Attachment 17

Appendix C, Establishment of Background Values for

Perchlorate, 1,4-Dioxane, and Mecoprop for the

Closed Collinsville Landfill, Collinsville, IL

Tetra Tech, October 2014.

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Statistical Formulas

The Shapiro-Wilk test for Normality

$$W = \frac{(\sum_{i=1}^{n} a_i x_{(i)})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

The above is the test statistic where:

n = number of samples
i = ith order stastistic
x = individual sample
$\bar{x}$ = average
a = a derived constant

The data are sorted in ascending order, then the W statistic is calculated. The obtained value is then compared to a table of the W statistics. If the calculated value is greater than the table value, the the data has a normal distribution. If the data is not normally distributed, then the W statistic is re-calculated using the natural log on the data points. This result is then compared to the W statistic table. Again, if the calculated value is larger than the table value, then the data is lognormally distributed, however if the calculated value is less than the table value, then the data should be treated as paranormal.

Spreadsheet example for dissolved manganese appears below:

Sample	Concentration	Qualifier	Conc. Used	ln
1	180		180	5.1929
2	205		205	5.3230
3	212		212	5.3565
4	220		220	5.3936
Minimum			180	5.1929
Maximum			220	5.3936
Average			204.25	5.3165
Standard Deviation			17.29	0.0872
Count			4	4
Calculated W			0.9160	0.9011
Shapiro Wilk W			0.748	0.748
Distribution			Normal	-

Note: ln values calculated automatically and only used when necessary.

99%UCL = Average + 4.541*Standard Deviation*Square root of (1+1/count)

95%UCL = Average + 2.353*Standard Deviation*Square root of (1+1/count)

Example: Manganese

99%UCL = 204.25 + 4.541*17.29*SQRT(1+1/4) = 292.03

95%UCL = 204.25 + 2.353*17.29*SQRT(1+1/4) = 249.73

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Summary of Statistics and Data Used to Calculate the Statistics for MW-6

Closed Collinsville Landfill

Monitoring Location MW6: Background Establishment Location

Organic Parameters	1/25/2013	2/26/2014	5/21/2014	7/31/2014	Mean	Variance	St. Dev.	99%CL	95%CL
Perchlorate (µg/L)	7.80	15.0	2.00	2.00	6.70	38.09333333	6.17	38.04	22.94
MCPP (Mecoprop) (µg/L)	7.00	7.00	7.00	7.00	7.00	NA	0.00	7.00	7.00
p-Dioxane (1,4-Dioxane) (µg/L)	0.5	1.800	0.5	1.09	0.97	0.381691667	0.62	4.11	2.60

Notes:

All results for MCPP were below the detection limit of 7 µg/ L and the UCL the becomes the detection limit.

When some, but not all results are less that the detction limit, the result is reported as 1/2 MDL

Background Statistics Data Sheet

Compound:	Perchlorate	(Units in µg/L)		MW-6
			UCL Calculations	
Sample ID	Reported Concentration	Qualifier	Concentration used in Calculations	Natural Log (ln) of Concentration
November 2013	7.80		7.8	2.054123734
February 2014	15.0		15	2.708050201
May 2014	4.00	U	2	0.693147181
July 2014	4.00	U	2	0.693147181
Minimum			2	0.693147181
Maximum			15	2.708050201
Average			6.7	1.537117074
Standard Deviation			6.171979693	1.010437304
Count			4	4
t			2.132	2.132
d			114.28	3.062950636
k			2	2
1/d			0.008750438	0.326482571
Calculated W			0.332672642	0.529209411
Shapiro-Wilk W			0.748	0.748
Distribution			Lognormal	Lognormal

Compound:	MCPP	(Units in µg/L)		MW-6
			UCL Calculations	
Sample ID	Reported Concentration	Qualifier	Concentration used in Calculations	Natural Log (ln) of Concentration
November 2013	7.0	U	3.5	1.252762968
February 2014	7.0	U	3.5	1.252762968
May 2014	7.0	U	3.5	1.252762968
July 2014	7.00	U	3.5	1.252762968
Minimum			3.5	1.252762968
Maximum			3.5	1.252762968
Average			3.5	1.252762968
Standard Deviation			0	0
Count			4	4
t			2.132	2.132
d			0	0
k			2	2
1/d			NA	NA
Calculated W			NA	NA
Shapiro-Wilk W			0.748	0.748
Distribution			NA	NA

Compound:	p-Dioxane	(Units in µg/L)		MW-6
			UCL Calculations	
Sample ID	Reported Concentration	Qualifier	Concentration used in Calculations	Natural Log (ln) of Concentration
November 2013	1.0	U	0.5	-0.693147181
February 2014	1.8		1.8	0.587786665
May 2014	1.0	U	0.5	-0.693147181
July 2014	1.09		1.09	0.086177696
Minimum			0.5	-0.693147181
Maximum			1.8	0.587786665
Average			0.9725	-0.1780825
Standard Deviation			0.617811999	0.629013057
Count			4	4
t			2.132	2.132
d			1.145075	1.186972279
k			2	2
1/d			0.873305242	0.842479658
Calculated W			0.030681836	0.086669079
Shapiro-Wilk W			0.748	0.748
Distribution			Lognormal	Lognormal