APPENDIX E

Three-Part Compliance Calculations Supporting Soil Excavation Design

Table E-1. Baseline (Pre-Cleanup) Soil Copper and Zinc Data within CA 2 Area of Influence

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Exploration ID	Sample Date	Sample Name	Metals Concentrations (mg/kg)	
			Copper	Zinc
AB-01	4/26/2022	AB-01-12.5-13	31	45
		AB-01-2.5-4	272	366
		AB-01-5.0-6.5	84	142
		AB-01-7.5-8	349	227
AB-02	4/26/2022	AB-02-11-12	88	262
		AB-02-2.5-4.0	470	1190
		AB-02-4.0-5.0	693	1720
		AB-02-6.0-7.5	87	320
AB-03	4/26/2022	AB-03-11-12.5	34	50
		AB-03-2.5-4.0	39	62
		AB-03-5.0-6.5	173	277
		AB-03-7.5-8.5	408	613
AB-04	4/25/2022	AB-04-12.5-14	41	73
		AB-04-2.5-3.0	432	1490
		AB-04-5-6.5	40	95
		AB-04-7.5-9.0	28	110
AB-05	4/25/2022	AB-05-12.5-13	84	222
		AB-05-2.5-4.0	66	106
		AB-05-5.0-6.5	126	195
		AB-05-6.5-7.5	312	1100
AB-06	4/25/2022	AB-06-11.5-12.5	30	47
		AB-06-2.5-4.0	477	292
		AB-06-4.0-5.0	277	250
		AB-06-7.5-9.0	54	104
AB-07	4/25/2022	AB-07-12.5-14.0	63	77
		AB-07-2.5-4.0	899	625
		AB-07-5-6.5	23	52
		AB-07-7.5-8.0	1890	1940

Table E-1. Baseline (Pre-Cleanup) Soil Copper and Zinc Data within CA 2 Area of Influence

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Exploration ID	Sample Date	Sample Name	Metals Concentrations (mg/kg)	
			Copper	Zinc
AB-08	4/25/2022	AB-08-11.5-12.5	23	43
		AB-08-2.5-4.0	419	751
		AB-08-5-6.5	160	260
		AB-08-7.5-9.0	303	512
AB-09	4/26/2022	AB-09-11-12.5	26	36
		AB-09-2.5-4	389	1140
		AB-09-5.0-6.5	156	191
		AB-09-7.5-9.0	34	72
AB-10	4/26/2022	AB-10-2.5-4.0	66	211
		AB-10-4.5-5.0	56	154
		AB-10-7.0-7.5	51	103
		AB-10-7.5-10	117	305
MW-12	2/9/2015	MW-12-0-1	958	2410
		MW-12-1-2	81	271
		MW-12-2-3	79	165
		MW-12-8-8.5	487	1810
		MW-12-10.5-11	73	131
		MW-12-11-12	45	98
		MW-12-13-14	75	256
		MW-12-14-15	79	160
FS02	3/16/2011	FS-02-2.5-3.5	930	3700
		FS-02-18	19	32
FS03	3/16/2011	FS-03-1.5-2.5	460	1500
		FS-03-11-12	160	250
FS-07	3/16/2011	FS-07-12.5-13.5	19	31
		FS-07-2-3	13	180
FS-09	3/15/2011	FS-09-18.5-20	15	36
		FS-09-8-8.5	24	40

Table E-1. Baseline (Pre-Cleanup) Soil Copper and Zinc Data within CA 2 Area of Influence

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Exploration ID	Sample Date	Sample Name	Metals Concentrations (mg/kg)	
			Copper	Zinc
MW-02A	3/15/2011	MW-02A-13.5	45	71
		MW-02A-7.5	14	48
MW-07	3/15/2011	MW-07-14	47	69
		MW-07-5.5	17	39
TP-10	4/27/1998	TP-10-1.2	1200	13000
MW-2	4/28/1998	MW-2 - 8.5'	114	281
TP-09	4/30/1998	TP-9-1.8	29	49
		TP-9-6	27	44
3-A	8/1/1993	3-A-0-0.3	2140	5120
3-B	8/1/1993	3-B-0.2-0.7	694	684

Notes:

1. Cleanup levels (CULs) are 390 mg/Kg for Copper and 960 mg/Kg Zinc
2. Highlighted cells indicate the following:

= Copper and/or Zinc in Soil > Cleanup Levels

= Copper and/or Zinc in Soil > 2x Cleanup Levels

[No Fill] = Copper and/or Zinc Detected in Soil < Cleanup Levels

Abbreviation

mg/kg = milligrams per kilogram

Table E-2. ProUCL 95 UCL Calculations for Baseline (Pre-Excavation) Data Set, Copper

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.2 2/6/2023 12:05:00 AM		
From File	Cu UCL replacement calc set .xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
C2			
General Statistics			
Total Number of Observations	66	Number of Distinct Observations	63
		Number of Missing Observations	3
Minimum	13	Mean	260.8
Maximum	2140	Median	80.2
SD	410.3	Std. Error of Mean	50.51
Coefficient of Variation	1.573	Skewness	2.871
Normal GOF Test			
Shapiro Wilk Test Statistic	0.626	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.273	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.126	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	345.1	95% Adjusted-CLT UCL (Chen-1995)	363
		95% Modified-t UCL (Johnson-1978)	348.1
Gamma GOF Test			
A-D Test Statistic	2.644	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.8	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.201	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.115	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.673	k star (bias corrected MLE)	0.652
Theta hat (MLE)	387.7	Theta star (bias corrected MLE)	399.9
nu hat (MLE)	88.79	nu star (bias corrected)	86.09
MLE Mean (bias corrected)	260.8	MLE Sd (bias corrected)	323
		Approximate Chi Square Value (0.05)	65.7
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	65.3

Table E-2. ProUCL 95 UCL Calculations for Baseline (Pre-Excavation) Data Set, Copper

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Assuming Gamma Distribution			
95% Approximate Gamma UCL	341.7	95% Adjusted Gamma UCL	343.8
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.938	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.00399	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.129	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0997	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.565	Mean of logged Data	4.66
Maximum of Logged Data	7.669	SD of logged Data	1.338
Assuming Lognormal Distribution			
95% H-UCL	373	90% Chebyshev (MVUE) UCL	414.1
95% Chebyshev (MVUE) UCL	487.5	97.5% Chebyshev (MVUE) UCL	589.3
99% Chebyshev (MVUE) UCL	789.2		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	343.9	95% BCA Bootstrap UCL	368.2
95% Standard Bootstrap UCL	343.6	95% Bootstrap-t UCL	385.8
95% Hall's Bootstrap UCL	395.4	95% Percentile Bootstrap UCL	348.5
90% Chebyshev(Mean, Sd) UCL	412.3	95% Chebyshev(Mean, Sd) UCL	481
97.5% Chebyshev(Mean, Sd) UCL	576.2	99% Chebyshev(Mean, Sd) UCL	763.4
Suggested UCL to Use			
95% Student's-t UCL	345.1		
The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.			
Please verify the data were collected from random locations.			
If the data were collected using judgmental or other non-random methods,			
then contact a statistician to correctly calculate UCLs.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Table E-3. ProUCL 95 UCL Calculations for Baseline (Pre-Excavation) Data Set, Zinc

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.2 2/6/2023 12:12:47 AM		
From File	Zn UCL replacement calc set.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
C2			
General Statistics			
Total Number of Observations	66	Number of Distinct Observations	65
		Number of Missing Observations	2
Minimum	31	Mean	701.6
Maximum	13000	Median	193
SD	1772	Std. Error of Mean	218.1
Coefficient of Variation	2.526	Skewness	5.629
Normal GOF Test			
Shapiro Wilk Test Statistic	0.402	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.353	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.126	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1066	95% Adjusted-CLT UCL (Chen-1995)	1222
		95% Modified-t UCL (Johnson-1978)	1091
Gamma GOF Test			
A-D Test Statistic	4.174	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.813	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.239	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.116	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.533	k star (bias corrected MLE)	0.519
Theta hat (MLE)	1316	Theta star (bias corrected MLE)	1351
nu hat (MLE)	70.39	nu star (bias corrected)	68.53
MLE Mean (bias corrected)	701.6	MLE Sd (bias corrected)	973.7
		Approximate Chi Square Value (0.05)	50.47
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	50.13

Table E-3. ProUCL 95 UCL Calculations for Baseline (Pre-Excavation) Data Set, Zinc

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Assuming Gamma Distribution			
95% Approximate Gamma UCL	952.6	95% Adjusted Gamma UCL	959.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	0.00193	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.116	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0997	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.434	Mean of logged Data	5.374
Maximum of Logged Data	9.473	SD of logged Data	1.397
Assuming Lognormal Distribution			
95% H-UCL	847.1	90% Chebyshev (MVUE) UCL	934.9
95% Chebyshev (MVUE) UCL	1106	97.5% Chebyshev (MVUE) UCL	1344
99% Chebyshev (MVUE) UCL	1812		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1060	95% BCA Bootstrap UCL	1348
95% Standard Bootstrap UCL	1056	95% Bootstrap-t UCL	1599
95% Hall's Bootstrap UCL	2471	95% Percentile Bootstrap UCL	1080
90% Chebyshev(Mean, Sd) UCL	1356	95% Chebyshev(Mean, Sd) UCL	1652
97.5% Chebyshev(Mean, Sd) UCL	2064	99% Chebyshev(Mean, Sd) UCL	2872
Suggested UCL to Use			
95% Student's-t UCL	1066		
The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.			
Please verify the data were collected from random locations.			
If the data were collected using judgmental or other non-random methods,			
then contact a statistician to correctly calculate UCLs.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Table E-4. ProUCL 95 UCL Calculations for Modified (Post-Excavation) Data Set, Copper

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

UCL Statistics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.2 2/6/2023 1:00:47 AM		
From File	CU 95UCL full EDR set.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
C2			
General Statistics			
Total Number of Observations	66	Number of Distinct Observations	53
		Number of Missing Observations	2
Minimum	13	Mean	154.4
Maximum	477	Median	80.2
SD	144.5	Std. Error of Mean	17.78
Coefficient of Variation	0.936	Skewness	0.746
Normal GOF Test			
Shapiro Wilk Test Statistic	0.794	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	1.995E-12	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.252	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.126	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	184	95% Adjusted-CLT UCL (Chen-1995)	185.4
		95% Modified-t UCL (Johnson-1978)	184.3
Gamma GOF Test			
A-D Test Statistic	2.581	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.778	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.155	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.076	k star (bias corrected MLE)	1.037
Theta hat (MLE)	143.4	Theta star (bias corrected MLE)	148.8
nu hat (MLE)	142.1	nu star (bias corrected)	136.9
MLE Mean (bias corrected)	154.4	MLE Sd (bias corrected)	151.6
		Approximate Chi Square Value (0.05)	110.9
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	110.4

Table E-4. ProUCL 95 UCL Calculations for Modified (Post-Excavation) Data Set, Copper

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Assuming Gamma Distribution			
95% Approximate Gamma UCL	190.6	95% Adjusted Gamma UCL	191.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	1.6411E-5	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.159	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0997	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.565	Mean of logged Data	4.508
Maximum of Logged Data	6.168	SD of logged Data	1.102
Assuming Lognormal Distribution			
95% H-UCL	226.7	90% Chebyshev (MVUE) UCL	245.6
95% Chebyshev (MVUE) UCL	282.5	97.5% Chebyshev (MVUE) UCL	333.7
99% Chebyshev (MVUE) UCL	434.3		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	183.6	95% BCA Bootstrap UCL	187.6
95% Standard Bootstrap UCL	184.2	95% Bootstrap-t UCL	185.9
95% Hall's Bootstrap UCL	184.7	95% Percentile Bootstrap UCL	184.7
90% Chebyshev(Mean, Sd) UCL	207.7	95% Chebyshev(Mean, Sd) UCL	231.9
97.5% Chebyshev(Mean, Sd) UCL	265.4	99% Chebyshev(Mean, Sd) UCL	331.3
Suggested UCL to Use			
95% Student's-t UCL	184		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

Table E-5. ProUCL 95 UCL Calculations for Modified (Post-Excavation) Data Set, Zinc

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

UCL StatisA1:L75tics for Uncensored Full Data Sets			
User Selected Options			
Date/Time of Computation	ProUCL 5.2 2/6/2023 1:01:57 AM		
From File	ZN 95UCL EDR full set.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
C2			
General Statistics			
Total Number of Observations	66	Number of Distinct Observations	56
		Number of Missing Observations	2
Minimum	31	Mean	355.1
Maximum	1490	Median	193
SD	392	Std. Error of Mean	48.25
Coefficient of Variation	1.104	Skewness	1.283
Normal GOF Test			
Shapiro Wilk Test Statistic	0.744	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk P Value	2.442E-15	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.263	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.126	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	435.6	95% Adjusted-CLT UCL (Chen-1995)	442.6
		95% Modified-t UCL (Johnson-1978)	436.9
Gamma GOF Test			
A-D Test Statistic	2.28	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.783	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.129	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.934	k star (bias corrected MLE)	0.901
Theta hat (MLE)	380.3	Theta star (bias corrected MLE)	394
nu hat (MLE)	123.2	nu star (bias corrected)	119
MLE Mean (bias corrected)	355.1	MLE Sd (bias corrected)	374
		Approximate Chi Square Value (0.05)	94.78
Adjusted Level of Significance	0.0464	Adjusted Chi Square Value	94.3

Table E-5. ProUCL 95 UCL Calculations for Modified (Post-Excavation) Data Set, Zinc

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Assuming Gamma Distribution			
95% Approximate Gamma UCL	445.7	95% Adjusted Gamma UCL	448
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.915	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk P Value	1.2856E-4	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.113	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.0997	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.434	Mean of logged Data	5.249
Maximum of Logged Data	7.307	SD of logged Data	1.16
Assuming Lognormal Distribution			
95% H-UCL	514.4	90% Chebyshev (MVUE) UCL	561.6
95% Chebyshev (MVUE) UCL	649.8	97.5% Chebyshev (MVUE) UCL	772.3
99% Chebyshev (MVUE) UCL	1013		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	434.4	95% BCA Bootstrap UCL	449.1
95% Standard Bootstrap UCL	435.4	95% Bootstrap-t UCL	448
95% Hall's Bootstrap UCL	442.8	95% Percentile Bootstrap UCL	441.4
90% Chebyshev(Mean, Sd) UCL	499.8	95% Chebyshev(Mean, Sd) UCL	565.4
97.5% Chebyshev(Mean, Sd) UCL	656.4	99% Chebyshev(Mean, Sd) UCL	835.2
Suggested UCL to Use			
95% Student's-t UCL	435.6		
The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.			
Please verify the data were collected from random locations.			
If the data were collected using judgmental or other non-random methods,			
then contact a statistician to correctly calculate UCLs.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			