean	99
H Statistic	17.1573
H Adjusted for Ties	19.3127

Basic Statistics

Parameter: Vanadium

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

	Total Observations
162	
Total Non-Detects	122
Pooled Mean	45.284
Pooled Std Dev	57.5439
Background Mean	80.75
Background Std Dev	81.4817

Background Wells

There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	16	7	43.75	1292

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	80.75	81.4817	0	1729.5	108.094

Compliance Wells

There are 9 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-10	17	17	100	340
MW-2	16	7	43.75	1746
MW-3	16	16	100	320
MW-4	16	13	81.25	721
MW-5	16	9	56.25	858
MW-6	16	14	87.5	406
MW-7	17	11	64.7059	822
MW-8	16	14	87.5	418
MW-9	16	14	87.5	413

Well	Mean	Std Dev	Dif From Bk	Std Err	Rank Sum	Rank Mean
MW-10	20	0	-60.75	18.0268	1045.5	61.5
MW-2	109.125	102.342	28.375	18.2979	1782.5	111.406
MW-3	20	0	-60.75	18.2979	984	61.5
MW-4	45.0625	54.5081	-35.6875	18.2979	1248.5	78.0313
MW-5	53.625	50.2592	-27.125	18.2979	1525.5	95.3438
MW-6	25.375	15.1344	-55.375	18.2979	1125	70.3125
MW-7	48.3529	58.8801	-32.3971	18.0268	1503.5	88.4412
MW-8	26.125	16.8795	-54.625	18.2979	1133	70.8125
MW-9	25.8125	17.8819	-54.9375	18.2979	1126	70.375

Analysis of Variance Statistics

SS Wells	125988
SS Total	533119

Kruskal-Wallis Statistics

Non-Detect Rank	61.5
Background Rank Sum	1729.5
Background Rank Mean	108.094
H Statistic	22.1378
H Adjusted for Ties	38.641

Basic Statistics

Parameter: Zinc, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

	Total Observations
162	
Total Non-Detects	141
Pooled Mean	40.2469
Pooled Std Dev	63.2408
Background Mean	32.6875
Background Std Dev	30.75

Background Wells

There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	16	15	93.75	523

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	32.6875	30.75	0	1221	76.3125

Compliance Wells

There are 9 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-10	17	16	94.1176	475
MW-2	16	14	87.5	498
MW-3	16	16	100	400
MW-4	16	15	93.75	520
MW-5	16	14	87.5	495
MW-6	16	16	100	400
MW-7	17	12	70.5882	926
MW-8	16	7	43.75	1883
MW-9	16	16	100	400

Well	Mean	Std Dev	Dif From Bk	Std Err	Rank Sum	Rank Mean
MW-10	27.9412	12.1268	-4.74632	20.4937	1285	75.5882
MW-2	31.125	17.7271	-1.5625	20.8019	1290	80.625
MW-3	25	0	-7.6875	20.8019	1136	71
MW-4	32.5	30	-0.1875	20.8019	1220	76.25
MW-5	30.9375	18.0239	-1.75	20.8019	1289	80.5625
MW-6	25	0	-7.6875	20.8019	1136	71
MW-7	54.4706	52.8277	21.7831	20.4937	1621	95.3529
MW-8	117.688	171.641	85	20.8019	1869	116.813
MW-9	25	0	-7.6875	20.8019	1136	71

Analysis of Variance Statistics

SS Wells	117717
SS Total	643904

Kruskal-Wallis Statistics

Non-Detect Rank	71
Background Rank Sum	1221
Background Rank Mean	76.3125
H Statistic	13.6323
H Adjusted for Ties	40.017

Interwell Analyses for Metals

Poisson Tolerance Limit

Parameter: Arsenic, total

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Poisson Count of 16 background Samples = 160
Degrees of Freedom = 322

95% Confidence Values

Chi-Squared Value (95% Confidence) = 364.847
Lambda (from Zack's formula) = 11.4015
Smallest Degrees of Freedom = 36
Upper Tolerance Limit (95%) = 17

99% Confidence Values

Chi-Squared Value (99% Confidence) = 383.959
Lambda (from Zack's formula) = 11.9987
Smallest Degrees of Freedom = 43
Upper Tolerance Limit (99%) = 20.5

	Date	Result	Impacted 95%	Impacted 99%
MW-4	12/30/1997	15	FALSE	FALSE
	2/25/1998	143	TRUE	TRUE
	4/27/1998	ND<10	FALSE	FALSE
	6/8/1998	ND<10	FALSE	FALSE
	2/23/1999	ND<10	FALSE	FALSE
	8/24/1999	ND<10	FALSE	FALSE
	2/10/2000	ND<10	FALSE	FALSE
	8/3/2000	26	TRUE	TRUE
	2/8/2001	ND<10	FALSE	FALSE
	8/8/2001	38	TRUE	TRUE
	2/14/2002	ND<10	FALSE	FALSE
	8/22/2002	ND<10	FALSE	FALSE
	2/6/2003	ND<10	FALSE	FALSE
	8/13/2003	ND<10	FALSE	FALSE
	2/18/2004	ND<10	FALSE	FALSE
	8/26/2004	15	FALSE	FALSE

Shapiro-Wilks Test of Normality
Parameter: Chromium, total
Background Wells
Normality Test of Parameter Concentrations

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL
K = 8; Samples = 16

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	5	108	103	0.5056	52.0768
2	5	96	91	0.329	29.939
3	5	90	85	0.2521	21.4285
4	5	60	55	0.1939	10.6645
5	5	57	52	0.1447	7.5244
6	5	47	42	0.1005	4.221
7	17	33	16	0.0593	0.9488
8	28	31	3	0.0196	0.0588
9	31	28	-3		
10	33	17	-16		
11	47	5	-42		
12	57	5	-52		
13	60	5	-55		
14	90	5	-85		
15	96	5	-91		
16	108	5	-103		

Sum of b values = 126.862
Sample Standard Deviation = 35.6234
W Statistic = 0.845471
5% Critical value of 0.887 exceeds 0.845471
Evidence of non-normality at 95% level of significance
1% Critical value of 0.844 is less than 0.845471
Data is normally distributed at 99% level of significance

Non-Parametric Tolerance Interval

Parameter: Chromium, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

Total Percent Non-Detects = 37.5%
Background Samples (n) = 16
Maximum Background Concentration = 108
Minimum Coverage = 82.9%
Average Coverage = 94.1176%

Well	Sample	Result	Impacted
MW-2	12/30/1997	144	TRUE
MW-2	2/25/1998	126	TRUE
MW-2	4/27/1998	46	FALSE
MW-2	6/8/1998	ND<5	FALSE
MW-2	2/23/1999	ND<5	FALSE
MW-2	8/24/1999	ND<5	FALSE
MW-2	2/10/2000	ND<5	FALSE
MW-2	8/3/2000	119	TRUE
MW-2	2/8/2001	15	FALSE
MW-2	8/8/2001	94	FALSE
MW-2	2/14/2002	ND<5	FALSE
MW-2	8/22/2002	ND<5	FALSE
MW-2	2/6/2003	221	TRUE
MW-2	8/13/2003	173	TRUE
MW-2	2/18/2004	36	FALSE
MW-2	8/26/2004	143	TRUE

Non-Parametric Tolerance Interval

Parameter: Lead, total

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

Total Percent Non-Detects = 53.125%
Background Samples (n) = 16
Maximum Background Concentration = 76
Minimum Coverage = 82.9%
Average Coverage = 94.1176%

Well	Sample	Result	Impacted
MW-2	12/30/1997	108	TRUE
MW-2	2/25/1998	23	FALSE
MW-2	4/27/1998	30	FALSE
MW-2	6/8/1998	ND<5	FALSE
MW-2	2/23/1999	ND<5	FALSE
MW-2	8/24/1999	ND<5	FALSE
MW-2	2/10/2000	ND<5	FALSE
MW-2	8/3/2000	25	FALSE
MW-2	2/8/2001	28	FALSE
MW-2	8/8/2001	ND<5	FALSE
MW-2	2/14/2002	ND<5	FALSE
MW-2	8/22/2002	ND<5	FALSE
MW-2	2/6/2003	53	FALSE
MW-2	8/13/2003	36	FALSE
MW-2	2/18/2004	23	FALSE
MW-2	8/26/2004	14	FALSE

Shapiro-Wilks Test of Normality
Parameter: Vanadium
Background Wells
Normality Test of Parameter Concentrations

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL
K = 8; Samples = 16

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	20	310	290	0.5056	146.624
2	20	195	175	0.329	57.575
3	20	157	137	0.2521	34.5377
4	20	107	87	0.1939	16.8693
5	20	106	86	0.1447	12.4442
6	20	81	61	0.1005	6.1305
7	20	79	59	0.0593	3.4987
8	56	61	5	0.0196	0.098
9	61	56	-5		
10	79	20	-59		
11	81	20	-61		
12	106	20	-86		
13	107	20	-87		
14	157	20	-137		
15	195	20	-175		
16	310	20	-290		

Sum of b values = 277.777
Sample Standard Deviation = 81.4817
W Statistic = 0.774787
5% Critical value of 0.887 exceeds 0.774787
Evidence of non-normality at 95% level of significance
1% Critical value of 0.844 exceeds 0.774787
Evidence of non-normality at 99% level of significance

Non-Parametric Tolerance Interval

Parameter: Vanadium

Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

Total Percent Non-Detects = 43.75%
Background Samples (n) = 16
Maximum Background Concentration = 310
Minimum Coverage = 82.9%
Average Coverage = 94.1176%

Well	Sample	Result	Impacted
MW-2	12/30/1997	241	FALSE
MW-2	2/25/1998	182	FALSE
MW-2	4/27/1998	65	FALSE
MW-2	6/8/1998	ND<20	FALSE
MW-2	2/23/1999	ND<20	FALSE
MW-2	8/24/1999	ND<20	FALSE
MW-2	2/10/2000	ND<20	FALSE
MW-2	8/3/2000	180	FALSE
MW-2	2/8/2001	ND<20	FALSE
MW-2	8/8/2001	135	FALSE
MW-2	2/14/2002	ND<20	FALSE
MW-2	8/22/2002	ND<20	FALSE
MW-2	2/6/2003	315	TRUE
MW-2	8/13/2003	228	FALSE
MW-2	2/18/2004	47	FALSE
MW-2	8/26/2004	213	FALSE

Non-Parametric Tolerance Interval

Parameter: Zinc, total

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 68.75%
Background Samples (n) = 16
Maximum Background Concentration = 148
Minimum Coverage = 82.9%
Average Coverage = 94.1176%

Well	Sample	Result	Impacted
MW-8	12/30/1997	481	TRUE
MW-8	2/25/1998	599	TRUE
MW-8	4/27/1998	70	FALSE
MW-8	6/8/1998	ND<50	FALSE
MW-8	2/23/1999	ND<50	FALSE
MW-8	8/24/1999	ND<50	FALSE
MW-8	2/10/2000	ND<50	FALSE
MW-8	8/3/2000	75	FALSE
MW-8	2/8/2001	52	FALSE
MW-8	8/8/2001	85	FALSE
MW-8	2/14/2002	ND<50	FALSE
MW-8	8/22/2002	ND<50	FALSE
MW-8	2/6/2003	189	TRUE
MW-8	8/13/2003	94	FALSE
MW-8	2/18/2004	ND<50	FALSE
MW-8	8/26/2004	63	FALSE