APPENDIX H

STATISTICAL ANALYSES

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\Documents and Settings\Julie Pettijohn\My Documents\Active Jobs\Doyle Drive SF\Contract 5 Report\Stat
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Calc TCLP Lead (1)

General Statistics

Number of Valid Data	20	Number of Detected Data	17
Number of Distinct Detected Data	17	Number of Non-Detect Data	3
		Percent Non-Detects	15.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.033	Minimum Detected	-3.411
Maximum Detected	6.4	Maximum Detected	1.856
Mean of Detected	0.964	Mean of Detected	-1.014
SD of Detected	1.603	SD of Detected	1.459
Minimum Non-Detect	0.03	Minimum Non-Detect	-3.507
Maximum Non-Detect	0.03	Maximum Non-Detect	-3.507

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.606	Shapiro Wilk Test Statistic	0.972
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.822	Mean	-1.492
SD	1.511	SD	1.776
90% DL/2 (t) UCL	1.27	90% H-Stat (DL/2) UCL	3.428
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.658	Mean in Log Scale	-1.531
SD	1.644	SD in Log Scale	1.849
90% MLE (t) UCL	1.146	Mean in Original Scale	0.821
90% MLE (Tiku) UCL	1.124	SD in Original Scale	1.511
		90% Percentile Bootstrap UCL	1.262
		90% BCA Bootstrap UCL	1.452

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.556	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	1.733		
nu star	18.91		
A-D Test Statistic	0.676	**Nonparametric Statistics**	
5% A-D Critical Value	0.787	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.787	Mean	0.824
5% K-S Critical Value	0.219	SD	1.471
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.339
		90% KM (t) UCL	1.275
Assuming Gamma Distribution		90% KM (z) UCL	1.259
Gamma ROS Statistics using Extrapolated Data		90% KM (jackknife) UCL	1.271
Minimum	1E-09	90% KM (bootstrap t) UCL	1.858
Maximum	6.4	90% KM (BCA) UCL	1.227
Mean	0.819	90% KM (Percentile Bootstrap) UCL	1.265
Median	0.233	90% KM (Chebyshev) UCL	1.842
SD	1.512	95% KM (Chebyshev) UCL	2.302
k star	0.2	97.5% KM (Chebyshev) UCL	2.942
Theta star	4.102	99% KM (Chebyshev) UCL	4.199
Nu star	7.99		
AppChi2	3.484	**Potential UCL to Use**	
90% Gamma Approximate UCL	1.879	**Recommendation Provided only**	
90% Adjusted Gamma UCL	1.981	**for 95% Confidence Coeficient**	

Note: DL/2 is not a recommended method.

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\Documents and Settings\Julie Pettijohn\My Documents\Active Jobs\Doyle Drive SF\Contract 5 Report\Statistics
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Calc WET Lead (1)

General Statistics

Number of Valid Observations	20	Number of Distinct Observations	20

Raw Statistics

Minimum	0.085
Maximum	1300
Mean	68.36
Median	1.25
SD	289.9
Coefficient of Variation	4.241
Skewness	4.47

Log-transformed Statistics

Minimum of Log Data	-2.465
Maximum of Log Data	7.17
Mean of log Data	0.632
SD of log Data	2.144

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.247
Shapiro Wilk Critical Value	0.905

Data not Normal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	154.4

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	197.7
90% Modified-t UCL	165.2

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.901
Shapiro Wilk Critical Value	0.905

Data not Lognormal at 5% Significance Level

Assuming Lognormal Distribution

90% H-UCL	94.39
90% Chebyshev (MVUE) UCL	38.64
95% Chebyshev (MVUE) UCL	49.84
97.5% Chebyshev (MVUE) UCL	65.39
99% Chebyshev (MVUE) UCL	95.92

Gamma Distribution Test

k star (bias corrected)	0.207
Theta Star	330.4
MLE of Mean	68.36
MLE of Standard Deviation	150.3
nu star	8.276
Approximate Chi Square Value (.05)	3.675
Adjusted Level of Significance	0.0866
Adjusted Chi Square Value	3.491
Anderson-Darling Test Statistic	3.68
Anderson-Darling 5% Critical Value	0.886
Kolmogorov-Smirnov Test Statistic	0.369
Kolmogorov-Smirnov 5% Critical Value	0.214

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

90% Approximate Gamma UCL	153.9
90% Adjusted Gamma UCL	162

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

90% CLT UCL	151.4
90% Jackknife UCL	154.4
90% Standard Bootstrap UCL	150.1
90% Bootstrap-t UCL	4495
90% Hall's Bootstrap UCL	2784
90% Percentile Bootstrap UCL	134.4
90% BCA Bootstrap UCL	198.8
90% Chebyshev(Mean, Sd) UCL	262.9
95% Chebyshev(Mean, Sd) UCL	351
97.5% Chebyshev(Mean, Sd) UCL	473.2
99% Chebyshev(Mean, Sd) UCL	713.4

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Calc WET Lead (2)

General Statistics

Number of Valid Observations	40	Number of Distinct Observations	38

Raw Statistics		Log-transformed Statistics	
Minimum	0.057	Minimum of Log Data	-2.865
Maximum	86	Maximum of Log Data	4.454
Mean	7.068	Mean of log Data	0.191
Median	0.875	SD of log Data	1.744
SD	18.45		
Coefficient of Variation	2.611		
Skewness	3.529		

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.415
Shapiro Wilk Critical Value	0.94

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.938
Shapiro Wilk Critical Value	0.94

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	10.87

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	11.97
90% Modified-t UCL	11.14

Assuming Lognormal Distribution

90% H-UCL	11.2
90% Chebyshev (MVUE) UCL	10.8
95% Chebyshev (MVUE) UCL	13.39
97.5% Chebyshev (MVUE) UCL	16.98
99% Chebyshev (MVUE) UCL	24.04

Gamma Distribution Test

k star (bias corrected)	0.365
Theta Star	19.36
MLE of Mean	7.068
MLE of Standard Deviation	11.7
nu star	29.2
Approximate Chi Square Value (.05)	19.94
Adjusted Level of Significance	0.0934
Adjusted Chi Square Value	19.71
Anderson-Darling Test Statistic	3.523
Anderson-Darling 5% Critical Value	0.841
Kolmogorov-Smirnov Test Statistic	0.232
Kolmogorov-Smirnov 5% Critical Value	0.15

Data not Gamma Distributed at 5% Significance Level

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

90% CLT UCL	10.81
90% Jackknife UCL	10.87
90% Standard Bootstrap UCL	10.65
90% Bootstrap-t UCL	14.48
90% Hall's Bootstrap UCL	11.39
90% Percentile Bootstrap UCL	10.77
90% BCA Bootstrap UCL	11.88
90% Chebyshev(Mean, Sd) UCL	15.82
95% Chebyshev(Mean, Sd) UCL	19.79
97.5% Chebyshev(Mean, Sd) UCL	25.29
99% Chebyshev(Mean, Sd) UCL	36.1

Assuming Gamma Distribution

90% Approximate Gamma UCL	10.35
90% Adjusted Gamma UCL	10.47

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\Documents and Settings\Julie Pettijohn\My Documents\Active Jobs\Doyle Drive SF\Contract 5 Report\Stat
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Calc WET Lead (4)

General Statistics

Number of Valid Observations 5

Number of Distinct Observations 5

Raw Statistics

Minimum	3.1
Maximum	69
Mean	26.82
Median	5.4
SD	31.34
Coefficient of Variation	1.168
Skewness	0.77

Log-transformed Statistics

Minimum of Log Data	1.131
Maximum of Log Data	4.234
Mean of log Data	2.506
SD of log Data	1.466

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.777
Shapiro Wilk Critical Value	0.762

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.815
Shapiro Wilk Critical Value	0.762

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	48.31

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	48.23
90% Modified-t UCL	49.11

Assuming Lognormal Distribution

90% H-UCL	771.3
90% Chebyshev (MVUE) UCL	73.06
95% Chebyshev (MVUE) UCL	94.25
97.5% Chebyshev (MVUE) UCL	123.7
99% Chebyshev (MVUE) UCL	181.4

Gamma Distribution Test

k star (bias corrected)	0.438
Theta Star	61.18
MLE of Mean	26.82
MLE of Standard Deviation	40.51
nu star	4.383
Approximate Chi Square Value (.05)	1.271
Adjusted Level of Significance	0.0432
Adjusted Chi Square Value	0.816
Anderson-Darling Test Statistic	0.64
Anderson-Darling 5% Critical Value	0.698
Kolmogorov-Smirnov Test Statistic	0.357
Kolmogorov-Smirnov 5% Critical Value	0.367

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

90% Approximate Gamma UCL	92.53
90% Adjusted Gamma UCL	144.1

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% CLT UCL	44.78
90% Jackknife UCL	48.31
90% Standard Bootstrap UCL	42.65
90% Bootstrap-t UCL	46.22
90% Hall's Bootstrap UCL	38.13
90% Percentile Bootstrap UCL	43.1
90% BCA Bootstrap UCL	43.4
90% Chebyshev(Mean, Sd) UCL	68.86
95% Chebyshev(Mean, Sd) UCL	87.91
97.5% Chebyshev(Mean, Sd) UCL	114.3
99% Chebyshev(Mean, Sd) UCL	166.3

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\Documents and Settings\Julie Pettijohn\My Documents\Active Jobs\Doyle Drive SF\Contract 5 Report\Statistics
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Calc WET Lead (5)

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12

Raw Statistics

Minimum	0.56
Maximum	48
Mean	9.047
Median	4.65
SD	12.97
Coefficient of Variation	1.434
Skewness	2.87

Log-transformed Statistics

Minimum of Log Data	-0.58
Maximum of Log Data	3.871
Mean of log Data	1.581
SD of log Data	1.147

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.608
Shapiro Wilk Critical Value	0.859

Data not Normal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	14.15

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	16.06
90% Modified-t UCL	14.67

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.98
Shapiro Wilk Critical Value	0.859

Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

90% H-UCL	20.46
90% Chebyshev (MVUE) UCL	17.95
95% Chebyshev (MVUE) UCL	22.16
97.5% Chebyshev (MVUE) UCL	28
99% Chebyshev (MVUE) UCL	39.48

Gamma Distribution Test

k star (bias corrected)	0.758
Theta Star	11.94
MLE of Mean	9.047
MLE of Standard Deviation	10.39
nu star	18.19
Approximate Chi Square Value (.05)	11.02
Adjusted Level of Significance	0.0752
Adjusted Chi Square Value	10.36
Anderson-Darling Test Statistic	0.507
Anderson-Darling 5% Critical Value	0.759
Kolmogorov-Smirnov Test Statistic	0.214
Kolmogorov-Smirnov 5% Critical Value	0.253

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

90% Approximate Gamma UCL	14.94
90% Adjusted Gamma UCL	15.89

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

90% CLT UCL	13.85
90% Jackknife UCL	14.15
90% Standard Bootstrap UCL	13.67
90% Bootstrap-t UCL	24.53
90% Hall's Bootstrap UCL	35.24
90% Percentile Bootstrap UCL	13.49
90% BCA Bootstrap UCL	15.98
90% Chebyshev(Mean, Sd) UCL	20.28
95% Chebyshev(Mean, Sd) UCL	25.37
97.5% Chebyshev(Mean, Sd) UCL	32.43
99% Chebyshev(Mean, Sd) UCL	46.31

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\Documents and Settings\Julie Pettijohn\My Documents\Active Jobs\Doyle Drive SF\Contract 5 Report\Statistics
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Calc WET Lead (9)

General Statistics

Number of Valid Observations	24	Number of Distinct Observations	20

Raw Statistics

Minimum	0.08
Maximum	18
Mean	2.433
Median	1.1
SD	3.824
Coefficient of Variation	1.572
Skewness	3.311

Log-transformed Statistics

Minimum of Log Data	-2.526
Maximum of Log Data	2.89
Mean of log Data	0.121
SD of log Data	1.279

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.585
Shapiro Wilk Critical Value	0.916

Data not Normal at 5% Significance Level

Assuming Normal Distribution

90% Student's-t UCL	3.462

90% UCLs (Adjusted for Skewness)

90% Adjusted-CLT UCL	3.81
90% Modified-t UCL	3.55

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.989
Shapiro Wilk Critical Value	0.916

Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

90% H-UCL	4.54
90% Chebyshev (MVUE) UCL	4.662
95% Chebyshev (MVUE) UCL	5.68
97.5% Chebyshev (MVUE) UCL	7.092
99% Chebyshev (MVUE) UCL	9.867

Gamma Distribution Test

k star (bias corrected)	0.707
Theta Star	3.442
MLE of Mean	2.433
MLE of Standard Deviation	2.893
nu star	33.93
Approximate Chi Square Value (.05)	23.89
Adjusted Level of Significance	0.088
Adjusted Chi Square Value	23.43
Anderson-Darling Test Statistic	0.584
Anderson-Darling 5% Critical Value	0.781
Kolmogorov-Smirnov Test Statistic	0.147
Kolmogorov-Smirnov 5% Critical Value	0.185

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

90% Approximate Gamma UCL	3.454
90% Adjusted Gamma UCL	3.523

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

90% CLT UCL	3.433
90% Jackknife UCL	3.462
90% Standard Bootstrap UCL	3.4
90% Bootstrap-t UCL	4.642
90% Hall's Bootstrap UCL	8.543
90% Percentile Bootstrap UCL	3.518
90% BCA Bootstrap UCL	3.921
90% Chebyshev(Mean, Sd) UCL	4.774
95% Chebyshev(Mean, Sd) UCL	5.835
97.5% Chebyshev(Mean, Sd) UCL	7.307
99% Chebyshev(Mean, Sd) UCL	10.2

Potential UCL to Use

Recommendation Provided only for 95% Confidence Coefficient