– APPENDICES –

Final Draft

BASELINE ECOLOGICAL RISK ASSESSMENT

Upper Animas Mining District

San Juan County, COLORADO

April 2015

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Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Measurement	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**	**pH**
Animas River upstream of mainstem Cement Creek																									
A56 ("upstream)											7.61	7.44												7.39	6.64
A60											7.66	7.44													6.48
A61											7.38	7.36													7.37
A64											7.54	7.35													6.26
A65											7.47	7.24													7.01
A66											7.45	7.15													6.99
A68	6.74	6.82	6.85	7.18		7.15	7.51	6.98	7.28	7.37	7.39	7.09	7.61	7.18	7.21	6.52	6.92	7.52	7.26	7.42	7.2	7.39	6.87	7.42	7.71
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								5.54	
A70B																								6.05	
Animas River downstream of mainstem Mineral Creek																									
A71B																								6.10	
A72	5.07	5.04	6.09	5.3		7.08	7.09	6.51	6.5	6.59	6.87	6.33	6.88	6.40	6.46	5.93	6.41	6.48	6.25	7.08	6.51	6.38	6.23	5.98	7.00
A73											7.25	7.19												6.54	7.24
A73B											7.26	7.24												6.74	7.24
A75D											7.49	7.44												7.21	6.93
A75B											7.42	7.29												7.02	6.89
Bakers Bridge											7.64	7.63												7.20	7.58
Mainstem Cement Creek																									
CC48	3.5	3.42	3.93	3.54		5.40	4.29	5.34	5.24	4.43	4.43	4.6	3.95	3.51	3.65	3.50	3.57	3.45	3.51	4.54	3.45	3.51	3.24	3.40	4.00
CC49																								3.43	
Mainstem Mineral Creek																									
M34	4.97	5.02	6.22	5.12		6.49	7.30	7.00	7.19	7.07	7.23	6.83	7.19	6.73	6.70	5.62	6.77	6.73	6.4	7.28	6.82	6.68	5.90	6.15	7.05

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

Appendix 1.b: Hardness measurements in surface water samples collected between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Measurement	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**	**hardness**
Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Animas River upstream of mainstem Cement Creek																									
A56 ("upstream")					131						65	79												168	114
A60											74	78													111
A61											78	80													111
A64											63	76													113
A65											65	80													117
A66											64	79													120
A68	202	179	148	172	151	49	65	50	53	71	66	87	85	135	141	167	97	144	154	66	111	140	138	174	114
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								297	
A70B																								295	
Animas River downstream of mainstem Mineral Creek																									
A71B																								263	
A72	352	337	177	273		45	78	54	55	86	82	103	109	211	199	296	136	245	232	75	161	210	183	261	144
A73					182						71	88												251	142
A73B											37	54												217	83
A75D					133						60	76												191	92
A75B											61	70												193	85
Bakers Bridge					127						58	73												183	99
Mainstem Cement Creek																									
CC48	571	541	301	493		81	189	88	76	177	129	126	293	467	470	495	345	509	517	191	398	474	435	515	67
CC49																								545	
Mainestem Mineral Creek																									
M34	309	308	150	247		52	72	49	53	77	79	92	91	186	156	238	114	199	219	65	144	188	155	220	118

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

Appendix 1.c: Total and Dissolved Aluminum Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**	**Al-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					71.2						817	392												100 U	188
A60											370	452													174
A61											322	549													168
A64											343	514													150
A65											698	454													160
A66											653	547													174
A68	269	177	368	275	438	1010	165	348	540	154	534	508	117	120	134	189	100 U	124	101	217	100 U	100 U	100 U	100 U	164
Animas River between mainsteam Cement Creek and mainstem Mineral Creek																									
A69A																								2520 D	
A70B																								2460 D	
Animas River downstream of confluence with mainstem Mineral Creek																									
A71B																								2780 D	
A72	4440	4090	1980	3310		3060	679	585	1200	713	938	2340	812	2080	2080	2750	1090	2180	2540	597	1370	2070	1800	2620 D	1110
A73					1620						1280	1050												2420 D	933
A73B											666	640												1980 D	612
A75D					1260						1630	1060												1790 D	534
A75B											1650	1040												830 D	562
Bakers Bridge					843						1310	734												234 JD	399
Mainstem Cement Creek																									
CC48	8610	8100	5020	7540		1780	2920	1750	1610	2690	2690	3280	4120	7110	7050	7850	5270	7230	7930	2710	5830	6770	6810	7670 D	4890 D
CC49																								7800 D	
Mainstem Mineral Creek																									
M34	5950	5360	2160	4830		1130	773	665	2200	824	1270	2610	933	2630	2480	4590	1200	2960	3080	563	1600	2610	2170	3390 D	1260

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**	**Al-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					40.8 J						48.7 J	58.1												42.7 J	61.4
A60											49.8 J	52.5													43.3 J
A61											70.4	116													64.9
A64											70.5	84.8													63
A65											81.4	89.9													54.7
A66											76.7	93.1													59.9
A68	141	100 U	100 U	100	82.9	100 U	100 U	100 U	100 U	57.2	93.3	112	100 U	100 U	100 U	103	100 U	25.0 U	25.0 U	100 U	100 U	100 U	100 U	62.2	73
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								603	
A70B																								1690	
Animas River downstream of confluence with mainstem Mineral Creek																									
A71B																								309	
A72	3290	2740	212	1570		100 U	100 U	100 U	100 U	33.6 J	58.9	37.4 J	100 U	131	171	959	100 U	25.0 U	193	100 U	100 U	117	103	342	38.9 J
A73					32.2 J						73.1	38.6 J												44.8 J	36.9 J
A73B											83.1	64.6												39.1 J	43.1 J
A75D					36.9 J						86.7	58.1												20 U	66.2
A75B											84.2	58.9												21.3 J	61.8
Bakers Bridge					69.1						84.2	79.3												26.2 J	76.9
Mainstem Cement Creek																									
CC48	8450	7820	4840	7660		751	2890	1050	798	2470	2290	2360	4050	7050	6930	7850	5270	7440	7720	2410	6030	7290	6770	7480 D	938
CC49																								7660 D	
Mainstem Mineral Creek																									
M34	4410	4700	160	3020		100 U	100 U	117	100 U	45.0 J	62.6	35.5 J	100 U	100 U	100 U	656	100 U	25.0 U	25.0 U	100 U	100 U	100 U	100 U	177 JD	46 J

prepared by: SJP (1/20/14)
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updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.d: Total and Dissolved Arsenic Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**	**As-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A60											2.5 U	2.5 U													2.5 U
A61											2.5 U	2.5 U													2.5 U
A64											2.5 U	2.5 U													U
A65											2.5 U	2.5 U													2.5 U
A66											2.5 U	2.5 U													2.5 U
A68	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U	2.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								2.5 U	
A70B																								2.5 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								2.5 U	
A72	4.0 U	4.0 U	4.0 U	4.0 U		5.0	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U	2.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U
A73					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A73B											2.5 U	2.5 U												2.5 U	2.5 U
A75D					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A75B											2.5 U	2.5 U												2.5 U	2.5 U
Bakers Bridge					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
Mainstem Cement Creek																									
CC48	7.7	6.6	4.0 U	5.0		4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	5.0 U	4.4 JD	4.0 U	4.0 U	4.0	5.4	4.0 U	1.0 U	4.3	4.0 U	4.0 U	4.0 U	4.0 U	4.8 JD	3.1 JD
CC49																								4.7 JD	
Mainstem Mineral Creek																									
M34	4.0 U	4.0 U	4.0 U	4.0 U		4.0 U	4.0 U	4.0 U	4.5	2.5 U	2.5 U	3.2 JD	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**	**As-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
A60											0.5 U	0.5 U													0.5 U
A61											0.5 U	0.5 U													0.5 U
A64											0.5 U	0.5 U													0.5 U
A65											0.5 U	0.5 U													0.5 U
A66											0.5 U	0.5 U													0.5 U
A68	4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	0.5 U	0.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	0.5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								0.5 U	
A70B																								0.5 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								0.5 U	
A72	4.0 U	4.0 U	4.0 U	4.0 U		4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	2.5 U	0.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	0.5 U
A73					0.5 U						2.5 U	0.5 U												0.5 U	0.5 U
A73B											0.5 U	0.5 U												0.5 U	0.5 U
A75D					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
A75B											0.5 U	0.5 U												0.5 U	0.5 U
Bakers Bridge					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
Mainstem Cement Creek																									
CC48	4.0 U	4.0 U	4.0 U	4.0 U		4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	5.0 U	0.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U
CC49																								2.5 U	
Mainstem Mineral Creek																									
M34	4.0 U	4.0 U	4.0 U	4.0 U		4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	2.5 U	0.5 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	1.0 U	1.0 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	0.5 U

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

Appendix 1.e: Total and Dissolved Beryllium Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

PRE-RUNOFF PERIOD — Be-total

Sampling Date Metal-fraction Units	Feb 2010 Be-total µg/L	Mar 2010 Be-total µg/L	Apr 2010 Be-total µg/L	Mar 2011 Be-total µg/L	April 2014 Be-total µg/L
Animas River upstream of the confluence with mainstem Cement Creek					
A56 ("upstream")					2.0 U
A60					
A61					
A64					
A65					
A66					
A68	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek					
A69A					
A70B					
Animas River downstream of the confluence with mainstem Mineral Creek					
A71B					
A72	1.0 U	1.0 U	1.0 U	1.0 U	
A73					2.0 U
A73B					
A75D					2.0 U
A75B					
Bakers Bridge					2.0 U
Mainstem Cement Creek					
CC48	1.3	1.3	1.0 U	1.0 U	
CC49					
Mainstem Mineral Creek					
M34	1.0 U	1.0 U	1.0 U	1.0 U	

RUNOFF PERIOD — Be-total

Sampling Date Metal-fraction Units	May 2009 Be-total µg/L	Jun 2009 Be-total µg/L	Jun 2010 Be-total µg/L	Jun 2011 Be-total µg/L	May 2012 Be-total µg/L	May 2013 Be-total µg/L	May 2014 Be-total µg/L
Animas River upstream of the confluence with mainstem Cement Creek							
A56 ("upstream")						2.0 U	2.0 U
A60						2.0 U	2.0 U
A61						2.0 U	2.0 U
A64						2.0 U	2.0 U
A65						2.0 U	2.0 U
A66						2.0 U	2.0 U
A68	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek							
A69A							
A70B							
Animas River downstream of the confluence with mainstem Mineral Creek							
A71B						2.0 U	
A72	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U
A73						2.0 U	2.0 U
A73B						2.0 U	2.0 U
A75D						2.0 U	2.0 U
A75B						2.0 U	2.0 U
Bakers Bridge						2.0 U	2.0 U
Mainstem Cement Creek							
CC48	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U
CC49							
Mainstem Mineral Creek							
M34	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U

POST-RUNOFF PERIOD — Be-total

Sampling Date Metal-fraction Units	Jul 2009 Be-total µg/L	Aug 2009 Be-total µg/L	Sep 2009 Be-total µg/L	Nov 2009 Be-total µg/L	Jul 2010 Be-total µg/L	Sep 2010 Be-total µg/L	Nov 2010 Be-total µg/L	Jul 2011 Be-total µg/L	Aug 2011 Be-total µg/L	Sep 2011 Be-total µg/L	Oct 2011 Be-total µg/L	Oct 2012 Be-total µg/L	Sept 2014 Be-total µg/L
Animas River upstream of the confluence with mainstem Cement Creek													
A56 ("upstream")												10.0 U	2.0 U
A60													2.0 U
A61													2.0 U
A64													2.0 U
A65													2.0 U
A66													U
A68	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	10.0 U	2.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek													
A69A												10.0 U	
A70B												10.0 U	
Animas River downstream of the confluence with mainstem Mineral Creek													
A71B												10.0 U	
A72	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	10.0 U	2.0 U
A73												10.0 U	2.0 U
A73B												10.0 U	2.0 U
A75D												10.0 U	2.0 U
A75B												10.0 U	2.0 U
Bakers Bridge												10.0 U	2.0 U
Mainstem Cement Creek													
CC48	1.0 U	1.2	1.2	1.2	1.0 U	1.3	1.4	1.0 U	1.0 U	1.0	1.0 U	10.0 U	10.0 U
CC49												10.0 U	
Mainstem Mineral Creek													
M34	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	10.0 U	2.0 U

PRE-RUNOFF PERIOD — Be-diss

Sampling Date Metal-fraction Units	Feb 2010 Be-diss ug/L	Mar 2010 Be-diss µg/L	Apr 2010 Be-diss µg/L	Mar 2011 Be-diss µg/L	April 2014 Be-diss µg/L
Animas River upstream of the confluence with mainstem Cement Creek					
A56 ("upstream")					2.0 U
A60					
A61					
A64					
A65					
A66					
A68	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek					
A69A					
A70B					
Animas River downstream of the confluence with mainstem Mineral Creek					
A71B					
A72	1.0 U	1.0 U	1.0 U	1.0 U	
A73					2.0 U
A73B					
A75D					2.0 U
A75B					
Bakers Bridge					2.0 U
Mainstem Cement Creek					
CC48	1.2	1.1	1.0 U	1.3	
CC49					
Mainstem Mineral Creek					
M34	1.0 U	1.0 U	1.0 U	1.0 U	

RUNOFF PERIOD — Be-diss

Sampling Date Metal-fraction Units	May 2009 Be-diss ug/L	Jun 2009 Be-diss µg/L	Jun 2010 Be-diss µg/L	Jun 2011 Be-diss µg/L	May 2012 Be-diss µg/L	May 2013 Be-diss µg/L	May 2014 Be-diss µg/L
Animas River upstream of the confluence with mainstem Cement Creek							
A56 ("upstream")						2.0 U	2.0 U
A60						2.0 U	2.0 U
A61						2.0 U	2.0 U
A64						2.0 U	2.0 U
A65						2.0 U	2.0 U
A66						2.0 U	2.0 U
A68	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek							
A69A							
A70B							
Animas River downstream of the confluence with mainstem Mineral Creek							
A71B							
A72	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U
A73						2.0 U	2.0 U
A73B						2.0 U	2.0 U
A75D						2.0 U	2.0 U
A75B						2.0 U	2.0 U
Bakers Bridge						2.0 U	2.0 U
Mainstem Cement Creek							
CC48	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U
CC49							
Mainstem Mineral Creek							
M34	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U

POST-RUNOFF PERIOD — Be-diss

Sampling Date Metal-fraction Units	Jul 2009 Be-diss µg/L	Aug 2009 Be-diss µg/L	Sep 2009 Be-diss µg/L	Nov 2009 Be-diss µg/L	Jul 2010 Be-diss µg/L	Sep 2010 Be-diss µg/L	Nov 2010 Be-diss µg/L	Jul 2011 Be-diss µg/L	Aug 2011 Be-diss µg/L	Sep 2011 Be-diss µg/L	Oct 2011 Be-diss µg/L	Oct 2012 Be-diss µg/L	Sept 2014 Be-diss µg/L
Animas River upstream of the confluence with mainstem Cement Creek													
A56 ("upstream")												2.0 U	2.0 U
A60													2.0 U
A61													2.0 U
A64													2.0 U
A65													2.0 U
A66													2.0 U
A68	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek													
A69A												2.0 U	
A70B												2.0 U	
Animas River downstream of the confluence with mainstem Mineral Creek													
A71B												2.0 U	
A72	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U
A73												2.0 U	2.0 U
A73B												2.0 U	2.0 U
A75D												2.0 U	2.0 U
A75B												2.0 U	2.0 U
Bakers Bridge												2.0 U	2.0 U
Mainstem Cement Creek													
CC48	1.0 U	1.1	1.2	1.2	1.0 U	0.2 U	1.1	1.0 U	1.1	1.1	1.0 U	10.0 U	2.0 U
CC49												10.0 U	
Mainstem Mineral Creek													
M34	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	10.0 U	2.0 U

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

Appendix 1.f: Total and Dissolved Cadmium Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**	**Cd-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					0.596 JD						1.6 D	1.33 D												1.0 D	0.99 JD
A60											1.3 D	1.17 D													0.93 JD
A61											1.2 D	1.83 D													0.99 JD
A64											1.3 D	1.49 D													0.93 JD
A65											1.3 D	1.37 D													0.94 JD
A66											1.4 D	1.5 D													1.0 D
A68	2.0	1.7	4.0	2.6	3.2 D	1.5	0.9	1.1	1.1	0.9 JD	1.5 D	1.52 D	0.8	1.0	1.3	1.6	0.8	1.3	1.3	0.8	1.0	1.1	1.2	1.3 D	1.1 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								3.0 D	
A70B																								2.7 D	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								2.0 D	
A72	2.5	2.8	2.9	2.7		1.2	0.8	0.9	0.9	0.9 JD	1.4 D	1.65 D	0.9	1.7	1.9	2.7	1.2	1.7	2.0	0.8	1.4	1.7	1.7	2.1 D	1.1 D
A73					2.18 D						1.0 JD	1.27 D												2.2 D	0.97 JD
A73B											0.5 U	0.5 U												1.5 D	0.58 JD
A75D					1.43 D						0.9 JD	0.924 JD												1.3 D	0.51 JD
A75B											1.0 D	0.896 JD												1.1 D	0.51 JD
Bakers Bridge					0.689 JD						0.7 JD	0.601 JD												0.8 JD	0.50 U
Mainstem Cement Creek																									
CC48	5.5	5.6	4.8	5.0		2.1	3.3	2.3	2.0	2.8 D	3.3 D	3.7 D	4.4	6.4	6.7	6.3	4.8	5.8	6.8	3.1	5.3	5.7	7.1	5.7 D	4.7 D
CC49																								5.5 D	
Maintstem Mineral Creek																									
M34	1.1	1.1	1.8	1.2		0.3	0.2	0.3	0.4	0.5 U	0.5 U	0.7 JD	0.4	0.7	0.7	0.9	0.4	0.7	0.7	0.3	0.5	0.7	0.6	0.7 D	5.0 U
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**	**Cd-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					0.582						0.7	0.97												0.6	0.86
A60											0.7	1.01													0.99
A61											1.0	1.51													0.93
A64											0.9	1.35													1.0
A65											0.9	1.31													1.1
A66											0.9	1.4													1.1
A68	1.8	1.6	4.1	2.7	3.0	0.9	0.8	0.9	0.9	0.9	1.0	1.33	0.8	1.0	1.2	1.7	0.8	1.3	1.4	0.8	0.9	1.1	1.1	1.2	1.1
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								2.7	
A70B																								2.7	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								1.9	
A72	2.6	2.7	2.9	2.6		0.6	0.8	0.7	0.8	0.9	1.0 D	1.4	0.9	1.8	1.8	2.8	1.1	1.8	2.1	0.7	1.3	1.7	1.6	1.8	1.2
A73					1.79						0.7 JD	1.09												1.7	1.0
A73B											0.3	0.564												1.4	0.57
A75D					1.02						0.5	0.711												1.1	0.54
A75B											0.5	0.694												1.1	0.52
Bakers Bridge					0.533						0.3	0.422												0.7	0.35
Mainstem Cement Creek																									
CC48	5.5	5.3	4.9	5.3		2.1	3.4	2.2	2.0	2.9	3.2 D	3.8	4.6	6.6	6.6	6.4	4.4	5.7	6.7	3.1	5.6	5.9	7.0	5.1 D	5.1 D
CC49																								5.6 D	
Mainstem Mineral Creek																									
M34	1.1	1.0	2.0	1.1		0.3	0.2	0.2 U	0.2	0.3	0.5 U	0.6	0.3	0.7	0.7	1.0	0.4	0.7	0.8	0.2	0.5	0.7	0.6	0.9 JD	0.39

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.g: Total and Dissolved Chromium Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**	**Cr-total**
Units	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					5.0 U						5.0 U	5.0 U												5.0 U	5.0 U
A60											5.0 U	5.0 U													5.0 U
A61											5.0 U	5.0 U													5.0 U
A64											5.2 JD	5.0 U													5.0 U
A65											5.3 JD	5.0 U													5.0 U
A66											5.0 U	5.0 U													5.0 U
A68	2.0 U	2.0 U	2.0 U	5.0 U	5.0 U	2.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								5.0 U	
A70B																								5.0 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								5.0 U	
A72	2.0 U	2.0 U	2.0 U	5.0 U		2.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
A73					5.0 U						5.0 U	5.0 U												5.0 U	5.0 U
A73B											5.0 U	5.0 U												5.8 JD	5.0 U
A75D					5.0 U						5.0 U	5.0 U												5.0 U	5.0 U
A75B											5.0 U	5.0 U												5.0 U	5.0 U
Bakers Bridge					5.0 U						5.0 U	5.0 U												5.0 U	5.0 U
Mainstem Cement Creek																									
CC48	2.0 U	4.3	2.0 U	5.0 U		2.0 U	2.0 U	5.0 U	5.0 U	5.0 U	10.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
CC49																								13.6 D	
Mainstem Mineral Creek																									
M34	2.0 U	2.0 U	2.0 U	5.0 U		2.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**	**Cr-diss**
Units	**ug/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**ug/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**	**μg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					1.0 U						1.0 U	1.0 U												1.0 U	1.0 U
A60											1.0 U	1.0 U													1.0 U
A61											1.0 U	1.0 U													1.0 U
A64											1.0 U	1.0 U													1.0 U
A65											1.0 U	1.0 U													1.0 U
A66											1.0 U	1.0 U													1.0 U
A68	2.0 U	2.0 U	2.0 U	5.0 U	1.0 U	2.0 U	2.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U	1.0 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								1.0 U	
A70B																								1.0 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								1.0 U	
A72	2.0 U	2.0 U	2.0 U	5.0 U		2.0 U	2.0 U	5.0 U	5.0 U	1.0 U	5.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	2.3	1.0 U
A73					1.0 U						5.0 U	1.0 U												1.0 U	1.0 U
A73B											1.0 U	1.0 U												1.0 U	1.0 U
A75D					1.0 U						1.0 U	1.0 U												1.0 U	1.0 U
A75B											1.0 U	1.0 U												1.0 U	1.0 U
Bakers Bridge					1.0 U						1.0 U	1.0 U												1.0 U	1.0 U
Mainstem Cement Creek																									
CC48	2.0 U	2.0 U	2.0 U	5.0 U		2.0 U	2.0 U	5.0 U	5.0 U	1.0 U	10.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
CC49																								5.0 U	
Mainstem Mineral Creek																									
M34	2.0 U	2.0 U	2.0 U	5.0 U		2.0 U	2.0 U	5.0 U	5.0 U	1.0 U	5.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	0.5 U	0.5 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.h: Total and Dissolved Copper Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**	**Cu-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					3.3 JD						46.0 D	25.9 D												2.5 U	3.9 JD
A60											33.1 D	27.1 D													4.1 JD
A61											21.7 D	33.5 D													5.0 D
A64											20.1 D	29.2 D													4.6 D
A65											25.7 D	29.9 D													5.0 JD
A66											24.9 D	30.3 D													5.1 D
A68	6.2	7.7	22.3	14.7	20.5 D	21.2	5.8	10.0 U	10.9	5.9 D	28.9 D	27.2 D	4.0	3.9	4.0	5.1	10.0 U	4.0 U	4.0 U	20.0 U	20.0 U	20.0 U	20.0 U	4.5 JD	4.7 JD
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								27.8 D	
A70B																								27.1 D	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								18.1 D	
A72	42.0	40.5	34.9	33.5		36.1	14.8	13.4	16.5	12.0 D	26.0 D	34.0 D	15.7	40.7	34.1	46.7	19.8	33.6	31.4	20.0 U	22.2	28.8	24.2	18.0 D	10.3 D
A73					19.3 D						22.8 D	22.5 D												15.9 D	8.3 D
A73B											8.5 D	11.8 D												13.1 D	4.3 JD
A75D					13.5 D						20.6 D	17.9 D												12.6 D	4.4 JD
A75B											21.5 D	17.9 D												5.2 D	4.1 JD
Bakers Bridge					7.9 D						16.3 D	11.0 D												2.5 U	2.8 JD
Mainstem Cement Creek																									
CC48	122	116	110	90.9		64.3	94.6	78.0	61.3	61.5 D	80.1 D	80.4 D	115	224	192	159	126	174	141	82.8	147	156	136	73.7 D	76.1 D
CC49																								66.9 D	
Mainstem Mineral Creek																									
M34	13.1	13.8	21.6	19.4		14.5	8.5	10.0 U	12.8	5.7 D	9.2 D	22.4 D	6.6	12.0	12.8	18.1	10.0 U	11.7	12.3	20.0 U	20.0 U	20.0 U	20.0 U	5.6 D	4.9 JD

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**	**Cu-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					2.1						8.4	13.4												0.7 J	2.4
A60											7.8	12.6													2.8
A61											9.6	16.5													3.4
A64											8.5	14.3													3.5
A65											8.9	14.1													3.0
A66											9.1	13.9													3.5
A68	3.0 U	3.0 U	8.3	10.0 U	6.0	4.5	3.7	10.0 U	10.0 U	4.3	10.3	11.3	3.0 U	3.0 U	3.0 U	3.0 U	10.0 U	4.0 U	4.0 U	20.0 U	20.0 U	20.0 U	20.0 U	2.7	3.3
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								16.3	
A70B																								24.8	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								8.7	
A72	35.9	35.2	19.2	25.2		3.6	4.5	10.0 U	10.0 U	4.1	7.6 D	6.4	4.8	17.4	14.7	36.9	10.0 U	13.0	14.5	20.0 U	20.0 U	20.0 U	20.0 U	9.5	3.0
A73					2.5						5.0 D	4.9												4.3	1.9
A73B											2.0	3.8												3.1	1.4
A75D					2.1						3.7	4.2												0.6 J	1.9
A75B											3.7	4.1												0.7 J	2.0
Bakers Bridge					2.5						3.5	3.7												0.5 U	1.9
Mainstem Cement Creek																									
CC48	119	109	110	89.1		56.3	90.6	72.0	55.6	61.2	79.3 D	65.4	110	221	189	152	118	166	140	76.6	145	148	139	74.4 D	65.3 JD
CC49																								78.3 D	
Mainstem Mineral Creek																									
M34	10.3	11.2	12.3	16.2		3.9	3.0 U	10.0 U	10.0 U	1.7	2.5 U	3.1	3.0 U	3.4	3.7	9.5	10.0 U	4.0 U	4.0 U	20.0 U	20.0 U	20.0 U	20.0 U	3.8 JD	1.5

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.i: Total and Dissolved Iron Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**41760**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**	**Fe-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					142 J						635	413												500 U	100 U
A60											257	408													100 U
A61											218 J	427													100 U
A64											130 J	497													100 U
A65											699	420													100 U
A66											669	675													111 J
A68	293	235	225	208	334	1100	100 U	376	544	111 J	437	536	100 U	115	151	234	100 U	129	169	189	116	158	169	500 U	100 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								5100 D	
A70B																								4890 D	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								4640 D	
A72	7710	7090	4190	5080		5300	948	986	1950	1270	2680	7200	1060	2990	3330	5490	1320	3230	4330	787	1750	2500	2740	4240 D	1340
A73					3850						4210	2580												3210 D	1080
A73B											1520	1400												2790 D	569
A75D					2730						4610	2530												2330 D	580
A75B											4810	2440												1060 JD	585
Bakers Bridge					1460						3560	1530												500 U	317
Mainstem Cement Creek																									
CC48	21700	19400	12700	14800		3950	4440	4160	3610	6510	17200	16600	6030	10800	13400	18600	5460	11500	14200	5230	7290	8630	11700	15100 D	8870 D
CC49																								14400 D	
Mainstem Mineral Creek																									
M34	6830	6380	4180	6080		2130	1060	1040	4200	1170	2720	6330	1340	3560	3500	8290	1780	4300	4870	754	2430	3340	3100	4630 D	1510

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**41760**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**	**Fe-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					<100 U						100 U	100 U												100 U	100 U
A60											100 U	100 U													100 U
A61											100 U	100 U													100 U
A64											100 U	100 U													100 U
A65											100 U	100 U													100 U
A66											100 U	100 U													100 U
A68	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	10.0 U	10.0 U	100 U	100 U	100 U	100 U	100 U	100 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								2180	
A70B																								2270	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								2480	
A72	3250	2500	1940	1800		100 U	343	224	199	746	628	913	463	1340	1500	3020	556	1610	2160	280	703	1050	1300	2210	443
A73					557						249 J	284												1020	115 J
A73B											120 J	157 J												810	104 J
A75D					100 U						144 J	100 U												100 U	100 U
A75B											137 J	100 U												100 U	100 U
Bakers Bridge					100 U						100 U	100 U												100 U	100 U
Mainstem Cement Creek																									
CC48	13300	9640	8610	10000		2000	3090	2300	2320	5360	4360	4590	3670	7750	9530	11600	4300	9010	11700	3600	5520	7110	8730	11300 D	1420
CC49																								11500 D	
Mainstem Mineral Creek																									
M34	2490	2470	1700	2390		139	374	173	100 U	512	554	545	764	2440	2050	4160	1190	3170	3900	337	1740	2400	2400	3510 D	858

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)

Appendix 1.j: Total and Dissolved Lead Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	Feb 2010	Mar 2010	Apr 2010	Mar 2011	April 2014	May 2009	Jun 2009	Jun 2010	Jun 2011	May 2012	May 2013	May 2014	Jul 2009	Aug 2009	Sep 2009	Nov 2009	Jul 2010	Sep 2010	Nov 2010	Jul 2011	Aug 2011	Sep 2011	Oct 2011	Oct 2012	Sept 2014
Metal-fraction	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total	Pb-total
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					2.4 D						81.3 D	14.1 D												2.3 D	1.9 D
A60											34.7 D	15.0 D													1.8 D
A61											23.1 D	12.8 D													2.0 D
A64											24.9 D	13.5 D													1.7 D
A65											50.5 D	14.3 D													2.8 D
A66											51.1 D	15.6 D													2.0 D
A68	2.7	2.4	4.4	5.4	3.9 D	52.3	2.5	15.3	19.6	2.8 D	43.3 D	14.7 D	2.1	1.4	2.0	1.9	1.5	2.2	1.7	4.9	1.7	1.7	1.7	2.9 D	2.01 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								6.2 D	
A70B																								5.8 D	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								4.5 D	
A72	8.9	6.6	14.7	9.2		99.8	3.3	12.3	24.8	4.3 D	29.2 D	24.3 D	4.0	4.5	5.8	6.2	5.8	5.6	7.0	6.0	4.8	5.6	5.6	4.8 D	3.42 D
A73					6.3 D						33.7 D	9.3 D												3.8 D	2.6 D
A73B											11.7 D	5.1 D												3.3 D	1.7 D
A75D					5.5 D						32.6 D	11.2 D												5.2 D	1.6 D
A75B											34.5 D	10.4 D												1.5 D	2.1 D
Bakers Bridge					5.4 D						26.0 D	5.7 D												0.6 JD	1.2 D
Mainstem Cement Creek																									
CC48	19.0	17.0	19.7	17.8		18.0	11.1	24.1	22.1	11.9 D	30.3 D	24.5 D	14.0	15.4	17.3	18.6	19.6	18.2	17.4	14.8	20.0	21.0	20.5	13.5 D	13.3 D
CC49																								13.0 D	
Mainstem Mineral Creek																									
M34	5.9	6.3	24.8	11.5		15.6	3.1	7.9	45.7	3.2 D	12.2 D	25.5 D	2.9	3.2	5.2	10.5	4.1	4.1	7.0	3.5	3.9	4.1	4.7	2.4 D	2.1 D

Sampling Date	Feb 2010	Mar 2010	Apr 2010	Mar 2011	April 2014	May 2009	Jun 2009	Jun 2010	Jun 2011	May 2012	May 2013	May 2014	Jul 2009	Aug 2009	Sep 2009	Nov 2009	Jul 2010	Sep 2010	Nov 2010	Jul 2011	Aug 2011	Sep 2011	Oct 2011	Oct 2012	Sept 2014
Metal-fraction	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss	Pb-diss
Units	ug/L	µg/L	µg/L	µg/L	µg/L	ug/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 (reference)					0.4						0.6	1.0												0.2 J	0.216
A60											0.7	0.9													0.322
A61											0.7	1.0													0.342
A64											1.2	1.0													0.294
A65											1.3	0.9													0.280
A66											1.5	1.1													0.436
A68	1.0 U	1.0 U	1.0 U	1.0 U	0.1 U	1.0 U	1.0 U	1.0 U	1.0 U	0.6	1.3	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.1 J	0.381
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								0.2 J	
A70B																								3.0	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								0.1 U	
A72	2.7	1.3	1.0 U	1.5		1.0 U	1.0 U	1.0 U	1.0 U	0.1 U	1.2 D	0.1 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 J	0.1 U
A73					0.1 U						0.7 JD	0.2 J												0.1 U	0.1 U
A73B											0.3	0.1 J												0.1 U	0.1 U
A75D					0.1 U						0.8	0.3												0.1 U	0.1 U
A75B											0.8	0.3												0.1 U	0.1 J
Bakers Bridge					0.1 U						0.5	0.3												0.1 U	0.1 U
Mainstem Cement Creek																									
CC48	13.2	14.2	14.3	15.1		4.2	9.6	8.0	9.0	8.0	13.1 D	6.9	13.0	16.8	14.5	16.2	17.4	16.8	17.1	8.5	19.2	21.4	18.7	11.2 D	14.2 D
CC49																								11.3 D	
Mainstem Mineral Creek																									
M34	1.5	2.0	1.7	4.2		1.0 U	1.0 U	1.0 U	1.0 U	0.1 J	0.5 U	0.1 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	0.1 U

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.k: Total and Dissolved Manganese Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD														
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**41760**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**		**Sept 2014**	
Metal-fraction	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**	**Mn-total**		**Mn-total**	
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**		**µg/L**	
Animas River upstream of the confluence with mainstem Cement Creek																											
A56 ("upstream")					187						567	287												189	D	482	
A60											348	302														424	
A61											477	917														481	
A64											412	756														576	
A65											578	771														630	
A66											635	944														862	
A68	3550	2830	3980	3200	3390	697	697	435	550	715	988	1300	676	1290	1580	2320	668	1280	1770	571	868	1120	1300	1350	D	835	
Animas River between mainstem Cement Creek and mainstem Mineral Creek																											
A69A																								2640	D		
A70B																								2550	D		
Animas River downstream of the confluence with mainstem Mineral Creek																											
A71B																								1670	D		
A72	2710	3110	1850	2440		755	492	311	397	488	734	898	596	1380	1430	2470	734	1450	1690	439	923	1290	1220	1580	D	884	
A73					1860						609	689												1470	D	813	
A73B											230	333												1210	D	395	
A75D					1100						571	507												909	D	385	
A75B											592	493												839	D	381	
Bakers Bridge					638						468	327												561	D	272	
Mainstem Cement Creek																											
CC48	5120	5490	3190	4950		809	1810	865	739	1660	1510	1770	2850	4900	5100	5530	3190	4780	5140	1790	3780	4490	4700	5070	D	3590	D
CC49																								5140	D		
Mainstem Mineral Creek																											
M34	615	559	328	567		219	130	112	313	123	151	242	174	401	374	596	209	440	429	115	275	394	302	428	D	226	

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**41760**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**		**Sept 2014**	
Metal-fraction	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**	**Mn-diss**		**Mn-diss**	
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**		**µg/L**	
Animas River upstream of the confluence with mainstem Cement Creek																											
A56 ("upstream")					172						140	196												184		469	
A60											153	189														416	
A61											328	786														464	
A64											240	639														569	
A65											304	655														614	
A66											343	805														860	
A68	3560	2710	3730	3160	3340	340	636	335	415	699	656	1220	668	1320	1540	2380	649	1310	1790	537	821	1140	1310	1340		826	
Animas River between mainstem Cement Creek and mainstem Mineral Creek																											
A69A																								2590			
A70B																								2540			
Animas River downstream of the confluence with mainstem Mineral Creek																											
A71B																								1660			
A72	2710	2920	1770	2340		219	450	241	305	471	478	823	603	1420	1370	2490	736	1590	1690	405	923	1290	1180	1580		863	
A73					1830						341	624												1440		811	
A73B											109	294												1210		419	
A75D					1090						232	408												847		371	
A75B											233	394												856		363	
Bakers Bridge					584						149	246												546		254	
Mainstem Cement Creek																											
CC48	5290	5200	3040	4940		766	1770	811	731	1620	1440	1740	2830	4810	4920	5270	3280	5030	5220	1740	3890	4900	4620	5050	D	710	
CC49																								5300	D		
Mainstem Mineral Creek																											
M34	630	634	324	530		160	120	84.9	150	115	128	184	169	410	336	592	212	435	456	104	293	406	303	435	D	221	

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.I: Total and Dissolved Nickel Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**	**Ni-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A60											2.5 U	2.5 U													2.5 U
A61											2.5 U	2.5 U													2.5 U
A64											2.5 U	2.5 U													2.5 U
A65											2.5 U	2.5 U													2.5 U
A66											2.5 U	2.5 U													2.5 U
A68	2.0 U	2.0 U	2.0 U	4.0 U	2.5 U	2.0 U	2.0 U	4.0 U	4.0 U	2.5 U	2.5 U	2.5 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	0.7 U	0.7 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	2.5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								4.6 JD	
A70B																								4.4 JD	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B											2.5 U													3.7 JD	
A72	7.0	7.0	2.0 U	5.2		2.0 U	2.0 U	4.0 U	4.0 U	2.5 U	2.5 U	2.5 U	2.0	3.9	3.3	6.3	4.0 U	0.7 U	5.4	4.0 U	4.0 U	4.0 U	4.0 U	4.6 JD	2.5 U
A73					2.5 U						2.5 U	2.5 U												3.8 JD	2.5 U
A73B											2.5 U	2.5 U												2.9 JD	2.5 U
A75D					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A75B											2.5 U	2.5 U												2.5 U	2.5 U
Bakers Bridge					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
Mainstem Cement Creek																									
CC48	17.8	17.9	9.7	14.8		2.0	6.6	4.3	4.0 U	4.8 JD	5.0 U	3.5 JD	10	16.3	15.7	17.3	10	15.1	17.1	6.4	12.3	14	13.4	16.4 D	2.5 U
CC49																								22.7 D	
Mainstem Mineral Creek																									
M34	4.0	3.2	2.0 U	4.0 U		2.0 U	2.0 U	4.0 U	4.0 U	2.5 U	2.5 U	<2.5 U	2.0 U	2.3	2.0 U	3.7	4.0 U	0.7 U	0.7 U	4.0 U	4.0 U	4.0 U	4.0 U	2.6 JD	2.5 U

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**	**Ni-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
A60											0.5 U	0.5 U													0.5 U
A61											0.5 U	0.5 U													0.5 U
A64											0.5 U	0.5 U													0.5 U
A65											0.5 U	0.5 U													0.5 U
A66											0.5 U	0.5 U													0.5 U
A68	2.0 U	2.0 U	2.0 U	4.0 U	0.5 U	2.0 U	2.0 U	4.0 U	4.0 U	0.5 U	0.5 U	0.5 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	0.7 U	0.7 U	4.0 U	4.0 U	4.0 U	4.0 U	0.5 U	0.5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								4.8	
A70B																								5.2	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								4.9	
A72	8.2	6.4	3.4	5.8		2.0 U	2.0 U	4.0 U	4.0 U	0.9 J	2.5 U	0.606 J	2.0 U	3.0	3.7	6.4	4.0 U	0.7 U	4.2	4.0 U	4.0 U	4.0 U	4.0 U	5.9	1.1
A73					0.9 J						2.5 U	0.5 U												4.8	0.9 J
A73B											1.4	0.8 J												3.3	1.9
A75D					0.8 J						0.6 J	0.5 U												2.3	1.0 J
A75B											0.5 J	0.5 U												2.4	1.0
Bakers Bridge					0.5 U						0.5 U	0.5 U												0.6 J	0.7 J
Mainstem Cement Creek																									
CC48	19.4	16.3	10.3	16.4		2.2	5.3	4.0 U	4.0 U	4.9	5.0 U	3.1	9.1	15.0	15.7	17.4	8.6	16.5	16.2	6.0	13.0	14.5	13.7	12.4 D	5.9 D
CC49																								13.5 D	
Mainstem Mineral Creek																									
M34	5.3	3.3	2.0 U	4.0		2.0 U	2.0 U	4.0 U	4.0 U	0.6 J	2.5 U	0.5 U	2.0 U	2.1	2.3	4.1	4.0 U	0.7 U	0.7 U	4.0 U	4.0 U	4.0 U	4.0 U	2.5 U	0.5 J

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.m: Total and Dissolved Selenium Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**	**Se-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					5.0 U						2.5 U	5.0 U												2.5 U	5.0 U
A60											2.5 U	5.0 U													5.0 U
A61											2.5 U	5.0 U													5.0 U
A64											2.5 U	5.0 U													5.0 U
A65											2.5 U	5.0 U													5.0 U
A66											2.5 U	5.0 U													5.0 U
A68	1.0 U	1.6	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	2.5 U	5 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								2.5 U	
A70B																								2.5 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								2.5 U	
A72	1.0 U	1.0	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	5 U
A73					5.0 U						2.5 U	5.0 U												2.5 U	5.0 U
A73B											2.5 U	5.0 U												2.5 U	5.0 U
A75D					5.0 U						2.5 U	5.0 U												2.5 U	5.0 U
A75B											2.5 U	5.0 U												2.5 U	5.0 U
Bakers Bridge					5.0 U						2.5 U	5.0 U												2.5 U	5.0 U
Mainstem Cement Creek																									
CC48	1.0 U	1.3	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	5.0 U
CC49																								2.5 U	
Mainstem Mineral Creek																									
M34	1.0 U	1.0	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	5.0 UJ
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**	**Se-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					1.0 U						0.5 U	1.0 U												0.5 U	1.0 U
A60											0.5 U	1.0 U													1.0 U
A61											0.5 U	1.0 U													1.0 U
A64											0.5 U	1.0 U													1.0 U
A65											0.5 U	1.0 U													1.0 U
A66											0.5 U	1.0 U													1.0 U
A68	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	0.5 U	1 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	1 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								0.5 U	
A70B																								0.5 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								0.5 U	
A72	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	2.5 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	1.0 U
A73					1.0 U						2.5 U	1.0 U												0.5 U	1.0 U
A73B											0.5 U	1.0 U												0.5 U	1.0 U
A75D					1.0 U						0.5 U	1.0 U												0.5 U	1.0 U
A75B											0.5 U	1.0 U												0.5 U	1.0 U
Bakers Bridge					1.0 U						0.5 U	1.0 U												0.5 U	1.0 U
Mainstem Cement Creek																									
CC48	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	3.2 JD	5.0 U
CC49																								2.5 U	
Mainstem Mineral Creek																									
M34	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	0.5 U	2.5 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.2 U	0.2 U	1.0 U	1.0 U	1.0 U	1.0 U	2.5 U	1.0 U

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.n: Total and Dissolved Silver Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**	**Ag-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A60											2.5 U	2.5 U													2.5 U
A61											2.5 U	2.5 U													2.5 U
A64											2.5 U	2.5 U													2.5 U
A65											2.5 U	2.5 U													2.5 U
A66											2.5 U	2.5 U													2.5 U
A68	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5	0.5 U	0.5 U	2.5 U	2.5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								2.5 U	
A70B																								2.5 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B											2.5 U													2.5 U	
A72	0.5 U	0.5 U	0.5 U	0.5 U		0.5	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U
A73					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A73B											2.5 U	2.5 U												2.5 U	2.5 U
A75D					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
A75B											2.5 U	2.5 U												2.5 U	2.5 U
Bakers Bridge					2.5 U						2.5 U	2.5 U												2.5 U	2.5 U
Mainstem Cement Creek																									
CC48	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	5.0 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U
CC49																								2.5 U	
Mainstem Mineral Creek																									
M34	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U

Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**	**Ag-diss**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
A60											0.5 U	0.5 U													0.5 U
A61											0.5 U	0.5 U													0.5 U
A64											0.5 U	0.5 U													0.5 U
A65											0.5 U	0.5 U													0.5 U
A66											0.5 U	0.5 U													0.5 U
A68	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								0.5 U	
A70B																								0.5 U	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								0.5 U	
A72	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
A73					0.5 U						2.5 U	0.5 U												0.5 U	0.5 U
A73B											0.5 U	0.5 U												0.5 U	0.5 U
A75D					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
A75B											0.5 U	0.5 U												0.5 U	0.5 U
Bakers Bridge					0.5 U						0.5 U	0.5 U												0.5 U	0.5 U
Mainstem Cement Creek																									
CC48	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5.0 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	2.5 U
CC49																								2.5 U	
Mainstem Mineral Creek																									
M34	0.6	0.5	0.5 U	0.5 U		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 U	0.1 U	0.5 U	0.5 U	0.5 U	0.5 U	2.5 U	0.5 U

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 1.o: Total and Dissolved Zinc Concentrations in Surface Water Samples Collected Between 2009 and 2014
Baseline Ecological Risk Assessment
Upper Animas Mining District

	PRE-RUNOFF PERIOD					RUNOFF PERIOD							POST-RUNOFF PERIOD												
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**	**Zn-total**
Units	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					247						467	396												189 D	255
A60											384	426													267
A61											375	547													263
A64											358	504													259
A65											395	502													293
A66											400	516													340
A68	663	597	1180	874	1020	405	324	318	307	289	454	491	270	333	413	581	273	380	441	252	290	317	399	306 D	273
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								1170 D	
A70B																								1150 D	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								731 D	
A72	1060	1320	966	1080		306	303	221	237	293	453	489	310	659	650	1140	393	717	786	251	469	573	600	726 D	391
A73					768						352	426												685 D	372
A73B											119	204												557 D	181
A75D					483						288	306												545 D	181
A75B											283	296												445 D	183
Bakers Bridge					273						221	195												264 D	126
Mainstem Cement Creek																									
CC48	2570	2730	1840	2430		641	1130	655	551	1070	1180	1270	1600	2580	2690	2890	1720	2710	2620	1100	1970	2160	2510	2560 D	2030 D
CC49																								2590 D	
Mainstem Mineral Creek																									
M34	285	251	573	357		90	94.7	56.8	77.7	80.2	121	196	92	194	189	280	114	196	236	62.8	132	169	157	177 D	110
Sampling Date	**Feb 2010**	**Mar 2010**	**Apr 2010**	**Mar 2011**	**April 2014**	**May 2009**	**Jun 2009**	**Jun 2010**	**Jun 2011**	**May 2012**	**May 2013**	**May 2014**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Nov 2009**	**Jul 2010**	**Sep 2010**	**Nov 2010**	**Jul 2011**	**Aug 2011**	**Sep 2011**	**Oct 2011**	**Oct 2012**	**Sept 2014**
Metal-fraction	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**	**Zn-diss**
Units	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**ug/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Animas River upstream of the confluence with mainstem Cement Creek																									
A56 ("upstream")					241						224	361												189	250
A60											242	360													266
A61											305	509													253
A64											280	452													260
A65											296	455													293
A66											292	461													341
A68	702	610	985	874	1030	295	270	286	274	281	347	446	268	332	407	567	261	410	436	237	282	311	393	300	270
Animas River between mainstem Cement Creek and mainstem Mineral Creek																									
A69A																								1160	
A70B																								1160	
Animas River downstream of the confluence with mainstem Mineral Creek																									
A71B																								743	
A72	1110	1230	864	972		133	249	206	217	284	369	453	313	636	617	1120	392	762	754	228	467	590	549	733	362
A73					701						242	364												682	327
A73B											79.0	178												561	180
A75D					367						140	217												427	152
A75B											140	210												442	149
Bakers Bridge					174						66.5	111												241	87.7
Mainstem Cement Creek																									
CC48	2670	2600	1600	2340		611	1080	660	614	1070	1160	1310	1620	2650	2570	2650	1800	2730	2890	1090	2140	2430	2400	2590 D	394
CC49																								2710 D	
Mainstem Mineral Creek																									
M34	328	292	499	312		48.1	72.5	68.6	50.0 U	68.2	100	146	88.7	180	175	317	106	196	242	54.4	131	170	142	173 D	98.8

prepared by: SJP (1/20/14)
checked by: Emily (1/23/14)

updated by: Beth (2/9/15)
checked by: Emily (2/10/15)

Appendix 2.1
Total metals concentrations in sediment samples collected in May 2012
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
Animas River above mainstem Cement Creek															
A56 ("upstream")	mg/kg dw														
A60	mg/kg dw														
A61	mg/kg dw														
A64	mg/kg dw														
A65	mg/kg dw														
A66	mg/kg dw														
A68	mg/kg dw	9050 D	25.9 D	<2.01 U	13.4 D	4.97 D	374 D	29100 D	1890 D	12200 D	0.081 D	8.95 D	1.29 D	7.09 D	3030 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek															
A69A	mg/kg dw														
A70B	mg/kg dw														
Animas River below mainstem Mineral Creek															
A71B	mg/kg dw														
A72	mg/kg dw	12200 D	40.6 D	<1.97 U	2.8 D	6.1 D	152 D	57500 D	581 D	2710 D	0.072 D	6.38 D	2.03 D	1.99 D	748 D
A73	mg/kg dw														
A73B	mg/kg dw														
A75D	mg/kg dw														
A75B	mg/kg dw														
Bakers Bridge	mg/kg dw														
mainstem Cement Creek															
CC48	mg/kg dw														
CC49	mg/kg dw														
mainstem Mineral Creek															
M34	mg/kg dw														

Lab Qualifiers:
U = undetected
D = diluted sample
< = less than

Appendix 2.2
Total metals concentrations in sediment samples collected in October 2012
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver
Animas River above mainstem Cement Creek														
A56 ("upstream")	mg/kg dw	10300 D	31.9 D	<2.01 U	4.66 D	7.47 D	250 D	35600 D	1490 D	3140 D	0.17 D	7.61 D	1.64 D	7.15 D
A60	mg/kg dw													
A61	mg/kg dw													
A64	mg/kg dw													
A65	mg/kg dw													
A66	mg/kg dw													
A68	mg/kg dw	15300 D	89.5 D	6.77 D	24.2 D	5.69 D	745 D	45300 D	3030 D	22300 D	0.19 D	16.5 D	2.86 D	13.3 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek														
A69A	mg/kg dw													
A70B	mg/kg dw													
Animas River below of mainstem Mineral Creek														
A71B	mg/kg dw													
A72	mg/kg dw	21500 D	36.3 D	<2.00 U	1.81 D	4.05 D	179 D	56900 D	542 D	1470 D	0.06 D	4.79 D	1.83 D	2.76 D
A73	mg/kg dw	11800 D	25.5 D	<1.97 U	3.64 D	4.02 D	223 D	51600 D	729 D	4140 D	0.05 D	6.84 D	1.43 D	2.32 D
A73B	mg/kg dw	31900 D	39.4 D	3.24 JD	4.24 D	5.02 D	292 D	70700 D	468 D	2610 D	0.09 D	12.1 D	2.89 D	3.09 D
A75D	mg/kg dw	15600 D	13.2 D	<1.97 U	4.87 D	3.73 D	152 D	33700 D	231 D	3010 D	0.04 D	9.09 D	1.4 D	0.724 JD
A75B	mg/kg dw	48600 D	37.2 D	5.98 D	10.5 D	5.16 D	413 D	84500 D	435 D	3820 D	0.07 D	16.5 D	3.26 D	2.18 D
Bakers Bridge	mg/kg dw	37400 D	29.7 D	4.85 JD	18.6 D	5.21 D	357 D	68400 D	378 D	10500 D	0.06 D	31.6 D	3.1 D	1.71 D
mainstem Cement Creek														
CC48	mg/kg dw													
CC49	mg/kg dw	5310 D	40.6 D	<1.99 U	0.595 D	4.62 D	55.6 D	143000 D	282 D	478 D	0.06 D	2.85 D	0.747 JD	2.0 D
mainstem Mineral Creek														
M34	mg/kg dw	22400 D	21.1 D	<1.98 U	0.888 D	3.44 D	53.8 D	46500 D	129 D	1430 D	0.02 D	4.64 D	1.74 D	0.651 JD

Lab Qualifiers:

U = undetected
D = diluted sample
J = estimated value
B = blank contamination
< = less than

Appendix 2.3
Total metals concentrations in sediment samples collected in May 2013
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
Animas River above mainstem Cement Creek															
A56 ("upstream")	mg/kg dw	8250 D	20.3 D	<1.97 U	12.8 D	4.65 BD	267 JD	26100 D	1820 BD	9760 D		5.99 D	0.548 JD	7.06 D	2330 D
A60	mg/kg dw	9160 D	24.4 D	<2.01 U	14.7 D	4.86 BD	286 D	24400 D	2100 BD	12600 D		7.58 D	<0.502 U	4.05 D	3180 D
A61	mg/kg dw	10600 D	44.0 D	2.53 JD	11.3 D	4.71 BD	466 D	27500 D	2120 BD	11000 D		7.19 D	<0.505 U	7.34 D	2840 D
A64	mg/kg dw	10500 D	44.2 D	2.77 JD	11.9 D	4.42 BD	336 D	30000 D	1770 BD	9670 D		7.2 D	0.905 JD	7.14 D	3470 D
A65	mg/kg dw	9250 D	30.3 D	<2.02 U	10.3 D	4.76 BD	328 D	28800 D	1840 BD	12900 D		6.68 D	<0.504 U	5.53 D	2590 D
A66	mg/kg dw	8370 D	26.9 D	<1.99 U	8.44 D	5.68 BD	257 D	29600 D	1750 BD	7830 D		5.92 D	<0.497 U	5.06 D	1950 D
A68	mg/kg dw	7650 D	26.3 D	<2.01 U	13.7 D	5.21 BD	352 D	28800 D	2180 BD	10300 D		8.76 D	<0.501 U	9.22 D	2830 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek															
A69A	mg/kg dw														
A70B	mg/kg dw														
Animas River below of mainstem Mineral Creek															
A71B	mg/kg dw														
A72	mg/kg dw	11800 D	26.1 D	<1.97 U	1.15 D	6.41 BD	77.8 D	45800 D	299 BD	1210 D		4.88 D	1.04 D	1.3 D	386 D
A73	mg/kg dw	9220 D	31.9 D	<2.02 U	4.1 D	5.6 BD	176 D	55700 D	591 BD	3320 D		6.07 D	0.717 JD	2.78 D	998 D
A73B	mg/kg dw	10600 D	30.4 D	<2.00 U	3.56 D	4.72 BD	140 D	67100 D	593 BD	4340 D		9.78 D	<0.5 U	1.65 D	964 D
A75D	mg/kg dw	8550 D	18.2 D	<1.99 U	3.88 D	4.99 BD	108 D	34400 D	367 BD	3730 D		7.27 D	<0.498 U	1.37 D	1030 D
A75B	mg/kg dw	7220 D	13.3 D	<1.99 U	2.65 D	5.45 BD	82.7 D	26000 D	354 BD	2340 D		5.93 D	0.588 JD	1.51 D	672 D
Bakers Bridge	mg/kg dw	7360 D	15.9 D	<1.98 U	2.46 D	7.38 BD	116 D	28200 D	328 BD	2130 D		7.36 D	<0.496 U	1.08 D	2080 D
mainstem Cement Creek															
CC48	mg/kg dw														
CC49	mg/kg dw														
mainstem Mineral Creek															
M34	mg/kg dw														

Lab Qualifiers:
U = undetected B = blank contamination
D = diluted sample < = less than
J = estimated value

Appendix 2.4
Total metals concentrations in sediment samples collected in April 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample location	Units	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
Animas River above mainstem Cement Creek															
A56 ("upstream")	mg/kg dw	15100 D	33.1 D	6.35 D	17.8 D	4.72 D	432 D	40700 D	1220 D	12700 D	0.171 D	9.92 D	1.62 JD	7.64 D	6200 D
A60	mg/kg dw	13400 D	16.4 D	<2.01 U	5.84 D	6.35 D	166 D	33500 D	554 D	3400 D	0.033 D	9.62 D	<1.0 U	3.48 D	1530 D
A61	mg/kg dw	13500 D	19.8 D	2.99 JD	9.02 D	5.28 D	638 D	32000 D	891 D	6400 D	0.091 D	8.56 D	1.1 JD	4.28 D	2530 D
A64	mg/kg dw	10700 D	18.8 D	<2.02 U	6.25 D	5.15 D	199 D	31400 D	1050 D	4920 D	0.053 D	7.44 D	<1.01 U	3.59 D	1950 D
A65	mg/kg dw	13100 D	21.8 D	2.16 JD	10.2 D	5.49 D	331 D	31600 D	900 D	10300 D	0.073 D	9.9 D	<1.01 U	3.87 D	2890 D
A66	mg/kg dw	11700 D	18.3 D	2.24 JD	18.3 D	4.07 D	378 D	31700 D	1230 D	20500 D	0.06 D	10.1 D	<1.0 U	4.13 D	4380 D
A68	mg/kg dw	13000 D	19.1 D	2.82 JD	15.7 D	4.21 D	390 D	32400 D	1080 D	19700 D	0.056 D	10.3 D	<0.998 U	4.35 D	4890 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek															
A69A	mg/kg dw														
A70B	mg/kg dw														
Animas River below mainstem Mineral Creek															
A71B	mg/kg dw														
A72	mg/kg dw	18900 D	37 D	<2.0 U	1.7 D	3.45 D	145 D	74600 D	470 D	1710 D	0.039 D	4.33 D	1.05 JD	1.68 D	616 D
A73	mg/kg dw	40700 D	33.8 D	4.2 JD	5.6 D	2.83 D	284 D	109000 D	297 D	7120 D	0.036 D	7.19 D	<1.0 U	1.35 D	1450 D
A73B	mg/kg dw														
A75D	mg/kg dw	29900 D	28.5 D	3.66 JD	6.75 D	4.39 D	223 D	67900 D	261 D	6900 D	0.038 D	13.1 D	1.06 JD	1.27 D	2910 D
A75B	mg/kg dw														
Bakers Bridge	mg/kg dw	27300 D	25.9 D	3.51 JD	14.6 D	4.28 D	199 D	62100 D	248 D	13100 D	0.043 D	22 D	1.16 JD	1.33 D	6030 D
mainstem Cement Creek															
CC48	mg/kg dw														
CC49	mg/kg dw														
mainstem Mineral Creek															
M34	mg/kg dw														

Lab Qualifiers:
U = undetected B = blank contamination
D = diluted sample < = less than
J = estimated value

Appendix 2.5
Total metals concentrations in sediment samples collected in September 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
Animas River above mainstem Cement Creek															
A56 ("upstream")	mg/kg dw	9310 D	20.2 D	2.94 JD	11.6 D	3.6 D	244 D	21700 D	1180 D	9250 D	0.06 D	7.13 D	<1 U	3.62 D	3220 D
A60	mg/kg dw	7730 D	20.4 D	<2.03 U	9.55 D	3.88 D	262 D	23400 D	1610 D	7460 D	0.07 D	6.26 D	<1.02 U	5.96 D	2130 D
A61	mg/kg dw	9280 D	20.5 D	2.1 JD	4.95 D	3.55 D	286 D	22800 D	1400 D	8210 D	0.05 D	6.52 D	<0.995 U	5.23 D	2330 D
A64	mg/kg dw	9610 D	21.3 D	3.0 JD	7.93 D	3.55 D	264 D	24500 D	1120 D	6850 D	0.13 D	6.84 D	<1.01 U	4.88 D	2730 D
A65	mg/kg dw	8190 D	19.4 D	<1.99 U	6.82 D	3.76 D	271 D	25000 D	1220 D	8180 D	0.03 D	6.49 D	<0.997 U	3.61 D	1700 D
A66	mg/kg dw	9190 D	23.7 D	<2.03 U	9.17 D	3.7 D	243 D	25700 D	1190 D	8190 D	0.05 D	7.11 D	<1.01 U	4.81 D	2500 D
A68	mg/kg dw	7700 D	17.5 D	<1.97 U	10.8 D	3.73 D	216 D	24000 D	1240 D	9430 D	0.02 JD	6.56 D	<0.985 U	2.9 D	2480 D
Animas River between mainstem Cement Creek and mainstem Mineral Creek															
A69A	mg/kg dw														
A70B	mg/kg dw														
Animas River below mainstem Mineral Creek															
A71B	mg/kg dw														
A72	mg/kg dw	9960 D	26.8 D	<2.03 U	3.03 D	3.01 D	133 D	42000 D	499 D	3400 D	0.05 D	5.33 D	<1.02 U	1.83 D	858 D
A73	mg/kg dw	6770 D	20.5 D	<2.04 U	2.7 D	3.5 D	113 D	36800 D	435 D	2780 D	0.02 JD	5.5 D	<1.02 U	1.24 D	749 D
A73B	mg/kg dw	6620 D	19.9 D	<2.03 U	2.72 D	3.68 D	98.8 D	35200 D	540 D	2480 D	0.04 D	8.16 D	<1.01 U	1.25 D	659 D
A75D	mg/kg dw	7660 D	17.5 D	<2.03 U	3.73 D	3.72 D	103 D	30800 D	339 D	3750 D	<0.02 U	8.2 BD	<1.02 U	0.948 JD	1080 D
A75B	mg/kg dw	6640 D	9.22 D	<1.99 U	1.99 D	5.01 D	67 D	20100 D	98 D	2070 D	<0.01 U	6.71 D	<0.994 U	0.512 JD	578 D
Bakers Bridge	mg/kg dw	8040 D	16.2 D	<1.99 U	4.63 D	4.74 D	92 D	27200 D	244 D	3970 D	0.02 JD	12.1 BD	<0.997 U	1.02 D	1700 D
mainstem Cement Creek															
CC48	mg/kg dw														
CC49	mg/kg dw														
mainstem Mineral Creek															
M34	mg/kg dw	29100 D	32.7 D	<2.01 U	1.87 D	2.79 D	127 D	89000 D	237 D	1160 D	0.05 D	5.93 BD	<1.01 U	0.896 JD	666 D

Lab Qualifiers:
U = undetected   B = blank contamination
D = diluted sample   < = less than
J = estimated value

Appendix 3.1: Dissolved Metals Concentrations in Pore Water Samples Collected in April 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Hardness (mg/L)	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Selenium	Silver	Zinc
Animas River above mainstem Cement Creek															
A56 ("upstream")	µg/L	136	23.8 J	<0.500 U	<2.00 U	0.232	<1.00 U	1.3	<100 U	0.964	4.87 J	<0.500 U	<1.00 U	<0.500 U	124
A60	µg/L	158	20.9 J	0.547 J	<2.00 U	0.809	<1.00 U	1.41	<100 U	<0.100 U	<2.00 U	<0.500 U	<1.00 U	<0.500 U	353
A61	µg/L	853D	6170 D	<5.00 U	<20.0 U	100 D	<10.0 U	2250 D	<1000 U	13.4 D	78300 D	77.5 D	<10.0 U	<5.00 U	29900 D
A64	µg/L	141	<20.0 U	<0.500 U	<2.00 U	0.279	<1.00 U	1.83	<100 U	<0.100 U	4.27 J	<0.500 U	<1.00 U	<0.500 U	264
A65	µg/L	349.5	671	<0.500 U	<2.00 U	22.4	0.8 J	53.8	<100 U	2.00	18450	11.3	<1.00 U	<0.500 U	6230
A66	µg/L	141	<20.0 U	<0.500 U	<2.00 U	0.546	1.83 J	1.4	<100 U	0.123 J	226	<0.500 U	<1.00 U	<0.500 U	307
A68	µg/L	149	42.2 J	<0.500 U	<2.00 U	1.67	<1.00 U	3.46	<100 U	<0.100 U	1540	<0.500 U	<1.00 U	<0.500 U	675
Animas River between mainstem Cement Creek and mainstem Mineral Creek															
A69A	µg/L														
A70B	µg/L														
Animas River below mainstem Mineral Creek															
A71B															
A72	µg/L	256	517	<0.500 U	<2.00 U	2.98	<1.00 U	8.07	<100 U	0.453	448	1.95	<1.00 U	<0.500 U	1630
A73	µg/L	185	29.2 J	<0.500 U	<2.00 U	2.03	<1.00 U	2.28	341	<0.100 U	1870	1.19	<1.00 U	<0.500 U	709
A73B	µg/L														
A75D	µg/L	135	27.7 J	<0.500 U	<2.00 U	0.387	<1.00 U	1.67	<100 U	<0.100 U	185	<0.500 U	<1.00 U	<0.500 U	173
A75B	µg/L														
Bakers Bridge	µg/L	125	47 J	<0.500 U	<2.00 U	0.334	1.15 J	2.21	<100 U	<0.100 U	325	<0.500 U	<1.00 U	<0.500 U	115
mainstem Cement Creek															
CC48	µg/L														
CC49	µg/L														
mainsem Mineral Creek															
M34	µg/L														

Appendix 3.2: Dissolved Metals Concentrations in Pore Water Samples Collected in September 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Hardness (mg/L)	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Selenium	Silver	Zinc
Animas River above mainstem Cement Creek															
A56 ("upstream")	µg/L	129	28.4 J	<0.500 U	<2.00 U	1.16	<1.00 U	4.15	<100 U	0.523	689	<0.500 U	<1.00 U	<0.500 U	463
A60	µg/L	340	119	<2.50 U	<2.00 U	3.86 D	<5.00 U	2.67 JD	<100 U	<0.500 U	6.46	<2.50 U	<5.00 U	<2.50 U	1630
A61	µg/L	496.5	2604.5 D	<3.8 U	<11.0 U	106.5 D	<7.5 U	95.9 JD	<550 U	65.6 D	63800 D	37.8 D	<7.5 U	<3.8 U	18490 D
A64	µg/L														
A65	µg/L	389	401	<2.50 U	<2.00 U	22 D	<5.00 U	47.2 D	<100 U	0.579 JD	16200	13.4 D	<5.00 U	<2.50 U	4760
A66	µg/L	118	<20.0 U	<0.500 U	<2.00 U	0.296	<1.00 U	1.27	<100 U	<0.100 U	2.57 J	<0.500 U	<1.00 U	<0.500 U	179
A68	µg/L	121	42.8 J	<0.500 U	<2.00 U	1.06	<1.00 U	4.13	<100 U	0.258	590	<0.500 U	<1.00 U	<0.500 U	294
Animas River between mainstem Cement Creek and mainstem Mineral Creek															
A69A	µg/L														
A70B	µg/L														
Animas River below mainstem Mineral Creek															
71B	µg/L														
A72	µg/L	160	46.9 J	<0.500 U	<2.00 U	1.40	<1.00 U	2.87	338	<0.100 U	995	1.31	<1.00 U	<0.500 U	407
A73	µg/L	151	23.3 J	<0.500 U	<2.00 U	0.374	<1.00 U	1.18	<100 U	<0.100 U	2.45 J	1.35	<1.00 U	<0.500 U	362
A73B	µg/L	49	<20.0 U	<0.500 U	<2.00 U	<0.100 U	<1.00 U	0.915 J	<100 U	<0.100 U	3.37 J	0.581 J	<1.00 U	<0.500 U	32.9
A75D	µg/L	96	40 J	<0.500 U	<2.00 U	0.786	<1.00 U	2.60	107 J	0.205	290	1.52	<1.00 U	<0.500 U	190
A75B	µg/L														
Bakers Bridge	µg/L	271	35.2 J	3.74	<2.00 U	<0.100 U	3.23	<0.500 U	1260	0.193 J	5870	0.85 J	<1.00 U	<0.500 U	13.3 J
mainstem Cement Creek															
CC48	µg/L														
CC49	µg/L														
mainstem Mineral Creek															
M34	µg/L	139	45.7 J	<0.500 U	<2.00 U	0.127 J	<1.00 U	1.18	<100 U	<0.100 U	27.6	<0.500 U	<1.00 U	<0.500 U	48.2

Appendix 4: Tissue residue data for benthic invertebrates collected from the Animas River in September 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sampling location	Analysis	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
		mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww
A56	Total Recoverable Metals	91.8 D	0.141 JD	0.09 JD	0.347 D	0.44 D	5.79 D	57.9 D	2.63 D	31.2D D	<0.025 U	0.0704 JD	0.256 D	<0.0614 U	99.8 D
A60	Total Recoverable Metals	120 D	0.13 JD	0.1 JD	0.545 D	0.703 D	19.5 D	73.4 D	5.25 D	25.6D D	<0.049 U	<0.123 U	<0.246 U	<0.123 U	108 D
A68	Total Recoverable Metals	212 D	0.631 D	0.1 JD	1.16 D	0.834 D	18 D	986 D	7.57 D	60.5D D	<0.053 U	0.155 JD	0.265 JD	<0.132 U	240 D
A72	Total Recoverable Metals	261 D	<0.16 U	<0.1 U	0.204 D	0.649 D	11.5 D	1190 D	2.27 D	17.3D D	<0.064 U	<0.16 U	<0.321 U	<0.16 U	49.9 D
A73	Total Recoverable Metals	251 D	0.208 JD	<0.1 U	0.281 D	0.61 JD	9.98 D	847 D	2.02 D	32.6D D	<0.066 U	0.173 JD	<0.33 U	<0.165 U	59.3 D
A75D	Total Recoverable Metals	78.4 D	<0.368 U	<0.3 U	0.235 D	0.978 JD	4.52 D	105 D	0.689 D	50.6D D	<0.147 U	<0.368 U	<0.735 U	<0.368 U	56.2 D
Bakers Bridge	Total Recoverable Metals	114 D	<0.139 U	<0.1 U	0.478 D	0.615 D	5.28 D	156 D	0.761 D	76.6D D	<0.056 U	0.477 D	<0.279 U	<0.139 U	106 D

Sampling location	Analysis	Aluminum	Arsenic	Beryllium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
		mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw	mg/kg dw
A56	Total Recoverable Metals	303 D	0.47 JD	0.30 JD	1.15 D	1.45 D	19.1 D	191 D	8.7 D	103 D	0.041 U	0.23 JD	0.84 D	0.10 U	329 D
A60	Total Recoverable Metals	396 D	0.43 JD	0.33 JD	1.80 D	2.32 D	64.4 D	242 D	17.3 D	84 D	0.081 U	0.20 U	0.41 U	0.20 U	356 D
A68	Total Recoverable Metals	700 D	2.08 D	0.33 JD	3.83 D	2.75 D	59.4 D	3254 D	25.0 D	200 D	0.087 U	0.51 JD	0.87 JD	0.22 U	792 D
A72	Total Recoverable Metals	861 D	0.26 U	0.17 U	0.67 D	2.14 D	38.0 D	3927 D	7.5 D	57 D	0.106 U	0.26 U	0.53 U	0.26 U	165 D
A73	Total Recoverable Metals	828 D	0.69 JD	0.17 U	0.93 D	2.01 JD	32.9 D	2795 D	6.7 D	108 D	0.109 U	0.57 JD	0.54 U	0.27 U	196 D
A75D	Total Recoverable Metals	259 D	0.61 U	0.50 U	0.78 D	3.23 JD	14.9 D	347 D	2.3 D	167 D	0.243 U	0.61 U	1.21 U	0.61 U	185 D
Bakers Bridge	Total Recoverable Metals	376 D	0.23 U	0.17 U	1.58 D	2.03 D	17.4 D	515 D	2.5 D	253 D	0.092 U	1.57 D	0.46 U	0.23 U	350 D

D = diluted; J = estimated value; U = not detected; dw = dry weight; ww = wet weight

notes:

all non-detected values were divided by half before calculating the dry weight concentrations

The moisture content of the benthic invertebrates was not measured and was assumed to equal 70% (= 30% dry matter); hence, the ww values were multiplied by a factor of 3.3 to convert them to dw values

Appendix 5

Steps and Background for Developing Trout Specific Hardness-Dependent Toxicity Thresholds

1) **BACKGROUND:**

This project evaluates acute and chronic laboratory toxicity studies to provide evidence of a stressor-response relationship between water hardness and key metals (i.e., cadmium [Cd], copper [Cu], and zinc [Zn]) associated with past mining activities in Colorado. The literature search focused on four trout species (i.e. brook trout, brown trout, cutthroat trout, and rainbow trout) with the objective of establishing protective threshold metal concentrations in surface water to inform risk management decisions at mining sites.

Data sources used for this evaluation include existing surface water criteria documents, EPA's Ecotox database (http://cfpub.epa.gov/ecotox/), peer-reviewed journal articles, and high-quality secondary literature. Pertinent information from each study was captured in a database and included organism parameters (length, weight, life stage), water quality characteristics (pH, hardness, alkalinity, temperature), design specifications (exposure duration, exposure type, method of chemical analysis), and toxicity endpoints.

This trout sensitivity project evaluated trout-specific acute and chronic toxicity data from exposure to aluminum. EPA issued aluminum water quality standards (i.e. 750 µg/L for acute exposure; 87 µg/L for chronic exposure) in 1988, which are protective of aquatic life including trout (USEPA, 1988). In 2011, Colorado promulgated new aluminum standards which take into account the hardness and pH of the receiving water (CDPHE, 2013).[1] As part of the 2011 Colorado recalculation effort, several aquatic species (i.e., midge, perch, snail, amphipod, daphnid, and trout) were evaluated and ranked for sensitivity to aluminum. The project described here, however, is exclusively focused on trout, for which not enough data points are available (i.e., 4 acute rainbow trout and 3 chronic brook trout) to confidently derive new toxicity thresholds. A literature search for post-2011 aluminum toxicity data on trout also did not uncover new information. Therefore, trout-specific acute and chronic toxicity threshold values for aluminum could not be calculated. Instead, the current pH- and hardness-dependent Colorado aluminum standard is adopted as the default standard.

2) **SCREENING CRITERIA:**

Acute toxicity data were screened to retain only studies conducted using the most acceptable procedures (Stephan *et al*., 1985) (**Appendix A**).

a. Only results from 96-hr LC_{50} tests were retained. Exposure periods less than or greater than 96 hours were excluded.
b. Results from flow-through tests were retained. Static tests were excluded.
c. Only results from exposures with a pH within the defined range for aquatic life use ($6.5 < pH < 9$) were retained.
d. Results from tests in which the concentrations of the test material were measured were retained. Tests in which concentrations were estimated or unreported were not retained.
e. Only data from trout younger than 1 year (~10 grams) were retained because smaller/younger trout are, to a limit, known to be more sensitive than large/older fish.

[1] Aluminum water quality standards adopted in 2011, as cited in Regulation – 31 (effective as of January 31, 2013).

Early life stage fish, which are still in the yolk sac (i.e. 1 day post hatch (dph)), were excluded from the data evaluation, as were eggs.

f. Results of acute toxicity tests in which organisms were fed during the 96-hour exposure period were not retained.
g. Results of tests conducted in unusual dilution waters were not retained. Stephan *et al.* (1985) defines unusual dilution waters as those, for example, with total organic carbon (TOC) > 5 mg/L. Other examples include those dilution waters with excessively high relative concentrations of cations and anions, (e.g. Na^+, Cl^-, Mg^{+2})
h. Acute values that appeared to be questionable in comparison with other acute and chronic data for the same species were not retained.
i. Retained toxicity values were converted to dissolved values using EPA metal-specific conversion factors if total metal concentration was reported, or if it was not stated.
j. Toxicity values from studies where fish were acclimated, or pre-exposed to the metal toxicant, were excluded from the data evaluation.

3) **RATIONALE:**

Geometric means and natural logarithms were calculated and used throughout this analysis because the most-widely used relationship is between hardness and acute toxicity of metals in fresh water. In addition, a log-log relationship fits these data (Stephan *et al*., 1985).

4) **METHODOLOGY:**

The literature search data were retained and entered in an Excel spreadsheet (Filename: TroutMetalDataEvaluation) for data evaluation. The data for Cd, Cu and Zn were entered in two separate tabs, namely Summary Metal and Metal Acute Trout. The pooled and species-specific trout slopes, species mean acute values (SMAV), Y-intercepts, and predicted toxicity thresholds (i.e. acute, chronic, LC50s) are outlined in Steps 5-13 below and cross-referenced in each of the Metal Acute Trout tabs in the Excel spreadsheets.

5) **DETERMINATION OF SPECIES-SPECIFIC SLOPE:**

The purpose of the species-specific slope is to decide whether the data for each species is useful, and the degree of agreement within, and between, species (Stephan *et al.*, 1985). This summary data is compiled in **Appendix A**.

A least-squares regression was developed in the Summary Metal tab for each species and each metal for which comparable 96-hour acute LC_{50} toxicity values were available for two or more different values of water quality characteristics (i.e. hardness). Regressions were plotted with the x-y graphing function in Excel. Slopes and R^2 values were determined for each trout species and each metal using the natural logarithms of acute toxicity values vs. the corresponding natural logarithms of the hardness values to calculate a species-specific slope for each metal. The species- and metal-specific information needed for data evaluation was entered in the Summary Metal tab, and includes the following information:

a. 96-hour LC_{50} (µg/L)
b. Hardness (mg/L $CaCO_3$)
c. Citation or source

6) **DETERMINATION OF POOLED SLOPE FOR SALMONIDS:**

The pooled slope of the regression line is the best estimate of the trout species relationship between toxicity and hardness, and required for Step 7.

Data is entered into the Metal Acute Trout tab for each metal, as follows:

a. Trout species
b. Metal of concern
c. Fish mass (grams)
d. Fish length (mm)
e. pH
f. Hardness (mg/L $CaCO_3$)
g. Alkalinity (mg/L $CaCO_3$)
h. Temperature (C°)
i. Reported or dissolved 96-hour toxicity endpoint value (µg/L), with a separate column indicating if the value is total ("T") or dissolved ("D"). This parameter is important as total values are converted to dissolved concentrations based on the methodology in Stephan *et al*., (1985).
j. Citation or source
k. Notes

A least-squares regression of the natural logarithms of acute toxicity values vs. the corresponding natural logarithms of the hardness was performed on all retained data cumulatively for all trout species to obtain a pooled salmonid slope (V) and R^2 for each metal (**Figures 1 to 3**). The pooled salmonid slope is calculated in the Metal Acute Trout tab and entered into cell K9.

7) **DETERMINATION OF SPECIES MEAN ACUTE VALUE:**

The data are pooled and averaged using the geometric mean to provide the SMAV and required for Step 8. The following equation was used to calculate the SMAV for each trout species as per the methodology described in Stephan *et al*., (1985):

$$SMAV_{50} = e^{(\ln W) - V (\ln X - \ln 50)}$$

where:

$SMAV_{50}$	= species mean acute value at hardness of 50 mg/L $CaCO_3$
W	= geometric mean of dissolved acute toxicity values
V	= pooled acute slope
X	= geometric mean of hardness values
Ln	= natural logarithm
E	= exponent

8) **DETERMINATION OF Y-INTERCEPT FOR LC50 TOXICITY THRESHOLDS:**

The y-intercept for LC50 toxicity thresholds is a statistical term that is required to calculate the LC50 toxicity threshold in Step 9. The following equation was used to calculate species-specific y-intercepts for each metal (**Table 1**):

$$\text{Y-Intercept} = \ln(SMAV_{50}) - (V \times \ln 50)$$

where:

$SMAV_{50}$	= species mean acute value at hardness of 50 mg/L $CaCO_3$
V	= pooled acute slope

Ln = natural logarithm of 50 mg/L $CaCO_3$ hardness value

9) **DETERMINATION OF LC_{50} TOXICITY THRESHOLDS**:

The calculation of LC_{50} toxicity thresholds, as reported in **Table 1**, is the initial step for determining acute and chronic toxicity thresholds in Steps 11 and 13 below. Species-specific LC_{50} equations were defined for each metal using the following equation:

$$\text{Predicted } LC_{50} = e^{(V * \ln(\text{hardness}) + \text{Y-intercept})}$$

where:
V = pooled acute slope
Ln = natural logarithm of 50 mg/L $CaCO_3$ hardness value

10) **DETERMINATION OF Y- INTERCEPT FOR ACUTE TOXICITY THRESHOLDS:**

The y-intercept for acute toxicity thresholds **(Table 1)** is a statistical term that is required to calculate the predicted acute toxicity thresholds in Step 11. The y-intercept was calculated using a safety factor of 2 (i.e., $SMAV_{50}/2$) for each metal using the equation in Step 8.

11) **DETERMINATION OF ACUTE TOXICITY THRESHOLDS:**

The calculation of acute toxicity thresholds **(Table 1)** is the final step in the derivation process, if an acute/ chronic ratio (ACR) is unavailable. The predicted acute toxicity threshold equation (with a safety factor) was reported in the same manner as in Step 9, but with the intercept calculated in Step 10**.**

12) **DETERMINATION OF Y-INTERCEPT FOR CHRONIC TOXICITY THRESHOLDS:**

The y-intercept for chronic toxicity thresholds **(Table 1)** is a statistical term that is necessary for calculation of the predicted chronic toxicity thresholds in Step 13. The y-intercept was calculated for each metal using the equation in Step 8. The $SMAV_{50}$ was divided by the species-specific ACR (**Table 2**).

13) **DETERMINATION OF CHRONIC TOXICITY THRESHOLDS:**

The predicted species-specific chronic toxicity threshold equation (with appropriate ACR applied) is reported in the same manner as in Step 9, however, with the intercept calculated in Step 12 **(Table 1).**

14) **SELECTION OF METAL TOXICITY THRESHOLD VALUE:**

The lesser of two values calculated via Steps 11 and 13 was used as the species specific metal toxicity threshold values (**Table 1**).

15) **UNCERTAINTY:**

Professional judgment is needed to determine the uncertainty associated with information taken from scientific literature, and any extrapolations used in developing the trout toxicity thresholds. In order to standardize the data selection process and reduce the number of potential confounding factors, data points from 96-hour acute toxicity tests were screened against the criteria outlined in Steps 2a-j. This screening process produces more "standardized" datasets, which reduces the overall level uncertainty of the data analysis, except as noted below.

The toxic action and bioavailability of the three target metals is influenced by the pH, hardness, and DOC of the surface water. Hardness is a critical data point as natural logarithms of the 96-hour toxicity values and water quality characteristics (i.e. hardness) are plotted to determine a species-specific slope. A weak statistical relationship between hardness and LC_{50} values is likely if the entire data set consists of a narrow range of hardness concentrations (e.g. 45 – 55 mg/L $CaCO_3$). Note that the reported brown trout correlation coefficient ($R^2 = 0.19$) for Cu and the brook trout species specific slope (i.e. 11.08) for Cu (**Tables 4b and 4c**, respectively) indicate a weak relationship based on the limited range of hardness values, and therefore, introduce some level of uncertainty into the data evaluation for this metal.

Much scientific literature is available to determine the effects of Zn exposure to trout in a wide range of hardness values (**Tables 3a – 3d**), and therefore, confidence is high when calculating the trout toxicity thresholds for this metal. No Cd data were available for brook trout that satisfied the flow-through criterion outlined in Step 2b. In the absence of flow-through data, static toxicity data points were incorporated into the data evaluation as outlined in Stephan *et al.* (1985). Therefore, the inclusion of static 96-hour Cd data points deviates from the accepted methodology, and introduces some degree of uncertainty.

The published data do not fully capture the sensitivity of all trout species to Cd. These missing data represent an uncertainty in the current evaluation. Future research efforts should concentrate on obtaining acute and chronic data endpoints (i.e. 96-hour LC50s, NOECs, LOECs, etc.) in both soft and hard dilution waters with special emphasis on cutthroat and brook trout species.

References:

Colorado Department of Public Health and the Environment (CDPHE), 2013. Regulation No. 31. CDPHE Water Quality Commission. Basic standards and methodologies for surface water (5 CCR 1002-31). Aluminum standards adopted in 2011. Most recent Regulation – 31 version: January 21, 2013.

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman, and W.A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. PB5-227049. Duluth, MN.

US Environmental Protection Agency (USEPA). 1988. Ambient water quality criteria for aluminum. Office of Water. EPA-440/5-88-008.

Figure 1: Zinc regression

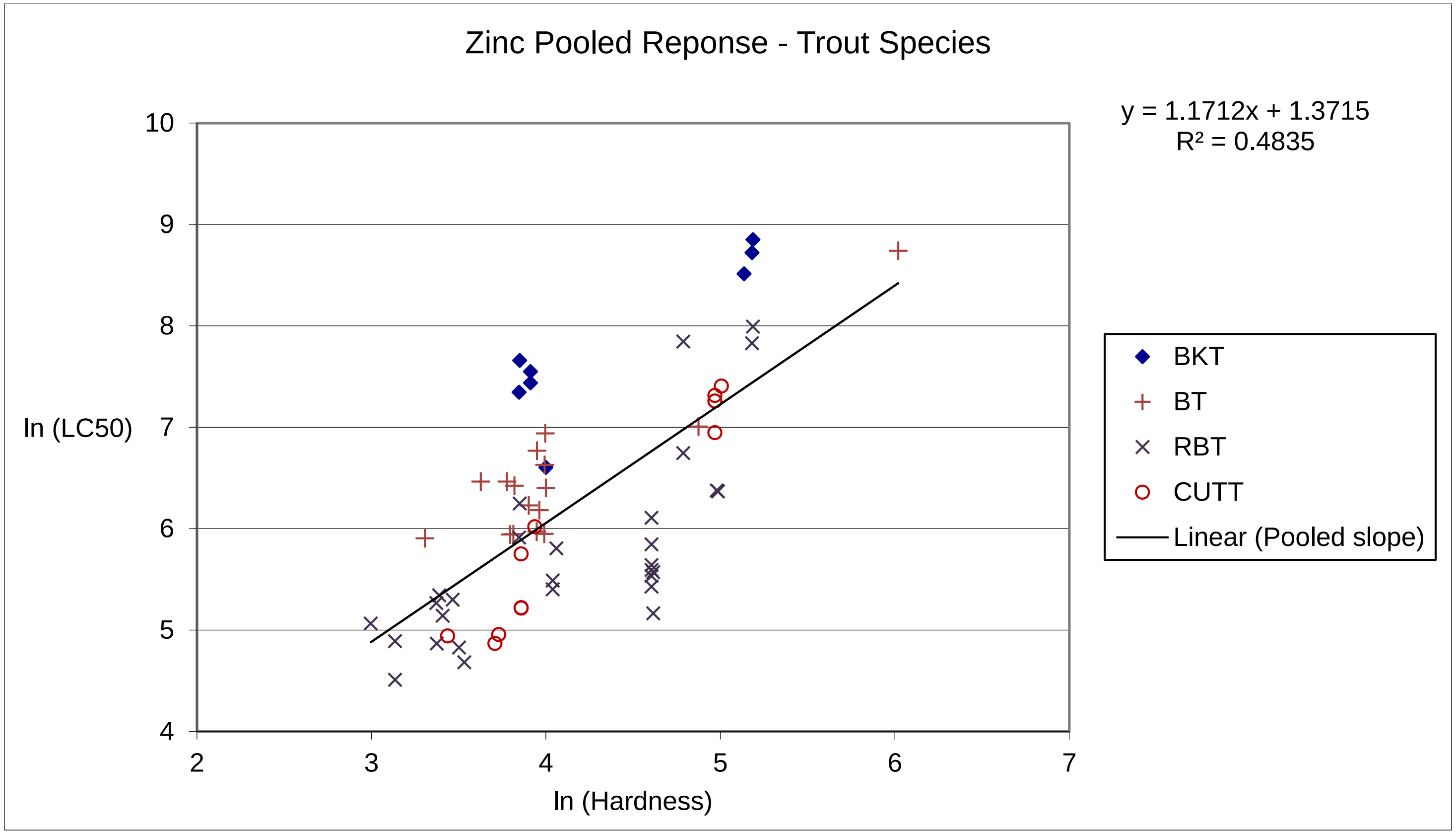

Figure 2: Copper regression

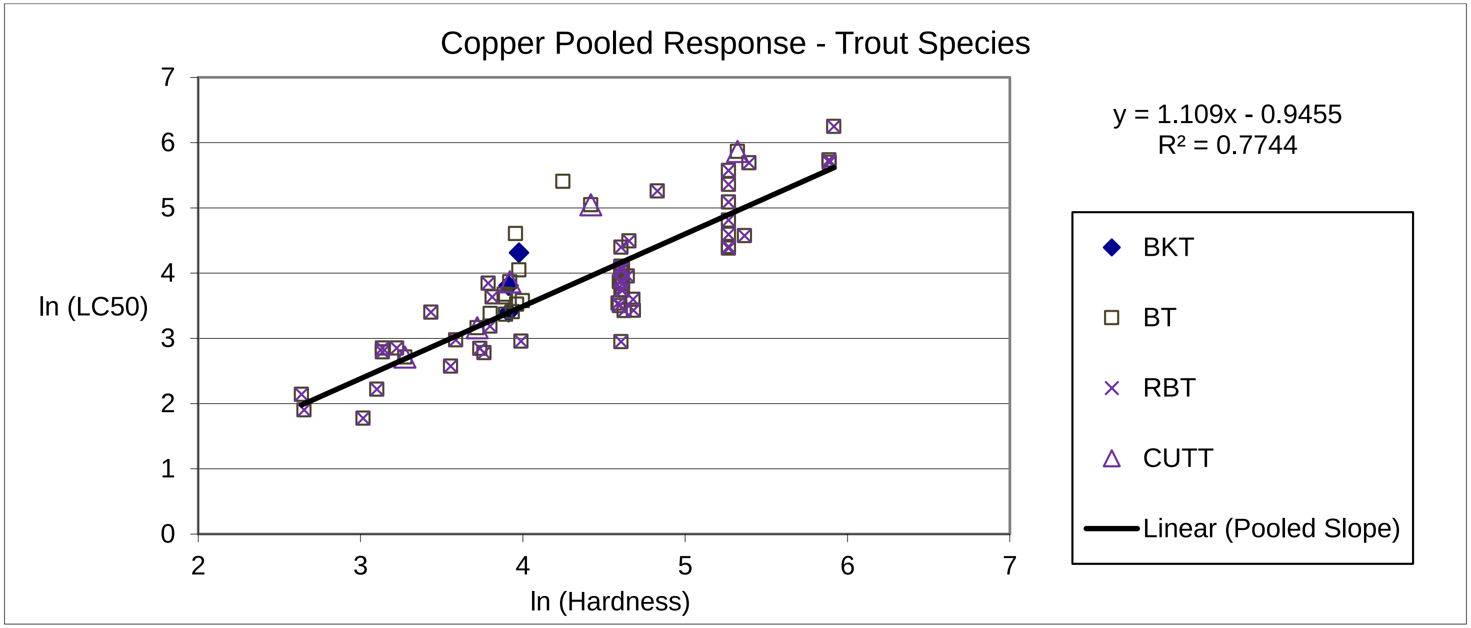

Figure 3: Cadmium regression

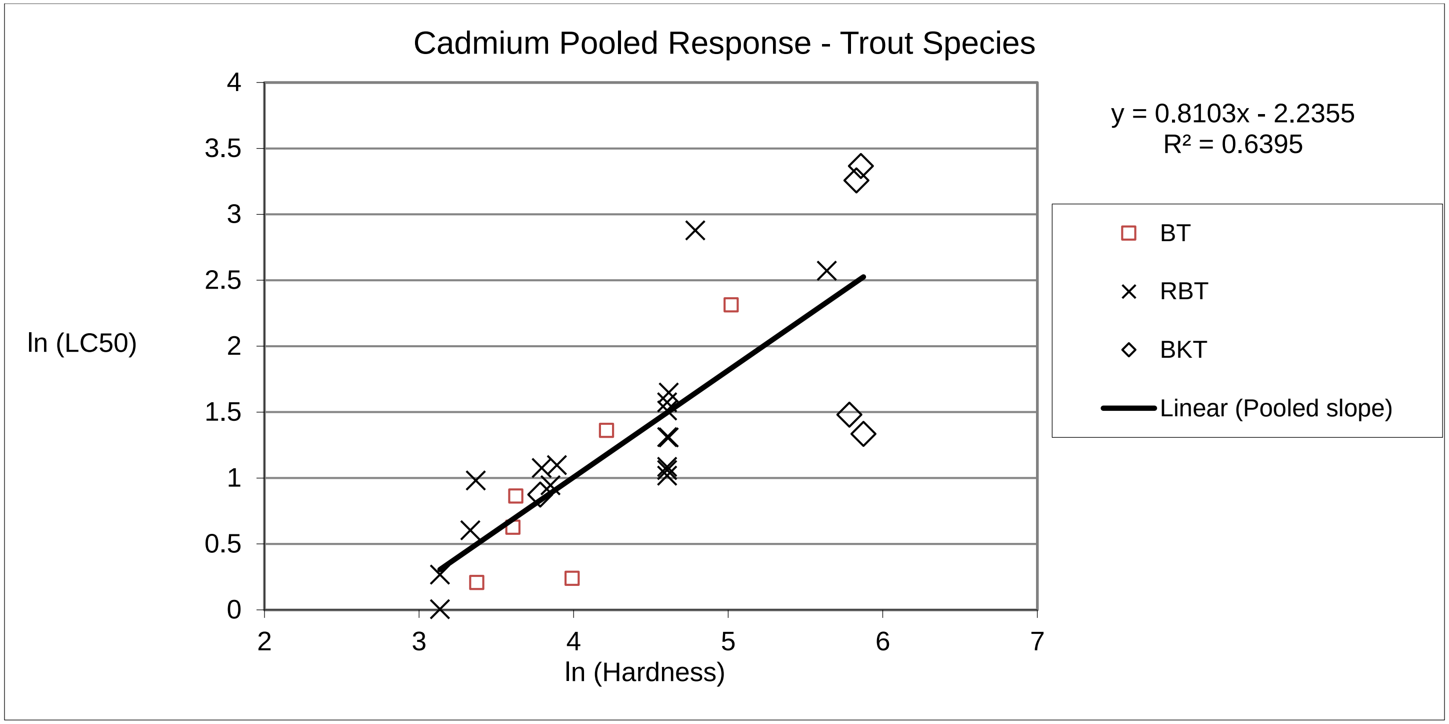

Table 1: Parameters for species-specific metal toxicity equations. Red values indicate an estimate of a protective species-specific threshold to be used at hardness 50 for individual metals of concern.

							Y-Intercepts			Calculated Values at Hardness of 50 mg/L $CaCO_3$		
Species	*Metal*	*Geomean of Hardness Values (X)*	*Geomean of Acute Dissolved LC50s (W)*	*Acute Chronic Ratio (ACR) (a)*	*Pooled R^2 (b)*	*Pooled Slope (V) (b)*	*LC50 Toxicity Thresholds (c)*	*Acute Toxicity Thresholds (d)*	*Chronic Toxicity Thresholds (e)*	*LC50 Toxicity Thresholds (f)*	*Acute Toxicity Thresholds (g)*	*Chronic Toxicity Thresholds (h)*
Brown Trout	Cadmium	53.11	2.55	2.44	0.64	0.8103	-2.283978729	-2.97712591	-3.177000834	2.43	1.21	0.99
Rainbow Trout	Cadmium	68.25	3.43	2.06	0.64	0.8103	-2.189457258	-2.882604439	-2.910608635	2.67	1.33	1.30
Brook Trout	Cadmium	227.23	7.87	*ACR (i)*	0.64	0.8103	-2.333165987	-3.026313167	*ACR (a)*	2.31	1.15	*ACR (i)*
Brook Trout	Copper	51.08	46.53	*ACR (i)*	0.77	1.109	-0.522060013	-1.215207193	*ACR (a)*	45.44	22.72	*ACR (i)*
Brown Trout	Copper	50.72	36.67	2.17	0.77	1.109	-0.752304666	-1.445451847	-1.5282753	36.09	18.05	16.61
Cutthroat Trout	Copper	62.22	62.21	*ACR (i)*	0.77	1.109	-0.450493193	-1.143640373	*ACR (a)*	48.81	24.41	*ACR (i)*
Rainbow Trout	Copper	83.27	47.04	2.48	0.77	1.109	-1.053054191	-1.746201372	-1.960465618	26.72	13.36	10.78
Brook Trout	Zinc	79.69	2528.70	2.34	0.48	1.1712	2.707789444	2.014642264	1.859649082	1464.91	732.46	627.29
Brown Trout	Zinc	57.31	663.90	1.63	0.48	1.1712	1.756526041	1.063378861	1.266107227	565.83	282.91	346.50
Cutthroat Trout	Zinc	67.33	399.50	*2.633 (j)*	0.48	1.1712	1.059889126	0.366741946	0.091765246	281.93	140.96	107.07
Rainbow Trout	Zinc	62.49	314.76	1.87	0.48	1.1712	0.908783827	0.215636646	0.283915487	242.39	121.19	129.76

Notes:

Values in red under *Calculated Values at Hardness of 50 mg/L $CaCO_3$* indicate an estimate of a protective, species-specific, dissolved toxicity applicable to waters of hardness values of 50 for individual metals of concern.

Refer to pages 3-5, steps 6-13, Steps and Background for Developing Trout Specific Hardness-Dependent Toxicity Thresholds

(a) See Table 2: Derivation of Acute to Chronic Ratios

(b) Step 6 - methodology for determining pooled slope and R^2

(c) Step 8 - equation and methodology for determining the y-intercept for LC50 toxicity thresholds

(d) Step 10 - methodology for determining the y-intercept for acute toxicity thresholds

(e) Step 12 - methodology for determining the y-intercept for chronic toxicity thresholds

(f) Step 9 - methodology and equation for calculating LC50 toxicity thresholds

(g) Step 11 - methodology for calculating acute toxicity thresholds

(h) Step 13 - methodology for calculating chronic toxicity thresholds

(i) ACR is unavailable

(j) Zinc Acute-to-Chronic Ratio for Cutthroat Trout was pre-populated for calculation of chronic endpoint.

Table 2: Derivation of Acute to Chronic Ratios (ACRs)

Metal	Species	Hardness	Acute	Chronic	Ratio	ACR	Reference
Cadmium	Brown Trout	37.6	2.4	0.4	5.9250	2.4425	Davies and Brinkman 1994a
	Brown Trout	29.0	1.2	1.0	1.2059		Brinkman and Hansen 2004
	Brown Trout	68.0	3.9	1.8	2.1311		Brinkman and Hansen 2004
	Brown Trout	151.0	10.1	6.5	1.5443		Brinkman and Hansen 2004
	Brown Trout	39.8	1.9	1.3	1.4060		Davies and Brinkman 1994b
	Rainbow Trout	47.0	2.6	1.5	1.7959	2.0568	Davies, Gorman, Carlson and Brinkman 1993
	Rainbow Trout	49.0	3.1	1.5	2.0952		Davies, Gorman, Carlson and Brinkman 1993
	Rainbow Trout	281.0	13.1	9.2	1.4317		Davies and Brinkman 1994c
	Rainbow Trout	29.0	2.7	1.3	2.1190		Davies and Brinkman 1994c
	Rainbow Trout	101.0	5.4	1.9	2.8421		Besser et al 2007
Copper	Brown Trout	50.0	30.2	13.9	2.1727	2.1727	Davies et al 2002
	Rainbow Trout	120.0	80.0	27.8	2.8808	2.4779	Seim et al 1984
	Rainbow Trout	101.0	83.0	40.0	2.0750		Besser et al 2007
Zinc	Brook Trout	45.9	1996.0	854.7	2.3353	2.3353	Holcombe and Andrew 1978
	Brown Trout	50.0	392.0	194.0	2.0206	1.6331	Davies and Brinkman 1999
	Brown Trout	39.0	550.0	457.0	1.2035		Davies and Brinkman 1994
	Brown Trout	27.3	367.0	251.0	1.4622		Davies et al 2003
	Brown Trout	131.0	1104.0	598.0	1.8462		Davies et al 2003
	Rainbow Trout	33.2	125.0	74.0	1.6892	1.8681	Brinkman and Hansen 2004
	Rainbow Trout	145.4	588.0	325.0	1.8092		Brinkman and Hansen 2004
	Rainbow Trout	25.5	430.0	276.7	1.5540		Sinley et al 1974
	Rainbow Trout	101.0	530.0	219.0	2.4201		Besser et al 2007

APPENDIX A

Summary of the calculation of Zn, Cu, and Cd thresholds of four salmonid species

Table 3a: Reported values of acute Zn toxicity (and corresponding test hardness) to rainbow trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Rainbow Trout	850	6.75	120.0	4.79	1
Oncorhynchus	158	5.06	20.0	3.00	1
mykiss	2257	7.72	120.0	4.79	2
	175	5.16	101.0	4.62	8
	263	5.57	101.0	4.62	8
	125	4.83	33.2	3.50	13
Slope= 0.9874	588	6.38	145.4	4.98	13
R^2 = 0.5691	222	5.40	56.8	4.04	14
	242	5.49	56.8	4.04	14
	228	5.43	100.0	4.61	26
	253	5.53	100.0	4.61	26
	269	5.59	100.0	4.61	26
	282	5.64	100.0	4.61	26
	346	5.85	100.0	4.61	26
	449	6.11	100.0	4.61	26
	91	4.51	23.0	3.14	29
	133	4.89	23.0	3.14	29
	200	5.30	32.0	3.47	35
	130	4.87	29.2	3.37	46
	171	5.14	30.2	3.41	46
	194	5.27	29.1	3.37	46
	209	5.34	29.6	3.39	46
	370	5.91	46.8	3.85	57
	517	6.25	47.0	3.85	57
	2510	7.83	178.0	5.18	57
	2960	7.99	179.0	5.19	57
	333	5.81	58.0	4.06	80
	108	4.68	34.2	3.53	86
	583	6.37	146.4	4.99	86
Geometric mean	313		62.5		

Table 3b: Reported values of acute Zn toxicity (and corresponding test hardness) to brown trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Brown Trout	642	6.46	43.7	3.78	14
Salmo trutta	381	5.94	44.5	3.80	14
	617	6.42	45.6	3.82	14
	757	6.63	54.2	3.99	14
	392	5.97	54.1	3.99	18
	642	6.46	37.6	3.63	37
Slope = 1.0158	392	5.97	51.8	3.95	40
R^2 = 0.7931	871	6.77	51.9	3.95	40
	1033	6.94	54.4	4.00	41
	484	6.18	52.6	3.96	42
	603	6.40	54.6	4.00	42
	382	5.95	45.3	3.81	43
	508	6.23	49.5	3.90	43
	367	5.91	27.3	3.31	45
	1104	7.01	131.0	4.88	45
	6259	8.74	411.4	6.02	45
Geometric mean	665		57.3		

Table 3c: Reported values of acute Zn toxicity (and corresponding test hardness) to brook trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Brook Trout	1700	7.44	50.0	3.91	23
Salvelinus fontinalis	1900	7.55	50.0	3.91	23
	738	6.60	54.6	4.00	42
	1550	7.35	46.8	3.85	57
Slope= 1.0568	2120	7.66	47.0	3.85	57
R^2 = 0.7822	4980	8.51	170.0	5.14	57
	6140	8.72	178.0	5.18	57
	6980	8.85	179.0	5.19	57
Geometric mean	2529		79.7		

Table 3d: Reported values of acute Zn toxicity (and corresponding test hardness) to cutthroat trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Cutthroat trout	140	4.94	31.1	3.44	13
Oncorhynchus	1645	7.41	149.4	5.01	13
clarkii	185	5.22	47.4	3.86	17
	1420	7.26	144.0	4.97	17
Slope = 1.6229	314	5.75	47.4	3.86	17
R^2 = 0.9347	1500	7.31	144.0	4.97	17
	184	5.21	47.4	3.86	17
	142	4.96	41.7	3.73	17
	1040	6.95	144.0	4.97	17
	130	4.87	40.8	3.71	42
	411	6.02	51.3	3.94	42
Geometric mean	400		67.3		

Table 3e: Values of acute Zn toxicity (and corresponding test hardness) to trout eliminated through screening of a larger dataset with 5 criteria known to influence Zn toxicity.

Excluded studies

Species	Hardness	LC50	Rationale	Source
RBT	10	101	c	2
RBT	33.0	170	a,e	4
RBT	33.0	177	e	4
RBT	33.0	187	e	4
RBT	33.0	200	e	4
RBT	33.0	207	e	4
RBT	33.0	221	e	4
RBT	33.0	241	e	4
RBT	33.0	245	e	4
RBT	33.0	265	e	4
RBT	33.0	290	e	4
RBT	33.0	336	e	4
RBT	33.0	459	e	4
RBT	33.0	93	e	4
RBT	33.0	105	e	4
RBT	33.0	129	e	4
RBT	33.0	138	e	4
BKT	170.0	1900	a	7
BKT	181.0	5400	a	7
RBT	97.5	1120	b,e	9
RBT	30.9	4530	a	10
RBT	30.2	170	a	10
RBT	31.2	190	a	10
RBT	31.3	110	a	10
RBT	31.4	880	a	10
RBT	387.0	4460	a	10
RBT	389.0	11100	a	10
RBT	389.0	5160	a	10
RBT	394.0	9950	a	10
RBT	390.0	7260	a	11
RBT	390.0	4850	a	11
RBT	390.0	4200	a	11
RBT	390.0	3960	a	11
RBT	390.0	5210	a	11
BT	54.1	871	g	18
RBT	5.6	40	b,e	19
RBT	41.3	169	b,e	20
RBT	41.3	2170	b,e	20
RBT	100.0	571	f	26
RBT	23.0	651	d	29
RBT	23.0	815	d	29
RBT	83.0	1755	d	30
RBT	9.2	65	e	32
RBT	9.2	95	e	32

BT	54.0	690	c	40
BT	206.7	2267	c	40
BKT	52.6	1178	d	42
RBT	330.8	730	c	46
RBT	30.0	441	c	46
RBT	105.6	1170	c	46
RBT	190.0	1470	c	46
RBT	399.0	2560	c	46
RBT	102.3	904	c	46
RBT	396.3	2280	c	46
RBT	45.1	153	c	46
RBT	139.0	214	c	46
RBT	228.3	283	c	46
RBT	332.3	483	c	46
RBT	29.1	1510	c	46
RBT	28.7	548	c	46
RBT	28.4	610	c	46
RBT	20.0	90	b,e	49
RBT	30.0	810	d,e	51
RBT	30.0	410	d,e	51
RBT	30.0	430	d,e	51
RBT	314.0	7210	d,e	54
RBT	312.0	4520	d,e	54
RBT	23.0	560	d,e	54
RBT	30.0	830	d,e	54
RBT	102.0	1000	d,e	54
RBT	312.0	1164	d,e	54
RBT	22.0	235	d,e	54
RBT	28.5	26.8	a	55
RBT	29.1	33.3	a	55
RBT	29.6	124	a	55
RBT	30.8	109	a	55
RBT	30.9	23.9	a	55
RBT	31.3	53.3	a	55
RBT	87.1	184	a	55
RBT	90.0	257	a	55
RBT	44.4	756	d	57
RBT	170.0	1910	d	57
BKT	44.4	2420	d	57
RBT	250.0	5300	b,e	60
RBT	250.0	1600	b,e	60
RBT	250.0	590	b,e	60
RBT	5.0	280	b,e	66
RBT	16.0	117	b	67
RBT	24.0	130	b	67
RBT	137.0	2600	b	68
RBT	143.0	2400	b	68
RBT	504.0	4760	a	81
RBT	14.0	560	b	83
RBT	14.0	670	b	83

a	Exposure longer than 96 h or unspecified
b	Static or static renewal exposure
c	Unusual dilution waters
d	Fish too large, too old
e	Water chemistry estimated or unreported
f	Fish too young, still in yolk sac
g	Fish pre-exposed to metals

Table 4a: Reported values of acute Cu toxicity (and corresponding test hardness) to rainbow trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Rainbow Trout	192	5.26	125.0	4.83	5
Oncorhynchus mykiss	58	4.06	101.0	4.62	8
	42	3.74	101.0	4.62	8
	6	1.77	20.4	3.02	22
	17	2.84	41.9	3.74	22
	38	3.63	45.2	3.81	22
	47	3.84	44.1	3.79	22
	24	3.19	44.6	3.80	22
	20	2.98	36.1	3.59	22
	19.1	2.95	100.0	4.61	26
	56.6	4.04	100.0	4.61	26
	59.9	4.09	100.0	4.61	26
	59	4.08	100.0	4.61	26
	42.4	3.75	100.0	4.61	26
	60.6	4.10	100.0	4.61	26
	162	5.09	194.0	5.27	28
	82	4.41	194.0	5.27	28
	80	4.38	194.0	5.27	28
	99	4.59	194.0	5.27	28
	263	5.57	194.0	5.27	28
	123	4.81	194.0	5.27	28
	212	5.36	194.0	5.27	28
	16	2.79	23.0	3.14	30
	17.28	2.85	23.0	3.14	30
	52.224	3.96	104.0	4.64	56
	296	5.69	220.0	5.39	56
	34	3.54	98.2	4.59	56
	97	4.57	214.0	5.37	56
	89	4.49	105.0	4.65	56
	33	3.50	99.0	4.60	59
	31	3.42	102.0	4.62	59
	309	5.73	360.0	5.89	59
	30	3.40	31.0	3.43	59
	48	3.87	100.0	4.61	59
	46	3.84	101.0	4.62	59
	48	3.87	99.0	4.60	59

Slope=	1.131
R^2 =	0.8196

	516	6.25	371.0	5.92	59
	298	5.70	361.0	5.89	59
	81	4.40	100.0	4.61	59
	39	3.67	107.7	4.68	61
	30	3.41	107.7	4.68	61
	17	2.85	25.1	3.22	63
	9	2.22	22.2	3.10	71
	9	2.14	14.0	2.64	71
	7	1.90	14.2	2.65	71
	19	2.95	54.0	3.99	80
	13	2.57	35.0	3.56	90
	16	2.78	43.0	3.76	90
Geometric mean	47		83.3		

Table 4b: Reported values of acute Cu toxicity (and corresponding test hardness) to brown trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Brown Trout	39.4	3.67	57.1	4.04	18
Salmo trutta	33.9	3.52	52.6	3.96	42
	57.3	4.05	53.3	3.98	42
Slope = 1.2413	29.4	3.38	44.7	3.80	42
R^2 = 0.1973	39.4	3.67	48.7	3.89	42
	30.2	3.41	51.2	3.94	42
	35.8	3.58	54.5	4.00	42
Geometric mean	37		50.7		

Table 4c: Reported values of acute Cu toxicity (and corresponding test hardness) to brook trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

		Dissolved LC50	ln LC50	hardness	ln hardness	Source
Brook Trout		74.6	4.31	53.3	3.98	42
Salvelinus fontinalis		45	3.81	50.0	3.91	23
Slope=	11.08	30	3.40	50.0	3.91	23
R^2 =	0.8027					
Geometric mean		46.5		51.1		

Table 4d: Reported values of acute Cu toxicity (and corresponding test hardness) to cutthroat trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

		Dissolved LC50	ln LC50	Hardness	ln hardness	Source
Cutthroat trout		15.072	2.71	26.4	3.27336	28
Oncorhynchus		155.52	5.05	83	4.41884	28
clarkii		352.32	5.86	205	5.32301	28
Slope=	1.6308	23.6	3.16	41.2	3.71844	42
R^2 =	0.9507	47.8	3.87	50.4	3.91999	42
Geometric mean		62.2		62.2		

Table 4e: Values of acute Cu toxicity (and corresponding test hardness) to trout eliminated through screening of a larger dataset with 5 criteria known to influence Cu toxicity.

Excluded studies Species	Hardness	LC50	Source	Rationale
RBT	33.0	7	4	e
RBT	125	190	5	d
RBT	125	210	5	d
BKT	170.0	64	7	a
BKT	181.0	38	7	a
RBT	97.5	110	9	b,e
BT	57.1	30.2	18	g
RBT	41.3	13.8	20	b,e
RBT	41.3	36	20	b,e
RBT	36.2	12.9	22	c
RBT	45.4	25.1	22	c
RBT	300	890	24	d
RBT	52.2	62.9	26	f
CUTT	222.72	69.9	28	c
RBT	194.0	165	28	d
RBT	194.0	197	28	d
RBT	194.0	514	28	d
RBT	194.0	243	28	d
RBT	23	29	29	d
RBT	23	28	29	d
RBT	42.0	57	30	e
RBT	132.5	120	31	b
RBT	9.2	2.8	32	e
RBT	9.2	4.2	32	e
RBT	112.0	160	33	e
BKT	52.6	48.2	42	d
RBT	169.0	110	47	b,e
RBT	169.0	100	47	b,e
RBT	169.0	50	47	b,e
RBT	169.0	60	47	b,e
RBT	362.5	102	48	d
RBT	33.0	400	50	b
RBT	36.0	52	54	e
RBT	100.0	56	54	e

RBT	350.0	150	54	e
RBT	98.0	85.9	59	c
RBT	101.0	176	59	c
RBT	370.0	232	59	c
RBT	364.0	111	59	c
RBT	366.0	70	59	c
RBT	32.0	22.4	59	c
RBT	371.0	82.2	59	c
RBT	31.0	28.9	59	c
RBT	101.0	40	59	c
RBT	30.0	30	59	c
RBT	30.0	19.9	59	c
RBT	250.0	930	60	b,e
RBT	250.0	1150	60	b,e
RBT	250.0	430	60	b,e
RBT	120.0	11.3	62	b,e
RBT	120.0	11.3	62	b,e
RBT	120.0	14.3	62	b,e
RBT	120.0	15.9	62	b,e
RBT	120.0	23.9	62	b,e
RBT	44.0	135	64	b,e
BKT	45.4	105.6	65	d
BKT	45.4	86.4	65	d
RBT	18.3	94	69	e
RBT	23.7	93	69	e
RBT	24.4	89	69	e
RBT	31.0	90	69	e
RBT	172.0	67.9	70	b
RBT	176.0	35.5	70	b
RBT	176.0	18.1	70	b
RBT	176.0	52.5	70	b
RBT	176.0	18.1	70	b
RBT	177.0	27.7	70	b
RBT	178.0	53.9	70	b
RBT	178.0	30.7	70	b
RBT	179.0	37.3	70	b
RBT	180.0	46.2	70	b
RBT	180.0	17.9	70	b
RBT	180.0	21.2	70	b
RBT	13.0	19.4	71	c
RBT	12.2	5.9	71	c

RBT	170.0	80	75	b,e
RBT	52.2	100	78	a
RBT	120	80	77	d
RBT	284.0	650	84	e
RBT	120.0	66.7	85	e
RBT	57.0	40	87	b
RBT	57.0	21	87	b
RBT	57.0	22	87	b
RBT	57.0	24	87	b
RBT	39.0	8.1	89	b
RBT	42.0	3.4	89	b
RBT	90.0	17.2	89	b
RBT	90.0	32	89	b
RBT	38.0	21	90	b
RBT	45.0	17.2	90	b

a	Exposure longer than 96 h or unspecified
b	Static or static renewal exposure
c	Unusual dilution waters
d	Fish too large or too old
e	Water chemistry estimated or unreported
f	Fish too young, still in yolk sac
g	Fish pre-exposed to metals

Table 5a: Reported values of acute Cd toxicity (and corresponding test hardness) to rainbow trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Rainbow Trout	3.70	1.31	101.0	4.62	8
Oncorhynchus mykiss	5.20	1.65	101.0	4.62	8
	2.77	1.02	100.0	4.61	26
Slope= 0.8249	2.89	1.06	100.0	4.61	26
R^2 = 0.6659	4.83	1.57	100.0	4.61	26
	3.71	1.31	100.0	4.61	26
	4.54	1.51	100.0	4.61	26
	2.96	1.09	100.0	4.61	26
	1.31	0.27	23.0	3.14	29
	1.01	0.01	23.0	3.14	29
	1.83	0.60	28.0	3.33	39
	2.67	0.98	29.0	3.37	39
	13.10	2.57	281.0	5.64	39
	2.58	0.95	47.0	3.85	36
	3.00	1.10	49.0	3.89	36
	17.79	2.88	120.0	4.79	72
	2.93	1.08	44.4	3.79	74
Geometric mean	3.43		68.2		

Table 5b: Reported values of acute Cd toxicity (and corresponding test hardness) to brown trout. These studies remain from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Brown Trout	1.23	0.21	29.2	3.37	13
Salmo trutta	3.90	1.36	67.6	4.21	13
Slope = 1.2018	10.10	2.31	151.4	5.02	13
R^2 = 0.9755	1.17	0.16	54.1	3.99	18
	1.87	0.63	36.9	3.61	38
	2.37	0.86	37.6	3.63	37
Geometric mean	2.51		53.1		

Table 5c: Reported values of acute Cd toxicity (and corresponding test hardness) to brook trout. This study remains from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

		Dissolved LC50	ln LC50	hardness	ln hardness	Source
Brook trout		1.5	0.41	42	3.74	27
Salvenius fontinalis		2.4	0.88	44	3.78	27
		26	3.26	340	5.83	27
Slope =	0.8336	29	3.37	350	5.86	27
R^2 =	0.5189	3.8	1.34	356	5.87	27
		4.4	1.48	325	5.78	27
Geometric mean		5.97		171.5		

Table 5d: Reported values of acute Cd toxicity (and corresponding test hardness) to cutthroat trout. This study remains from the screening of a larger dataset with 5 criteria known to influence metal toxicity.

	Dissolved LC50	ln LC50	hardness	ln hardness	Source
Cutthroat Trout	2.40	0.88	44.9	3.80	12
Oncorhynchus clarkii					
No slope					
Geometric mean	2.4		44.9		

Table 5e: Values of acute Cd toxicity (and corresponding test hardness) to trout eliminated through screening of a larger dataset with 5 criteria known to influence Cu toxicity.

Excluded studies Species	Hardness	LC50	Source	Rationale
RBT	33.0	7	4	e
RBT	125	190	5	d
RBT	125	210	5	d
BKT	170.0	64	7	a
BKT	181.0	38	7	a
RBT	97.5	110	9	b,e
BT	57.1	30.2	18	g
RBT	41.3	13.8	20	b,e
RBT	41.3	36	20	b,e
RBT	36.2	12.9	22	c
RBT	45.4	25.1	22	c
RBT	300	890	24	d
RBT	52.2	62.9	26	f
CUTT	222.72	69.9	28	c
RBT	194.0	165	28	d
RBT	194.0	197	28	d
RBT	194.0	514	28	d
RBT	194.0	243	28	d
RBT	23	29	29	d
RBT	23	28	29	d
RBT	42.0	57	30	e
RBT	132.5	120	31	b
RBT	9.2	2.8	32	e
RBT	9.2	4.2	32	e
RBT	112.0	160	33	e
BKT	52.6	48.2	42	d
RBT	169.0	110	47	b,e
RBT	169.0	100	47	b,e
RBT	169.0	50	47	b,e
RBT	169.0	60	47	b,e
RBT	362.5	102	48	d
RBT	33.0	400	50	b
RBT	36.0	52	54	e
RBT	100.0	56	54	e

RBT	350.0	150	54	e
RBT	98.0	85.9	59	c
RBT	101.0	176	59	c
RBT	370.0	232	59	c
RBT	364.0	111	59	c
RBT	366.0	70	59	c
RBT	32.0	22.4	59	c
RBT	371.0	82.2	59	c
RBT	31.0	28.9	59	c
RBT	101.0	40	59	c
RBT	30.0	30	59	c
RBT	30.0	19.9	59	c
RBT	250.0	930	60	b,e
RBT	250.0	1150	60	b,e
RBT	250.0	430	60	b,e
RBT	120.0	11.3	62	b,e
RBT	120.0	11.3	62	b,e
RBT	120.0	14.3	62	b,e
RBT	120.0	15.9	62	b,e
RBT	120.0	23.9	62	b,e
RBT	44.0	135	64	b,e
BKT	45.4	105.6	65	d
BKT	45.4	86.4	65	d
RBT	18.3	94	69	e
RBT	23.7	93	69	e
RBT	24.4	89	69	e
RBT	31.0	90	69	e
RBT	172.0	67.9	70	b
RBT	176.0	35.5	70	b
RBT	176.0	18.1	70	b
RBT	176.0	52.5	70	b
RBT	176.0	18.1	70	b
RBT	177.0	27.7	70	b
RBT	178.0	53.9	70	b
RBT	178.0	30.7	70	b
RBT	179.0	37.3	70	b
RBT	180.0	46.2	70	b
RBT	180.0	17.9	70	b
RBT	180.0	21.2	70	b
RBT	13.0	19.4	71	c
RBT	12.2	5.9	71	c

RBT	170.0	80	75	b,e
RBT	52.2	100	78	a
RBT	120	80	77	d
RBT	284.0	650	84	e
RBT	120.0	66.7	85	e
RBT	57.0	40	87	b
RBT	57.0	21	87	b
RBT	57.0	22	87	b
RBT	57.0	24	87	b
RBT	39.0	8.1	89	b
RBT	42.0	3.4	89	b
RBT	90.0	17.2	89	b
RBT	90.0	32	89	b
RBT	38.0	21	90	b
RBT	45.0	17.2	90	b

a	Exposure longer than 96h or unspecified
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c	Unusual dilution waters
d	Fish too large or too old
e	Water chemistry estimated or unreported
f	Fish too young, still in yolk sac
g	Fish pre-exposed to metals

Source	Bibliography

1 Alsop, D.H., J.C. McGeer, D.G. McDonald and C.M. Wood. 1999. Costs of chronic waterborne zinc exposure and the consequences of zinc acclimation on the gill/zinc interactions of rainbow trout in hard and soft water. Environmental Toxicology and Chemistry 18: 1014-1025.

2 Alsop, D.H. and C.M. Wood. 1999. Influence of waterborne cations on zinc uptake and toxicity in rainbow trout, Oncorhynchus mykiss. Canadian Journal of Fisheries and Aquatic Sciences 56: 2112-2119.

3 Alsop, D.H. and C.M. Wood. 2000. Kinetic analysis of zinc accumulation in the gills of juvenile rainbow trout: Effects of zinc acclimation and implications for biotic ligand modeling. Environmental Toxicology and Chemistry 19: 1911-1918.

4 Anadu, D.I., G.A. Chapman, L.R. Curtis and R.A. Tubb. 1989. Effect of zinc exposure on subsequent acute tolerance to heavy-metals in rainbow trout. Bulletin of Environmental Contamination and Toxicology 43: 329-336.

5 Anderson, P.D. and P.A. Spear. 1980. Copper pharmacokinetics in fish gills: 2. Body size relationships for accumulation and tolerance. Water Research 14: 1107-1111.

6 Bentley, R.E., T. Heitmuller, B.H. Sleight III, and P.R. Parrish. 1975. Acute toxicity of cadmium to bluegill (Lepomis macrochirus), rainbow trout (Salmo gairdneri), and pink shrimp (Penaeus duorarum). U.S. Environmental Protection Agency, Criteria Branch, WA-6-99-1414-B, Washington, D.C.

7 Besser, J.M., A.L. Allert, D. Hardesty, C.G. Ingersoll, T.W. May, N. Wang and K.J. Leib. 2001. Evaluation of metal toxicity in streams of the upper Animas River watershed, CO. Biological Science Report 2001-0001, U.S. Geological Survey, Columbia, MO.

8 Besser, J.M., C.A. Mebane, D.R. Mount, C.D. Ivey, J.L. Kunz, I.E. Greer, T.W. May and C.G. Ingersoll. 2007. Sensitivity of mottled sculpins (Cottus bairdi) and rainbow trout (Onchorhynchus mykiss) to acute and chronic toxicity of cadmium, copper, and zinc. Environmental Toxicology and Chemistry 26: 1657-1665.

9 Birge, W.J., J.A. Black, A.G. Westerman and B.A. Ramey. 1983. Fish and amphibian embryos - a model system for evaluating teratogenicity. Fundamentals of Applied Toxicology 3: 237-242.

10 Bradley, R.W. and J.B. Sprague. 1985. The influence of pH, water Hardness, and alkalinity on the acute lethality of zinc to rainbow trout (Salmo gairdneri). Canadian Journal of Fisheries and Aquatic Sciences 42: 731-736.

11 Bradley, R.W., C. Duquesnay, and J.B. Sprague. 1985. Acclimation of rainbow trout, Salmo gairdneri Richardson, to zinc: kinetics and mechanism of enhanced tolerance induction. Journal of Fish Biology 27(4): 367-369.

12 Brinkman, S.F. 2012. Acute and Chronic Toxicity of Cadmium to Early Life Stage Rio Grande Cutthroat Trout (Oncorhynchus clarkii virginalis). In: Water Pollution Studies: Federal Aid Project F-234-R19. Colorado Division of Wildlife, Fort Collins, CO, July, 2012.

13 Brinkman, S. and D. Hansen. 2004. Effect of hardness on zinc toxicity to Colorado River cutthroat (Oncorhynchus clarkia pleuriticus) and rainbow trout (Oncorhynchus mykiss) embryos and fry. In: Water Pollution Studies, Federal Aid Project F-243-R11, Colorado Division of Wildlife, Fort Collins, CO, July, 2004.

14 Brinkman, S. and N.M.K. Vieira. 2006. Effect of embryo-larval incubation temperature on the toxicity of zinc to brown trout (Salmo trutta). In: Water Pollution Studies, Federal Aid Project F-243-R13, Colorado Division of Wildlife, Fort Collins, CO, June, 2006.

15 Brinkman, S. and N.M.K. Vieira. 2006b. A comparison of the acute sensitivity of two strains of rainbow trout (Oncorhynchus mykiss) to zinc. In: Water Pollution Studies, Federal Aid Project F-243-R13, Colorado Division of Wildlife, Fort Collins, CO, June 2006.

16 Brinkman, S. and D.L. Hansen. 2007. Toxicity of cadmium to early life stages of brown trout (Salmo trutta) at multiple water hardnesses. Environmental Toxicology and Chemistry 26: 1666-1671.

17 Brickman and Johnston. 2012. Acute Toxicity of Zinc to Several Aquatic Species Native to the Rocky Mountains. Arch Env Contam Tox 62: 272 - 281.

18 Brinkman and Woodling. 2014. Acclimation and Deacclimation of Brown Trout (Salmo trutta) to Zinc and Copper Singly and in Combination with Cadmium or Copper. Arch Env Contam Tox 67: 214-223.

19 British Columbia Research Laboratory. 1978. Avoidance Reactions of Salmonids to Pulpmill Effluents. Environment Canada, Environmental Protection Service, Cooperative Pollution Abatement Research, CPAR Project Rep. 688-1:36.

20 Buhl, K.J. and S.J. Hamilton. 1990. Comparative toxicity of inorganic contaminants released by placer mining to early life stages of salmonids. Ecotoxicology and Environmental Safety 20: 325-342.

21 Buhl, K.J. and S.J. Hamilton. 1991. Relative sensitivity of early life stages of Arctic Grayling, Coho salmon, and rainbow trout to 9 inorganics. Ecotoxicology and Environmental Safety 22: 184-197.

22 Cacela, D., R. Hudson, J. Lipton, J. Marr, T. Podrabsky and P. Welsh. 1996. Preliminary toxicological evaluation: U.S. v. Iron Mountain Mines, Inc., Data Report, Prepared by Hagler Bailly Consulting Inc. for Breidenbach, Buckley, Huchting, Halm & Hamblet, Volume 1, California Office of the Attorney General, Boulder, CO. 53 pgs.

23 Cadmus, P. 2014. Effects of Copper and Zinc on Brook Trout and Cutthroat Trout under Fluctuating and Static Temperature Regimes. In: Water Pollution Studies: Federal Aid Project F-234-R21, Colorado Division of Wildlife, Fort Collins, CO, July 2004.

24 Calamari, D. and R. Marchetti. 1973. Toxicity of mixtures of metals and surfactants to rainbow trout (Salmo gairdneri Rich). Water Research 7: 1453-1464.

25 Calamari, D., R. Marchetti and G. Vailati. 1980. Influence of water hardness on cadmium toxicity to Salmo gairdneri Rich. Water Research 14: 1421-1426.

26 Calfee, R.D., E.E. Little, H.J. Puglis, E. Scott and W. Brumbaugh. 2014. Acute Sensitivity of Whte Sturgeon (Acipenser transmontanus) and Rainbow trout (Oncorhynchus mykiss) to Copper, Cadmium, or Zinc in Water-Only Lab Exposures. Environmental Toxicology and Chemistry 33(10): 2259 - 2272.

27 Carroll, J.J., S.J. Ellis and W.S. Oliver. 1979. Influences of hardness constituents on the acute toxicity of cadmium to brook trout (Salvelinus-fontinalis). Bulletin of Environmental Contamination and Toxicology 22: 575-581.

28 Chakoumakos, C., R.C. Russo and R.V. Thurston. 1979. Toxicity of copper to cutthroat trout (Salmo clarki) under different conditions of alkalinity, pH, and hardness. Environmental Science & Technology 13: 213-219.

29 Chapman, G.A. 1978. Toxicities of Cadmium, Copper, and Zinc to 4 Juvenile Stages of Chinook Salmon and Steelhead. Transactions of the American Fisheries Society 107: 841-847.

30 Chapman, G.A. and D.G. Stevens. 1978. Acutely Lethal Levels of Cadmium, Copper, and Zinc to Adult Male Coho Salmon and Steelhead. Transactions of the American Fisheries Society 107: 837-840.

31 Craig, G.R., and G.L. Beggs. 1979. Evaluation of Fish Loading Rates in Regulatory Static Bioassays. Tech. Rep. Fish. Mar. Serv. 862: 146-160.

32 Cusimano, R.F., D.F. Brakke and G.A. Chapman. 1986. Effects of pH on the toxicities of cadmium, copper, and zinc to steelhead trout (Salmo gairdneri). Canadian Journal of Fisheries and Aquatic Sciences 43: 1497-1503.

33 Daoust, P.Y. 1981. Acute pathological effects of mercury, cadmium and copper in rainbow trout. Ph.D.Thesis, Saskatoon, Saskatchewan: 331 p.

34 Davies, P. 1976. Use of dialysis tubing in defining the toxic fractions of heavy metals in natural waters. In: R.W. Andrew, P.V. Hodson, and D.E. Konasewich (Editors), Toxicity to Biota of Metal Forms in Natural Water, Windsor, Canada.

35 Davies, P.H. 1987. Zinc acclimation: exposure in feed versus water. In Water Pollution Studies, Federal Aid Project F-33-R, Colorado Division of Wildlife, Fort Collins, CO, October, 1987.

36 Davies, P.H., W.C. Gorman, C.A. Carlson and S.F. Brinkman. 1993. Effect of hardness on bioavailability and toxicity of cadmium to rainbow trout. Chemical Speciation and Bioavailability 5: 67-77.

37 Davies, P.H. and S. Brinkman. 1994. Toxicity of cadmium and zinc to wild brown trout. In: Water Pollution Studies, Federal Aid Project F-33, Colorado Division of Wildlife, Fort Collins, CO, March, 1994.

38 Davies, P.H. and S. Brinkman. 1994b. Effects of pre-exposure to sublethal waterborne cadmium on cadmium toxicity, metallothionein concentrations, and subcellular distribution of cadmium in the gill and kidney of brown trout. In: Appendix I to Water Pollution Studies, Federal Aid Project F-33, Colorado Division of Wildlife, Fort Collins, CO, March, 1994.

39 Davies, P.H. and S. Brinkman. 1994c. Cadmium toxicity to rainbow trout: Bioavailability and kinetics in waters of high and low complexing capacities. In: Appendix II to Water Pollution Studies, Federal Aid Project #F-33, Colorado Division of Wildlife, Fort Collins, Colorado, March 1994.

40 Davies, P.H. and S. Brinkman. 1999. Toxicity of zinc to brown trout under conditions of embryonic exposure (acclimated), non-exposure (unacclimated) and following 2 and 3 weeks deacclimation. In: Water Pollution Studies, Federal Aid Project F-243-R6, Colorado Division of Wildlife, Fort Collins, CO, August, 1999.

41 Davies, P.H. and S. Brinkman. 1999b. Effect of hardness and alkalinity on the toxicity of zinc to brown trout (Salmo trutta). In: Water Pollution Studies, Federal Aid Project F-243-R6, Colorado Division of Wildlife, Fort Collins, CO, August, 1999.

42 Davies, P.H., S. Brinkman and D. Hansen. 2000. Toxicity of copper and zinc to three species of trout in the Animas River and laboratory water. In: Water Pollution Studies, Federal Aid Project F-243-R6, Colorado Division of Wildlife, Fort Collins, CO, August, 2000.

43 Davies, P.H., S. Brinkman and D. Hansen. 2002. Acute toxicity of copper and zinc alone and in combination to brown trout (Salmo trutta) in 50mg/L hardness. In: Water Pollution Studies, Federal Aid Project F-243-R9, Colorado Division of Wildlife, Fort Collins, CO, June, 2002.

44 Davies, P.H., S. Brinkman and D. Hansen. 2002b. Toxicity, acclimation, and de-acclimation of early life stage brown trout exposed to copper in water hardness of 50 mg/L. In: Water Pollution Studies, Federal Aid Project F-243-R9, Colorado Division of Wildlife, Fort Collins, CO, June, 2002.

45 Davies, P.H., S. Brinkman and D. Hansen. 2003. Effect of hardness on zinc toxicity to brown trout (Salmo trutta) embryos and fry. In: Water Pollution Studies, Federal Aid Project F-243-R10, Colorado Division of Wildlife, Fort Collins, CO, August, 2003.

46 De Schamphelaere, K.A.C. & C.R. Janssen. 2004. Bioavailability and chronic toxicity of zinc to juvenile rainbow trout (Oncorhynchus mykiss): Comparison with other fish species and development of a biotic ligand model. Environmental Science & Technology 38: 6201-6209.

47 Dwyer, F.J., F.L. Mayer, L.C. Sappington, D.R. Buckler, C.M. Bridges, I.E. Greer, D.K. Hardesty, C.E. Henke, C.G. Ingersoll, J.L. Kunz, D.W. Whites, T. Augspurger, D.R. Mount, K. Hattala, and G.N. Neuderfer. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals Archives of Environmental Contamination and Toxicology 48(2): 143-154.

48 Fogels, A. and J.B. Sprague. 1977. Comparative short-term tolerance of Zebrafish, Flagfish, and rainbow trout to 5 poisons including potential reference toxicants. Water Research 11: 811-817.

49 Garton, R.B. 1972. Biological Effects of Cooling Tower Blowdown, AIChE Symp.Ser.Water 69(129):284-292.

50 Giles, M.A. and J.F. Klaverkamp. 1982. The acute toxicity of vanadium and copper to eyed eggs of rainbow trout (Salmo gairdneri). Water Research 16(6): 885-889.

51 Goettl, J.P., J.R. Sinley, and P.H. Davies. 1972. Laboratory Studies: Water Pollution Studies. In: L.E. Yeager and D.T. Weber (Editors), Colorado Fisheries Research Review No.7, Division of Game Fish and Parks, Fort Collins, CO: 36-49.

52 Goettl, J.P. and P.H. Davies. 1975. Water Pollution Studies. Job Progress Report, Federal Aid Project #F-33-R-10, Colorado Division of Wildlife, Boulder, Colorado.

53 Goettl, J.P. and P.H. Davies. 1976. Water Pollution Studies. Job Progress Report, Federal Aid Project F-33-R-11, Colorado Division of Wildlife, Boulder, Colorado.

54 Goettl, J.P., P.H. Davies, and J.R. Sinley. 1976. Water Pollution Studies. In: D.B.Cope (Editor), Colorado Fisheries Research Review 1972-1975, DOW-R-R-F72-75, Colorado Division of Wildlife, Boulder, CO, August, 1976.

55 Hansen, J.A., J. Lipton and P.G. Welsh. 2002a. Relative sensitivity of bull trout (Salvelinus confluentus) and rainbow trout (Oncorhynchus mykiss) to acute copper toxicity. Environmental Toxicology and Chemistry 21: 633-639.

56 Hansen, J.A., P.G. Welsh, J. Lipton, D. Cacela and A.D. Dailey. 2002b. Relative sensitivity of bull trout (Salvelinus confluentus) and rainbow trout (Oncorhynchus mykiss) to acute exposures of cadmium and zinc. Environmental Toxicology and Chemistry 21: 67-75.

57 Holcombe, G.W. and R.W. Andrew. 1978. The acute toxicity of zinc to rainbow and brook trout: comparisons in hard and soft water. EPA-600/3-78-094, U.S.EPA, Duluth, MN.

58 Hollis, L., J.C. McGeer, D.G. McDonald and C.M. Wood. 1999. Cadmium accumulation, gill Cd binding, acclimation, and physiological effects during long term sublethal Cd exposure in rainbow trout. Aquatic Toxicology 46: 101-119.

59 Howarth, R.S. and J.B. Sprague. 1978. Copper lethality to rainbow trout in waters of various hardness and pH. Water Research 12: 455-462.

60 Kazlauskiene, N., A. Burba and G. Svecevicius. 1994. Acute toxicity of five galvanic heavy metals to hydrobionts. Ekologija 1: 33-36.

61 Little, E.E., R.D. Calfee and G. Linder. 2012. Toxicity of Copper to Early-life Stage Kootenai River White Sturgeon, Columbia River White Sturgeon and Rainbow Trout. Archives of Environmental Contamination and Toxicology 63:400-408.

62 Marking, L.L., T.D. Bills, and J.R. Crowther. 1984. Effects of five diets on sensitivity of rainbow trout to eleven chemicals. Progressive Fish Culturist. 46(1): 1-5.

63 Marr, J.C.A., J.A. Hansen, J.S. Meyer, D. Cacela, T. Podrabsky, J. Lipton and H.L. Bergman. 1998. Toxicity of cobalt and copper to rainbow trout: application of a mechanistic model for predicting survival. Aquatic Toxicology 43: 225-238.

64 Mayer, F.L. and M.R. Ellersieck. 1986. Manual of acute toxicity: Interpretation and database for 410 chemicals and 66 species of freshwater animals. Resource Publication No.160, U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC: 505 pgs.

65 McKim, J.M. and D.A. Benoit. 1971. Effects of long-term exposures to copper on survival, growth, and reproduction of brook trout (Salvelinus-Fontinalis). Journal of the Fisheries Research Board of Canada 28.

66 McLeay, D.J. 1976. A rapid method for measuring the acute toxicity of pulpmill effluents and other toxicants to salmonid fish at ambient room temperature. Journal of the Fisheries Research Board of Canada 33(6): 1303-1311.

67 Mebane, C.A., D.P. Hennessy & F.S. Dillon. 2008. Developing acute-to-chronic toxicity ratios for lead, cadmium, and zinc using rainbow trout, a mayfly, and a midge. Water Air and Soil Pollution 188: 41-66.

68 Meisner, J.D. and W.Q. Hum. 1987. Acute toxicity of zinc to juvenile and subadult rainbow trout, Salmo gairdneri. Bulletin of Environmental Contamination and Toxicology 39: 898-902.

69 Mudge, J.E., T.E. Northstrom, G.S. Jeane, W. Davis, and J.L. Hickam. 1993. Effect of varying environmental conditions on the toxicity of copper to salmon. In: J.W.Gorsuch, F.J.Dwyer, C.G.Ingersoll, and T.W.La Point (Editors), Environmental Toxicology and Risk Assessment, 2nd Volume, ASTM STP 1216, Philadelphia, PA: 19-33.

70 Naddy, R.B., W.A. Stubblefield, J.R. May, S.A. Tucker and J.R. Hockett. 2002. The effect of calcium and magnesium ratios on the toxicity of copper to five aquatic species in freshwater. Environmental Toxicology and Chemistry 21: 347-352.

71 Ng, T. Y. T., Chowdhury, M. J., & C. M. Wood. 2010. Can the biotic ligand model predict Cu toxicity across a range of pHs in softwater-acclimated rainbow trout? Environmental Science & Technology, 44(16), 6263-6268.

72 Niyogi, S., P. Couture, G. Pyle, D.G. McDonald and C.M. Wood. 2004. Acute cadmium biotic ligand model characteristics of laboratory-reared and wild yellow perch (Perca flavescens) relative to rainbow trout (Oncorhynchus mykiss). Canadian Journal of Fisheries and Aquatic Sciences 61: 942-953.

73 Pascoe, D., S.A. Evans, and J. Woodworth. 1986. Heavy metal toxicity to fish and the influence of water hardness. Archives of Environmental Contamination and Toxicology 15(5): 481-487.

74 Phipps, G.L. and G.W. Holcombe. 1985. A method for aquatic multiple species toxicant testing - Acute toxicity of 10 chemicals to 5 vertebrates and 2 invertebrates. Environmental Pollution Series A- Ecological and Biological 38: 141-157.

75 Sappington, L.C., F.L. Mayer, F.J. Dwyer, D.R. Buckler, J.R. Jones, and M.R. Ellersieck. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environmental Toxicology and Chemistry. 20(12): 2869-2876.

76 Sauter, S., K.S. Buxton, K.J. Macek, and S.R. Petrocelli. 1976. Effects of exposure to heavy metals on selected freshwater fish. EPA-600/3-76-105. U.S. Environmental Protection Agency, Duluth, MN.

77 Seim, W.K., L.R. Curtis, S.W. Glenn and G.A. Chapman. 1984. Growth and survival of developing steelhead trout (Salmo gairdneri) continuously or intermittently exposed to copper. Canadian Journal of Fisheries and Aquatic Sciences 41: 433-438.

78 Shaw, B.J., G. Al-Bairuty and R.D. Handy. 2012. Effects of Waterborne Copper Nanoparticle and Copper Sulphate on Rainbow Trout (Oncorhynchus mykiss): Physiology and Accumulation. Aq Tox 116/117: 90-101.

79 Sinley, J.R., J.P. Goettl and P.H. Davies. 1974. Effects of zinc on rainbow trout (Salmo gairdneri) in hard and soft water. Bulletin of Environmental Contamination and Toxicology 12: 193-201.

80 Skidmore, J.F. and I.C. Firth. 1983. Acute sensitivity of selected Australian fresh-water animals to copper and zinc. Australian Water Resources Council Technical Paper: 1-129.

81 Solbe, J.F.D. 1974. The toxicity of zinc sulfate to rainbow trout in very hard water. Water Research 8(6):389-391.

82 Spehar, R.L. & A.R. Carlson. 1984. Derivation of site-specific water quality criteria for cadmium and the St-Louis River Basin, Duluth, Minnesota. Environmental Toxicology and Chemistry 3: 651-665.

83 Spry, D.J. and C.M. Wood. 1984. Acid-base, plasma ion and blood-gas changes in rainbow trout during short-term toxic zinc exposure. Journal of Comparative Physiology 154: 149-158.

84 Svecevicius, G. and M.Z. Vosyliene. 1996. Acute toxicity of copper to common freshwater fishes of Lithuania. Ekologija 2: 17-21.

85 Taylor, L.N., C.M. Wood and D.G. McDonald. 2003. An evaluation of sodium loss and gill metal binding properties in rainbow trout and yellow perch to explain species differences in copper tolerance. Environmental Toxicology and Chemistry 22: 2159-2166.

86 Todd, A.S., Brinkman S., Wolf, R.E., Lamothe, P.J., Smith K.S., and Ranville, J.F. (2009) Use of an Enriched Stable-Isotope Approach to Determine the Gill-Zinc Binding Properties of Juvenile Rainbow Trout (Oncorhynchus mykiss) During Acute Zinc Exposures in Hard and Soft Waters. Environmental Toxicology and Chemistry 28(6): 1233-1243.

87 Vardy, D.W., J. Oellers, J.A. Doering, H. Hollert, J.P. Giesy and M. Hecker. 2013. Sensitivity of early life stages of white sturgeon, rainbow trout, and fathead minnow to copper. Ecotoxicology 22: 139-147.

88 Water Pollution Research Laboratory. 1967. Effects of pollution on fish. In: Water Pollution Research 1966, Ministry of Technology, London, England: 50-61.

89 Welsh, P.G., J. Lipton, G.A. Chapman and T.L. Podrabsky. 2000. Relative importance of calcium and magnesium in hardness-based modification of copper toxicity. Environmental Toxicology and Chemistry 19: 1624-1631.

90 Welsh, P.G., J. Lipton, C.A. Mebane and J.C.A. Marr. 2008. Influence of flow-through and renewal exposures on the toxicity of copper to rainbow trout. Ecotoxicology and Environmental Safety 69: 199-208.

Appendix 5.a: Normalizing dissolved metal concentrations to a standard surface water hardness of 50 mg/L

1.0 INTRODUCTION

Surface water hardness affects the toxicity of several metals, including cadmium (Cd), copper (Cu), and zinc (Zn) (CDPHE, 2013). The toxicity of these metals to aquatic receptors changes with water hardness at a rate which is non-linear and metal-specific.

EPA has collected surface water samples from the Upper Animas River for several years in support of the Upper Animas River Baseline Ecological Risk Assessment (BERA). Of special interest to EPA is determining to what extent exposures to dissolved Cd, Cu, and Zn in the stretch of river evaluated in the BERA may result in chronic toxicity to four trout species of interest, namely brook trout, brown trout, rainbow trout, and cutthroat trout.

Appendix 5 of the BERA presents species-specific Cd, Cu and Zn Chronic Toxicity Thresholds (CTTs) which are standardized to a surface water hardness of 50 mg/L calcium carbonate. It would be inaccurate to directly compare the dissolved metals levels measured in Upper Animas River surface water samples (each one of which has a different hardness) to these CTTs without first standardizing the surface water concentrations to a standard hardness of 50 mg/L.

This appendix describes the approach used for normalizing the dissolved Cd, Cu and Zn concentrations to a standard hardness of 50 mg/L. This hardness value was retained because it represents the hardness used to derive the CTTs presented in Appendix 5.

2.0 NORMALIZATION APPROACH

The following steps are used to normalize the dissolved Cd, Cu and Zn data from the Upper Animas River to a standard hardness of 50 mg/L for comparison to the CTTs.

2.1 Step 1: Obtain the equations to calculate hardness-specific water quality benchmarks

CDPHE (2013) provides the equations to calculate chronic water quality benchmarks for Cd, Cu and Zn applicable to any surface water hardness up to 400 mg/L. These equations are as follows:

- Cd benchmark = $(1.101672 - [\ln(\text{hardness}) * 0.041838]) * \exp^{0.7998 * \ln(\text{hardness}) - 4.4451}$
- Cu benchmark = $\exp^{0.8545 * \ln(\text{hardness}) - 1.7428}$
- Zn benchmark = $0.986 * \exp^{0.9094 * \ln(\text{hardness}) + 0.6235}$

2.2 Step 2: Calculate hardness-specific benchmarks

The equations provided in Step 1 are used to calculate metal-specific chronic surface water benchmarks for hardness ranging between 10 and 400 mg/L. **Attachment 1** provides the results of these calculations for Cd, Cu and Zn.

2.3 Step 3: Calculate metal-specific chronic hardness multipliers

The Chronic Hardness Multipliers (CHMs) are obtained by dividing the chronic metal-specific benchmarks at a hardness of 50 mg/L (the standard hardness selected for this project) by the equivalent metal-specific chronic benchmark at the other hardnesses between 10 and 400 mg/L shown in **Attachment 1**.

As an example, the chronic benchmark for dissolved Cu equals 4.95 µg/L at a hardness of 50 mg/L, but 2.74 µg/L at a hardness of 25 mg/L (see **Attachment 1**). The CHM for dissolved Cu at a hardness of 25 mg/L equals 1.81 (4.95/2.74). This value indicates that dissolved Cu at a hardness of 25 mg/L has 1.81 times the chronic toxicity, all else being equal, than the dissolved Cu at a hardness of 50 mg/L. This difference is hardness- and metal-specific.

Attachment 2 provides the results of the calculations to obtain the CHMs for Cd, Cu and Zn.

2.4 Step 4: Derive metal-specific, hardness-multiplier regression equations

The last step in the process consists of regressing the surface water hardness (the "x variable") for Cd, Cu and Zn against their corresponding CHMs calculated in Step 2.3 (the "y variable"). The goal is to obtain a regression equation for Cd, Cu and Zn to help derive an exposure- and metal-specific hardness multiplier at <u>any</u> hardness between 10 and 400 mg/L.

The figures in **Attachments 3 to 5** provide the data graphs for Cd, Cu and Zn, respectively. The metal-specific CHM regression equations are as follows:

- Cd $= 19.058 * \text{hardness}^{-0.753}$ (equation 1)
- Cu $= 28.299 * \text{hardness}^{-0.854}$ (equation 2)
- Zn $= 35.079 * \text{hardness}^{-0.909}$ (equation 3)

3.0 NORMALIZING DISSOLVED METALS TO A STANDARD HARDNESS

The regression equations provided in Step 4 are used to normalize all of the dissolved Cd, Cu and Zn data collected in support of the Upper Animas River BERA to a standard hardness of 50 mg/L for comparison against the CTTs developed for brook trout, brown trout, rainbow trout, and cutthroat trout as presented in Appendix 5 of the BERA.

Table 1 provides a hypothetical example on how to normalize dissolved Cu concentrations to a standard hardness of 50 mg/L using the CHM regression equation for Cu. The calculations proceed as follows:

- Enter the hardness in equation 2 of Section 2.4 above to calculate the CHM for a particular sample.
- Multiply the measured Cu concentration by the CHM to obtain the Cu concentration normalized to a hardness of 50 mg/L.

Table 1: Hypothetical example for normalizing dissolved Cu using the CHMs

Surface water hardness (mg/L)	Measured Cu conc. (µg/L)	CHM for Cu (for normalizing to 50 mg/L hardness)	Hardness-Normalized Cu Conc. (µg/L)
27	39.5	1.696	67.0
40	27.0	1.212	32.7
52	15.0	0.969	14.5
84	9.0	0.643	5.8
179	10.9	0.337	3.7
247	94	0.256	24.1
381	179	0.177	31.7

The same general approach applies to Cd and Zn. The hardness-normalized concentrations are then divided by the species-specific CTTs presented in Appendix 5 of the Animas River BERA to obtain the Hazard Quotients (HQs) used in the surface water HQ scatter plots for Cd, Cu and Zn.

4.0 REFERENCES

Colorado Department of Public Health and Environment (CDPHE), 2013. Regulation No. 31. The basic standards and methodologies for surface water (5 CCR 1002-31). Available at http://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=5031&fileName=5 CCR 1002-31

Appendix 6

La Plata county

Known or Likely Species Occurrence

Group	Common Name	Scientific Name	Occurence	Abundance
Amphibians	Boreal Toad	Bufo boreas	Likely to occur	Unknown
Amphibians	Bullfrog	Rana catesbeiana	Known to occur	Locally Common
Amphibians	Canyon Treefrog	Hyla arenicolor	Likely to occur	Unknown
Amphibians	New Mexico Spadefoot	Spea multiplicata	Known to occur	Unknown
Amphibians	Northern Leopard Frog	Rana pipiens	Known to occur	Locally Common
Amphibians	Red-spotted Toad	Bufo punctatus	Known to occur	Rare
Amphibians	Tiger Salamander	Ambystoma tigrinum	Known to occur	Locally Common
Amphibians	Western Chorus Frog	Pseudacris triseriata	Known to occur	Common
Amphibians	Woodhouse's Toad	Bufo woodhousii	Known to occur	Common
Birds	Acorn Woodpecker	Melanerpes formicivorus	Known to occur	Casual/Accidental
Birds	American Avocet	Recurvirostra americana	Known to occur	Unknown
Birds	American Bittern	Botaurus lentiginosus	Known to occur	Unknown
Birds	American Coot	Fulica americana	Known to occur	Fairly Common
Birds	American Crow	Corvus brachyrhynchos	Known to occur	Fairly Common
Birds	American Dipper	Cinclus mexicanus	Known to occur	Uncommon
Birds	American Goldfinch	Carduelis tristis	Known to occur	Uncommon
Birds	American Kestrel	Falco sparverius	Known to occur	Fairly Common
Birds	American Peregrine Falcon	Falco peregrinus anatum	Known to occur	Rare
Birds	American Pipit	Anthus rubescens	Known to occur	Uncommon
Birds	American Redstart	Setophaga ruticilla	Known to occur	Unknown
Birds	American Robin	Turdus migratorius	Known to occur	Common
Birds	American Tree Sparrow	Spizella arborea	Known to occur	Unknown
Birds	American White Pelican	Pelecanus erythrorhynchos	Known to occur	Unknown
Birds	American Wigeon	Anas americana	Known to occur	Unknown
Birds	Ash-throated Flycatcher	Myiarchus cinerascens	Known to occur	Fairly Common
Birds	Baird's Sandpiper	Calidris bairdii	Known to occur	Unknown
Birds	Bald Eagle	Haliaeetus leucocephalus	Known to occur	Unknown
Birds	Band-tailed Pigeon	Columba fasciata	Known to occur	Uncommon
Birds	Bank Swallow	Riparia riparia	Known to occur	Common
Birds	Barn Owl	Tyto alba	Known to occur	Unknown
Birds	Barn Swallow	Hirundo rustica	Known to occur	Common
Birds	Barrow's Goldeneye	Bucephala islandica	Known to occur	Unknown
Birds	Belted Kingfisher	Ceryle alcyon	Known to occur	Fairly Common

Birds	Bewick's Wren	Thryomanes bewickii	Known to occur	Fairly Common
Birds	Black Phoebe	Sayornis nigricans	Known to occur	Unknown
Birds	Black Rosy Finch	Leucosticte atrata	Known to occur	Unknown
Birds	Black Swift	Cypseloides niger	Known to occur	Uncommon
Birds	Black Tern	Chlidonias niger	Known to occur	Unknown
Birds	Black-billed Magpie	Pica pica	Known to occur	Common
Birds	Black-capped Chickadee	Poecile atricapillus	Known to occur	Fairly Common
Birds	Black-chinned Hummingbird	Archilochus alexandri	Known to occur	Common
Birds	Black-crowned Night-Heron	Nycticorax nycticorax	Known to occur	Unknown
Birds	Black-headed Grosbeak	Pheucticus melanocephalus	Known to occur	Fairly Common
Birds	Black-necked Stilt	Himantopus mexicanus	Known to occur	Unknown
Birds	Black-throated Gray Warbler	Dendroica nigrescens	Known to occur	Fairly Common
Birds	Black-throated Sparrow	Amphispiza bilineata	Known to occur	Rare
Birds	Blue Grosbeak	Guiraca caerulea	Known to occur	Fairly Common
Birds	Blue Grouse	Dendragapus obscurus	Known to occur	Uncommon
Birds	Blue Jay	Cyanocitta cristata	Known to occur	Unknown
Birds	Blue-gray Gnatcatcher	Polioptila caerulea	Known to occur	Common
Birds	Blue-winged Teal	Anas discors	Known to occur	Unknown
Birds	Bobolink	Dolichonyx oryzivorus	Known to occur	Unknown
Birds	Bonaparte's Gull	Larus philadelphia	Likely to occur	No Occurrence
Birds	Boreal Owl	Aegolius funereus	Known to occur	Rare
Birds	Brewer's Blackbird	Euphagus cyanocephalus	Known to occur	Common
Birds	Brewer's Sparrow	Spizella breweri	Known to occur	Fairly Common
Birds	Broad-tailed Hummingbird	Selasphorus platycercus	Known to occur	Common
Birds	Brown Creeper	Certhia americana	Known to occur	Uncommon
Birds	Brown Thrasher	Toxostoma rufum	Known to occur	Unknown
Birds	Brown-capped Rosy Finch	Leucosticte australis	Known to occur	Uncommon
Birds	Brown-headed Cowbird	Molothrus ater	Known to occur	Common
Birds	Bufflehead	Bucephala albeola	Known to occur	Unknown
Birds	Bullock's Oriole	Icterus bullockii	Known to occur	Fairly Common
Birds	Bushtit	Psaltriparus minimus	Known to occur	Fairly Common
Birds	California Gull	Larus californicus	Known to occur	Unknown
Birds	Calliope Hummingbird	Stellula calliope	Known to occur	Unknown
Birds	Canada Goose	Branta canadensis	Known to occur	Fairly Common
Birds	Canvasback	Aythya valisineria	Known to occur	Unknown
Birds	Canyon Wren	Catherpes mexicanus	Known to occur	Uncommon
Birds	Cassin's Finch	Carpodacus cassinii	Known to occur	Uncommon

Birds	Cassin's Kingbird	Tyrannus vociferans	Known to occur	Fairly Common
Birds	Cattle Egret	Bubulcus ibis	Known to occur	Unknown
Birds	Cedar Waxwing	Bombycilla cedrorum	Known to occur	Rare
Birds	Chimney Swift	Chaetura pelagica	Known to occur	Unknown
Birds	Chipping Sparrow	Spizella passerina	Known to occur	Common
Birds	Cinnamon Teal	Anas cyanoptera	Known to occur	Uncommon
Birds	Clark's Grebe	Aechmophorus clarkii	Known to occur	Unknown
Birds	Clark's Nutcracker	Nucifraga columbiana	Known to occur	Fairly Common
Birds	Clay-colored Sparrow	Spizella pallida	Likely to occur	No Occurrence
Birds	Cliff Swallow	Petrochelidon pyrrhonota	Known to occur	Abundant
Birds	Common Goldeneye	Bucephala clangula	Known to occur	Unknown
Birds	Common Grackle	Quiscalus quiscula	Known to occur	Uncommon
Birds	Common Loon	Gavia immer	Known to occur	Unknown
Birds	Common Merganser	Mergus merganser	Known to occur	Rare
Birds	Common Nighthawk	Chordeiles minor	Known to occur	Common
Birds	Common Poorwill	Phalaenoptilus nuttallii	Known to occur	Uncommon
Birds	Common Raven	Corvus corax	Known to occur	Fairly Common
Birds	Common Redpoll	Carduelis flammea	Likely to occur	No Occurrence
Birds	Common Snipe	Gallinago gallinago	Known to occur	Uncommon
Birds	Common Yellowthroat	Geothlypis trichas	Known to occur	Fairly Common
Birds	Cooper's Hawk	Accipiter cooperii	Known to occur	Uncommon
Birds	Cordilleran Flycatcher	Empidonax occidentalis	Known to occur	Fairly Common
Birds	Dark-eyed Junco	Junco hyemalis	Known to occur	Common
Birds	Double-crested Cormorant	Phalacrocorax auritus	Known to occur	Unknown
Birds	Downy Woodpecker	Picoides pubescens	Known to occur	Uncommon
Birds	Dusky Flycatcher	Empidonax oberholseri	Known to occur	Fairly Common
Birds	Eared Grebe	Podiceps nigricollis	Known to occur	Unknown
Birds	Eastern Kingbird	Tyrannus tyrannus	Known to occur	Rare
Birds	Eastern Phoebe	Sayornis phoebe	Known to occur	Unknown
Birds	European Starling	Sturnus vulgaris	Known to occur	Abundant
Birds	Evening Grosbeak	Coccothraustes vespertinus	Known to occur	Fairly Common
Birds	Ferruginous Hawk	Buteo regalis	Known to occur	Unknown
Birds	Flammulated Owl	Otus flammeolus	Known to occur	Uncommon
Birds	Forster's Tern	Sterna forsteri	Known to occur	Unknown
Birds	Fox Sparrow	Passerella iliaca	Known to occur	Unknown
Birds	Franklin's Gull	Larus pipixcan	Likely to occur	No Occurrence
Birds	Gadwall	Anas strepera	Known to occur	Unknown

Birds	Gambel's Quail	Callipepla gambelii	Known to occur	Uncommon
Birds	Golden Eagle	Aquila chrysaetos	Known to occur	Uncommon
Birds	Golden-crowned Kinglet	Regulus satrapa	Known to occur	Uncommon
Birds	Grace's Warbler	Dendroica graciae	Known to occur	Uncommon
Birds	Gray Catbird	Dumetella carolinensis	Known to occur	Rare
Birds	Gray Flycatcher	Empidonax wrightii	Known to occur	Uncommon
Birds	Gray Jay	Perisoreus canadensis	Known to occur	Uncommon
Birds	Gray Vireo	Vireo vicinior	Known to occur	Rare
Birds	Gray-crowned Rosy Finch	Leucosticte tephrocotis	Known to occur	Unknown
Birds	Great Blue Heron	Ardea herodias	Known to occur	Rare
Birds	Great Egret	Ardea alba	Known to occur	Unknown
Birds	Great Horned Owl	Bubo virginianus	Known to occur	Uncommon
Birds	Greater Roadrunner	Geococcyx californianus	Known to occur	Very Rare
Birds	Greater Sandhill Crane	Grus canadensis tabida	Known to occur	Unknown
Birds	Great-tailed Grackle	Quiscalus mexicanus	Known to occur	Uncommon
Birds	Green Heron	Butorides virescens	Known to occur	Unknown
Birds	Green-tailed Towhee	Pipilo chlorurus	Known to occur	Common
Birds	Green-winged Teal	Anas crecca	Known to occur	Uncommon
Birds	Gunnison Sage Grouse	Centrocercus minimus	Known to occur	Casual/Accidental
Birds	Hairy Woodpecker	Picoides villosus	Known to occur	Uncommon
Birds	Hammond's Flycatcher	Empidonax hammondii	Known to occur	Uncommon
Birds	Harris' Sparrow	Zonotrichia querula	Likely to occur	No Occurrence
Birds	Hermit Thrush	Catharus guttatus	Known to occur	Common
Birds	Hooded Merganser	Lophodytes cucullatus	Known to occur	Unknown
Birds	Horned Grebe	Podiceps auritus	Likely to occur	No Occurrence
Birds	Horned Lark	Eremophila alpestris	Known to occur	Uncommon
Birds	House Finch	Carpodacus mexicanus	Known to occur	Common
Birds	House Sparrow	Passer domesticus	Known to occur	Abundant
Birds	House Wren	Troglodytes aedon	Known to occur	Common
Birds	Indigo Bunting	Passerina cyanea	Known to occur	Rare
Birds	Juniper Titmouse	Baeolophus griseus	Known to occur	Fairly Common
Birds	Killdeer	Charadrius vociferus	Known to occur	Fairly Common
Birds	Lapland Longspur	Calcarius lapponicus	Known to occur	Unknown
Birds	Lark Bunting	Calamospiza melanocorys	Known to occur	Casual/Accidental
Birds	Lark Sparrow	Chondestes grammacus	Known to occur	Fairly Common
Birds	Lazuli Bunting	Passerina amoena	Known to occur	Fairly Common
Birds	Least Sandpiper	Calidris minutilla	Likely to occur	No Occurrence

Birds	Lesser Goldfinch	Carduelis psaltria	Known to occur	Fairly Common
Birds	Lesser Scaup	Aythya affinis	Known to occur	Unknown
Birds	Lewis' Woodpecker	Melanerpes lewis	Known to occur	Uncommon
Birds	Lincoln's Sparrow	Melospiza lincolnii	Known to occur	Fairly Common
Birds	Loggerhead Shrike	Lanius ludovicianus	Known to occur	Unknown
Birds	Long-billed Curlew	Numenius americanus	Known to occur	Unknown
Birds	Long-eared Owl	Asio otus	Known to occur	Uncommon
Birds	MacGillivray's Warbler	Oporornis tolmiei	Known to occur	Uncommon
Birds	Mallard	Anas platyrhynchos	Known to occur	Common
Birds	Marsh Wren	Cistothorus palustris	Known to occur	Unknown
Birds	Mexican Spotted Owl	Strix occidentalis lucida	Known to occur	Unknown
Birds	Mountain Bluebird	Sialia currucoides	Known to occur	Fairly Common
Birds	Mountain Chickadee	Poecile gambeli	Known to occur	Common
Birds	Mourning Dove	Zenaida macroura	Known to occur	Common
Birds	Nashville Warbler	Vermivora ruficapilla	Known to occur	Unknown
Birds	Northern Flicker	Colaptes auratus	Known to occur	Fairly Common
Birds	Northern Goshawk	Accipiter gentilis	Known to occur	Rare
Birds	Northern Harrier	Circus cyaneus	Known to occur	Rare
Birds	Northern Mockingbird	Mimus polyglottos	Known to occur	Rare
Birds	Northern Pintail	Anas acuta	Known to occur	Unknown
Birds	Northern Pygmy-Owl	Glaucidium gnoma	Known to occur	Rare
Birds	Northern Rough-winged Swallow	Stelgidopteryx serripennis	Known to occur	Fairly Common
Birds	Northern Saw-whet Owl	Aegolius acadicus	Known to occur	Uncommon
Birds	Northern Shoveler	Anas clypeata	Known to occur	Unknown
Birds	Northern Waterthrush	Seiurus noveboracensis	Known to occur	Unknown
Birds	Olive-sided Flycatcher	Contopus cooperi	Known to occur	Uncommon
Birds	Orange-crowned Warbler	Vermivora celata	Known to occur	Fairly Common
Birds	Osprey	Pandion haliaetus	Known to occur	Rare
Birds	Pacific Loon	Gavia pacifica	Likely to occur	No Occurrence
Birds	Peregrine Falcon	Falco peregrinus	Known to occur	Rare
Birds	Pied-billed Grebe	Podilymbus podiceps	Known to occur	Uncommon
Birds	Pine Grosbeak	Pinicola enucleator	Known to occur	Uncommon
Birds	Pine Siskin	Carduelis pinus	Known to occur	Common
Birds	Pinyon Jay	Gymnorhinus cyanocephalus	Known to occur	Fairly Common
Birds	Plumbeous Vireo	Vireo plumbeus	Known to occur	Fairly Common
Birds	Prairie Falcon	Falco mexicanus	Known to occur	Uncommon
Birds	Purple Martin	Progne subis	Known to occur	Rare

Birds	Pygmy Nuthatch	Sitta pygmaea	Known to occur	Fairly Common
Birds	Red Crossbill	Loxia curvirostra	Known to occur	Uncommon
Birds	Red-breasted Nuthatch	Sitta canadensis	Known to occur	Fairly Common
Birds	Red-eyed Vireo	Vireo olivaceus	Known to occur	Unknown
Birds	Redhead	Aythya americana	Known to occur	Unknown
Birds	Red-headed Woodpecker	Melanerpes erythrocephalus	Known to occur	Unknown
Birds	Red-naped Sapsucker	Sphyrapicus nuchalis	Known to occur	Uncommon
Birds	Red-necked Phalarope	Phalaropus lobatus	Likely to occur	No Occurrence
Birds	Red-tailed Hawk	Buteo jamaicensis	Known to occur	Fairly Common
Birds	Red-winged Blackbird	Agelaius phoeniceus	Known to occur	Abundant
Birds	Ring-billed Gull	Larus delawarensis	Known to occur	Unknown
Birds	Ring-necked Duck	Aythya collaris	Known to occur	Unknown
Birds	Ring-necked Pheasant	Phasianus colchicus	Known to occur	Uncommon
Birds	Rock Dove	Columba livia	Known to occur	Common
Birds	Rock Wren	Salpinctes obsoletus	Known to occur	Fairly Common
Birds	Rose-breasted Grosbeak	Pheucticus ludovicianus	Known to occur	Unknown
Birds	Rough-legged Hawk	Buteo lagopus	Known to occur	Unknown
Birds	Ruby-crowned Kinglet	Regulus calendula	Known to occur	Common
Birds	Ruddy Duck	Oxyura jamaicensis	Known to occur	Rare
Birds	Rufous Hummingbird	Selasphorus rufus	Known to occur	Unknown
Birds	Sabine's Gull	Xema sabini	Likely to occur	No Occurrence
Birds	Sage Grouse	Centrocercus urophasianus	Known to occur	Unknown
Birds	Sage Sparrow	Amphispiza belli	Known to occur	Casual/Accidental
Birds	Sage Thrasher	Oreoscoptes montanus	Known to occur	Rare
Birds	Sandhill Crane	Grus canadensis	Known to occur	Unknown
Birds	Savannah Sparrow	Passerculus sandwichensis	Known to occur	Unknown
Birds	Say's Phoebe	Sayornis saya	Known to occur	Fairly Common
Birds	Scissor-tailed Flycatcher	Tyrannus forficatus	Known to occur	Unknown
Birds	Semipalmated Sandpiper	Calidris pusilla	Likely to occur	No Occurrence
Birds	Sharp-shinned Hawk	Accipiter striatus	Known to occur	Uncommon
Birds	Short-eared Owl	Asio flammeus	Known to occur	Unknown
Birds	Snowy Egret	Egretta thula	Known to occur	Unknown
Birds	Snowy Plover	Charadrius alexandrinus	Known to occur	Unknown
Birds	Solitary Sandpiper	Tringa solitaria	Known to occur	Unknown
Birds	Song Sparrow	Melospiza melodia	Known to occur	Fairly Common
Birds	Sora	Porzana carolina	Known to occur	Uncommon
Birds	Southwestern Willow Flycatcher	Empidonax traillii extimus	Known to occur	Uncommon

Birds	Spotted Owl	Strix occidentalis	Known to occur	Unknown
Birds	Spotted Sandpiper	Actitis macularia	Known to occur	Fairly Common
Birds	Spotted Towhee	Pipilo maculatus	Known to occur	Common
Birds	Steller's Jay	Cyanocitta stelleri	Known to occur	Fairly Common
Birds	Summer Tanager	Piranga rubra	Likely to occur	No Occurrence
Birds	Swainson's Hawk	Buteo swainsoni	Known to occur	Rare
Birds	Swainson's Thrush	Catharus ustulatus	Known to occur	Rare
Birds	Three-toed Woodpecker	Picoides tridactylus	Known to occur	Uncommon
Birds	Townsend's Solitaire	Myadestes townsendi	Known to occur	Uncommon
Birds	Townsend's Warbler	Dendroica townsendi	Likely to occur	No Occurrence
Birds	Tree Swallow	Tachycineta bicolor	Known to occur	Common
Birds	Tundra Swan	Cygnus columbianus	Likely to occur	No Occurrence
Birds	Turkey Vulture	Cathartes aura	Known to occur	Common
Birds	Vermilion Flycatcher	Pyrocephalus rubinus	Known to occur	Unknown
Birds	Vesper Sparrow	Pooecetes gramineus	Known to occur	Common
Birds	Violet-green Swallow	Tachycineta thalassina	Known to occur	Common
Birds	Virginia Rail	Rallus limicola	Known to occur	Uncommon
Birds	Virginia's Warbler	Vermivora virginiae	Known to occur	Fairly Common
Birds	Warbling Vireo	Vireo gilvus	Known to occur	Common
Birds	Western Bluebird	Sialia mexicana	Known to occur	Fairly Common
Birds	Western Burrowing Owl	Athene cunicularia	Known to occur	Casual/Accidental
Birds	Western Grebe	Aechmophorus occidentalis	Known to occur	Unknown
Birds	Western Kingbird	Tyrannus verticalis	Known to occur	Fairly Common
Birds	Western Meadowlark	Sturnella neglecta	Known to occur	Abundant
Birds	Western Sandpiper	Calidris mauri	Likely to occur	No Occurrence
Birds	Western Screech-Owl	Otus kennicottii	Known to occur	Rare
Birds	Western Scrub Jay	Aphelocoma californica	Known to occur	Fairly Common
Birds	Western Snowy Plover	Charadrius alexandrinus nivosus	Known to occur	Unknown
Birds	Western Tanager	Piranga ludoviciana	Known to occur	Fairly Common
Birds	Western Wood-Pewee	Contopus sordidulus	Known to occur	Fairly Common
Birds	White-breasted Nuthatch	Sitta carolinensis	Known to occur	Fairly Common
Birds	White-crowned Sparrow	Zonotrichia leucophrys	Known to occur	Common
Birds	White-faced Ibis	Plegadis chihi	Known to occur	Unknown
Birds	White-rumped Sandpiper	Calidris fuscicollis	Likely to occur	No Occurrence
Birds	White-tailed Ptarmigan	Lagopus leucurus	Known to occur	Rare
Birds	White-throated Sparrow	Zonotrichia albicollis	Likely to occur	No Occurrence
Birds	White-throated Swift	Aeronautes saxatalis	Known to occur	Fairly Common

Birds	Wild Turkey	Meleagris gallopavo	Known to occur	Uncommon
Birds	Willet	Catoptrophorus semipalmatus	Known to occur	Unknown
Birds	Williamson's Sapsucker	Sphyrapicus thyroideus	Known to occur	Uncommon
Birds	Willow Flycatcher	Empidonax traillii	Known to occur	Uncommon
Birds	Wilson's Phalarope	Phalaropus tricolor	Known to occur	Rare
Birds	Wilson's Warbler	Wilsonia pusilla	Known to occur	Fairly Common
Birds	Wood Duck	Aix sponsa	Known to occur	Unknown
Birds	Yellow Warbler	Dendroica petechia	Known to occur	Fairly Common
Birds	Yellow-billed Cuckoo	Coccyzus americanus	Known to occur	Very Rare
Birds	Yellow-breasted Chat	Icteria virens	Known to occur	Fairly Common
Birds	Yellow-headed Blackbird	Xanthocephalus xanthocephalus	Known to occur	Common
Birds	Yellow-rumped Warbler	Dendroica coronata	Known to occur	Common
Mammals	Abert's Squirrel	Sciurus aberti	Known to occur	Fairly Common
Mammals	American Badger	Taxidea taxus	Known to occur	Uncommon
Mammals	American Beaver	Castor canadensis	Known to occur	Fairly Common
Mammals	American Elk	Cervus elaphus	Known to occur	Abundant
Mammals	American Marten	Martes americana	Known to occur	Uncommon
Mammals	American Pika	Ochotona princeps	Known to occur	Fairly Common
Mammals	Big Brown Bat	Eptesicus fuscus	Known to occur	Abundant
Mammals	Big Free-tailed Bat	Nyctinomops macrotis	Likely to occur	Unknown
Mammals	Bighorn Sheep	Ovis canadensis	Known to occur	Fairly Common
Mammals	Black Bear	Ursus americanus	Known to occur	Common
Mammals	Black-footed Ferret	Mustela nigripes	Known to occur	Extirpated
Mammals	Black-tailed Jackrabbit	Lepus californicus	Known to occur	Uncommon
Mammals	Bobcat	Lynx rufus	Known to occur	Uncommon
Mammals	Botta's Pocket Gopher	Thomomys bottae	Known to occur	Fairly Common
Mammals	Brazilian Free-tailed Bat	Tadarida brasiliensis	Known to occur	Unknown
Mammals	Brush Mouse	Peromyscus boylii	Known to occur	Fairly Common
Mammals	Bushy-tailed Woodrat	Neotoma cinerea	Known to occur	Fairly Common
Mammals	California Myotis	Myotis californicus	Known to occur	Fairly Common
Mammals	Colorado Chipmunk	Tamias quadrivittatus	Known to occur	Fairly Common
Mammals	Common Muskrat	Ondatra zibethicus	Known to occur	Common
Mammals	Common Porcupine	Erethizon dorsatum	Known to occur	Uncommon
Mammals	Coyote	Canis latrans	Known to occur	Common
Mammals	Deer Mouse	Peromyscus maniculatus	Known to occur	Abundant
Mammals	Desert Cottontail	Sylvilagus audubonii	Known to occur	Fairly Common
Mammals	Dwarf Shrew	Sorex nanus	Known to occur	Rare

Mammals	Ermine	Mustela erminea	Known to occur	Uncommon
Mammals	Fringed Myotis	Myotis thysanodes	Known to occur	Rare
Mammals	Golden-mantled Ground Squirrel	Spermophilus lateralis	Known to occur	Fairly Common
Mammals	Gray Fox	Urocyon cinereoargenteus	Known to occur	Uncommon
Mammals	Gunnison's Prairie Dog	Cynomys gunnisoni	Known to occur	Fairly Common
Mammals	Hoary Bat	Lasiurus cinereus	Known to occur	Common
Mammals	House Mouse	Mus musculus	Known to occur	Abundant
Mammals	Least Chipmunk	Tamias minimus	Known to occur	Common
Mammals	Little Brown Myotis	Myotis lucifugus	Known to occur	Abundant
Mammals	Long-eared Myotis	Myotis evotis	Known to occur	Fairly Common
Mammals	Long-legged Myotis	Myotis volans	Known to occur	Common
Mammals	Long-tailed Vole	Microtus longicaudus	Known to occur	Fairly Common
Mammals	Long-tailed Weasel	Mustela frenata	Known to occur	Uncommon
Mammals	Lynx	Lynx canadensis	Known to occur	Very Rare
Mammals	Masked Shrew	Sorex cinereus	Likely to occur	Unknown
Mammals	Mexican Woodrat	Neotoma mexicana	Known to occur	Fairly Common
Mammals	Mink	Mustela vison	Known to occur	Uncommon
Mammals	Montane Vole	Microtus montanus	Known to occur	Common
Mammals	Moose	Alces alces	Known to occur	Rare
Mammals	Mountain Cottontail	Sylvilagus nuttallii	Known to occur	Fairly Common
Mammals	Mountain Lion	Felis concolor	Known to occur	Uncommon
Mammals	Mule Deer	Odocoileus hemionus	Known to occur	Abundant
Mammals	Northern Pocket Gopher	Thomomys talpoides	Known to occur	Common
Mammals	Northern River Otter	Lutra canadensis	Known to occur	Rare
Mammals	Pallid Bat	Antrozous pallidus	Likely to occur	Unknown
Mammals	Pine Squirrel	Tamiasciurus hudsonicus	Likely to occur	Unknown
Mammals	Pinyon Mouse	Peromyscus truei	Known to occur	Common
Mammals	Plains Pocket Mouse	Perognathus flavescens	Known to occur	Unknown
Mammals	Raccoon	Procyon lotor	Known to occur	Fairly Common
Mammals	Red Fox	Vulpes vulpes	Known to occur	Fairly Common
Mammals	Ringtail	Bassariscus astutus	Known to occur	Rare
Mammals	Rock Squirrel	Spermophilus variegatus	Known to occur	Fairly Common
Mammals	Silver-haired Bat	Lasionycteris noctivagans	Known to occur	Common
Mammals	Snowshoe Hare	Lepus americanus	Known to occur	Fairly Common
Mammals	Southern Red-backed Vole	Clethrionomys gapperi	Known to occur	Fairly Common
Mammals	Striped Skunk	Mephitis mephitis	Known to occur	Fairly Common
Mammals	Townsend's Big-eared Bat	Plecotus townsendii	Known to occur	Uncommon

Mammals	Water Shrew	Sorex palustris	Known to occur	Uncommon
Mammals	Western Harvest Mouse	Reithrodontomys megalotis	Known to occur	Fairly Common
Mammals	Western Jumping Mouse	Zapus princeps	Known to occur	Fairly Common
Mammals	Western Pipistrelle	Pipistrellus hesperus	Known to occur	Fairly Common
Mammals	Western Small-footed Myotis	Myotis ciliolabrum	Known to occur	Common
Mammals	White-tailed Jackrabbit	Lepus townsendii	Known to occur	Fairly Common
Mammals	White-throated Woodrat	Neotoma albigula	Known to occur	Fairly Common
Mammals	Wolverine	Gulo gulo	Known to occur	Extirpated
Mammals	Yuma Myotis	Myotis yumanensis	Known to occur	Fairly Common
Reptiles	Blackneck Garter Snake	Thamnophis cyrtopsis	Known to occur	Rare
Reptiles	Collared Lizard	Crotaphytus collaris	Known to occur	Uncommon
Reptiles	Fence Lizard	Sceloporus undulatus	Known to occur	Common
Reptiles	Gopher Snake	Pituophis catenifer	Known to occur	Uncommon
Reptiles	Many-lined Skink	Eumeces multivirgatus	Known to occur	Fairly Common
Reptiles	Midget Faded Rattlesnake	Crotalus viridis concolor	Known to occur	Uncommon
Reptiles	Milk Snake	Lampropeltis triangulum	Known to occur	Rare
Reptiles	Painted Turtle	Chrysemys picta	Known to occur	Fairly Common
Reptiles	Plateau Striped Whiptail	Cnemidophorus velox	Known to occur	Common
Reptiles	Racer	Coluber constrictor	Known to occur	Rare
Reptiles	Sagebrush Lizard	Sceloporus graciosus	Known to occur	Common
Reptiles	Short-horned Lizard	Phrynosoma hernandesi	Known to occur	Fairly Common
Reptiles	Side-blotched Lizard	Uta stansburiana	Likely to occur	Unknown
Reptiles	Smooth Green Snake	Liochlorophis vernalis	Known to occur	Uncommon
Reptiles	Striped Whipsnake	Masticophis taeniatus	Known to occur	Uncommon
Reptiles	Tree Lizard	Urosaurus ornatus	Known to occur	Uncommon
Reptiles	Variable Skink	Eumeces gaigeae	Known to occur	Fairly Common
Reptiles	Western Rattlesnake	Crotalus viridis	Known to occur	Uncommon
Reptiles	Western Terrestrial Garter Snake	Thamnophis elegans	Known to occur	Fairly Common
Reptiles	Western Whiptail	Cnemidophorus tigris	Likely to occur	Unknown

San Juan county
Known or Likely Species Occurrence

Group	Common Name	Scientific Name	Occurence	Abundance
Amphibians	Boreal Toad	Bufo boreas	Likely to occur	Unknown
Amphibians	Bullfrog	Rana catesbeiana	Likely to occur	Unknown
Amphibians	Northern Leopard Frog	Rana pipiens	Known to occur	Unknown
Amphibians	Tiger Salamander	Ambystoma tigrinum	Known to occur	Locally Common
Amphibians	Western Chorus Frog	Pseudacris triseriata	Known to occur	Common
Amphibians	Woodhouse's Toad	Bufo woodhousii	Likely to occur	Unknown
Birds	American Coot	Fulica americana	Known to occur	Uncommon
Birds	American Crow	Corvus brachyrhynchos	Known to occur	Uncommon
Birds	American Dipper	Cinclus mexicanus	Known to occur	Uncommon
Birds	American Goldfinch	Carduelis tristis	Known to occur	Unknown
Birds	American Kestrel	Falco sparverius	Known to occur	Rare
Birds	American Peregrine Falcon	Falco peregrinus anatum	Known to occur	Unknown
Birds	American Pipit	Anthus rubescens	Known to occur	Fairly Common
Birds	American Robin	Turdus migratorius	Known to occur	Common
Birds	American Tree Sparrow	Spizella arborea	Known to occur	Unknown
Birds	Baird's Sandpiper	Calidris bairdii	Likely to occur	No Occurrence
Birds	Band-tailed Pigeon	Columba fasciata	Known to occur	Unknown
Birds	Belted Kingfisher	Ceryle alcyon	Known to occur	Uncommon
Birds	Black Rosy Finch	Leucosticte atrata	Known to occur	Unknown
Birds	Black Swift	Cypseloides niger	Known to occur	Uncommon
Birds	Black-billed Magpie	Pica pica	Known to occur	Fairly Common
Birds	Black-capped Chickadee	Poecile atricapillus	Known to occur	Fairly Common
Birds	Black-crowned Night-Heron	Nycticorax nycticorax	Known to occur	Unknown
Birds	Black-headed Grosbeak	Pheucticus melanocephalus	Known to occur	Fairly Common
Birds	Blue Grouse	Dendragapus obscurus	Known to occur	Uncommon
Birds	Bonaparte's Gull	Larus philadelphia	Known to occur	Unknown
Birds	Boreal Owl	Aegolius funereus	Known to occur	Rare
Birds	Brewer's Blackbird	Euphagus cyanocephalus	Known to occur	Fairly Common
Birds	Brewer's Sparrow	Spizella breweri	Known to occur	Uncommon
Birds	Broad-tailed Hummingbird	Selasphorus platycercus	Known to occur	Common
Birds	Brown Creeper	Certhia americana	Known to occur	Uncommon
Birds	Brown-capped Rosy Finch	Leucosticte australis	Known to occur	Fairly Common
Birds	Brown-headed Cowbird	Molothrus ater	Known to occur	Common

Birds	Bullock's Oriole	Icterus bullockii	Known to occur	Unknown
Birds	Calliope Hummingbird	Stellula calliope	Likely to occur	No Occurrence
Birds	Canada Goose	Branta canadensis	Known to occur	Unknown
Birds	Cassin's Finch	Carpodacus cassinii	Known to occur	Fairly Common
Birds	Cedar Waxwing	Bombycilla cedrorum	Known to occur	Unknown
Birds	Chipping Sparrow	Spizella passerina	Known to occur	Common
Birds	Clark's Nutcracker	Nucifraga columbiana	Known to occur	Fairly Common
Birds	Clay-colored Sparrow	Spizella pallida	Likely to occur	No Occurrence
Birds	Cliff Swallow	Petrochelidon pyrrhonota	Known to occur	Abundant
Birds	Common Goldeneye	Bucephala clangula	Known to occur	Unknown
Birds	Common Loon	Gavia immer	Known to occur	Unknown
Birds	Common Merganser	Mergus merganser	Known to occur	Unknown
Birds	Common Nighthawk	Chordeiles minor	Known to occur	Unknown
Birds	Common Raven	Corvus corax	Known to occur	Fairly Common
Birds	Common Redpoll	Carduelis flammea	Likely to occur	No Occurrence
Birds	Common Snipe	Gallinago gallinago	Known to occur	Unknown
Birds	Cooper's Hawk	Accipiter cooperii	Known to occur	Rare
Birds	Cordilleran Flycatcher	Empidonax occidentalis	Known to occur	Fairly Common
Birds	Dark-eyed Junco	Junco hyemalis	Known to occur	Common
Birds	Downy Woodpecker	Picoides pubescens	Known to occur	Uncommon
Birds	Dusky Flycatcher	Empidonax oberholseri	Known to occur	Fairly Common
Birds	Eared Grebe	Podiceps nigricollis	Known to occur	Unknown
Birds	European Starling	Sturnus vulgaris	Known to occur	Uncommon
Birds	Evening Grosbeak	Coccothraustes vespertinus	Known to occur	Fairly Common
Birds	Flammulated Owl	Otus flammeolus	Known to occur	Unknown
Birds	Fox Sparrow	Passerella iliaca	Known to occur	Uncommon
Birds	Franklin's Gull	Larus pipixcan	Likely to occur	No Occurrence
Birds	Golden Eagle	Aquila chrysaetos	Known to occur	Rare
Birds	Golden-crowned Kinglet	Regulus satrapa	Known to occur	Uncommon
Birds	Gray Catbird	Dumetella carolinensis	Known to occur	Unknown
Birds	Gray Jay	Perisoreus canadensis	Known to occur	Uncommon
Birds	Gray-crowned Rosy Finch	Leucosticte tephrocotis	Likely to occur	No Occurrence
Birds	Great Blue Heron	Ardea herodias	Known to occur	Unknown
Birds	Great Horned Owl	Bubo virginianus	Known to occur	Uncommon
Birds	Greater Scaup	Aythya marila	Known to occur	Unknown
Birds	Green-winged Teal	Anas crecca	Known to occur	Uncommon
Birds	Hairy Woodpecker	Picoides villosus	Known to occur	Uncommon

Birds	Hammond's Flycatcher	Empidonax hammondii	Known to occur	Uncommon
Birds	Harris' Sparrow	Zonotrichia querula	Likely to occur	No Occurrence
Birds	Hermit Thrush	Catharus guttatus	Known to occur	Common
Birds	Horned Grebe	Podiceps auritus	Likely to occur	No Occurrence
Birds	Horned Lark	Eremophila alpestris	Known to occur	Uncommon
Birds	House Finch	Carpodacus mexicanus	Known to occur	Uncommon
Birds	House Sparrow	Passer domesticus	Known to occur	Uncommon
Birds	House Wren	Troglodytes aedon	Known to occur	Common
Birds	Juniper Titmouse	Baeolophus griseus	Known to occur	Unknown
Birds	Killdeer	Charadrius vociferus	Known to occur	Fairly Common
Birds	Lazuli Bunting	Passerina amoena	Known to occur	Rare
Birds	Least Sandpiper	Calidris minutilla	Likely to occur	No Occurrence
Birds	Lesser Goldfinch	Carduelis psaltria	Known to occur	Unknown
Birds	Lincoln's Sparrow	Melospiza lincolnii	Known to occur	Common
Birds	Loggerhead Shrike	Lanius ludovicianus	Known to occur	Unknown
Birds	Long-eared Owl	Asio otus	Known to occur	Unknown
Birds	MacGillivray's Warbler	Oporornis tolmiei	Known to occur	Uncommon
Birds	Mallard	Anas platyrhynchos	Known to occur	Common
Birds	Marsh Wren	Cistothorus palustris	Known to occur	Unknown
Birds	Mountain Bluebird	Sialia currucoides	Known to occur	Fairly Common
Birds	Mountain Chickadee	Poecile gambeli	Known to occur	Common
Birds	Mourning Dove	Zenaida macroura	Known to occur	Uncommon
Birds	Northern Flicker	Colaptes auratus	Known to occur	Fairly Common
Birds	Northern Goshawk	Accipiter gentilis	Known to occur	Rare
Birds	Northern Harrier	Circus cyaneus	Known to occur	Unknown
Birds	Northern Pintail	Anas acuta	Known to occur	Unknown
Birds	Northern Rough-winged Swallow	Stelgidopteryx serripennis	Known to occur	Rare
Birds	Northern Saw-whet Owl	Aegolius acadicus	Known to occur	Unknown
Birds	Olive-sided Flycatcher	Contopus cooperi	Known to occur	Uncommon
Birds	Orange-crowned Warbler	Vermivora celata	Known to occur	Fairly Common
Birds	Pacific Loon	Gavia pacifica	Likely to occur	No Occurrence
Birds	Peregrine Falcon	Falco peregrinus	Known to occur	Unknown
Birds	Pied-billed Grebe	Podilymbus podiceps	Known to occur	Unknown
Birds	Pine Grosbeak	Pinicola enucleator	Known to occur	Fairly Common
Birds	Pine Siskin	Carduelis pinus	Known to occur	Common
Birds	Pinyon Jay	Gymnorhinus cyanocephalus	Known to occur	Unknown
Birds	Plumbeous Vireo	Vireo plumbeus	Known to occur	Rare

Birds	Prairie Falcon	Falco mexicanus	Known to occur	Uncommon
Birds	Pygmy Nuthatch	Sitta pygmaea	Known to occur	Uncommon
Birds	Red Crossbill	Loxia curvirostra	Known to occur	Uncommon
Birds	Red-breasted Nuthatch	Sitta canadensis	Known to occur	Uncommon
Birds	Red-naped Sapsucker	Sphyrapicus nuchalis	Known to occur	Uncommon
Birds	Red-necked Phalarope	Phalaropus lobatus	Likely to occur	No Occurrence
Birds	Red-tailed Hawk	Buteo jamaicensis	Known to occur	Uncommon
Birds	Red-winged Blackbird	Agelaius phoeniceus	Known to occur	Common
Birds	Ring-billed Gull	Larus delawarensis	Known to occur	Unknown
Birds	Ring-necked Duck	Aythya collaris	Known to occur	Rare
Birds	Rock Dove	Columba livia	Known to occur	Unknown
Birds	Rock Wren	Salpinctes obsoletus	Known to occur	Rare
Birds	Rough-legged Hawk	Buteo lagopus	Known to occur	Unknown
Birds	Ruby-crowned Kinglet	Regulus calendula	Known to occur	Common
Birds	Ruddy Duck	Oxyura jamaicensis	Known to occur	Unknown
Birds	Rufous Hummingbird	Selasphorus rufus	Known to occur	Unknown
Birds	Sabine's Gull	Xema sabini	Likely to occur	No Occurrence
Birds	Sage Thrasher	Oreoscoptes montanus	Known to occur	Unknown
Birds	Semipalmated Sandpiper	Calidris pusilla	Likely to occur	No Occurrence
Birds	Sharp-shinned Hawk	Accipiter striatus	Known to occur	Uncommon
Birds	Solitary Sandpiper	Tringa solitaria	Likely to occur	No Occurrence
Birds	Song Sparrow	Melospiza melodia	Known to occur	Fairly Common
Birds	Sora	Porzana carolina	Known to occur	Unknown
Birds	Southwestern Willow Flycatcher	Empidonax traillii extimus	Known to occur	Uncommon
Birds	Spotted Sandpiper	Actitis macularia	Known to occur	Uncommon
Birds	Steller's Jay	Cyanocitta stelleri	Known to occur	Fairly Common
Birds	Swainson's Thrush	Catharus ustulatus	Known to occur	Rare
Birds	Three-toed Woodpecker	Picoides tridactylus	Known to occur	Uncommon
Birds	Townsend's Solitaire	Myadestes townsendi	Known to occur	Uncommon
Birds	Tree Swallow	Tachycineta bicolor	Known to occur	Common
Birds	Tundra Swan	Cygnus columbianus	Likely to occur	No Occurrence
Birds	Turkey Vulture	Cathartes aura	Known to occur	Rare
Birds	Varied Thrush	Ixoreus naevius	Likely to occur	No Occurrence
Birds	Vesper Sparrow	Pooecetes gramineus	Known to occur	Unknown
Birds	Violet-green Swallow	Tachycineta thalassina	Known to occur	Common
Birds	Virginia's Warbler	Vermivora virginiae	Known to occur	Uncommon
Birds	Warbling Vireo	Vireo gilvus	Known to occur	Common

Birds	Western Bluebird	Sialia mexicana	Known to occur	Rare
Birds	Western Meadowlark	Sturnella neglecta	Known to occur	Unknown
Birds	Western Sandpiper	Calidris mauri	Likely to occur	No Occurrence
Birds	Western Tanager	Piranga ludoviciana	Known to occur	Uncommon
Birds	Western Wood-Pewee	Contopus sordidulus	Known to occur	Fairly Common
Birds	White-breasted Nuthatch	Sitta carolinensis	Known to occur	Uncommon
Birds	White-crowned Sparrow	Zonotrichia leucophrys	Known to occur	Common
Birds	White-faced Ibis	Plegadis chihi	Known to occur	Unknown
Birds	White-tailed Ptarmigan	Lagopus leucurus	Known to occur	Uncommon
Birds	White-throated Sparrow	Zonotrichia albicollis	Likely to occur	No Occurrence
Birds	White-throated Swift	Aeronautes saxatalis	Known to occur	Common
Birds	White-winged Crossbill	Loxia leucoptera	Known to occur	Unknown
Birds	Williamson's Sapsucker	Sphyrapicus thyroideus	Known to occur	Uncommon
Birds	Willow Flycatcher	Empidonax traillii	Known to occur	Uncommon
Birds	Wilson's Warbler	Wilsonia pusilla	Known to occur	Common
Birds	Wood Thrush	Hylocichla mustelina	Likely to occur	No Occurrence
Birds	Yellow Warbler	Dendroica petechia	Known to occur	Unknown
Birds	Yellow-rumped Warbler	Dendroica coronata	Known to occur	Common
Mammals	American Badger	Taxidea taxus	Known to occur	Uncommon
Mammals	American Beaver	Castor canadensis	Known to occur	Fairly Common
Mammals	American Elk	Cervus elaphus	Known to occur	Abundant
Mammals	American Marten	Martes americana	Known to occur	Uncommon
Mammals	American Pika	Ochotona princeps	Known to occur	Common
Mammals	Big Brown Bat	Eptesicus fuscus	Likely to occur	Unknown
Mammals	Bighorn Sheep	Ovis canadensis	Known to occur	Fairly Common
Mammals	Black Bear	Ursus americanus	Known to occur	Common
Mammals	Bobcat	Lynx rufus	Known to occur	Uncommon
Mammals	Bushy-tailed Woodrat	Neotoma cinerea	Known to occur	Fairly Common
Mammals	Colorado Chipmunk	Tamias quadrivittatus	Known to occur	Fairly Common
Mammals	Common Muskrat	Ondatra zibethicus	Known to occur	Common
Mammals	Common Porcupine	Erethizon dorsatum	Known to occur	Uncommon
Mammals	Coyote	Canis latrans	Known to occur	Fairly Common
Mammals	Deer Mouse	Peromyscus maniculatus	Known to occur	Abundant
Mammals	Ermine	Mustela erminea	Known to occur	Uncommon
Mammals	Golden-mantled Ground Squirrel	Spermophilus lateralis	Known to occur	Fairly Common
Mammals	Hoary Bat	Lasiurus cinereus	Likely to occur	Unknown
Mammals	House Mouse	Mus musculus	Known to occur	Abundant

Mammals	Little Brown Myotis	Myotis lucifugus	Likely to occur	Unknown
Mammals	Long-eared Myotis	Myotis evotis	Known to occur	Fairly Common
Mammals	Long-legged Myotis	Myotis volans	Known to occur	Common
Mammals	Long-tailed Vole	Microtus longicaudus	Known to occur	Fairly Common
Mammals	Long-tailed Weasel	Mustela frenata	Known to occur	Uncommon
Mammals	Lynx	Lynx canadensis	Known to occur	Very Rare
Mammals	Masked Shrew	Sorex cinereus	Known to occur	Fairly Common
Mammals	Mink	Mustela vison	Known to occur	Uncommon
Mammals	Montane Shrew	Sorex monticolus	Known to occur	Common
Mammals	Montane Vole	Microtus montanus	Known to occur	Common
Mammals	Moose	Alces alces	Known to occur	Uncommon
Mammals	Mountain Cottontail	Sylvilagus nuttallii	Known to occur	Fairly Common
Mammals	Mountain Goat	Oreamnos americanus	Known to occur	Fairly Common
Mammals	Mountain Lion	Felis concolor	Known to occur	Uncommon
Mammals	Mule Deer	Odocoileus hemionus	Known to occur	Abundant
Mammals	Northern Pocket Gopher	Thomomys talpoides	Known to occur	Common
Mammals	Pine Squirrel	Tamiasciurus hudsonicus	Known to occur	Fairly Common
Mammals	Raccoon	Procyon lotor	Likely to occur	Unknown
Mammals	Red Fox	Vulpes vulpes	Known to occur	Uncommon
Mammals	Silver-haired Bat	Lasionycteris noctivagans	Likely to occur	Unknown
Mammals	Snowshoe Hare	Lepus americanus	Known to occur	Fairly Common
Mammals	Southern Red-backed Vole	Clethrionomys gapperi	Known to occur	Fairly Common
Mammals	Striped Skunk	Mephitis mephitis	Known to occur	Fairly Common
Mammals	Water Shrew	Sorex palustris	Likely to occur	Unknown
Mammals	Western Jumping Mouse	Zapus princeps	Known to occur	Fairly Common
Mammals	Western Small-footed Myotis	Myotis ciliolabrum	Known to occur	Fairly Common
Mammals	White-tailed Jackrabbit	Lepus townsendii	Known to occur	Fairly Common
Mammals	Wolverine	Gulo gulo	Known to occur	Extirpated
Mammals	Yellow-bellied Marmot	Marmota flaviventris	Known to occur	Common
Reptiles	Fence Lizard	Sceloporus undulatus	Likely to occur	Unknown
Reptiles	Gopher Snake	Pituophis catenifer	Likely to occur	Unknown
Reptiles	Milk Snake	Lampropeltis triangulum	Likely to occur	Unknown
Reptiles	Painted Turtle	Chrysemys picta	Likely to occur	Unknown
Reptiles	Short-horned Lizard	Phrynosoma hernandesi	Likely to occur	Unknown
Reptiles	Smooth Green Snake	Liochlorophis vernalis	Likely to occur	Unknown
Reptiles	Western Terrestrial Garter Snake	Thamnophis elegans	Known to occur	Locally Common

Appendix 7.1.a: Calculating hardness-specific benchmarks and HQs for aluminum in surface water samples collected during the pre-runoff period
Baseline Ecological Risk Assessment
Upper Animas River Mining District

	PRE-RUNOFF PERIOD																											
Sampling Date **Metal-fraction** **Units**	2/10 Al-total µg/L	pH	hardness (mg/L)	benchm. criterion	benchm. equation	criterion HQ	equation HQ	3/10 Al-total µg/L	pH	hardness (mg/L)	benchm. criterion	benchm. equation	criterion HQ	equation HQ	4/10 Al-total µg/L	pH	hardness (mg/L)	benchm. criterion	benchm. equation	criterion HQ	equation HQ	3/11 Al-total µg/L	pH	hardness (mg/L)	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	5950	4.97	309	87	--	68	--	5360	5.02	308	87	--	62	--	2160	6.22	150	87	851	25	2.5	4830	5.12	247	87	--	56	--
CC48	8610	3.50	571	87	--	99	--	8100	3.42	541	87	--	93	--	5020	3.93	301	87	--	58	--	7540	3.54	493	87	--	87	--
A56 ("upstream")	NS							NS							NS							NS						
A68	269	6.74	202	87	1279	3.1	0.2	177	6.82	179	87	1084	2.0	0.2	368	6.85	148	87	835	4.2	0.4	275	7.18	172	--	1026	--	0.3
A72	4440	5.07	352	87	--	51	--	4090	5.04	337	87	--	47	--	1980	6.09	177	87	1067	23	1.9	3310	5.30	273	87	--	38	--
A73	NS							NS							NS							NS						
A75D	NS							NS							NS							NS						
Bakers Bridge	NS							NS							NS							NS						

NS = not sampled
criterion HQ = hazard quotient calculated using the chronic benchmark criterion; equation HQ = hazard quotient calculated using the chronic benchmark ec
shading shows HQ > 1.0 or highest HQ
[a] surface water pH was not measured in April 2014. To support the calculations, it was assumed that surface water pH fell below 7.0 based on pH values from previous years
the chronic surface water benchmarks for aluminum were calculated using the following equation: $e^{(1.3695*\ln \text{hardness})-0.1158}$
The procedures for calculating the chronic HQs are as follows:
- use the chronic hardness-dependent equation if (a) pH $\geq$ 7.0 <u>and</u> (b) hardness $\leq$ 220 mg/L
- use the more stringent of the chronic hardness-dependent equation or the 87 ug/L chronic total recoverable Al criterion if (a) pH $\leq$ 7.0 <u>and</u> (b) hardness $\leq$ 220 mg/L
- use the 87 ug/L chronic total recoverable Al criterion if hardness > 220 mg/L

Appendix 7.1.b: Calculating hardness-specific benchmarks and HQs for aluminum in surface water samples collected during the runoff period
Baseline Ecological Risk Assessment
Upper Animas River Mining District

RUNOFF PERIOD

Sampling Date **Metal-fraction** **Units**	5/09 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ	6/09 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ	6/10 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	1130	6.49	52	87	199	13	5.7	773	7.30	72	--	311	--	2.5	665	7.00	49	--	184	--	3.6
CC48	1780	5.40	81	87	366	20	4.9	2920	4.29	189	87	1168	34	2.5	1750	5.34	88	87	410	20	4.3
A56 ("upstream")	NS							NS							NS						
A60	NS							NS							NS						
A61	NS							NS							NS						
A64	NS							NS							NS						
A65	NS							NS							NS						
A66	NS							NS							NS						
A68	1010	7.15	49	--	184	--	5.5	165	7.51	65	--	271	--	0.6	348	6.98	50	87	189	4.0	1.8
A72	3060	7.08	45	--	164	--	19	679	7.09	78	--	347	--	2.0	585	6.51	54	87	210	6.7	2.8
A73	NS							NS							NS						
A73B	NS							NS							NS						
A75B	NS							NS							NS						
A75D	NS							NS							NS						
Bakers Bridge	NS							NS							NS						

Sampling Date **Metal-fraction** **Units**	6/11 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ	5/12 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	2200	7.19	53	--	205	--	11	824	7.07	77	--	341	--	2.4
CC48	1610	5.24	76	87	335	19	4.8	2690	4.43	177	87	1067	31	2.5
A56 ("upstream")	NS							NS						
A60	NS							NS						
A61	NS							NS						
A64	NS							NS						
A65	NS							NS						
A66	NS							NS						
A68	540	7.28	53	--	205	--	2.6	154	7.37	71	--	305	--	0.5
A72	1200	6.50	55	87	215	14	5.6	713	6.59	86	87	397	8.2	1.8
A73	NS							NS						
A73B	NS							NS						
A75B	NS							NS						
A75D	NS							NS						
Bakers Bridge	NS							NS						

Sampling Date **Metal-fraction** **Units**	5/13 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ	5/14 Al-total µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	1270	7.23	79	--	354	--	3.6	2610	6.83	92	87	436	30	6.0
CC48	2690	4.43	129	87	692	31	3.9	3280	4.60	126	87	670	38	4.9
A56 ("upstream")	817	7.61	65	--	271	--	3.0	392	7.44	79	--	354	--	1.1
A60	370	7.66	74	--	323	--	1.1	452	7.44	78	--	347	--	1.3
A61	322	7.38	78	--	347	--	0.9	549	7.36	80	--	360	--	1.5
A64	343	7.54	63	--	259	--	1.3	514	7.35	76	--	335	--	1.5
A65	698	7.47	65	--	271	--	2.6	454	7.24	80	--	360	--	1.3
A66	653	7.45	64	--	265	--	2.5	547	7.15	79	--	354	--	1.5
A68	534	7.39	66	--	276	--	1.9	508	7.09	87	--	404	--	1.3
A72	938	6.87	82	87	372	11	2.5	2340	6.33	103	87	508	27	4.6
A73	1280	7.25	71	--	305	--	4.2	1050	7.19	88	--	410	--	2.6
A73B	666	7.26	37	--	125	--	5.3	640	7.24	54	--	210	--	3.0
A75B	1650	7.42	61	--	248	--	6.6	1040	7.29	70	--	300	--	3.5
A75D	1630	7.49	60	--	243	--	6.7	1060	7.44	76	--	335	--	3.2
Bakers Bridge	1310	7.64	58	--	232	--	5.7	734	7.63	73	--	317	--	2.3

criterion HQ = hazard quotient calculated using the chronic benchmark criterion; equation HQ = hazard quotient calculated using the chronic benchmark equation
shading shows HQ > 1.0 or highest HQ

the chronic surface water benchmarks for aluminum were calculated using the following equation: $e^{(1.3695*\ln \text{hardness})-0.1158}$
The procedures for calculating the chronic HQs are as follows:
- use the chronic hardness-dependent equation if (a) pH $\geq$ 7.0 and (b) hardness $\leq$ 220 mg/L
- use the more stringent of the chronic hardness-dependent equation or the 87 ug/L chronic total recoverable Al criterion if (a) pH $\leq$ 7.0 and (b) hardness $\leq$ 220 mg/L
- use the 87 ug/L chronic total recoverable Al criterion if hardness > 220 mg/L

Appendix 7.1.c: Calculating hardness-specific benchmarks and HQs for aluminum in surface water samples collected during the post-runoff period
Baseline Ecological Risk Assessment
Upper Animas River Mining District

POST-RUNOFF PERIOD

Sampling Date	7/09						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	933	7.19	91	--	429	--	2.2
CC48	4120	3.95	293	87	--	47	--
CC49	NS						
A56 (reference)	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	117	7.61	85	--	391	--	0.3
A69A	NS						
A70B	NS						
A71B	NS						
A72	812	6.88	109	87	549	9.3	1.5
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	8/09						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	2630	6.73	186	87	1142	30	2.3
CC48	7110	3.51	467	87	--	82	--
CC49	NS						
A56 (reference)	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	120	7.18	135	--	737	--	0.2
A69A	NS						
A70B	NS						
A71B	NS						
A72	2080	6.40	211	87	1358	24	1.5
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	9/09						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	2480	6.70	156	87	898	29	2.8
CC48	7050	3.65	470	87	--	81	--
CC49	NS						
A56 (reference)	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	134	7.21	141	--	782	--	0.2
A69A	NS						
A70B	NS						
A71B	NS						
A72	2080	6.46	199	87	1253	24	1.7
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	11/09						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	4590	5.62	238	87	--	53	--
CC48	7850	3.50	495	87	--	90	--
CC49	NS						
A56 (reference)	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	189	6.52	167	87	986	2.2	0.2
A69A	NS						
A70B	NS						
A71B	NS						
A72	2750	5.93	296	87	--	32	--
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	7/10						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	1200	6.77	114	87	584	14	2.1
CC48	5270	3.57	345	87	--	61	--
CC49	NS						
A56 (reference)	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	50	6.92	97	87	468	0.6	0.1
A69A	NS						
A70B	NS						
A71B	NS						
A72	1090	6.41	136	87	744	13	1.5
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	9/10						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	2960	6.73	199	87	1253	34	2.4
CC48	7230	3.45	509	87	--	83	--
CC49	NS						
A56 (reference)	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	124	7.52	144	--	805	--	0.2
A69A	NS						
A70B	NS						
A71B	NS						
A72	2180	6.48	245	87	--	25	--
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

POST-RUNOFF PERIOD

Sampling Date	11/10						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	3080	6.40	219	87	1429	35	2.2
CC48	7930	3.51	517	87	--	91	--
CC49	NS						
A56 ("upstream")	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	101	7.26	154	--	882	--	0.1
A69A	NS						
A70B	NS						
A71B	NS						
A72	2540	6.25	232	87	--	29	--
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	7/11						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	563	7.28	65	--	271	--	2.1
CC48	2710	4.54	191	87	1185	31	2.3
CC49	NS						
A56 ("upstream")	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	217	7.42	66	--	276	--	0.8
A69A	NS						
A70B	NS						
A71B	NS						
A72	597	7.08	75	--	329	--	1.8
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	8/11						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	1600	6.82	144	87	805	18	2.0
CC48	5830	3.45	398	87	--	67	--
CC49	NS						
A56 ("upstream")	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	50	7.20	111	--	563	--	0.1
A69A	NS						
A70B	NS						
A71B	NS						
A72	1370	6.51	161	87	937	16	1.5
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	9/11						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	2610	6.68	188	87	1159	30	2.3
CC48	6770	3.51	474	87	--	78	--
CC49	NS						
A56 ("upstream")	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	50	7.39	140	--	774	--	0.1
A69A	NS						
A70B	NS						
A71B	NS						
A72	2070	6.38	210	87	1349	24	1.5
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	10/11						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	2170	5.90	155	87	890	25	2.4
CC48	6810	3.24	435	87	--	78	--
CC49	NS						
A56 ("upstream")	NS						
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	50	6.87	138	87	759	0.6	0.1
A69A	NS						
A70B	NS						
A71B	NS						
A72	1800	6.23	183	87	1117	21	1.6
A73	NS						
A73B	NS						
A75B	NS						
A75D	NS						
Bakers Bridge	NS						

Sampling Date	10/12						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	3390	6.15	220	87	1438	39	2.4
CC48	7670	3.40	515	87	--	88	--
CC49	7800	3.43	545	87	--	90	--
A56 ("upstream")	50	7.39	168	--	994	--	0.1
A60	NS						
A61	NS						
A64	NS						
A65	NS						
A66	NS						
A68	50	7.42	174	--	1043	--	0.05
A69A	2520	5.54	297	87	--	29	--
A70B	2460	6.05	295	87	--	28	--
A71B	2780	6.10	263	87	--	32	--
A72	2620	5.98	261	87	--	30	--
A73	2420	6.54	251	87	--	28	--
A73B	1980	6.74	217	87	1411	23	1.4
A75B	830	7.02	193	--	1202	--	0.7
A75D	1790	7.21	191	--	1185	--	1.5
Bakers Bridge	234	7.20	183	--	1117	--	0.2

Sampling Date	9/14						
Metal-fraction	Al-total						
Units	µg/L	pH	hardness	benchm. criterion	benchm. equation	criterion HQ	equation HQ
M34	1260	7.05	118	--	613	--	2.1
CC48	4890	4.00	67	87	282	56.2	17.3
CC49	NS						
A56 ("upstream")	188	6.64	114	87	584	2.2	0.3
A60	174	6.48	111	87	563	2.0	0.3
A61	168	7.37	111	--	563	--	0.3
A64	150	6.26	113	87	577	1.7	0.3
A65	160	7.01	117	--	605	--	0.3
A66	174	6.99	120	87	627	2.0	0.3
A68	164	7.71	114	--	584	--	0.3
A69A	NS						
A70B	NS						
A71B	NS						
A72	1110	7.00	144	--	805	--	1.4
A73	933	7.24	142	--	789	--	1.2
A73B	612	7.24	83	--	378	--	1.6
A75B	562	6.89	85	87	391	6.5	1.4
A75D	534	6.93	92	87	436	6.1	1.2
Bakers Bridge	399	7.58	99	--	482	--	0.8

criterion HQ = hazard quotient calculated using the chronic benchmark criterion; equation HQ = hazard quotient calculated using the chronic benchmark equation
shading shows HQ > 1.0 or highest HQ
the chronic surface water benchmarks for aluminum were calculated using the following equation: $e^{(1.3695 \cdot \ln \text{hardness}) - 0.1158}$
The procedures for calculating the chronic HQs are as follows:
- use the chronic hardness-dependent equation if (a) pH $\geq$ 7.0 and (b) hardness $\leq$ 220 mg/L
- use the more stringent of the chronic hardness-dependent equation or the 87 ug/L chronic total recoverable Al criterion if (a) pH $\leq$ 7.0 and (b) hardness $\leq$ 220 mg/L
- use the 87 ug/L chronic total recoverable Al criterion if hardness > 220 mg/L

Appendix 7.2: Calculating hardness-specific benchmarks and HQs for dissolved cadmium in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date Metal-fraction Units	2/10 Cd-diss ug/L	nardness	benchm.	HQ	3/10 Cd-diss µg/L	nardness	benchm.	HQ	4/10 Cd-diss µg/L	nardness	benchm.	HQ	3/11 Cd-diss µg/L	nardness	benchm.	HQ	4/14 Cd-diss µg/L	nardness	benchm.	HQ
M34	1.10	309	0.99	1.1	1.00	308	0.99	1.0	2.00	150	0.58	3.5	1.10	247	0.84	1.3				
CC48	5.50	571	1.57	3.5	5.30	541	1.51	3.5	4.90	301	0.97	5.0	5.30	493	1.41	3.8				
A56 ("upstream")																	0.58	131	0.52	1.1
A60																				
A61																				
A64																				
A65																				
A66																				
A68	1.80	202	0.72	2.5	1.60	179	0.66	2.4	4.10	148	0.57	7.2	2.70	172	0.64	4.2	3.00	151	0.58	5.2
A72	2.60	352	1.09	2.4	2.70	337	1.06	2.6	2.90	177	0.65	4.4	2.60	273	0.90	2.9				
A73																	1.79	182	0.67	2.7
A73B																				
A75D																	1.02	133	0.53	1.9
A75B																				
Bakers Bridge																	0.53	127	0.51	1.0

RUNOFF PERIOD

Sampling Date Metal-fraction Units	5/09 Cd-diss ug/L	nardnes	benchm	HQ	6/09 Cd-diss µg/L	nardnes	benchm	HQ	6/10 Cd-diss µg/L	nardnes	benchm	HQ	6/11 Cd-diss µg/L	nardnes	benchm	HQ	5/12 Cd-diss µg/L	nardnes	benchm	HQ	5/13 Cd-diss µg/L	nardnes	benchm	HQ	5/14 Cd-diss µg/L	nardnes	benchm	HQ
M34	0.30	52	0.26	1.2	0.20	72	0.33	0.6	0.10	49	0.25	0.4	0.20	53	0.26	0.8	0.28	77	0.35	0.8	0.25	79	0.35	0.7	0.56	92	0.40	1.4
CC48	2.10	81	0.36	5.8	3.40	189	0.68	5.0	2.20	88	0.38	5.7	2.00	76	0.34	5.8	2.91	177	0.65	4.5	3.20	129	0.51	6.3	3.83	126	0.50	7.6
A56 ("upstream")																					0.70	65	0.31	2.3	0.97	79	0.35	2.7
A60																					0.70	74	0.34	2.1	1.01	78	0.35	2.9
A61																					1.00	78	0.35	2.9	1.51	80	0.36	4.2
A64																					0.90	63	0.30	3.0	1.35	76	0.34	3.9
A65																					0.90	65	0.31	2.9	1.31	80	0.36	3.7
A66																					0.90	64	0.30	3.0	1.40	79	0.35	4.0
A68	0.90	49	0.25	3.6	0.80	65	0.31	2.6	0.90	50	0.25	3.6	0.90	53	0.26	3.4	0.87	71	0.33	2.7	1.00	66	0.31	3.2	1.33	87	0.38	3.5
A72	0.60	45	0.23	2.6	0.80	78	0.35	2.3	0.70	54	0.27	2.6	0.80	55	0.27	3.0	0.89	86	0.38	2.4	1.00	82	0.36	2.7	1.40	103	0.43	3.2
A73																					0.70	71	0.33	2.1	1.09	88	0.38	2.8
A73B																					0.30	37	0.20	1.5	0.56	54	0.27	2.1
A75D																					0.50	60	0.29	1.7	0.71	76	0.34	2.1
A75B																					0.50	61	0.29	1.7	0.69	70	0.32	2.1
Bakers Bridge																					0.30	58	0.28	1.1	0.42	73	0.33	1.3

POST-RUNOFF PERIOD

Sampling Date Metal-fraction Units	7/09 Cd-diss µg/L	nardnes	benchm	HQ	8/09 Cd-diss µg/L	nardnes	benchm	HQ	9/09 Cd-diss µg/L	nardnes	benchm	HQ	11/09 Cd-diss µg/L	nardnes	benchm	HQ	7/10 Cd-diss µg/L	nardnes	benchm	HQ	9/10 Cd-diss µg/L	nardnes	benchm	HQ	11/10 Cd-diss µg/L	nardnes	benchm	HQ
M34	0.30	91	0.39	0.8	0.70	186	0.67	1.0	0.70	156	0.59	1.2	1.00	238	0.81	1.2	0.40	114	0.47	0.9	0.70	199	0.71	1.0	0.80	219	0.76	1.1
CC48	4.60	293	0.95	4.9	6.60	467	1.34	4.9	6.60	470	1.35	4.9	6.40	495	1.40	4.6	4.40	345	1.07	4.1	5.70	509	1.43	4.0	6.70	517	1.45	4.6
CC49																												
A56 ("upstream")																												
A60																												
A61																												
A64																												
A65																												
A66																												
A68	0.80	85	0.37	2.1	1.00	135	0.53	1.9	1.20	141	0.55	2.2	1.70	167	0.62	2.7	0.80	97	0.41	1.9	1.30	144	0.56	2.3	1.40	154	0.58	2.4
A69A																												
A70B																												
A71B																												
A72	0.90	109	0.45	2.0	1.80	211	0.74	2.4	1.80	199	0.71	2.5	2.80	296	0.95	2.9	1.10	136	0.53	2.1	1.80	245	0.83	2.2	2.10	232	0.80	2.6
A73																												
A73B																												
A75D																												
A75B																												
Bakers Bridge																												

Sampling Date Metal-fraction Units	7/11 Cd-diss µg/L	nardnes	benchm	HQ	8/11 Cd-diss µg/L	nardnes	benchm	HQ	9/11 Cd-diss µg/L	nardnes	benchm	HQ	10/11 Cd-diss µg/L	nardnes	benchm	HQ	10/12 Cd-diss µg/L	nardnes	benchm	HQ	9/14 Cd-diss µg/L	nardnes	benchm	HQ
M34	0.20	65	0.31	0.7	0.50	144	0.56	0.9	0.70	188	0.68	1.0	0.60	155	0.59	1.0	0.90	220	0.76	1.2	0.39	118	0.48	0.8
CC48	3.10	191	0.69	4.5	5.60	398	1.19	4.7	5.90	474	1.36	4.3	7.00	435	1.27	5.5	5.10	515	1.45	3.5	5.08	67	0.31	16.3
CC49																	5.60	545	1.51	3.7				
A56 ("upstream")																	0.60	168	0.62	1.0	0.86	114	0.47	1.9
A60																					0.99	111	0.46	2.2
A61																					0.93	111	0.46	2.0
A64																					1.01	113	0.46	2.2
A65																					1.05	117	0.48	2.2
A66																					1.13	120	0.48	2.3
A68	0.80	66	0.31	2.6	0.90	111	0.46	2.0	1.10	140	0.54	2.0	1.10	138	0.54	2.0	1.20	174	0.64	1.9	1.08	114	0.47	2.3
A69A																	2.70	297	0.96	2.8				
A70B																	2.70	295	0.95	2.8				
A71B																	1.90	263	0.87	2.2				
A72	0.70	75	0.34	2.1	1.30	161	0.60	2.2	1.70	210	0.74	2.3	1.60	183	0.67	2.4	1.80	261	0.87	2.1	1.19	144	0.56	2.1
A73																	1.70	251	0.84	2.0	1.01	142	0.55	1.8
A73B																	1.40	217	0.76	1.9	0.57	83	0.37	1.6
A75D																	1.10	191	0.69	1.6	0.54	92	0.40	1.4
A75B																	1.10	193	0.69	1.6	0.52	85	0.37	1.4
Bakers Bridge																	0.70	183	0.67	1.1	0.35	99	0.42	0.8

shading shows HQs > 1.0

the hardness-specific chronic surface water benchmarks for cadmium were calculated using the following equation: $((1.101672 - \ln \text{hardness}) * 0.041838) * e^{(0.7988 * \ln \text{hardness}) - 4.4451}$

Appendix 7.3: Calculating hardness-specific benchmarks and HQs for dissolved chromium in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date	2/10				3/10				4/10				3/11				4/14			
Metal-fraction	Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	1.0	309	187	0.01	1.0	308	186	0.01	1.0	150	103	0.01	2.5	247	155	0.02				
CC48	1.0	571	309	0.00	1.0	541	295	0.00	1.0	301	183	0.01	2.5	493	274	0.01				
A56 ("upstream")																	0.5	131	92	0.01
A60																				
A61																				
A64																				
A65																				
A66																				
A68	1.0	202	132	0.01	1.0	179	119	0.01	1.0	148	102	0.01	2.5	172	116	0.02	0.5	151	104	<0.01
A72	1.0	352	208	0.00	1.0	337	200	0.00	1.0	177	118	0.01	2.5	273	169	0.01				
A73																	0.5	182	121	<0.01
A73B																				
A75D																	0.5	133	94	0.01
A75B																				
Bakers Bridge																	0.5	127	90	0.01

RUNOFF PERIOD

Sampling Date	5/09				6/09				6/10				6/11				5/12				5/13				5/14			
Metal-fraction	Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.	
Units	ug/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	1.0	52	43	0.02	1.0	72	57	0.02	2.5	49	41	0.06	2.5	53	44	0.06	0.5	77	60	0.01	2.5	79	61	0.04	0.5	92	69	0.01
CC48	1.0	81	62	0.02	1.0	189	125	0.01	2.5	88	67	0.04	2.5	76	59	0.04	0.5	177	118	0.00	5.0	129	91	0.05	0.5	126	90	0.01
A56 ("upstream")																					0.5	65	52	0.01	0.5	79	61	0.01
A60																					0.5	74	58	0.01	0.5	78	60	0.01
A61																					0.5	78	60	0.01	0.5	80	62	0.01
A64																					0.5	63	51	0.01	0.5	76	59	0.01
A65																					0.5	65	52	0.01	0.5	80	62	0.01
A66																					0.5	64	51	0.01	0.5	79	61	0.01
A68	1.0	49	41	0.02	1.0	65	52	0.02	2.5	50	42	0.06	2.5	53	44	0.06	0.5	71	56	0.01	0.5	66	53	0.01	0.5	87	66	0.01
A72	1.0	45	39	0.03	1.0	78	60	0.02	2.5	54	45	0.06	2.5	55	45	0.06	0.5	86	66	0.01	2.5	82	63	0.04	0.5	103	76	0.01
A73																					2.5	71	56	0.04	0.5	88	67	0.01
A73B																					0.5	37	33	0.02	0.5	54	45	0.01
A75D																					0.5	60	49	0.01	0.5	76	59	0.01
A75B																					0.5	61	49	0.01	0.5	70	55	0.01
Bakers Bridge																					0.5	58	47	0.01	0.5	73	57	0.01

POST-RUNOFF PERIOD

Sampling Date	7/09				8/09				9/09				11/09				7/10				9/10				11/10			
Metal-fraction	Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	1.0	91	69	0.01	1.0	186	123	0.01	1.0	156	107	0.01	1.0	238	151	0.01	2.5	114	83	0.03	0.3	199	130	<0.01	0.3	219	141	<0.01
CC48	1.0	293	179	0.01	1.0	467	262	0.00	1.0	470	263	<0.01	1.0	495	275	0.00	2.5	345	204	0.01	0.3	509	281	<0.01	0.3	517	285	<0.01
CC49																												
A56 ("upstream")																												
A60																												
A61																												
A64																												
A65																												
A66																												
A68	1.0	85	65	0.02	1.0	135	95	0.01	1.0	141	98	0.01	1.0	167	113	0.01	2.5	97	72	0.03	0.3	144	100	<0.01	0.3	154	106	<0.01
A69A																												
A70B																												
A71B																												
A72	1.0	109	80	0.01	1.0	211	137	0.01	1.0	199	130	0.01	1.0	296	180	0.01	2.5	136	95	0.03	0.3	245	154	<0.01	0.3	232	148	<0.01
A73																												
A73B																												
A75D																												
A75B																												
Bakers Bridge																												

Sampling Date	7/11				8/11				9/11				10/11				10/12				9/14			
Metal-fraction	Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.		Cr-diss	hardness	benchm.	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	2.5	65	52	0.05	2.5	144	100	0.03	2.5	188	124	0.02	2.5	155	106	0.02	2.5	220	141	0.02	0.5	118	85	0.01
CC48	2.5	191	126	0.02	2.5	398	230	0.01	2.5	474	265	0.01	2.5	435	247	0.01	2.5	515	284	0.01	2.5	67	53	0.05
CC49																	2.5	545	297	0.01				
A56 ("upstream")																	0.5	168	113	<0.01	0.5	114	83	0.01
A60																					0.5	111	81	0.01
A61																					0.5	111	81	0.01
A64																					0.5	113	82	0.01
A65																					0.5	117	84	0.01
A66																					0.5	120	86	0.01
A68	2.5	66	53	0.05	2.5	111	81	0.03	2.5	140	98	0.03	2.5	138	96	0.03	0.5	174	117	<0.01	0.5	114	83	0.01
A69A																	0.5	297	181	<0.01				
A70B																	0.5	295	180	<0.01				
A71B																	0.5	263	164	<0.01				
A72	2.5	75	59	0.04	2.5	161	109	0.02	2.5	210	136	0.02	2.5	183	122	0.02	2.3	261	163	0.01	0.5	144	100	0.01
A73																	0.5	251	157	<0.01	0.5	142	99	0.01
A73B																	0.5	217	140	<0.01	0.5	83	64	0.01
A75D																	0.5	191	126	<0.01	0.5	92	69	0.01
A75B																	0.5	193	127	<0.01	0.5	85	65	0.01
Bakers Bridge																	0.5	183	122	<0.01	0.5	99	74	0.01

the hardness-specific chronic surface water benchmarks for chromium were calculated using the following equation: $e^{(0.819*\ln hardness)+0.534}$

Appendix 7.4: Calculating hardness-specific benchmarks and HQs for dissolved copper in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date	2/10				3/10				4/10				3/11				4/14			
Metal-fraction	Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.	
Units	ug/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ
M34	10.3	309	23	0.4	11.2	308	23	0.5	12.3	150	13	1.0	16.2	247	19	0.8				
CC48	119	571	40	3.0	109	541	38	2.9	110	301	23	4.8	89.1	493	35	2.5				
A56 ("upstream")																	2.07	131	11	0.2
A60																				
A61																				
A64																				
A65																				
A66																				
A68	1.5	202	16	0.1	1.5	179	15	0.1	8.3	148	13	0.7	5.0	172	14	0.4	6.0	151	13	0.5
A72	35.9	352	26	1.4	35.2	337	25	1.4	19.2	177	15	1.3	25.2	273	21	1.2				
A73																	2.48	182	15	0.2
A73B																				
A75D																	2.14	133	11	0.2
A75B																				
Bakers Bridge																	2.49	127	11	0.2

RUNOFF PERIOD

Sampling Date	5/09				6/09				6/10				6/11			
Metal-fraction	Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.	
Units	ug/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ
M34	3.9	52	5.1	0.8	1.5	72	6.8	0.2	5.0	49	4.9	1.0	5.0	53	5.2	1.0
CC48	56.3	81	7.5	7.5	90.6	189	15	5.9	72.0	88	8.0	9.0	55.6	76	7.1	7.8
A56 ("upstream")																
A60																
A61																
A64																
A65																
A66																
A68	4.5	49	4.9	0.9	3.7	65	6.2	0.6	5.0	50	5.0	1.0	5.0	53	5.2	1.0
A72	3.6	45	4.5	0.8	4.5	78	7.2	0.6	5.0	54	5.3	0.9	5.0	55	5.4	0.9
A73																
A73B																
A75D																
A75B																
Bakers Bridge																

Sampling Date	5/12				5/13				5/14			
Metal-fraction	Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.	
Units	μg/L			HQ	μg/L			HQ	μg/L			HQ
M34	1.7	77	7.2	0.2	1.3	79	7.3	0.2	3.1	92	8.3	0.4
CC48	61.2	177	15	4.2	79.3	129	11	7.1	65.4	126	11	6.0
A56 ("upstream")					8.4	65.0	6.2	1.4	13.4	79	7.3	1.8
A60					7.8	74.0	6.9	1.1	12.6	78	7.2	1.7
A61					9.6	78.0	7.2	1.3	16.5	80	7.4	2.2
A64					8.5	63.0	6.0	1.4	14.3	76	7.1	2.0
A65					8.9	65.0	6.2	1.4	14.1	80	7.4	1.9
A66					9.1	64.0	6.1	1.5	13.9	79	7.3	1.9
A68	4.3	71	6.7	0.6	10.3	66	6.3	1.6	11.3	87	8.0	1.4
A72	4.1	86	7.9	0.5	7.6	82	7.6	1.0	6.4	103	9.2	0.7
A73					5.0	71.0	6.7	0.7	4.9	88	8.0	0.6
A73B					2.0	37.0	3.8	0.5	3.8	54	5.3	0.7
A75D					3.7	60.0	5.8	0.6	4.2	76	7.1	0.6
A75B					3.7	61.0	5.9	0.6	4.1	70	6.6	0.6
Bakers Bridge					3.5	58.0	5.6	0.6	3.7	73	6.8	0.5

POST-RUNOFF PERIOD

Sampling Date	7/09				8/09				9/09				11/09				7/10			
Metal-fraction	Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.	
Units	μg/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ
M34	1.5	91	8.3	0.2	3.4	186	15	0.2	3.7	156	13	0.3	9.5	238	19	0.5	5.0	114	10	0.5
CC48	110	293	22	4.9	221	467	33	6.6	189	470	34	5.6	152	495	35	4.3	118	345	26	4.6
CC49																				
A56 ("upstream")																				
A60																				
A61																				
A64																				
A65																				
A66																				
A68	1.5	85	7.8	0.2	1.5	135	12	0.1	1.5	141	12	0.1	1.5	167	14	0.1	5.0	97	8.7	0.6
A69A																				
A70B																				
A71B																				
A72	4.8	109	9.6	0.5	17.4	211	17	1.0	14.7	199	16	0.9	36.9	296	23	1.6	5.0	136	12	0.4
A73																				
A73B																				
A75D																				
A75B																				
Bakers Bridge																				

Sampling Date	9/10				11/10				7/11				8/11			
Metal-fraction	Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.	
Units	μg/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ
M34	2.0	199	16	0.1	2.0	219	17	0.1	10.0	65	6.2	1.6	10.0	144	12	0.8
CC48	166	509	36	4.6	140	517	36	3.8	76.6	191	16	4.9	145	398	29	5.0
CC49																
A56 ("upstream")																
A60																
A61																
A64																
A65																
A66																
A68	2.0	144	12	0.2	2.0	154	13	0.2	10.0	66	6.3	1.6	10.0	111	9.8	1.0
A69A																
A70B																
A71B																
A72	13.0	245	19	0.7	14.5	232	18	0.8	10.0	75	7.0	1.4	10.0	161	13	0.7
A73																
A73B																
A75D																
A75B																
Bakers Bridge																

Sampling Date	9/11				10/11				10/12				9/14			
Metal-fraction	Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.		Cu-diss	nardness	benchm.	
Units	μg/L			HQ	μg/L			HQ	μg/L			HQ	μg/L			HQ
M34	10.0	188	15	0.7	10.0	155	13	0.8	3.8	220	18	0.2	1.5	118	10	0.1
CC48	148	474	34	4.4	139	435	31	4.4	74.4	515	36	2.0	65.3	67	6.4	10.3
CC49									78.3	545	38	2.1				
A56 ("upstream")									0.7	168	14	0.1	2.4	114	10	0.2
A60													2.8	111	9.8	0.3
A61													3.4	111	9.8	0.4
A64													3.5	113	9.9	0.3
A65													3.0	117	10	0.3
A66													3.5	120	10	0.3
A68	10.0	140	12	0.8	10.0	138	12	0.8	2.7	174	14	0.2	3.3	114	10	0.3
A69A									16.3	297	23	0.7				
A70B									24.8	295	23	1.1				
A71B									8.7	263	20	0.4				
A72	10.0	210	17	0.6	10.0	183	15	0.7	9.5	261	20	0.5	3.0	144	12	0.2
A73									4.3	251	20	0.2	1.9	142	12	0.2
A73B									3.1	217	17	0.2	1.4	83	7.6	0.2
A75D									0.6	191	16	0.0	1.9	92	8.3	0.2
A75B									0.7	193	16	0.0	2.0	85	7.8	0.3
Bakers Bridge									0.3	183	15	0.0	1.9	99	8.9	0.2

shading shows HQs > 1.0

the hardness-specific chronic surface water benchmarks for copper were calculated using the following equation: $e^{(0.854*\ln \text{hardness})-1.7428}$

Appendix 7.5: Calculating hardness-specific benchmarks and HQs for dissolved manganese in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date	2/10	hardness	benchm.	HQ	3/10	hardness	benchm.	HQ	4/10	hardness	benchm.	HQ	3/11	hardness	benchm.	HQ	4/14	hardness	benchm.	HQ
Metal-fraction	Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss			
Units	ug/L				µg/L				µg/L				µg/L				µg/L			
M34	630	309	2402	0.3	634	308	2399	0.3	324	150	1888	0.2	530	247	2229	0.2				
CC48	5290	571	2947	1.8	5200	541	2895	1.8	3040	301	2381	1.3	4940	493	2806	1.8				
A56 ("upstream")																	172	131	1805	0.1
A60																				
A61																				
A64																				
A65																				
A66																				
A68	3560	202	2085	1.7	2710	179	2003	1.4	3730	148	1880	2.0	3160	172	1976	1.6	3340	151	1892	1.8
A72	2710	352	2509	1.1	2920	337	2472	1.2	1770	177	1995	0.9	2340	273	2305	1.0				
A73																	1830	182	2014	0.9
A73B																				
A75D																	1090	133	1814	0.6
A75B																				
Bakers Bridge																	584	127	1786	0.3

RUNOFF PERIOD

Sampling Date	5/09	hardness	benchm.	HQ	6/09	hardness	benchm.	HQ	6/10	hardness	benchm.	HQ	6/11	hardness	benchm.	HQ	5/12	hardness	benchm.	HQ	5/13	hardness	benchm.	HQ	5/14	hardness	benchm.	HQ
Metal-fraction	Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss			
Units	ug/L				µg/L				µg/L				µg/L				µg/L				µg/L				µg/L			
M34	160	52	1327	0.1	120	72	1479	0.1	84.9	49	1301	0.1	150	53	1335	0.1	115	77	1512	0.1	128	79	1525	0.1	184	92	1604	0.1
CC48	766	81	1538	0.5	1770	189	2039	0.9	811	88	1581	0.5	731	76	1505	0.5	1620	177	1995	0.8	1440	129	1796	0.8	1740	126	1782	1.0
A56 ("upstream")																					140	65	1429	0.1	196	79	1525	0.1
A60																					153	74	1492	0.1	189	78	1519	0.1
A61																					328	78	1519	0.2	786	80	1531	0.5
A64																					240	63	1414	0.2	639	76	1505	0.4
A65																					304	65	1429	0.2	655	80	1531	0.4
A66																					343	64	1422	0.2	805	79	1525	0.5
A68	340	49	1301	0.3	636	65	1429	0.4	335	50	1309	0.3	415	53	1335	0.3	699	71	1472	0.5	656	66	1436	0.5	1220	87	1575	0.8
A72	219	45	1264	0.2	450	78	1519	0.3	241	54	1343	0.2	305	55	1352	0.2	471	86	1569	0.3	478	82	1544	0.3	823	103	1666	0.5
A73																					341	71	1472	0.2	624	88	1581	0.4
A73B																					109	37	1185	0.1	294	54	1343	0.2
A75D																					232	60	1391	0.2	408	76	1505	0.3
A75B																					233	61	1399	0.2	394	70	1465	0.3
Bakers Bridge																					149	58	1376	0.1	246	73	1485	0.2

POST-RUNOFF PERIOD

Sampling Date	7/09	hardness	benchm.	HQ	8/09	hardness	benchm.	HQ	9/09	hardness	benchm.	HQ	11/09	hardness	benchm.	HQ	7/10	hardness	benchm.	HQ	9/10	hardness	benchm.	HQ	11/10	hardness	benchm.	HQ
Metal-fraction	Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss			
Units	µg/L				µg/L				µg/L				µg/L				µg/L				µg/L				µg/L			
M34	169	91	1599	0.1	410	186	2028	0.2	336	156	1913	0.2	592	238	2202	0.3	212	114	1723	0.1	435	199	2075	0.2	456	219	2142	0.2
CC48	2830	293	2360	1.2	4810	467	2756	1.7	4920	470	2762	1.8	5270	495	2810	1.9	3280	345	2492	1.3	5030	509	2837	1.8	5220	517	2851	1.8
CC49																												
A56 ("upstream")																												
A60																												
A61																												
A64																												
A65																												
A66																												
A68	668	85	1563	0.4	1320	135	1823	0.7	1540	141	1850	0.8	2380	167	1957	1.2	649	97	1633	0.4	1310	144	1863	0.7	1790	154	1905	0.9
A69A																												
A70B																												
A71B																												
A72	603	109	1698	0.4	1420	211	2115	0.7	1370	199	2075	0.7	2490	296	2368	1.1	736	136	1828	0.4	1590	245	2223	0.7	1690	232	2183	0.8
A73																												
A73B																												
A75D																												
A75B																												
Bakers Bridge																												

Sampling Date	7/11	hardness	benchm.	HQ	8/11	hardness	benchm.	HQ	9/11	hardness	benchm.	HQ	10/11	hardness	benchm.	HQ	10/12	hardness	benchm.	HQ	9/14	hardness	benchm.	HQ
Metal-fraction	Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss				Mn-diss			
Units	µg/L				µg/L				µg/L				µg/L				µg/L				µg/L			
M34	104	65	1429	0.1	293	144	1863	0.2	406	188	2036	0.2	303	155	1909	0.2	435	220	2145	0.2	221	118	1743	0.1
CC48	1740	191	2046	0.9	3890	398	2613	1.5	4900	474	2770	1.8	4620	435	2692	1.7	5050	515	2848	1.8	710	67	1444	0.5
CC49																	5300	545	2902	1.8				
A56 ("upstream")																	184	168	1961	0.1	469	114	1723	0.3
A60																					416	111	1708	0.2
A61																					464	111	1708	0.3
A64																					569	113	1718	0.3
A65																					614	117	1738	0.4
A66																					860	120	1753	0.5
A68	537	66	1436	0.4	821	111	1708	0.5	1140	140	1845	0.6	1310	138	1836	0.7	1340	174	1984	0.7	826	114	1723	0.5
A69A																	2590	297	2371	1.1				
A70B																	2540	295	2365	1.1				
A71B																	1660	263	2276	0.7				
A72	405	75	1499	0.3	923	161	1933	0.5	1290	210	2112	0.6	1180	183	2017	0.6	1580	261	2271	0.7	863	144	1863	0.5
A73																	1440	251	2241	0.6	811	142	1854	0.4
A73B																	1210	217	2135	0.6	419	83	1550	0.3
A75D																	847	191	2046	0.4	371	92	1604	0.2
A75B																	856	193	2054	0.4	363	85	1563	0.2
Bakers Bridge																	546	183	2017	0.3	254	99	1644	0.2

shading shows HQs > 1.0

the hardness-specific chronic surface water benchmarks for dissolved manganese were calculated using the following equation: $e^{(0.3331*\ln hardness)+5.8743}$

Appendix 7.6: Calculating hardness-specific benchmarks and HQs for dissolved nickel in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date	2/10	hardness	benchm.	HQ	3/10	hardness	benchm.	HQ	4/10	hardness	benchm.	HQ	3/11	hardness	benchm.	HQ	4/14	hardness	benchm.	HQ
Metal-fraction	Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss			
Units	ug/L				µg/L				µg/L				µg/L				µg/L			
M34	5.3	309	135	0.04	3.3	308	135	0.02	1.0	150	73	0.01	4.0	247	112	0.04				
CC48	19.4	571	227	0.09	16.3	541	217	0.08	10.3	301	132	0.08	16.4	493	201	0.08				
A56 ("upstream")																	0.3	131	65	<0.01
A60																				
A61																				
A64																				
A65																				
A66																				
A68	1.0	202	94	0.01	1.0	179	85	0.01	1.0	148	72	0.01	2.0	172	82	0.02	0.3	151	74	<0.01
A72	8.2	352	151	0.05	6.4	337	145	0.04	3.4	177	84	0.04	5.8	273	122	0.05				
A73																	0.9	182	86	0.01
A73B																				
A75D																	0.8	133	66	0.01
A75B																				
Bakers Bridge																	0.3	127	64	0.00

RUNOFF PERIOD

Sampling Date	5/09	hardness	benchm.	HQ	6/09	hardness	benchm.	HQ	6/10	hardness	benchm.	HQ	6/11	hardness	benchm.	HQ	5/12	hardness	benchm.	HQ	5/13	hardness	benchm.	HQ	5/14	hardness	benchm.	HQ
Metal-fraction	Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss			
Units	ug/L				µg/L				µg/L				µg/L				µg/L				µg/L				µg/L			
M34	1.0	52	30	0.03	1.0	72	39	0.03	2.0	49	28	0.07	2.0	53	30	0.07	0.6	77	42	0.02	1.3	79	43	0.03	0.3	92	48	0.01
CC48	2.2	81	44	0.05	5.3	189	89	0.06	2.0	88	47	0.04	2.0	76	41	0.05	4.9	177	84	0.06	2.5	129	65	0.04	3.1	126	63	0.05
A56 ("upstream")																					0.3	65	36	0.01	0.3	79	43	0.01
A60																					0.3	74	40	0.01	0.3	78	42	0.01
A61																					0.3	78	42	0.01	0.3	80	43	0.01
A64																					0.3	63	35	0.01	0.3	76	41	0.01
A65																					0.3	65	36	0.01	0.3	80	43	0.01
A66																					0.3	64	36	0.01	0.3	79	43	0.01
A68	1.0	49	28	0.04	1.0	65	36	0.03	2.0	50	29	0.07	2.0	53	30	0.07	0.3	71	39	0.01	0.3	66	37	0.01	0.3	87	46	0.01
A72	1.0	45	26	0.04	1.0	78	42	0.02	2.0	54	31	0.06	2.0	55	31	0.06	0.9	86	46	0.02	1.3	82	44	0.03	0.6	103	53	0.01
A73																					1.3	71	39	0.03	0.3	88	47	0.01
A73B																					1.4	37	22	0.06	0.8	54	31	0.03
A75D																					0.6	60	34	0.02	0.3	76	41	0.01
A75B																					0.5	61	34	0.01	0.3	70	38	0.01
Bakers Bridge																					0.3	58	33	0.01	0.3	73	40	0.01

POST-RUNOFF PERIOD

Sampling Date	7/09	hardness	benchm.	HQ	8/09	hardness	benchm.	HQ	9/09	hardness	benchm.	HQ	11/09	hardness	benchm.	HQ	7/10	hardness	benchm.	HQ	9/10	hardness	benchm.	HQ
Metal-fraction	Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss			
Units	µg/L				µg/L				µg/L				µg/L				µg/L				µg/L			
M34	1.0	91	48	0.02	2.1	186	88	0.02	2.3	156	76	0.03	4.1	238	108	0.04	2.0	114	58	0.03	0.4	199	93	0
CC48	9.1	293	129	0.07	15.0	467	192	0.08	15.7	470	193	0.08	17.4	495	201	0.09	8.6	345	148	0.06	16.5	509	206	0.08
CC49																								
A56 ("upstream")																								
A60																								
A61																								
A64																								
A65																								
A66																								
A68	1.0	85	45	0.02	1.0	135	67	0.01	1.0	141	70	0.01	1.0	167	80	0.01	2.0	97	51	0.04	0.4	144	71	0
A69A																								
A70B																								
A71B																								
A72	1.0	109	56	0.02	3.0	211	98	0.03	3.7	199	93	0.04	6.4	296	130	0.05	2.0	136	67	0.03	0.4	245	111	0
A73																								
A73B																								
A75D																								
A75B																								
Bakers Bridge																								

Sampling Date	11/10	hardness	benchm.	HQ	7/11	hardness	benchm.	HQ	8/11	hardness	benchm.	HQ	9/11	hardness	benchm.	HQ	10/11	hardness	benchm.	HQ	10/12	hardness	benchm.	HQ	9/14	hardness	benchm.	HQ
Metal-fraction	Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss				Ni-diss			
Units	µg/L				µg/L				µg/L				µg/L				µg/L				µg/L				µg/L			
M34	0.4	219	101	0	2.0	65	36	0.06	2.0	144	71	0.03	2.0	188	89	0.02	2.00	155	75	0.03	1.3	220	101	0.01	0.5	118	60	0.01
CC48	16.2	517	209	0.08	6.0	191	90	0.07	13.0	398	167	0.08	14.5	474	194	0.07	13.70	435	180	0.08	12.4	515	208	0.06	5.9	67	37	0.16
CC49																					13.5	545	218	0.06				
A56 ("upstream")																					0.3	168	81	0.00	0.3	114	58	<0.01
A60																									0.3	111	57	<0.01
A61																									0.3	111	57	<0.01
A64																									0.3	113	58	<0.01
A65																									0.3	117	59	<0.01
A66																									0.3	120	61	<0.01
A68	0.4	154	75	0	2.0	66	37	0.05	2.0	111	57	0.04	2.0	140	69	0.03	2.00	138	68	0.03	0.3	174	83	0.00		114	58	<0.01
A69A																					4.8	297	131	0.04				
A70B																					5.2	295	130	0.04				
A71B																					4.9	263	118	0.04				
A72	4.2	232	106	0.04	2.0	75	41	0.05	2.0	161	78	0.03	2.0	210	97	0.02	2.00	183	87	0.02	5.9	261	117	0.05	1.1	144	71	0.02
A73																					4.8	251	113	0.04	0.9	142	70	0.01
A73B																					3.3	217	100	0.03	1.9	83	44	0.04
A75D																					2.3	191	90	0.03	1.0	92	48	0.02
A75B																					2.4	193	91	0.03	1.0	85	45	0.02
Bakers Bridge																					0.6	183	87	0.01	0.7	99	52	0.01

shading shows HQs > 1.0

the hardness-specific chronic surface water benchmarks for dissolved nickel were calculated using the following equation: $e^{(0.846*\ln \text{hardness})+0.0554}$

Appendix 7.7: Calculating hardness-specific benchmarks and HQs for dissolved lead in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

	PRE-RUNOFF PERIOD																			
Sampling Date	**2/10**	**hardness**	**benchm.**		**3/10**	**hardness**	**benchm.**		**4/10**	**hardness**	**benchm.**		**3/11**	**hardness**	**benchm.**		**4/14**	**hardness**	**benchm.**	
Metal-fraction	**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**			
Units	**ug/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**
M34	1.5	309	8.4	0.2	2.0	308	8.4	0.2	1.7	150	3.9	0.4	4.2	247	6.6	0.6				
CC48	13.2	571	15.7	0.8	14.2	541	14.9	1.0	14.3	301	8.2	1.8	15.1	493	13.5	1.1				
A56 ("upstream")																	0.381	131	3.4	0.1
A60																				
A61																				
A64																				
A65																				
A66																				
A68	0.5	202	5.4	0.1	0.5	179	4.7	0.1	0.5	148	3.8	0.1	0.5	172	4.5	0.1	0.05	151	3.9	0.01
A72	2.7	352	9.6	0.3	1.3	337	9.2	0.1	0.5	177	4.7	0.1	1.5	273	7.4	0.2				
A73																	0.05	182	4.8	0.01
A73B																				
A75D																	0.05	133	3.4	0.01
A75B																				
Bakers Bridge																	0.05	127	3.3	0.02

	RUNOFF PERIOD																											
Sampling Date	**5/09**	**hardnes**	**benchm**		**6/09**	**hardnes**	**benchm**		**6/10**	**hardnes**	**benchm**		**6/11**	**hardnes**	**benchm**		**5/12**	**hardnes**	**benchm**		**5/13**	**hardnes**	**benchm**		**5/14**	**hardnes**	**benchm**	
Metal-fraction	**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**			
Units	**ug/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**
M34	0.5	52	1.2	0.4	0.5	72	1.8	0.3	0.5	49	1.1	0.4	0.5	53	1.3	0.4	0.1	77	1.9	0.1	0.3	79	1.9	0.1	0.1	92	2.3	0.05
CC48	4.2	81	2.0	2.1	9.6	189	5.0	1.9	8	88	2.2	3.7	9	76	1.9	4.8	8.0	177	4.7	1.7	13.1	129	3.3	3.9	6.9	126	3.2	2.1
A56 ("upstream")																					0.6	65	1.6	0.4	1.0	79	1.9	0.5
A60																					0.7	74	1.8	0.4	0.9	78	1.9	0.5
A61																					0.7	78	1.9	0.4	1.0	80	2.0	0.5
A64																					1.2	63	1.5	0.8	1.0	76	1.9	0.5
A65																					1.3	65	1.6	0.8	0.9	80	2.0	0.4
A66																					1.5	64	1.5	1.0	1.1	79	1.9	0.6
A68	0.5	49	1.1	0.4	0.5	65	1.6	0.3	0.5	50	1.2	0.4	0.5	53	1.3	0.4	0.6	71	1.7	0.4	1.3	66	1.6	0.8	1.1	87	2.2	0.5
A72	0.5	45	1.0	0.5	0.5	78	1.9	0.3	0.5	54	1.3	0.4	0.5	55	1.3	0.4	0.05	86	2.1	0.02	1.2	82	2.0	0.6	0.1	103	2.6	0.02
A73																					0.7	71	1.7	0.4	0.2	88	2.2	0.1
A73B																					0.3	37	0.8	0.4	0.1	54	1.3	0.1
A75D																					0.8	60	1.4	0.6	0.3	76	1.9	0.2
A75B																					0.8	61	1.5	0.5	0.3	70	1.7	0.2
Bakers Bridge																					0.5	58	1.4	0.4	0.3	73	1.8	0.2

	POST-RUNOFF PERIOD																											
Sampling Date	**7/09**	**hardnes**	**benchm**		**8/09**	**hardnes**	**benchm**		**9/09**	**hardnes**	**benchm**		**11/09**	**hardnes**	**benchm**		**7/10**	**hardnes**	**benchm**		**9/10**	**hardnes**	**benchm**		**11/10**	**hardnes**	**benchm**	
Metal-fraction	**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**			
Units	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**
M34	0.5	91	2.3	0.2	0.5	186	4.9	0.1	0.5	156	4.1	0.1	0.5	238	6.4	0.1	0.5	114	2.9	0.2	0.1	199	5.3	0.0	0.1	219	5.8	0.02
CC48	13	293	7.9	1.6	16.8	467	12.8	1.3	14.5	470	12.9	1.1	16.2	495	13.6	1.2	17.4	345	9.4	1.9	16.8	509	14.0	1.2	17.1	517	14.2	1.2
CC49																												
A56 ("upstream")																												
A60																												
A61																												
A64																												
A65																												
A66																												
A68	0.5	85	2.1	0.2	0.5	135	3.5	0.1	0.5	141	3.7	0.1	0.5	167	4.4	0.1	0.5	97	2.4	0.2	0.1	144	3.7	0.0	0.1	154	4.0	0.02
A69A																												
A70B																												
A71B																												
A72	0.5	109	2.8	0.2	0.5	211	5.6	0.1	0.5	199	5.3	0.1	0.5	296	8.0	0.1	0.5	136	3.5	0.1	0.1	245	6.6	0.0	0.1	232	6.2	0.02
A73																												
A73B																												
A75D																												
A75B																												
Bakers Bridge																												

	POST-RUNOFF PERIOD (continued)																							
Sampling Date	**7/11**	**hardnes**	**benchm**		**8/11**	**hardnes**	**benchm**		**9/11**	**hardnes**	**benchm**		**10/11**	**hardnes**	**benchm**		**10/12**	**hardnes**	**benchm**		**9/14**	**hardnes**	**benchm**	
Metal-fraction	**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**				**Pb-diss**			
Units	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**	**µg/L**			**HQ**
M34	0.5	65	1.6	0.3	0.5	144	3.7	0.1	0.5	188	5.0	0.1	0.5	155	4.0	0.1	0.3	220	5.9	0.04	0.1	118	3.0	0.02
CC48	8.5	191	5.1	1.7	19.2	398	10.9	1.8	21.4	474	13.0	1.6	18.7	435	11.9	1.6	11.2	515	14.2	0.8	14.2	67	1.6	8.7
CC49																	11.3	545	15.0	0.8				
A56 ("upstream")																	0.2	168	4.4	0.05	0.2	114	2.9	0.07
A60																					0.3	111	2.8	0.11
A61																					0.3	111	2.8	0.12
A64																					0.3	113	2.9	0.10
A65																					0.3	117	3.0	0.09
A66																					0.4	120	3.1	0.14
A68	0.5	66	1.6	0.3	0.5	111	2.8	0.2	0.5	140	3.6	0.1	0.5	138	3.6	0.1	0.1	174	4.6	0.02	0.4	114	2.9	0.13
A69A																	0.2	297	8.0	0.02				
A70B																	3.0	295	8.0	0.4				
A71B																	0.05	263	7.1	0.01				
A72	0.5	75	1.8	0.3	0.5	161	4.2	0.1	0.5	210	5.6	0.1	0.5	183	4.8	0.1	0.2	261	7.0	0.03	0.1	144	3.7	0.01
A73																	0.05	251	6.7	0.01	0.05	142	3.7	0.01
A73B																	0.05	217	5.8	0.01	0.05	83	2.1	0.02
A75D																	0.05	191	5.1	0.01	0.05	92	2.3	0.02
A75B																	0.05	193	5.1	0.01	0.14	85	2.1	0.07
Bakers Bridge																	0.05	183	4.8	0.01	0.05	99	2.5	0.02

Appendix 7.8: Calculating hardness-specific benchmarks and HQs for dissolved silver in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date	2/10				3/10				4/10				3/11				4/14			
Metal-fraction	Ag-dissol	hardness	benchm.		Ag-dissol	hardness	benchm.		Ag-dissol	hardness	benchm.		Ag-dissol	hardness	benchm.		Ag-dissol	hardness	benchm.	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	0.60	309	0.52	1.1	0.50	308	0.52	1.0	0.25	150	0.15	1.7	0.25	247	0.36	0.7				
CC48	0.25	571	1.50	0.2	0.25	541	1.37	0.2	0.25	301	0.50	0.5	0.25	493	1.17	0.2				
A56 ("upstream")																	0.25	131	0.12	2.1
A60																				
A61																				
A64																				
A65																				
A66																				
A68	0.25	202	0.25	1.0	0.25	179	0.20	1.2	0.25	148	0.15	1.7	0.25	172	0.19	1.3	0.25	151	0.15	1.6
A72	0.25	352	0.65	0.4	0.25	337	0.61	0.4	0.25	177	0.20	1.2	0.25	273	0.42	0.6				
A73																	0.25	182	0.21	1.2
A73B																				
A75D																	0.25	133	0.12	2.0
A75B																				
Bakers Bridge																	0.25	127	0.11	2.2

RUNOFF PERIOD

Sampling Date	5/09				6/09				6/10				6/11				5/12				5/13				5/14			
Metal-fraction	Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	0.25	52	0.02	10.3	0.25	72	0.04	5.9	0.25	49	0.02	11.4	0.25	53	0.03	9.9	0.25	77	0.05	5.2	1.25	79	0.05	25.0	0.25	92	0.07	3.8
CC48	0.25	81	0.05	4.8	0.25	189	0.22	1.1	0.25	88	0.06	4.1	0.25	76	0.05	5.3	0.25	177	0.20	1.2	2.50	129	0.12	21.5	0.25	126	0.11	2.2
A56 ("upstream")																					0.25	65	0.04	7.0	0.25	79	0.05	5.0
A60																					0.25	74	0.04	5.6	0.25	78	0.05	5.1
A61																					0.25	78	0.05	5.1	0.25	80	0.05	4.9
A64																					0.25	63	0.03	7.4	0.25	76	0.05	5.3
A65																					0.25	65	0.04	7.0	0.25	80	0.05	4.9
A66																					0.25	64	0.03	7.2	0.25	79	0.05	5.0
A68	0.25	49	0.02	11.4	0.25	65	0.04	7.0	0.25	50	0.02	11.0	0.25	53	0.03	9.9	0.25	71	0.04	6.0	0.25	66	0.04	6.8	0.25	87	0.06	4.2
A72	0.25	45	0.02	13.1	0.25	78	0.05	5.1	0.25	54	0.03	9.6	0.25	55	0.03	9.3	0.25	86	0.06	4.3	1.25	82	0.05	23.4	0.25	103	0.08	3.2
A73																					1.25	71	0.04	30.0	0.25	88	0.06	4.1
A73B																					0.25	37	0.01	18.4	0.25	54	0.03	9.6
A75D																					0.25	60	0.03	8.0	0.25	76	0.05	5.3
A75B																					0.25	61	0.03	7.8	0.25	70	0.04	6.1
Bakers Bridge																					0.25	58	0.03	8.5	0.25	73	0.04	5.7

POST-RUNOFF PERIOD

Sampling Date	7/09				8/09				9/09				11/09				7/10				9/10				11/10			
Metal-fraction	Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	0.25	91	0.06	3.9	0.25	186	0.22	1.1	0.25	156	0.16	1.5	0.25	238	0.33	0.7	0.25	114	0.09	2.7	0.05	199	0.25	0.2	0.05	219	0.29	0.2
CC48	0.25	293	0.48	0.5	0.25	467	1.06	0.2	0.25	470	1.08	0.2	0.25	495	1.18	0.2	0.25	345	0.63	0.4	0.05	509	1.23	0.04	0.05	517	1.27	0.0
CC49																												
A56 ("upstream")																												
A60																												
A61																												
A64																												
A65																												
A66																												
A68	0.25	85	0.06	4.4	0.25	135	0.13	2.0	0.25	141	0.14	1.8	0.25	167	0.18	1.4	0.25	97	0.07	3.5	0.05	144	0.14	0.4	0.05	154	0.16	0.3
A69A																												
A70B																												
A71B																												
A72	0.25	109	0.09	2.9	0.25	211	0.27	0.9	0.25	199	0.25	1.0	0.25	296	0.49	0.5	0.25	136	0.13	2.0	0.05	245	0.35	0.1	0.05	232	0.32	0.2
A73																												
A73B																												
A75D																												
A75B																												
Bakers Bridge																												

Sampling Date	7/11				8/11				9/11				10/11				12/12				9/14			
Metal-fraction	Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm		Ag-dissol	hardnes	benchm	
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	0.25	65	0.04	7.0	0.25	144	0.14	1.8	0.25	188	0.22	1.1	0.25	155	0.16	1.6	1.25	220	0.29	4.3	0.25	118	0.10	2.5
CC48	0.25	191	0.23	1.1	0.25	398	0.81	0.3	0.25	474	1.09	0.2	0.25	435	0.94	0.3	1.25	515	1.26	1.0	1.25	67	0.04	33.2
CC49																	1.25	545	1.39	0.9				
A56 ("upstream")																	0.25	168	0.18	1.4	0.25	114	0.09	2.7
A60																					0.25	111	0.09	2.8
A61																					0.25	111	0.09	2.8
A64																					0.25	113	0.09	2.7
A65																					0.25	117	0.10	2.5
A66																					0.25	120	0.10	2.4
A68	0.25	66	0.04	6.8	0.25	111	0.09	2.8	0.25	140	0.13	1.9	0.25	138	0.13	1.9	0.25	174	0.19	1.3	0.25	114	0.09	2.7
A69A																	0.25	297	0.49	0.5				
A70B																	0.25	295	0.48	0.5				
A71B																	0.25	263	0.40	0.6				
A72	0.25	75	0.05	5.5	0.25	161	0.17	1.5	0.25	210	0.27	0.9	0.25	183	0.21	1.2	0.25	261	0.39	0.6	0.25	144	0.14	1.8
A73																	0.25	251	0.37	0.7	0.25	142	0.14	1.8
A73B																	0.25	217	0.28	0.9	0.25	83	0.05	4.6
A75D																	0.25	191	0.23	1.1	0.25	92	0.07	3.8
A75B																	0.25	193	0.23	1.1	0.25	85	0.06	4.4
Bakers Bridge																	0.25	183	0.21	1.2	0.25	99	0.07	3.4

shading shows HQs > 1.0

the hardness-specific chronic surface water benchmarks for dissolved silver were calculated using the following equation: $e^{(1.72*\ln \text{hardness})-10.51}$

Appendix 7.9: Calculating hardness-specific benchmarks and HQs for dissolved zinc in surface water samples
Baseline Ecological Risk Assessment
Upper Animas River Mining District

PRE-RUNOFF PERIOD

Sampling Date	2/10	hardness	benchm.		3/10	hardness	benchm.		4/10	hardness	benchm.		3/11	hardness	benchm.		4/14	hardness	benchm.	
Metal-fraction	Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss			
Units	ug/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	328	309	338	1.0	292	308	337	0.9	499	150	175	2.8	312	247	276	1.1				
CC48	2670	571	591	4.5	2600	541	563	4.6	1600	301	330	4.8	2340	493	517	4.5				
A56 ("upstream")																	241	131	155	1.6
A60																				
A61																				
A64																				
A65																				
A66																				
A68	702	202	230	3.1	610	179	206	3.0	985	148	173	5.7	874	172	198	4.4	1030	151	176	5.8
A72	1110	352	381	2.9	1230	337	366	3.4	864	177	204	4.2	972	273	302	3.2				
A73																	701	182	209	3.4
A73B																				
A75D																	367	133	157	2.3
A75B																				
Bakers Bridge																	174	127	151	1.2

RUNOFF PERIOD

Sampling Date	5/09	hardness	benchm.		6/09	hardness	benchm.		6/10	hardness	benchm.		6/11	hardness	benchm.		5/12	hardness	benchm.		5/13	hardness	benchm.		5/14	hardness	benchm.	
Metal-fraction	Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss			
Units	ug/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	48.1	52	67	0.7	72.5	72	90	0.8	68.6	49	63	1.1	25.0	53	68	0.4	68.2	77	96	0.7	100	79	98	1.0	146	92	112	1.3
CC48	611	81	100	6.1	1080	189	216	5.0	660	88	108	6.1	614	76	94	6.5	1070	177	204	5.3	1160	129	153	7.6	1310	126	150	8.8
A56 ("upstream")																					224	65.0	82	2.7	361	79.0	98	3.7
A60																					242	74.0	92	2.6	360	78.0	97	3.7
A61																					305	78.0	97	3.2	509	80.0	99	5.1
A64																					280	63.0	80	3.5	452	76.0	94	4.8
A65																					296	65.0	82	3.6	455	80.0	99	4.6
A66																					292	64.0	81	3.6	461	79.0	98	4.7
A68	295	49	63	4.7	270	65	82	3.3	286	50	65	4.4	274	53	68	4.0	281	71	89	3.2	347	66	83	4.2	446	87	107	4.2
A72	133	45	59	2.3	249	78	97	2.6	206	54	69	3.0	217	55	70	3.1	284	86	106	2.7	369	82	101	3.6	453	103	124	3.6
A73																					242	71.0	89	2.7	364	88.0	108	3.4
A73B																					79.0	37.0	49	1.6	178	54.0	69	2.6
A75D																					140	60.0	76	1.8	217	76.0	94	2.3
A75B																					140	61.0	77	1.8	210	70.0	88	2.4
Bakers Bridge																					66.5	58.0	74	0.9	111	73.0	91	1.2

POST-RUNOFF PERIOD

Sampling Date	7/09	hardness	benchm.		8/09	hardness	benchm.		10/09	hardness	benchm.		11/09	hardness	benchm.		7/10	hardness	benchm.		9/10	hardness	benchm.		11/10	hardness	benchm.	
Metal-fraction	Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss			
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	88.7	91	111	0.8	180	186	213	0.8	175	156	182	1.0	317	238	267	1.2	106	114	137	0.8	196	199	227	0.9	242	219	247	1.0
CC48	1620	293	322	5.0	2650	467	492	5.4	2570	470	495	5.2	2650	495	519	5.1	1800	345	374	4.8	2730	509	532	5.1	2890	517	540	5.4
CC49																												
A56 ("upstream")																												
A60																												
A61																												
A64																												
A65																												
A66																												
A68	268	85	105	2.6	332	135	159	2.1	407	141	166	2.5	567	167	193	2.9	261	97	118	2.2	410	144	169	2.4	436	154	179	2.4
A69A																												
A70B																												
A71B																												
A72	313	109	131	2.4	636	211	239	2.7	617	199	227	2.7	1120	296	325	3.4	392	136	160	2.4	762	245	274	2.8	754	232	261	2.9
A73																												
A73B																												
A75D																												
A75B																												
Bakers Bridge																												

Sampling Date	7/11	hardness	benchm.		8/11	hardness	benchm.		9/11	hardness	benchm.		10/11	hardness	benchm.		10/12	hardness	benchm.		9/14	hardness	benchm.	
Metal-fraction	Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss				Zn-diss			
Units	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ	µg/L			HQ
M34	54.4	65	82	0.7	131	144	169	0.8	170	188	215	0.8	142	155	181	0.8	173	220	248	0.7	99	118	141	0.7
CC48	1090	191	218	5.0	2140	398	426	5.0	2430	474	499	4.9	2400	435	461	5.2	2590	515	538	4.8	394	67	84	4.7
CC49																	2710	545	566	4.8				
A56 ("upstream")																	189	168	194	1.0	250	114	137	1.8
A60																					266	111	133	2.0
A61																					253	111	133	1.9
A64																					260	113	135	1.9
A65																					293	117	140	2.1
A66																					341	120	143	2.4
A68	237	66	83	2.9	282	111	133	2.1	311	140	165	1.9	393	138	162	2.4	300	174	201	1.5	270	114	137	2.0
A69A																	1160	297	326	3.6				
A70B																	1160	295	324	3.6				
A71B																	743	263	292	2.5				
A72	228	75	93	2.4	467	161	187	2.5	590	210	238	2.5	549	183	210	2.6	733	261	290	2.5	362	144	169	2.1
A73																	682	251	280	2.4	327	142	167	2.0
A73B																	561	217	245	2.3	180	83	102	1.8
A75D																	427	191	218	2.0	152	92	112	1.4
A75B																	442	193	220	2.0	149	85	105	1.4
Bakers Bridge																	241	183	210	1.1	87.7	99	120	0.7

shading shows HQs > 1.0

the hardness-specific chronic surface water benchmarks for dissolved zinc were calculated using the following equation: $e^{((0.8525*\ln \text{hardness})+0.9109)*0.986}$

Appendix 8.1: Calculating sample-specific HQs for dissolved metals in pore water samples collected in April 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Hardness (mg/L)	Aluminum				Arsenic				Beryllium			
					BM	HQ			BM	HQ			BM	HQ
Animas River above mainstem Cement Creek														
A56 ("upstream")	µg/L	136	23.8 J	23.8	87	0.3	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A60	µg/L	158	20.9 J	20.9	87	0.2	0.547 J	0.547	150	0.00	<2.00 U	1.0	0.66	1.5
A61	µg/L	853	6170 D	6170	87	70.9	<5.00 U	2.5	150	0.02	<20.0 U	10.0	0.66	15
A64	µg/L	141	<20.0 U	10	87	0.1	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A65	µg/L	350	671	671	87	7.7	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A66	µg/L	141	<20.0 U	10	87	0.1	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A68	µg/L	149	42.2 J	42.2	87	0.5	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
Animas River between mainstem Cement Creek and mainstem Mineral Crreek														
A69A	µg/L													
A70B	µg/L													
Animas River below mainstem Mineral Creek														
A71B														
A72	µg/L	256	517	517	87	5.9	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A73	µg/L	185	29.2 J	29.2	87	0.3	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A73B	µg/L													
A75D	µg/L	135	27.7 J	27.7	87	0.3	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
A75B	µg/L													
Bakers Bridge	µg/L	125	47 J	47	87	0.5	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5
mainstem Cement Creek														
CC48	µg/L													
CC49	µg/L													
mainstem Mineral Creek														
M34	µg/L													

Sample Location	Cadmium			Chromium				Copper			Iron			
		BM	HQ			BM	HQ		BM	HQ			BM	HQ
Animas River above mainstem Cement Creek														
A56 ("upstream")	0.232	0.53	0.4	<1.00 U	0.5	95	0.01	1.3	12	0.1	<100 U	50	1000	0.05
A60	0.809	0.60	1.4	<1.00 U	0.5	108	0.00	1.41	13	0.1	<100 U	50	1000	0.05
A61	100 D	2.12	47.1	<10.0 U	5.0	429	0.01	2250 D	56	40.2	<1000 U	500	1000	0.5
A64	0.279	0.55	0.5	<1.00 U	0.5	98	0.01	1.83	12	0.2	<100 U	50	1000	0.05
A65	22.4	1.09	20.6	0.8 J	0.8	207	0.00	53.8	26	2.1	<100 U	50	1000	0.05
A66	0.546	0.55	1.0	1.83 J	1.83	98	0.02	1.4	12	0.1	<100 U	50	1000	0.05
A68	1.67	0.57	2.9	<1.00 U	0.5	103	0.00	3.46	13	0.3	<100 U	50	1000	0.05
Animas River between mainstem Cement Creek and mainstem Mineral Crreek														
A69A														
A70B														
Animas River below mainstem Mineral Creek														
A71B														
A72	2.98	0.86	3.5	<1.00 U	0.5	160	0.00	8.07	20	0.4	<100 U	50	1000	0.05
A73	2.03	0.67	3.0	<1.00 U	0.5	123	0.00	2.28	15	0.2	341	341	1000	0.341
A73B														
A75D	0.387	0.53	0.7	<1.00 U	0.5	95	0.01	1.67	12	0.1	<100 U	50	1000	0.05
A75B														
Bakers Bridge	0.334	0.50	0.7	1.15 J	1.15	89	0.01	2.21	11	0.2	<100 U	50	1000	0.05
mainstem Cement Creek														
CC48														
CC49														
mainstem Mineral Creek														
M34														

BM = benchmark; HQ = hazard quotient

the hardness-specific chronic surface water benchmarks for dissolved cadmium were calculated using the following equation: $((1.101672-\ln \text{hardness})*0.041838)*e^{(0.7988*\ln \text{hardness})-4.4451}$

the hardness-specific chronic surface water benchmarks for dissolved chromium were calculated using the following equation: $e^{(0.819*\ln \text{hardness})+0.534}$

the hardness-specific chronic surface water benchmarks for dissolved copper were calculated using the following equation: $e^{(0.854*\ln \text{hardness})-1.7428}$

the hardness-specific chronic surface water benchmarks for dissolved manganese were calculated using the following equation: $e^{(0.3331*\ln \text{hardness})+5.8743}$

the hardness-specific chronic surface water benchmarks for dissolved nickel were calculated using the following equation: $e^{(0.846*\ln \text{hardness})+0.0554}$

the hardness-specific chronic surface water benchmarks for dissolved lead were calculated using the following equation: $((1.46203-\ln \text{hardness})*0.145712)*e^{(1.273*\ln \text{hardness})-4.705}$

the hardness-specific chronic surface water benchmarks for dissolved silver were calculated using the following equation: $e^{(1.72*\ln \text{hardness})-10.51}$

the hardness-specific chronic surface water benchmarks for dissolved zinc were calculated using the following equation: $0.986*e^{((0.9094*\ln \text{hardness})+0.6235)}$

prepared by: SJP (2/22/15)
reviewed by:

Appendix 8.1: Calculating sample-specific HQs for dissolved metals in pore water samples collected in April 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Hardness (mg/L)	Lead				Manganese				Nickel				Selenium				Silver				Zinc		
Animas River above mainstem Cement Creek					BM	HQ			BM	HQ			BM	HQ			BM	HQ			BM	HQ		BM	HQ
A56 ("upstream")	µg/L	136	0.964	0.964	3.5	0.27	4.87 J	4.87	1828	0.00	<0.500 U	0.25	67	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.13	2.0	124	160	0.8
A60	µg/L	158	<0.100 U	0.05	4.1	0.01	<2.00 U	1.0	1921	0.00	<0.500 U	0.25	77	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.16	1.5	353	184	1.9
A61	µg/L	853	13.4 D	13.4	23.3	0.57	78300 D	78300	3369	23.24	77.5 D	77.5	319	0.24	<10.0 U	5.0	4.6	1.1	<5.00 U	2.5	3.00	0.8	29900 D	851	35.1
A64	µg/L	141	<0.100 U	0.05	3.7	0.01	4.27 J	4.27	1850	0.00	<0.500 U	0.25	70	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.14	1.8	264	166	1.6
A65	µg/L	350	2.00	2.00	9.5	0.21	18450	18450	2503	7.37	11.3	11.3	150	0.08	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.65	0.4	6230	378	16.5
A66	µg/L	141	0.123 J	0.123	3.7	0.03	226	226	1850	0.12	<0.500 U	0.25	70	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.14	1.8	307	166	1.9
A68	µg/L	149	<0.100 U	0.05	3.9	0.01	1540	1540	1884	0.82	<0.500 U	0.25	73	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.15	1.7	675	174	3.9
Animas River between mainstem Cement Creek and mainstem Mineral Crreek																									
A69A	µg/L																								
A70B	µg/L																								
Animas River below mainstem Mineral Creek																									
A71B																									
A72	µg/L	256	0.453	0.453	6.9	0.07	448	448	2256	0.20	1.95	1.95	115	0.02	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.38	0.7	1630	285	5.7
A73	µg/L	185	<0.100 U	0.05	4.9	0.01	1870	1870	2025	0.92	1.19	1.19	88	0.01	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.22	1.2	709	212	3.3
A73B	µg/L																								
A75D	µg/L	135	<0.100 U	0.05	3.5	0.01	185	185	1823	0.10	<0.500 U	0.25	67	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.13	2.0	173	159	1.1
A75B	µg/L																								
Bakers Bridge	µg/L	125	<0.100 U	0.05	3.2	0.02	325	325	1777	0.18	<0.500 U	0.25	63	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.11	2.3	115	148	0.8
mainstem Cement Creek																									
CC48	µg/L																								
CC49	µg/L																								
mainstem Mineral Creek																									
M34	µg/L																								

BM = benchmark; HQ = hazard quotient

the hardness-specific chronic surface water benchmarks for dissolved chromium were calculated using the following equation: $e^{(0.819*\ln \text{hardness})+0.534}$

the hardness-specific chronic surface water benchmarks for dissolved copper were calculated using the following equation: $e^{(0.854*\ln \text{hardness})-1.7428}$

the hardness-specific chronic surface water benchmarks for dissolved manganese were calculated using the following equation: $e^{(0.3331*\ln \text{hardness})+5.8743}$

the hardness-specific chronic surface water benchmarks for dissolved nickel were calculated using the following equation: $e^{(0.846*\ln \text{hardness})+0.0554}$

the hardness-specific chronic surface water benchmarks for dissolved lead were calculated using the following equation: $((1.46203-\ln \text{hardness})*0.145712)*e^{(1.273*\ln \text{hardness})-4.705}$

the hardness-specific chronic surface water benchmarks for dissolved silver were calculated using the following equation: $e^{(1.72*\ln \text{hardness})-10.51}$

the hardness-specific chronic surface water benchmarks for dissolved zinc were calculated using the following equation: $0.986*e^{((0.9094*\ln \text{hardness})+0.6235)}$

Appendix 8.2: Calculating sample-specific HQs for dissolved metals in pore water samples collected in September 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Hardness (mg/L)	Aluminum				Arsenic				Beryllium				Cadmium			
Animas River above mainstem Cement Creek					BM	HQ			BM	HQ			BM	HQ			BM	HQ
A56 ("upstream")	µg/L	129	28.4 J	28.4	87	0.33	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	1.16	1.16	0.51	2.3
A60	µg/L	340	119	119	87	1.37	<2.50 U	0.12	150	0.00	<2.00 U	1.0	0.66	1.5	3.86 D	3.86	1.07	3.6
A61	µg/L	497	2604.5 D	2604.5	87	29.9	<3.8 U	1.7	150	0.01	<11.0 U	5.5	0.66	8.3	106.5 D	106.5	1.42	75.2
A64	µg/L																	
A65	µg/L	389	401	401	87	4.61	<2.50 U	1.25	150	0.01	<2.00 U	1.0	0.66	1.5	22 D	22	1.18	18.7
A66	µg/L	118	<20.0 U	10	87	0.11	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	0.296	0.296	0.48	0.6
A68	µg/L	121	42.8 J	42.8	87	0.49	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	1.06	1.06	0.49	2.2
Animas River between mainstem Cement Creek and mainstem Mineral Crreek																		
A69A	µg/L																	
A70B	µg/L																	
Animas River below mainstem Mineral Creek																		
71B	µg/L																	
A72	µg/L	160	46.9 J	46.9	87	0.54	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	1.4	1.4	0.60	2.3
A73	µg/L	151	23.3 J	23.3	87	0.27	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	0.374	0.374	0.58	0.6
A73B	µg/L	49	<20.0 U	10	87	0.11	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	<0.100 U	0.05	0.25	0.2
A75D	µg/L	96	40 J	40	87	0.46	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	0.786	0.786	0.41	1.9
A75B	µg/L																	
Bakers Bridge	µg/L	271	35.2 J	35.2	87	0.4	3.74	3.74	150	0.02	<2.00 U	1.0	0.66	1.5	<0.100 U	0.5	0.90	0.6
mainstem Cement Creek																		
CC48	µg/L																	
CC49	µg/L																	
mainstem Mineral Creek																		
M34	µg/L	139	45.7 J	45.7	87	0.53	<0.500 U	0.25	150	0.00	<2.00 U	1.0	0.66	1.5	0.127 J	0.127	0.54	0.2

Sample Location	Chromium				Copper				Iron			
Animas River above mainstem Cement Creek			BM	HQ			BM	HQ			BM	HQ
A56 ("upstream")	<1.00 U	0.5	91	0.01	4.15	4.15	11	0.4	<100 U	50	1000	0.1
A60	<5.00 U	2.5	202	0.01	2.67 JD	2.67	25	0.1	<100 U	50	1000	0.1
A61	<7.5 U	3.75	275	0.01	95.9 JD	95.9	35	2.7	<550 U	275	1000	0.3
A64												
A65	<5.00 U	2.5	225	0.01	47.2 D	47.2	29	1.7	<100 U	50	1000	0.1
A66	<1.00 U	0.5	85	0.01	1.27	1.27	10	0.1	<100 U	50	1000	0.1
A68	<1.00 U	0.5	87	0.01	4.13	4.13	11	0.4	<100 U	50	1000	0.1
Animas River between mainstem Cement Creek and mainstem Mineral Crreek												
A69A												
A70B												
Animas River below mainstem Mineral Creek												
71B												
A72	<1.00 U	0.5	109	0.00	2.87	2.87	13	0.2	338	338	1000	0.3
A73	<1.00 U	0.5	104	0.00	1.18	1.18	13	0.1	<100 U	50	1000	0.1
A73B	<1.00 U	0.5	41	0.01	0.915 J	0.915	4.9	0.2	<100 U	50	1000	0.1
A75D	<1.00 U	0.5	72	0.01	2.6	2.6	8.6	0.3	107 J	107	1000	0.1
A75B												
Bakers Bridge	3.23	3.23	168	0.02	<0.500 U	0.25	21	0.0	1260	1260	1000	1.3
mainstem Cement Creek												
CC48												
CC49												
mainstem Mineral Creek												
M34	<1.00 U	0.5	97	0.01	1.18	1.18	12	0.1	<100 U	50	1000	0.1

BM = benchmark; HQ = hazard quotient

the hardness-specific chronic surface water benchmarks for cadmium were calculated using the following equation: $((1.101672\text{-ln hardness})*0.041838)*e^{(0.7988*\ln \text{hardness})-4.4451}$

the hardness-specific chronic surface water benchmarks for chromium were calculated using the following equation: $e^{(0.819*\ln \text{hardness})+0.534}$

the hardness-specific chronic surface water benchmarks for copper were calculated using the following equation: $e^{(0.854*\ln \text{hardness})-1.7428}$

the hardness-specific chronic surface water benchmarks for dissolved manganese were calculated using the following equation: $e^{(0.3331*\ln \text{hardness})+5.8743}$

the hardness-specific chronic surface water benchmarks for dissolved nickel were calculated using the following equation: $e^{(0.846*\ln \text{hardness})+0.0554}$

the hardness-specific chronic surface water benchmarks for dissolved lead were calculated using the following equation: $((1.46203\text{-ln hardness})*0.145712)*e^{(1.273*\ln \text{hardness})-4.705}$

the hardness-specific chronic surface water benchmarks for dissolved silver were calculated using the following equation: $e^{(1.72*\ln \text{hardness})-10.51}$

the hardness-specific chronic surface water benchmarks for dissolved zinc were calculated using the following equation: $0.986*e^{((0.9094*\ln \text{hardness})+0.6235)}$

prepared by: SJP (2/22/15)
reviewed by:

Appendix 8.2: Calculating sample-specific HQs for dissolved metals in pore water samples collected in September 2014
Baseline Ecological Risk Assessment
Upper Animas River Mining District

Sample Location	Units	Hardness (mg/L)	Lead				Manganese			Nickel				Selenium				Silver				Zinc		
Animas River above mainstem Cement Creek					BM	HQ		BM	HQ			BM	HQ			BM	HQ			BM	HQ		BM	HQ
A56 ("upstream")	µg/L	129	0.523	0.523	3.3	0.16	689	1796	0.38	<0.500 U	0.25	65	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.1	2.1	463	153	3.0
A60	µg/L	340	<0.500 U	0.25	9.3	0.03	6.46	2480	0.00	<2.50 U	1.25	146	0.01	<5.00 U	2.5	4.6	0.5	<2.50 U	1.25	0.6	2.0	1630	369	4.4
A61	µg/L	497	65.6 D	65.6	13.6	4.8	63800 D	2813	22.7	37.8 D	37.8	202	0.19	<7.5 U	3.8	4.6	0.8	<3.8 U	1.9	1.2	1.6	18490 D	520	35.5
A64	µg/L										13.4													
A65	µg/L	389	0.579 JD	0.579	10.6	0.05	16200	2594	6.25	13.4 D	0.25	164	0.00	<5.00 U	2.5	4.6	0.5	<2.50 U	1.25	0.8	1.6	4760	417	11.4
A66	µg/L	118	<0.100 U	0.05	3.0	0.02	2.57 J	1743	0.00	<0.500 U	0.25	60	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.1	2.5	179	141	1.3
A68	µg/L	121	0.258	0.258	3.1	0.08	590	1758	0.34	<0.500 U		61	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.1	2.4	294	144	2.0
Animas River between mainstem Cement Creek and mainstem Mineral Crreek																								
A69A	µg/L																							
A70B	µg/L																							
Animas River below mainstem Mineral Creek																								
71B	µg/L																							
A72	µg/L	160	<0.100 U	0.05	4.2	0.01	995	1929	0.52	1.31	1.31	77	0.02	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.2	1.5	407	186	2.2
A73	µg/L	151	<0.100 U	0.05	3.9	0.01	2.45 J	1892	0.00	1.35	1.35	74	0.02	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.2	1.6	362	176	2.1
A73B	µg/L	49	<0.100 U	0.05	1.1	0.04	3.37 J	1301	0.00	0.581 J	0.581	28	0.02	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.02	11.4	32.9	63	0.5
A75D	µg/L	96	0.205	0.205	2.4	0.09	290	1627	0.18	1.52	1.52	50	0.03	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.1	3.6	190	117	1.6
A75B	µg/L																							
Bakers Bridge	µg/L	271	0.193 J	0.193	7.3	0.03	5870	2299	2.6	0.85 J	0.85	121	0.01	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.4	0.6	13.3 J	300	0.0
mainstem Cement Creek																								
CC48	µg/L																							
CC49	µg/L																							
mainstem Mineral Creek																								
M34	µg/L	139	<0.100 U	0.05	3.6	0.01	27.6	1841	0.01	<0.500 U	0.25	69	0.00	<1.00 U	0.5	4.6	0.1	<0.500 U	0.25	0.1	1.9	48.2	163	0.3

BM = benchmark; HQ = hazard quotient

the hardness-specific chronic surface water benchmarks for cadmium were calculated using the following equation: $((1.101672-\ln \text{hardness})*0.041838)*e^{(0.7988*\ln \text{hardness})-4.4451}$

the hardness-specific chronic surface water benchmarks for chromium were calculated using the following equation: $e^{(0.819*\ln \text{hardness})+0.534}$

the hardness-specific chronic surface water benchmarks for copper were calculated using the following equation: $e^{(0.854*\ln \text{hardness})-1.7428}$

the hardness-specific chronic surface water benchmarks for dissolved manganese were calculated using the following equation: $e^{(0.3331*\ln \text{hardness})+5.8743}$

the hardness-specific chronic surface water benchmarks for dissolved nickel were calculated using the following equation: $e^{(0.846*\ln \text{hardness})+0.0554}$

the hardness-specific chronic surface water benchmarks for dissolved lead were calculated using the following equation: $((1.46203-\ln \text{hardness})*0.145712)*e^{(1.273*\ln \text{hardness})-4.705}$

the hardness-specific chronic surface water benchmarks for dissolved silver were calculated using the following equation: $e^{(1.72*\ln \text{hardness})-10.51}$

the hardness-specific chronic surface water benchmarks for dissolved zinc were calculated using the following equation: $0.986*e^{((0.9094*\ln \text{hardness})+0.6235)}$

prepared by: SJP (2/16/15)

Appendix 9a

Final
Upper Animas River
2012 Surface Water Toxicity Testing Report

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Acronym List

BERA	Baseline Ecological Risk Assessment
BLM	Bureau of Land Management
ºC	Degrees Celsius
CETIS	Comprehensive Environmental Toxicity Information System
DO	Dissolved Oxygen
DRMS	Division of Reclamation, Mining and Safety
EC_{50}	50% Effect Concentration
EPA	United States Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FS	Feasibility Study
gpm	Gallons Per Minute
LC_{50}	50% Lethal Concentration
LCL	Lower Confidence Limit
MHRW	Moderately Hard Reconstituted Water
mL	Milliliter
mg/L	Milligrams per liter
µg/L	Micrograms per liter
µs/cm	Microsiemens/centimeter
QA	Quality Assurance
RI	Remedial Investigation
SGC	Sunnyside Gold Corporation
UCL	Upper Confidence Limit

1.0 INTRODUCTION

Two 96-hour static renewal toxicity tests were performed at the United States Environmental Protection Agency (EPA) Region 8 Laboratory in October and November 2012 using juvenile rainbow trout (*Oncorhynchus mykiss*) to determine the acute toxicity of surface water samples collected from the Animas River and its two major tributaries Cement Creek and Mineral Creek, located in Silverton in the San Juan Country, Colorado. During the first test, conducted in October of 2012, three sets of Site samples were run consisting of an undiluted set, a set diluted with reference water from sample location A56 and another set diluted with reference water from sample location A68. As a Quality Assurance (QA) measure, a simultaneous reference toxicity test with a separate batch of juvenile rainbow trout was performed using Moderately Hard Reconstituted Water (MHRW) spiked with different concentrations of zinc sulfate heptahydrate ($ZnSO_4$).

A second Site toxicity test and concurrent reference toxicity test were conducted following the October, 2012 round of testing. This Site test consisted of three sets of diluted samples, all diluted with reference water from sample location A68. Section 2.5 below provides a detailed description of the sample preparation for all the diluted samples from the October and November 2012 Site tests.

Survival was the endpoint evaluated in all tests. This toxicity test report includes a brief background of the Upper Animas River area, materials and methods, test results, a discussion of results, and supporting references.

1.1 Background

Information in this section was obtained from the *Final 2012 Sampling and Analysis Plan/Quality Assurance Project Plan, Revision 1, Upper Animas Mining District Gladstone, San Juan County, Colorado*, dated September 2012 (Environmental Services Assistance Team [ESAT], 2012).

The discovery of gold and silver brought miners to the Silverton area and Animas Mining District in the early 1870's. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, there were 12 concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down circa 1905, and mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. After 1907, mining and milling continued throughout the basin whenever prices were favorable.

Gladstone, located about eight miles upstream of Silverton on Cement Creek, is the site of an historic mining town developed in the 1880s commensurate with the onset of mining in the surrounding area. The town was the central location and railroad terminus for the milling and shipping of mine ores from the surrounding three-square-mile valley. The town declined in the 1920 s and no remnants of the town remain. By the 1970's only one year-round producing mine (Sunnyside Mine) remained in the county. This mine ceased production in 1991, and has since undergone extensive reclamation efforts. The Gold King Mine's permit with Division of Reclamation, Mining and Safety (DRMS) is currently in inactive status; however, landowners hope to rehabilitate the mine. Both the Sunnyside and Gold King properties were partially accessed through the American Tunnel that has its portal in Gladstone.

Previously the American Tunnel drained as much as 1,600 gallons per minute (gpm) of water from the mines. A lime feed and settling pond type treatment facility was constructed in Gladstone in 1979 by Standard Metals Corporation. Water discharging from the American Tunnel was treated as required by the water discharge permit. The facility operations and mine ownership was later transferred to the Sunnyside Gold Corporation (SGC). Under jurisdiction of a court consent decree to terminate their discharge permit, SGC installed several bulkheads within the Sunnyside Mine that greatly reduced the amount of discharge from the American Tunnel. Seventy to one hundred gpm continue to discharge presumably from near surface groundwater. All terms of the consent decree were met by SGC in 2002.

In January 2003 the treatment facility, operations, and permit were transferred to the Gold King Mines Corporation. The settling ponds were deeded to the San Juan Corporation by SGC prior to the lease between the Gold King Mines and San Juan Corporations. The treatment facility continued to treat the remaining American Tunnel discharge and the Gold King discharge until September 2004. The San Juan Corporation required SGC to reclaim the four settling ponds (completed in 2005) following termination of the San Juan Corporation and SGC lease. The Gold King Mines Corporation was subsequently evicted and the balance of the Gold King Mines Corporation land was acquired by the San Juan Corporation as the lien holder. The American Tunnel portal reclamation and removal of some out buildings were completed in 2006. The Bureau of Land Management (BLM) manages land associated with the American Tunnel portal and vicinity; however, the San Juan Corporation owns the majority of the land surrounding the portal.

Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, and Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River, the confluence located about eight miles downstream of Gladstone. The Animas River Stakeholder Group, Bureau of Land Management, Division of Reclamation, Mining and Safety and private stakeholders have completed remediation projects at the Evelyne, Henrietta, Joe and John, and Lark mines. The remaining sites located in the Cement Creek drainage that will be the focus of these sampling efforts include the American Tunnel, Grand Mogul, Mogul, Red and Bonita, and the Upper Gold King 7 Level.

1.2 Objective

The objective of these toxicity tests was to characterize the effects of mine waste-impacted surface water on juvenile rainbow trout under acute exposure conditions. The results will be used to support the development of a site-wide Remedial Investigation/Feasibility Study (RI/FS) that will include a Baseline Ecological Risk Assessment (BERA) for the Animas River Site.

2.0 MATERIALS AND METHODS

This section outlines the materials and methods used for testing purposes, including surface water collection procedures, water preparation and delivery, test organisms, food preparation, and test conditions. The general test methods and testing criteria followed EPA protocol (EPA, 2002) and are summarized in **Table 2.5-1**.

2.1 Surface Water Collection

Surface water was collected in October 2012 from six locations along the Animas River. Samples from two reference locations (A56 and A68) were collected above where Cement Creek flows into the Animas River. Four Site samples (A72, A73B, A75B, and Baker Bridge) were collected downstream of the confluence with Cement Creek. Surface water was collected from two tributaries (Cement Creek and Mineral Creek) for diluting the Site samples (**Figure 2.1-1**). The water from these two tributaries was not included in the toxicity test other than as a diluent. However, analytical results for water collected from Cement Creek and Mineral Creek are included in the analytical results (**Tables 2.5-2, 2.5-3,** and **2.5-4**). The weather before and during the sampling event was sunny with no rain.

Surface water was collected in November 2012 for a follow-up Site test. Samples were collected from four locations; one reference location on the Animas River (A68) upstream of the confluence with Cement Creek, one location on the Animas River downstream of the confluence with Mineral Creek (A72), one location on Cement Creek (CC48), and one location on Mineral Creek (M34).

Adequate volume of water was collected for each sample location with a minimum of 5 gallons collected at each location. This was accomplished by using one gallon and two and a half gallon cubitainers that were dedicated for each sample location. Equipment decontamination was not necessary because cubitainers were used once. All surface water samples were stored on ice in coolers immediately after collection and were then transported to the Region 8 laboratory in

Golden, CO. All samples were placed in a 4ºC refrigerator at the laboratory for preservation until test initiation, which took place within 36 hours of the last sample collection.

2.2 Water Preparation and Renewal

The MHRW used in the reference toxicity tests was prepared in accordance with Smith *et al.* (1997) by adding 47.4 grams of calcium sulfate, 122.8 grams of magnesium sulfate heptahydrate, 96 grams of sodium bicarbonate, and 4 grams of potassium chloride to the laboratory stainless steel batch tank containing 1,000 liters of deionized water. The batch tank of MHRW was continuously aerated during the toxicity test. The water quality of the MHRW was checked to verify that the following parameters had been met: hardness between 90 and 100 milligrams per liter (mg/L), alkalinity between 50 and 70 mg/L, conductivity between 330 and 360 microsiemens/centimeter (µs/cm), and pH between 7.8 and 8.2 standard units (EPA, 2002). The average results from the four replicates for the MHRW batch water for the October test were as follows: hardness = 96 mg/L; alkalinity = 59.4 mg/L; conductivity = 312 µs/cm; and pH = 7.38. The average results from the four replicates for the MHRW for the November test were as follows: hardness= 91 mg/L; alkalinity = 55.2 mg/L; conductivity = 297.6 µs/cm; and pH = 7.63. Note that both the average conductivity and average pH of the October and November 2012 MHRW fell below the expected range.

The MHRW and site water in the test chambers were renewed entirely each day by pouring 900 mL of site water into a clean 1000 milliters (mL) glass beaker and carefully removing live organisms and placing them into the newly mixed water. Site water used for renewal was first warmed to 12 degrees Celsius (ºC). The water temperature was held constant during the 96-hour exposure period by placing all the test chambers in a temperature-controlled water bath.

2.3 Test Organisms

Juvenile rainbow trout (*O. mykiss*) obtained from Trout Lodge, Inc. (located in Sumner, Washington) were used for site water and reference toxicity testing. An importation license was obtained from the Colorado Division of Wildlife before the *O. mykiss* were shipped by the supplier. The fish in the shipping bag were placed in the holding tank after they arrived at the Region 8 laboratory to equilibrate the temperature. Once temperature was equilibrated, the shipping bag was carefully opened to allow a small amount of laboratory reconstituted water to enter the bag. This procedure was repeated several times throughout the day until laboratory MHRW and shipping water were well mixed. The fish were then released from the shipping bag into the holding tank where they were held for 5 days until used for testing. The fish were also cultured and shipped in MHRW such that water quality acclimation was not an issue. At the time of testing, organisms were 15-30 days post yolk sac absorption and were uniform in size. The average weight of the organisms was 0.28 grams at the start of the October test and an average weight of 0.84 grams at the start of the November test.

2.4 Feeding Procedure

The fish were fed starter trout chow obtained from Nelson's Silver Cup, Inc. in accordance with EPA methodology (EPA, 2002). They were fed twice daily before the test started and once daily thereafter. The fish were not fed for 24 hours before the test started in order to reduce the accumulation of metabolic wastes.

2.5 Test Procedures

The following sections discuss the procedures used for the site water toxicity test and reference toxicity tests.

2.5.1 October 2012 Site Water Toxicity Testing

Site water used for testing purposes during the October 2012 Site test was obtained from the following four locations along the Animas River: A72, A73B, A75B, and Baker Bridge (the furthest down-river sample location). Reference surface water samples were collected from sample locations A56 and A68 on the Animas River, upstream of the confluence with Cement Creek. All six samples were run un-diluted in the Site test. Surface water was also collected from Mineral Creek (M34) and Cement Creek (CC48). The water from these two tributaries was combined in a 61% (M34), 39% (CC48) ratio and then diluted using water from the reference location A56 at concentrations of 6.25%, 12.5%, 25%, 50% and 100% (see table below). The ratio of M34 and CC48 were based on the flow rate of each tributary into the Animas River.

Concentration	Volume M34* (ml)	Volume CC48** (ml)	Volume A56 (ml) (Reference Water)
M34/CC48/A56-Control	0	0	900 (MHRW)
M34/CC48/56A-6.25%	34.3	21.9	844
M34/CC48/A56-12.5%	68.6	43.9	788
M34/CC48/A56-25%	137	87.8	675
M34/CC48/A56-50%	275	176	450
M34/CC48/A56-100%	549	351	0

*Based off a flow rate of 23 cubic feet per second (61%).
** Based off a flow rate of 14 cubic feet per second (39%).

A second set of diluted samples was run using water from Reference location A68 as the diluent to a mixture of M34 and CC48. The identical ratio of M34 and CC48 were used as indicated above, except a 100% solution of M34/CC48 was not included in the Site test (see table below)

Concentration	Volume M34* (ml)	Volume CC48* (ml)	Volume A68 (ml) (Reference Water)
M34/CC48/A68-Control	0	0	900 (MHRW)
M34/CC48/A68-6.25%	34.3	21.9	844
M34/CC48/A68-12.5%	68.6	43.9	788
M34/CC48/A68-25%	137	87.8	675
M34/CC48/A68-50%	275	176	450

*Based off a flow rate of 23 cubic feet per second (61%).
** Based off a flow rate of 14 cubic feet per second (39%).

2.5.2 November 2012 Site Water Toxicity Test

Surface water for use in the November 2012 Site test was obtained from the following four locations; A68 and A72 on the Animas River, M34 from Mineral Creek, and CC48 from Cement Creek. Reference location A68 was collected on the Animas River upstream of the confluence with Cement Creek. Samples M34 and A68 were run undiluted in the Site toxicity test. Surface water from reference location A68 was used to dilute samples A72 and CC48 at various dilutions. Water from A68 was also used to dilute a mixture of CC48 and M34. The tables below explain the three sets of dilutions.

Concentration Percentage of A72 water	Volume A72 (ml)	Volume A68 (ml) (Reference water)
Control	0	900 (MHRW)
A72/A68-5%	45	855
A72/A68-10%	90	810
A72/A68-25%	225	675
A72/A68-50%	450	450

A72/A68-75%	675	225
A72/A68-100%	900	0

Concentration Percentage of CC48 water	**Volume CC48 (ml)**	**Volume A68 (ml)** (Reference water)
Control	0	900 (MHRW)
CC48/A68- 1%	9	891
CC48/A68- 3%	27	873
CC48/A68- 6%	54	846
CC48/A68- 12%	108	792
CC48/A68- 25%	225	675
CC48/A68- 50%	450	450

Concentration Percentage of CC48/M34 water	**Volume CC48 (ml)**	**Volume M34 (ml)**	**Volume A68 (ml)** (Reference water)
Control	0	0	900 (MHRW)
CC48/M34/A68-4%	12	24	864
CC48/M34/A68-9%	26	55	819
CC48/M34/A68-20%	58	122	720
CC48/M34/A68-40%	115	245	540
CC48/M34/A68-65%	187	398	315
CC48/M34/A68-85%	245	520	135

A laboratory control sample of MHRW was simultaneously tested during both the October 2012 and November 2012 Site tests to verify the health of the fish used in the test. The same test procedure was followed for each test. The test chambers consisted of 1-L glass beakers, which were placed in a water bath to maintain a constant temperature of 12º C during the 96-hour exposure period. Four replicates were tested for each location and each sample dilution, as well as the laboratory control. Testing criteria specified in EPA (2002) were followed (**Table 2.5-1**).

Ten organisms were added to each test chamber at the start of the test using a small dip net and an 8-ounce cup, in which the count was quickly verified. Four replicate chambers were used for each of the Site and reference water samples. Each chamber contained 10 fish, for a total of 40 fish per sample location, dilution series or reference test dilution.

As previously stated, each test took place over a 96-hour period, with one daily water renewal. Water quality was measured daily for Dissolved Oxygen (DO), pH, conductivity, and temperature. Water samples were analyzed for alkalinity and hardness at the start and end of each test. Fish mortality was observed daily in each test chamber and recorded. All dead organisms were removed and discarded.

Appendix A provides the water chemistry and mortality data sheets for the October 2012 Site surface water toxicity test and **Appendix B** provides the water chemistry and mortality data sheets for the November 2012 Site surface water toxicity test. Water samples were collected on Day 0 and Day 4 for the following analyses: total and dissolved metals (EPA Method 200.7/200.8), anions (EPA Method 300.0), ammonia (EPA Method 350.1), and alkalinity (EPA Method 310.1). Results from the October 2012 test for dissolved metals are included in **Table 2.5-2**. **Table 2.5-3** shows initial and final results for total recoverable metals and **Table 2.5-4** includes wet chemistry data. **Table 2.5-5a** (Site test) and **Table 2.5-5b** (reference test) show initial and final results for ammonia, as well as calculated ammonia criteria. Results from the November 2012 test for dissolved metals are included in **Table 2.5-6**. **Table 2.5-7** shows initial and final results for total recoverable metals and **Table 2.5-8** includes wet chemistry data. **Table 2.5-9a** (Site test) and **Table 2.5-9b** (reference test) shows initial and final results for ammonia, as well as calculated ammonia criteria for acute toxicity.

2.5.3 Control Water Toxicity Testing

For QA purposes, a control toxicity test using *O. mykiss* was run concurrently with the October 2012 and November 2012 Site water toxicity tests. Test solutions were made by spiking MHRW with $ZnSO_4$ solution via serial dilution. Zinc concentrations were reduced by 50% starting with the highest target concentration (1000 µg/L) until the lowest dilution concentration of 6.25% (62.5 µg/L target concentration) was reached.

The following are the dilutions and average zinc concentrations (calculated from initial and final dissolved metals results) used for the October 2012 reference test: 100% concentration (1029.5 µg/L), 50% concentration (518.5 µg/L), 25% concentration (263.5 µg/L), 12.5% concentration (131.5 µg/L), and 6.25% concentration (68.85µg/L). The following are the dilutions and average zinc concentrations (calculated from initial and final dissolved metals results) used for the November 2012 reference test: 100% concentration (874 µg/L), 50% concentration (435 µg/L), 25% concentration (220 µg/L), 12.5% concentration (107 µg/L), and 6.25% concentration (55.3µg/L).

Zinc concentrations were verified in the analytical laboratory using EPA Method 200.7/200.8. The control surface water toxicity tests were performed using the same approach as outlined at the end of **Section 2.5.2** (November 2012 Site Water Toxicity Test). Mortality and daily water chemistry data for the control tests run in October 2012 and November 2012 are included in **Appendices A and B, respectively.** The measured zinc concentrations for the October 2012 and November 2012 tests are provided in **Tables 2.5-2 and 2.5-6,** respectively.

3.0 RESULTS

This section presents the results for the Site-specific surface water and reference toxicity testing, and also addresses any issues or potentially confounding conditions encountered during the tests.

Appendix A shows that the water quality parameters were consistently within the established criteria throughout both Site water toxicity tests, with one exception. DO was consistently above 6.0 mg/L, and average test chamber temperatures were maintained within +/- 2ºC of the target test temperature (12ºC), which met performance criteria. Sample A68/CC48- Control-Rep 1 was above the target test temperature on day one, ranging from 14.48 to 15.42°C. The average initial and final ammonia levels measured in the four replicates of each of the surface water samples used in the toxicity test were compared to their pH-dependent acute ammonia criterion. **Tables 2.5-5a and 2.5-9a** show the ammonia levels for the October 2012 and November 2012 tests, respectively. All ammonia levels for both tests fell consistently below the relevant criteria. This comparison indicates that any observed toxicity was not caused by excess ammonia in the test chambers.

3.1 Site-Specific Surface Water Toxicity Test - October 2012

Daily mortality numbers were evaluated at the end of the test to determine the Site water toxicity to the test organisms (**Appendix A** and **Figure 3.1-1**). The results of the undiluted Site samples showed 100% survival at both reference locations A56 and A68. Survival was also 100% at locations A73B, A75B, and Baker Bridge. Survival at location A72 was 0%. The laboratory control showed 100% survival, which met the performance criterion of 90% survival.

A combination of water from M34 and CC48 was diluted with water from reference location A56 and run at five different dilutions (6.25%, 12.5%, 25%, 50% and 100%). The results of the acute test showed 100% survival in the 6.25%, 12.5%, and 25% dilutions. The 50% dilution had 97.5% survival while the 100% dilution (with no reference water) had 0% survival. The control, which consisted of 100% reference water from A56, had 100% survival.

A combination of M34 and CC48 surface water was diluted with water from reference location A68 and run at four different dilutions (6.25%, 12.5%, 25%, and 50%). The results of the dilutions showed 100% survival in the 6.25%, 12.5%, and 25% dilutions. The 50% dilution had 37.5% survival. A 100% dilution (with no reference water) was not run. The control sample (0% dilution), consisting of 100% reference water from A68, had 100% survival.

3.2 Control Water Toxicity Test - October 2012

Water quality parameters were similar in all testing chambers, and water chemistries were held within acceptable ranges for temperature, DO, pH, and conductivity (**Appendix B**). Zinc levels are presented as average zinc concentrations taken from the initial and final dissolved metals analysis. The control and the 6.25% concentration (68.85 µg/L zinc) had 100% survival. The 12.5% concentration (131.5 µg/L zinc) had 75% survival. The 25% (263.5 µg/L zinc) showed 5% survival. The 50% (518.5 µg/L zinc) concentration and the 100% concentration (1029.5 µg/L zinc) had 0% survival (see **Figure 3.2-1**).

The Spearman-Karber Estimates method [Comprehensive Environmental Toxicity Information System (CETIS), 2011] was used to calculate the 50% Lethal Concentration (LC_{50}) value for zinc, as well as Upper Confidence Limits (UCLs) and Lower Confidence Limits (LCLs) confidence limits. The LC_{50} value for the control toxicity test was 162.9 µg/L, with a UCL and LCL of 180.6 µg/L and 146.9 µg/L, respectively. This LC_{50} value is comparable to previous reference toxicity tests performed from 2005 through 2011. **Figure 3.5-1** provides the zinc LC_{50} control chart which shows historical LC_{50} data obtained at the Region 8 laboratory. Note that CETIS uses the term "EC50" (50% maximal Effect Concentration) instead of LC_{50}. Both terms represent the same calculated value.

3.3 Site-Specific Surface Water Toxicity Test - November 2012

Daily mortality numbers were evaluated at the end of the test to determine the Site water toxicity to the test organisms (**Appendix A** and **Figure 3.3**). The results of the undiluted Site samples showed 92.5% survival at reference location A68 and 0% survival at M34. The laboratory control showed 100% survival, which met the performance criterion of 90% survival.

Site sample A72 was diluted with water from reference location A68 and run at six different dilutions (5%, 10%, 25%, 50%, 75%, and 100%). The results of the dilutions showed A68/A72-5% with 92.5% survival while A68/A72-10% and A68/A72-25% showed 94.7% and 92.2% survival, respectively. Sample A68/A72-50% and A68/A72-75% each had 100% survival. Sample A68/A72-100% showed 2.5% survival. The A68/A72 control, which consisted of 100% A68, water had 100% survival.

Site sample CC48 was diluted with water from reference location A68 and run at six different dilutions (1%, 3%, 6%, 12%, 25%, and 50%). The results of the dilutions showed A68/CC48 1% with 85% survival while A68/CC48-3% and A68/CC48-6% had 97.5% survival. A68/CC48-12% and A68/CC48-25% showed 90% survival in each dilution. A68/CC48-50% had 0% survival. The A68/CC48 control which consisted of 100% A68 water had 100% survival.

A combination of CC48 and M34 surface water was diluted with water from reference location A68 at six different dilutions (4%, 9%, 20%, 40%, 65%, and 85%). The results of the dilutions showed A68/CC48/M34-4% with 97.5% survival, A68/CC48/M34-9% showed 95% survival, and A68/CC48/M34-20% showed 100% survival. Sample A68/CC48/M34-40% had 92.5% survival while A68/CC48/M34-65% and A68/CC48/M34-85% had 0% survival. The A68/CC48/M34 control, which consisted of 100% A68 water, had 100% survival.

Nine juvenile rainbow trout escaped from eight separate testing chambers during the November 2012 toxicity test and were found swimming in the water bath. These fish were excluded from the results and the statistical analyses. The number of fish exposed was reduced by the number of fish that escaped to prevent biasing the results (i.e. if one of the ten fish in a test chamber escaped and one of the remaining nine fish died, survival was calculated as 8/9, or 88.9%).

3.4 Control Water Toxicity Test - November 2012

Water quality parameters were similar in all testing chambers, and water chemistries were held within acceptable ranges for temperature, DO, pH, and conductivity (**Appendix B**). Zinc levels are presented as average zinc concentrations taken from the initial and final dissolved metals analysis. Survival was 100% in the control and the 6.25% concentration (55.3 µg/L zinc), and 75% in the 12.5% concentration (107 µg/L zinc). The 25% (220 µg/L zinc), 50% (435 µg/L zinc), and 100% (874 µg/L zinc) concentrations all had 0% survival, (**Figure 3.4-1)**.

The Trimmed Spearman-Karber Estimates method (CETIS, 2011) was used to calculate the LC_{50} value for zinc, as well as UCLs and LCLs. The LC_{50} for the reference toxicity test was 129.1 µg/L, with a UCL and LCL equal to 141.9 µg/L and 117.5 µg/L, respectively. The LC_{50} is comparable to previous control toxicity tests performed from 2005 through 2011. **Figure 3.5-1** provides the zinc LC_{50} control chart which shows historical LC_{50} data obtained at the Region 8 laboratory.

4.0 DISCUSSION

4.1 October 2012 Toxicity Test

Un-diluted Site Samples

Results of the site-specific surface water toxicity test conducted in October 2012 using un-diluted surface water indicated that location A72 was acutely toxic, with 0% survival, to *O. mykiss* over a 96-hour exposure period. 100% survival was observed at A56 (reference location), A68 (reference location), A73B, A75B, and Baker Bridge.

A Steel Many-One Rank Test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The Steel Many-One Rank test is a non-parametric test which was used in the analyses because the data distribution was non-normal. The data were determined to be non-normal by the Shapiro-Wilk W test because they did not follow a predictable pattern with 50% of the values greater than the mean and 50% values less than the mean. The results of the statistical analysis show the presence of significant mortality at location A72 (p = 0.0480) when compared to the laboratory control sample. No significant difference was observed in mortality between the remaining locations when compared to the laboratory control sample.

A Steel Many-One Rank Test was also used to compare the Site locations to reference locations A56 and A68. The results of this comparison were identical because both reference samples had 100% survival. There was significant mortality at sample location A72 ($p = 0.0350$) when compared to each reference location. No significant difference in mortality was observed between the remaining locations when compared to either A56 or A68.

M34/CC48 diluted with A56

Results of the Site-specific surface water toxicity test conducted in October 2012 using a combination of M34 and CC48 surface water diluted with water from reference location A56 at five different concentrations indicated that M34/CC48/A56 at 100% was acutely toxic to *O. mykiss* over a 96-hour exposure period. 100% survival was observed in M34/CC48/A56 concentrations of 6.25%, 12.5%, and 25%. M34/CC48/A56-50% had 97.5% survival. Site control sample M34/CC48/A56 (which consisted of 100% A56 surface water) had 100% survival.

A Steel Many-One Rank Test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The results of the statistical analysis show the presence of significant mortality at M34/CC48/A56-100% ($p = 0.0417$) when compared to M34/CC48/A56-Control. No significant difference was observed in mortality between the remaining dilutions when compared to the Site control sample.

M34/CC48 diluted with A68

Results of the Site-specific surface water toxicity test conducted in October 2012 using a combination of M34 and CC48 surface water diluted with water from reference location A68 at four different concentrations indicated that M34/CC48/A68 at 50% was acutely toxic to *O. mykiss* over a 96-hour exposure period, with only 37.5% survival. 100% survival was observed in M34/CC48/A68 at concentrations 6.25%, 12.5%, and 25%. The Site control sample, M34/CC48/A68, (100% A68 surface water) had 100% survival.

A Steel Many-One Rank Test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The results of the statistical analysis show the presence of significant mortality at M34/CC48/A56-100% ($p = 0.0350$) when compared to M34/CC48/A68-Control. No significant difference was observed in mortality between the remaining dilutions when compared to the Site control sample.

Summary

In conclusion, the results of the October 2012 toxicity test showed that the surface water samples collected from A72 and tested un-diluted, as well as M34/CC48/A56-100% and M34/CC48/A68-50%, were acutely toxic to juvenile rainbow trout after 96 hours of exposure. The mortality at all the other locations and dilutions were not statistically different from either the laboratory control sample or the two Animas River reference samples.

4.2 November Toxicity Test

Undiluted Samples

Results of the Site-specific surface water toxicity test conducted in November 2012 using un-diluted surface water indicated that location M34 was acutely toxic (0 % survival) to *O. mykiss* over a 96-hour exposure period when tested as an undiluted sample. 92.5% survival was observed at reference location A68. Only a M34 and A68 were run un-diluted during the November 2012 test.

An Equal Variance Two- Sample *t*-test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The data met the conditions for conducting a t-test because the sample variances were statistically equal, determined by Mod Levene Equality of Variance test and the data had normal distribution determined by Shapiro-Wilk W Normality test. The results of the statistical analysis show the presence of significant mortality at location M34 ($p = <0.0001$) when compared to A68.

Site sample A72 diluted with A68

Results of the site-specific surface water toxicity test conducted in November 2012 using A72 surface water diluted with water from reference location A68 at six different concentrations indicated that A68/A72 at 100% was acutely toxic to *O. mykiss* over a 96-hour exposure period with 2.5% survival. 100% survival was observed in the 75% and 50% dilutions. Survival in the 5%, 10% and 25% dilutions resulted in 92.5%, 94.7%, and 92.2% survival, respectively. The Site control sample, A68/A72, (100% A68 surface water) had 100% survival.

A Steel Many-One Rank Test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The results of the statistical analysis show the presence of significant mortality at A68/A72-100% ($p = 0.0480$) when compared to A68/A72-Control. No significant difference was observed in mortality between the remaining dilutions when compared to the Site control sample.

Site sample CC48 diluted with A68

Results of the Site-specific surface water toxicity test conducted in November 2012 using CC48 surface water diluted with water from reference location A68 at six different concentrations indicated that A68/CC48 at 50% was acutely toxic (0% survival) to *O. mykiss* over a 96-hour exposure period. 90% survival was observed in the 25% and 12% dilutions. The 6%, 3% and 1% dilutions resulted in 97.5%, 97.5%, and 85% survival respectively. The Site control sample, A68/CC48, (100% A68 surface water) had 100% survival.

A Steel Many-One Rank Test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The results of the statistical analysis show the presence of significant mortality at A68/CC48-50% ($p = 0.0480$) when compared to A68/CC48-Control. No significant difference was observed in mortality between the remaining dilutions when compared to the Site control sample.

CC48/M34 diluted with A68

Results of the Site-specific surface water toxicity test conducted in November 2012 using a mixture of CC48 and M34 surface water diluted with water from reference location A68 at six different concentrations indicated that A68/CC48/M34 at 65% and 85% were acutely toxic (0% survival) to *O. mykiss* over a 96-hour exposure period. 92.5% survival was observed in A68/CC48/M34-40% while 20%, 9% and 4% dilutions resulted in 100%, 95%, and 97.5% survival, respectively. The Site control sample, A68/CC48/M34, (100% A68 surface water) had 100% survival.

A Steel Many-One Rank Test was performed in order to determine the significance of the observed toxic effects (**Attachment A**). The results of the statistical analysis show the presence of significant mortality at A68/CC48-65% and A68/CC48/M34 ($p = 0.0480$, for both dilutions) when compared to A68/CC48/M34-Control. No significant difference was observed in mortality between the remaining dilutions when compared to the Site control sample.

Summary

In conclusion, the results of the November 2012 toxicity test showed that the surface water samples collected from M34 (un-diluted) as well as A68/A72-100%, A68/CC48-50%, A68/CC48/M34-65% and A68/CC48/M34-85% were acutely toxic to juvenile rainbow trout after 96 hours of exposure. The survival for all other locations and dilutions was not statistically different from either the laboratory control sample or the two reference samples.

5.0 REFERENCES

Colorado Department of Public Health and Environment, Water Quality Control Commission. 1979-2012. Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31). Amended June 11, 2012.

Comprehensive Environmental Toxicity Information System (v1.8.0.13). 2000-2011. Tidepool Scientific Software, McKinleyville, CA 95519.

EPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, fifth edition (EPA-821-R-02-012). October 2002.

ESAT. 2012. *Final 2012 Sampling and Analysis Plan/Quality Assurance Project Plan, Revision 1, Upper Animas Mining District Gladstone, San Juan County, Colorado*. September 2012.

Smith, M.E., Lazorchak, J.M., Herrin, L.E., Brewer-Swartz, S., and Thoney, W.T. 1997. A reformulated, reconstituted water for testing the freshwater amphipod, *Hyalella azteca*. Environ. Toxicol. Chem. 16: 1229-1233.

Tables

Table 2.5-1 Summary of Test Conditions

October 2012 and November 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O. mykiss*

Test Parameter	Criteria
Test Type	Static Renewal
Test Duration	96-Hour
Temperature	12°C ± 2°C
Light Quality	Ambient Laboratory Illumination
Light Intensity	50-100 ft-c
Photo Period	16 Hours Light, 8 Hours Dark
Test Chamber Size	1 liter
Test Solution Volume	900mL
Renewal of Test Solutions	Daily
Age of Test Organisms	15-30 Days Post Yolk-Sac Absorption
No. Replicate Chambers per Concentration	Four
No. Organisms per Chamber	Ten
No. Organisms per Concentration	40
Feeding Regime	Feeding Not Required
Test Chamber Cleaning	Cleaning Not Required
Test Solution Aeration	Not Exceeding 100 Bubbles per Minute
Dissolved Oxygen	≥6.0 mg/L
Dilution Water	Moderatley Hard Reconstituted Water
End Point	Mortality
Sample Holding Time	36 hours after collection of last sample
Test Acceptability	≥90% survival in controls

Table 2.5-2 Initial and Final Dissolved Metals Results
October 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O.mykiss*

Initial Dissolved Metals (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness (mg/L)	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River, Mineral creek, and Cement Creek surface water samples																								
Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13800	<1.00U	<0.100U	0.736J	96	<100U	<0.100U	14900	<2.00U	0.543J	2210	<0.500U	<0.500U	26900	79.4	<0.500U	<2.00U	<10.0U
Baker Bridge	<20.0U	<0.500U	<0.500U	32.0	<2.00U	0.760	71500	<1.00U	2.42	<0.500U	206	<100U	<0.100U	6690	682	0.829J	1080	<0.500U	<0.500U	3240	649	<0.500U	<2.00U	333
A75B	<20.0U	<0.500U	<0.500U	29.3	<2.00U	1.03	73200	<1.00U	3.87	<0.500U	208	<100U	<0.100U	6080	912	1.95	1020	<0.500U	<0.500U	3290	688	<0.500U	<2.00U	437
A73B	321	<0.500U	<0.500U	24.8	<2.00U	1.61	87200	<1.00U	6.08	8.17	243	429	0.115J	6170	1410	3.11	975J	<0.500U	<0.500U	3450	882	<0.500U	<2.00U	695
A56	29.9J	<0.500U	<0.500U	25.0	<2.00U	0.399	62000	<1.00U	<0.100U	<0.500U	170	<100U	0.218	3580	121	<0.500U	684J	<0.500U	<0.500U	2670	600	<0.500U	<2.00U	165
A72	753	<0.500U	<0.500U	21.5	<2.00U	2.07	108000	<1.00U	7.96	12.6	299	2520	0.574	7050	1910	3.66	1100	<0.500U	<0.500U	4070	1090	<0.500U	<2.00U	864
A68	51.6	<0.500U	<0.500U	24.6	<2.00U	1.26	67000	<1.00U	<0.100U	1.89	183	<100U	0.414	3750	1600	<0.500U	689J	<0.500U	<0.500U	2830	666	<0.500U	<2.00U	374
M34	834	<0.500U	<0.500U	25.0	<2.00U	0.809	94600	<1.00U	9.02	5.19	268	4420	0.735B	7660	536	1.84	833J	0.517J	<0.500U	4390	870	<0.500U	<2.00U	211
CC48	7960D	<5.00U	<5.00U	<50.0U	<20.0U	5.46D	200000D	<10.0U	27.3D	71.0D	546D	6360D	13.7BD	11700D	5330D	16.4D	<2500U	<5.00U	<5.00U	5050JD	2400D	<5.00U	<20.0U	2730D
Combined sample M34/CC48 serially diluted by Animas River surface water sample A56																								
M34/CC48/A56 Control																								
M34/CC48/A56 6.25%	76.0	<0.500U	<0.500U	24.7	<2.00U	1.22	70500	<1.00U	0.805	1.68	193	<100U	<0.100U	4090	1640	<0.500U	735J	0.530J	<0.500U	3010	714	<0.500U	<2.00U	399
M34/CC48/A56 12.5%	33.2J	<0.500U	<0.500U	24.9	<2.00U	0.654	70800	<1.00U	1.63	1.62	194	372	<0.100U	4290	399	0.830J	770J	<0.500U	<0.500U	2950	706	<0.500U	<2.00U	276
M34/CC48/A56 25%	49.8J	<0.500U	<0.500U	24.9	<2.00U	0.854	79700	<1.00U	3.46	2.66	220	822	<0.100U	4990	675	1.75	821J	<0.500U	<0.500U	3220	810	<0.500U	<2.00U	404
M34/CC48/A56 50%	582	<0.500U	<0.500U	22.6	<2.00U	1.37	97700	<1.00U	7.47	9.70	270	1680	0.601B	6360	1240	2.83	986J	<0.500U	<0.500U	3680	1020	<0.500U	<2.00U	654
M34/CC48/A56 100%	3780	<0.500U	<0.500U	18.2	<2.00U	2.45	138000	<1.00U	14.8	25.0	382	4610	5.39B	9230	2410	5.57	1330	0.933J	<0.500U	4620	1430	<0.500U	<2.00U	1190
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																								
M34/CC48/A68 Control																								
M34/CC48/A68 6.25%	70.8	<0.500U	<0.500U	26.1	<2.00U	0.484	65600	<1.00U	0.392	1.29	180	151J	<0.100U	3940	261	<0.500U	735J	1.07	<0.500U	2860	656	<0.500U	<2.00U	219
M34/CC48/A68 12.5%	48.4J	<0.500U	<0.500U	24.5	<2.00U	1.25	71400	<1.00U	1.16	1.06	196	178J	<0.100U	4220	1610	0.518J	744J	<0.500U	<0.500U	3020	724	<0.500U	<2.00U	385
M34/CC48/A68 25%	52.4	<0.500U	<0.500U	23.0	<2.00U	1.46	84000	<1.00U	3.66	2.47	231	615	<0.100U	5150	1800	1.55	847J	0.542J	<0.500U	3330	867	<0.500U	<2.00U	555
M34/CC48/A68 50%	476	<0.500U	<0.500U	22.3	<2.00U	1.73	101000	<1.00U	6.95	8.50	278	1210	0.355JB	6470	1980	2.57	1010	0.772J	<0.500U	3770	1050	<0.500U	<2.00U	768
Reference toxicity test																								
Control-Ref	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13800	<1.00U	<0.100U	0.503J	96	<100U	<0.100U	14900	<2.00U	<0.500U	2220	<0.500U	<0.500U	26800	79.4	<0.500U	<2.00U	<10.0U
6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13900	<1.00U	<0.100U	0.694J	96	<100U	<0.100U	14900	<2.00U	<0.500U	2200	<0.500U	<0.500U	26700	79.1	<0.500U	<2.00U	70.0
12.50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14000	<1.00U	<0.100U	0.686J	96	<100U	<0.100U	14900	<2.00U	<0.500U	2230	<0.500U	<0.500U	26400	78.7	<0.500U	<2.00U	142
25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14100	<1.00U	<0.100U	0.617J	96	<100U	<0.100U	14900	<2.00U	<0.500U	2170	<0.500U	<0.500U	26300	78.6	<0.500U	<2.00U	279
50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14000	<1.00U	<0.100U	0.630J	96	<100U	<0.100U	14900	<2.00U	<0.500U	2190	<0.500U	<0.500U	26300	78.6	<0.500U	<2.00U	543
100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14000	2.03	<0.100U	0.577J	96	<100U	<0.100U	14700	<2.00U	<0.500U	2170	<0.500U	<0.500U	26100	78.2	<0.500U	<2.00U	1080

Final Dissolved Metals (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness (mg/L)	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River surface water samples																								
Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13400	1.90J	<0.100U	0.820J	95	<100U	<0.100U	14900	<2.00U	<0.500U	2440	<0.500U	<0.500U	27000	80.5	<0.500U	<2.00U	<10.0U
Baker Bridge	<20.0U	<0.500U	<0.500U	32.5	<2.00U	0.844	68000	<1.00U	2.39	<0.500U	197	<100U	<0.100U	6530	648	2.30	1380	<0.500U	<0.500U	3180	627	<0.500U	<2.00U	302
A75B	<20.0U	<0.500U	<0.500U	29.5	<2.00U	1.01	72100	<1.00U	3.63	0.718J	205	<100U	<0.100U	6100	902	2.14	1220	<0.500U	<0.500U	3300	693	<0.500U	<2.00U	411
A73B	62.2	<0.500U	<0.500U	24.7	<2.00U	1.66	85700	<1.00U	5.87	3.62	239	<100U	<0.100U	6140	1380	3.01	1250	<0.500U	<0.500U	3540	871	<0.500U	<2.00U	645
A56	21.5J	<0.500U	<0.500U	25.1	<2.00U	0.415	60700	<1.00U	<0.100U	0.676J	166	<100U	<0.100U	3590	106	<0.500U	882J	<0.500U	<0.500U	2680	598	<0.500U	<2.00U	149
A72	560	<0.500U	<0.500U	20.0	<2.00U	2.04	107000	<1.00U	7.42	10.0	296	1420	0.110J	7060	1840	3.03	2350	0.519J	<0.500U	4790	1060	<0.500U	<2.00U	812
A68	34.6J	<0.500U	<0.500U	24.6	<2.00U	1.20	65800	<1.00U	<0.100U	1.71	180	<100U	<0.100U	3720	1590	<0.500U	920J	<0.500U	<0.500U	2820	658	<0.500U	<2.00U	356
Combined sample M34/CC48 serially diluted by Animas River surface water sample A56																								
M34/CC48/A56 Control																								
M34/CC48/A56 6.25%	33.8J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	64500	<5.00U	0.650JD	<2.50U	177	<100U	<0.500U	3970	258	<2.50U	926J	<2.50U	<2.50U	2880	652	<2.50U	<10.0U	174
M34/CC48/A56 12.5%	20.3J	<2.50U	<2.50U	25.0JD	<2.00U	0.536JD	69700	12.9D	1.70D	<2.50U	192	<100U	<0.500U	4270	398	8.68D	951J	<2.50U	<2.50U	2960	699	<2.50U	<10.0U	211
M34/CC48/A56 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	0.696JD	78700	<5.00U	3.62D	<2.50U	217	<100U	<0.500U	5010	682	<2.50U	1050	<2.50U	<2.50U	3220	813	<2.50U	<10.0U	306
M34/CC48/A56 50%	51.2	<5.00U	<5.00U	<50.0U	<2.00U	1.56JD	98400	<10.0U	8.09D	<5.00U	272	420	<1.00U	6430	1230	5.79JD	1390	<5.00U	<5.00U	4050	1020	<5.00U	<20.0U	622
M34/CC48/A56 100%	5740	<5.00U	<5.00U	<50.0U	<2.00U	2.27D	139000	22.9D	15.4D	35.3D	385	1220	4.72BD	9440	2380	19.8D	4180	6.96JD	<5.00U	5760	1430	<5.00U	<20.0U	1180
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																								
M34/CC48/A68 Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	<5.00U	<0.500U	<2.50U	94	<100U	<0.500U	14800	<2.00U	<2.50U	2430	<2.50U	<2.50U	26900	80.1	<2.50U	<10.0U	<10.0U
M34/CC48/A68 6.25%	34.6J	<2.50U	<2.50U	25.7JD	<2.00U	1.23D	70900	<5.00U	0.930JD	3.47JD	194	<100U	<0.500U	4120	1630	<2.50U	794J	<2.50U	<2.50U	3310	716	<2.50U	<10.0U	364
M34/CC48/A68 12.5%	24.3J	<2.50U	<2.50U	<25.0U	<2.00U	1.14D	74000	<5.00U	1.69D	3.75JD	203	<100U	<0.500U	4440	1660	<2.50U	720J	<2.50U	<2.50U	3460	764	<2.50U	<10.0U	372
M34/CC48/A68 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	1.42D	83400	<5.00U	3.71D	3.40JD	230	<100U	<0.500U	5170	1770	<2.50U	866J	<2.50U	<2.50U	3710	863	<2.50U	<10.0U	466
M34/CC48/A68 50%	42.5J	<5.00U	<5.00U	<50.0U	<2.00U	1.91JD	101000	<10.0U	7.40D	<5.00U	278	375	<1.00U	6590	1960	5.89JD	1360	<5.00U	<5.00U	4210	1040	<5.00U	<20.0U	730
Reference toxicity test																								
Control-Ref	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13200	3.13	<0.100U	1.81	94	<100U	<0.100U	14800	<2.00U	1.21	2440	0.872J	<0.500U	27000	79.2	<0.500U	<2.00U	<10.0U
6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13800	1.40J	<0.100U	0.826J	97	<100U	<0.100U	15300	<2.00U	<0.500U	2450	<0.500U	<0.500U	27400	82.1	<0.500U	<2.00U	67.7
12.50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13000	1.10J	<0.100U	1.34	91	<100U	<0.100U	14300	<2.00U	<0.500U	2410	<0.500U	<0.500U	26400	75.8	<0.500U	<2.00U	121
25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13500	2.76	<0.100U	1.26	95	<100U	<0.100U	14800	<2.00U	1.09	3410	<0.500U	<0.500U	27400	78.8	<0.500U	<2.00U	248
50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13700	3.58	<0.100U	0.927J	95	<100U	<0.100U	14900	<2.00U	0.918J	3050	<0.500U	<0.500U	27200	78.3	<0.500U	<2.00U	494
100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13600	<1.00U	<0.100U	<0.500U	94	<100U	<0.100U	14600	<2.00U	<0.500U	2730	<0.500U	<0.500U	26500	78.2	<0.500U	<2.00U	979

* No analytical data is available

Qualifiers:

D= Diluted sample

J= Estimated value

U= Non-detect

Prepared by: EC 3.7.13

Reviewed by: BGK 3.11.13

Table 2.5-3 Initial and Final Total Recoverable Metals Results
October 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O.mykiss*

Initial Total Metals (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River, Mineral Creek, and Cement Creek surface water samples																							
Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	5.60JD	<0.500U	<2.50U	<100U	<0.500U	14000	<2.00U	<2.50U	2070	<2.50U	<2.50U	25300	78.0	<2.50U	<10.0U	<10.0U
Bbridge	285	<2.50U	<2.50U	31.6JD	<2.00U	0.853JD	69500	<5.00U	2.50D	<2.50U	284	<0.500U	6390	677	<2.50U	1010	<2.50U	<2.50U	3050	641	<2.50U	<10.0U	334
A75B	1560	<2.50U	<2.50U	30.1JD	<2.00U	1.03D	71400	<5.00U	3.73D	7.99D	1830	2.21D	5790	920	<2.50U	970J	<2.50U	<2.50U	3080	688	<2.50U	<10.0U	495
A73B	2450	<2.50U	<2.50U	<25.0U	<2.00U	1.69D	85500	<5.00U	5.81D	13.9D	3290	3.65D	5920	1410	<2.50U	933J	<2.50U	<2.50U	3240	875	<2.50U	<10.0U	659
A56	<20.0U	<2.50U	<2.50U	25.9JD	<2.00U	<0.500U	60300	5.37JD	<0.500U	<2.50U	<100U	0.549JD	3440	123	<2.50U	636J	<2.50U	<2.50U	2530	597	<2.50U	<10.0U	160
A72	3730	<2.50U	2.62JD	<25.0U	<2.00U	1.93D	105000	<5.00U	7.47D	17.2D	6220	6.32D	6700	1890	2.87JD	1020	<2.50U	<2.50U	3810	1080	<2.50U	<10.0U	830
A68	62.9	<2.50U	<2.50U	25.3JD	<2.00U	1.29D	64900	<5.00U	<0.500U	3.17JD	<100U	1.42D	3530	1580	<2.50U	667J	<2.50U	<2.50U	2620	657	<2.50U	<10.0U	354
M34	3900	<2.50U	<2.50U	<25.0U	<2.00U	0.663JD	91500	<5.00U	9.34D	6.83D	5730	2.49D	7230	532	<2.50U	744J	<2.50U	<2.50U	4070	853	<2.50U	<10.0U	197
CC48	7390D	<5.00U	<5.00U	<50.0U	<20.0U	3.58D	199000D	<10.0U	16.9D	43.3D	13800D	9.63D	11300D	5370D	10.5D	<2500U	<5.00U	<5.00U	4630JD	2380D	7.83JD	<20.0U	2720D
Combined sample M34/CC48 serially diluted by Animas River surface water sample A56																							
M34/CC48/A56 Control*																							
M34/CC48/A56 6.25%	386	<2.50U	<2.50U	<25.0U	<2.00U	1.45D	69700	<5.00U	0.725JD	3.91JD	588	1.47D	3960	1660	<2.50U	698J	<2.50U	<2.50U	2860	715	<2.50U	<10.0U	411
M34/CC48/A56 12.5%	651	<2.50U	<2.50U	<25.0U	<2.00U	0.705JD	68100	<5.00U	1.42D	4.47JD	1030	1.19D	4060	402	<2.50U	705J	<2.50U	<2.50U	2750	700	<2.50U	<10.0U	272
M34/CC48/A56 25%	1290	<2.50U	<2.50U	<25.0U	<2.00U	0.912JD	76600	<5.00U	3.26D	7.24D	2040	2.27D	4700	663	<2.50U	784J	<2.50U	<2.50U	2980	785	<2.50U	<10.0U	390
M34/CC48/A56 50%	2670	<2.50U	<2.50U	<25.0U	<2.00U	1.39D	96900	<5.00U	7.25D	13.6D	4270	3.29D	6190	1250	2.52JD	939J	<2.50U	<2.50U	3500	1020	<2.50U	<10.0U	653
M34/CC48/A56 100%	5530	<2.50U	<2.50U	<25.0U	<2.00U	2.32D	136000	<5.00U	16.0D	29.6D	8720	6.70D	8880	2400	6.53D	1220	<2.50U	<2.50U	4360	1420	<2.50U	<10.0U	1160
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																							
M34/CC48/A68 Control*																							
M34/CC48/A68 6.25%	323	<2.50U	<2.50U	25.2JD	<2.00U	<0.500U	63500	<5.00U	0.537JD	<2.50U	510	0.872JD	3740	262	<2.50U	648J	<2.50U	<2.50U	2650	647	<2.50U	<10.0U	216
M34/CC48/A68 12.5%	561	<2.50U	<2.50U	<25.0U	<2.00U	1.37D	70300	<5.00U	1.22D	5.12D	830	1.60D	4040	1630	<2.50U	688J	<2.50U	<2.50U	2830	721	<2.50U	<10.0U	403
M34/CC48/A68 25%	1490	<2.50U	<2.50U	<25.0U	<2.00U	1.62D	80900	<5.00U	3.92D	9.58D	2170	2.65D	4870	1780	<2.50U	781J	<2.50U	<2.50U	3100	852	<2.50U	<10.0U	547
M34/CC48/A68 50%	2610	<2.50U	<2.50U	<25.0U	<2.00U	1.64D	100000	<5.00U	7.66D	15.0D	4070	3.40D	6310	2010	2.95JD	932J	<2.50U	<2.50U	3610	1060	<2.50U	<10.0U	751
Reference toxicity test																							
Control-Ref	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	<5.00U	<0.500U	<2.50U	<100U	<0.500U	14200	<2.00U	<2.50U	2110	<2.50U	<2.50U	25500	78.7	<2.50U	<10.0U	<10.0U
6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13600	5.15JD	<0.500U	<2.50U	<100U	<0.500U	14300	<2.00U	<2.50U	2100	<2.50U	<2.50U	25600	79.5	<2.50U	<10.0U	66.2
12.50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13500	19.9D	<0.500U	2.59JD	<100U	0.877JD	14300	<2.00U	9.83D	2140	<2.50U	<2.50U	25400	78.6	3.79JD	<10.0U	132
25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	7.14JD	<0.500U	<2.50U	<100U	<0.500U	14000	<2.00U	2.75JD	2090	<2.50U	<2.50U	25100	78.3	<2.50U	<10.0U	259
50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13400	<5.00U	<0.500U	<2.50U	<100U	<0.500U	14200	<2.00U	<2.50U	2110	<2.50U	<2.50U	25400	79.0	<2.50U	<10.0U	516
100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13400	<5.00U	<0.500U	<2.50U	<100U	<0.500U	14100	<2.00U	<2.50U	2170	<2.50U	<2.50U	25300	78.2	<2.50U	<10.0U	1000

Final Total Metals (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River surface water samples																							
Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	17.0D	<0.500U	<2.50U	<100U	<0.500U	14500	<2.00U	6.19D	2450	<2.50U	<2.50U	26200	81.0	<2.50U	<10.0U	<10.0U
Bbridge	147	<2.50U	<2.50U	32.2JD	<2.00U	0.856JD	67300	7.01JD	2.60D	<2.50U	114J	<0.500U	6460	662	<2.50U	1360	<2.50U	<2.50U	3130	658	<2.50U	<10.0U	306
A75B	557	<2.50U	<2.50U	31.4JD	<2.00U	1.16D	70500	5.61JD	3.85D	3.17JD	576	0.931JD	5970	911	<2.50U	1240	<2.50U	<2.50U	3250	711	<2.50U	<10.0U	424
A73B	568	<2.50U	<2.50U	25.5JD	<2.00U	1.53D	82800	5.80JD	6.15D	5.97D	644	0.935JD	5990	1390	<2.50U	1250	<2.50U	<2.50U	3490	883	<2.50U	<10.0U	621
A56	38.9J	<2.50U	<2.50U	26.0JD	<2.00U	0.579JD	58600	6.01JD	<0.500U	<2.50U	<100U	1.33D	3470	114	<2.50U	880J	4.89JD	<2.50U	2600	605	<2.50U	<10.0U	147
A72	831	<2.50U	<2.50U	<25.0U	<2.00U	1.96D	103000	5.11JD	8.24D	11.6D	1750	0.841JD	6820	1860	3.13JD	2350	4.98JD	<2.50U	4660	1090	<2.50U	<10.0U	786
A68	72.7	<2.50U	<2.50U	<25.0U	<2.00U	1.25D	62000	6.00JD	<0.500U	2.97JD	<100U	1.25D	3570	1550	<2.50U	928J	4.44JD	<2.50U	2720	653	<2.50U	<10.0U	333
Combined sample M34/CC48 serially diluted by Animas River surface water sample A56																							
M34/CC48/A56 Control*																							
M34/CC48/A56 6.25%	308	<2.50U	<2.50U	26.5JD	<2.00U	0.663JD	64300	5.16JD	0.574JD	<2.50U	463	0.831JD	3890	265	<2.50U	930J	<2.50U	<2.50U	2800	675	<2.50U	<10.0U	201
M34/CC48/A56 12.5%	412	<2.50U	<2.50U	26.4JD	<2.00U	0.583JD	67400	5.31JD	1.41D	<2.50U	625	0.960JD	4170	400	<2.50U	967J	3.29JBD	<2.50U	2880	717	<2.50U	<10.0U	238
M34/CC48/A56 25%	601	<2.50U	<2.50U	<25.0U	<2.00U	0.722JD	76700	<5.00U	3.46D	3.03JD	951	1.30D	4890	683	<2.50U	1070	5.23JBD	<2.50U	3130	825	<2.50U	<10.0U	328
M34/CC48/A56 50%	1540	<2.50U	<2.50U	<25.0U	<2.00U	1.49D	95100	<5.00U	7.03D	7.96D	2620	2.12D	6240	1230	<2.50U	1410	6.03JBD	<2.50U	3950	1020	<2.50U	<10.0U	616
M34/CC48/A56 100%	5700	<2.50U	<2.50U	<25.0U	<2.00U	2.67D	135000	<5.00U	15.2D	27.3D	1930	5.12D	9170	2400	5.94D	4180	<2.50U	<2.50U	5600	1470	<2.50U	<10.0U	1140
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																							
M34/CC48/A68 Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	7.61JD	<0.500U	<2.50U	<100U	<0.500U	14300	<2.00U	<2.50U	2440	<2.50U	<2.50U	26000	81.2	<2.50U	<10.0U	<10.0U
M34/CC48/A68 6.25%	335	<2.50U	<2.50U	26.1JD	<2.00U	1.26D	68900	5.33JD	0.842JD	4.00JD	474	1.55D	3960	1630	<2.50U	795J	<2.50U	<2.50U	3170	723	<2.50U	<10.0U	382
M34/CC48/A68 12.5%	577	<2.50U	<2.50U	<25.0U	<2.00U	1.32D	73000	5.25JD	1.79D	5.00D	809	1.91D	4300	1670	<2.50U	722J	<2.50U	<2.50U	3290	775	<2.50U	<10.0U	419
M34/CC48/A68 25%	1190	<2.50U	<2.50U	<25.0U	<2.00U	1.58D	81300	<5.00U	3.87D	7.94D	1710	2.57D	4970	1770	<2.50U	869J	<2.50U	<2.50U	3530	873	<2.50U	<10.0U	523
M34/CC48/A68 50%	753	<2.50U	<2.50U	<25.0U	<2.00U	1.83D	100000	<5.00U	7.70D	6.11D	1310	0.956JD	6360	1970	3.45JD	1330	<2.50U	<2.50U	4010	1060	<2.50U	<10.0U	709
Reference toxicity test																							
Control-Ref	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13200	<5.00U	<0.500U	<2.50U	<100U	<0.500U	14500	<2.00U	<2.50U	2440	7.76JBD	<2.50U	26300	84.3	<2.50U	<10.0U	<10.0U
6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13100	6.02JD	<0.500U	<2.50U	<100U	<0.500U	14700	<2.00U	<2.50U	2460	5.17D	<2.50U	26600	81.6	<2.50U	<10.0U	60.1
12.50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	5.84JD	<0.500U	<2.50U	<100U	0.580JD	14600	<2.00U	<2.50U	2470	3.38JD	<2.50U	26200	80.8	3.60JD	<10.0U	121
25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	8.14JD	<0.500U	<2.50U	<100U	<0.500U	14500	<2.00U	2.71JD	3390	<2.50U	<2.50U	26600	80.0	<2.50U	<10.0U	238
50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	5.05JD	<0.500U	<2.50U	<100U	<0.500U	14500	<2.00U	<2.50U	3060	4.65JD	<2.50U	26600	80.3	<2.50U	<10.0U	465
100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13100	<5.00U	<0.500U	<2.50U	<100U	<0.500U	14100	<2.00U	<2.50U	2740	<2.50U	<2.50U	25500	78.4	<2.50U	<10.0U	910

* No Aanalytical data is available

Qualifiers:

D= Diluted sample

J= Estimated value

U= Non-detect

Prepared by: EC 3.7.13

Reviewed by: BGK 3.11.3

Table 2.5-4 Initial and Final Wet Chemistry Results
October 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O.mykiss*

Initial Wet Chemistry Results (mg/L)

STATION_ID	Chloride	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Dissolved Organic Carbon	Total Alkalinity (mg CaCO3/L)
Profile test of the Animas River, Mineral Creek, and Cement Creek surface water samples						
Control	2.3	<0.1U	<0.2U	84.3	<1.0U	59.4
Baker Bridge	16.8JD	4.3D	<2.0U	1730D	<1.0U	26.5
A75B	1.6J	0.4	<0.2U	184	<1.0U	17.1
A73B	1.5J	0.5	<0.2U	234	<1.0U	<5.00U
A56	1.3J	0.5	<0.2U	127	<1.0U	37.8
A72	<10.0U	<1.0U	<2.0U	263D	<1.0U	<5.00U
A68	1.2J	0.5	<0.2U	141	<1.0U	35.8
M34	<10.0U	<1.0U	<2.0U	232D	<1.0U	<5.00U
CC48	<1.0U	0.2	<0.2U	60.9	<1.0U	<5.00U
Combined sample M34/CC48 serially diluted by Animas River surface water sample A56						
M34/CC48/A56 Control*	--	--	--	--	--	--
M34/CC48/A56 6.25%	1.3J	0.5	<0.2U	145	<1.0U	32.3
M34/CC48/A56 100%	<10.0U	<1.0U	<2.0U	357D	<1.0U	<5.00U
M34/CC48/A56 12.5%	1.3J	0.5	<0.2U	162	<1.0U	27.5
M34/CC48/A56 25%	1.3J	0.5	<0.2U	196	<1.0U	17.5
M34/CC48/A56 50%	<10.0U	<1.0U	<2.0U	239D	<1.0U	<5.00U
M34/CC48/A56 100%	<10.0U	<1.0U	<2.0U	357D	<1.0U	<5.00U
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68						
M34/CC48/A68 Control*	--	--	--	--	--	--
M34/CC48/A68 6.25%	1.2J	0.5	<0.2U	158	<1.0U	31.6
M34/CC48/A68 12.5%	1.3J	0.5	<0.2U	164	<1.0U	31.2
M34/CC48/A68 25%	1.2J	0.6	<0.2U	210	<1.0U	17.6
M34/CC48/A68 50%	<10.0U	<1.0U	<2.0U	254D	<1.0U	<5.00U
Reference toxicity test						
Control-Ref	2.3	<0.1U	<0.2U	84.1	<1.0U	56.6
6.25%	2.3	<0.1U	<0.2U	84.3	<1.0U	60.0
12.50%	2.3	<0.1U	<0.2U	84.3	<1.0U	56.7
25%	2.3	<0.1U	<0.2U	85.0	<1.0U	59.5
50%	2.3	<0.1U	<0.2U	85.2	<1.0U	58.4
100%	2.3	<0.1U	<0.2U	84.3	<1.0U	60.5

Final Wet Chemistry Results (mg/L)

STATION_ID	Chloride	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Dissolved Organic Carbon	Total Alkalinity (mg CaCO3/L)
Profile test of the Animas River, Mineral Creek, and Cement Creek surface water samples						
Control	2.3	<0.1U	<0.2U	85.0	<1.0U	61.0
Baker Bridge	<10.0U	<1.0U	<2.0U	160D	<1.0U	31.8
A75B	1.6J	0.4	<0.2U	183	<1.0U	20.5
A73B	1.6J	0.4	<0.2U	232	<1.0U	<5.00U
A56	1.3J	0.4	<0.2U	125	<1.0U	40.9
A72	<10.0U	1.6JD	<2.0U	282D	3.1	<5.00U
A68	1.2J	0.5	<0.2U	139	<1.0U	42.7
Combined sample M34/CC48 serially diluted by Animas River surface water sample A56						
M34/CC48/A56 Control*	--	--	--	--	--	--
M34/CC48/A56 6.25%	1.3J	0.5	<0.2U	144	<1.0U	37.1
M34/CC48/A56 12.5%	1.2J	0.5	<0.2U	161	<1.0U	32.0
M34/CC48/A56 25%	1.3J	0.5	<0.2U	195	1.0	19.5
M34/CC48/A56 50%	<10.0U	<1.0U	<2.0U	242D	<1.0U	5.82
M34/CC48/A56 100%	<10.0U	<1.0U	<2.0U	371D	6.3	<5.00U
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68						
M34/CC48/A68 Control	2.4	<0.1U	<0.2U	85.3	<1.0U	72.2
M34/CC48/A68 6.25%	1.7J	0.5	<0.2U	157	1.2	35.7
M34/CC48/A68 12.5%	1.7J	0.5	<0.2U	173	1.1	28.1
M34/CC48/A68 25%	1.8J	0.5	<0.2U	206	1.0	19.5
M34/CC48/A68 50%	<10.0U	<1.0U	<2.0U	248D	1.3	5.00
Reference toxicity test						
Control-Ref	2.3	<0.1U	<0.2U	84.6	<1.0U	70.5
Ref 6.25%	2.3	<0.1U	<0.2U	85.3	<1.0U	63.8
Ref 12.50%	2.3	<0.1U	<0.2U	85.4	<1.0U	66.3
Ref 25%	3.4	<0.1U	<0.2U	85.4	1.6	64.0
Ref 50%	3.1	<0.1U	<0.2U	84.8	1.3	62.4
Ref 100%	2.8	<0.1U	<0.2U	85.7	<1.0U	59.7

* No analytical data is available

Qualifiers:

D= Diluted sample

J= Estimated value

U= Non-detect

Prepared by: EC 3.7.13

Reviewed by: BGK 3.11.13

Table 2.5-5a: Initial and Final Average Ammonia Results for October 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O. mykiss*

Replicate ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)[a]	Day 4 Measured Ammonia Conc. (mg N/L)[b]	Day 4 Measured pH [b]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)[a]
PROFILE TEST										
Control-01	0.09422	7.3	0.0932	7.38	15.87	0.9190	7.5	0.9231	7.58	11.84
Control-02	0.09144	7.4				0.8345	7.6			
Control-03	0.08965	7.4				0.9018	7.6			
Control-04	0.09735	7.4				1.0370	7.6			
A56-01	0.10340	6.9	0.1012	7.00	24.10	1.0190	7.0	0.9032	7.10	21.94
A56-02	0.09974	7.0				0.8928	7.2			
A56-03	0.09829	7.0				0.8984	7.1			
A56-04	0.10330	7.1				0.8024	7.1			
A68-01	0.06243	7.2	0.0627	7.23	19.17	0.9075	7.3	0.9958	7.38	15.87
A68-02	0.06379	7.2				1.0410	7.4			
A68-03	0.06102	7.2				1.0590	7.4			
A68-04	0.06375	7.3				0.9758	7.4			
A72-01	0.10640	5.5	0.1072	5.50	38.25	1.1350	6.2	0.8267	6.03	36.59
A72-02	0.10750	5.5				0.7567	6.1			
A72-03	0.10750	5.5				0.4720	5.9			
A72-04	0.10740	5.5				0.9430	5.9			
A73B-01	0.11070	6.3	0.1149	6.15	35.86	1.1990	7.1	1.0718	6.85	27.12
A73B-02	0.11420	6.1				1.1250	6.9			
A73B-03	0.11800	6.1				1.0270	6.7			
A73B-04	0.11680	6.1				0.9361	6.7			
A75B-01	0.10380	7.1	0.1016	7.10	21.94	0.9501	7.4	0.9497	7.35	16.41
A75B-02	0.10130	7.1				0.9315	7.4			
A75B-03	0.10340	7.1				0.8740	7.3			
A75B-04	0.09803	7.1				1.0430	7.3			
Baker Bridge-01	0.11120	7.1	0.1088	7.10	21.94	0.9039	7.4	0.9099	7.40	15.34
Baker Bridge-02	0.10180	7.1				0.8546	7.4			
Baker Bridge-03	0.10270	7.1				0.8947	7.4			
Baker Bridge-04	0.11930	7.1				0.9865	7.4			
SERIAL DILUTION OF SAMPLE 34/48 WITH 56 AS THE DILUENT										
34/48/56 -Control-01	0.05895	7.6	0.0608	7.45	14.30	0.8217	7.6	0.8483	7.68	10.06
34/48/56 -Control-02	0.06058	7.4				0.8818	7.7			
34/48/56 -Control-03	0.06092	7.4				0.8147	7.7			
34/48/56 -Control-04	0.06276	7.4				0.8750	7.7			
34/48/56-6.25%-01	0.06189	7.3	0.0619	7.28	18.06	0.9375	7.6	0.8716	7.53	12.79
34/48/56-6.25%-02	0.06267	7.2				0.8028	7.5			
34/48/56-6.25%-03	0.06153	7.3				0.8767	7.5			
34/48/56-6.25%-04	0.06162	7.3				0.8695	7.5			
34/48/56-12.5%-01	0.05990	7.2	0.0570	7.20	19.73	0.8763	7.5	0.8755	7.43	14.81
34/48/56-12.5%-02	0.05917	7.2				0.9640	7.4			
34/48/56-12.5%-03	0.05431	7.2				0.8171	7.4			
34/48/56-12.5%-04	0.05476	7.2				0.8446	7.4			
34/48/56-25%-01	0.05823	7.1	0.0581	7.08	22.49	0.9556	7.4	0.9013	7.38	15.87
34/48/56-25%-02	0.05733	7.1				0.8771	7.4			
34/48/56-25%-03	0.05855	7.1				0.9341	7.3			
34/48/56-25%-04	0.05816	7.0				0.8384	7.4			
34/48/56-50%-01	0.05896	6.2	0.0581	6.18	35.69	0.9973	7.1	0.9348	6.98	24.63
34/48/56-50%-02	0.05784	6.2				1.0670	7.0			
34/48/56-50%-03	0.05704	6.2				0.7439	6.9			
34/48/56-50%-04	0.05855	6.1				0.9308	6.9			
34/48/56-100%-01	0.05955	3.9	0.0594	3.85	38.98	1.6430	4.2	0.7493	4.15	38.97
34/48/56-100%-02	0.05658	3.9				0.4627	4.1			
34/48/56-100%-03	0.06055	3.8				0.3219	4.1			
34/48/56-100%-04	0.06089	3.8				0.5694	4.2			
SERIAL DILUTION OF SAMPLE 34/48 WITH 68AS THE DILUENT										
34/48/68 Control-01	0.05814	7.2	0.0580	7.23	19.17	0.8449	7.3	0.8699	7.48	13.79
34/48/68 Control-02	0.05853	7.2				0.8881	7.4			
34/48/68 Control-03	0.05827	7.2				0.8595	7.6			
34/48/68 Control-04	0.05719	7.3				0.8872	7.6			
34/48/68-6.25%-01	0.17650	7.3	0.1822	7.33	16.96	0.5949	7.7	0.6156	7.60	11.37
34/48/68-6.25%-02	0.19660	7.3				0.6748	7.6			
34/48/68-6.25%-03	0.16030	7.3				0.5602	7.6			
34/48/68-6.25%-04	0.19520	7.4				0.6323	7.5			
34/48/68-12.5%-01	0.17150	7.3	0.1607	7.25	18.61	0.6344	7.6	0.6206	7.55	12.31
34/48/68-12.5%-02	0.15250	7.3				0.5795	7.6			
34/48/68-12.5%-03	0.15520	7.2				0.6419	7.5			
34/48/68-12.5%-04	0.16350	7.2				0.6265	7.5			
34/48/68-25%-01	0.16250	7.1	0.1656	6.98	24.63	0.6199	7.4	0.7245	7.45	14.30
34/48/68-25%-02	0.17310	6.9				0.8713	7.5			
34/48/68-25%-03	0.15450	7.0				0.6583	7.4			
34/48/68-25%-04	0.17230	6.9				0.7485	7.5			
34/48/68-50%-01	0.14220	6.1	0.1414	6.03	36.59	0.8853	7.1	0.9240	7.00	24.10
34/48/68-50%-02	0.14290	5.9				1.0520	7.1			
34/48/68-50%-03	0.14380	6.0				0.9768	6.9			
34/48/68-50%-04	0.13680	6.1				0.7819	6.9			

[a] The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b] Values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed.

Prepared by: EC 3/7/13

Reviewed by: BGK 3/13/13

Table 2.5-5b Initial and Final Average Ammonia Results for October 2012 Upper Animas River Concurrent Reference Toxicity Test Using Juvenile O. mykiss

Replicate ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)[a]	Day 4 Measured Ammonia Conc. (mg N/L)[b]	Day 4 Measured pH[b]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)[a]
Ref Control-01	0.08144	7.40	0.0831	7.50	13.28	0.7470	7.60	0.7812	7.63	10.92
Ref Control-02	0.08438	7.50				0.8759	7.60			
Ref Control-03	0.08350	7.50				0.7547	7.70			
Ref Control-04	0.08304	7.60				0.7471	7.60			
6.25%-01	0.07884	7.50	0.0844	7.55	12.31	0.8604	7.60	0.8056	7.60	11.37
6.25%-02	0.08514	7.50				0.7369	7.60			
6.25%-03	0.08633	7.60				0.7664	7.60			
6.25%-04	0.08711	7.60				0.8588	7.60			
12.5%-01	0.06867	7.60	0.0693	7.60	11.37	0.5868	7.60	0.7010	7.65	10.49
12.5%-02	0.06773	7.60				0.6369	7.70			
12.5%-03	0.07157	7.60				0.8041	7.70			
12.5%-04	0.06908	7.60				0.7761	7.60			
25%-01	0.06999	7.60	0.0710	7.60	11.37	0.3805	7.60	0.4599	7.70	9.64
25%-02	0.07186	7.60				0.6962	7.70			
25%-03	0.07181	7.60				0.2761	7.70			
25%-04	0.07049	7.60				0.4869	7.80			
50%-01	0.06989	7.60	0.0699	7.60	11.37	0.2685	7.70	0.3577	7.75	8.85
50%-02	0.07212	7.60				0.2968	7.80			
50%-03	0.06837	7.60				0.5770	7.70			
50%-04	0.06923	7.60				0.2884	7.80			
100%-01	0.08044	7.60	0.0726	7.60	11.37	0.2373	7.70	0.2477	7.70	9.64
100%-02	0.06943	7.60				0.2355	7.70			
100%-03	0.06942	7.60				0.3495	7.80			
100%-04	0.07124	7.60				0.1686	7.60			

[a] The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b] Values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed.

Prepared by:EC 3/7/13

Reviewed by: BGK 3/11/13

Table 2.5-6 Initial and Final Dissolved Metals Results
November 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O.mykiss*

Initial Analytical Data (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness (mg/L)	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River, Mineral Creek, and Cement Creek surface water samples																								
Profile Control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13000	<1.00U	<0.100	0.544J	91	<100U	<0.100	14100	<2.00U	<0.500	2040	<0.500U	<0.500	25500	73.4	<0.500	<2.00U	<10.0U
A72	965	<2.50U	<2.50U	<25.0U	<2.00U	2.10D	107000	<5.00U	8.95D	17.0D	296	2770	0.849JD	7000	1860	5.13D	1080	<2.50U	<2.50U	4060	1080	<2.50U	<10.0U	827
A68	55.5	<0.500U	<0.500	24.1	<2.00U	1.40	66400	<1.00U	<0.100	1.56J	181	<100U	0.212	3730	1870	<0.500	695J	<0.500U	<0.500	2780	660	<0.500	<2.00U	397
CC48	7700D	<5.00U	<5.00U	<50.0U	<10.0U	5.51D	196000	<10.0U	26.1D	71.0D	536D	6460D	13.1D	11400D	5380D	17.2D	2040JD	<5.00U	<5.00U	4760JD	2370D	<5.00U	<20.0U	2710D
M34	1200	<2.50U	<2.50U	<25.0U	<2.00U	0.789JD	97600	<5.00U	10.1D	6.91D	276	5060	1.03D	7790	585	3.25JD	835J	<2.50U	<2.50U	4470	942	<2.50U	<10.0U	216
Aminas River surface water sample A72 serially diluted by Animas River surface water sample A68																								
A68/A72 control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13100	<1.00U	<0.100	<0.500	92	<100U	<0.100	14500	<2.00U	<0.500	2100	<0.500U	<0.500	26100	78.1	<0.500	<2.00U	<10.0U
A68/A72 5%	67.8	<0.500U	<0.500	23.5	<2.00U	1.40	68500	<1.00U	0.509	1.02J	187	<100U	<0.100	3890	1860	0.840J	682J	<0.500U	<0.500	2860	688	<0.500	<2.00U	389
A68/A72 10%	73.0	<0.500U	<0.500	23.3	<2.00U	1.41	70600	2.43	0.963	1.97J	193	172J	<0.100	4120	1870	2.65	742J	<0.500U	<0.500	2970	715	<0.500	<2.00U	423
A68/A72 25%	33.4J	<0.500U	<0.500	22.5	<2.00U	1.48	76300	<1.00U	2.07	1.86J	209	492	<0.100	4570	1860	1.66	791J	0.643J	<0.500	3150	771	<0.500	<2.00U	482
A68/A72 50%	38.2J	<0.500U	<0.500	22.6	<2.00U	1.74	86500	<1.00U	4.06	3.92	238	1250	<0.100	5440	1700	2.21	920J	0.796J	<0.500	3490	805	<0.500	<2.00U	566
A68/A72 75%	197	<0.500U	<0.500	21.7	<2.00U	1.92	90300	<1.00U	6.27	8.80	250	1880	0.126J	5880	1940	3.84	918J	<0.500U	<0.500	3640	1030	<0.500	<2.00U	727
A68/A72 100%	990	<0.500U	<0.500	20.9	<2.00U	2.12	107000	3.41	8.47	15.0	298	2730	0.860	7130	1910	6.47	1080	0.664J	<0.500	4120	1130	<0.500	<2.00U	835
Cement Creek surface water sample CC48 serially diluted by Animas River surface water sample A68																								
A68/CC48 Control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13100	1.36J	<0.100	0.580J	92	<100U	<0.100	14400	<2.00U	0.709J	2090	<0.500U	<0.500	26200	74.9	<0.500	<2.00U	<10.0U
A68/CC48 1%	101	<0.500U	<0.500	23.9	<2.00U	1.42	67500	<1.00U	0.347	2.07	184	<100U	0.127J	3820	1890	0.748J	700J	<0.500U	<0.500	2840	686	<0.500	<2.00U	410
A68/CC48 3%	72.2	<0.500U	<0.500	23.9	<2.00U	1.47	70700	<1.00U	0.879	1.91J	193	<100U	0.107J	3980	1960	1.52	729J	<0.500U	<0.500	2910	720	<0.500	<2.00U	447
A68/CC48 6%	76.7	<0.500U	<0.500	24.1	<2.00U	1.52	74500	1.22J	1.59	2.67	204	129J	<0.100	4250	2060	1.80	760J	0.728J	<0.500	3000	770	<0.500	<2.00U	516
A68/CC48 12%	56.5	<0.500U	<0.500	22.2	<2.00U	1.84	82600	<1.00U	3.01	2.85	226	248J	<0.100	4710	2310	2.50	843J	0.690J	<0.500	3090	886	<0.500	<2.00U	655
A68/CC48 25%	403	<0.500U	<0.500	20.5	<2.00U	2.34	99600	<1.00U	6.15	8.48	272	483	0.227	5740	2690	4.41	1030	0.520J	<0.500	3380	1070	<0.500	<2.00U	954
A68/CC48 50%	3870	<2.50U	<2.50U	<25.0U	<2.00U	3.26D	134000	6.67JD	12.5D	32.1D	368	1090	4.28D	7830	3510	11.7D	1400	<2.50U	<2.50U	3950	1480	<2.50U	<10.0U	1510
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																								
A68/M34/CC48 Control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13200	<1.00U	<0.100	0.755J	91	<100U	<0.100	14200	<2.00U	<0.500	2030	<0.500U	<0.500	25500	73.2	<0.500	<2.00U	<10.0U
A68/M34/CC48 4%	99.7	<0.500U	<0.500	23.6	<2.00U	1.39	67800	<1.00U	0.561	1.39	185	150J	<0.100	3890	1850	<0.500	721J	<0.500U	<0.500	2880	690	<0.500	<2.00U	397
A68/M34/CC48 9%	84.1	<0.500U	<0.500	23.8	<2.00U	1.48	72600	<1.00U	1.22	1.83	199	373	<0.100	4190	1880	1.00	719J	<0.500U	<0.500	2960	723	<0.500	<2.00U	433
A68/M34/CC48 20%	73.3	<0.500U	<0.500	22.6	<2.00U	1.56	77500	<1.00U	2.91	2.68	213	783	0.119J	4700	1880	2.35	772J	<0.500U	<0.500	3150	802	<0.500	<2.00U	485
A68/M34/CC48 40%	332	<2.50U	<2.50U	<25.0U	<2.00U	1.82D	88300	<5.00U	5.88D	11.1D	244	1600	0.524JD	5680	1910	3.68JD	890J	<2.50U	<2.50U	3480	930	<2.50U	<10.0U	612
A68/M34/CC48 65%	1580	<2.50U	<2.50U	<25.0U	<2.00U	1.92D	107000	<5.00U	9.67D	18.7D	296	2670	1.90D	7150	1960	5.41D	1060	<2.50U	<2.50U	4000	1100	<2.50U	<10.0U	758
A68/M34/CC48 85%	2900	<2.50U	<2.50U	<25.0U	<2.00U	2.26D	118000	5.45JD	12.6D	28.9D	328	3770	5.19D	8190	1980	9.29D	1140	<2.50U	<2.50U	4440	1220	<2.50U	<10.0U	870
Reference toxicity test																								
Control-Ref	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13100	<1.00U	<0.100	<0.500	91	<100U	<0.100	14100	<2.00U	<0.500	2010	<0.500U	<0.500	25400	72.8	<0.500	<2.00U	<10.0U
Ref 6.25%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13000	<1.00U	<0.100	<0.500	90	<100U	<0.100	14100	<2.00U	<0.500	2020	<0.500U	<0.500	25300	73.9	<0.500	<2.00U	57.9
Ref 12.5%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13100	<1.00U	<0.100	0.519J	91	<100U	<0.100	14200	<2.00U	<0.500	2040	<0.500U	<0.500	25600	71.7	<0.500	<2.00U	108
Ref 25%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13100	<1.00U	<0.100	<0.500	91	<100U	<0.100	14200	<2.00U	<0.500	2040	<0.500U	<0.500	25500	73.2	<0.500	<2.00U	214
Ref 50%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13000	<1.00U	<0.100	0.594J	91	<100U	<0.100	14200	<2.00U	<0.500	2040	<0.500U	<0.500	25500	73.2	<0.500	<2.00U	430
Ref 100%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12900	<1.00U	<0.100	0.835J	90	<100U	<0.100	14000	<2.00U	<0.500	2030	<0.500U	<0.500	25300	75.3	<0.500	<2.00U	866

Final Analytical Data (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness (mg/L)	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River and Mineral Creek surface water samples																								
Profile Control	25.1J	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12800	<1.00U	<0.100	1.12	93	<100U	<0.100	14800	<2.00U	<0.500	2500	<0.500U	<0.500	27100	78.5	<0.500	<2.00U	<10.0U
A68	43.9J	<0.500U	<0.500	23.3	<2.00U	1.21	64700	<1.00U	<0.100	2.16	177	<100U	0.106J	3710	1720	<0.500	909J	1.25JB	<0.500	2990	661	<0.500	<2.00U	413
M34	248	<2.50U	<2.50U	<25.0U	<2.00U	0.712JD	99500	<5.00U	8.80D	3.14JD	282	4270	<0.500	8250	592	2.56JD	4010	<2.50U	<2.50U	7380	937	<2.50U	<10.0U	230
Aminas River surface water sample A72 serially diluted by Animas River surface water sample A68																								
A68/A72 control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12700	<1.00U	<0.100	1.35	93	<100U	<0.100	14800	<2.00U	<0.500	2440	<0.500U	<0.500	27200	78.1	<0.500	<2.00U	<10.0U
A68/A72 5%	53.7	<0.500U	<0.500	23.4	<2.00U	1.43	68400	<1.00U	0.480	2.75	187	<100U	<0.100	4000	1910	<0.500	860J	<0.500U	<0.500	3070	701	<0.500	<2.00U	388
A68/A72 10%	46.4J	<0.500U	<0.500	23.5	<2.00U	1.29	70100	1.02J	0.860	2.66	192	<100U	<0.100	4110	1880	0.572J	869J	2.32B	<0.500	3100	720	<0.500	<2.00U	389
A68/A72 25%	41.7J	<0.500U	<0.500	22.5	<2.00U	1.39	76200	<1.00U	1.97	2.62	209	<100U	0.230	4620	1900	0.961J	952J	1.10JB	<0.500	3230	787	<0.500	<2.00U	411
A68/A72 50%	<20.0U	<0.500U	<0.500	20.8	<2.00U	1.54	86100	<1.00U	4.15	1.62	238	<100U	<0.100	5450	1900	2.18	1150	<0.500U	<0.500	3600	898	<0.500	<2.00U	521
A68/A72 75%	20.5J	<0.500U	<0.500	21.2	<2.00U	1.88	96600	<1.00U	6.26	2.12	267	206J	<0.100	6300	1890	3.35	1390	<0.500U	<0.500	4490	1000	<0.500	<2.00U	693
A68/A72 100%	1170	<0.500U	<0.500	19.8	<2.00U	2.08	108000	<1.00U	8.88	14.5	298	758	0.633	7160	1870	4.29	1870	<0.500U	<0.500	4740	1090	<0.500	<2.00U	852
Aminas River surface water sample CC48 serially diluted by Animas River surface water sample A68																								
A68/CC48 Control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12800	1.09J	<0.100	1.42	93	<100U	<0.100	14800	<2.00U	<0.500	2440	<0.500U	<0.500	27000	78.3	<0.500	<2.00U	<10.0U
A68/CC48 1%	72.6	<0.500U	<0.500	23.0	<2.00U	1.35	66800	<1.00U	0.279	1.93	183	<100U	<0.100	3920	1910	0.654J	1020	<0.500U	<0.500	3230	696	<0.500	<2.00U	395
A68/CC48 3%	65.4	<0.500U	<0.500	22.6	<2.00U	1.38	66700	1.30J	0.742	2.13	182	<100U	<0.100	3850	1800	0.690J	899J	0.572JB	<0.500	3000	698	<0.500	<2.00U	431
A68/CC48 6%	56.4	<0.500U	<0.500	22.3	<2.00U	1.46	73400	<1.00U	1.47	2.78	201	<100U	<0.100	4240	1950	1.12	1020	1.12JB	<0.500	3100	776	<0.500	<2.00U	461
A68/CC48 12%	39.7J	<0.500U	<0.500	21.3	<2.00U	1.75	82200	<1.00U	3.17	2.55	225	<100U	<0.100	4790	2170	2.83	1110	<0.500U	<0.500	3350	878	<0.500	<2.00U	573
A68/CC48 25%	34.1J	<0.500U	<0.500	19.6	<2.00U	2.27	98300	<1.00U	6.39	4.32	269	<100U	<0.100	5750	2600	5.15	1390	<0.500U	<0.500	3780	1070	<0.500	<2.00U	820
A68/CC48 50%	2530	<0.500U	<0.500	17.3	<2.00U	3.42	135000	<1.00U	12.1	24.9	371	179J	2.33	8030	3620	7.87	3300	1.68JB	<0.500	9320	1510	<0.500	<2.00U	1560
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																								
A68/M34/CC48 Control	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12600	<1.00U	<0.100	1.16	92	<100U	<0.100	14700	<2.00U	<0.500	2390	<0.500U	<0.500	26600	77.7	<0.500	<2.00U	<10.0U
A68/M34/CC48 4%	60.6	<0.500U	<0.500	23.2	<2.00U	1.30	68100	<1.00U	0.615	2.17	187	<100U	<0.100	4020	1760	0.875J	860J	1.46	<0.500	3180	707	<0.500	<2.00U	408
A68/M34/CC48 9%	40.8J	<0.500U	<0.500	23.2	<2.00U	1.22	71500	<1.00U	1.28	2.11	196	<100U	0.769	4280	1780	0.767J	923J	0.523J	<0.500	3180	741	<0.500	<2.00U	402
A68/M34/CC48 20%	31.6J	<0.500U	<0.500	22.9	<2.00U	1.32	78700	<1.00U	2.70	1.70	217	<100U	0.249	4890	1810	1.35	1100	0.706J	<0.500	3540	816	<0.500	<2.00U	413
A68/M34/CC48 40%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	1.71D	90400	<5.00U	5.62D	7.71D	250	<100U	0.587JD	5930	1890	4.93JD	1250	<2.50U	<2.50U	4040	943	<2.50U	<10.0U	572
A68/M34/CC48 65%	1460	<2.50U	<2.50U	<25.0U	<2.00U	2.01D	109000	<5.00U	9.06D	16.5D	302	1340	1.36D	7440	1980	6.24D	1800	3.35JD	<2.50U	4620	1130	<2.50U	<10.0U	815
A68/M34/CC48 85%	2400	<2.50U	<2.50U	<25.0U	<2.00U	2.26D	122000	<5.00U	12.7D	20.4D	341	2690	2.81D	8600	2080	6.32D	2680	3.54JD	<2.50U	9760	1270	<2.50U	<10.0U	921
Reference toxicity test																								
Control-Ref	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12700	<1.00U	<0.100	0.617J	93	<100U	<0.100	14800	<2.00U	<0.500	2550	<0.500U	<0.500	27100	78.1	<0.500	<2.00U	<10.0U
Ref 6.25%	<20.0U	<0.500U	1.82J	<5.00U	<2.00U	<0.100U	12600	<1.00U	<0.100	0.902J	92	101J	0.279	14800	<2.00U	<0.500	2550	<0.500U	<0.500	27200	78.1	<0.500	<2.00U	52.7
Ref 12.5%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	12700	<1.00U	<0.100	1.02	93	<100U	<0.100	14800	<2.00U	<0.500	2350	1.03J	<0.500	27000	77.9	<0.500	<2.00U	106
Ref 25%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13300	1.58J	<0.100	<0.500	94	<100U	<0.100	14800	<2.00U	<0.500	2540	<0.500U	<0.500	27100	78.3	<0.500	<2.00U	226
Ref 50%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13300	2.01	<0.100	0.657J	94	<100U	<0.100	14900	<2.00U	<0.500	3710	<0.500U	<0.500	27600	78.0	<0.500	<2.00U	440
Ref 100%	<20.0U	<0.500U	<0.500	<5.00U	<2.00U	<0.100U	13300	1.96J	<0.100	<0.500	94	<100U	<0.100	14700	<2.00U	<0.500	3550	0.921J	<0.500	27400	77.6	<0.500	<2.00U	882

Qualifiers:
D= Diluted sample
J= Estimated value
U= Non-detect

Prepared by: EC 3/8/13
Reviewed by: EB 3/13/13

Table 2.5-7 Initial and Final Total Recoverable Metals Results
November 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O.mykiss*

Initial Analytical Data (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River, Mineral Creek, and Cement Creek Surface water samples																							
Profile Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13200	6.34JD	<0.500U	<2.50U	<100U	<0.500U	14000	<2.00U	<2.50U	2000	<2.50U	<2.50U	25200	76.8	<2.50U	<10.0U	<10.0U
A68	102	<2.50U	<2.50U	<25.0U	<2.00U	1.86D	64500	<5.00U	<0.500U	3.56JD	104J	8.37D	3610	1900	<2.50U	765J	<2.50U	<2.50U	2750	671	<2.50U	<10.0U	410
A72	3420	<2.50U	<2.50U	<25.0U	<2.00U	1.89D	106000	6.07JD	7.91D	18.6D	5920	5.78D	6770	1910	2.78JD	1080	<2.50U	<2.50U	3910	1100	<2.50U	<10.0U	850
CC48	8080D	<2.50U	2.73JD	<25.0U	<10.0U	5.58D	210000	5.11JD	25.2D	65.5D	16000D	16.2D	11900D	5550D	12.6D	2050JD	<2.50U	<2.50U	4880JD	2420D	<2.50U	<10.0U	2860D
M34	4560	<2.50U	<2.50U	<25.0U	<2.00U	0.914JD	98700	<5.00U	9.97D	7.33D	7080	3.24D	7750	590	<2.50U	856J	<2.50U	<2.50U	4390	931	<2.50U	<10.0U	220
Animas River surface water sample A72 serially diluted by Animas River surface water sample A68																							
A68/A72 control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12800	5.76JD	<0.500U	<2.50U	<100U	2.88D	13900	<2.00U	<2.50U	2000	<2.50U	<2.50U	25200	76.2	<2.50U	<10.0U	<10.0U
A68/A72 5%	293	<2.50U	<2.50U	<25.0U	<2.00U	1.72D	66900	5.52JD	<0.500U	4.01JD	464	7.69D	3760	1900	<2.50U	706J	2.94JD	<2.50U	2780	702	<2.50U	<10.0U	432
A68/A72 10%	448	<2.50U	<2.50U	<25.0U	<2.00U	1.85D	68800	8.10JD	0.869JD	5.46D	727	4.16D	3900	1890	<2.50U	718J	<2.50U	<2.50U	2800	715	4.77JD	<10.0U	446
A68/A72 25%	873	<2.50U	<2.50U	<25.0U	<2.00U	2.07D	74900	5.05JD	2.20D	8.86D	1480	8.24D	4430	1920	<2.50U	799J	<2.50U	<2.50U	3070	794	<2.50U	<10.0U	526
A68/A72 50%	1330	<2.50U	<2.50U	<25.0U	<2.00U	2.21D	85600	5.37JD	4.09D	10.2D	2470	8.56D	5250	1900	<2.50U	871J	<2.50U	<2.50U	3370	891	<2.50U	<10.0U	620
A68/A72 75%	2380	<2.50U	<2.50U	<25.0U	<2.00U	1.96D	95100	5.21JD	6.32D	14.8D	4120	7.11D	6170	1920	<2.50U	988J	<2.50U	<2.50U	3830	1010	<2.50U	<10.0U	740
A68/A72 100%	3010	<2.50U	<2.50U	<25.0U	<2.00U	3.04D	105000	5.05JD	8.24D	18.8D	5330	10.6D	6850	1900	4.62JD	1120	<2.50U	<2.50U	3980	1120	<2.50U	<10.0U	842
Cement Creek surface wtaer sample CC48 serially diluted by Animas River surface water sample A68																							
A68/CC48 Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	5.53JD	<0.500U	<2.50U	<100U	<0.500U	14100	<2.00U	<2.50U	2030	<2.50U	<2.50U	25500	77.0	<2.50U	<10.0U	<10.0U
A68/CC48 1%	168	<2.50U	<2.50U	<25.0U	<2.00U	1.89D	67000	6.87JD	<0.500U	3.67JD	216J	4.71D	3730	1950	<2.50U	717J	<2.50U	<2.50U	2780	697	<2.50U	<10.0U	427
A68/CC48 3%	322	<2.50U	<2.50U	<25.0U	<2.00U	1.40D	69000	<5.00U	0.670JD	4.06JD	473	1.66D	3840	1990	<2.50U	717J	5.18D	<2.50U	2800	731	<2.50U	<10.0U	472
A68/CC48 6%	555	<2.50U	<2.50U	<25.0U	<2.00U	1.72D	72600	6.22JD	1.66D	7.02D	850	2.20D	4070	2110	<2.50U	758J	<2.50U	<2.50U	2900	781	<2.50U	<10.0U	546
A68/CC48 12%	1010	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	80600	<5.00U	<0.500U	<2.50U	1600	<0.500U	4520	2300	<2.50U	820J	<2.50U	<2.50U	2950	876	<2.50U	<10.0U	672
A68/CC48 25%	2020	<2.50U	<2.50U	<25.0U	<2.00U	1.48D	98700	<5.00U	4.04D	11.8D	3500	2.86D	5600	2770	<2.50U	1000	<2.50U	<2.50U	3260	1100	<2.50U	<10.0U	981
A68/CC48 50%	3990	<2.50U	<2.50U	<25.0U	<2.00U	3.61D	133000	<5.00U	13.0D	33.6D	7400	8.55D	7630	3630	5.62D	1360	4.85JD	<2.50U	3840	1510	<2.50U	<10.0U	1550
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																							
A68/M34/CC48 Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	7.52JD	<0.500U	<2.50U	<100U	<0.500U	13800	<2.00U	<2.50U	1980	<2.50U	<2.50U	24500	75.6	<2.50U	<10.0U	<10.0U
A68/M34/CC48 4%	314	<2.50U	<2.50U	<25.0U	<2.00U	1.42D	66800	6.39JD	0.573JD	4.13JD	465	1.75D	3770	1910	<2.50U	668J	<2.50U	<2.50U	2760	703	<2.50U	<10.0U	429
A68/M34/CC48 9%	588	<2.50U	<2.50U	<25.0U	<2.00U	1.46D	70200	5.44JD	1.32D	5.28D	904	2.37D	4010	1920	<2.50U	699J	<2.50U	<2.50U	2830	732	<2.50U	<10.0U	462
A68/M34/CC48 20%	1200	<2.50U	<2.50U	<25.0U	<2.00U	1.70D	76200	6.48JD	3.01D	8.36D	1930	2.61D	4600	1930	<2.50U	752J	<2.50U	<2.50U	3050	815	<2.50U	<10.0U	521
A68/M34/CC48 40%	2310	<2.50U	<2.50U	<25.0U	<2.00U	2.04D	90700	6.04JD	5.94D	13.0D	3720	4.36D	5630	2000	<2.50U	876J	<2.50U	<2.50U	3370	950	4.98JD	<10.0U	653
A68/M34/CC48 65%	3760	<2.50U	<2.50U	<25.0U	<2.00U	2.06D	107000	<5.00U	8.87D	16.6D	6620	5.78D	6960	2030	3.22JD	1010	<2.50U	<2.50U	3850	1130	<2.50U	<10.0U	805
A68/M34/CC48 85%	4950	<2.50U	<2.50U	<25.0U	<2.00U	2.45D	119000	<5.00U	12.3D	25.7D	8200	7.97D	7970	2050	4.39JD	1100	<2.50U	<2.50U	4230	1250	<2.50U	<10.0U	912
Reference toxicity test																							
Control-Ref	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	5.97JD	<0.500U	<2.50U	<100U	<0.500U	13900	<2.00U	<2.50U	1980	<2.50U	<2.50U	24700	76.0	<2.50U	<10.0U	<10.0U
Ref 6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13100	8.78JD	<0.500U	<2.50U	<100U	<0.500U	13900	<2.00U	<2.50U	2000	<2.50U	<2.50U	24800	75.8	<2.50U	<10.0U	55.8
Ref 12.5%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	6.03JD	<0.500U	<2.50U	<100U	<0.500U	13900	<2.00U	<2.50U	1980	<2.50U	<2.50U	25000	75.9	<2.50U	<10.0U	111
Ref 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	8.12JD	<0.500U	<2.50U	<100U	<0.500U	13800	<2.00U	<2.50U	1970	<2.50U	<2.50U	24700	75.7	<2.50U	<10.0U	217
Ref 50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	7.31JD	<0.500U	<2.50U	<100U	<0.500U	13800	<2.00U	<2.50U	1980	<2.50U	<2.50U	24600	75.4	<2.50U	<10.0U	430
Ref 100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	5.06JD	<0.500U	<2.50U	<100U	<0.500U	13900	<2.00U	<2.50U	1990	<2.50U	<2.50U	24900	75.8	<2.50U	<10.0U	872

Final Analytical Data (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of Animas River and Mineral Creek surface water samples																							
Profile Control	25.2J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	10700	9.66JD	<0.500U	<2.50U	<100U	<0.500U	12700	<2.00U	<2.50U	2370	<2.50U	<2.50U	25000	70.1	<2.50U	<10.0U	<10.0U
A68	84.4	<2.50U	<2.50U	<25.0U	<2.00U	1.49D	60100	<5.00U	<0.500U	3.40JD	125J	1.85D	3470	1640	<2.50U	976J	<2.50U	<2.50U	2890	636	<2.50U	<10.0U	390
M34	396	<2.50U	<2.50U	<25.0U	<2.00U	0.968JD	94300	8.67JD	10.1D	<2.50U	4100	<0.500U	7940	584	3.01JD	4040	<2.50U	<2.50U	7300	952	<2.50U	<10.0U	212
Animas River surface water sample A72 serially diluted by Animas River surface water sample A68																							
A68/A72 control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	10700	9.90JD	<0.500U	<2.50U	<100U	<0.500U	12800	<2.00U	<2.50U	2360	<2.50U	<2.50U	24900	69.9	<2.50U	<10.0U	<10.0U
A68/A72 5%	168	<2.50U	<2.50U	<25.0U	<2.00U	1.41D	60000	7.65JD	<0.500U	4.11JD	226J	1.72D	3590	1750	<2.50U	857J	<2.50U	<2.50U	2900	657	<2.50U	<10.0U	362
A68/A72 10%	323	<2.50U	<2.50U	<25.0U	<2.00U	1.58D	65500	11.2D	0.857JD	5.24D	503	2.82D	3830	1810	3.30JD	894J	<2.50U	<2.50U	2930	702	4.01JD	<10.0U	402
A68/A72 25%	597	<2.50U	<2.50U	<25.0U	<2.00U	1.60D	70500	6.50JD	2.21D	6.30D	911	3.39D	4370	1840	<2.50U	990J	<2.50U	<2.50U	3160	776	<2.50U	<10.0U	455
A68/A72 50%	830	<2.50U	<2.50U	<25.0U	<2.00U	1.67D	78100	7.70JD	3.85D	7.39D	1310	3.01D	5060	1800	<2.50U	1150	<2.50U	<2.50U	3460	859	<2.50U	<10.0U	525
A68/A72 75%	1450	<2.50U	<2.50U	<25.0U	<2.00U	1.99D	92300	7.30JD	6.33D	9.86D	2380	3.63D	6150	1870	3.02JD	1440	<2.50U	<2.50U	4460	1020	<2.50U	<10.0U	682
A68/A72 100%	1320	<2.50U	<2.50U	<25.0U	<2.00U	2.19D	100000	7.19JD	8.66D	16.7D	1110	1.32D	6780	1840	5.15D	1890	<2.50U	<2.50U	4590	1100	<2.50U	<10.0U	779
Cement Creek surface wtaer sample CC48 serially diluted by Animas River surface water sample A68																							
A68/CC48 Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11000	8.94JD	<0.500U	<2.50U	<100U	<0.500U	12900	2.02J	<2.50U	2330	<2.50U	<2.50U	25100	71.4	<2.50U	<10.0U	<10.0U
A68/CC48 1%	144	<2.50U	<2.50U	<25.0U	<2.00U	1.32D	61600	8.26JD	<0.500U	3.13JD	143J	1.58D	3660	1830	<2.50U	996J	<2.50U	<2.50U	3130	680	<2.50U	<10.0U	377
A68/CC48 3%	255	<2.50U	<2.50U	<25.0U	<2.00U	1.51D	67000	6.18JD	0.815JD	4.59JD	318	2.19D	3890	1880	<2.50U	922J	<2.50U	<2.50U	3020	740	<2.50U	<10.0U	453
A68/CC48 6%	445	<2.50U	<2.50U	<25.0U	<2.00U	1.45D	70900	7.86JD	1.29D	5.50D	591	2.90D	4130	1930	<2.50U	1050	<2.50U	<2.50U	3090	780	<2.50U	<10.0U	509
A68/CC48 12%	719	<2.50U	<2.50U	<25.0U	<2.00U	1.77D	77000	8.62JD	2.86D	8.47D	825	4.03D	4540	2110	<2.50U	1080	<2.50U	<2.50U	3230	875	<2.50U	<10.0U	623
A68/CC48 25%	990	<2.50U	<2.50U	<25.0U	<2.00U	2.33D	92600	8.49JD	6.01D	10.9D	1300	3.42D	5490	2540	3.68JD	1380	<2.50U	<2.50U	3670	1070	<2.50U	<10.0U	847
A68/CC48 50%	2560	<2.50U	<2.50U	<25.0U	<2.00U	3.53D	130000	7.28JD	12.4D	26.8D	201J	2.62D	7770	3580	7.52D	3270	<2.50U	<2.50U	9100	1540	<2.50U	<10.0U	1450
Combined sample M34/CC48 serially diluted by Animas River surface water sample A68																							
A68/M34/CC48 Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12000	8.44JD	<0.500U	<2.50U	<100U	<0.500U	14200	<2.00U	<2.50U	2460	<2.50U	<2.50U	26700	78.4	<2.50U	<10.0U	<10.0U
A68/M34/CC48 4%	229	<2.50U	<2.50U	<25.0U	<2.00U	1.40D	60800	7.94JD	<0.500U	3.52JD	290	1.98D	3620	1630	<2.50U	849J	<2.50U	<2.50U	3010	666	4.26JD	<10.0U	390
A68/M34/CC48 9%	391	<2.50U	<2.50U	<25.0U	<2.00U	1.25D	63600	7.62JD	1.17D	3.81JD	476	1.87D	3870	1660	<2.50U	912J	<2.50U	<2.50U	3020	701	<2.50U	<10.0U	414
A68/M34/CC48 20%	805	<2.50U	<2.50U	<25.0U	<2.00U	1.39D	70500	6.91JD	2.92D	6.84D	967	2.65D	4470	1690	<2.50U	1080	<2.50U	<2.50U	3390	783	<2.50U	<10.0U	468
A68/M34/CC48 40%	1560	<2.50U	<2.50U	<25.0U	<2.00U	1.75D	84600	6.39JD	5.60D	11.7D	1970	7.59D	5590	1830	3.33JD	1240	<2.50U	<2.50U	3940	934	<2.50U	<10.0U	613
A68/M34/CC48 65%	2510	<2.50U	<2.50U	<25.0U	<2.00U	1.87D	100000	7.11JD	9.88D	16.7D	3370	3.46D	6900	1870	5.99D	1710	<2.50U	<2.50U	4400	1110	<2.50U	<10.0U	735
A68/M34/CC48 85%	2830	<2.50U	<2.50U	<25.0U	<2.00U	2.29D	117000	7.09JD	11.7D	18.7D	3300	3.98D	8380	2040	5.60D	2690	<2.50U	<2.50U	9690	1300	<2.50U	<10.0U	863
Reference toxicity test																							
Control-Ref	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11800	11.6D	<0.500U	<2.50U	<100U	<0.500U	14000	<2.00U	<2.50U	2540	<2.50U	<2.50U	26600	76.3	<2.50U	<10.0U	<10.0U
Ref 6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11700	8.27JD	<0.500U	<2.50U	<100U	<0.500U	13900	<2.00U	<2.50U	2500	<2.50U	<2.50U	26300	76.3	<2.50U	<10.0U	47.6
Ref 12.5%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11400	6.26JD	<0.500U	<2.50U	<100U	<0.500U	13500	<2.00U	<2.50U	2280	<2.50U	<2.50U	25600	74.1	<2.50U	<10.0U	94.0
Ref 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12700	8.25JD	<0.500U	<2.50U	<100U	<0.500U	14400	<2.00U	<2.50U	2620	<2.50U	<2.50U	26800	79.6	<2.50U	<10.0U	206
Ref 50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13300	9.99JD	<0.500U	<2.50U	<100U	<0.500U	15000	<2.00U	<2.50U	3800	<2.50U	<2.50U	28100	80.5	<2.50U	<10.0U	403
Ref 100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12700	9.91JD	<0.500U	<2.50U	<100U	<0.500U	14400	<2.00U	<2.50U	3560	<2.50U	<2.50U	27200	79.5	<2.50U	<10.0U	794

Qualifiers:
D= Diluted sample
J= Estimated value
U= Non-detect

Prepared by: EC 3/8/13
Reviewed by: EB 3/13/13

Table 2.5-8 Initial and Final Wet Chemistry Results
November 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile *O.mykiss*

Initial Wet Chemistry (mg/L)

STATION_ID	Chloride	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Dissolved Organic Carbon	Total Alkalinity (mg CaCO3/L)
Profile test of the Animas River, Mineral Creek, and Cement Creek surface water samples						
Profile Control	2.3	<0.1U	<0.2U	86.6	<1.0U	55.2
A68	1.2J	0.5	<0.2U	150	<1.0U	37.6
A72	<10.0U	1.7JD	<2.0U	286D	<1.0U	<5.00U
CC48	<10.0U	1.7JD	<2.0U	594D	<1.0U	<5.00U
M34	22.9D	<1.0U	<2.0U	856D	<1.0U	<5.00U
Animas River surface water sample A72 serially diluted by Animas River surface water sample A68						
A68/A72 control	2.3	<0.1U	<0.2U	85.6	<1.0U	63.1
A68/A72 5%	1.2J	0.4	<0.2U	147	<1.0U	38.5
A68/A72 10%	1.3J	0.5	<0.2U	166	<1.0U	29.9
A68/A72 25%	1.2J	0.4	<0.2U	160	<1.0U	25.9
A68/A72 50%	1.5J	0.6	<0.2U	227	<1.0U	16.6
A68/A72 75%	<10.0U	<1.0U	<2.0U	264D	<1.0U	<5.00U
A68/A72 100%	<10.0U	2.4D	<2.0U	281D	<1.0U	<5.00U
Cement Creek surface water sample CC48 serially diluted by Animas River surface water sample A68						
A68/CC48 Control	2.3	<0.1U	<0.2U	85.9	<1.0U	62.4
A68/CC48 1%	1.2J	0.5	<0.2U	154	<1.0U	33.1
A68/CC48 3%	1.2J	0.5	<0.2U	165	<1.0U	35.9
A68/CC48 6%	1.2J	0.6	<0.2U	179	<1.0U	29.1
A68/CC48 12%	1.2J	0.6	<0.2U	223	<1.0U	22.4
A68/CC48 25%	<10.0U	1.4JD	<2.0U	254D	<1.0U	10.2
A68/CC48 50%	<10.0U	2.1D	<2.0U	364D	<1.0U	<5.00U
Combined sample M34/CC48 serially diluted by Animas River surface water samples A68						
A68/M34/CC48 Control	2.3	<0.1U	<0.2U	85.5	<1.0U	54.8
A68/M34/CC48 4%	1.2J	0.5	<0.2U	160	<1.0U	34.9
A68/M34/CC48 9%	1.2J	0.5	<0.2U	172	<1.0U	28.2
A68/M34/CC48 20%	1.3J	0.5	<0.2U	201	<1.0U	25.2
A68/M34/CC48 40%	<10.0U	<1.0U	<2.0U	268D	<1.0U	10.8
A68/M34/CC48 65%	<10.0U	3.4D	<2.0U	293D	<1.0U	<5.00U
A68/M34/CC48 85%	<10.0U	<1.0U	<2.0U	334D	<1.0U	<5.00U
Reference toxicity test						
Control-Ref	<1.0U	0.2	<0.2U	27.0	<1.0U	61.9
Ref 6.25%	2.3	<0.1U	<0.2U	85.5	<1.0U	58.9
Ref 12.5%	2.3	<0.1U	<0.2U	85.6	<1.0U	61.4
Ref 25%	2.4	<0.1U	<0.2U	97.0	<1.0U	58.2
Ref 50%	2.3	<0.1U	<0.2U	85.7	<1.0U	57.7
Ref 100%	2.2	<0.1U	<0.2U	85.5	<1.0U	60.5

Final Wet Chemistry (mg/L)

STATION_ID	Chloride	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Dissolved Organic Carbon	Total Alkalinity (mg CaCO3/L)
Profile test of the Animas River and Mineral Creek						
Profile Control	2.6	<0.1U	<0.2U	87.2	1.5	65.8
A68	1.4J	0.5	<0.2U	147	1.9	47.0J
M34	25.5D	<1.0U	<0.2U	871D	6.6	8.16
Animas River surface water sample A72 serially diluted by Animas River surface water sample A68						
A68/A72 control	2.7	<0.1U	<0.2U	87.8	1.7	72.9
A68/A72 5%	1.3J	0.5	<0.2U	159	1.5	39.2
A68/A72 10%	1.4J	0.5	<0.2U	166	1.5	33.8
A68/A72 25%	1.4J	0.5	<0.2U	189	1.8	33.4
A68/A72 50%	1.5J	0.5	<0.2U	229	1.7	17.5
A68/A72 75%	<10.0U	<1.0U	<2.0U	251D	1.4	7.50
A68/A72 100%	<10.0U	<1.0U	<2.0U	287D	2.3	<5.00U
Cement Creek surface water sample CC48 serially diluted by Animas River surface water sample A68						
A68/CC48 Control	2.6	<0.1U	<0.2U	87.6	1.6	68.7
A68/CC48 1%	1.4J	0.5	<0.2U	155	1.7	39.4
A68/CC48 3%	1.3J	0.5	<0.2U	164	1.1	36.2
A68/CC48 6%	1.3J	0.5	<0.2U	178	1.4	36.8
A68/CC48 12%	1.4J	0.6	<0.2U	209	1.7	32.0
A68/CC48 25%	<10.0U	<1.0U	<2.0U	248D	1.6	13.4
A68/CC48 50%	13.0JD	<1.0U	<2.0U	358D	2.5	<5.00U
Combined sample M34/CC48 serially diluted by Animas River surface water samples A68						
A68/M34/CC48 Control	2.5	<0.1U	<0.2U	87.7	1.6	63.4
A68/M34/CC48 4%	1.4J	0.5	<0.2U	158	1.7	40.8
A68/M34/CC48 9%	1.4J	0.5	<0.2U	171	1.4	38.9
A68/M34/CC48 20%	1.5J	0.5	<0.2U	199	1.8	26.0
A68/M34/CC48 40%	1.7J	0.5	<0.2U	247	1.6	12.5
A68/M34/CC48 65%	<10.0U	<1.0U	<2.0U	294D	2.4	<5.00U
A68/M34/CC48 85%	13.3JD	<1.0U	<2.0U	338D	3.1	<5.00U
Reference toxicity test						
Control-Ref	2.5	<0.1U	<0.2U	86.7	1.5	70.5
Ref 6.25%	2.5	<0.1U	<0.2U	87.3	1.6	63.4
Ref 12.5%	2.2	<0.1U	<0.2U	87.1	1.1	63.6
Ref 25%	2.6	<0.1U	<0.2U	86.3	1.1	60.4
Ref 50%	3.6	<0.1U	<0.2U	87.5	2.9	61.8
Ref 100%	3.5	<0.1U	<0.2U	87.5	3.3	56.2

Qualifiers:
D= Diluted sample
J= Estimated value
U= Non-detect

Prepared by: EC 3/8/13
Reviewed by: EB 3/13/13

Table 2.5-9a: Initial and Final Average Ammonia Results for November 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile O.mykiss

Replicate ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)[a]	Day 4 Measured Ammonia Conc. (mg N/L)[b]	Day 4 Measured pH[b]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)[a]
PROFILE TEST										
Profile Control -01	0.09915	7.6	0.0938	7.63	10.92	1.0820	7.5	1.1470	7.50	13.33
Profile Control -02	0.09042	7.6				1.1090	7.5			
Profile Control -03	0.09398	7.6				1.1560	7.5			
Profile Control -04	0.09148	7.7				1.2410	7.5			
M34-01	0.10580	5.5	0.0931	5.45	38.33	1.5840	6.9	1.2936	6.58	31.60
M34-02	0.08369	5.5				1.6090	6.6			
M34-03	0.09395	5.4				0.1302	6.4			
M34-04	0.08881	5.4				1.8510	6.5			
A68-01	0.07452	7.4	0.0734	7.40	15.34	0.9252	6.3	1.1336	6.53	32.26
A68-02	0.07001	7.4				1.2240	6.6			
A68-03	0.07439	7.4				1.1930	6.6			
A68-04	0.07466	7.4				1.1920	6.6			
SERIAL DILUTION OF SAMPLE A72 WITH A68 AS THE DILUENT										
A68/A72-Control-01	0.04135	7.4	0.0440	7.35	16.41	1.1260	7.1	1.2693	7.07	22.55
A68/A72-Control-02	0.04542	7.4				1.2280	7.1			
A68/A72-Control-03	0.04386	7.3				1.3020	7.1			
A68/A72-Control-04	0.04523	7.3				1.4210	7.1			
A68/A72-5%-01	0.04698	7.8	0.0476	7.80	8.11	1.2880	6.9	1.1100	6.93	25.55
A68/A72-5%-02	0.04922	7.8				1.0150	7.0			
A68/A72-5%-03	0.04737	7.8				1.1230	6.9			
A68/A72-5%-04	0.04678	7.8				1.0140	7.0			
A68/A72 10% -01	0.04988	7.7	0.0372	7.63	10.92	0.9636	6.9	0.9880	6.95	25.19
A68/A72 10% -02	ND	7.6				0.9351	7.0			
A68/A72 10% -03	0.04844	7.6				0.9634	7.0			
A68/A72 10% -04	0.05062	7.6				1.0900	6.9			
A68/A72 25% -01	0.05549	7.5	0.0544	7.43	14.81	0.9789	6.9	1.2147	6.92	25.70
A68/A72 25% -02	0.05454	7.4				1.2540	6.9			
A68/A72 25% -03	0.05449	7.4				1.3120	6.9			
A68/A72 25% -04	0.05306	7.4				1.3140	6.9			
A68/A72 50% -01	0.05491	7.2	0.0551	7.15	20.84	1.2970	6.9	1.2483	6.89	26.35
A68/A72 50% -02	0.05637	7.2				1.3870	6.9			
A68/A72 50% -03	0.05432	7.1				1.1950	6.9			
A68/A72 50% -04	0.05488	7.1				1.1140	6.9			
A68/A72 75% -01	0.06126	6.7	0.0606	6.50	32.61	1.3580	6.9	1.5163	6.81	27.91
A68/A72 75% -02	0.06013	6.5				1.5560	6.8			
A68/A72 75% -03	0.05979	6.4				1.6440	6.8			
A68/A72 75% -04	0.06129	6.4				1.5070	6.8			
A68/A72 100% -01	0.06464	5.6	0.0636	5.60	38.06	0.3088	6.2	0.5028	5.91	37.12
A68/A72 100% -02	0.06302	5.6				0.6791	6.0			
A68/A72 100% -03	0.06331	5.6				0.6192	5.8			
A68/A72 100% -04	0.06358	5.6				0.4039	5.6			
SERIAL DILUTION OF SAMPLE CC48 WITH A68 AS THE DILUENT										
A68/CC48 Control-01	0.08444	7.6	0.0904	7.65	10.49	1.1240	7.2	1.2055	7.31	17.40
A68/CC48 Control-02	0.08753	7.6				1.0750	7.4			
A68/CC48 Control-03	0.09032	7.7				1.2050	7.4			
A68/CC48 Control-04	0.09938	7.7				1.4180	7.2			
A68/CC48 1% -01	0.09961	7.6	0.1049	7.50	13.28	1.3070	7.1	1.2458	7.09	22.11
A68/CC48 1% -02	0.10530	7.5				1.5330	7.1			
A68/CC48 1% -03	0.11370	7.5				1.2920	7.1			
A68/CC48 1% -04	0.10080	7.4				0.8512	7.1			
A68/CC48 3% -01	0.11190	7.4	0.1115	7.40	15.34	1.2220	7.1	1.2065	7.10	21.94
A68/CC48 3% -02	0.10720	7.4				1.3410	7.1			
A68/CC48 3% -03	0.10940	7.4				1.0690	7.1			
A68/CC48 3% -04	0.11750	7.4				1.1940	7.1			
A68/CC48 6% -01	0.12730	7.4	0.1213	7.30	17.51	1.0900	7.1	1.3280	7.09	22.27
A68/CC48 6% -02	0.10770	7.3				1.4650	7.1			
A68/CC48 6% -03	0.11730	7.2				1.1930	7.1			
A68/CC48 6% -04	0.13300	7.3				1.5640	7.1			
A68/CC48 12% -01	0.12320	7.1	0.1320	7.08	22.49	1.0650	7.1	1.2238	7.06	22.93
A68/CC48 12% -02	0.12810	7.1				1.5190	7.1			
A68/CC48 12% -03	0.13000	7.1				1.2540	7.1			
A68/CC48 12% -04	0.14660	7.0				1.0570	7.0			
A68/CC48 25% -01	0.12710	6.4	0.1340	6.28	34.92	0.7729	7.0	1.3542	6.96	24.94
A68/CC48 25% -02	0.13970	6.3				1.5710	7.0			
A68/CC48 25% -03	0.13020	6.2				1.4080	7.0			
A68/CC48 25% -04	0.13910	6.2				1.6650	6.9			
A68/CC48 50% -01	0.11610	4.8	0.1217	4.80	38.85	1.7450	5.2	1.9440	5.20	38.62
A68/CC48 50% -02	0.12460	4.8				1.8930	5.2			
A68/CC48 50% -03	0.11380	4.8				1.9700	5.2			
A68/CC48 50% -04	0.13210	4.8				2.1680	5.2			

Table 2.5-9a: Initial and Final Average Ammonia Results for November 2012 Upper Animas River Surface Water Toxicity Test Using Juvenile O.mykiss

Replicate ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)[a]	Day 4 Measured Ammonia Conc. (mg N/L)[b]	Day 4 Measured pH[b]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)[a]
SERIAL DILUTION OF SAMPLE M34/CC48 WITH A68 AS THE DILUTENT										
A68/M34/CC48 Control -01	0.04273	7.7	0.0421	7.63	10.92	1.0710	7.3	1.1590	7.35	16.36
A68/M34/CC48 Control -02	0.04165	7.6				1.3430	7.4			
A68/M34/CC48 Control -03	0.04259	7.6				1.1660	7.4			
A68/M34/CC48 Control -04	0.04136	7.6				1.0560	7.4			
A68/M34/CC48 4% -01	0.04308	7.4	0.0434	7.40	15.34	1.1190	7.1	1.2160	7.07	22.60
A68/M34/CC48 4% -02	0.04428	7.4				1.0230	7.1			
A68/M34/CC48 4% -03	0.04365	7.4				1.4570	7.1			
A68/M34/CC48 4% -04	0.04270	7.4				1.2650	7.1			
A68/M34/CC48 9% -01	0.04428	7.4	0.0445	7.33	16.96	1.1650	7.1	1.1380	7.08	22.33
A68/M34/CC48 9% -02	0.04636	7.3				1.2340	7.1			
A68/M34/CC48 9% -03	0.04378	7.3				0.9838	7.1			
A68/M34/CC48 9% -04	0.04353	7.3				1.1690	7.1			
A68/M34/CC48 20% -01	0.04468	7.3	0.0439	7.25	18.61	1.1900	7.1	1.1478	7.08	22.49
A68/M34/CC48 20% -02	0.04355	7.3				1.1460	7.1			
A68/M34/CC48 20% -03	0.04479	7.2				1.1490	7.1			
A68/M34/CC48 20% -04	0.04263	7.2				1.1060	7.1			
A68/M34/CC48 40% -01	0.04493	7.1	0.0448	7.08	22.49	1.4140	7.0	1.4218	6.99	24.26
A68/M34/CC48 40% -02	0.04445	7.1				1.4350	7.0			
A68/M34/CC48 40% -03	0.04535	7.1				1.2290	7.0			
A68/M34/CC48 40% -04	0.04454	7.0				1.6090	7.0			
A68/M34/CC48 65% -01	0.04417	5.7	0.0448	5.63	38.01	0.2124	6.5	0.3039	6.10	36.20
A68/M34/CC48 65% -02	0.04407	5.6				0.1931	6.4			
A68/M34/CC48 65% -03	0.04552	5.6				0.3011	5.8			
A68/M34/CC48 65% -04	0.04535	5.6				0.5090	5.6			
A68/M34/CC48 85% -01	0.04524	4.8	0.0461	4.75	38.86	1.7680	5.1	1.7890	5.10	38.70
A68/M34/CC48 85% -02	0.04522	4.8				1.7120	5.1			
A68/M34/CC48 85% -03	0.04697	4.7				2.0110	5.1			
A68/M34/CC48 85% -04	0.04696	4.7				1.6650	5.1			

[a]The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b]Values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed.

Prepared by: EC 3/7/13

Reviewed by: EB 3/13/13

Table 2.5-9b Initial and Final Average Ammonia Results for November 2012 Upper Animas River Concurrent Reference Toxicity Toxicity Test Using Juvenile *O.mykiss*

Replicate ID	Initial (Day 0) Measured Ammonia Conc. (mg N/L)[a]	Initial (Day 0) Measured pH	Initial (Day 0) Average Measured Ammonia Conc. (mg N/L)	Initial (Day 0) Average Measured pH	Initial (Day 0) Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)	Final Measured pH	Final Average Measured Ammonia Conc. (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
Ref Control-01	0.04525	8.00	0.0431	8.00	5.62	1.0190	7.47	1.0740	7.46	14.04
Ref Control-02	0.04274	8.00				1.1450	7.47			
Ref Control-03	0.04226	8.00				1.0550	7.46			
Ref Control-04	0.04211	8.00				1.0770	7.45			
6.25%-01	0.04487	8.00	0.0429	8.05	5.11	1.1310	7.46	1.1548	7.46	14.14
6.25%-02	0.04148	8.10				1.2320	7.46			
6.25%-03	0.04279	8.00				1.2320	7.46			
6.25%-04	0.04244	8.10				1.0240	7.45			
12.5%-01	0.04344	8.00	0.0434	8.08	4.87	0.6100	7.46	0.9802	7.45	14.40
12.5%-02	0.04696	8.00				1.2480	7.46			
12.5%-03	0.04195	8.20				1.1050	7.43			
12.5%-04	0.04107	8.10				0.9578	7.43			
25%-01	0.04180	8.00	0.0422	8.00	5.62	1.5420	7.20	0.4968	7.28	18.00
25%-02	0.04242	8.00				0.1751	7.30			
25%-03	0.04186	8.00				0.1281	7.31			
25%-04	0.04271	8.00				0.1420	7.30			
50%-01	0.04197	8.00	0.0428	8.03	5.36	0.9176	7.24	0.9436	7.26	18.34
50%-02	0.04282	8.00				1.2000	7.25			
50%-03	0.04278	8.10				0.9934	7.27			
50%-04	0.04359	8.00				0.6633	7.29			
100%-01	0.04281	8.00	0.0425	8.00	5.62	0.4526	6.50	0.4550	6.73	29.35
100%-02	0.04205	8.00				0.4628	6.60			
100%-03	0.04292	8.00				0.3182	6.90			
100%-04	0.04216	8.00				0.5862	6.90			

[a] The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b]Values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed.

Prepared by: EC 3/7/13
Reviewed by: EB 3/13/13

Figures

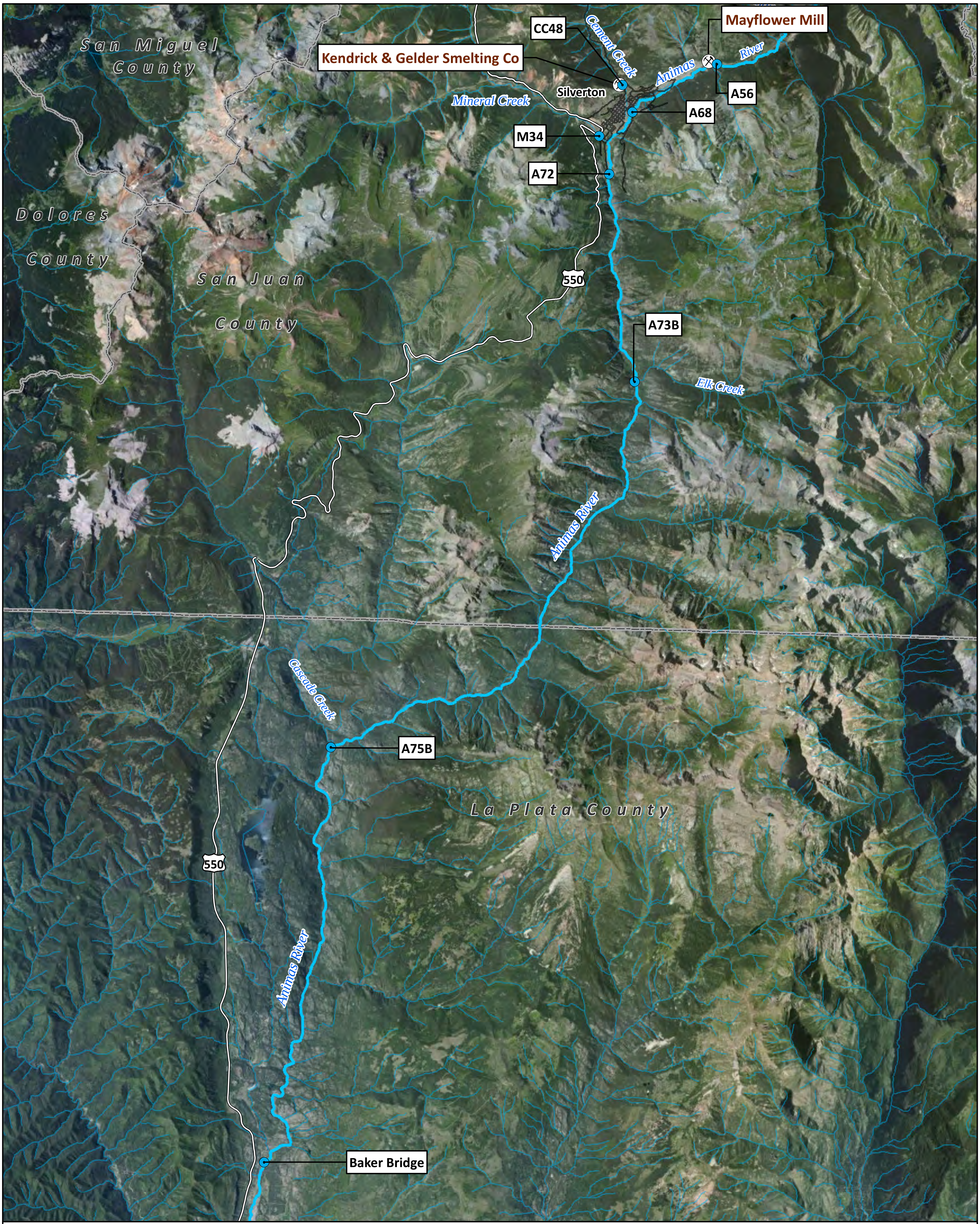


Figure 2.1-1
Upper Animas Mining District
2012 Surface Water Toxicity Test

Sample Locations
Mine Locations
Rivers and Streams
Roads
County Boundaries

Date: July 15, 2013

Data Sources:
Sample Locations: U.S. EPA Region 8 and UOS (2013)
Mine Locations: U.S. EPA and ESAT (2012)
Roads: Navteq (2011)
Rivers and Streams: CDOW 1:24k (2004)
County Boundaries: U.S. Census Bureau (2011)
Image: Bing (2013)

Coordinate System/Projection:
UTM Zone 13 North, NAD 83, Meters

TechLaw

N W E S

0 1 2 Miles

0 1 2 Kilometers

Colorado

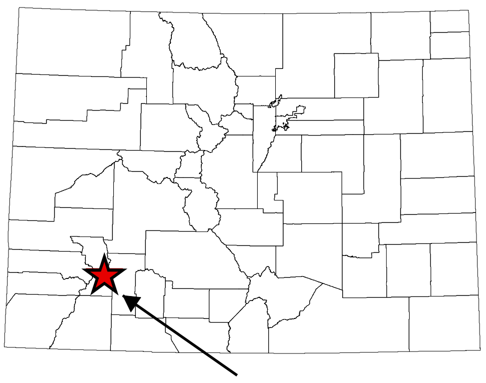


Figure 3.1-1
October 2012 Upper Animas River
Acute Surface Water Toxicity Test Using *O. mykiss*
Average Percent Survival + Percent SD per Location

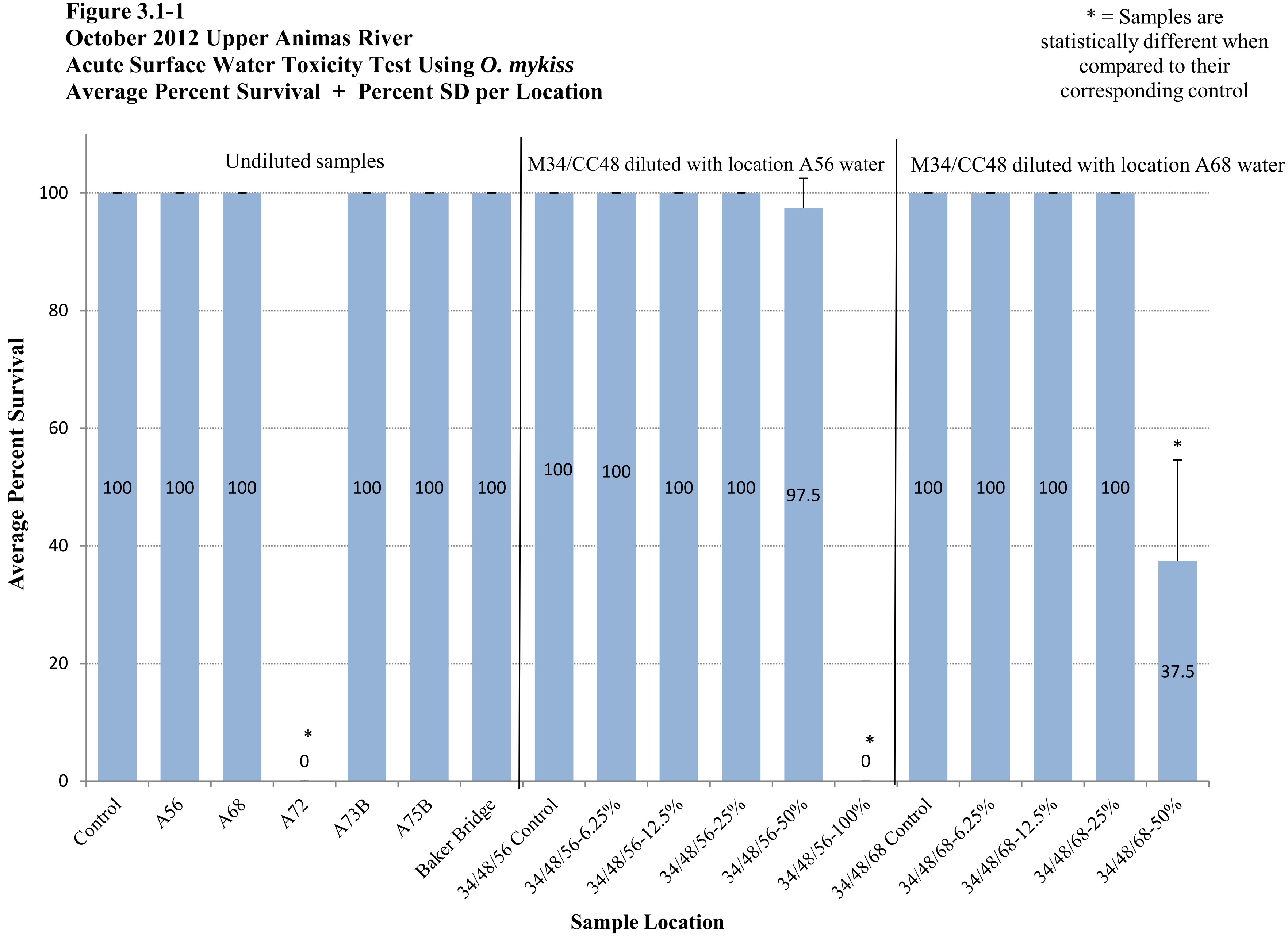


Figure 3.2-1
October 2012 Acute Reference Toxicity Test Using *O. mykiss* and Zinc Sulfate ($ZnSO_4$)
Average Percent Survival + Percent SD per Zinc Concentration

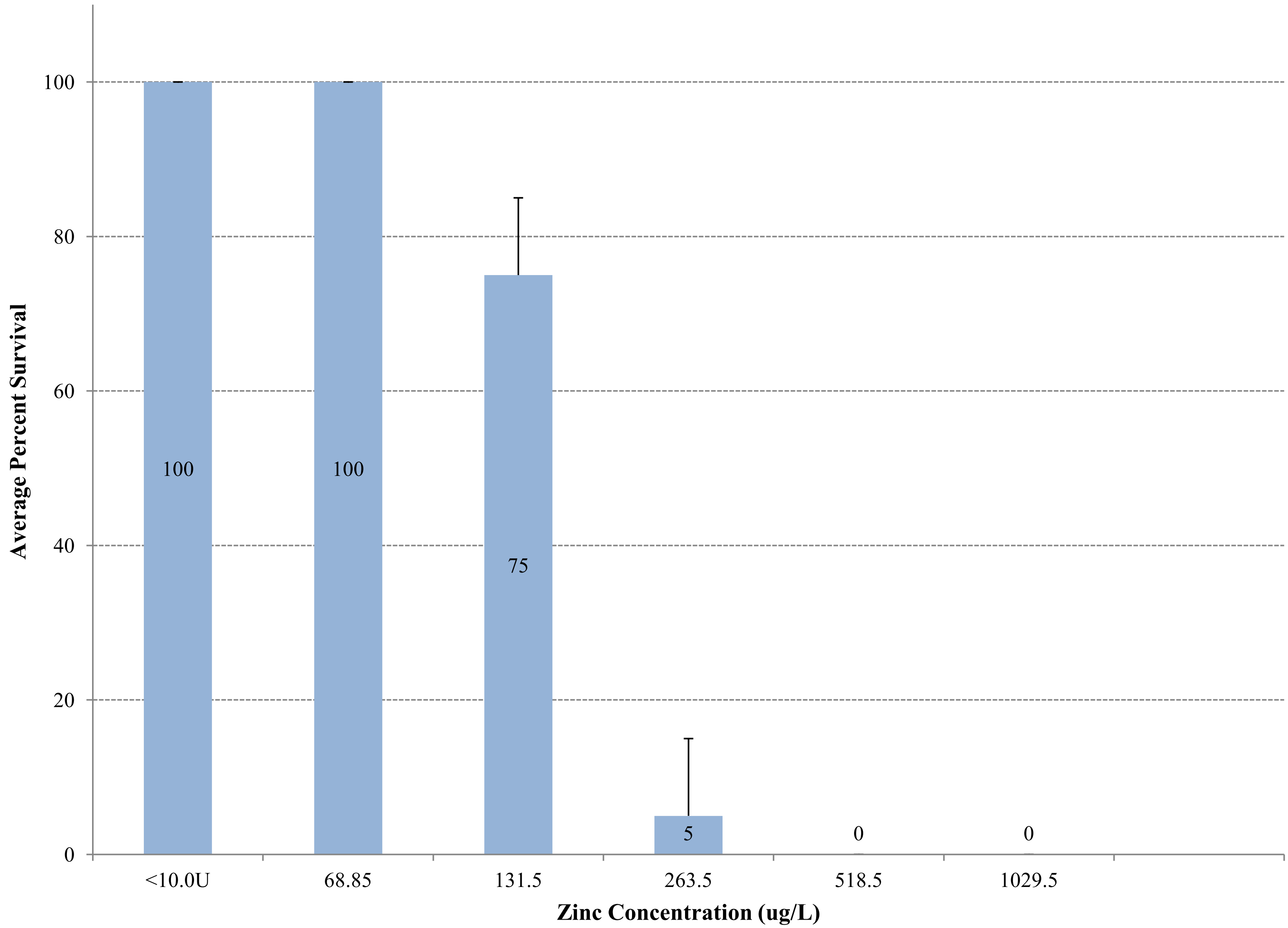


Figure 3.3-1
November 2012 Upper Animas River
Acute Surface Water Toxicity Test Using *O. mykiss*
Average Percent Survival + Percent SD per Location

* = Samples are statistically different when compared to the corresponding control.

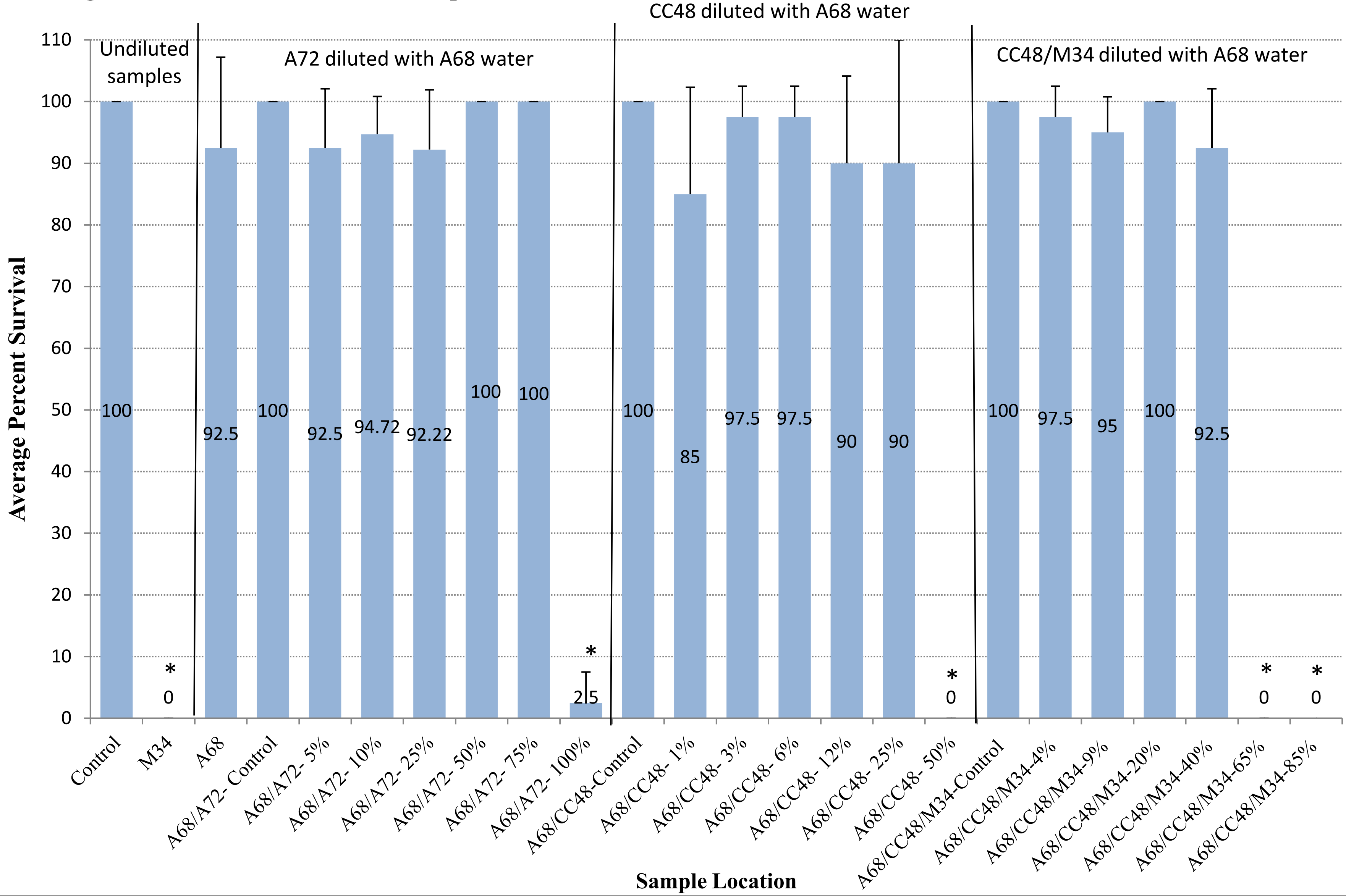
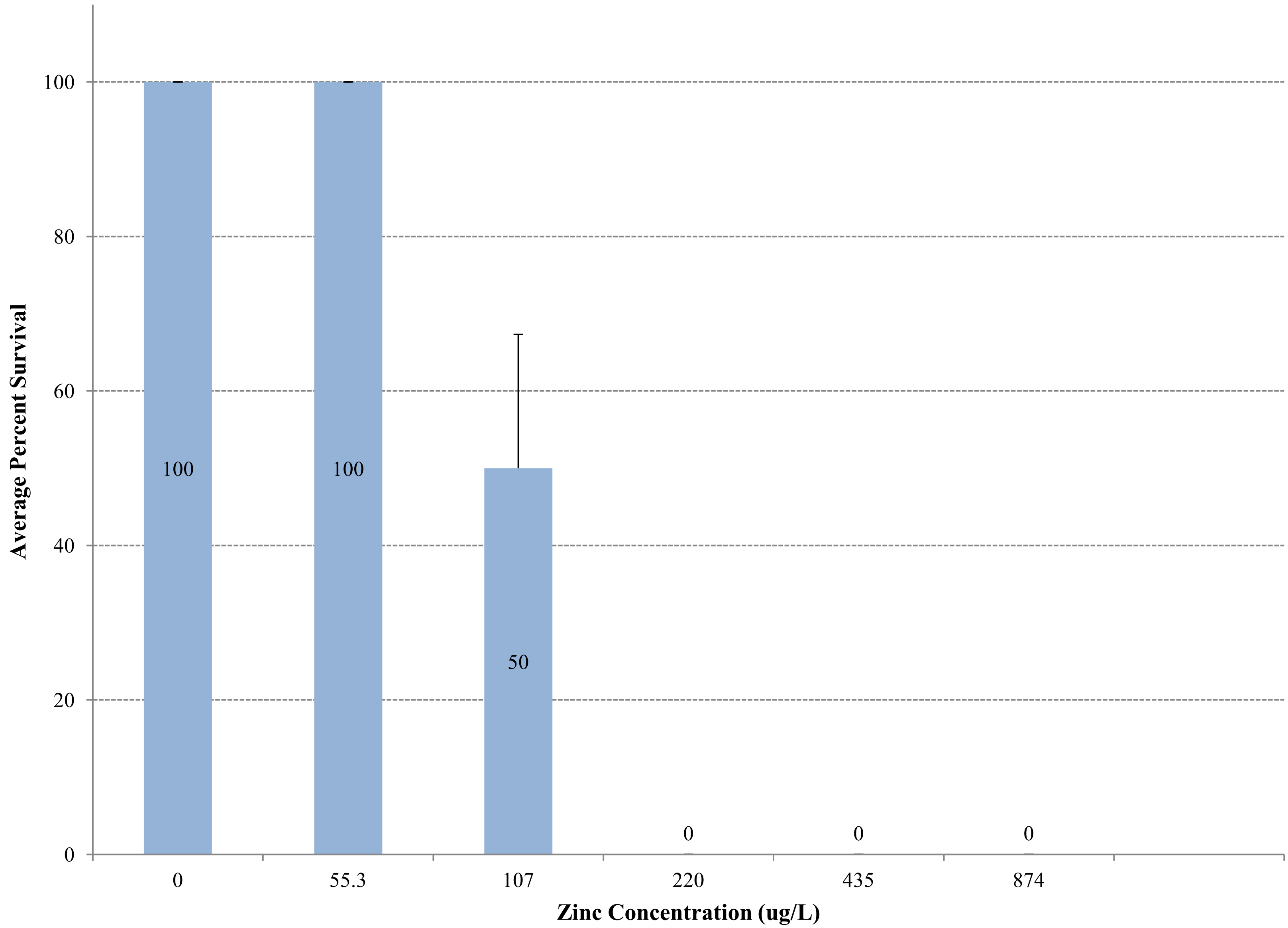


Figure 3.4-1
November 2012 Acute Reference Toxicity Test Using *O. mykiss* and Zinc Sulfate ($ZnSO_4$)
Average Percent Survival + Percent SD per Zinc Concentration



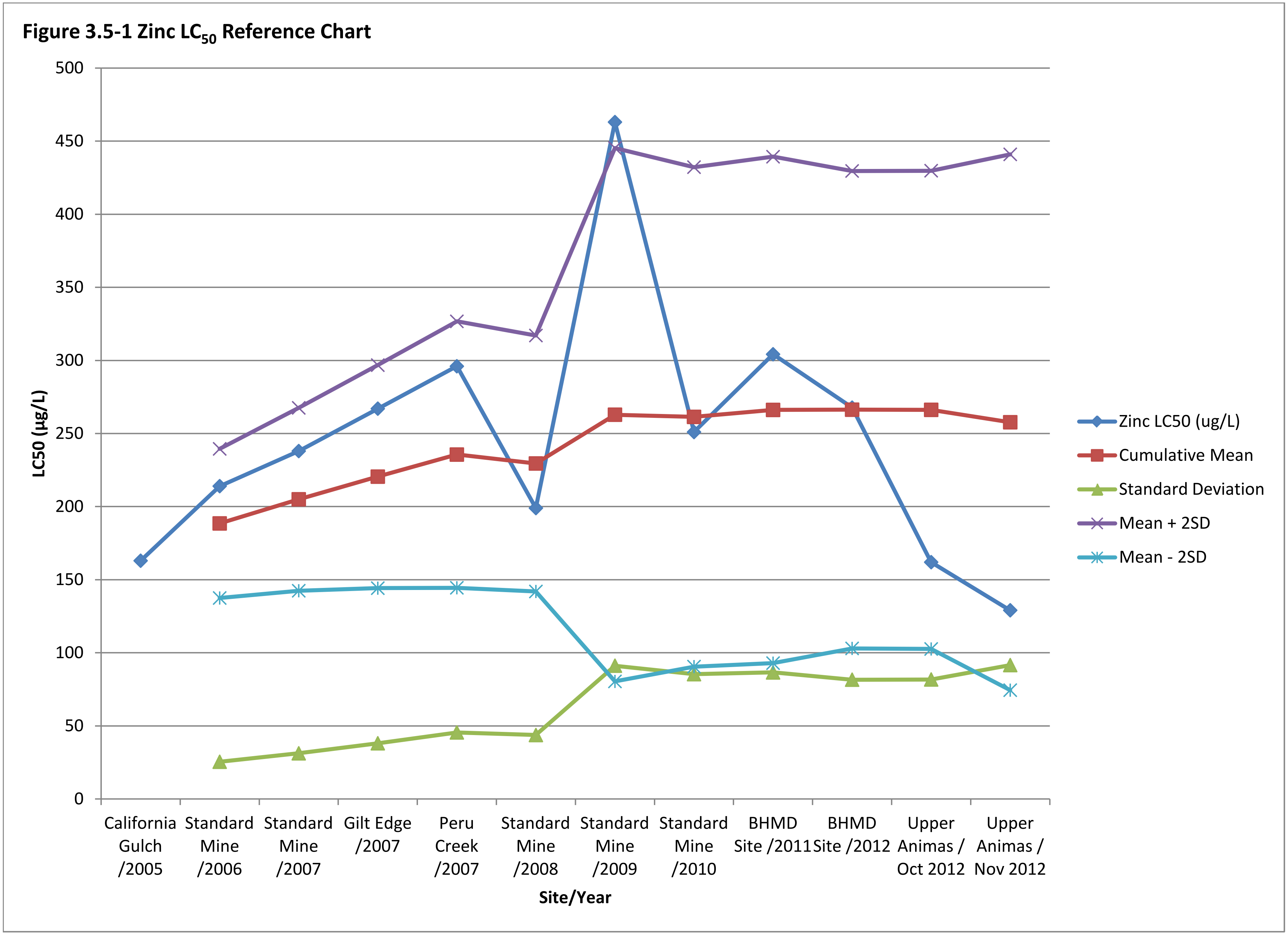


Figure 3.5-1 Zinc LC_{50} Reference Chart
LC50 (µg/L)
500
450
400
350
300
250
200
150
100
50
0
California Gulch /2005
Standard Mine /2006
Standard Mine /2007
Gilt Edge /2007
Peru Creek /2007
Standard Mine /2008
Standard Mine /2009
Standard Mine /2010
BHMD Site /2011
BHMD Site /2012
Upper Animas / Oct 2012
Upper Animas / Nov 2012
Site/Year
Zinc LC50 (ug/L)
Cumulative Mean
Standard Deviation
Mean + 2SD
Mean - 2SD

Appendix A
October 2012 Upper Animas River Superfund Site
Site Water Toxicity Test and Reference Toxicity Test
Daily Water Chemistries

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Profile Test

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-01	No. Alive	10	10	10	10	10
Control-01	pH	7.3	7.1	7.3	7.4	7.5
Control-01	Temp °(C)	11.91	11.63	11.77	11.97	11.66
Control-01	D.O. (mg/L)	7.76	7.93	7.76	7.9	8.14
Control-01	Conductivity (us/cm)	310.9	315.4	316.8	319.5	319.3
Control-01	Alkalinity (mg $CaCO_3$/L)	59.4	-	-	-	61
Control-01	Hardness (mg /L)	96	-	-	-	95

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-02	No. Alive	10	10	10	10	10
Control-02	pH	7.4	7.2	7.3	7.4	7.6
Control-02	Temp °(C)	11.8	11.61	11.65	11.82	11.6
Control-02	D.O. (mg/L)	8.31	7.87	7.76	7.95	8.06
Control-02	Conductivity (us/cm)	312.2	314.7	318.3	318.8	320.5
Control-02	Alkalinity (mg $CaCO_3$/L)	59.4	-	-	-	61
Control-02	Hardness (mg /L)	96	-	-	-	95

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-03	No. Alive	10	10	10	10	10
Control-03	pH	7.4	7.3	7.3	7.4	7.6
Control-03	Temp °(C)	11.76	11.62	11.64	11.83	11.63
Control-03	D.O. (mg/L)	8.48	7.89	7.76	7.99	8.11
Control-03	Conductivity (us/cm)	309.9	315.5	318.5	319.1	320.9
Control-03	Alkalinity (mg $CaCO_3$/L)	59.4	-	-	-	61
Control-03	Hardness (mg /L)	96	-	-	-	95

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-04	No. Alive	10	10	10	10	10
Control-04	pH	7.4	7.4	7.4	7.4	7.6
Control-04	Temp °(C)	11.79	11.61	11.65	11.82	11.64
Control-04	D.O. (mg/L)	8.52	8.05	7.83	8.13	8.12
Control-04	Conductivity (us/cm)	311.2	315.4	318.6	320.4	321.7
Control-04	Alkalinity (mg $CaCO_3$/L)	59.4	-	-	-	61
Control-04	Hardness (mg /L)	96	-	-	-	95

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Baker-01	No. Alive	10	10	10	10	10
Baker-01	pH	7.1	7.2	7.1	7.3	7.4
Baker-01	Temp °(C)	12.49	11.69	11.76	11.92	11.69
Baker-01	D.O. (mg/L)	8.63	7.18	7.37	7.39	7.55
Baker-01	Conductivity (us/cm)	427.4	430	435.9	433.3	434.7
Baker-01	Alkalinity (mg $CaCO_3$/L)	26.5	-	-	-	31.8
Baker-01	Hardness (mg /L)	206	-	-	-	197

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Baker-02	No. Alive	10	10	10	10	10
Baker-02	pH	7.1	7.3	7.1	7.4	7.4
Baker-02	Temp °(C)	11.79	11.61	11.65	11.86	11.66
Baker-02	D.O. (mg/L)	8.64	7.4	7.47	7.57	7.77
Baker-02	Conductivity (us/cm)	423.1	429	431.7	431	432.6
Baker-02	Alkalinity (mg $CaCO_3$/L)	26.5	-	-	-	31.8
Baker-02	Hardness (mg /L)	206	-	-	-	197

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Baker-03	No. Alive	10	10	10	10	10
Baker-03	pH	7.1	7.3	7.1	7.4	7.4
Baker-03	Temp °(C)	11.79	11.58	11.58	11.78	11.6
Baker-03	D.O. (mg/L)	8.69	7.42	7.66	7.68	7.97
Baker-03	Conductivity (us/cm)	424	428.8	432.3	431.5	431.6
Baker-03	Alkalinity (mg $CaCO_3$/L)	26.5	-	-	-	31.8
Baker-03	Hardness (mg /L)	206	-	-	-	197

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Baker-04	No. Alive	10	10	10	10	10
Baker-04	pH	7.1	7.2	7.2	7.3	7.4
Baker-04	Temp °(C)	11.76	11.55	11.59	11.8	11.58
Baker-04	D.O. (mg/L)	8.69	7.62	7.71	7.81	7.96
Baker-04	Conductivity (us/cm)	422	430	431.8	431.2	431.5
Baker-04	Alkalinity (mg $CaCO_3$/L)	26.5	-	-	-	31.8
Baker-04	Hardness (mg /L)	206	-	-	-	197

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-01	No. Alive	10	10	10	10	10
A75B-01	pH	7.1	7.3	7.1	7.3	7.4
A75B-01	Temp °(C)	11.76	11.52	11.6	11.78	11.69
A75B-01	D.O. (mg/L)	8.7	8.24	8.1	8.09	8.05
A75B-01	Conductivity (us/cm)	432	438.5	438.1	440.4	440.5
A75B-01	Alkalinity (mg $CaCO_3$/L)	17.1	-	-	-	20.5
A75B-01	Hardness (mg /L)	208	-	-	-	205

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-02	No. Alive	10	10	10	10	10
A75B-02	pH	7.1	7.2	7.1	7.2	7.4
A75B-02	Temp °(C)	11.77	11.56	11.59	11.78	11.6
A75B-02	D.O. (mg/L)	8.73	8.16	7.87	8.04	8.06
A75B-02	Conductivity (us/cm)	433.6	437.8	440.1	439.2	440.9
A75B-02	Alkalinity (mg $CaCO_3$/L)	17.1	-	-	-	20.5
A75B-02	Hardness (mg /L)	208	-	-	-	205

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-03	No. Alive	10	10	10	10	10
A75B-03	pH	7.1	7.2	7.1	7.2	7.3
A75B-03	Temp °(C)	11.77	11.56	11.59	11.77	11.61
A75B-03	D.O. (mg/L)	8.73	8.12	7.85	7.95	7.99
A75B-03	Conductivity (us/cm)	433.8	438	439	438.5	438.8
A75B-03	Alkalinity (mg $CaCO_3$/L)	17.1	-	-	-	20.5
A75B-03	Hardness (mg /L)	208	-	-	-	205

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-04	No. Alive	10	10	10	10	10
A75B-04	pH	7.1	7.2	7.1	7.2	7.3
A75B-04	Temp °(C)	11.75	11.55	11.58	11.78	11.6
A75B-04	D.O. (mg/L)	8.69	7.82	7.83	8	8.13
A75B-04	Conductivity (us/cm)	430.6	438.8	439.8	440.1	440.5
A75B-04	Alkalinity (mg $CaCO_3$/L)	17.1	-	-	-	20.5
A75B-04	Hardness (mg /L)	208	-	-	-	205

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A73B-01	No. Alive	10	10	10	10	10
A73B-01	pH	6.3	6.9	6.8	7	7.1
A73B-01	Temp °(C)	11.7	11.56	11.56	11.78	11.57
A73B-01	D.O. (mg/L)	8.69	7.98	8.2	8.29	8.33
A73B-01	Conductivity (us/cm)	505	509.9	512.2	512.6	515
A73B-01	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	<5.00U
A73B-01	Hardness (mg /L)	243	-	-	-	239

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A73B-02	No. Alive	10	10	10	10	10
A73B-02	pH	6.1	6.8	6.6	6.9	6.9
A73B-02	Temp °(C)	11.67	11.55	11.61	11.77	11.58
A73B-02	D.O. (mg/L)	8.72	8	8.07	8.29	8.27
A73B-02	Conductivity (us/cm)	502.8	510.1	511.3	511.3	512.2
A73B-02	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	<5.00U
A73B-02	Hardness (mg /L)	243	-	-	-	239

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A73B-03	No. Alive	10	10	10	10	10
A73B-03	pH	6.1	6.7	6.5	6.8	6.7
A73B-03	Temp °(C)	11.69	11.55	11.59	11.74	11.59
A73B-03	D.O. (mg/L)	8.72	7.89	8.02	8.22	8.13
A73B-03	Conductivity (us/cm)	501.9	508.7	510.7	511.3	511.1
A73B-03	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	<5.00U
A73B-03	Hardness (mg /L)	243	-	-	-	239

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A73B-04	No. Alive	10	10	10	10	10
A73B-04	pH	6.1	6.6	6.5	6.7	6.7
A73B-04	Temp °(C)	11.75	11.56	11.58	11.77	11.59
A73B-04	D.O. (mg/L)	8.71	7.94	8	8.1	8.2
A73B-04	Conductivity (us/cm)	504	507.3	510.5	509.1	510.3
A73B-04	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	<5.00U
A73B-04	Hardness (mg /L)	243	-	-	-	239

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A56-01	No. Alive	10	10	10	10	10
A56-01	pH	6.9	7.1	7.1	7.5	7
A56-01	Temp °(C)	12.02	11.59	11.65	11.84	11.57
A56-01	D.O. (mg/L)	7.91	7.82	8.16	7.99	8.38
A56-01	Conductivity (us/cm)	350.4	358.1	358.9	359.2	360.9
A56-01	Alkalinity (mg $CaCO_3$/L)	37.8	-	-	-	40.9
A56-01	Hardness (mg /L)	170	-	-	-	166

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A56-02	No. Alive	10	10	10	10	10
A56-02	pH	7	7.1	7.2	7.6	7.2
A56-02	Temp °(C)	11.71	11.6	11.58	11.8	11.6
A56-02	D.O. (mg/L)	8.4	7.59	8.24	8.28	8.4
A56-02	Conductivity (us/cm)	351.2	356.7	359.2	358.2	359.9
A56-02	Alkalinity (mg $CaCO_3$/L)	37.8	-	-	-	40.9
A56-02	Hardness (mg /L)	170	-	-	-	166

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A56-03	No. Alive	10	10	10	10	10
A56-03	pH	7	7.2	7.2	7.5	7.1
A56-03	Temp °(C)	11.73	11.59	11.59	11.79	11.57
A56-03	D.O. (mg/L)	8.57	7.67	8.21	8.28	8.28
A56-03	Conductivity (us/cm)	352.6	356.6	358.9	359.8	360.2
A56-03	Alkalinity (mg $CaCO_3$/L)	37.8	-	-	-	40.9
A56-03	Hardness (mg /L)	170	-	-	-	166

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A56-04	No. Alive	10	10	10	10	10
A56-04	pH	7.1	7.2	7.2	7.5	7.1
A56-04	Temp °(C)	11.76	11.59	11.6	11.77	11.53
A56-04	D.O. (mg/L)	8.6	7.74	7.92	8.07	8.16
A56-04	Conductivity (us/cm)	353.1	356.4	359.1	357.6	358.4
A56-04	Alkalinity (mg $CaCO_3$/L)	37.8	-	-	-	40.9
A56-04	Hardness (mg /L)	170	-	-	-	166

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-01	No. Alive	10	10	9	0	-
A72-01	pH	5.5	6.1	6.2	6.2	-
A72-01	Temp °(C)	11.94	11.57	11.59	11.8	-
A72-01	D.O. (mg/L)	8.13	8.23	8.47	8.54	-
A72-01	Conductivity (us/cm)	607.2	612.5	612.3	614.1	-
A72-01	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	<5.00U	-
A72-01	Hardness (mg /L)	299	-	-	296	-

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-02	No. Alive	10	10	8	0	-
A72-02	pH	5.5	6.1	6.1	6.1	-
A72-02	Temp °(C)	11.88	11.57	11.61	11.79	-
A72-02	D.O. (mg/L)	8.29	8.29	7.99	8.61	-
A72-02	Conductivity (us/cm)	605.6	613.1	616.6	615.3	-
A72-02	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	<5.00U	-
A72-02	Hardness (mg /L)	299	-	-	296	-

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-03	No. Alive	10	10	4	0	-
A72-03	pH	5.5	6.1	6.1	5.9	-
A72-03	Temp °(C)	11.73	11.6	11.59	11.78	-
A72-03	D.O. (mg/L)	8.51	8.17	8.21	8.67	-
A72-03	Conductivity (us/cm)	607.7	613	618.6	610	-
A72-03	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	<5.00U	-
A72-03	Hardness (mg /L)	299	-	-	296	-

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-04	No. Alive	10	10	7	0	-
A72-04	pH	5.5	6.1	6.1	5.9	-
A72-04	Temp °(C)	11.73	11.59	11.6	11.8	-
A72-04	D.O. (mg/L)	8.63	8.21	8.41	8.71	-
A72-04	Conductivity (us/cm)	603.3	613.3	616.3	612.6	-
A72-04	Alkalinity (mg $CaCO_3$/L)	<5.00U			<5.00U	
A72-04	Hardness (mg /L)	299			296	

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-01	No. Alive	10	10	10	10	10
A68-01	pH	7.2	7.4	7.4	7.1	7.3
A68-01	Temp °(C)	11.77	11.75	11.85	11.95	11.86
A68-01	D.O. (mg/L)	8.41	8.34	8.4	7.99	8.08
A68-01	Conductivity (us/cm)	379.9	384.1	386	382.6	385
A68-01	Alkalinity (mg $CaCO_3$/L)	35.8	-	-	-	42.7
A68-01	Hardness (mg /L)	183	-	-	-	180

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-02	No. Alive	10	10	10	10	10
A68-02	pH	7.2	7.3	7.4	7.2	7.4
A68-02	Temp °(C)	11.78	11.74	11.83	11.93	11.82
A68-02	D.O. (mg/L)	8.37	8.32	8.44	8.07	8.14
A68-02	Conductivity (us/cm)	382.5	385.7	386.9	386.7	386.1
A68-02	Alkalinity (mg $CaCO_3$/L)	35.8	-	-	-	42.7
A68-02	Hardness (mg /L)	183	-	-	-	180

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-03	No. Alive	10	10	10	10	10
A68-03	pH	7.2	7.3	7.4	7.3	7.4
A68-03	Temp °(C)	11.76	11.81	11.83	11.93	11.81
A68-03	D.O. (mg/L)	8.3	7.98	8.24	8.01	8.06
A68-03	Conductivity (us/cm)	380.9	385.1	386.9	386.3	388.7
A68-03	Alkalinity (mg $CaCO_3$/L)	35.8	-	-	-	42.7
A68-03	Hardness (mg /L)	183	-	-	-	180

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-04	No. Alive	10	10	10	10	10
A68-04	pH	7.3	7.3	7.4	7.4	7.4
A68-04	Temp °(C)	11.78	11.82	11.83	11.91	11.8
A68-04	D.O. (mg/L)	8.24	8.03	7.84	7.87	7.92
A68-04	Conductivity (us/cm)	379.8	385	388.7	387.6	388.6
A68-04	Alkalinity (mg $CaCO_3$/L)	35.8	-	-	-	42.7
A68-04	Hardness (mg /L)	183	-	-	-	180

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Serial dilution of M34/CC48 with A56

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-control-01	No. Alive	10	10	10	10	10
34/48/56-control-01	pH	7.6	7.4	7.5	7.5	7.6
34/48/56-control-01	Temp °(C)	11.79	11.63	11.68	11.9	11.8
34/48/56-control-01	D.O. (mg/L)	7.73	7.87	8.32	8.4	8.08
34/48/56-control-01	Conductivity (us/cm)	309.6	316.5	319.1	319	320.9
34/48/56-control-01	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	*
34/48/56-control-01	Hardness (mg /L)	*	-	-	-	*

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-control-02	No. Alive	10	10	10	10	10
34/48/56-control-02	pH	7.4	7.4	7.5	7.6	7.7
34/48/56-control-02	Temp °(C)	11.69	11.63	11.69	11.86	11.68
34/48/56-control-02	D.O. (mg/L)	7.82	7.86	8.27	8.41	8.07
34/48/56-control-02	Conductivity (us/cm)	309.9	315.3	318.8	319.6	320.9
34/48/56-control-02	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	*
34/48/56-control-02	Hardness (mg /L)	*	-	-	-	*

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-control-03	No. Alive	10	10	10	10	10
34/48/56-control-03	pH	7.4	7.4	7.5	7.6	7.7
34/48/56-control-03	Temp °(C)	11.65	11.62	11.67	11.85	11.66
34/48/56-control-03	D.O. (mg/L)	7.79	8.06	8.25	8.26	8.32
34/48/56-control-03	Conductivity (us/cm)	311.9	315	318.5	319.2	320.5
34/48/56-control-03	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	*
34/48/56-control-03	Hardness (mg /L)	*	-	-	-	*

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-control-04	No. Alive	10	10	10	10	10
34/48/56-control-04	pH	7.4	7.4	7.4	7.5	7.7
34/48/56-control-04	Temp °(C)	11.63	11.64	11.65	11.85	11.67
34/48/56-control-04	D.O. (mg/L)	7.88	7.84	8.13	8.21	8.17
34/48/56-control-04	Conductivity (us/cm)	311.4	314.9	320.1	318.9	321
34/48/56-control-04	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	*
34/48/56-control-04	Hardness (mg /L)	*	-	-	-	*

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-6.25%-01	No. Alive	10	10	10	10	10
34/48/56-6.25%-01	pH	7.3	7.1	7.4	7.4	7.6
34/48/56-6.25%-01	Temp °(C)	11.68	11.62	11.64	11.86	11.67
34/48/56-6.25%-01	D.O. (mg/L)	7.92	7.54	8.27	8.3	7.99
34/48/56-6.25%-01	Conductivity (us/cm)	382.3	384.4	386.1	386.8	388.8
34/48/56-6.25%-01	Alkalinity (mg $CaCO_3$/L)	32.3	-	-	-	37.1
34/48/56-6.25%-01	Hardness (mg /L)	193	-	-	-	177

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-6.25%-02	No. Alive	10	10	10	10	10
34/48/56-6.25%-02	pH	7.2	7.2	7.3	7.4	7.5
34/48/56-6.25%-02	Temp °(C)	11.65	11.63	11.66	11.87	11.66
34/48/56-6.25%-02	D.O. (mg/L)	7.97	7.69	8.11	8.25	8.04
34/48/56-6.25%-02	Conductivity (us/cm)	377.2	380.7	385	384	385.6
34/48/56-6.25%-02	Alkalinity (mg $CaCO_3$/L)	32.3	-	-	-	37.1
34/48/56-6.25%-02	Hardness (mg /L)	193	-	-	-	177

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-6.25%-03	No. Alive	10	10	10	10	10
34/48/56-6.25%-03	pH	7.3	7.2	7.4	7.4	7.5
34/48/56-6.25%-03	Temp °(C)	11.65	11.65	11.66	11.85	11.66
34/48/56-6.25%-03	D.O. (mg/L)	8.13	7.82	8.19	8.24	8.25
34/48/56-6.25%-03	Conductivity (us/cm)	380.6	382.4	385.2	384.9	387
34/48/56-6.25%-03	Alkalinity (mg $CaCO_3$/L)	32.3	-	-	-	37.1
34/48/56-6.25%-03	Hardness (mg /L)	193	-	-	-	177

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-6.25%-04	No. Alive	10	10	10	10	10
34/48/56-6.25%-04	pH	7.3	7.2	7.4	7.4	7.5
34/48/56-6.25%-04	Temp °(C)	11.66	11.64	11.66	11.85	11.65
34/48/56-6.25%-04	D.O. (mg/L)	8.2	7.76	8.19	8.31	8.31
34/48/56-6.25%-04	Conductivity (us/cm)	377	383	385.5	385	386
34/48/56-6.25%-04	Alkalinity (mg $CaCO_3$/L)	32.3	-	-	-	37.1
34/48/56-6.25%-04	Hardness (mg /L)	193	-	-	-	177

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12		No. Organisms per replicate: 10
End Date	10/26/12		No. of Replicates: 4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-12.5%-01	No. Alive	10	10	10	10	10
34/48/56-12.5%-01	pH	7.2	7.2	7.3	7.3	7.5
34/48/56-12.5%-01	Temp °(C)	11.65	11.61	11.68	11.84	11.66
34/48/56-12.5%-01	D.O. (mg/L)	8.25	8.12	7.93	8.29	8.36
34/48/56-12.5%-01	Conductivity (us/cm)	405.9	408	412.7	410.5	413.6
34/48/56-12.5%-01	Alkalinity (mg $CaCO_3$/L)	27.5	-	-	-	32
34/48/56-12.5%-01	Hardness (mg /L)	194	-	-	-	192

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-12.5%-02	No. Alive	10	10	10	10	10
34/48/56-12.5%-02	pH	7.2	7.3	7.2	7.3	7.4
34/48/56-12.5%-02	Temp °(C)	11.65	11.63	11.67	11.83	11.66
34/48/56-12.5%-02	D.O. (mg/L)	8.29	8.17	7.86	8.06	7.94
34/48/56-12.5%-02	Conductivity (us/cm)	405.5	409.8	413.3	411	412.3
34/48/56-12.5%-02	Alkalinity (mg $CaCO_3$/L)	27.5	-	-	-	32
34/48/56-12.5%-02	Hardness (mg /L)	194	-	-	-	192

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-12.5%-03	No. Alive	10	10	10	10	10
34/48/56-12.5%-03	pH	7.2	7.3	7.2	7.3	7.4
34/48/56-12.5%-03	Temp °(C)	11.64	11.62	11.68	11.85	11.65
34/48/56-12.5%-03	D.O. (mg/L)	8.32	8.3	7.7	7.85	7.82
34/48/56-12.5%-03	Conductivity (us/cm)	408	408.9	412	410.5	409.4
34/48/56-12.5%-03	Alkalinity (mg $CaCO_3$/L)	27.5	-	-	-	32
34/48/56-12.5%-03	Hardness (mg /L)	194	-	-	-	192

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-12.5%-04	No. Alive	10	10	10	10	10
34/48/56-12.5%-04	pH	7.2	7.2	7.3	7.3	7.4
34/48/56-12.5%-04	Temp °(C)	11.66	11.62	11.67	11.85	11.66
34/48/56-12.5%-04	D.O. (mg/L)	8.31	8.28	7.93	7.86	8.18
34/48/56-12.5%-04	Conductivity (us/cm)	404.6	408.3	412.7	410.4	412.1
34/48/56-12.5%-04	Alkalinity (mg $CaCO_3$/L)	27.5	-	-	-	32
34/48/56-12.5%-04	Hardness (mg /L)	194	-	-	-	192

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-25%-01	No. Alive	10	10	10	10	10
34/48/56-25%-01	pH	7.1	7.1	7.2	7.2	7.4
34/48/56-25%-01	Temp °(C)	11.66	11.66	11.68	11.88	11.67
34/48/56-25%-01	D.O. (mg/L)	8.23	7.76	8.07	8.28	8.27
34/48/56-25%-01	Conductivity (us/cm)	456.6	458.5	461.7	462.9	465.4
34/48/56-25%-01	Alkalinity (mg $CaCO_3$/L)	17.5	-	-	-	19.5
34/48/56-25%-01	Hardness (mg /L)	220	-	-	-	217

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-25%-02	No. Alive	10	10	10	10	10
34/48/56-25%-02	pH	7.1	7.1	7.2	7.2	7.4
34/48/56-25%-02	Temp °(C)	11.66	11.66	11.67	11.87	11.59
34/48/56-25%-02	D.O. (mg/L)	8.15	7.84	8.06	8.17	8.29
34/48/56-25%-02	Conductivity (us/cm)	452.2	457.9	463.4	461.8	464.4
34/48/56-25%-02	Alkalinity (mg $CaCO_3$/L)	17.5	-	-	-	19.5
34/48/56-25%-02	Hardness (mg /L)	220	-	-	-	217

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-25%-03	No. Alive	10	10	10	10	10
34/48/56-25%-03	pH	7.1	7.1	7.1	7.2	7.3
34/48/56-25%-03	Temp °(C)	11.68	11.66	11.66	11.86	11.66
34/48/56-25%-03	D.O. (mg/L)	8.21	7.9	8.08	8.05	8.27
34/48/56-25%-03	Conductivity (us/cm)	456.1	458	464.8	461.1	465.4
34/48/56-25%-03	Alkalinity (mg $CaCO_3$/L)	17.5	-	-	-	19.5
34/48/56-25%-03	Hardness (mg /L)	220	-	-	-	217

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/56-25%-04	No. Alive	10	10	10	10	10
34/48/56-25%-04	pH	7	7.1	7.1	7.1	7.4
34/48/56-25%-04	Temp °(C)	11.67	11.65	11.66	11.86	11.66
34/48/56-25%-04	D.O. (mg/L)	8.24	7.75	8.1	7.99	8.29
34/48/56-25%-04	Conductivity (us/cm)	458.8	458.2	463	460.9	464.1
34/48/56-25%-04	Alkalinity (mg $CaCO_3$/L)	17.5	-	-	-	19.5
34/48/56-25%-04	Hardness (mg /L)	220	-	-	-	217

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-50%-01	No. Alive	10	10	10	10	10
34/48/56-50%-01	pH	6.2	6.5	6.7	6.9	7.1
34/48/56-50%-01	Temp °(C)	11.66	11.66	11.69	11.87	11.67
34/48/56-50%-01	D.O. (mg/L)	8.25	8.1	7.84	8.55	8.48
34/48/56-50%-01	Conductivity (us/cm)	559.1	563.6	569.4	567.1	569.1
34/48/56-50%-01	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.82
34/48/56-50%-01	Hardness (mg /L)	270	-	-	-	272

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-50%-02	No. Alive	10	10	10	10	10
34/48/56-50%-02	pH	6.2	6.5	6.7	6.8	7
34/48/56-50%-02	Temp °(C)	11.66	11.67	11.65	11.91	11.69
34/48/56-50%-02	D.O. (mg/L)	8.28	7.95	7.84	8.35	8.54
34/48/56-50%-02	Conductivity (us/cm)	563.2	564	568.8	568.1	568.9
34/48/56-50%-02	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.82
34/48/56-50%-02	Hardness (mg /L)	270	-	-	-	272

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-50%-03	No. Alive	10	10	10	9	9
34/48/56-50%-03	pH	6.2	6.5	6.6	6.7	6.9
34/48/56-50%-03	Temp °(C)	11.67	11.67	11.65	11.89	11.69
34/48/56-50%-03	D.O. (mg/L)	8.28	7.96	8.1	8.31	8.43
34/48/56-50%-03	Conductivity (us/cm)	556	563	569.3	565.6	565.5
34/48/56-50%-03	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.82
34/48/56-50%-03	Hardness (mg /L)	270	-	-	-	272

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-50%-04	No. Alive	10	10	10	10	10
34/48/56-50%-04	pH	6.1	6.5	6.6	6.7	6.9
34/48/56-50%-04	Temp °(C)	11.68	11.67	11.68	11.88	11.69
34/48/56-50%-04	D.O. (mg/L)	8.24	8.16	8.23	8.35	8.49
34/48/56-50%-04	Conductivity (us/cm)	555.3	563.3	568.1	566.7	568.4
34/48/56-50%-04	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.82
34/48/56-50%-04	Hardness (mg /L)	270	-	-	-	272

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-100%-01	No. Alive	10	10	0	-	-
34/48/56-100%-01	pH	3.9	4.5	4.2	-	-
34/48/56-100%-01	Temp °(C)	11.68	11.67	11.69	-	-
34/48/56-100%-01	D.O. (mg/L)	8.32	8.51	8.58	-	-
34/48/56-100%-01	Conductivity (us/cm)	814.1	798.6	841.3	-	-
34/48/56-100%-01	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	<5.00U	-	-
34/48/56-100%-01	Hardness (mg /L)	382	-	385	-	-

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-100%-02	No. Alive	10	4	0	-	-
34/48/56-100%-02	pH	3.9	4.5	4.1	-	-
34/48/56-100%-02	Temp °(C)	11.67	11.65	11.69	-	-
34/48/56-100%-02	D.O. (mg/L)	8.33	8.43	8.61	-	-
34/48/56-100%-02	Conductivity (us/cm)	818.9	802.4	816.7	-	-
34/48/56-100%-02	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	<5.00U	-	-
34/48/56-100%-02	Hardness (mg /L)	382	-	385	-	-

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-100%-03	No. Alive	10	2	0	-	-
34/48/56-100%-03	pH	3.8	4.1	4.1	-	-
34/48/56-100%-03	Temp °(C)	11.7	11.69	11.65	-	-
34/48/56-100%-03	D.O. (mg/L)	8.22	8.37	8.67	-	-
34/48/56-100%-03	Conductivity (us/cm)	836	822.4	816	-	-
34/48/56-100%-03	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	<5.00U	-	-
34/48/56-100%-03	Hardness (mg /L)	382	-	385	-	-

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/56-100%-04	No. Alive	10	7	0	-	-
34/48/56-100%-04	pH	3.8	4.3	4.2	-	-
34/48/56-100%-04	Temp °(C)	11.72	11.7	11.71	-	-
34/48/56-100%-04	D.O. (mg/L)	8.17	8.19	8.63	-	-
34/48/56-100%-04	Conductivity (us/cm)	825.4	807.5	817.6	-	-
34/48/56-100%-04	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	<5.00U	-	-
34/48/56-100%-04	Hardness (mg /L)	382	-	385	-	-

Serial dilution of M34/CC48 with A68

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-control-01	No. Alive	10	10	10	10	10
34/48/68-control-01	pH	7.2	7	7.1	7.6	7.3
34/48/68-control-01	Temp °(C)	12.05	11.76	12.05	11.95	11.82
34/48/68-control-01	D.O. (mg/L)	7.74	7.54	7.7	7.66	7.85
34/48/68-control-01	Conductivity (us/cm)	308.4	314.9	315.4	318.1	321.3
34/48/68-control-01	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	72.2
34/48/68-control-01	Hardness (mg /L)	*	-	-	-	94

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-control-02	No. Alive	10	10	10	10	10
34/48/68-control-02	pH	7.2	7.1	7.2	7.6	7.4
34/48/68-control-02	Temp °(C)	12.01	11.72	11.74	11.91	11.73
34/48/68-control-02	D.O. (mg/L)	7.79	7.69	8.07	8.1	7.78
34/48/68-control-02	Conductivity (us/cm)	287.5	315.3	318.5	319.1	321.4
34/48/68-control-02	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	72.2
34/48/68-control-02	Hardness (mg /L)	*	-	-	-	94

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-control-03	No. Alive	10	10	10	10	10
34/48/68-control-03	pH	7.2	7.1	7.3	7.6	7.6
34/48/68-control-03	Temp °(C)	11.91	11.71	11.74	11.91	11.71
34/48/68-control-03	D.O. (mg/L)	7.88	7.96	8.08	8.22	8.15
34/48/68-control-03	Conductivity (us/cm)	310.8	314.7	318	318.6	320.4
34/48/68-control-03	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	72.2
34/48/68-control-03	Hardness (mg /L)	*	-	-	-	94

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-control-04	No. Alive	10	10	10	10	10
34/48/68-control-04	pH	7.3	7.1	7.3	7.6	7.6
34/48/68-control-04	Temp °(C)	11.88	11.72	11.73	11.91	11.72
34/48/68-control-04	D.O. (mg/L)	7.87	7.87	7.94	8.09	8.13
34/48/68-control-04	Conductivity (us/cm)	311.2	314	318.4	318.7	320.6
34/48/68-control-04	Alkalinity (mg $CaCO_3$/L)	*	-	-	-	72.2
34/48/68-control-04	Hardness (mg /L)	*	-	-	-	94

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-6.25%-01	No. Alive	10	10	10	10	10
34/48/68-6.25%-01	pH	7.3	7	7.4	7.3	7.7
34/48/68-6.25%-01	Temp °(C)	11.84	11.76	11.91	11.73	11.91
34/48/68-6.25%-01	D.O. (mg/L)	8.12	6.29	7.9	7.7	8.04
34/48/68-6.25%-01	Conductivity (us/cm)	406.2	426.9	415.3	412.3	414.4
34/48/68-6.25%-01	Alkalinity (mg $CaCO_3$/L)	31.6	-	-	-	35.7
34/48/68-6.25%-01	Hardness (mg /L)	180	-	-	-	194

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-6.25%-02	No. Alive	10	10	10	10	10
34/48/68-6.25%-02	pH	7.3	7.1	7.4	7.3	7.6
34/48/68-6.25%-02	Temp °(C)	11.76	11.75	11.9	11.73	11.8
34/48/68-6.25%-02	D.O. (mg/L)	8.3	6.47	7.75	7.61	7.78
34/48/68-6.25%-02	Conductivity (us/cm)	406.6	423.8	414.4	411.5	414.3
34/48/68-6.25%-02	Alkalinity (mg $CaCO_3$/L)	31.6	-	-	-	35.7
34/48/68-6.25%-02	Hardness (mg /L)	180	-	-	-	194

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-6.25%-03	No. Alive	10	10	10	10	10
34/48/68-6.25%-03	pH	7.3	7.1	7.3	7.3	7.6
34/48/68-6.25%-03	Temp °(C)	11.75	11.76	11.86	11.72	11.81
34/48/68-6.25%-03	D.O. (mg/L)	8.37	6.87	7.86	7.77	7.61
34/48/68-6.25%-03	Conductivity (us/cm)	406.1	424.1	416.5	415.9	413
34/48/68-6.25%-03	Alkalinity (mg $CaCO_3$/L)	31.6	-	-	-	35.7
34/48/68-6.25%-03	Hardness (mg /L)	180	-	-	-	194

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-6.25%-04	No. Alive	10	10	10	10	10
34/48/68-6.25%-04	pH	7.4	7.1	7.3	7.3	7.5
34/48/68-6.25%-04	Temp °(C)	11.72	11.77	11.89	11.7	11.81
34/48/68-6.25%-04	D.O. (mg/L)	8.4	7.18	7.78	7.66	7.61
34/48/68-6.25%-04	Conductivity (us/cm)	405.9	423	415.6	419.9	413
34/48/68-6.25%-04	Alkalinity (mg $CaCO_3$/L)	31.6	-	-	-	35.7
34/48/68-6.25%-04	Hardness (mg /L)	180	-	-	-	194

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-12.5%-01	No. Alive	10	10	10	10	10
34/48/68-12.5%-01	pH	7.3	7.3	7.4	7.3	7.6
34/48/68-12.5%-01	Temp °(C)	11.75	11.77	11.93	11.74	11.82
34/48/68-12.5%-01	D.O. (mg/L)	8.47	7.88	8.18	7.74	8.3
34/48/68-12.5%-01	Conductivity (us/cm)	430	449	440.7	442.9	443.1
34/48/68-12.5%-01	Alkalinity (mg $CaCO_3$/L)	31.2	-	-	-	28.1
34/48/68-12.5%-01	Hardness (mg /L)	196	-	-	-	203

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-12.5%-02	No. Alive	10	10	10	10	10
34/48/68-12.5%-02	pH	7.3	7.2	7.4	7.3	7.6
34/48/68-12.5%-02	Temp °(C)	11.73	11.77	11.93	11.73	11.8
34/48/68-12.5%-02	D.O. (mg/L)	8.5	8.03	8.25	8.03	8.02
34/48/68-12.5%-02	Conductivity (us/cm)	429.7	446.8	440.4	442.4	440.2
34/48/68-12.5%-02	Alkalinity (mg $CaCO_3$/L)	31.2	-	-	-	28.1
34/48/68-12.5%-02	Hardness (mg /L)	196	-	-	-	203

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-12.5%-03	No. Alive	10	10	10	10	10
34/48/68-12.5%-03	pH	7.2	7.2	7.4	7.4	7.5
34/48/68-12.5%-03	Temp °(C)	11.67	11.77	11.93	11.72	11.81
34/48/68-12.5%-03	D.O. (mg/L)	8.57	7.86	8.21	8.18	7.99
34/48/68-12.5%-03	Conductivity (us/cm)	429.6	447.9	440.1	444.3	441.7
34/48/68-12.5%-03	Alkalinity (mg $CaCO_3$/L)	31.2	-	-	-	28.1
34/48/68-12.5%-03	Hardness (mg /L)	196	-	-	-	203

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-12.5%-04	No. Alive	10	10	10	10	10
34/48/68-12.5%-04	pH	7.2	7.2	7.3	7.4	7.5
34/48/68-12.5%-04	Temp °(C)	11.68	11.76	11.92	11.74	11.81
34/48/68-12.5%-04	D.O. (mg/L)	8.56	7.81	8.1	8.31	7.78
34/48/68-12.5%-04	Conductivity (us/cm)	429.9	449.4	442	443.7	441.2
34/48/68-12.5%-04	Alkalinity (mg $CaCO_3$/L)	31.2	-	-	-	28.1
34/48/68-12.5%-04	Hardness (mg /L)	196	-	-	-	203

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/68-25%-01	No. Alive	10	10	10	10	10
34/48/68-25%-01	pH	7.1	7.2	7.3	7.3	7.4
34/48/68-25%-01	Temp °(C)	11.8	11.76	11.81	11.73	11.8
34/48/68-25%-01	D.O. (mg/L)	8.55	7.84	8.24	8.29	7.77
34/48/68-25%-01	Conductivity (us/cm)	480.8	497	489.2	490.4	491.1
34/48/68-25%-01	Alkalinity (mg $CaCO_3$/L)	17.6	-	-	-	19.5
34/48/68-25%-01	Hardness (mg /L)	231	-	-	-	230

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/68-25%-02	No. Alive	10	10	10	10	10
34/48/68-25%-02	pH	6.9	7.1	7.2	7.3	7.5
34/48/68-25%-02	Temp °(C)	11.77	11.77	11.91	11.72	11.82
34/48/68-25%-02	D.O. (mg/L)	8.54	8.02	8.01	8.12	8.07
34/48/68-25%-02	Conductivity (us/cm)	479.2	496.8	489	493.1	492.1
34/48/68-25%-02	Alkalinity (mg $CaCO_3$/L)	17.6	-	-	-	19.5
34/48/68-25%-02	Hardness (mg /L)	231	-	-	-	230

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/68-25%-03	No. Alive	10	10	10	10	10
34/48/68-25%-03	pH	7	7.2	7.3	7.3	7.4
34/48/68-25%-03	Temp °(C)	11.74	11.75	11.92	11.72	11.84
34/48/68-25%-03	D.O. (mg/L)	8.55	7.79	7.94	8.05	8.01
34/48/68-25%-03	Conductivity (us/cm)	480	495.9	489	491.8	490.1
34/48/68-25%-03	Alkalinity (mg $CaCO_3$/L)	17.6	-	-	-	19.5
34/48/68-25%-03	Hardness (mg /L)	231	-	-	-	230

Replicate I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
34/48/68-25%-04	No. Alive	10	10	10	10	10
34/48/68-25%-04	pH	6.9	7.1	7.2	7.3	7.5
34/48/68-25%-04	Temp °(C)	11.73	11.76	11.94	11.72	11.85
34/48/68-25%-04	D.O. (mg/L)	8.57	8.05	8.08	8.23	7.9
34/48/68-25%-04	Conductivity (us/cm)	480	497.9	488	490.2	486.2
34/48/68-25%-04	Alkalinity (mg $CaCO_3$/L)	17.6	-	-	-	19.5
34/48/68-25%-04	Hardness (mg /L)	231	-	-	-	230

Appendix A 1: Upper Animas October 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms per replicate: 10	
End Date	10/26/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA,CL,LC

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-50%-01	No. Alive	10	10	10	7	3
34/48/68-50%-01	pH	6.1	6.9	7.1	7.1	7.1
34/48/68-50%-01	Temp °(C)	11.94	11.79	11.79	11.74	11.86
34/48/68-50%-01	D.O. (mg/L)	8.5	7.9	8.3	8.23	7.97
34/48/68-50%-01	Conductivity (us/cm)	574.7	590	582.3	588.7	590.1
34/48/68-50%-01	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.00
34/48/68-50%-01	Hardness (mg /L)	278	-	-	-	278

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-50%-02	No. Alive	10	10	8	5	2
34/48/68-50%-02	pH	5.9	6.9	6.9	7	7.1
34/48/68-50%-02	Temp °(C)	11.66	11.77	11.78	11.74	11.84
34/48/68-50%-02	D.O. (mg/L)	8.53	7.94	8.48	8.43	8.11
34/48/68-50%-02	Conductivity (us/cm)	572.7	591.4	584.6	587.4	589.2
34/48/68-50%-02	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.00
34/48/68-50%-02	Hardness (mg /L)	278	-	-	-	278

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-50%-03	No. Alive	10	10	10	8	6
34/48/68-50%-03	pH	6	6.9	6.9	6.9	6.9
34/48/68-50%-03	Temp °(C)	11.6	11.77	11.89	11.75	11.9
34/48/68-50%-03	D.O. (mg/L)	8.58	7.8	8.33	8.57	8.21
34/48/68-50%-03	Conductivity (us/cm)	572.7	592	585.1	589.9	588.3
34/48/68-50%-03	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.00
34/48/68-50%-03	Hardness (mg /L)	278	-	-	-	278

Replicate I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
34/48/68-50%-04	No. Alive	10	10	10	8	4
34/48/68-50%-04	pH	6.1	6.9	6.9	6.9	6.9
34/48/68-50%-04	Temp °(C)	11.59	11.77	11.91	11.69	11.87
34/48/68-50%-04	D.O. (mg/L)	8.61	8.03	8.37	8.63	7.92
34/48/68-50%-04	Conductivity (us/cm)	572	588.2	582	587.2	591.2
34/48/68-50%-04	Alkalinity (mg $CaCO_3$/L)	<5.00U	-	-	-	5.00
34/48/68-50%-04	Hardness (mg /L)	278	-	-	-	278

* No data available

Qualifiers:

U= Non Detect

Prepared by: EC 3/6/13

QC'd by: BGK 3/13/13

Appendix A 2: October 2012 Aquatic Toxicity Test
Reference Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms	10
End Date	10/26/12	No. of Replicates	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-01	No. Alive	10	10	10	10	10
Control-01	pH	7.4	7.5	7.6	7.6	7.6
Control-01	Temp °(C)	11.73	11.85	11.91	11.94	11.64
Control-01	D.O. (mg/L)	8.33	8.18	8.14	7.99	8.42
Control-01	Conductivity (us/cm)	309.6	315.2	317.9	317.7	318.4
Control-01	Alkalinity (mg $CaCO_3$/L)	56.6	-	-	-	70.5
Control-01	Hardness (mg/L)	96	-	-	-	94

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-02	No. Alive	10	10	10	10	10
Control-02	pH	7.5	7.6	7.6	7.6	7.6
Control-02	Temp °(C)	11.68	11.83	11.88	11.88	11.65
Control-02	D.O. (mg/L)	8.66	8.27	8.27	8.25	8.44
Control-02	Conductivity (us/cm)	308.4	316.2	318.5	319	320
Control-02	Alkalinity (mg $CaCO_3$/L)	56.6	-	-	-	70.5
Control-02	Hardness (mg/L)	96	-	-	-	94

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-03	No. Alive	10	10	10	10	10
Control-03	pH	7.5	7.6	7.6	7.6	7.7
Control-03	Temp °(C)	11.71	11.84	11.84	11.86	11.64
Control-03	D.O. (mg/L)	8.65	8.13	8.28	8.32	8.46
Control-03	Conductivity (us/cm)	310.1	315.8	317.4	317.7	319.3
Control-03	Alkalinity (mg $CaCO_3$/L)	56.6	-	-	-	70.5
Control-03	Hardness (mg/L)	96	-	-	-	94

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-04	No. Alive	10	10	10	10	10
Control-04	pH	7.6	7.6	7.6	7.6	7.6
Control-04	Temp °(C)	11.72	11.84	11.85	11.83	11.63
Control-04	D.O. (mg/L)	8.64	7.73	8.12	8.25	8.33
Control-04	Conductivity (us/cm)	308	315.4	317.4	318.3	319.3
Control-04	Alkalinity (mg $CaCO_3$/L)	56.6	-	-	-	70.5
Control-04	Hardness (mg/L)	96	-	-	-	94

Appendix A 2: October 2012 Aquatic Toxicity Test
Reference Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms	10
End Date	10/26/12	No. of Replicates	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
6.25%-01	No. Alive	10	10	10	10	10
6.25%-01	pH	7.5	7.5	7.6	7.6	7.6
6.25%-01	Temp °(C)	11.71	11.84	11.84	11.85	11.62
6.25%-01	D.O. (mg/L)	8.65	7.72	8.03	8.23	8.34
6.25%-01	Conductivity (us/cm)	311.6	316.8	318.4	318.8	320.2
6.25%-01	Alkalinity (mg $CaCO_3$/L)	60	-	-	-	63.8
6.25%-01	Hardness (mg/L)	96	-	-	-	97

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
6.25%-02	No. Alive	10	10	10	10	10
6.25%-02	pH	7.5	7.6	7.5	7.6	7.6
6.25%-02	Temp °(C)	11.71	11.85	11.83	11.82	11.63
6.25%-02	D.O. (mg/L)	8.62	7.72	7.6	7.87	8.43
6.25%-02	Conductivity (us/cm)	308.1	315.5	317.7	317.6	318.9
6.25%-02	Alkalinity (mg $CaCO_3$/L)	60	-	-	-	63.8
6.25%-02	Hardness (mg/L)	96	-	-	-	97

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
6.25%-03	No. Alive	10	10	10	10	10
6.25%-03	pH	7.6	7.5	7.5	7.5	7.6
6.25%-03	Temp °(C)	11.66	11.86	11.83	11.83	11.63
6.25%-03	D.O. (mg/L)	8.6	7.65	7.54	7.71	8.01
6.25%-03	Conductivity (us/cm)	307.7	316	318.4	317.9	319
6.25%-03	Alkalinity (mg $CaCO_3$/L)	60	-	-	-	63.8
6.25%-03	Hardness (mg/L)	96	-	-	-	97

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
6.25%-04	No. Alive	10	10	10	10	10
6.25%-04	pH	7.6	7.6	7.6	7.6	7.6
6.25%-04	Temp °(C)	11.66	11.85	11.84	11.76	11.65
6.25%-04	D.O. (mg/L)	8.61	7.58	7.77	8.16	7.97
6.25%-04	Conductivity (us/cm)	311.5	316.4	318.9	319	319.9
6.25%-04	Alkalinity (mg $CaCO_3$/L)	60	-	-	-	63.8
6.25%-04	Hardness (mg/L)	96	-	-	-	97

Appendix A 2: October 2012 Aquatic Toxicity Test
Reference Static Renewal Data Sheets

Start Date	10/22/12		No. Organisms	10
End Date	10/26/12		No. of Replicates	4
Organism	Juvenile *O.mykiss* (rainbow trout)		Analysts	SA, CL, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-01	No. Alive	10	10	8	8	8
12.5%-01	pH	7.6	7.5	7.6	7.6	7.6
12.5%-01	Temp °(C)	11.67	11.85	11.83	11.79	11.64
12.5%-01	D.O. (mg/L)	8.67	7.81	8.17	8.24	8.45
12.5%-01	Conductivity (us/cm)	311.4	317.5	319.7	316.5	318
12.5%-01	Alkalinity (mg $CaCO_3$/L)	56.7	-	-	-	66.3
12.5%-01	Hardness (mg/L)	96	-	-	-	91

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-02	No. Alive	10	10	6	6	6
12.5%-02	pH	7.6	7.5	7.6	7.6	7.7
12.5%-02	Temp °(C)	11.65	11.86	11.84	11.75	11.64
12.5%-02	D.O. (mg/L)	8.67	7.76	8.2	8.25	8.52
12.5%-02	Conductivity (us/cm)	311.8	318.3	322.9	317.4	318.4
12.5%-02	Alkalinity (mg $CaCO_3$/L)	56.7	-	-	-	66.3
12.5%-02	Hardness (mg/L)	96	-	-	-	91

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-03	No. Alive	10	10	8	8	8
12.5%-03	pH	7.6	7.5	7.6	7.6	7.7
12.5%-03	Temp °(C)	11.66	11.86	11.84	11.77	11.65
12.5%-03	D.O. (mg/L)	8.68	7.63	8.15	8.38	8.51
12.5%-03	Conductivity (us/cm)	309.8	317.8	321.8	319.6	320.1
12.5%-03	Alkalinity (mg $CaCO_3$/L)	56.7	-	-	-	66.3
12.5%-03	Hardness (mg/L)	96	-	-	-	91

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-04	No. Alive	10	10	8	8	8
12.5%-04	pH	7.6	7.5	7.6	7.6	7.6
12.5%-04	Temp °(C)	11.67	11.86	11.85	11.77	11.64
12.5%-04	D.O. (mg/L)	8.69	7.78	8	8.32	8.44
12.5%-04	Conductivity (us/cm)	308.2	319.2	323.5	318.9	319.1
12.5%-04	Alkalinity (mg $CaCO_3$/L)	56.7	-	-	-	66.3
12.5%-04	Hardness (mg/L)	96	-	-	-	91

Appendix A 2: October 2012 Aquatic Toxicity Test
Reference Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms	10
End Date	10/26/12	No. of Replicates	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-01	No. Alive	10	6	0	-	-
25%-01	pH	7.6	7.5	7.6	-	-
25%-01	Temp °(C)	11.69	11.86	11.77	-	-
25%-01	D.O. (mg/L)	8.68	7.82	8.32	-	-
25%-01	Conductivity (us/cm)	311.3	318.6	319.2	-	-
25%-01	Alkalinity (mg $CaCO_3$/L)	59.5		64	-	-
25%-01	Hardness (mg/L)	96		95	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-02	No. Alive	10	10	0	-	-
25%-02	pH	7.6	7.4	7.7	-	-
25%-02	Temp °(C)	11.69	11.87	11.86	-	-
25%-02	D.O. (mg/L)	8.64	7.6	8.49	-	-
25%-02	Conductivity (us/cm)	308.2	320.4	324	-	-
25%-02	Alkalinity (mg $CaCO_3$/L)	59.5	-	64	-	-
25%-02	Hardness (mg/L)	96	-	95	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-03	No. Alive	10	9	2	2	2
25%-03	pH	7.6	7.4	7.7	7.7	7.7
25%-03	Temp °(C)	11.7	11.87	11.88	11.75	11.67
25%-03	D.O. (mg/L)	8.62	6.83	8.51	8.51	8.6
25%-03	Conductivity (us/cm)	309.2	318.6	323.1	313.9	315.1
25%-03	Alkalinity (mg $CaCO_3$/L)	59.5	-	64	-	-
25%-03	Hardness (mg/L)	96	-	95	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-04	No. Alive	10	7	0	-	-
25%-04	pH	7.6	7.4	7.8	-	-
25%-04	Temp °(C)	11.67	11.88	11.88	-	-
25%-04	D.O. (mg/L)	8.65	7.39	8.49	-	-
25%-04	Conductivity (us/cm)	311	319.5	319.3	-	-
25%-04	Alkalinity (mg $CaCO_3$/L)	59.5	-	64	-	-
25%-04	Hardness (mg/L)	96	-	95	-	-

Appendix A 2: October 2012 Aquatic Toxicity Test
Reference Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms	10
End Date	10/26/12	No. of Replicates	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-01	No. Alive	10	7	0	-	-
50%-01	pH	7.6	7.4	7.7	-	-
50%-01	Temp °(C)	11.68	11.84	11.86	-	-
50%-01	D.O. (mg/L)	8.7	7.87	8.63	-	-
50%-01	Conductivity (us/cm)	308.9	319.5	316.4	-	-
50%-01	Alkalinity (mg $CaCO_3$/L)	58.4	-	62.4	-	-
50%-01	Hardness (mg/L)	96	-	95	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-02	No. Alive	10	7	0	-	-
50%-02	pH	7.6	7.4	7.8	-	-
50%-02	Temp °(C)	11.7	11.88	11.88	-	-
50%-02	D.O. (mg/L)	8.67	7.42	8.63	-	-
50%-02	Conductivity (us/cm)	308.6	319.3	316	-	-
50%-02	Alkalinity (mg $CaCO_3$/L)	58.4	-	62.4	-	-
50%-02	Hardness (mg/L)	96	-	95	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-03	No. Alive	10	9	0	-	-
50%-03	pH	7.6	7.4	7.7	-	-
50%-03	Temp °(C)	11.71	11.91	11.89	-	-
50%-03	D.O. (mg/L)	8.65	7.2	8.63	-	-
50%-03	Conductivity (us/cm)	308.9	319.5	322.8	-	-
50%-03	Alkalinity (mg $CaCO_3$/L)	58.4	-	62.4	-	-
50%-03	Hardness (mg/L)	96	-	95	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-04	No. Alive	10	6	0	-	-
50%-04	pH	7.6	7.4	7.8	-	-
50%-04	Temp °(C)	11.68	11.91	11.88	-	-
50%-04	D.O. (mg/L)	8.68	7.87	8.57	-	-
50%-04	Conductivity (us/cm)	309.6	320.2	318.4	-	-
50%-04	Alkalinity (mg $CaCO_3$/L)	58.4	-	62.4	-	-
50%-04	Hardness (mg/L)	96	-	95	-	-

Appendix A 2: October 2012 Aquatic Toxicity Test
Reference Static Renewal Data Sheets

Start Date	10/22/12	No. Organisms	10
End Date	10/26/12	No. of Replicates	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-01	No. Alive	10	4	0	-	-
100%-01	pH	7.6	7.4	7.7	-	-
100%-01	Temp °(C)	11.72	11.88	11.88	-	-
100%-01	D.O. (mg/L)	8.67	8	8.66	-	-
100%-01	Conductivity (us/cm)	309.8	319.5	315.8	-	-
100%-01	Alkalinity (mg $CaCO_3$/L)	60.5	-	59.7	-	-
100%-01	Hardness (mg/L)	96	-	94	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-02	No. Alive	10	3	0	-	-
100%-02	pH	7.6	7.4	7.7	-	-
100%-02	Temp °(C)	11.69	11.88	11.89	-	-
100%-02	D.O. (mg/L)	8.69	8.15	8.6	-	-
100%-02	Conductivity (us/cm)	310.9	320.4	316	-	-
100%-02	Alkalinity (mg $CaCO_3$/L)	60.5	-	59.7	-	-
100%-02	Hardness (mg/L)	96	-	94	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-03	No. Alive	10	5	0	-	-
100%-03	pH	7.6	7.5	7.8	-	-
100%-03	Temp °(C)	11.68	11.9	11.88	-	-
100%-03	D.O. (mg/L)	8.71	8.19	8.66	-	-
100%-03	Conductivity (us/cm)	311.9	319.7	318	-	-
100%-03	Alkalinity (mg $CaCO_3$/L)	60.5	-	59.7	-	-
100%-03	Hardness (mg/L)	96	-	94	-	-

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-04	No. Alive	10	7	1	0	-
100%-04	pH	7.6	7.4	7.8	7.6	-
100%-04	Temp °(C)	11.67	11.9	11.9	11.79	-
100%-04	D.O. (mg/L)	8.8	8.09	8.66	8.7	-
100%-04	Conductivity (us/cm)	313.1	320.4	318.3	313.2	-
100%-04	Alkalinity (mg $CaCO_3$/L)	60.5	-	59.7	-	-
100%-04	Hardness (mg/L)	96	-	94	-	-

Appendix B
November 2012 Upper Animas River Superfund Site
Site Water Toxicity Test and Reference Toxicity Test
Daily Water Chemistries

Appendix B 1: Upper Animas November 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Profile Test

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-01	No. Alive	10	10	10	10	10
Control-01	pH	7.6	7.3	7.27	7.22	7.52
Control-01	Temp (°C)	11.87	11.83	11.62	11.97	11.74
Control-01	D.O. (mg/L)	8.59	7.61	8.01	8.33	8.15
Control-01	Conductivity (us/cm)	298.3	304.2	322	327.2	318.9
Control-01	Alkalinity (mg $CaCO_3$/L)	55.2	-	-	-	65.8
Control-01	Hardness (mg/L)	91	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-02	No. Alive	10	10	10	10	10
Control-02	pH	7.6	7.2	7.21	7.24	7.51
Control-02	Temp (°C)	11.71	11.82	11.83	11.94	11.79
Control-02	D.O. (mg/L)	8.71	7.51	8	8.27	8.03
Control-02	Conductivity (us/cm)	297.3	303.3	318	324.6	317.7
Control-02	Alkalinity (mg $CaCO_3$/L)	55.2	-	-	-	65.8
Control-02	Hardness (mg/L)	91	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-03	No. Alive	10	10	10	10	10
Control-03	pH	7.6	7.2	7.2	7.26	7.5
Control-03	Temp (°C)	11.71	11.82	11.61	11.89	11.74
Control-03	D.O. (mg/L)	8.71	7.68	8.2	8.11	8
Control-03	Conductivity (us/cm)	297.4	303.6	316	326.8	319.3
Control-03	Alkalinity (mg $CaCO_3$/L)	55.2	-	-	-	65.8
Control-03	Hardness (mg/L)	91	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-04	No. Alive	10	10	10	10	10
Control-04	pH	7.7	7.3	7.3	7.28	7.46
Control-04	Temp (°C)	11.74	11.82	11.52	11.88	11.77
Control-04	D.O. (mg/L)	8.72	7.95	7.7	8.03	7.77
Control-04	Conductivity (us/cm)	297.2	303.6	311	328.1	318.6
Control-04	Alkalinity (mg $CaCO_3$/L)	55.2	-	-	-	65.8
Control-04	Hardness (mg/L)	91	-	-	-	93

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-01	No. Alive	10	9	0	-	-
M34-01	pH	5.5	6.5	6.87	-	-
M34-01	Temp (°C)	11.75	11.84	11.83	-	-
M34-01	D.O. (mg/L)	8.79	8.15	8.09	-	-
M34-01	Conductivity (us/cm)	574.2	600.8	621	-	-
M34-01	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	8.16	-	-
M34-01	Hardness (mg/L)	276	-	282	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-02	No. Alive	10	8	1	0	-
M34-02	pH	5.5	6.4	6.67	6.61	-
M34-02	Temp (°C)	11.7	11.8	11.87	11.82	-
M34-02	D.O. (mg/L)	8.81	8.37	8	8.7	-
M34-02	Conductivity (us/cm)	577	602.4	627	622.3	-
M34-02	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	8.16	-
M34-02	Hardness (mg/L)	276	-	-	282	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-03	No. Alive	10	10	1	1	0
M34-03	pH	5.4	6.5	6.71	6.54	6.35
M34-03	Temp (°C)	11.69	11.86	11.9	11.76	11.67
M34-03	D.O. (mg/L)	8.81	8.32	7.87	8.74	8.33
M34-03	Conductivity (us/cm)	577.2	608.1	629	632.1	591.9
M34-03	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	8.16
M34-03	Hardness (mg/L)	276	-	-	-	282

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-04	No. Alive	10	8	1	0	-
M34-04	pH	5.4	6.4	6.61	6.48	-
M34-04	Temp (°C)	11.75	11.85	11.83	11.73	-
M34-04	D.O. (mg/L)	8.8	8.18	8.01	8.75	-
M34-04	Conductivity (us/cm)	577.4	609.1	629	633.1	-
M34-04	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	8.16	-
M34-04	Hardness (mg/L)	276	-	-	282	-

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-01	No. Alive	10	10	10	9	9
A68-01	pH	7.4	7	6.93	7.08	6.29
A68-01	Temp (°C)	11.7	11.85	11.68	11.76	11.65
A68-01	D.O. (mg/L)	8.73	7.6	8.05	8.18	8
A68-01	Conductivity (us/cm)	378.4	389.6	406	413.5	393.9
A68-01	Alkalinity (mg $CaCO_3$/L)	37.6	-	-	-	47
A68-01	Hardness (mg/L)	181	-	-	-	177

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-02	No. Alive	10	10	9	8	8
A68-02	pH	7.4	7	6.98	7.05	6.61
A68-02	Temp (°C)	11.68	11.85	11.59	11.79	11.62
A68-02	D.O. (mg/L)	8.79	7.54	8.05	7.4	8
A68-02	Conductivity (us/cm)	378.6	388.3	406	421.3	395.8
A68-02	Alkalinity (mg $CaCO_3$/L)	37.6	-	-	-	47
A68-02	Hardness (mg/L)	181	-	-	-	177

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-03	No. Alive	10	10	10	10	10
A68-03	pH	7.4	7	6.93	7.06	6.6
A68-03	Temp (°C)	11.66	11.86	11.58	11.79	11.59
A68-03	D.O. (mg/L)	8.79	7.09	8.32	7.41	7.82
A68-03	Conductivity (us/cm)	378.7	388.7	405	413.3	395.2
A68-03	Alkalinity (mg $CaCO_3$/L)	37.6	-	-	-	47
A68-03	Hardness (mg/L)	181	-	-	-	177

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-04	No. Alive	10	10	10	10	10
A68-04	pH	7.4	6.9	6.97	7.05	6.61
A68-04	Temp (°C)	11.68	11.87	11.57	11.79	11.6
A68-04	D.O. (mg/L)	8.8	6.62	6.97	7.53	7.66
A68-04	Conductivity (us/cm)	378.5	387.6	404	414.3	395.1
A68-04	Alkalinity (mg $CaCO_3$/L)	37.6	-	-	-	47
A68-04	Hardness (mg/L)	181	-	-	-	177

Appendix B 1: Upper Animas November 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Serial dilution of A72 with A68

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-100%-Rep1	No. Alive	10	10	3	2	0
A68/A72-100%-Rep1	pH	5.6	6.5	6.84	6.8	6.23
A68/A72-100%-Rep1	Temp (°C)	12.2	11.77	11.7	11.91	11.58
A68/A72-100%-Rep1	D.O. (mg/L)	8.66	8.33	8.06	8.63	8.67
A68/A72-100%-Rep1	Conductivity (us/cm)	602.2	632.3	664	672	624.7
A68/A72-100%-Rep1	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/A72-100%-Rep1	Hardness (mg/L)	298	-	-	-	298

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-100%-Rep2	No. Alive	10	10	5	4	1
A68/A72-100%-Rep2	pH	5.6	6.3	6.72	6.79	6
A68/A72-100%-Rep2	Temp (°C)	12.21	11.77	11.62	11.91	11.62
A68/A72-100%-Rep2	D.O. (mg/L)	8.62	8.37	8.35	8.53	8.71
A68/A72-100%-Rep2	Conductivity (us/cm)	602.4	623.9	660	672.2	627.1
A68/A72-100%-Rep2	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/A72-100%-Rep2	Hardness (mg/L)	298	-	-	-	298

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-100%-Rep3	No. Alive	10	10	5	4	0
A68/A72-100%-Rep3	pH	5.6	6.3	6.66	6.79	5.81
A68/A72-100%-Rep3	Temp (°C)	12.24	11.76	11.6	11.91	11.62
A68/A72-100%-Rep3	D.O. (mg/L)	8.63	8.24	8.43	8.47	8.71
A68/A72-100%-Rep3	Conductivity (us/cm)	602.3	626.1	655	667.5	626.7
A68/A72-100%-Rep3	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/A72-100%-Rep3	Hardness (mg/L)	298	-	-	-	298

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-100%-Rep4	No. Alive	10	10	5	3	0
A68/A72-100%-Rep4	pH	5.6	6.3	6.64	6.77	5.61
A68/A72-100%-Rep4	Temp (°C)	12.25	11.78	11.58	11.91	11.59
A68/A72-100%-Rep4	D.O. (mg/L)	8.68	8.36	8.54	8.69	8.75
A68/A72-100%-Rep4	Conductivity (us/cm)	603	626.2	665	678.4	628
A68/A72-100%-Rep4	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/A72-100%-Rep4	Hardness (mg/L)	298	-	-	-	298

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	
A68/A72-75%-Rep1	No. Alive	10	9	9	9	9	1 Jumper
A68/A72-75%-Rep1	pH	6.7	6.5	6.93	6.91	6.85	
A68/A72-75%-Rep1	Temp (°C)	12.04	11.7	11.75	11.89	11.58	
A68/A72-75%-Rep1	D.O. (mg/L)	8.71	8.23	8.26	8.16	8.35	
A68/A72-75%-Rep1	Conductivity (us/cm)	547	560.6	582.6	597	566.4	
A68/A72-75%-Rep1	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	7.5	
A68/A72-75%-Rep1	Hardness (mg/L)	250	-	-	-	267	

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	
A68/A72-75%-Rep2	No. Alive	10	9	9	9	9	1 Jumper
A68/A72-75%-Rep2	pH	6.5	6.4	6.88	6.89	6.82	
A68/A72-75%-Rep2	Temp (°C)	12.02	11.7	11.72	11.88	11.59	
A68/A72-75%-Rep2	D.O. (mg/L)	8.74	8.09	8.11	8.21	8.3	
A68/A72-75%-Rep2	Conductivity (us/cm)	546.4	559.5	582	591.9	569.4	
A68/A72-75%-Rep2	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	7.5	
A68/A72-75%-Rep2	Hardness (mg/L)	250	-	-	-	267	

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-75%-Rep3	No. Alive	10	10	10	10	10
A68/A72-75%-Rep3	pH	6.4	6.6	6.86	6.88	6.79
A68/A72-75%-Rep3	Temp (°C)	12.02	11.73	11.76	11.87	11.61
A68/A72-75%-Rep3	D.O. (mg/L)	8.74	7.98	6.96	8.02	8.09
A68/A72-75%-Rep3	Conductivity (us/cm)	546.4	564.9	580	595.8	569.8
A68/A72-75%-Rep3	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	7.5
A68/A72-75%-Rep3	Hardness (mg/L)	250	-	-	-	267

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-75%-Rep4	No. Alive	10	10	10	10	10
A68/A72-75%-Rep4	pH	6.4	6.6	6.84	6.88	6.77
A68/A72-75%-Rep4	Temp (°C)	12.1	11.72	11.72	11.88	11.6
A68/A72-75%-Rep4	D.O. (mg/L)	8.72	8.06	7.6	8.31	8.13
A68/A72-75%-Rep4	Conductivity (us/cm)	546.9	557.5	577.4	587.3	577.4
A68/A72-75%-Rep4	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	7.5
A68/A72-75%-Rep4	Hardness (mg/L)	250	-	-	-	267

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-50%-Rep1	No. Alive	10	10	10	10	10
A68/A72-50%-Rep1	pH	7.2	7.3	7.2	6.99	6.9
A68/A72-50%-Rep1	Temp (°C)	11.96	11.67	11.86	11.87	11.6
A68/A72-50%-Rep1	D.O. (mg/L)	8.78	7.8	7.87	8.03	8.19
A68/A72-50%-Rep1	Conductivity (us/cm)	489.6	499.2	515	527.4	512.3
A68/A72-50%-Rep1	Alkalinity (mg $CaCO_3$/L)	16.6	-	-	-	17.5
A68/A72-50%-Rep1	Hardness (mg/L)	238	-	-	-	238

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-50%-Rep2	No. Alive	10	10	10	10	10
A68/A72-50%-Rep2	pH	7.2	7.3	7.1	6.96	6.89
A68/A72-50%-Rep2	Temp (°C)	11.96	11.68	11.85	11.87	11.6
A68/A72-50%-Rep2	D.O. (mg/L)	8.79	7.87	7.96	7.97	8.14
A68/A72-50%-Rep2	Conductivity (us/cm)	489.7	499.7	520	532.5	513.4
A68/A72-50%-Rep2	Alkalinity (mg $CaCO_3$/L)	16.6	-	-	-	17.5
A68/A72-50%-Rep2	Hardness (mg/L)	238	-	-	-	238

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	
A68/A72-50%-Rep3	No. Alive	10	9	9	9	9	1 Jumper
A68/A72-50%-Rep3	pH	7.1	7.3	7	6.97	6.89	
A68/A72-50%-Rep3	Temp (°C)	12	11.66	11.84	11.87	11.64	
A68/A72-50%-Rep3	D.O. (mg/L)	8.8	7.97	8.36	8.05	8.16	
A68/A72-50%-Rep3	Conductivity (us/cm)	490	499.6	523.5	532.5	509.8	
A68/A72-50%-Rep3	Alkalinity (mg $CaCO_3$/L)	16.6	-	-	-	17.5	
A68/A72-50%-Rep3	Hardness (mg/L)	238	-	-	-	238	

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-50%-Rep4	No. Alive	10	10	10	10	10
A68/A72-50%-Rep4	pH	7.1	7.3	6.99	6.93	6.88
A68/A72-50%-Rep4	Temp (°C)	12.07	11.67	11.84	11.86	11.63
A68/A72-50%-Rep4	D.O. (mg/L)	8.77	7.87	8.28	8.19	8.14
A68/A72-50%-Rep4	Conductivity (us/cm)	489.8	499.6	518	527	507.7
A68/A72-50%-Rep4	Alkalinity (mg $CaCO_3$/L)	16.6	-	-	-	17.5
A68/A72-50%-Rep4	Hardness (mg/L)	238	-	-	-	238

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-25%-Rep1	No. Alive	10	10	10	8	8
A68/A72-25%-Rep1	pH	7.5	7.4	7.24	7	6.93
A68/A72-25%-Rep1	Temp (°C)	12.18	11.65	11.88	11.85	11.58
A68/A72-25%-Rep1	D.O. (mg/L)	8.76	7.58	8.1	7.51	8.37
A68/A72-25%-Rep1	Conductivity (us/cm)	435.3	445.4	471	486.8	459.1
A68/A72-25%-Rep1	Alkalinity (mg $CaCO_3$/L)	25.9	-	-	-	33.4
A68/A72-25%-Rep1	Hardness (mg/L)	209	-	-	-	209

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-25%-Rep2	No. Alive	10	10	10	10	10
A68/A72-25%-Rep2	pH	7.4	7.4	7.15	7	6.92
A68/A72-25%-Rep2	Temp (°C)	12.21	11.65	11.88	11.85	11.6
A68/A72-25%-Rep2	D.O. (mg/L)	8.75	7.35	8.31	7.74	8.4
A68/A72-25%-Rep2	Conductivity (us/cm)	435.4	445.4	467	480.9	460.6
A68/A72-25%-Rep2	Alkalinity (mg $CaCO_3$/L)	25.9	-	-	-	33.4
A68/A72-25%-Rep2	Hardness (mg/L)	209	-	-	-	209

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
A68/A72-25%-Rep3	No. Alive	10	9	9	8	8	1 Jumper
A68/A72-25%-Rep3	pH	7.4	7.4	7.12	7.02	6.92	
A68/A72-25%-Rep3	Temp (°C)	12.22	11.66	11.88	11.86	11.66	
A68/A72-25%-Rep3	D.O. (mg/L)	8.74	7.47	8.23	7.62	7.65	
A68/A72-25%-Rep3	Conductivity (us/cm)	435.3	447.4	470	481	455.4	
A68/A72-25%-Rep3	Alkalinity (mg $CaCO_3$/L)	25.9	-	-	-	33.4	
A68/A72-25%-Rep3	Hardness (mg/L)	209	-	-	-	209	

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-25%-Rep4	No. Alive	10	10	10	10	10
A68/A72-25%-Rep4	pH	7.4	7.4	7.06	7.02	6.92
A68/A72-25%-Rep4	Temp (°C)	12.35	11.66	11.89	11.84	11.6
A68/A72-25%-Rep4	D.O. (mg/L)	8.74	7.76	8.24	7.59	7.54
A68/A72-25%-Rep4	Conductivity (us/cm)	435	445.5	454	464.6	447.9
A68/A72-25%-Rep4	Alkalinity (mg $CaCO_3$/L)	25.9	-	-	-	33.4
A68/A72-25%-Rep4	Hardness (mg/L)	209	-	-	-	209

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
A68/A72-10%-Rep1	No. Alive	10	9	8	8	8	1 Jumper
A68/A72-10%-Rep1	pH	7.7	7.4	7.16	7.1	6.94	
A68/A72-10%-Rep1	Temp (°C)	11.82	11.64	11.83	11.85	11.63	
A68/A72-10%-Rep1	D.O. (mg/L)	8.79	8.01	8.3	8.37	8.25	
A68/A72-10%-Rep1	Conductivity (us/cm)	401.3	414.9	453	443.1	420	
A68/A72-10%-Rep1	Alkalinity (mg $CaCO_3$/L)	29.9	-	-	-	33.8	
A68/A72-10%-Rep1	Hardness (mg/L)	193	-	-	-	192	

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
A68/A72-10%-Rep2	No. Alive	10	10	10	8	8	2 Jumpers
A68/A72-10%-Rep2	pH	7.6	7.5	7.17	7.1	6.96	
A68/A72-10%-Rep2	Temp (°C)	11.81	11.66	11.84	11.85	11.64	
A68/A72-10%-Rep2	D.O. (mg/L)	8.82	7.76	8.24	8.34	8.25	
A68/A72-10%-Rep2	Conductivity (us/cm)	401.2	413.4	433	444.2	420.2	
A68/A72-10%-Rep2	Alkalinity (mg $CaCO_3$/L)	29.9	-	-	-	33.8	
A68/A72-10%-Rep2	Hardness (mg/L)	193	-	-	-	192	

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-10%-Rep3	No. Alive	10	10	10	9	9
A68/A72-10%-Rep3	pH	7.6	7.4	7.06	7.1	6.95
A68/A72-10%-Rep3	Temp (°C)	11.82	11.63	11.84	11.85	11.6
A68/A72-10%-Rep3	D.O. (mg/L)	8.84	7.55	8.06	8.05	8.28
A68/A72-10%-Rep3	Conductivity (us/cm)	401.4	414.9	433	443.7	419.8
A68/A72-10%-Rep3	Alkalinity (mg $CaCO_3$/L)	29.9	-	-	-	33.8
A68/A72-10%-Rep3	Hardness (mg/L)	193	-	-	-	192

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-10%-Rep4	No. Alive	10	10	10	10	10
A68/A72-10%-Rep4	pH	7.6	7.4	7.06	7.07	6.94
A68/A72-10%-Rep4	Temp (°C)	11.89	11.64	11.86	11.83	11.66
A68/A72-10%-Rep4	D.O. (mg/L)	8.87	7.76	7.87	8.34	8.24
A68/A72-10%-Rep4	Conductivity (us/cm)	401.3	414.1	432	440	420.5
A68/A72-10%-Rep4	Alkalinity (mg $CaCO_3$/L)	29.9	-	-	-	33.8
A68/A72-10%-Rep4	Hardness (mg/L)	193	-	-	-	192

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-5%-Rep1	No. Alive	10	10	10	10	10
A68/A72-5%-Rep1	pH	7.8	7.4	7.19	7.1	6.88
A68/A72-5%-Rep1	Temp (°C)	12.27	11.67	11.81	11.84	11.72
A68/A72-5%-Rep1	D.O. (mg/L)	8.36	7.37	7.2	7.91	7.98
A68/A72-5%-Rep1	Conductivity (us/cm)	392.6	407.1	442	436.6	413.8
A68/A72-5%-Rep1	Alkalinity (mg $CaCO_3$/L)	38.5	-	-	-	39.2
A68/A72-5%-Rep1	Hardness (mg/L)	187	-	-	-	187

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-5%-Rep2	No. Alive	10	10	10	8	8
A68/A72-5%-Rep2	pH	7.8	7.4	7.17	7.1	6.98
A68/A72-5%-Rep2	Temp (°C)	12.21	11.64	11.83	11.85	11.73
A68/A72-5%-Rep2	D.O. (mg/L)	8.75	7.39	7.83	8.06	8.12
A68/A72-5%-Rep2	Conductivity (us/cm)	390.4	402.2	422	436.7	410.5
A68/A72-5%-Rep2	Alkalinity (mg $CaCO_3$/L)	38.5	-	-	-	39.2
A68/A72-5%-Rep2	Hardness (mg/L)	187	-	-	-	187

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-5%-Rep3	No. Alive	10	10	10	10	10
A68/A72-5%-Rep3	pH	7.8	7.4	7.16	7.1	6.9
A68/A72-5%-Rep3	Temp (°C)	12.18	11.59	11.83	11.82	11.67
A68/A72-5%-Rep3	D.O. (mg/L)	8.78	7.32	7.57	8.18	8.09
A68/A72-5%-Rep3	Conductivity (us/cm)	391.4	402.5	419	429.3	412.5
A68/A72-5%-Rep3	Alkalinity (mg $CaCO_3$/L)	38.5	-	-	-	39.2
A68/A72-5%-Rep3	Hardness (mg/L)	187	-	-	-	187

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/A72-5%-Rep4	No. Alive	10	10	10	9	9
A68/A72-5%-Rep4	pH	7.8	7.5	7.17	7.1	6.96
A68/A72-5%-Rep4	Temp (°C)	12.27	11.63	11.83	11.84	11.65
A68/A72-5%-Rep4	D.O. (mg/L)	8.78	7.64	7.89	8.34	8.25
A68/A72-5%-Rep4	Conductivity (us/cm)	390.8	401.2	418	430.2	412.1
A68/A72-5%-Rep4	Alkalinity (mg $CaCO_3$/L)	38.5	-	-	-	39.2
A68/A72-5%-Rep4	Hardness (mg/L)	187	-	-	-	187

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-Control-Rep1	No. Alive	10	10	10	10	10
A68/A72-Control-Rep1	pH	7.4	7.6	7.48	7.3	7.05
A68/A72-Control-Rep1	Temp (°C)	11.63	11.79	11.9	11.87	11.93
A68/A72-Control-Rep1	D.O. (mg/L)	7.42	7.74	8.32	8.1	7.88
A68/A72-Control-Rep1	Conductivity (us/cm)	301.5	307.7	326	337.4	321.8
A68/A72-Control-Rep1	Alkalinity (mg $CaCO_3$/L)	63.1	-	-	-	72.9
A68/A72-Control-Rep1	Hardness (mg/L)	92	-	-	-	93

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-Control-Rep2	No. Alive	10	10	10	10	10
A68/A72-Control-Rep2	pH	7.4	7.6	7.5	7.3	7.07
A68/A72-Control-Rep2	Temp (°C)	11.6	11.65	11.83	11.85	11.89
A68/A72-Control-Rep2	D.O. (mg/L)	6.38	7.61	7.97	7.86	7.82
A68/A72-Control-Rep2	Conductivity (us/cm)	299.9	306.6	323	333.9	320.7
A68/A72-Control-Rep2	Alkalinity (mg $CaCO_3$/L)	63.1	-	-	-	72.9
A68/A72-Control-Rep2	Hardness (mg/L)	92	-	-	-	93

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-Control-Rep3	No. Alive	10	10	10	10	10
A68/A72-Control-Rep3	pH	7.3	7.6	7.43	7.31	7.08
A68/A72-Control-Rep3	Temp (°C)	11.62	11.64	11.81	11.86	11.85
A68/A72-Control-Rep3	D.O. (mg/L)	6.19	7.76	8.16	7.64	7.57
A68/A72-Control-Rep3	Conductivity (us/cm)	299.6	306	325.8	336.6	320.9
A68/A72-Control-Rep3	Alkalinity (mg $CaCO_3$/L)	63.1	-	-	-	72.9
A68/A72-Control-Rep3	Hardness (mg/L)	92	-	-	-	93

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/A72-Control-Rep4	No. Alive	10	10	10	10	10
A68/A72-Control-Rep4	pH	7.3	7.6	7.35	7.3	7.09
A68/A72-Control-Rep4	Temp (°C)	11.6	11.64	11.8	11.84	11.8
A68/A72-Control-Rep4	D.O. (mg/L)	6.04	7.62	8.28	7.63	7.4
A68/A72-Control-Rep4	Conductivity (us/cm)	299.2	304.8	324.6	336.2	321.4
A68/A72-Control-Rep4	Alkalinity (mg $CaCO_3$/L)	63.1	-	-	-	72.9
A68/A72-Control-Rep4	Hardness (mg/L)	92	-	-	-	93

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Serial dilution of CC48 with A68

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
A68/CC48-Control-Rep1	No. Alive	10	9	9	9	9	1 Jumper
A68/CC48-Control-Rep1	pH	7.6	7.5	7.29	7.2	7.24	
A68/CC48-Control-Rep1	Temp (°C)	15.42	11.62	11.63	11.72	11.9	
A68/CC48-Control-Rep1	D.O. (mg/L)	7.75	7.88	7.9	8.11	8.02	
A68/CC48-Control-Rep1	Conductivity (us/cm)	299.1	306.2	323	329.8	318.1	
A68/CC48-Control-Rep1	Alkalinity (mg $CaCO_3$/L)	62.4	-	-	-	68.7	
A68/CC48-Control-Rep1	Hardness (mg/L)	92	-	-	-	93	

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-Control-Rep2	No. Alive	10	10	10	10	10
A68/CC48-Control-Rep2	pH	7.6	7.7	7.3	7.22	7.4
A68/CC48-Control-Rep2	Temp (°C)	14.67	11.56	11.59	11.71	11.87
A68/CC48-Control-Rep2	D.O. (mg/L)	7.77	8.3	8.13	7.91	7.5
A68/CC48-Control-Rep2	Conductivity (us/cm)	299	304.4	323	332.5	331
A68/CC48-Control-Rep2	Alkalinity (mg $CaCO_3$/L)	62.4	-	-	-	68.7
A68/CC48-Control-Rep2	Hardness (mg/L)	92	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-Control-Rep3	No. Alive	10	10	10	10	10
A68/CC48-Control-Rep3	pH	7.7	7.8	7.34	7.24	7.4
A68/CC48-Control-Rep3	Temp (°C)	15.24	11.54	11.58	11.62	11.84
A68/CC48-Control-Rep3	D.O. (mg/L)	7.85	8.18	8.29	8.3	8.11
A68/CC48-Control-Rep3	Conductivity (us/cm)	298.8	304.4	324	333.9	334
A68/CC48-Control-Rep3	Alkalinity (mg $CaCO_3$/L)	62.4	-	-	-	68.7
A68/CC48-Control-Rep3	Hardness (mg/L)	92	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-Control-Rep4	No. Alive	10	10	10	10	10
A68/CC48-Control-Rep4	pH	7.7	7.8	7.35	7.25	7.18
A68/CC48-Control-Rep4	Temp (°C)	14.48	11.55	11.58	11.61	11.92
A68/CC48-Control-Rep4	D.O. (mg/L)	7.89	8.37	8.09	8.28	8.14
A68/CC48-Control-Rep4	Conductivity (us/cm)	298.6	304.3	324	334.2	331
A68/CC48-Control-Rep4	Alkalinity (mg $CaCO_3$/L)	62.4	-	-	-	68.7
A68/CC48-Control-Rep4	Hardness (mg/L)	92	-	-	-	93

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-50%-Rep1	No. Alive	10	0	-	-	-
A68/CC48-50%-Rep1	pH	4.8	5.2	-	-	-
A68/CC48-50%-Rep1	Temp (°C)	12.45	11.65	-	-	-
A68/CC48-50%-Rep1	D.O. (mg/L)	8.68	8.73	-	-	-
A68/CC48-50%-Rep1	Conductivity (us/cm)	732.6	760.5	-	-	-
A68/CC48-50%-Rep1	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48-50%-Rep1	Hardness (mg/L)	368	371	-	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-50%-Rep2	No. Alive	10	0	-	-	-
A68/CC48-50%-Rep2	pH	4.8	5.2	-	-	-
A68/CC48-50%-Rep2	Temp (°C)	12.2	11.63	-	-	-
A68/CC48-50%-Rep2	D.O. (mg/L)	8.72	8.67	-	-	-
A68/CC48-50%-Rep2	Conductivity (us/cm)	736.5	768.6	-	-	-
A68/CC48-50%-Rep2	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48-50%-Rep2	Hardness (mg/L)	368	371	-	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-50%-Rep3	No. Alive	10	0	-	-	-
A68/CC48-50%-Rep3	pH	4.8	5.2	-	-	-
A68/CC48-50%-Rep3	Temp (°C)	12.04	11.65	-	-	-
A68/CC48-50%-Rep3	D.O. (mg/L)	8.76	8.7	-	-	-
A68/CC48-50%-Rep3	Conductivity (us/cm)	735.8	761.9	-	-	-
A68/CC48-50%-Rep3	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48-50%-Rep3	Hardness (mg/L)	368	371	-	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-50%-Rep4	No. Alive	10	0	-	-	-
A68/CC48-50%-Rep4	pH	4.8	5.2	-	-	-
A68/CC48-50%-Rep4	Temp (°C)	12.21	11.63	-	-	-
A68/CC48-50%-Rep4	D.O. (mg/L)	8.73	8.67	-	-	-
A68/CC48-50%-Rep4	Conductivity (us/cm)	737	772.6	-	-	-
A68/CC48-50%-Rep4	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48-50%-Rep4	Hardness (mg/L)	368	371	-	-	-

Appendix B 1: Upper Animas November 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-25%-Rep1	No. Alive	10	10	10	6	6
A68/CC48-25%-Rep1	pH	6.4	6.9	7.09	6.98	6.98
A68/CC48-25%-Rep1	Temp (°C)	12.12	11.68	11.83	11.64	11.86
A68/CC48-25%-Rep1	D.O. (mg/L)	8.78	8.15	8.31	8.2	8.38
A68/CC48-25%-Rep1	Conductivity (us/cm)	554.6	566.9	599.7	612.4	578
A68/CC48-25%-Rep1	Alkalinity (mg $CaCO_3$/L)	10.2	-	-	-	13.4
A68/CC48-25%-Rep1	Hardness (mg/L)	272	-	-	-	269

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-25%-Rep2	No. Alive	10	10	10	10	10
A68/CC48-25%-Rep2	pH	6.3	6.9	7	6.96	6.96
A68/CC48-25%-Rep2	Temp (°C)	12.17	11.63	11.84	11.65	11.85
A68/CC48-25%-Rep2	D.O. (mg/L)	8.81	8.17	8.12	7.93	8.34
A68/CC48-25%-Rep2	Conductivity (us/cm)	553.6	565.8	600	611.8	572
A68/CC48-25%-Rep2	Alkalinity (mg $CaCO_3$/L)	10.2	-	-	-	13.4
A68/CC48-25%-Rep2	Hardness (mg/L)	272	-	-	-	269

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-25%-Rep3	No. Alive	10	10	10	10	10
A68/CC48-25%-Rep3	pH	6.2	6.9	6.98	6.95	6.96
A68/CC48-25%-Rep3	Temp (°C)	12.78	11.62	11.83	11.64	11.83
A68/CC48-25%-Rep3	D.O. (mg/L)	8.53	8.24	8.27	7.65	8.14
A68/CC48-25%-Rep3	Conductivity (us/cm)	548.1	565.9	599.8	609.4	568.5
A68/CC48-25%-Rep3	Alkalinity (mg $CaCO_3$/L)	10.2	-	-	-	13.4
A68/CC48-25%-Rep3	Hardness (mg/L)	272	-	-	-	269

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-25%-Rep4	No. Alive	10	10	10	10	10
A68/CC48-25%-Rep4	pH	6.2	6.9	6.96	6.93	6.94
A68/CC48-25%-Rep4	Temp (°C)	12.34	11.65	11.84	11.64	11.38
A68/CC48-25%-Rep4	D.O. (mg/L)	8.67	8.26	8.23	7.1	8.14
A68/CC48-25%-Rep4	Conductivity (us/cm)	552.9	567.2	601.2	614.1	571.1
A68/CC48-25%-Rep4	Alkalinity (mg $CaCO_3$/L)	10.2	-	-	-	13.4
A68/CC48-25%-Rep4	Hardness (mg/L)	272	-	-	-	269

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-12%-Rep1	No. Alive	10	10	10	9	9
A68/CC48-12%-Rep1	pH	7.1	7.2	7.05	7.06	7.06
A68/CC48-12%-Rep1	Temp (°C)	12.62	11.64	11.79	11.65	11.94
A68/CC48-12%-Rep1	D.O. (mg/L)	8.59	7.85	8.05	7.96	7.84
A68/CC48-12%-Rep1	Conductivity (us/cm)	464.6	475.5	500	508.6	484.1
A68/CC48-12%-Rep1	Alkalinity (mg $CaCO_3$/L)	22.4	-	-	-	32
A68/CC48-12%-Rep1	Hardness (mg/L)	226	-	-	-	225

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-12%-Rep2	No. Alive	10	10	10	10	10
A68/CC48-12%-Rep2	pH	7.1	7.2	7.05	7.04	7.05
A68/CC48-12%-Rep2	Temp (°C)	12.1	11.63	11.78	11.61	11.9
A68/CC48-12%-Rep2	D.O. (mg/L)	8.62	7.83	8.11	7.85	8.01
A68/CC48-12%-Rep2	Conductivity (us/cm)	465.4	476.1	505	519.9	490.4
A68/CC48-12%-Rep2	Alkalinity (mg $CaCO_3$/L)	22.4	-	-	-	32
A68/CC48-12%-Rep2	Hardness (mg/L)	226	-	-	-	225

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-12%-Rep3	No. Alive	10	10	10	10	10
A68/CC48-12%-Rep3	pH	7.1	7.2	7.06	7.05	7.07
A68/CC48-12%-Rep3	Temp (°C)	12.5	11.62	11.79	11.62	11.88
A68/CC48-12%-Rep3	D.O. (mg/L)	8.5	7.38	8.13	7.77	7.45
A68/CC48-12%-Rep3	Conductivity (us/cm)	467.8	476.4	505	509.3	486.7
A68/CC48-12%-Rep3	Alkalinity (mg $CaCO_3$/L)	22.4	-	-	-	32
A68/CC48-12%-Rep3	Hardness (mg/L)	226	-	-	-	225

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-12%-Rep4	No. Alive	10	10	8	7	7
A68/CC48-12%-Rep4	pH	7	7.2	7.06	7.03	7.04
A68/CC48-12%-Rep4	Temp (°C)	12.19	11.62	11.78	11.01	11.88
A68/CC48-12%-Rep4	D.O. (mg/L)	8.43	7.93	8.34	8.26	7.53
A68/CC48-12%-Rep4	Conductivity (us/cm)	466.1	479.7	513.9	531.1	484
A68/CC48-12%-Rep4	Alkalinity (mg $CaCO_3$/L)	22.4	-	-	-	32
A68/CC48-12%-Rep4	Hardness (mg/L)	226	-	-	-	225

Appendix B 1: Upper Animas November 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-6%-Rep1	No. Alive	10	10	9	9	9
A68/CC48-6%-Rep1	pH	7.4	7.4	7.07	7.08	7.08
A68/CC48-6%-Rep1	Temp (°C)	12.04	11.62	11.69	11.6	11.94
A68/CC48-6%-Rep1	D.O. (mg/L)	8.83	7.94	7.13	8.41	7.84
A68/CC48-6%-Rep1	Conductivity (us/cm)	422.7	435.7	460	466.6	441.3
A68/CC48-6%-Rep1	Alkalinity (mg $CaCO_3$/L)	29.1	-	-	-	36.8
A68/CC48-6%-Rep1	Hardness (mg/L)	204	-	-	-	201

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-6%-Rep2	No. Alive	10	10	10	10	10
A68/CC48-6%-Rep2	pH	7.3	7.2	7.04	7.09	7.08
A68/CC48-6%-Rep2	Temp (°C)	11.88	11.61	11.77	11.62	11.93
A68/CC48-6%-Rep2	D.O. (mg/L)	8.85	7.1	7.25	8.16	7.99
A68/CC48-6%-Rep2	Conductivity (us/cm)	422.6	431.4	456	465.1	443.8
A68/CC48-6%-Rep2	Alkalinity (mg $CaCO_3$/L)	29.1	-	-	-	36.8
A68/CC48-6%-Rep2	Hardness (mg/L)	204	-	-	-	201

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-6%-Rep3	No. Alive	10	10	10	10	10
A68/CC48-6%-Rep3	pH	7.2	7.2	7.13	7.09	7.09
A68/CC48-6%-Rep3	Temp (°C)	11.81	11.6	11.71	11.61	11.93
A68/CC48-6%-Rep3	D.O. (mg/L)	8.89	7.36	7.97	7.98	8.23
A68/CC48-6%-Rep3	Conductivity (us/cm)	422	432	458	467.2	439.7
A68/CC48-6%-Rep3	Alkalinity (mg $CaCO_3$/L)	29.1	-	-	-	36.8
A68/CC48-6%-Rep3	Hardness (mg/L)	204	-	-	-	201

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-6%-Rep4	No. Alive	10	10	10	10	10
A68/CC48-6%-Rep4	pH	7.3	7.2	7.07	7.08	7.09
A68/CC48-6%-Rep4	Temp (°C)	11.82	11.59	11.74	11.6	11.92
A68/CC48-6%-Rep4	D.O. (mg/L)	8.87	7.13	7.57	8.04	8.26
A68/CC48-6%-Rep4	Conductivity (us/cm)	423.9	435	463	473.7	443
A68/CC48-6%-Rep4	Alkalinity (mg $CaCO_3$/L)	29.1	-	-	-	36.8
A68/CC48-6%-Rep4	Hardness (mg/L)	204	-	-	-	201

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-3%-Rep1	No. Alive	10	10	10	10	10
A68/CC48-3%-Rep1	pH	7.4	7.2	7.12	7.03	7.09
A68/CC48-3%-Rep1	Temp (°C)	11.91	11.61	11.63	11.62	11.95
A68/CC48-3%-Rep1	D.O. (mg/L)	8.87	6.59	8.12	7.56	8.07
A68/CC48-3%-Rep1	Conductivity (us/cm)	401.5	410.8	437	447.2	422.4
A68/CC48-3%-Rep1	Alkalinity (mg $CaCO_3$/L)	35.9	-	-	-	36.2
A68/CC48-3%-Rep1	Hardness (mg/L)	193	-	-	-	182

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	
A68/CC48-3%-Rep2	No. Alive	10	10	10	9	9	1 Jumper
A68/CC48-3%-Rep2	pH	7.4	7.3	7.03	7.06	7.1	
A68/CC48-3%-Rep2	Temp (°C)	12.01	11.58	11.63	11.6	11.93	
A68/CC48-3%-Rep2	D.O. (mg/L)	8.82	7.14	8.1	8.24	8.27	
A68/CC48-3%-Rep2	Conductivity (us/cm)	399.9	410.6	437	448.1	420.8	
A68/CC48-3%-Rep2	Alkalinity (mg $CaCO_3$/L)	35.9	-	-	-	36.2	
A68/CC48-3%-Rep2	Hardness (mg/L)	193	-	-	-	182	

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-3%-Rep3	No. Alive	10	10	9	9	9
A68/CC48-3%-Rep3	pH	7.4	7.3	7.11	7.08	7.11
A68/CC48-3%-Rep3	Temp (°C)	12.06	11.56	11.63	11.58	11.93
A68/CC48-3%-Rep3	D.O. (mg/L)	8.84	7.11	8.22	8.3	8.23
A68/CC48-3%-Rep3	Conductivity (us/cm)	401.3	411	437	446.4	418.8
A68/CC48-3%-Rep3	Alkalinity (mg $CaCO_3$/L)	35.9	-	-	-	36.2
A68/CC48-3%-Rep3	Hardness (mg/L)	193	-	-	-	182

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
A68/CC48-3%-Rep4	No. Alive	10	10	10	10	10
A68/CC48-3%-Rep4	pH	7.4	7.2	7.12	7.1	7.1
A68/CC48-3%-Rep4	Temp (°C)	12.1	11.59	11.65	11.61	11.95
A68/CC48-3%-Rep4	D.O. (mg/L)	8.82	6.72	7.92	8	8.12
A68/CC48-3%-Rep4	Conductivity (us/cm)	401.7	410.4	432	439.8	419
A68/CC48-3%-Rep4	Alkalinity (mg $CaCO_3$/L)	35.9	-	-	-	36.2
A68/CC48-3%-Rep4	Hardness (mg/L)	193	-	-	-	182

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-1%-Rep1	No. Alive	10	10	9	9	9
A68/CC48-1%-Rep1	pH	7.6	7.4	7.13	7.02	7.1
A68/CC48-1%-Rep1	Temp (°C)	11.43	11.44	11.62	11.64	11.93
A68/CC48-1%-Rep1	D.O. (mg/L)	8.54	8.13	7.92	7.79	7.44
A68/CC48-1%-Rep1	Conductivity (us/cm)	390.5	396.5	421	432.8	407
A68/CC48-1%-Rep1	Alkalinity (mg $CaCO_3$/L)	33.1				39.4
A68/CC48-1%-Rep1	Hardness (mg/L)	184				183

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-1%-Rep2	No. Alive	10	10	9	9	9
A68/CC48-1%-Rep2	pH	7.5	7.4	7.1	6.99	7.08
A68/CC48-1%-Rep2	Temp (°C)	11.56	11.58	11.61	11.64	11.9
A68/CC48-1%-Rep2	D.O. (mg/L)	8.71	7.62	7.82	7.53	7.5
A68/CC48-1%-Rep2	Conductivity (us/cm)	386.2	397.7	423	434.4	412.6
A68/CC48-1%-Rep2	Alkalinity (mg $CaCO_3$/L)	33.1	-	-	-	39.4
A68/CC48-1%-Rep2	Hardness (mg/L)	184	-	-	-	183

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-1%-Rep3	No. Alive	10	10	10	10	10
A68/CC48-1%-Rep3	pH	7.5	7.4	7.09	7.04	7.09
A68/CC48-1%-Rep3	Temp (°C)	11.54	11.58	11.61	11.63	11.91
A68/CC48-1%-Rep3	D.O. (mg/L)	8.84	7.63	7.66	7.04	7.74
A68/CC48-1%-Rep3	Conductivity (us/cm)	386.3	396.8	419	426.6	408.8
A68/CC48-1%-Rep3	Alkalinity (mg $CaCO_3$/L)	33.1	-	-	-	39.4
A68/CC48-1%-Rep3	Hardness (mg/L)	184	-	-	-	183

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48-1%-Rep4	No. Alive	10	10	8	6	6
A68/CC48-1%-Rep4	pH	7.4	7.3	7.07	6.99	7.1
A68/CC48-1%-Rep4	Temp (°C)	11.67	11.58	11.61	11.59	11.92
A68/CC48-1%-Rep4	D.O. (mg/L)	8.87	6.92	7.68	8.16	8.07
A68/CC48-1%-Rep4	Conductivity (us/cm)	386.4	396.2	422	431.6	405.4
A68/CC48-1%-Rep4	Alkalinity (mg $CaCO_3$/L)	33.1	-	-	-	39.4
A68/CC48-1%-Rep4	Hardness (mg/L)	184	-	-	-	183

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Serial dilution of M34/CC48 with A68

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-85%-Rep1	No. Alive	10	0	-	-	-
A68/CC48/M34-85%-Rep1	pH	4.8	5.1	-	-	-
A68/CC48/M34-85%-Rep1	Temp (°C)	11.69	11.82	-	-	-
A68/CC48/M34-85%-Rep1	D.O. (mg/L)	8.25	8.5	-	-	-
A68/CC48/M34-85%-Rep1	Conductivity (us/cm)	695.5	719.8	-	-	-
A68/CC48/M34-85%-Rep1	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48/M34-85%-Rep1	Hardness (mg/L)	328	341	-	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-85%-Rep2	No. Alive	10	0	-	-	-
A68/CC48/M34-85%-Rep2	pH	4.8	5.1	-	-	-
A68/CC48/M34-85%-Rep2	Temp (°C)	11.66	11.84	-	-	-
A68/CC48/M34-85%-Rep2	D.O. (mg/L)	8.14	8.6	-	-	-
A68/CC48/M34-85%-Rep2	Conductivity (us/cm)	697.4	724.5	-	-	-
A68/CC48/M34-85%-Rep2	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48/M34-85%-Rep2	Hardness (mg/L)	328	341	-	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-85%-Rep3	No. Alive	10	0	-	-	-
A68/CC48/M34-85%-Rep3	pH	4.7	5.1	-	-	-
A68/CC48/M34-85%-Rep3	Temp (°C)	11.67	11.84	-	-	-
A68/CC48/M34-85%-Rep3	D.O. (mg/L)	8.09	8.46	-	-	-
A68/CC48/M34-85%-Rep3	Conductivity (us/cm)	694.3	719.2	-	-	-
A68/CC48/M34-85%-Rep3	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48/M34-85%-Rep3	Hardness (mg/L)	328	341	-	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-85%-Rep4	No. Alive	10	0	-	-	-
A68/CC48/M34-85%-Rep4	pH	4.7	5.1	-	-	-
A68/CC48/M34-85%-Rep4	Temp (°C)	11.66	11.86	-	-	-
A68/CC48/M34-85%-Rep4	D.O. (mg/L)	7.56	8.53	-	-	-
A68/CC48/M34-85%-Rep4	Conductivity (us/cm)	698.8	722.2	-	-	-
A68/CC48/M34-85%-Rep4	Alkalinity (mg $CaCO_3$/L)	<5.00 U	<5.00 U	-	-	-
A68/CC48/M34-85%-Rep4	Hardness (mg/L)	328	341	-	-	-

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-65%-Rep1	No. Alive	10	7	3	1	0
A68/CC48/M34-65%-Rep1	pH	5.7	6.3	6.93	6.85	6.49
A68/CC48/M34-65%-Rep1	Temp (°C)	11.67	11.82	11.58	11.72	11.75
A68/CC48/M34-65%-Rep1	D.O. (mg/L)	7.96	7.92	8.03	8.62	8.61
A68/CC48/M34-65%-Rep1	Conductivity (us/cm)	615.5	641.5	685	688.5	632.7
A68/CC48/M34-65%-Rep1	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/CC48/M34-65%-Rep1	Hardness (mg/L)	296	-	-	-	302

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-65%-Rep2	No. Alive	10	9	3	1	0
A68/CC48/M34-65%-Rep2	pH	5.6	6.4	6.93	6.83	6.42
A68/CC48/M34-65%-Rep2	Temp (°C)	11.64	11.82	11.58	11.75	11.73
A68/CC48/M34-65%-Rep2	D.O. (mg/L)	7.92	8.14	8.03	8.65	8.71
A68/CC48/M34-65%-Rep2	Conductivity (us/cm)	615.8	646.3	685	699.6	634.1
A68/CC48/M34-65%-Rep2	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/CC48/M34-65%-Rep2	Hardness (mg/L)	296	-	-	-	302

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-65%-Rep3	No. Alive	10	9	2	2	0
A68/CC48/M34-65%-Rep3	pH	5.6	6.4	6.93	6.82	5.83
A68/CC48/M34-65%-Rep3	Temp (°C)	11.64	11.83	11.58	11.75	11.68
A68/CC48/M34-65%-Rep3	D.O. (mg/L)	7.89	8.22	8.03	8.67	8.6
A68/CC48/M34-65%-Rep3	Conductivity (us/cm)	614.5	641.1	685	685	640.6
A68/CC48/M34-65%-Rep3	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/CC48/M34-65%-Rep3	Hardness (mg/L)	296	-	-	-	302

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-65%-Rep4	No. Alive	10	10	4	4	0
A68/CC48/M34-65%-Rep4	pH	5.6	6.5	6.93	6.81	5.64
A68/CC48/M34-65%-Rep4	Temp (°C)	11.61	11.83	11.58	11.77	11.68
A68/CC48/M34-65%-Rep4	D.O. (mg/L)	7.99	8.3	8.03	8.67	8.78
A68/CC48/M34-65%-Rep4	Conductivity (us/cm)	613.1	642.1	685	692.6	639.6
A68/CC48/M34-65%-Rep4	Alkalinity (mg $CaCO_3$/L)	<5.00 U	-	-	-	<5.00 U
A68/CC48/M34-65%-Rep4	Hardness (mg/L)	296	-	-	-	302

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-40%-Rep1	No. Alive	10	10	10	10	9
A68/CC48/M34-40%-Rep1	pH	7.1	6.9	7.07	7.04	7.01
A68/CC48/M34-40%-Rep1	Temp (°C)	11.68	11.78	11.71	11.72	11.73
A68/CC48/M34-40%-Rep1	D.O. (mg/L)	7.78	7.81	8.02	7.78	7.43
A68/CC48/M34-40%-Rep1	Conductivity (us/cm)	524.5	533.7	569	575.9	543.5
A68/CC48/M34-40%-Rep1	Alkalinity (mg $CaCO_3$/L)	10.8	-	-	-	12.5
A68/CC48/M34-40%-Rep1	Hardness (mg/L)	244	-	-	-	250

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-40%-Rep2	No. Alive	10	10	10	10	10
A68/CC48/M34-40%-Rep2	pH	7.1	6.9	7.03	7.02	7
A68/CC48/M34-40%-Rep2	Temp (°C)	11.67	11.78	11.68	11.71	11.7
A68/CC48/M34-40%-Rep2	D.O. (mg/L)	7.69	7.82	8.09	7.79	7.45
A68/CC48/M34-40%-Rep2	Conductivity (us/cm)	524.7	533.9	568	575.6	530.4
A68/CC48/M34-40%-Rep2	Alkalinity (mg $CaCO_3$/L)	10.8	-	-	-	12.5
A68/CC48/M34-40%-Rep2	Hardness (mg/L)	244	-	-	-	250

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-40%-Rep3	No. Alive	10	10	10	10	8
A68/CC48/M34-40%-Rep3	pH	7.1	6.9	7.01	7.01	6.99
A68/CC48/M34-40%-Rep3	Temp (°C)	11.62	11.8	11.63	11.72	11.3
A68/CC48/M34-40%-Rep3	D.O. (mg/L)	7.88	7.63	8.1	7.63	7.52
A68/CC48/M34-40%-Rep3	Conductivity (us/cm)	523.9	534.4	572	575.6	530.2
A68/CC48/M34-40%-Rep3	Alkalinity (mg $CaCO_3$/L)	10.8	-	-	-	12.5
A68/CC48/M34-40%-Rep3	Hardness (mg/L)	244	-	-	-	250

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-40%-Rep4	No. Alive	10	10	10	10	10
A68/CC48/M34-40%-Rep4	pH	7	6.9	7	7.01	6.97
A68/CC48/M34-40%-Rep4	Temp (°C)	11.62	11.8	11.66	11.72	11.66
A68/CC48/M34-40%-Rep4	D.O. (mg/L)	7.97	7.64	8.02	7.63	7.98
A68/CC48/M34-40%-Rep4	Conductivity (us/cm)	524.5	533.8	568	575.6	545.6
A68/CC48/M34-40%-Rep4	Alkalinity (mg $CaCO_3$/L)	10.8	-	-	-	12.5
A68/CC48/M34-40%-Rep4	Hardness (mg/L)	244	-	-	-	250

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-20%-Rep1	No. Alive	10	10	10	10	10
A68/CC48/M34-20%-Rep1	pH	7.3	7.1	7.12	7.11	7.08
A68/CC48/M34-20%-Rep1	Temp (°C)	11.71	11.77	11.78	11.7	11.65
A68/CC48/M34-20%-Rep1	D.O. (mg/L)	7.91	7.78	8.06	7.82	8.07
A68/CC48/M34-20%-Rep1	Conductivity (us/cm)	451.9	459.8	492	499.3	469.1
A68/CC48/M34-20%-Rep1	Alkalinity (mg $CaCO_3$/L)	25.2	-	-	-	26
A68/CC48/M34-20%-Rep1	Hardness (mg/L)	213	-	-	-	217

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-20%-Rep2	No. Alive	10	10	10	10	10
A68/CC48/M34-20%-Rep2	pH	7.3	7.1	7.12	7.11	7.07
A68/CC48/M34-20%-Rep2	Temp (°C)	11.68	11.77	11.77	11.7	11.68
A68/CC48/M34-20%-Rep2	D.O. (mg/L)	7.2	7.84	8.18	8.07	8.28
A68/CC48/M34-20%-Rep2	Conductivity (us/cm)	451.9	459.7	487	495.3	471.1
A68/CC48/M34-20%-Rep2	Alkalinity (mg $CaCO_3$/L)	25.2	-	-	-	26
A68/CC48/M34-20%-Rep2	Hardness (mg/L)	213	-	-	-	217

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-20%-Rep3	No. Alive	10	10	10	10	10
A68/CC48/M34-20%-Rep3	pH	7.2	7.1	7.12	7.11	7.08
A68/CC48/M34-20%-Rep3	Temp (°C)	11.66	11.77	11.72	11.7	11.66
A68/CC48/M34-20%-Rep3	D.O. (mg/L)	7.99	7.66	8.03	8.09	8.42
A68/CC48/M34-20%-Rep3	Conductivity (us/cm)	452	458.6	487	495.4	470.6
A68/CC48/M34-20%-Rep3	Alkalinity (mg $CaCO_3$/L)	25.2	-	-	-	26
A68/CC48/M34-20%-Rep3	Hardness (mg/L)	213	-	-	-	217

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-20%-Rep4	No. Alive	10	10	10	10	10
A68/CC48/M34-20%-Rep4	pH	7.2	7.1	7.12	7.09	7.07
A68/CC48/M34-20%-Rep4	Temp (°C)	11.62	11.79	11.72	11.71	11.7
A68/CC48/M34-20%-Rep4	D.O. (mg/L)	7.96	7.52	8.11	7.83	8.18
A68/CC48/M34-20%-Rep4	Conductivity (us/cm)	451.5	461.2	488	493.5	469.5
A68/CC48/M34-20%-Rep4	Alkalinity (mg $CaCO_3$/L)	25.2	-	-	-	26
A68/CC48/M34-20%-Rep4	Hardness (mg/L)	213	-	-	-	217

Appendix B 1: Upper Animas November 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-9%-Rep1	No. Alive	10	10	10	10	10
A68/CC48/M34-9%-Rep1	pH	7.4	7.2	7.15	7.16	7.07
A68/CC48/M34-9%-Rep1	Temp (°C)	11.79	11.74	11.84	11.67	11.74
A68/CC48/M34-9%-Rep1	D.O. (mg/L)	7.64	7.65	8.11	8.02	7.91
A68/CC48/M34-9%-Rep1	Conductivity (us/cm)	413	422.2	446	453.6	430.9
A68/CC48/M34-9%-Rep1	Alkalinity (mg $CaCO_3$/L)	28.2	-	-	-	38.9
A68/CC48/M34-9%-Rep1	Hardness (mg/L)	199	-	-	-	196

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-9%-Rep2	No. Alive	10	10	9	9	9
A68/CC48/M34-9%-Rep2	pH	7.3	7.3	7.16	7.14	7.07
A68/CC48/M34-9%-Rep2	Temp (°C)	11.74	11.73	11.81	11.66	11.77
A68/CC48/M34-9%-Rep2	D.O. (mg/L)	7.69	8.05	8.26	8.08	8.1
A68/CC48/M34-9%-Rep2	Conductivity (us/cm)	412.5	421.4	448	456.4	429.6
A68/CC48/M34-9%-Rep2	Alkalinity (mg $CaCO_3$/L)	28.2	-	-	-	38.9
A68/CC48/M34-9%-Rep2	Hardness (mg/L)	199	-	-	-	196

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-9%-Rep3	No. Alive	10	10	10	10	10
A68/CC48/M34-9%-Rep3	pH	7.3	7.2	7.17	7.15	7.09
A68/CC48/M34-9%-Rep3	Temp (°C)	11.76	11.73	11.79	11.66	11.68
A68/CC48/M34-9%-Rep3	D.O. (mg/L)	7.6	7.65	8.28	8.17	8.31
A68/CC48/M34-9%-Rep3	Conductivity (us/cm)	412.4	419.7	443	450	427.5
A68/CC48/M34-9%-Rep3	Alkalinity (mg $CaCO_3$/L)	28.2	-	-	-	38.9
A68/CC48/M34-9%-Rep3	Hardness (mg/L)	199	-	-	-	196

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-9%-Rep4	No. Alive	10	10	10	9	9
A68/CC48/M34-9%-Rep4	pH	7.3	7.2	7.15	7.15	7.1
A68/CC48/M34-9%-Rep4	Temp (°C)	11.7	11.77	11.78	11.68	11.67
A68/CC48/M34-9%-Rep4	D.O. (mg/L)	7.65	7.73	7.69	8.04	7.94
A68/CC48/M34-9%-Rep4	Conductivity (us/cm)	412.8	421.2	445	455.3	428.4
A68/CC48/M34-9%-Rep4	Alkalinity (mg $CaCO_3$/L)	28.2	-	-	-	38.9
A68/CC48/M34-9%-Rep4	Hardness (mg/L)	199	-	-	-	196

Appendix B 1: Upper Animas November 2012
Aquatic Toxicity Test
Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-4%-Rep1	No. Alive	10	10	10	10	10
A68/CC48/M34-4%-Rep1	pH	7.4	7.3	7.18	7.17	7.07
A68/CC48/M34-4%-Rep1	Temp (°C)	11.89	11.68	11.91	11.67	11.91
A68/CC48/M34-4%-Rep1	D.O. (mg/L)	7.53	8	8.46	8.41	8.37
A68/CC48/M34-4%-Rep1	Conductivity (us/cm)	394.7	403.2	428	434.9	412.4
A68/CC48/M34-4%-Rep1	Alkalinity (mg $CaCO_3$/L)	34.9	-	-	-	40.8
A68/CC48/M34-4%-Rep1	Hardness (mg/L)	185	-	-	-	187

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
A68/CC48/M34-4%-Rep2	No. Alive	10	9	9	9	9	1 Jumper
A68/CC48/M34-4%-Rep2	pH	7.4	7.3	7.21	7.18	7.06	
A68/CC48/M34-4%-Rep2	Temp (°C)	11.82	11.71	11.88	11.66	11.79	
A68/CC48/M34-4%-Rep2	D.O. (mg/L)	7.76	8.09	8.19	8.34	8.31	
A68/CC48/M34-4%-Rep2	Conductivity (us/cm)	394.6	401.4	421	427.2	408	
A68/CC48/M34-4%-Rep2	Alkalinity (mg $CaCO_3$/L)	34.9	-	-	-	40.8	
A68/CC48/M34-4%-Rep2	Hardness (mg/L)	185	-	-	-	187	

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-4%-Rep3	No. Alive	10	10	10	10	10
A68/CC48/M34-4%-Rep3	pH	7.4	7.3	7.17	7.16	7.07
A68/CC48/M34-4%-Rep3	Temp (°C)	11.79	11.72	11.87	11.68	11.75
A68/CC48/M34-4%-Rep3	D.O. (mg/L)	7.72	7.96	8.03	8.21	8.02
A68/CC48/M34-4%-Rep3	Conductivity (us/cm)	394.9	403.5	426	435.7	412.5
A68/CC48/M34-4%-Rep3	Alkalinity (mg $CaCO_3$/L)	34.9	-	-	-	40.8
A68/CC48/M34-4%-Rep3	Hardness (mg/L)	185	-	-	-	187

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-4%-Rep4	No. Alive	10	10	10	9	9
A68/CC48/M34-4%-Rep4	pH	7.4	7.3	7.16	7.16	7.08
A68/CC48/M34-4%-Rep4	Temp (°C)	11.77	11.71	11.88	11.68	11.71
A68/CC48/M34-4%-Rep4	D.O. (mg/L)	7.77	7.66	7.61	8.04	7.7
A68/CC48/M34-4%-Rep4	Conductivity (us/cm)	394.5	404.2	427	436.7	411.1
A68/CC48/M34-4%-Rep4	Alkalinity (mg $CaCO_3$/L)	34.9	-	-	-	40.8
A68/CC48/M34-4%-Rep4	Hardness (mg/L)	185	-	-	-	187

Appendix B 1: Upper Animas November 2012

Aquatic Toxicity Test

Site Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates: 4	
Organism	Juvenile *O.mykiss* (rainbow trout) (0.84 grams)	Analysts	SA,CL,LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-Control-Rep1	No. Alive	10	10	10	10	10
A68/CC48/M34-Control-Rep1	pH	7.7	7.4	7.28	7.33	7.33
A68/CC48/M34-Control-Rep1	Temp (°C)	12.14	11.75	12.02	11.68	12.12
A68/CC48/M34-Control-Rep1	D.O. (mg/L)	7.19	7.81	8.06	8.08	7.77
A68/CC48/M34-Control-Rep1	Conductivity (us/cm)	298.1	302.8	317	323.8	319.5
A68/CC48/M34-Control-Rep1	Alkalinity (mg $CaCO_3$/L)	54.8	-	-	-	63.4
A68/CC48/M34-Control-Rep1	Hardness (mg/L)	91	-	-	-	92

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-Control-Rep2	No. Alive	10	10	10	10	10
A68/CC48/M34-Control-Rep2	pH	7.6	7.4	7.36	7.34	7.35
A68/CC48/M34-Control-Rep2	Temp (°C)	12.01	11.72	11.92	11.71	11.91
A68/CC48/M34-Control-Rep2	D.O. (mg/L)	6.97	8.1	8.08	8.11	7.21
A68/CC48/M34-Control-Rep2	Conductivity (us/cm)	299.1	305.8	319	327.9	319.1
A68/CC48/M34-Control-Rep2	Alkalinity (mg $CaCO_3$/L)	54.8	-	-	-	63.4
A68/CC48/M34-Control-Rep2	Hardness (mg/L)	91	-	-	-	92

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-Control-Rep3	No. Alive	10	10	10	10	10
A68/CC48/M34-Control-Rep3	pH	7.6	7.5	7.41	7.37	7.36
A68/CC48/M34-Control-Rep3	Temp (°C)	12.08	11.71	11.9	11.65	11.88
A68/CC48/M34-Control-Rep3	D.O. (mg/L)	6.71	8.14	8.15	8.11	7.92
A68/CC48/M34-Control-Rep3	Conductivity (us/cm)	298.7	304	318	326.9	320.8
A68/CC48/M34-Control-Rep3	Alkalinity (mg $CaCO_3$/L)	54.8	-	-	-	63.4
A68/CC48/M34-Control-Rep3	Hardness (mg/L)	91	-	-	-	92

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/CC48/M34-Control-Rep4	No. Alive	10	10	10	10	10
A68/CC48/M34-Control-Rep4	pH	7.6	7.5	7.39	7.37	7.37
A68/CC48/M34-Control-Rep4	Temp (°C)	11.98	11.71	11.91	11.68	11.91
A68/CC48/M34-Control-Rep4	D.O. (mg/L)	6.69	7.93	7.39	8.01	7.91
A68/CC48/M34-Control-Rep4	Conductivity (us/cm)	298.9	304.1	318	325.2	323.6
A68/CC48/M34-Control-Rep4	Alkalinity (mg $CaCO_3$/L)	54.8	-	-	-	63.4
A68/CC48/M34-Control-Rep4	Hardness (mg/L)	91	-	-	-	92

Prepared by: EC 3/8/13

Reviewed by: EB 3/13/13

Appendix B 2: November 2012 Aquatic Toxicity Test

Reference Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates:	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-01	No. Alive	10	10	10	10	10
Control-01	pH	8	7.4	7.4	7.4	7.47
Control-01	Temp (°C)	13.9	11.91	11.76	11.71	11.74
Control-01	D.O. (mg/L)	7.81	7.74	8.3	8.18	8.31
Control-01	Conductivity (us/cm)	302	308.5	317	319	319.8
Control-01	Alkalinity (mg $CaCO_3$/L)	61.9	-	-	-	70.5
Control-01	Hardness (mg/L)	91	-	-	-	93

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-02	No. Alive	10	10	10	10	10
Control-02	pH	8	7.5	7.5	7.4	7.47
Control-02	Temp (°C)	13.79	11.94	11.92	11.67	11.75
Control-02	D.O. (mg/L)	8.17	7.67	8.03	8.26	8.2
Control-02	Conductivity (us/cm)	298.9	304.6	311.3	319.4	318.6
Control-02	Alkalinity (mg $CaCO_3$/L)	61.9	-	-	-	70.5
Control-02	Hardness (mg/L)	91	-	-	-	93

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-03	No. Alive	10	10	10	10	10
Control-03	pH	8	7.4	7.5	7.4	7.46
Control-03	Temp (°C)	13.7	11.92	11.63	11.68	11.77
Control-03	D.O. (mg/L)	8.14	7.21	8.02	8.09	8.03
Control-03	Conductivity (us/cm)	298.5	303.9	316.5	316.9	318.9
Control-03	Alkalinity (mg $CaCO_3$/L)	61.9	-	-	-	70.5
Control-03	Hardness (mg/L)	91	-	-	-	93

Replicate ID	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**
Control-04	No. Alive	10	10	10	10	10
Control-04	pH	8	7.4	7.4	7.4	7.45
Control-04	Temp (°C)	13.75	11.9	11.63	11.69	11.77
Control-04	D.O. (mg/L)	8.15	6.62	7.95	8.12	8.12
Control-04	Conductivity (us/cm)	298.1	303.9	317.9	317.7	318.3
Control-04	Alkalinity (mg $CaCO_3$/L)	61.9	-	-	-	70.5
Control-04	Hardness (mg/L)	91	-	-	-	93

Appendix B 2: November 2012 Aquatic Toxicity Test

Reference Static Renewal Data Sheets

Start Date 11/02/12
End Date 11/06/12
Organism Juvenile *O.mykiss* (rainbow trout)

No. Organisms per replicate: 10
No. of Replicates: 4
Analysts SA, CL, LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-01	No. Alive	10	10	10	10	10
6.25%-01	pH	8	7.5	7.6	7.3	7.46
6.25%-01	Temp (°C)	13.64	11.91	11.65	11.73	11.76
6.25%-01	D.O. (mg/L)	8.17	6.69	8.24	8.26	8.35
6.25%-01	Conductivity (us/cm)	297.8	303.7	321	319.5	318.1
6.25%-01	Alkalinity (mg $CaCO_3$/L)	58.9	-	-	-	63.4
6.25%-01	Hardness (mg/L)	90	-	-	-	92

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-02	No. Alive	10	10	10	10	10
6.25%-02	pH	8.1	7.4	7.5	7.3	7.46
6.25%-02	Temp (°C)	13.71	11.92	11.62	11.69	11.75
6.25%-02	D.O. (mg/L)	8.17	7.5	8.17	8.39	8.35
6.25%-02	Conductivity (us/cm)	297.6	304.6	320	321.2	320.1
6.25%-02	Alkalinity (mg $CaCO_3$/L)	58.9	-	-	-	63.4
6.25%-02	Hardness (mg/L)	90	-	-	-	92

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-03	No. Alive	10	10	10	10	10
6.25%-03	pH	8	7.4	7.6	7.3	7.46
6.25%-03	Temp (°C)	13.67	11.91	11.63	11.7	11.78
6.25%-03	D.O. (mg/L)	8.19	6.74	8.16	8.35	8.15
6.25%-03	Conductivity (us/cm)	297.7	304.5	321	319.8	318.7
6.25%-03	Alkalinity (mg $CaCO_3$/L)	58.9	-	-	-	63.4
6.25%-03	Hardness (mg/L)	90	-	-	-	92

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-04	No. Alive	10	10	10	10	10
6.25%-04	pH	8.1	7.4	7.6	7.3	7.45
6.25%-04	Temp (°C)	13.73	11.89	11.65	11.72	11.78
6.25%-04	D.O. (mg/L)	8.22	6.85	8.17	8.21	8.13
6.25%-04	Conductivity (us/cm)	296.3	304.3	320.7	318.3	317.3
6.25%-04	Alkalinity (mg $CaCO_3$/L)	58.9	-	-	-	63.4
6.25%-04	Hardness (mg/L)	90	-	-	-	92

Appendix B 2: November 2012 Aquatic Toxicity Test

Reference Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate:	10
End Date	11/06/12	No. of Replicates:	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-01	No. Alive	10	10	5	5	5
12.5%-01	pH	8	7.6	7.5	7.3	7.46
12.5%-01	Temp (°C)	13.74	11.89	11.63	11.74	11.79
12.5%-01	D.O. (mg/L)	8.18	7.8	8.16	8.58	8.55
12.5%-01	Conductivity (us/cm)	298.4	309.1	329	315.7	314.1
12.5%-01	Alkalinity (mg $CaCO_3$/L)	61.4	-	-	-	63.6
12.5%-01	Hardness (mg/L)	91	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-02	No. Alive	10	10	9	8	8
12.5%-02	pH	8	7.6	7.6	7.3	7.46
12.5%-02	Temp (°C)	13.69	11.88	11.65	11.73	11.8
12.5%-02	D.O. (mg/L)	8.2	7.8	8.36	8.34	8.5
12.5%-02	Conductivity (us/cm)	297.8	308	328	320.1	318.8
12.5%-02	Alkalinity (mg $CaCO_3$/L)	61.4	-	-	-	63.6
12.5%-02	Hardness (mg/L)	91	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-03	No. Alive	10	10	9	9	9
12.5%-03	pH	8.2	7.5	7.5	7.3	7.43
12.5%-03	Temp (°C)	13.66	11.89	11.67	11.73	11.82
12.5%-03	D.O. (mg/L)	8.21	7.75	8.22	8.37	7.93
12.5%-03	Conductivity (us/cm)	297.7	306.5	324	320	316.7
12.5%-03	Alkalinity (mg $CaCO_3$/L)	61.4	-	-	-	63.6
12.5%-03	Hardness (mg/L)	91	-	-	-	93

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-04	No. Alive	10	9	9	8	8
12.5%-04	pH	8.1	7.5	7.5	7.3	7.43
12.5%-04	Temp (°C)	13.86	11.86	11.67	11.75	11.81
12.5%-04	D.O. (mg/L)	8.22	7.34	8.17	8.41	8.12
12.5%-04	Conductivity (us/cm)	297.8	306	322.9	321	315.4
12.5%-04	Alkalinity (mg $CaCO_3$/L)	61.4	-	-	-	63.6
12.5%-04	Hardness (mg/L)	91	-	-	-	93

Appendix B 2: November 2012 Aquatic Toxicity Test

Reference Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate:	10
End Date	11/06/12	No. of Replicates:	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-01	No. Alive	10	10	0	-	-
25%-01	pH	8	7.5	7.2	-	-
25%-01	Temp (°C)	13.79	11.85	11.64	-	-
25%-01	D.O. (mg/L)	8.22	7.79	8.62	-	-
25%-01	Conductivity (us/cm)	297.9	307.3	333.6	-	-
25%-01	Alkalinity (mg $CaCO_3$/L)	58.2	-	-	60.4	-
25%-01	Hardness (mg/L)	91	-	-	94	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-02	No. Alive	10	9	1	0	-
25%-02	pH	8	7.4	7.19	7.3	-
25%-02	Temp (°C)	13.89	11.82	11.68	11.76	-
25%-02	D.O. (mg/L)	8.21	7.15	8.62	8.78	-
25%-02	Conductivity (us/cm)	297.8	310.7	328.7	315.2	-
25%-02	Alkalinity (mg $CaCO_3$/L)	58.2	-	-	60.4	-
25%-02	Hardness (mg/L)	91	-	-	94	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-03	No. Alive	10	8	1	0	-
25%-03	pH	8	7.4	7.31	7.31	-
25%-03	Temp (°C)	13.74	11.8	11.7	11.77	-
25%-03	D.O. (mg/L)	8.2	6.88	8.56	8.79	-
25%-03	Conductivity (us/cm)	297.8	308.7	324.8	312.9	-
25%-03	Alkalinity (mg $CaCO_3$/L)	58.2	-	-	60.4	-
25%-03	Hardness (mg/L)	91	-	-	94	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-04	No. Alive	10	10	2	0	-
25%-04	pH	8	7.4	7.22	7.3	-
25%-04	Temp (°C)	13.86	11.76	11.68	11.76	-
25%-04	D.O. (mg/L)	8.22	6.66	8.61	8.78	-
25%-04	Conductivity (us/cm)	297.8	309.6	335	312.9	-
25%-04	Alkalinity (mg $CaCO_3$/L)	58.2	-	-	60.4	-
25%-04	Hardness (mg/L)	91	-	-	94	-

Appendix B 2: November 2012 Aquatic Toxicity Test

Reference Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates:	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-01	No. Alive	10	6	0	-	-
50%-01	pH	8	7.4	7.24	-	-
50%-01	Temp (°C)	12.95	11.75	11.71	-	-
50%-01	D.O. (mg/L)	8.28	7.29	8.61	-	-
50%-01	Conductivity (us/cm)	297.3	311.7	323.4	-	-
50%-01	Alkalinity (mg $CaCO_3$/L)	57.7	-	61.8	-	-
50%-01	Hardness (mg/L)	91	-	94	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-02	No. Alive	10	10	0	-	-
50%-02	pH	8	7.4	7.25	-	-
50%-02	Temp (°C)	12.7	11.7	11.73	-	-
50%-02	D.O. (mg/L)	8.32	7.4	8.64	-	-
50%-02	Conductivity (us/cm)	297.2	311.4	331.4	-	-
50%-02	Alkalinity (mg $CaCO_3$/L)	57.7	-	61.8	-	-
50%-02	Hardness (mg/L)	91	-	94	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-03	No. Alive	10	9	0	-	-
50%-03	pH	8.1	7.4	7.27	-	-
50%-03	Temp (°C)	12.79	11.68	11.72	-	-
50%-03	D.O. (mg/L)	8.3	7.38	8.62	-	-
50%-03	Conductivity (us/cm)	297.2	310.4	330.2	-	-
50%-03	Alkalinity (mg $CaCO_3$/L)	57.7	-	61.8	-	-
50%-03	Hardness (mg/L)	91	-	94	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
50%-04	No. Alive	10	6	0	-	-	1 Jumper
50%-04	pH	8	7.4	7.29	-	-	
50%-04	Temp (°C)	13.74	11.66	11.73	-	-	
50%-04	D.O. (mg/L)	8.25	7.49	8.74	-	-	
50%-04	Conductivity (us/cm)	297.8	310.7	324.6	-	-	
50%-04	Alkalinity (mg $CaCO_3$/L)	57.7	-	61.8	-	-	
50%-04	Hardness (mg/L)	91	-	94	-	-	

Appendix B 2: November 2012 Aquatic Toxicity Test

Reference Static Renewal Data Sheets

Start Date	11/02/12	No. Organisms per replicate: 10	
End Date	11/06/12	No. of Replicates:	4
Organism	Juvenile *O.mykiss* (rainbow trout)	Analysts	SA, CL, LC

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
100%-01	No. Alive	10	5	0	-	-	2 Jumpers
100%-01	pH	8	7.4	6.5	-	-	
100%-01	Temp (°C)	12.61	11.68	12.08	-	-	
100%-01	D.O. (mg/L)	8.31	7.63	8.55	-	-	
100%-01	Conductivity (us/cm)	297.3	311.9	322	-	-	
100%-01	Alkalinity (mg $CaCO_3$/L)	60.5	-	56.2	-	-	
100%-01	Hardness (mg/L)	90	-	94	-	-	

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-02	No. Alive	10	5	0	-	-
100%-02	pH	8	7.4	6.6	-	-
100%-02	Temp (°C)	12.71	11.67	11.87	-	-
100%-02	D.O. (mg/L)	8.32	7.35	8.6	-	-
100%-02	Conductivity (us/cm)	297.3	311.9	*	-	-
100%-02	Alkalinity (mg $CaCO_3$/L)	60.5	-	56.2	-	-
100%-02	Hardness (mg/L)	90	-	94	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-03	No. Alive	10	4	0	-	-
100%-03	pH	8	7.3	6.9	-	-
100%-03	Temp (°C)	12.62	11.65	11.92	-	-
100%-03	D.O. (mg/L)	8.37	6.74	6.48	-	-
100%-03	Conductivity (us/cm)	297.1	313.2	322	-	-
100%-03	Alkalinity (mg $CaCO_3$/L)	60.5	-	56.2	-	-
100%-03	Hardness (mg/L)	90	-	94	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
100%-04	No. Alive	10	5	0	-	-	1 Jumper
100%-04	pH	8	7.3	6.9	-	-	
100%-04	Temp (°C)	12.68	11.65	11.97	-	-	
100%-04	D.O. (mg/L)	8.37	6.36	8.65	-	-	
100%-04	Conductivity (us/cm)	297.1	310.5	324	-	-	
100%-04	Alkalinity (mg $CaCO_3$/L)	60.5	-	56.2	-	-	
100%-04	Hardness (mg/L)	90	-	94	-	-	

* No data available

Prepared by: EC 3/8/13

Reviewed by: EB 3/13/13

Attachment 1
October 2012 Upper Animas River Surface Water Toxicity Report
CETIS Analytical Reports

CETIS Test Data Worksheet

Report Date: 13 Mar-13 12:50 (p 1 of 1)
Test Code: 05-7143-8472/220F7588

Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Start Date:	22 Oct-12	**Species:**	Oncorhynchus mykiss	**Sample Code:**	Control
End Date:	26 Oct-12	**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Upper Animas River
Sample Date:	22 Oct-12	**Material:**	Lab Control	**Sample Station:**	Control

Batch Note: R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED)

Sample Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
Control	1	1	10	10	10	10	10	
Control	2	25	10	10	10	10	10	
Control	3	26	10	10	10	10	10	
Control	4	15	10	10	10	10	10	
A56	1	23	10	10	10	10	10	
A56	2	13	10	10	10	10	10	
A56	3	7	10	10	10	10	10	
A56	4	9	10	10	10	10	10	
A68	1	27	10	10	10	10	10	
A68	2	2	10	10	10	10	10	
A68	3	24	10	10	10	10	10	
A68	4	20	10	10	10	10	10	
A72	1	5	10	10	9	0	0	
A72	2	17	10	10	8	0	0	
A72	3	16	10	10	4	0	0	
A72	4	28	10	10	7	0	0	
A73B	1	11	10	10	10	10	10	
A73B	2	14	10	10	10	10	10	
A73B	3	8	10	10	10	10	10	
A73B	4	19	10	10	10	10	10	
A75B	1	22	10	10	10	10	10	
A75B	2	12	10	10	10	10	10	
A75B	3	10	10	10	10	10	10	
A75B	4	6	10	10	10	10	10	
Baker Bridge	1	18	10	10	10	10	10	
Baker Bridge	2	4	10	10	10	10	10	
Baker Bridge	3	21	10	10	10	10	10	
Baker Bridge	4	3	10	10	10	10	10	

Analyst: BCK QA: EC

Fish 96-h Acute Survival Test U.S. EPA Region 8 Lab

Analysis ID:	14-7261-3366	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 12:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
Control	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A56	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A68	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A72	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A73B	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A75B	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
Baker Bridge	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					2.5%

Steel Many-One Rank Test

Sample Code	vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
Control		A56	18	10	6	1	0.8571	Non-Significant Effect
		A68	18	10	6	1	0.8571	Non-Significant Effect
		A72	10	10	6	0	0.0480	Significant Effect
		A73B	18	10	6	1	0.8571	Non-Significant Effect
		A75B	18	10	6	1	0.8571	Non-Significant Effect
		Baker Bridge	18	10	6	1	0.8571	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	5.384915	0.8974859	6	65540	<0.0001	Significant Effect
Error	0	0	21			
Total	5.384915	0.8974859	27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	65540	3.812	<0.0001	Unequal Variances

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control	4	1	1	1	1	1	0	0	0.0%	0.0%
A56	4	1	1	1	1	1	0	0	0.0%	0.0%
A68	4	1	1	1	1	1	0	0	0.0%	0.0%
A72	4	0	0	0	0	0	0	0		100.0%
A73B	4	1	1	1	1	1	0	0	0.0%	0.0%
A75B	4	1	1	1	1	1	0	0	0.0%	0.0%
Baker Bridge	4	1	1	1	1	1	0	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A56	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A68	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A72	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
A73B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A75B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
Baker Bridge	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%

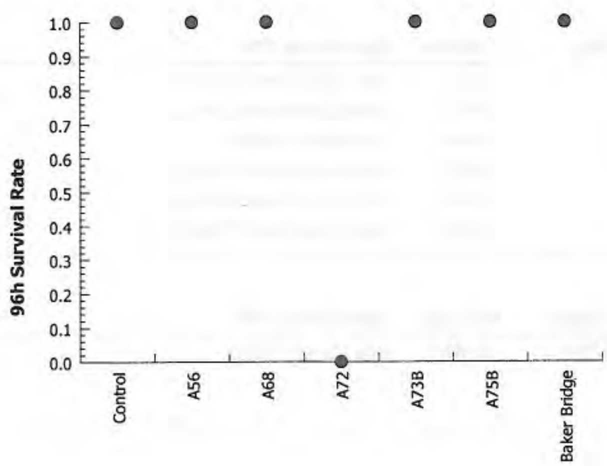
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

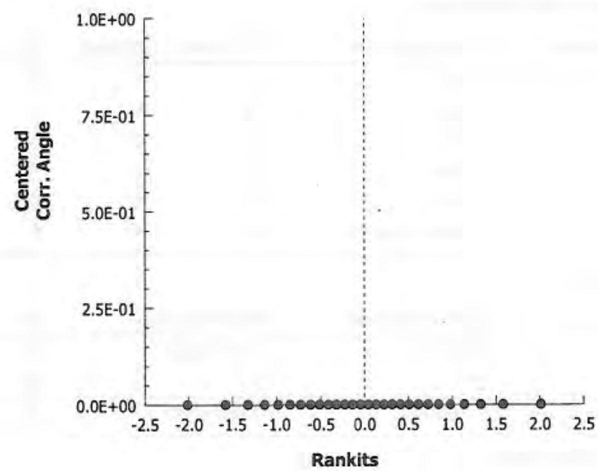
Analysis ID:	14-7261-3366	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 12:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
Control	1	1	1	1
A56	1	1	1	1
A68	1	1	1	1
A72	0	0	0	0
A73B	1	1	1	1
A75B	1	1	1	1
Baker Bridge	1	1	1	1

Graphics





Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Analysis ID:	14-2444-3659	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 12:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
Control	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A56	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A68	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A72	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A73B	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A75B	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
Baker Bridge	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					2.5%

Steel Many-One Rank Test

Sample Code	vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
A56		A72	10	10	6	0	0.0350	Significant Effect
		A73B	18	10	6	1	0.8000	Non-Significant Effect
		A75B	18	10	6	1	0.8000	Non-Significant Effect
		Baker Bridge	18	10	6	1	0.8000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	5.025921	1.25648	4	65540	<0.0001	Significant Effect
Error	0	0	15			
Total	5.025921	1.25648	19			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	65540	4.893	<0.0001	Unequal Variances

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A56	4	1	1	1	1	1	0	0	0.0%	0.0%
A72	4	0	0	0	0	0	0	0		100.0%
A73B	4	1	1	1	1	1	0	0	0.0%	0.0%
A75B	4	1	1	1	1	1	0	0	0.0%	0.0%
Baker Bridge	4	1	1	1	1	1	0	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A56	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A72	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
A73B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A75B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
Baker Bridge	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%

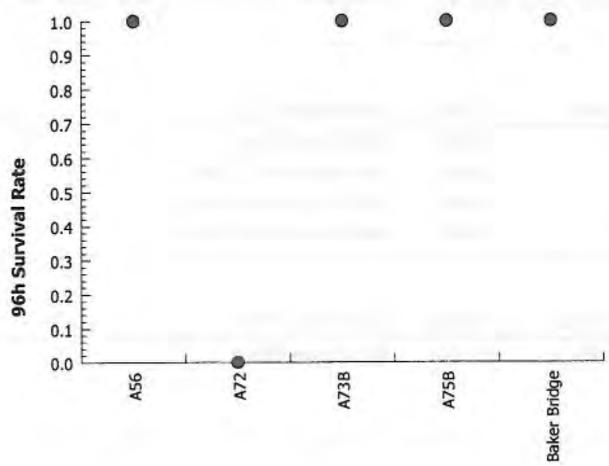
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

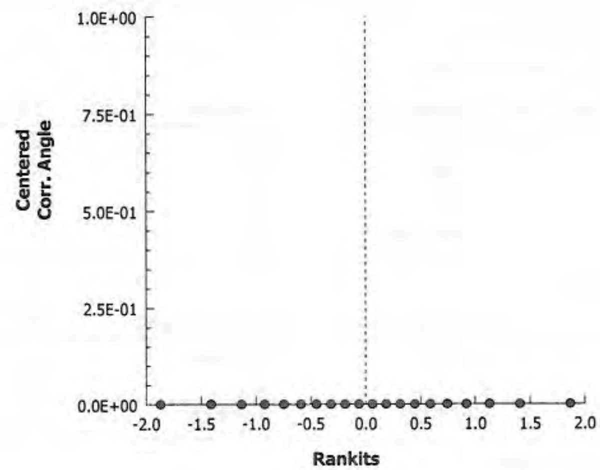
Analysis ID:	14-2444-3659	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 12:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
A56	1	1	1	1
A72	0	0	0	0
A73B	1	1	1	1
A75B	1	1	1	1
Baker Bridge	1	1	1	1

Graphics





Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Analysis ID:	02-5955-8725	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 12:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
Control	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A56	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A68	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A72	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A73B	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
A75B	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
Baker Bridge	R8: October 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					2.5%

Steel Many-One Rank Test

Sample Code	vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
A68		A72	10	10	6	0	0.0350	Significant Effect
		A73B	18	10	6	1	0.8000	Non-Significant Effect
		A75B	18	10	6	1	0.8000	Non-Significant Effect
		Baker Bridge	18	10	6	1	0.8000	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	5.025921	1.25648	4	65540	<0.0001	Significant Effect
Error	0	0	15			
Total	5.025921	1.25648	19			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	65540	4.893	<0.0001	Unequal Variances

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68	4	1	1	1	1	1	0	0	0.0%	0.0%
A72	4	0	0	0	0	0	0	0		100.0%
A73B	4	1	1	1	1	1	0	0	0.0%	0.0%
A75B	4	1	1	1	1	1	0	0	0.0%	0.0%
Baker Bridge	4	1	1	1	1	1	0	0	0.0%	0.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A72	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
A73B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A75B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
Baker Bridge	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%

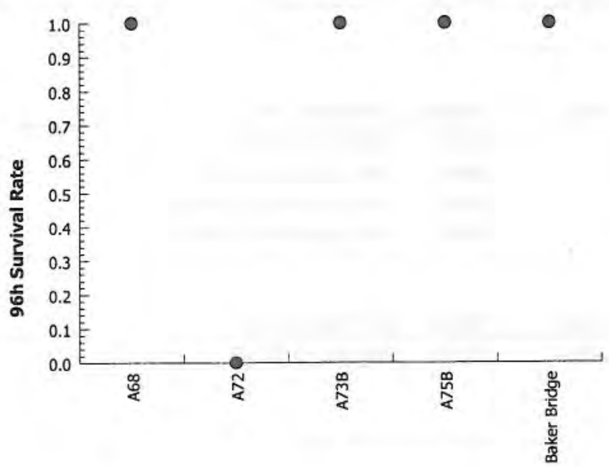
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

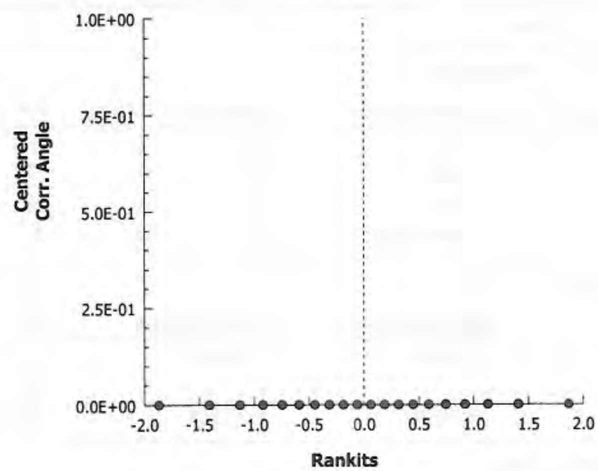
Analysis ID:	02-5955-8725	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 12:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
A68	1	1	1	1
A72	0	0	0	0
A73B	1	1	1	1
A75B	1	1	1	1
Baker Bridge	1	1	1	1

Graphics





CETIS Test Data Worksheet

Report Date: 15 Mar-13 11:14 (p 1 of 1)
Test Code: 19-6852-7945/75555A49

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Start Date:	22 Oct-12	**Species:**	Oncorhynchus mykiss	**Sample Code:**	34/48/56 6.25%
End Date:	26 Oct-12	**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Upper Animas River
Sample Date:	22 Oct-12	**Material:**	Mining Discharge/Runoff	**Sample Station:**	M34/CC48/A56 6.25%

Batch Note: R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water)

Sample Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
M34/CC48/A56CON	1	22	10	10	10	10	10	
M34/CC48/A56CON	2	10	10	10	10	10	10	
M34/CC48/A56CON	3	11	10	10	10	10	10	
M34/CC48/A56CON	4	14	10	10	10	10	10	
34/48/56 6.25%	1	13	10	10	10	10	10	
34/48/56 6.25%	2	2	10	10	10	10	10	
34/48/56 6.25%	3	7	10	10	10	10	10	
34/48/56 6.25%	4	8	10	10	10	10	10	
34/48/56 12.5%	1	19	10	10	10	10	10	
34/48/56 12.5%	2	17	10	10	10	10	10	
34/48/56 12.5%	3	3	10	10	10	10	10	
34/48/56 12.5%	4	18	10	10	10	10	10	
34/48/56 25%	1	1	10	10	10	10	10	
34/48/56 25%	2	23	10	10	10	10	10	
34/48/56 25%	3	6	10	10	10	10	10	
34/48/56 25%	4	9	10	10	10	10	10	
34/48/56 50%	1	21	10	10	10	10	10	
34/48/56 50%	2	15	10	10	10	10	10	
34/48/56 50%	3	20	10	10	10	9	9	
34/48/56 50%	4	24	10	10	10	10	10	
34/48/56 100%	1	5	10	10	0	0	0	
34/48/56 100%	2	16	10	4	0	0	0	
34/48/56 100%	3	4	10	2	0	0	0	
34/48/56 100%	4	12	10	7	0	0	0	

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	07-7333-0804	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 13:50	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
M34/CC48/A56CON	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water).
34/48/56 6.25%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water).
34/48/56 12.5%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water).
34/48/56 25%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water).
34/48/56 50%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water).
34/48/56 100%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A56 water).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run				N/A	4.57%

Steel Many-One Rank Test

Sample Code vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
M34/CC48/A56CO	34/48/56 6.25%	18	10	6	1	0.8333	Non-Significant Effect
	34/48/56 12.5%	18	10	6	1	0.8333	Non-Significant Effect
	34/48/56 25%	18	10	6	1	0.8333	Non-Significant Effect
	34/48/56 50%	16	10	6	1	0.6105	Non-Significant Effect
	34/48/56 100%	10	10	6	0	0.0417	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	5.172787	1.034557	5	934.9	<0.0001	Significant Effect
Error	0.0199195	0.001106639	18			
Total	5.192707	1.035664	23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	4.248	0.4457	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.4634	0.884	<0.0001	Non-normal Distribution

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
M34/CC48/A56CON	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/56 6.25%	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/56 12.5%	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/56 25%	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/56 50%	4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
34/48/56 100%	4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
M34/CC48/A56CON	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/56 6.25%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/56 12.5%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/56 25%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/56 50%	4	1.371	1.34	1.402	1.249	1.412	0.04074	0.08149	5.94%	2.89%
34/48/56 100%	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%

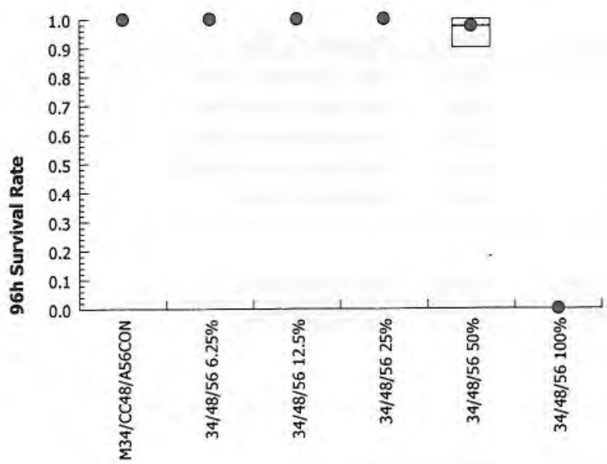
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

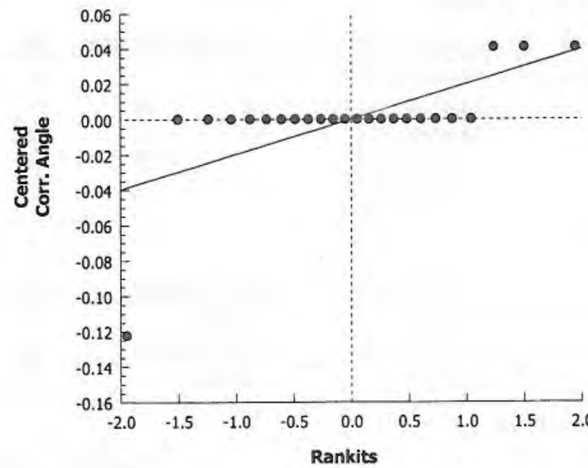
Analysis ID:	07-7333-0804	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 13:50	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
M34/CC48/A56CON	1	1	1	1
34/48/56 6.25%	1	1	1	1
34/48/56 12.5%	1	1	1	1
34/48/56 25%	1	1	1	1
34/48/56 50%	1	1	0.9	1
34/48/56 100%	0	0	0	0

Graphics





Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Start Date: 22 Oct-12 **Species:** Oncorhynchus mykiss **Sample Code:** 34/48/68 CON
End Date: **Protocol:** EPA/821/R-02-012 (2002) **Sample Source:** Upper Animas River
Sample Date: 22 Oct-12 **Material:** Mining Discharge/Runoff **Sample Station:** M34/CC48/A68 Control

Batch Note: R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A68 water)

Conc-%	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
34/48/68 CON	1	11	10	10	10	10	10	
34/48/68 CON	2	13	10	10	10	10	10	
34/48/68 CON	3	14	10	10	10	10	10	
34/48/68 CON	4	6	10	10	10	10	10	
34/48/68 6.25%	1	12	10	10	10	10	10	
34/48/68 6.25%	2	8	10	10	10	10	10	
34/48/68 6.25%	3	10	10	10	10	10	10	
34/48/68 6.25%	4	16	10	10	10	10	10	
34/48/68 12.5%	1	4	10	10	10	10	10	
34/48/68 12.5%	2	15	10	10	10	10	10	
34/48/68 12.5%	3	7	10	10	10	10	10	
34/48/68 12.5%	4	5	10	10	10	10	10	
34/48/68 25%	1	17	10	10	10	10	10	
34/48/68 25%	2	2	10	10	10	10	10	
34/48/68 25%	3	3	10	10	10	10	10	
34/48/68 25%	4	20	10	10	10	10	10	
34/48/68 50%	1	9	10	10	10	7	3	
34/48/68 50%	2	1	10	10	8	5	2	
34/48/68 50%	3	19	10	10	10	8	6	
34/48/68 50%	4	18	10	10	10	8	4	

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	00-4654-0837	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 16:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
34/48/68 CON	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A68 water).
34/48/68 6.25%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A68 water).
34/48/68 12.5%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A68 water).
34/48/68 25%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A68 water).
34/48/68 50%	R8: October 2012 Upper Animas RBT Acute SW Tox Test (DILUTED with A68 water).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run				N/A	8.31%

Steel Many-One Rank Test

Sample Code	vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
34/48/68 CON		34/48/68 6.25%	18	10	6	1	0.8000	Non-Significant Effect
		34/48/68 12.5%	18	10	6	1	0.8000	Non-Significant Effect
		34/48/68 25%	18	10	6	1	0.8000	Non-Significant Effect
		34/48/68 50%	10	10	6	0	0.0350	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.841008	0.460252	4	71.49	<0.0001	Significant Effect
Error	0.09656602	0.006437735	15			
Total	1.937574	0.4666897	19			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	7.241	4.893	0.0019	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.5659	0.866	<0.0001	Non-normal Distribution

96h Survival Rate Summary

Conc-%	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
34/48/68 CON	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/68 6.25%	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/68 12.5%	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/68 25%	4	1	1	1	1	1	0	0	0.0%	0.0%
34/48/68 50%	4	0.375	0.31	0.44	0.2	0.6	0.08539	0.1708	45.54%	62.5%

Angular (Corrected) Transformed Summary

Conc-%	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
34/48/68 CON	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/68 6.25%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/68 12.5%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/68 25%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
34/48/68 50%	4	0.6535	0.5853	0.7218	0.4636	0.8861	0.08971	0.1794	27.45%	53.72%

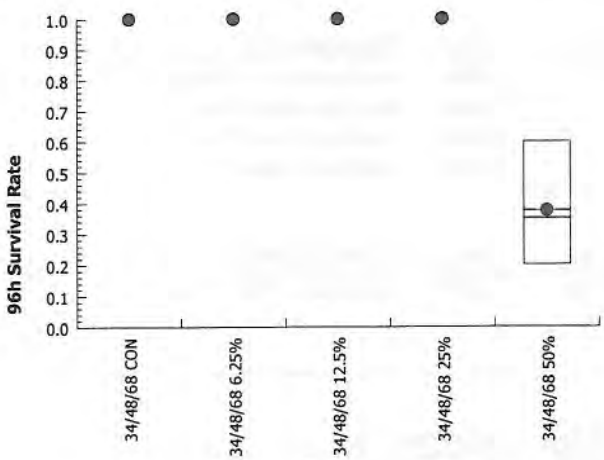
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

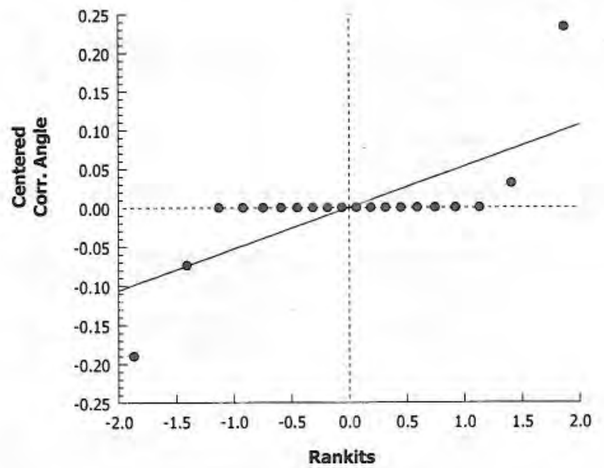
Analysis ID:	00-4654-0837	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	13 Mar-13 16:51	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Conc-%	Rep 1	Rep 2	Rep 3	Rep 4
34/48/68 CON	1	1	1	1
34/48/68 6.25%	1	1	1	1
34/48/68 12.5%	1	1	1	1
34/48/68 25%	1	1	1	1
34/48/68 50%	0.3	0.2	0.6	0.4

Graphics





Fish 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Start Date:	22 Oct-12	**Species:**	Oncorhynchus mykiss	**Sample Code:**	1012OMARTT
End Date:	26 Oct-12	**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Reference Toxicant
Sample Date:	22 Oct-12	**Material:**	Zinc sulfate	**Sample Station:**	

Batch Note: Region 8: Acute RBT Ref Tox Test (concurrent to Oct 2012 Upper Animas SW Tox Test)

Sample Note: Region 8: Acute RBT Ref Tox Test (concurrent to Oct 2012 Upper Animas SW Tox Test)

Conc-µg/L	Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
0	L	1	19	10	10	10	10	10	
0	L	2	18	10	10	10	10	10	
0	L	3	12	10	10	10	10	10	
0	L	4	17	10	10	10	10	10	
68.85		1	16	10	10	10	10	10	
68.85		2	23	10	10	10	10	10	
68.85		3	11	10	10	10	10	10	
68.85		4	6	10	10	10	10	10	
131.5		1	21	10	10	8	8	8	
131.5		2	10	10	10	6	6	6	
131.5		3	5	10	10	8	8	8	
131.5		4	20	10	10	8	8	8	
263.5		1	4	10	6	0	0	0	
263.5		2	24	10	10	0	0	0	
263.5		3	14	10	9	2	2	2	
263.5		4	9	10	7	0	0	0	
518.5		1	22	10	7	0	0	0	
518.5		2	2	10	7	0	0	0	
518.5		3	7	10	9	0	0	0	
518.5		4	13	10	6	0	0	0	
1029.5		1	15	10	4	0	0	0	
1029.5		2	3	10	3	0	0	0	
1029.5		3	8	10	5	0	0	0	
1029.5		4	1	10	7	1	0	0	

CETIS Analytical Report

Report Date: 14 Mar-13 10:27 (p 1 of 1)
Test Code: 7978ECB8 | 20-3796-8056

Fish 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Analysis ID:	09-5896-4300	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 10:27	**Analysis:**	Untrimmed Spearman-Kärber	**Official Results:**	Yes

Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	0.00%	2.212	0.02244	162.9	146.9	180.6

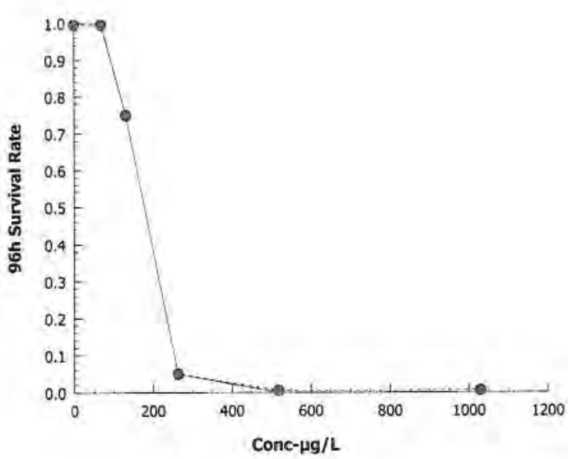
96h Survival Rate Summary

										Calculated Variate(A/B)	
Conc-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
68.85		4	1	1	1	0	0	0.0%	0.0%	40	40
131.5		4	0.75	0.6	0.8	0.05	0.1	13.33%	25.0%	30	40
263.5		4	0.05	0	0.2	0.05	0.1	200.0%	95.0%	2	40
518.5		4	0	0	0	0	0		100.0%	0	40
1029.5		4	0	0	0	0	0		100.0%	0	40

96h Survival Rate Detail

Conc-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
68.85		1	1	1	1
131.5		0.8	0.6	0.8	0.8
263.5		0	0	0.2	0
518.5		0	0	0	0
1029.5		0	0	0	0

Graphics



Attachment 2
November 2012 Upper Animas River Surface Water Toxicity Report
CETIS Analytical Reports

Attachment 2
November 2012 Upper Animas River Surface Water Toxicity Report
CETIS Analytical Reports

CETIS Test Data Worksheet

Report Date: 14 Mar-13 11:25 (p 1 of 1)
Test Code: 04-0904-1595/18617ABB

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Start Date:	02 Nov-12	**Species:**	Oncorhynchus mykiss	**Sample Code:**	M34
End Date:	06 Nov-12	**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Upper Animas River
Sample Date:	02 Nov-12	**Material:**	Mining Discharge/Runoff	**Sample Station:**	M34

Batch Note: R8: November 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED)

Conc-NA	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
A68	1	7	10	10	10	9	9	
A68	2	2	10	10	9	8	8	
A68	3	3	10	10	10	10	10	
A68	4	5	10	10	10	10	10	
M34	1	4	10	9	0	0	0	
M34	2	8	10	8	1	0	0	
M34	3	1	10	10	1	1	0	
M34	4	6	10	8	1	0	0	

Analyst: BGK QA: EC

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	14-8077-4318	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 11:25	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Sample Code	Sample Comments
A68	R8: November 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).
M34	R8: November 2012 Upper Animas RBT Acute SW Tox Test (UNDILUTED).

Data Transform	Zeta	Alt Hyp	MC Trials	Test Result	PMSD
Angular (Corrected)	0	C > T	Not Run	Sample passes 96h survival rate endpoint	9.75%

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	DF	MSD	P-Value	Decision(α:5%)
A68		M34	15.46	1.943	6	0.1428	<0.0001	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.582248	2.582248	1	239.2	<0.0001	Significant Effect
Error	0.06478542	0.01079757	6			
Total	2.647034	2.593046	7			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	10.87	13.75	0.0165	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.8598	0.6451	0.1195	Normal Distribution

96h Survival Rate Summary

Conc-NA	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68	4	0.925	0.8886	0.9614	0.8	1	0.04787	0.09574	10.35%	0.0%
M34	4	0	0	0	0	0	0	0		100.0%

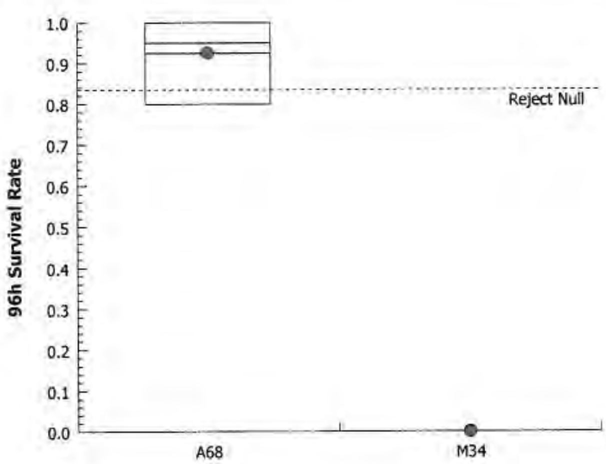
Angular (Corrected) Transformed Summary

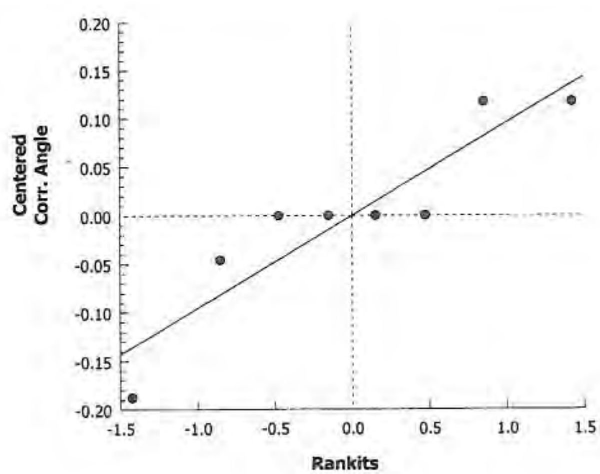
Conc-NA	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68	4	1.295	1.239	1.351	1.107	1.412	0.07348	0.147	11.35%	0.0%
M34	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	87.74%

96h Survival Rate Detail

Conc-NA	Rep 1	Rep 2	Rep 3	Rep 4
A68	0.9	0.8	1	1
M34	0	0	0	0

Graphics





CETIS Test Data Worksheet

Report Date: 14 Mar-13 14:38 (p 1 of 1)
Test Code: 08-8242-7016/3498C488

Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Start Date:	02 Nov-12	**Species:**	Oncorhynchus mykiss	**Sample Code:**	A68/A72 100%
End Date:	06 Nov-12	**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Upper Animas River
Sample Date:	02 Nov-12	**Material:**	Mining Discharge/Runoff	**Sample Station:**	A68/A72 100%

Batch Note: R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68)

Conc-NA	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
A68/A72 Control	1	8	10	10	10	10	10	
A68/A72 Control	2	5	10	10	10	10	10	
A68/A72 Control	3	3	10	10	10	10	10	
A68/A72 Control	4	10	10	10	10	10	10	
A68/A72 5%	1	4	10	10	10	10	10	
A68/A72 5%	2	1	10	10	10	8	8	
A68/A72 5%	3	26	10	10	10	10	10	
A68/A72 5%	4	12	10	10	10	9	9	
A68/A72 10%	1	20	9	9	8	8	8	
A68/A72 10%	2	17	8	8	8	8	8	
A68/A72 10%	3	2	10	10	10	9	9	
A68/A72 10%	4	22	10	10	10	10	10	
A68/A72 25%	1	28	10	10	10	8	8	
A68/A72 25%	2	16	10	10	10	10	10	
A68/A72 25%	3	15	9	9	9	8	8	
A68/A72 25%	4	11	10	10	10	10	10	
A68/A72 50%	1	27	10	10	10	10	10	
A68/A72 50%	2	24	10	10	10	10	10	
A68/A72 50%	3	14	9	9	9	9	9	
A68/A72 50%	4	25	10	10	10	10	10	
A68/A72 75%	1	23	9	9	9	9	9	
A68/A72 75%	2	6	9	9	9	9	9	
A68/A72 75%	3	13	10	10	10	10	10	
A68/A72 75%	4	9	10	10	10	10	10	
A68/A72 100%	1	7	10	10	3	2	0	
A68/A72 100%	2	21	10	10	5	4	1	
A68/A72 100%	3	18	10	10	5	4	0	
A68/A72 100%	4	19	10	10	5	3	0	

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	12-0049-8676	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 14:38	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
A68/A72 Control	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).
A68/A72 5%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).
A68/A72 10%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).
A68/A72 25%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).
A68/A72 50%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).
A68/A72 75%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).
A68/A72 100%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (A72 DILUTED w/A68).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					9.79%

Steel Many-One Rank Test

Sample Code vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
A68/A72 Control	A68/A72 5%	14	10	6	1	0.3760	Non-Significant Effect
	A68/A72 10%	14	10	6	1	0.3760	Non-Significant Effect
	A68/A72 25%	14	10	6	1	0.3760	Non-Significant Effect
	A68/A72 50%	18	10	6	1	0.8571	Non-Significant Effect
	A68/A72 75%	18	10	6	1	0.8571	Non-Significant Effect
	A68/A72 100%	10	10	6	0	0.0480	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4.657713	0.7762855	6	91.43	<0.0001	Significant Effect
Error	0.1782962	0.008490295	21			
Total	4.836009	0.7847758	27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	5.219	3.812	0.0020	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9013	0.8975	0.0123	Normal Distribution

96h Survival Rate Summary

Conc-NA	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68/A72 Control	4	1	1	1	1	1	0	0	0.0%	0.0%
A68/A72 5%	4	0.925	0.8886	0.9614	0.8	1	0.04787	0.09574	10.35%	7.5%
A68/A72 10%	4	0.9472	0.924	0.9705	0.8889	1	0.03056	0.06111	6.45%	5.28%
A68/A72 25%	4	0.9222	0.8854	0.9591	0.8	1	0.04843	0.09686	10.5%	7.78%
A68/A72 50%	4	1	1	1	1	1	0	0	0.0%	0.0%
A68/A72 75%	4	1	1	1	1	1	0	0	0.0%	0.0%
A68/A72 100%	4	0.025	0.005981	0.04402	0	0.1	0.025	0.05	200.0%	97.5%

Angular (Corrected) Transformed Summary

Conc-NA	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68/A72 Control	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A68/A72 5%	4	1.295	1.239	1.351	1.107	1.412	0.07348	0.147	11.35%	8.28%
A68/A72 10%	4	1.321	1.285	1.357	1.231	1.412	0.04723	0.09445	7.15%	6.43%
A68/A72 25%	4	1.291	1.234	1.347	1.107	1.412	0.07455	0.1491	11.55%	8.6%
A68/A72 50%	4	1.41	1.408	1.412	1.403	1.412	0.002171	0.004341	0.31%	0.15%
A68/A72 75%	4	1.408	1.406	1.41	1.403	1.412	0.002505	0.00501	0.36%	0.31%
A68/A72 100%	4	0.1995	0.1685	0.2305	0.1588	0.3218	0.04074	0.08149	40.84%	85.87%

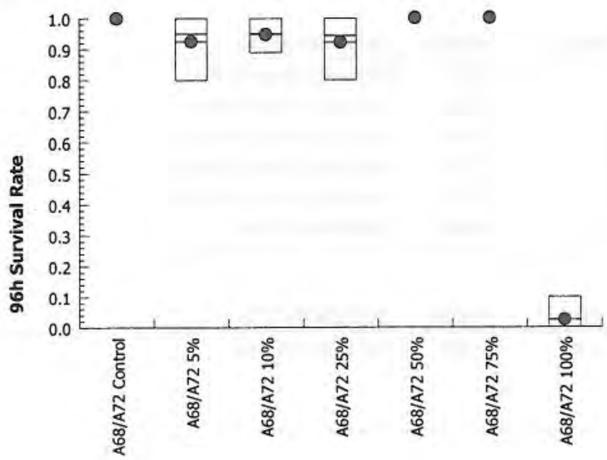
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

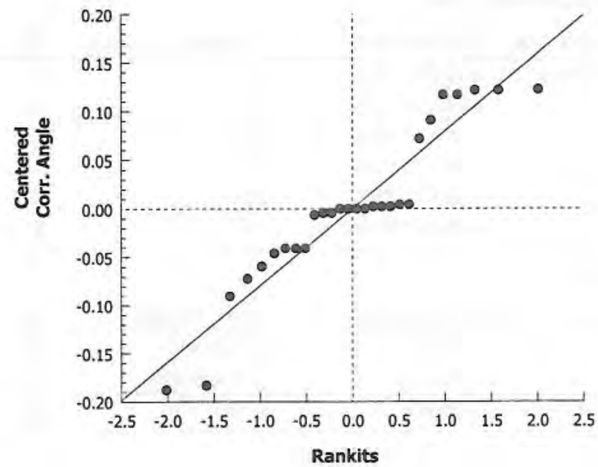
Analysis ID:	12-0049-8676	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 14:38	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Conc-NA	Rep 1	Rep 2	Rep 3	Rep 4
A68/A72 Control	1	1	1	1
A68/A72 5%	1	0.8	1	0.9
A68/A72 10%	0.8889	1	0.9	1
A68/A72 25%	0.8	1	0.8889	1
A68/A72 50%	1	1	1	1
A68/A72 75%	1	1	1	1
A68/A72 100%	0	0.1	0	0

Graphics





CETIS Test Data Worksheet

Report Date: 14 Mar-13 11:42 (p 1 of 1)
Test Code: 04-7825-5370/1C81990A

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Start Date: 02 Nov-12 | **Species:** Oncorhynchus mykiss | **Sample Code:** A68/CC48 Con
End Date: 06 Nov-12 | **Protocol:** EPA/821/R-02-012 (2002) | **Sample Source:** Upper Animas River
Sample Date: 02 Nov-12 | **Material:** Mining Discharge/Runoff | **Sample Station:** A68/CC48 Control

Batch Note: R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68)

Conc-NA	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
A68/CC48 Con	1	25	9	9	9	9	9	
A68/CC48 Con	2	23	10	10	10	10	10	
A68/CC48 Con	3	28	10	10	10	10	10	
A68/CC48 Con	4	22	10	10	10	10	10	
A68/CC48 1%	1	18	10	10	9	9	9	
A68/CC48 1%	2	16	10	10	9	9	9	
A68/CC48 1%	3	15	10	10	10	10	10	
A68/CC48 1%	4	14	10	10	8	6	6	
A68/CC48 3%	1	9	10	10	10	10	10	
A68/CC48 3%	2	3	9	9	9	9	9	
A68/CC48 3%	3	2	10	10	9	9	9	
A68/CC48 3%	4	27	10	10	10	10	10	
A68/CC48 6%	1	6	10	10	9	9	9	
A68/CC48 6%	2	4	10	10	10	10	10	
A68/CC48 6%	3	5	10	10	10	10	10	
A68/CC48 6%	4	13	10	10	10	10	10	
A68/CC48 12%	1	24	10	10	10	9	9	
A68/CC48 12%	2	17	10	10	10	10	10	
A68/CC48 12%	3	20	10	10	10	10	10	
A68/CC48 12%	4	21	10	10	8	7	7	
A68/CC48 25%	1	7	10	10	10	6	6	
A68/CC48 25%	2	1	10	10	10	10	10	
A68/CC48 25%	3	10	10	10	10	10	10	
A68/CC48 25%	4	8	10	10	10	10	10	
A68/CC48 50%	1	26	10	0	0	0	0	
A68/CC48 50%	2	12	10	0	0	0	0	
A68/CC48 50%	3	19	10	0	0	0	0	
A68/CC48 50%	4	11	10	0	0	0	0	

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	15-7164-8232	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 11:42	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
A68/CC48 Con	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).
A68/CC48 1%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).
A68/CC48 3%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).
A68/CC48 6%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).
A68/CC48 12%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).
A68/CC48 25%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).
A68/CC48 50%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48 DILUTED w/A68).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					17.5%

Steel Many-One Rank Test

Sample Code vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
A68/CC48 Con	A68/CC48 1%	12	10	6	1	0.1598	Non-Significant Effect
	A68/CC48 3%	16	10	6	1	0.6450	Non-Significant Effect
	A68/CC48 6%	16	10	6	1	0.6450	Non-Significant Effect
	A68/CC48 12%	14	10	6	1	0.3760	Non-Significant Effect
	A68/CC48 25%	16	10	6	1	0.6450	Non-Significant Effect
	A68/CC48 50%	10	10	6	0	0.0480	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4.719674	0.7866123	6	32.17	<0.0001	Significant Effect
Error	0.5134777	0.02445132	21			
Total	5.233151	0.8110636	27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	0.8895	3.812	0.5201	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.8407	0.8975	0.0006	Non-normal Distribution

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68/CC48 Con	4	1	1	1	1	1	0	0	0.0%	0.0%
A68/CC48 1%	4	0.85	0.7841	0.9159	0.6	1	0.0866	0.1732	20.38%	15.0%
A68/CC48 3%	4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
A68/CC48 6%	4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
A68/CC48 12%	4	0.9	0.8462	0.9538	0.7	1	0.07071	0.1414	15.71%	10.0%
A68/CC48 25%	4	0.9	0.8239	0.9761	0.6	1	0.1	0.2	22.22%	10.0%
A68/CC48 50%	4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68/CC48 Con	4	1.41	1.408	1.412	1.403	1.412	0.002171	0.004341	0.31%	0.0%
A68/CC48 1%	4	1.199	1.114	1.284	0.8861	1.412	0.1112	0.2223	18.54%	14.95%
A68/CC48 3%	4	1.369	1.339	1.4	1.249	1.412	0.04007	0.08015	5.85%	2.89%
A68/CC48 6%	4	1.371	1.34	1.402	1.249	1.412	0.04074	0.08149	5.94%	2.74%
A68/CC48 12%	4	1.266	1.19	1.342	0.9912	1.412	0.09936	0.1987	15.7%	10.2%
A68/CC48 25%	4	1.281	1.181	1.381	0.8861	1.412	0.1315	0.263	20.54%	9.17%
A68/CC48 50%	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.74%

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	15-7164-8232	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 11:42	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
A68/CC48 Con	1	1	1	1
A68/CC48 1%	0.9	0.9	1	0.6
A68/CC48 3%	1	1	0.9	1
A68/CC48 6%	0.9	1	1	1
A68/CC48 12%	0.9	1	1	0.7
A68/CC48 25%	0.6	1	1	1
A68/CC48 50%	0	0	0	0

CETIS Test Data Worksheet

Report Date: 25 Mar-13 12:58 (p 1 of 1)
Test Code: 13-6195-9587/512DDAA3

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Start Date: 02 Nov-12 **Species:** Oncorhynchus mykiss **Sample Code:** A68/CC48/M34CON
End Date: 06 Nov-12 **Protocol:** EPA/821/R-02-012 (2002) **Sample Source:** Upper Animas River
Sample Date: 02 Nov-12 **Material:** Mining Discharge/Runoff **Sample Station:** A68/CC48/M34 Control

Batch Note: R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68)

Sample Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
A68/CC48/M34CON	1	2	10	10	10	10	10	
A68/CC48/M34CON	2	16	10	10	10	10	10	
A68/CC48/M34CON	3	27	10	10	10	10	10	
A68/CC48/M34CON	4	21	10	10	10	10	10	
68/48/34 4%	1	5	10	10	10	10	10	
68/48/34 4%	2	26	9	9	9	9	9	
68/48/34 4%	3	19	10	10	10	10	10	
68/48/34 4%	4	17	10	10	10	9	9	
68/48/34 9%	1	12	10	10	10	10	10	
68/48/34 9%	2	6	10	10	9	9	9	
68/48/34 9%	3	8	10	10	10	10	10	
68/48/34 9%	4	10	10	10	10	9	9	
68/48/34 20%	1	22	10	10	10	10	10	
68/48/34 20%	2	15	10	10	10	10	10	
68/48/34 20%	3	4	10	10	10	10	10	
68/48/34 20%	4	11	10	10	10	10	10	
68/48/34 40%	1	9	10	10	10	10	9	
68/48/34 40%	2	13	10	10	10	10	10	
68/48/34 40%	3	18	10	10	10	10	8	
68/48/34 40%	4	24	10	10	10	10	10	
68/48/34 65%	1	7	10	7	3	1	0	
68/48/34 65%	2	14	10	9	3	1	0	
68/48/34 65%	3	25	10	9	2	2	0	
68/48/34 65%	4	23	10	10	4	4	0	
68/48/34 85%	1	1	10	0	0	0	0	
68/48/34 85%	2	20	10	0	0	0	0	
68/48/34 85%	3	3	10	0	0	0	0	
68/48/34 85%	4	28	10	0	0	0	0	

Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Analysis ID:	19-2177-9212	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 15:03	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
A68/CC48/M34CON	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).
68/48/34 4%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).
68/48/34 9%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).
68/48/34 20%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).
68/48/34 40%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).
68/48/34 65%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).
68/48/34 85%	R8: November 2012 Upper Animas RBT Acute SW Tox Test (CC48/M34 DILUTED with A68).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					7.87%

Steel Many-One Rank Test

Sample Code vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
A68/CC48/M34CO	68/48/34 4%	16	10	6	1	0.6450	Non-Significant Effect
	68/48/34 9%	14	10	6	1	0.3760	Non-Significant Effect
	68/48/34 20%	18	10	6	1	0.8571	Non-Significant Effect
	68/48/34 40%	14	10	6	1	0.3760	Non-Significant Effect
	68/48/34 65%	10	10	6	0	0.0480	Significant Effect
	68/48/34 85%	10	10	6	0	0.0480	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	8.338845	1.389808	6	263.9	<0.0001	Significant Effect
Error	0.1106143	0.005267348	21			
Total	8.449459	1.395075	27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	5.879	3.812	0.0010	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8503	0.8975	0.0009	Non-normal Distribution

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68/CC48/M34CON	4	1	1	1	1	1	0	0	0.0%	0.0%
68/48/34 4%	4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
68/48/34 9%	4	0.95	0.928	0.972	0.9	1	0.02887	0.05773	6.08%	5.0%
68/48/34 20%	4	1	1	1	1	1	0	0	0.0%	0.0%
68/48/34 40%	4	0.925	0.8886	0.9614	0.8	1	0.04787	0.09574	10.35%	7.5%
68/48/34 65%	4	0	0	0	0	0	0	0		100.0%
68/48/34 85%	4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
A68/CC48/M34CON	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
68/48/34 4%	4	1.369	1.339	1.4	1.249	1.412	0.04007	0.08015	5.85%	3.04%
68/48/34 9%	4	1.331	1.295	1.366	1.249	1.412	0.04705	0.09409	7.07%	5.77%
68/48/34 20%	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
68/48/34 40%	4	1.295	1.239	1.351	1.107	1.412	0.07348	0.147	11.35%	8.28%
68/48/34 65%	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
68/48/34 85%	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%

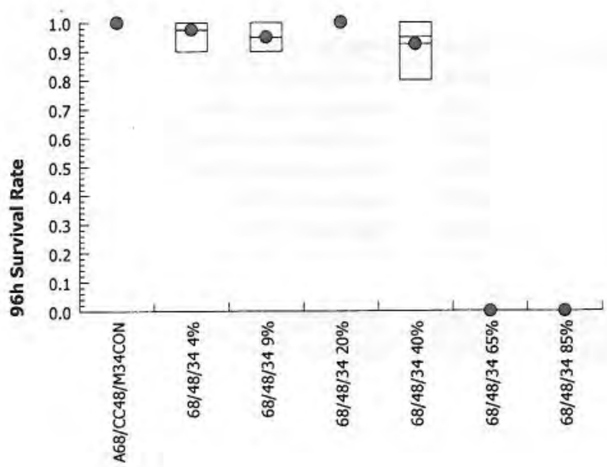
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

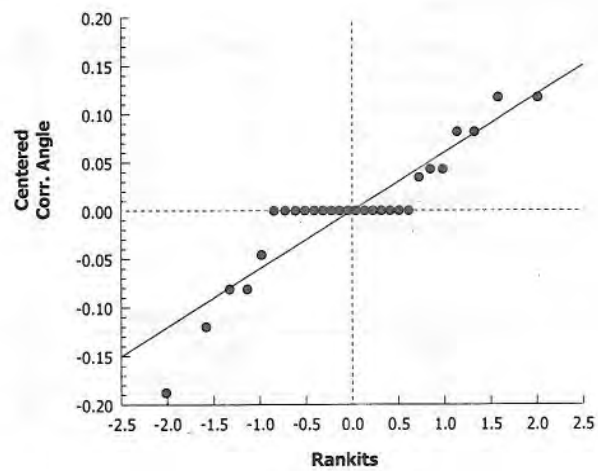
Analysis ID:	19-2177-9212	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 15:03	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
A68/CC48/M34CON	1	1	1	1
68/48/34 4%	1	1	1	0.9
68/48/34 9%	1	0.9	1	0.9
68/48/34 20%	1	1	1	1
68/48/34 40%	0.9	1	0.8	1
68/48/34 65%	0	0	0	0
68/48/34 85%	0	0	0	0

Graphics





CETIS Test Data Worksheet

Report Date: 14 Mar-13 12:01 (p 1 of 1)
Test Code: 08-3088-5134/1112OMARTT

Fish 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Start Date:	02 Nov-12	**Species:**	Oncorhynchus mykiss	**Sample Code:**	1112OMARTT
End Date:	06 Nov-12	**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Reference Toxicant
Sample Date:	02 Nov-12	**Material:**	Zinc sulfate	**Sample Station:**	

Batch Note: Region 8: Acute RBT Ref Tox Test (concurrent to Nov 2012 Upper Animas SW Tox Test)

Sample Note: Region 8: Acute RBT Ref Tox Test (concurrent to Nov 2012 Upper Animas SW Tox Test)

Conc-µg/L	Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
0	L	1	1	10	10	10	10	10	
0	L	2	6	10	10	10	10	10	
0	L	3	22	10	10	10	10	10	
0	L	4	3	10	10	10	10	10	
55.3		1	14	10	10	10	10	10	
55.3		2	17	10	10	10	10	10	
55.3		3	16	10	10	10	10	10	
55.3		4	10	10	10	10	10	10	
107		1	4	10	10	5	5	5	
107		2	15	10	10	9	8	8	
107		3	5	10	10	9	9	9	
107		4	8	10	9	9	8	8	
220		1	9	10	10	0	0	0	
220		2	13	10	9	1	0	0	
220		3	20	10	8	1	0	0	
220		4	7	10	10	2	0	0	
435		1	11	10	6	0	0	0	
435		2	21	10	10	0	0	0	
435		3	12	10	9	0	0	0	
435		4	18	9	6	0	0	0	
874		1	24	8	5	0	0	0	
874		2	2	10	5	0	0	0	
874		3	19	10	4	0	0	0	
874		4	23	9	5	0	0	0	

CETIS Analytical Report

Report Date:	14 Mar-13 12:02 (p 1 of 1)
Test Code:	1112OMARTT | 08-3088-5134

Fish 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Analysis ID:	12-5759-7385	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	14 Mar-13 12:01	**Analysis:**	Untrimmed Spearman-Kärber	**Official Results:**	Yes

Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	0.00%	2.111	0.02053	129.1	117.5	141.9

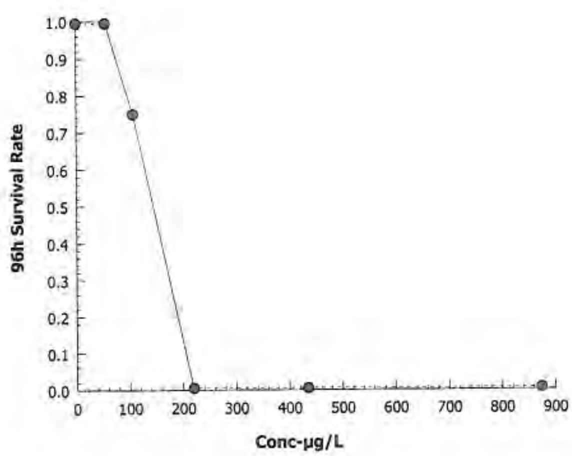
96h Survival Rate Summary — **Calculated Variate(A/B)**

Conc-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
55.3		4	1	1	1	0	0	0.0%	0.0%	40	40
107		4	0.75	0.5	0.9	0.0866	0.1732	23.09%	25.0%	30	40
220		4	0	0	0	0	0		100.0%	0	40
435		4	0	0	0	0	0		100.0%	0	39
874		4	0	0	0	0	0		100.0%	0	37

96h Survival Rate Detail

Conc-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
55.3		1	1	1	1
107		0.5	0.8	0.9	0.8
220		0	0	0	0
435		0	0	0	0
874		0	0	0	0

Graphics



Appendix 9b

Upper Animas River
Surface Water Toxicity Testing Report
April 2013 Surface Water Collection
Final

Prepared for:

United States Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation-Program Support
1595 Wynkoop St.
Denver, Colorado 80202

Prepared By:

Region 8 Environmental Services Assistance Team (ESAT)
TechLaw, Inc.
16194 W. 45th Drive
Golden, Colorado

September 2013

Contract No. EP-W-06-033
DCN: EP8-7-7604

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List of Acronyms

BERA	Baseline Ecological Risk Assessment
ºC	Degrees Celsius
CDPHE	Colorado Department of Public Health and Environment
CETIS	Comprehensive Environmental Toxicity Information System
EPA	United States Environmental Protection Agency
ESAT	Environmental Services Assistance Team
LC50	50% Lethal Concentration
LCL	Lower Confidence Limit
mg/L	Milligrams per liter
MHRW	Moderately Hard Reconstituted Water
mL	Milliliter
ms/cm	Millisiemens/centimeter
QA	Quality assurance
QAPP	Quality Assurance Project Plan
SI	Site Inspection
UCL	Upper Confidence Limit
ug/L	Micrograms per liter

1.0 INTRODUCTION

Acute (96-hour), static-renewal toxicity tests were performed in April of 2013 at the United States Environmental Protection Agency (EPA) Region 8 Laboratory using juvenile rainbow trout (*Oncorhynchus mykiss*) exposed to undiluted and serially-diluted surface water samples from the Animas River, Cement Creek, and Mineral Creek collected at and downstream of the town of Silverton, CO. Three tests were performed during 2012 and 2013 to better understand the chemistry and potential acute aquatic toxicity of metal contamination in these streams associated with historical mining activities and to provide data in support of a future Baseline Ecological Risk Assessment (BERA) as part of an on-going Remedial Investigation (RI).

As a Quality Assurance (QA) measure, a simultaneous reference toxicity test with a separate batch of juvenile rainbow trout was performed using Hard Reconstituted Water (HRW) spiked with different concentrations of zinc sulfate heptahydrate (include formula). Survival was the endpoint evaluated in all tests. This report includes a brief background of the Upper Animas River area in the vicinity of Silverton, materials and methods, test results, a discussion of those results, and supporting references.

1.1 Background

The following background information was obtained from the *Baseline Sampling and Analysis Plan for Upper Cement Creek Water Quality Characterization* (EPA, 2009). The discovery of gold and silver brought miners to the Silverton area and Animas Mining District in the early 1870's. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. Twelve concentration mills in the valley were sending their products to the Kendrick and Gelder Smelter near the mouth of Cement Creek by 1900. Mining and milling operations slowed down around 1905. At that point in time, the remaining mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. Mining and milling activities continued throughout the basin after 1907, but only when prices were relatively favorable.

Gladstone, located about eight miles upstream of Silverton on Cement Creek, is the site of an historic mining town which developed in the 1880s with the onset of mining in the surrounding area. The town was the central location and railroad terminus for milling and shipping mine ores from the surrounding valley. The town declined in the 1920's and no remnants of it remain today. Only one, year-round, producing mine (Sunnyside Mine) remained in the county by the 1970's. This mine ceased production in 1991, and has since undergone extensive reclamation efforts. The Gold King Mine's permit with the Division of Reclamation, Mining and Safety (DRMS) is currently in inactive status; however, landowners hope to rehabilitate the mine.

Both the Sunnyside and Gold King properties were partially accessed through the American Tunnel which has its portal in Gladstone. Previously, this feature drained as much as 1,600 gallons per minute (gpm) of water from the mines. A lime feed and settling pond-type treatment facility was constructed in Gladstone in 1979 by Standard Metals Corporation. Water discharging from the American Tunnel was treated as required by the water discharge permit. The facility operations and mine ownership was later transferred to the Sunnyside Gold Corporation (SGC). SGC installed several bulkheads within the Sunnyside Mine under jurisdiction of a court consent decree to terminate their discharge permit. This action greatly reduced the volume of discharge from the American Tunnel. However, the tunnel currently continues to discharge 70 to 100 gpm, presumably from near-surface groundwater. SGC met all terms of the consent decree in 2002.

Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, and Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River.

1.2 Objective

The objectives of the toxicity tests were to: (a) characterize the effects of mine waste-impacted surface water samples on juvenile rainbow trout under acute exposure conditions, (b) refine the understanding of the extent of toxicity in Mineral Creek, Cement Creek, and the Animas River with and without dilution, and (c) generate data to support the future BERA and RI.

2.0 MATERIALS AND METHODS

This section outlines the materials and methods used in the test, including surface water collection procedures, water preparation and delivery, test organisms, food preparation, and test conditions. The general test methods and testing criteria followed EPA protocol (EPA, 2002) and are summarized in **Table 2.5-1**.

2.1 Surface water collection

Surface water samples were collected on April 16, 2013 from the Animas River, Cement Creek, and Mineral Creek. These samples were intended to represent low-flow conditions (i.e., before the May-June snowmelt period). The weather before and during the sampling event was sunny, windy, and cool with ambient temperature in the morning around 35°C and afternoon temperature of approximately 50°C.

The surface water samples used in the toxicity tests were obtained from the following locations (see **Figure 2.1-1)**:

- *A68*: sample collected from the Animas River about 0.5 mile upstream of the confluence with Cement Creek in Silverton; this sample represents the regional conditions in the Animas River above Silverton.

- *M34*: sample collected from Mineral Creek about 0.29 miles above the confluence with the Animas River in Silverton.
- *A72*: sample collected from the Animas River about 0.71 miles downstream of the confluence with Mineral Creek below Silverton.
- *A73*: sample collected from the Animas River just above the confluence with Elk Creek, located about 5 miles downstream from A72.
- *A73B*: Sample collected from the Animas River below the confluence with Elk Creek, located about 5.1 miles downstream from A72.
- *A75B*: sample collected from the Animas River below the confluence with Cascade Creek, located about 12.80 miles downstream from A73B.
- *CC48/M34:* a mixed sample collected from Cement Creek at location CC48 and Mineral Creek at location M34 (note: CC48 is located about 0.80 miles above the confluence with the Animas River in Silverton).

Surface water samples A68, M34, A72, A73, A73B, and A75B represent composite samples collected in the mid-water column across the width of the Animas River and Mineral Creek.

Mixed surface water sample CC48/M34 was collected using a discharge-weighted approach based on the total discharge of the two creeks. As a result, this sample represented roughly two parts Mineral Creek for every one part Cement Creek.

All the surface water samples were immediately stored on ice in coolers in the field and transported to the Region 8 laboratory until use for testing. Once at the laboratory, they were placed in a cooler at 4ºC until the test started, which took place within 36 hours after the last sample was collected.

2.2 Water preparation and renewal

The water samples collected from A68, M34, A72, A73, A73B, and A75B were tested undiluted (full strength) for acute toxicity. The water sample obtained from location A72 in the Animas River was also serially diluted with HRW (laboratory control water) before these dilutions were tested for acute toxicity. Mixed water sample CC48/M34 was serially diluted twice, using the water sample obtained from location A68 and using HRW, before these two dilution series were tested separately for acute toxicity.

The HRW was prepared according to Smith *et al*. (1997) by adding 95 grams of calcium sulfate, 246 grams of magnesium sulfate heptahydrate, 192 grams of sodium bicarbonate, and 8 grams of potassium chloride to the laboratory stainless steel batch tank containing 1,000 liters of deionized water. Once the HRW was prepared, the batch tank was continuously aerated during the toxicity test. The water quality of the HRW was measured to verify that key parameters had been met, as follows: hardness between 160-180 milligrams per liter (mg/L), alkalinity between 110-120 mg/L, and pH between 7.6 and 8.0 (EPA, 2002). Actual results for HRW batch water are as follows: hardness of 176 mg/L, alkalinity of 120 mg/L, conductivity of 634 ms/cm and pH of 7.4

The exposure water in each of the test chambers was replaced daily. The renewal was achieved when >90% of the water in each vessel was replaced (measured volumetrically). Site water used for renewal was first warmed to 12 degrees Celsius (ºC) prior to use. The water temperature was held constant during the 96-hour exposure period by placing all the test chambers in a temperature-controlled water bath.

2.3 Test organisms

Juvenile (15-30 days post yolk-sac absorption) rainbow trout (*O. mykiss*) were obtained from Trout Lodge, Inc. (Sumner, Washington) for use in the toxicity tests. An importation license was obtained from the Colorado Division of Wildlife before the *O. mykiss* were shipped by the supplier. The trout were of uniform size and had an average wet weight of 0.38 grams.

The fish in the shipping bag were placed in a 20-gallon holding tank at 12°C to equilibrate the temperature after they arrived at the Region 8 laboratory. Afterwards, the shipping bag was carefully opened to allow a small amount of HRW water to enter the bag. This procedure was repeated several times throughout the day until laboratory HRW and shipping water were well mixed. The fish were then released from the shipping bag into the holding tank where they were held for five days until used for testing.

2.4 Feeding procedure

The fish were fed starter trout chow obtained from Nelson's Silver Cup, Inc. in accordance with EPA methods (EPA, 2002). The fish were fed twice each day before the test started and once daily thereafter. They were not fed for 24 hours before the start of the test to reduce waste accumulation.

2.5 Toxicity test procedures

The following subsections summarize the procedures used for the acute toxicity tests and the reference toxicity test.

All test chambers consisted of 1-L glass beakers placed in a water bath to maintain a temperature of 12º C during the 96-hour exposure period. Four replicates were tested for each water sample, including the laboratory control. The test followed the criteria specified in EPA (2002) (see also **Table 2.5-1**).

A laboratory control consisting of HRW was also tested to verify the health of the test organisms and to serve as a reference sample. Note that sample A68 was not used as a reference because it was impacted by mining-related activities or natural discharges in the watershed upstream of Silverton.

Ten fish were added to each test chamber at the start of the test using a small dip net and an 8-ounce cup, in which the count was quickly verified. Four replicate test chambers were used for each of the site and reference water samples.

Dissolved Oxygen (DO), pH, conductivity, and temperature were measured directly from each replicate. Water samples were also collected on Day 0 and Day 4 from each test chamber for the following analyses: total and dissolved metals (EPA Method 200.7/200.80), anions (EPA Method 300.0), ammonia (EPA Method 350.1), and alkalinity (EPA Method 310.1). Fish mortality was observed daily and recorded. All dead organisms were removed and discarded.

2.5.1 Profile testing of the Animas River and Mineral Creek surface water samples

The composite surface water samples collected from the Animas River (A68, A72, A73, A73B, and A75B) and Mineral Creek (M34) were tested undiluted (i.e., 100% strength).

Appendix A provides the survival and daily water chemistry data for this test. **Table 2.5-2** provides the initial and final results for total recoverable metals, whereas **Table 2.5-3** provides the initial and final results for dissolved metals. **Table 2.5-4** summarizes the initial and final wet chemistry results, whereas **Table 2.5-5** shows initial and final ammonia levels, as well as the calculated pH-adjusted acute ammonia surface water criteria for comparison.

2.5.2 Serial Dilution Toxicity Testing

2.5.2.1 Animas River water (A72) diluted by HRW

The surface water sample collected from location A72 in the Animas River was serially diluted with HRW to determine what dilutions of site water would cause acute toxicity to juvenile rainbow trout. The serial dilutions resulted in Animas River A72 surface water samples of 88%, 75%, 50%, 35%, 25%, and 12% strength.

Appendix B provides the survival and daily water chemistry data for this dilution series. **Table 2.5-2** provides the initial and final results for total recoverable metals, whereas **Table 2.5-3** provides the initial and final results for dissolved metals. **Table 2.5-4** summarizes the initial and final wet chemistry results, whereas **Table 2.5-5** shows initial and final ammonia levels, as well as the calculated pH-adjusted acute ammonia surface water criteria for comparison.

2.5.2.2 Combined Mineral Creek and Cement Creek water (M34/CC48) diluted by A68 and HRW

The stream discharge-weighted mixed surface water sample M34/CC48 was serially diluted either with HRW or with Animas River water collected upstream of Silverton (i.e., A68) to determine what dilutions would cause acute toxicity to juvenile rainbow trout. The serial dilutions resulted in M34/CC48 surface water samples of 100%, 95%, 90%, 80%, 75%, 50%, and 25% strength.

Appendices C and D provide the survival and daily water chemistry data for the A68 diluent series and HRW diluent series, respectively. **Table 2.5-2** provides the initial and final results for total recoverable metals, whereas **Table 2.5-3** provides the initial and final results for dissolved metals. **Table 2.5-4** summarizes the initial and final wet chemistry results, whereas **Table 2.5-5** shows initial and final ammonia levels, as well as the calculated pH-adjusted acute ammonia surface water criteria for comparison.

2.5.3 Reference Toxicity Testing

For QA purposes, a reference toxicity test using juvenile rainbow trout was performed simultaneously with the site water toxicity tests. HRW was spiked with different concentrations of a zinc sulfate heptahydrate. Zinc concentrations were reduced by 50% starting with the highest target concentration until the lowest dilution of 6.25% was reached.

The following values present the dilutions and average dissolved zinc levels (obtained by averaging the initial and final dissolved zinc results) used for this reference test: 100% concentration (1075 µg/L Zn), 50% concentration (525 µg/L Zn), 25% concentration (305 µg/L), 12.5% concentration (155 µg/L Zn), and 6.25% concentration (87.7 µg/L). The zinc levels were verified in the analytical laboratory using EPA Method 200.7/200.8.

Appendix E provides the survival and daily water chemistry data for the reference toxicity test. **Table 2.5-2** provides the initial and final results for total recoverable metals, whereas **Table 2.5-3** provides the initial and final results for dissolved metals. **Table 2.5-4** summarizes the initial and final wet chemistry results, whereas **Table 2.5-5** shows initial and final ammonia levels, as well as the calculated pH-adjusted acute ammonia surface water criteria for comparison.

3.0 RESULTS

This section presents the results of the various toxicity tests performed on the surface water samples collected from the Animas River, Cement Creek, and Mineral Creek, plus the reference toxicity test.

The juvenile rainbow trout exposed to the laboratory control water (HRW) showed 100% survival after 96 hours of exposure, which exceeded the minimum performance criterion of 90% survival. As a result, all the tests discussed below are considered valid.

The Comprehensive Environmental Toxicity Information System (CETIS) statistical software package (version 1.8.0.13) was used to analyze the significance of the results discussed below.

CETIS was used to perform Analyses of Variance (ANOVAs) to identify the presence of statistically significant differences in survival measured in the profile test and serial dilution tests when compared to those measured in the laboratory control sample.

In addition, CETIS was used to calculate EC_{50} values based on the survival data from all the serial dilution tests and the reference toxicity test.

3.1 The Animas River and Mineral Creek profile test

The water quality parameters were consistent throughout this toxicity test (see **Appendix A** and **Table 2.5-5**). All DO readings remained above 6.0 mg/L, and the average test chamber temperatures fell within +/- 2ºC of the target (12ºC), which met the performance criteria for these two parameters. The ammonia measured on day 0 and day 4 remained well below the pH-adjusted and sample-specific acute ammonia criteria, indicating that ammonia levels were not a concern in this test.

The results showed 67.5% survival at A68, 15% at M34, 0% survival at A72, 97.5% survival at A73, 97.5% survival at 73B, and 100% survival at A75B (see **Appendix A** and **Figure 3.1**). The ANOVA and Steel Many-One Rank Test found no statistically significant differences when survival in A73, 73B, and A75B was compared to that measured in the control. Survival was significantly lower in A68, M34, and A72 when compared to that measured in the control (see **Attachment 1**).

3.2 A72 diluted by HRW

The water quality parameters were consistent throughout the toxicity test (see **Appendix B** and **Table 2.5-5**). All DO readings remained above 6.0 mg/L, and the average test chamber temperatures fell within +/- 2ºC of the target (12ºC), which met the performance criteria for these two parameters. The ammonia measured on day 0 and day 4 remained well below the pH-adjusted and sample-specific acute ammonia criteria, indicating that ammonia levels were not a concern in this test.

The results showed that 100% of the juvenile rainbow trout survived at all the dilutions except the 88% dilution which had a survival of 97.5% (see **Appendix B** and **Figure 3.1**).

These data were statistically analyzed using CETIS, which provided the following results:

- The ANOVA and Steel Many-One Rank Test found that survival in all the dilutions did not differ significantly from that measured in the HRW sample (see **Attachment 2**).

- CETIS selected a Linear Interpolation to calculate an EC_{50} of >88% based on the dose-response data (see **Attachment 2**).

3.3 M34/CC48 diluted by A68 and HRW

3.3.1 A68 as a diluent

The water quality parameters were consistent throughout the toxicity test (see **Appendix C** and **Table 2.5-5**). All DO readings remained above 6.0 mg/L, and the average test chamber temperatures fell within +/- 2ºC of the target (12ºC), which met the performance criteria for these two parameters. The ammonia measured on day 0 and day 4 remained well below the pH-adjusted and sample-specific acute ammonia criteria, indicating that ammonia levels were not a concern in this test or a source of toxicity.

Survival in juvenile rainbow trout exposed for 96 hours to the CC48/M34 sample diluted with A68 surface water was as follows: 100% CC48/M34 = 0% survival; 95% CC48/M34 = 0% survival; 90% CC48/M34 = 0% survival; 80% CC48/M34 = 0% survival; 75% CC48/M34 = 0% survival; 50% CC48/M34 = 90% survival; and 25% CC48/M34 = 100% survival (see **Appendix C** and **Figure 3.2**).

These data were statistically analyzed using CETIS, which provided the following results:

- The ANOVA and Steel Many-One Rank Sum Test found that survival in the 100%, 95%, 90%, 80%, and 75% CC48/M34 samples was significantly lower than that measured in the HRW sample. Survival in the 50% and 25% CC48/M34 samples did not differ significantly from that measured in the HRW sample (see **Attachment 3**).

- CETIS selected the Spearman-Karber method to calculate an EC_{50} of 58% based on the dose-response data. This value indicated that half of the juvenile rainbow trout can be expected to die after 96 hours of exposure to a mixture consisting of 58% of CC48/M34 surface water and 42% of A68 surface water. The EC_{50} had a 95% Lower Confidence Limit (95% LCL) of 55.0% and a 95% Upper Confidence Limit (95% UCL) of 61.1% (see **Attachment 3**).

3.3.2 HRW as a diluent

The water quality parameters were consistent throughout the toxicity test (see **Appendix D** and **Table 2.5-5**). All DO readings remained above 6.0 mg/L, and the average test chamber temperatures fell within +/- 2ºC of the target (12ºC), which met the performance criteria for these two parameters. The ammonia measured on day 0 and day 4 remained well below the pH-adjusted and sample-specific acute ammonia criteria, indicating that ammonia levels were not a concern in this test.

Survival in juvenile rainbow trout exposed for 96 hours to the CC48/M34 sample diluted with HRW was as follows: 95% CC48/M34 = 0% survival; 90% CC48/M34 = 0% survival; 75% CC48/M34 = 100% survival; 50% CC48/M34 = 100% survival; and 25% CC48/M34 = 100% survival (see **Appendix D** and **Figure 3.2**).

These data were statistically analyzed using CETIS, which provided the following results:

- The ANOVA and Steel Many-One Rank Test found that survival in the 95% and 90% CC48/M34 samples were significantly lower than that measured in the HRW sample. Survival in the 75%, 50% and 25% CC48/M34 samples did not differ significantly from that measured in the HRW sample (see **Attachment 4**).

- CETIS selected the Binomial/Graphical Estimates method to calculate an EC_{50} of 82.2% based on the dose-response data (see **Attachment 4**). This value indicated that half of juvenile rainbow trout can be expected to die after 96 hours of exposure to a mixture consisting of 82.2% of CC48/M34 surface water and 17.8% of HRW. The EC_{50} had a 95% LCL of 79.8% and a 95% UCL of 84.6% **(Attachment 4)**.

3.4 Reference Toxicity Test

A reference toxicity test was conducted simultaneously with the other toxicity tests to check for the quality of the juvenile rainbow trout. The water quality parameters were consistent throughout this test (see **Appendix E** and **Table 2.5-5**). All DO readings remained above 6.0 mg/L, and the average test chamber temperatures fell within +/- 2ºC of the target (12ºC), which met the performance criteria for these two parameters. The ammonia measured on day 0 and day 4 remained well below the pH-adjusted and sample-specific acute ammonia criteria, indicating that ammonia levels were not a concern in this test.

The zinc concentrations used in the reference toxicity test increased sequentially as follows (the % survival at the end of the 96-hour exposure period is included in parentheses): 6.25% strength = 88 µg/L (97.5% survival); 12.5% strength = 155 µg/L (85% survival); 25% strength = 305 µg/L (15% survival); 50% strength = 525 µg/L (0% survival); and 100% strength (i.e., no dilution) = 1075 µg/L (0% survival) (see **Appendix E** and **Figure 3.3**).

CETIS selected the Trimmed Spearman-Karber method to calculate an EC_{50} of 215.8 µg/L based on the dose-response data (see **Attachment 5**). This value indicated that half of juvenile rainbow trout can be expected to die after 96 hours of exposure to surface water that contains 215.8 µg/L of zinc. The EC_{50} had a LCL of 194.5 µg/L and an UCL of 239.4 µg/L(see **Attachment 5**). This value is comparable to previous reference toxicity tests performed from 2005 through 2011. **Figure 3.4** provides the zinc LC_{50} control chart which shows historical LC_{50} data obtained at the Region 8 Laboratory.

4.0 DISCUSSION

The results of the profile test showed that surface water collected from the Animas River above the confluence of Cement Creek (A68) indicated toxic effects in juvenile rainbow trout (67.5 % survival). This suggests that natural or mining-related sources of contamination further upstream in the watershed.

100% mortality was observed just below the confluence with Mineral and Cement Creeks at location A72. One contributing factor is the input of highly-toxic water from Mineral

Creek (M34 = 15% survival). In addition, and although not included in the April 2013 investigation, previous analyses of surface water samples collected from Cement Creek showed that the contaminant levels in this stream would be lethal to aquatic organisms.

The high toxicity observed at A72 was not observed in the water sample collected from A73 (95% survival), which is located about 5 miles further downstream. The most likely reason is the continuous input of water from the numerous creeks and streams that discharge to this stretch of the mainstem, thereby diluting the high metal levels observed at A72. This trend continued further downstream approximately 17 miles to A75B where100% survival was observed. It was therefore concluded that the stretch of the Animas River which is acutely toxic to juvenile rainbow trout extends for less than 5 miles below Silverton.

Results of the A72 serial dilution test support this conclusion. Even though the undiluted water sample collected at A72 was acutely toxic to juvenile rainbow trout, no mortality was observed when this sample was diluted with only 12% HRW.

The acute toxicity to juvenile rainbow trout associated with the undiluted mixed CC48/M34 sample was severe (0% survival). Note that the effect of dilution with A68 water was contradictory, as follows: undiluted (full-strength) A68 water resulted in 67.5% survival, whereas diluting the highly toxic CC48/M34 sample by half using A68 water resulted in 90% survival. It is not known what may have caused this discrepancy.

The reference toxicity test generated a 96-hour EC_{50} for the juvenile rainbow trout equal to 215.8 µg/L zinc.

5.0 REFERENCES

Comprehensive Environmental Toxicity Information System. (2001-2007). Tidepool Scientific Software, McKinleyville, CA 95519

Smith, M.E., Lazorchak, J.M., Herrin, L.E., Brewer-Swartz, S., & Thoney, W.T. (1997). A reformulated, reconstituted water for testing the freshwater amphipod, *Hyalella azteca*. *Environ. Toxicol. Chem.* 16: 1229-1233.

U.S Environmental Protection Agency (EPA). 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms. 5th ed., October 2002. EPA-821-R-02-012.

U.S. Environmental Protection Agency (EPA). 2009. "Baseline Sampling and Analysis Plan for Upper Cement Creek Watershed, Gladstone, San Juan County, Colorado Revision 1". April 8, 2009.

Tables

Table 2.5-1: April 2013 Upper Animas River Surface Water Toxicity Test Summary of the Test Conditions

Test Parameter	Criterion
Test type	static renewal
Test duration	96 hour
Temperature range	12ºC +/- 2ºC
Light quality	ambient laboratory illumination
Light intensity	50-100 ft-c
Photo period	16 hours light, 8 hours dark
Test chamber size	1 liter
Test solution volume	900 mL
Renewal of test solutions	daily
Age of test organisms	RBT (15-30 days post yolk-sac absorption)
No. of replicate chambers per sample	4
No. of fish per chamber	10
No. of fish per sample	40
Feeding regime	once daily
Test chamber cleaning	cleaning not required
Test solution aeration	not to exceed 100 bubbles per minute
Dissolved oxygen concentration	≥6.0 mg/L
Dilution water used	hard reconstituted water
End point evaluated	mortality
Sample holding time	36 hours after collecting the last surface water sample in the field
Test acceptability	90% or greater survival in controls

Table 2.5-2 April 2013 Upper Animas River Surface Water Toxicity Testing

Total Recoverable Metals Initial Analytical Results (ug/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River and Mineral Creek surface water samples																							
A68	317	<2.50U	<2.50U	<25.0U	<2.00U	2.98D	65700	7.09JD	1.42D	14.4D	213J	3.46BD	3940	3920	2.76JD	767J	<2.50U	<2.50U	2750	702	<2.50U	<10.0U	962
M34	3290	<2.50U	<2.50U	27.2JD	<2.00U	1.20D	76400	<5.00U	6.44D	7.60D	4720	11.7D	5890	433	<2.50U	809J	<2.50U	<2.50U	5680	796	<2.50U	<10.0U	317
A72	2690	<2.50U	<2.50U	<25.0U	<2.00U	2.54D	86900	<5.00U	6.51D	17.7D	4680	8.79BD	5790	2340	2.82JD	1020	<2.50U	<2.50U	4250	972	<2.50U	<10.0U	935
A73	2220	<2.50U	<2.50U	<25.0U	<2.00U	2.28D	79400	6.10JD	6.00D	15.4D	3620	7.70BD	5590	1950	2.56JD	975J	<2.50U	<2.50U	4090	874	<2.50U	<10.0U	835
A73B	1930	<2.50U	<2.50U	25.6JD	<2.00U	2.05D	75200	<5.00U	4.94D	13.0D	3220	6.81BD	5430	1860	2.86JD	960J	<2.50U	<2.50U	3950	827	<2.50U	<10.0U	798
A75B	1230	<2.50U	<2.50U	25.0JD	<2.00U	1.39D	60100	7.09JD	3.45D	7.56D	1290	4.09BD	4780	1260	<2.50U	976J	<2.50U	<2.50U	3330	640	<2.50U	<10.0U	563
Animas River surface water sample A72 serially diluted by hard reconstituted water (HRW)																							
HRW Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	23800	5.50JD	<0.500U	<2.50U	<100U	<0.500U	27100	<2.00U	<2.50U	4940	<2.50U	<2.50U	58700	158	<2.50U	<10.0U	<10.0U
HRW(A72)-88%	2440	<2.50U	<2.50U	<25.0U	<2.00U	2.21D	80500	<5.00U	6.68D	17.1D	4160	7.33D	8420	2080	3.02JD	1480	<2.50U	<2.50U	10900	877	<2.50U	<10.0U	840
HRW(A72)-75%	2120	<2.50U	<2.50U	<25.0U	<2.00U	1.82D	72200	<5.00U	5.29D	14.7D	3670	6.46D	11300	1770	2.92JD	2020	<2.50U	<2.50U	18200	773	<2.50U	<10.0U	699
HRW(A72)-50%	1190	<2.50U	<2.50U	<25.0U	<2.00U	1.30D	55600	6.38JD	3.49D	8.97D	2100	3.70D	16700	1180	<2.50U	3010	<2.50U	<2.50U	32000	570	<2.50U	<10.0U	451
HRW(A72)-35%	914	<2.50U	<2.50U	<25.0U	<2.00U	0.770JD	46100	7.08JD	2.33D	6.05D	1560	2.69BD	19700	864	<2.50U	3550	<2.50U	<2.50U	39900	502	<2.50U	<10.0U	345
HRW(A72)-25%	684	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	39300	6.94JD	1.56D	4.93JD	1170	2.24JBD	21800	582	<2.50U	3950	<2.50U	<2.50U	45300	361	<2.50U	<10.0U	225
HRW(A72)-12%	320	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	31300	5.62JD	0.550JD	<2.50U	547	1.01JBD	24600	273	<2.50U	4450	<2.50U	<2.50U	52100	255	<2.50U	<10.0U	110
Combined sample CC48/M34 serially diluted by Animas River surface water sample A68																							
A68(CC48/M34) Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	24100	7.44JD	<0.500U	<2.50U	<100U	<0.500U	27300	<2.00U	<2.50U	4910	<2.50U	<2.50U	58400	159	<2.50U	<10.0U	<10.0U
A68(CC48/M34)-100%	4330	<2.50U	<2.50U	<25.0U	<2.00U	2.46D	99800	<5.00U	12.5D	24.1D	7160	12.1BD	6870	1700	5.72D	1130	<2.50U	<2.50U	5020	1110	<2.50U	<10.0U	921
A68(CC48/M34)-95%	4210	<2.50U	<2.50U	<25.0U	<2.00U	2.50D	98100	5.23JD	10.6D	23.3D	6910	12.0BD	6770	1840	4.79JD	1120	<2.50U	<2.50U	4960	1120	<2.50U	<10.0U	940
A68(CC48/M34)-90%	3860	<2.50U	<2.50U	<25.0U	<2.00U	2.67D	96900	<5.00U	9.88D	21.7D	6430	11.2BD	6630	1900	4.57JD	1100	<2.50U	<2.50U	4840	1080	<2.50U	<10.0U	923
A68(CC48/M34)-80%	3570	<2.50U	<2.50U	<25.0U	<2.00U	2.37D	92200	5.63JD	9.44D	23.1D	5810	10.7BD	6270	2110	4.84JD	1050	<2.50U	<2.50U	4570	1040	<2.50U	<10.0U	931
A68(CC48/M34)-75%	3510	<2.50U	<2.50U	<25.0U	<2.00U	2.53D	92500	5.24JD	9.23D	22.8D	5650	11.1BD	6210	2340	4.11JD	1060	<2.50U	<2.50U	4410	1030	<2.50U	<10.0U	966
A68(CC48/M34)-50%	2300	<2.50U	<2.50U	<25.0U	<2.00U	2.57D	81400	5.23JD	6.17D	16.4D	3740	7.65BD	5320	2740	4.08JD	922J	<2.50U	<2.50U	3820	902	<2.50U	<10.0U	914
A68(CC48/M34)-25%	1350	<2.50U	<2.50U	<25.0U	<2.00U	2.83D	74000	7.10JD	4.03D	15.6D	1960	5.81BD	4710	3340	2.70JD	851J	<2.50U	<2.50U	3360	801	<2.50U	<10.0U	956
Combined sample CC48/M34 serially diluted by hard reconstituted water (HRW)																							
HRW(CC48/M34)-95%	4190	<2.50U	<2.50U	<25.0U	<2.00U	2.17D	96600	<5.00U	9.90D	20.3D	6870	11.6D	7990	1610	4.78JD	1320	<2.50U	<2.50U	7880	1070	<2.50U	<10.0U	870
HRW(CC48/M34)-90%	4050	<2.50U	<2.50U	<25.0U	<2.00U	2.07D	95400	<5.00U	9.79D	21.0D	6680	11.7D	9080	1560	4.63JD	1520	<2.50U	<2.50U	10500	1060	<2.50U	<10.0U	849
HRW(CC48/M34)-75%	3260	<2.50U	<2.50U	<25.0U	<2.00U	1.59D	80800	5.55JD	7.89D	17.1D	5190	9.18D	12000	1280	3.32JD	2090	<2.50U	<2.50U	18700	879	<2.50U	<10.0U	688
HRW(CC48/M34)-50%	2190	<2.50U	<2.50U	<25.0U	<2.00U	1.08D	62300	7.42JD	5.54D	11.6D	3560	6.16D	17200	849	2.75JD	3050	<2.50U	<2.50U	32400	644	<2.50U	<10.0U	441
HRW(CC48/M34)-25%	1190	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	42900	6.12JD	2.75D	5.83D	1850	3.41D	22500	421	<2.50U	4040	<2.50U	<2.50U	46400	399	<2.50U	<10.0U	224
Reference toxicity test																							
Ref. Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11600	8.46JD	<0.500U	<2.50U	<100U	<0.500U	13100	<2.00U	<2.50U	1990	<2.50U	<2.50U	24100	71.6	<2.50U	<10.0U	<10.0U
Ref. 100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11700	5.64JD	<0.500U	<2.50U	<100U	<0.500U	13300	<2.00U	<2.50U	2010	<2.50U	<2.50U	24300	72.8	<2.50U	<10.0U	974
Ref. 50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11900	7.20JD	<0.500U	<2.50U	<100U	<0.500U	13600	<2.00U	<2.50U	2070	<2.50U	<2.50U	24900	72.2	<2.50U	<10.0U	480
Ref. 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11700	5.92JD	<0.500U	<2.50U	<100U	<0.500U	13200	<2.00U	<2.50U	2000	<2.50U	<2.50U	24100	72.7	<2.50U	<10.0U	219
Ref. 12.5%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12000	<5.00U	<0.500U	<2.50U	<100U	<0.500U	13500	<2.00U	<2.50U	2050	<2.50U	<2.50U	24700	74.9	<2.50U	<10.0U	115
Ref. 6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11600	9.88JD	<0.500U	<2.50U	<100U	<0.500U	13100	<2.00U	<2.50U	2000	<2.50U	<2.50U	24100	72.6	<2.50U	<10.0U	80.3

Table 2.5-2 (cont'd) April 2013 Upper Animas River Surface Water Toxicity Testing

Total Recoverable Metals Final Analytical Results (ug/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River and Mineral Creek surface water samples																							
A68	150	<2.50U	<2.50U	<25.0U	<2.00U	2.85D	70800	<5.00U	1.49D	7.41D	<100U	1.47D	4200	4090	<2.50U	1070	<2.50U	<2.50U	2840	696	<2.50U	<10.0U	982
M34	2250	<2.50U	<2.50U	26.8JD	<2.00U	1.45D	81400	<5.00U	6.16D	7.36D	4010	8.70D	6180	457	5.89D	1380	<2.50U	<2.50U	6220	824	<2.50U	<10.0U	349
A72	710	<2.50U	<2.50U	<25.0U	<2.00U	2.94D	95200	5.69JD	7.28D	11.8D	2040	1.12D	6270	2450	4.15JD	2090	<2.50U	<2.50U	5010	985	<2.50U	<10.0U	985
A73	1030	<2.50U	<2.50U	<25.0U	<2.00U	2.42D	87200	6.11JD	6.23D	8.44D	1720	3.30D	6070	2070	3.75JD	1370	<2.50U	<2.50U	4280	888	<2.50U	<10.0U	875
A73B	1050	<2.50U	<2.50U	25.1JD	<2.00U	2.13D	81400	<5.00U	5.53D	8.44D	1750	3.61D	5780	1950	3.16JD	1330	<2.50U	<2.50U	4030	831	<2.50U	<10.0U	836
A75B	1230	<2.50U	<2.50U	25.1JD	<2.00U	1.50D	65300	5.01JD	3.69D	8.17D	1450	4.31D	5120	1310	2.89JD	1370	<2.50U	<2.50U	3490	642	<2.50U	<10.0U	591
Animas River surface water sample A72 serially diluted by hard reconstituted water (HRW)																							
HRW Control	20.3J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	23400	5.08JD	<0.500U	<2.50U	<100U	<0.500U	29600	<2.00U	<2.50U	5620	<2.50U	<2.50U	62900	173	<2.50U	<10.0U	<10.0U
HRW(A72)-88%	1550	<2.50U	<2.50U	<25.0U	<2.00U	2.20D	87200	<5.00U	5.82D	9.89D	2770	4.61D	9070	2210	3.75JD	1880	<2.50U	<2.50U	11600	915	<2.50U	<10.0U	817
HRW(A72)-75%	1300	<2.50U	<2.50U	<25.0U	<2.00U	2.08D	77200	<5.00U	5.61D	9.48D	2310	4.01D	12000	1870	4.05JD	2400	<2.50U	<2.50U	19000	812	<2.50U	<10.0U	626
HRW(A72)-50%	871	<2.50U	<2.50U	<25.0U	<2.00U	1.21D	58200	<5.00U	3.49D	6.44D	1580	2.74D	17700	1220	<2.50U	3400	<2.50U	<2.50U	33100	583	<2.50U	<10.0U	377
HRW(A72)-35%	752	<2.50U	<2.50U	<25.0U	<2.00U	0.908JD	47400	<5.00U	2.52D	6.23D	1300	2.37D	21000	848	<2.50U	3990	<2.50U	<2.50U	41400	456	<2.50U	<10.0U	274
HRW(A72)-25%	366	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	39900	7.19JD	1.58D	<2.50U	504	0.928JD	23100	593	<2.50U	4410	<2.50U	<2.50U	47100	370	<2.50U	<10.0U	141
HRW(A72)-12%	206	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	31300	7.74JD	0.638JD	<2.50U	146J	<0.500U	26500	289	<2.50U	5000	<2.50U	<2.50U	55300	267	<2.50U	<10.0U	60.7
Combined sample CC48/M34 serially diluted by Animas River surface water sample A68																							
A68(CC48/M34)-Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	23000	5.59JD	<0.500U	<2.50U	<100U	<0.500U	28700	<2.00U	<2.50U	5340	<2.50U	<2.50U	60300	167	<2.50U	<10.0U	<10.0U
A68(CC48/M34)-100%	4010	<2.50U	<2.50U	<25.0U	<2.00U	2.55D	110000	<5.00U	13.0D	22.7D	1770	6.77D	7480	1820	6.19D	2260	<2.50U	<2.50U	7820	1160	<2.50U	<10.0U	1020
A68(CC48/M34)-95%	3750	<2.50U	<2.50U	<25.0U	<2.00U	2.52D	110000	5.18JD	11.8D	21.4D	1700	6.66D	7480	1970	6.04D	2190	<2.50U	<2.50U	7770	1150	<2.50U	<10.0U	1040
A68(CC48/M34)-90%	3190	<2.50U	<2.50U	<25.0U	<2.00U	2.67D	108000	5.05JD	11.0D	17.9D	1710	5.77D	7240	2040	5.53D	2320	<2.50U	<2.50U	7680	1100	<2.50U	<10.0U	1010
A68(CC48/M34)-80%	2140	<2.50U	<2.50U	<25.0U	<2.00U	2.39D	99400	5.06JD	9.64D	17.2D	1660	4.26D	6650	2200	4.46JD	1930	<2.50U	<2.50U	7000	1040	<2.50U	<10.0U	1010
A68(CC48/M34)-75%	1710	<2.50U	<2.50U	<25.0U	<2.00U	2.55D	99400	5.03JD	9.16D	16.3D	1860	3.96D	6640	2350	4.90JD	2090	<2.50U	<2.50U	7030	1030	<2.50U	<10.0U	1010
A68(CC48/M34)-50%	1080	<2.50U	<2.50U	<25.0U	<2.00U	2.47D	87800	5.89JD	6.34D	10.1D	1840	3.69D	5710	2900	3.00JD	1360	<2.50U	<2.50U	4210	913	<2.50U	<10.0U	960
A68(CC48/M34)-25%	384	<2.50U	<2.50U	<25.0U	<2.00U	2.70D	78700	5.89JD	4.07D	6.39D	498	1.73D	4980	3480	2.71JD	1200	<2.50U	<2.50U	3560	803	<2.50U	<10.0U	815
Combined sample CC48/M34 serially diluted by hard reconstituted water (HRW)																							
HRW(CC48/M34)-95%	2680	<2.50U	<2.50U	<25.0U	<2.00U	2.25D	106000	<5.00U	11.0D	17.7D	2680	5.33D	8570	1760	5.15D	2550	<2.50U	<2.50U	10800	1150	<2.50U	<10.0U	988
HRW(CC48/M34)-90%	1490	<2.50U	<2.50U	<25.0U	<2.00U	1.98D	102000	<5.00U	9.37D	14.2D	2780	3.92D	9610	1630	5.02D	2850	<2.50U	<2.50U	13400	1080	<2.50U	<10.0U	908
HRW(CC48/M34)-75%	2260	<2.50U	<2.50U	<25.0U	<2.00U	1.70D	87200	<5.00U	7.97D	12.0D	3980	6.52D	12900	1360	4.70JD	2470	<2.50U	<2.50U	19700	931	<2.50U	<10.0U	670
HRW(CC48/M34)-50%	2220	<2.50U	<2.50U	<25.0U	<2.00U	1.04D	66200	<5.00U	5.12D	10.1D	3830	6.37D	18700	900	2.91JD	3530	<2.50U	<2.50U	34400	669	<2.50U	<10.0U	456
HRW(CC48/M34)-25%	865	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	43600	<5.00U	2.61D	5.66D	1480	2.46D	24100	440	<2.50U	4590	<2.50U	<2.50U	48900	423	<2.50U	<10.0U	195
Reference toxicity test																							
Ref. 100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11200	5.46JD	<0.500U	<2.50U	<100U	<0.500U	12500	<2.00U	<2.50U	1930	<2.50U	<2.50U	22400	67.3	<2.50U	<10.0U	1120
Ref. 50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11200	5.82JD	<0.500U	<2.50U	<100U	<0.500U	12600	<2.00U	<2.50U	1920	<2.50U	<2.50U	22700	68.1	<2.50U	<10.0U	623
Ref. 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	11100	<5.00U	<0.500U	<2.50U	<100U	<0.500U	12500	<2.00U	<2.50U	1930	<2.50U	<2.50U	22500	68.0	<2.50U	<10.0U	299
Ref. 12.5%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	10900	<5.00U	<0.500U	<2.50U	<100U	<0.500U	12600	<2.00U	<2.50U	2210	<2.50U	<2.50U	22700	67.6	<2.50U	<10.0U	182
Ref. 6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	10800	6.66JD	<0.500U	<2.50U	<100U	<0.500U	12600	<2.00U	<2.50U	2180	<2.50U	<2.50U	22700	67.0	<2.50U	<10.0U	89.8
Ref. Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	10900	7.11JD	<0.500U	<2.50U	<100U	<0.500U	12700	<2.00U	<2.50U	2240	<2.50U	<2.50U	22900	69.0	<2.50U	<10.0U	<10.0U

Table 2.5-3 April 2013 Upper Animas River Surface Water Toxicity Testing Dissolved Metals Initial Analytical Results (ug/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness (mg/L)	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River and Mineral Creek surface water samples																								
A68	38.5J	<0.500U	<0.500U	23.7	<2.00U	3.11	70600	1.68J	1.44	3.70	194	<100U	0.134J	4260	3960	1.49	765J	<0.500U	<0.500U	2910	695	<0.500U	<2.00U	994
M34	887	<0.500U	<0.500U	25.7	<2.00U	1.20	80700	<1.00U	6.10	7.35	227	3170	5.16	6210	444	2.04	829J	<0.500U	<0.500U	5830	809	<0.500U	<2.00U	335
A72	694	<0.500U	<0.500U	22.4	<2.00U	2.74	91900	<1.00U	7.39	13.4	255	2720	1.27	6160	2380	3.63	1010	0.705J	<0.500U	4440	974	<0.500U	<2.00U	979
A73	187	<0.500U	<0.500U	23.6	<2.00U	2.32	85000	<1.00U	5.82	6.06	237	1310	<0.100U	5980	2000	3.54	998J	<0.500U	<0.500U	4300	876	<0.500U	<2.00U	892
A73B	145	<0.500U	<0.500U	24.6	<2.00U	2.25	80800	<1.00U	5.73	5.60	226	1150	0.704	5860	1870	3.86	999J	0.609J	<0.500U	4180	827	<0.500U	<2.00U	825
A75B	24.3J	<0.500U	<0.500U	25.3	<2.00U	1.58	65100	<1.00U	3.64	1.16	184	<100U	1.02	5190	1270	2.84	998J	0.654J	<0.500U	3540	641	<0.500U	<2.00U	566
Animas River surface water sample A72 serially diluted by hard reconstituted water (HRW)																								
HRW Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	24200	6.30	<0.100U	<0.500U	176	<100U	<0.100U	28100	<2.00U	<0.500U	4860	<0.500U	<0.500U	59900	154	<0.500U	<2.00U	<10.0U
HRW(A72)-88%	67.1	<0.500U	<0.500U	19.2	<2.00U	2.38	85700	<1.00U	5.61	6.36	251	2010	0.212	8900	2120	3.02	1520	<0.500U	<0.500U	11200	878	<0.500U	<2.00U	859
HRW (A72)-75%	69.1	<0.500U	<0.500U	16.1	<2.00U	1.92	77800	1.24J	5.06	4.31	244	1800	0.106J	12100	1820	3.12	2080	<0.500U	<0.500U	19000	781	<0.500U	<2.00U	725
HRW(A72)-50%	68.2	<0.500U	<0.500U	10.7	<2.00U	1.13	59700	2.50	3.38	0.933J	223	653	<0.100U	17800	1210	1.70	3110	<0.500U	<0.500U	33000	569	<0.500U	<2.00U	399
HRW(A72)-35%	84.2	<0.500U	<0.500U	7.65J	<2.00U	0.667	49700	4.27	2.29	<0.500U	211	141J	<0.100U	21100	846	1.29	3690	<0.500U	<0.500U	41200	446	<0.500U	<2.00U	216
HRW(A72)-25%	123	<0.500U	0.596J	5.81J	<2.00U	0.359	41900	4.82	1.67	1.06	200	<100U	<0.100U	23200	590	1.39	4060	<0.500U	<0.500U	47100	361	<0.500U	<2.00U	111
HRW(A72)-12%	80.6	<0.500U	<0.500U	<5.00U	<2.00U	0.178J	32800	6.33	0.733	1.70	190	218J	<0.100U	26300	270	0.832J	4590	<0.500U	<0.500U	54900	249	<0.500U	<2.00U	93.6
Combined sample CC48/M34 serially diluted by Animas River surface water sample A68																								
A68(CC48/M34) Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	25300	6.77	<0.100U	<0.500U	183	<100U	0.230	29000	<2.00U	<0.500U	5000	<0.500U	<0.500U	60600	159	<0.500U	<2.00U	<10.0U
A68(CC48/M34)-100%	2910	<0.500U	<0.500U	21.2	<2.00U	2.51	106000	<1.00U	10.1	20.1	294	3900	8.64	7280	1760	4.46	1130	0.813J	<0.500U	5210	1140	<0.500U	<2.00U	1020
A68(CC48/M34)-95%	2800	<0.500U	<0.500U	21.6	<2.00U	2.48	105000	<1.00U	11.2	21.2	293	3780	8.26	7250	1880	4.76	1120	<0.500U	<0.500U	5180	1120	<0.500U	<2.00U	1010
A68(CC48/M34)-90%	2680	<0.500U	<0.500U	21.2	<2.00U	2.57	104000	<1.00U	9.85	19.7	291	3460	7.67	7200	1960	4.27	1130	<0.500U	<0.500U	5160	1090	<0.500U	<2.00U	994
A68(CC48/M34)-80%	2290	<0.500U	<0.500U	21.8	<2.00U	2.68	99000	<1.00U	9.22	18.7	275	2480	5.93	6740	2150	3.80	1060	<0.500U	<0.500U	4840	1030	<0.500U	<2.00U	977
A68(CC48/M34)-75%	2110	<0.500U	<0.500U	21.8	<2.00U	2.82	98600	<1.00U	8.15	16.5	274	2230	5.08	6680	2400	3.67	1070	<0.500U	<0.500U	4690	1050	<0.500U	<2.00U	1030
A68(CC48/M34)-50%	553	<0.500U	<0.500U	22.6	<2.00U	2.76	88300	<1.00U	6.30	9.84	244	1610	1.67	5800	2860	3.26	939J	<0.500U	<0.500U	4100	919	<0.500U	<2.00U	1010
A68(CC48/M34)-25%	102	<0.500U	<0.500U	23.0	<2.00U	2.93	77500	<1.00U	3.70	3.97	214	787	0.365	4940	3390	2.39	851J	<0.500U	<0.500U	3470	806	<0.500U	<2.00U	972
Combined sample CC48/M34 serially diluted by hard reconstituted water (HRW)																								
HRW(CC48/M34)-95%	2770	<0.500U	<0.500U	20.2	<2.00U	2.30	103000	<1.00U	10.2	19.4	293	3320	6.67	8510	1670	4.61	1390	<0.500U	<0.500U	8210	1100	<0.500U	<2.00U	944
HRW(CC48/M34)-90%	1980	<0.500U	<0.500U	18.7	<2.00U	2.09	97700	<1.00U	9.36	18.0	283	3110	4.91	9400	1580	4.41	1540	<0.500U	<0.500U	10800	1050	<0.500U	<2.00U	902
HRW(CC48/M34)-75%	248	<0.500U	<0.500U	15.7	<2.00U	1.73	86100	1.22J	8.30	7.68	267	2380	0.465	12700	1300	4.79	2160	<0.500U	<0.500U	19300	887	<0.500U	<2.00U	710
HRW(CC48/M34)-50%	39.2J	<0.500U	<0.500U	10.9	<2.00U	1.16	66600	2.68	5.29	1.81	242	1520	0.113J	18300	864	3.00	3170	<0.500U	<0.500U	33700	647	<0.500U	<2.00U	427
HRW(CC48/M34)-25%	126	<0.500U	<0.500U	5.61J	<2.00U	0.351	44900	3.74	2.32	0.987J	210	305	0.120J	23800	433	1.39	4090	<0.500U	<0.500U	47900	402	<0.500U	<2.00U	154
Reference toxicity test																								
Ref. 100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12700	2.67	<0.100U	<0.500U	90	<100U	<0.100U	14200	<2.00U	<0.500U	2110	<0.500U	<0.500U	25100	73.1	<0.500U	<2.00U	1050
Ref. 50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12600	3.19	<0.100U	<0.500U	89	<100U	<0.100U	14100	<2.00U	<0.500U	2090	<0.500U	<0.500U	25100	73.6	<0.500U	<2.00U	478
Ref. 25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12600	2.47	<0.100U	<0.500U	90	<100U	<0.100U	14100	<2.00U	<0.500U	2100	<0.500U	<0.500U	25100	73.0	<0.500U	<2.00U	314
Ref. 12.5%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12400	2.85	<0.100U	<0.500U	88	<100U	<0.100U	13800	<2.00U	<0.500U	2050	<0.500U	<0.500U	24400	74.2	<0.500U	<2.00U	128
Ref. 6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12700	2.88	<0.100U	<0.500U	90	<100U	<0.100U	14200	<2.00U	<0.500U	2120	<0.500U	<0.500U	25300	73.2	<0.500U	<2.00U	85.6
Ref. Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12500	3.02	<0.100U	<0.500U	89	<100U	0.360	14000	<2.00U	<0.500U	2090	<0.500U	<0.500U	25000	73.6	<0.500U	<2.00U	<10.0U

Table 2.5-3 (cont'd) April 2013 Upper Animas River Surface Water Toxicity Testing Dissolved Metals Final Analytical Results (ug/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness (mg/l)	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Profile test of the Animas River and Mineral Creek surface water samples																								
A68	41.3J	<0.500U	<0.500U	22.8	<2.00U	2.79	69400	1.52J	1.25	3.48	191	<100U	<0.100U	4180	3920	1.34	1050	0.538J	<0.500U	2840	689	<0.500U	<2.00U	905
M34	761	<0.500U	<0.500U	25.2	<2.00U	1.19	79500	<1.00U	7.13	7.09	224	2530	3.75	6140	438	2.72	1400	<0.500U	<0.500U	6210	791	<0.500U	<2.00U	337
A72	562	<0.500U	<0.500U	22.7	<2.00U	2.60	95900	<1.00U	7.24	13.2	265	1850	0.907	6280	2460	3.16	1950	0.875J	<0.500U	4940	1010	<0.500U	<2.00U	1010
A73	35.1J	<0.500U	<0.500U	23.8	<2.00U	2.17	85600	<1.00U	5.93	3.26	238	<100U	<0.100U	5940	2000	3.27	1360	0.581J	<0.500U	4190	855	<0.500U	<2.00U	857
A73B	26.2J	<0.500U	<0.500U	24.5	<2.00U	1.95	80900	<1.00U	5.43	2.71	226	<100U	<0.100U	5740	1880	3.54	1290	0.792J	<0.500U	3990	816	<0.500U	<2.00U	796
A75B	20.0J	<0.500U	<0.500U	25.1	<2.00U	1.40	67000	<1.00U	3.60	2.37	189	<100U	<0.100U	5300	1290	3.15	1380	0.932J	<0.500U	3620	647	<0.500U	<2.00U	525
Animas River surface water sample A72 serially diluted by hard reconstituted water (HRW)																								
HRW Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	23500	6.03	<0.100U	0.712J	181	<100U	<0.100U	29700	<2.00U	<0.500U	5630	<0.500U	<0.500U	62300	169	<0.500U	<2.00U	<10.0U
HRW(A72)-88%	24.2J	<0.500U	<0.500U	18.4	<2.00U	1.97	82300	<1.00U	5.78	1.29	241	<100U	<0.100U	8680	2040	3.19	1830	0.557J	<0.500U	11100	865	<0.500U	<2.00U	679
HRW(A72)-75%	31.6J	<0.500U	<0.500U	15.7	<2.00U	1.49	75300	<1.00U	5.13	1.11	237	<100U	<0.100U	11900	1780	2.19	2380	<0.500U	<0.500U	18800	768	<0.500U	<2.00U	453
HRW(A72)-50%	48.1J	<0.500U	<0.500U	10.6	<2.00U	0.854	57900	2.10	3.35	1.44	218	<100U	<0.100U	17800	1060	2.03	3500	<0.500U	<0.500U	33300	522	<0.500U	<2.00U	200
HRW(A72)-35%	79.1	<0.500U	<0.500U	7.55J	<2.00U	0.465	46400	2.94	2.16	1.26	201	<100U	0.113J	20800	808	0.930J	3980	<0.500U	<0.500U	41600	446	<0.500U	<2.00U	108
HRW(A72)-25%	91.3	<0.500U	<0.500U	5.31J	<2.00U	0.259	37000	4.99	1.44	1.35	182	<100U	<0.100U	21700	538	1.44	4140	0.717J	<0.500U	44900	340	<0.500U	<2.00U	68.9
HRW(A72)-12%	136	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	30400	5.66	0.611	1.59	182	<100U	<0.100U	25800	271	1.01	4820	0.727J	<0.500U	53500	256	<0.500U	<2.00U	37.2
Combined sample CC48/M34 serially diluted by Animas River surface water sample A68																								
A68(CC48/M34)-Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	23400	6.52	<0.100U	<0.500U	179	<100U	<0.100U	29300	<2.00U	<0.500U	5430	0.736J	<0.500U	61400	169	<0.500U	<2.00U	<10.0U
A68(CC48/M34)-100%	4040	<0.500U	<0.500U	21.2	<2.00U	2.42	109000	<1.00U	10.5	19.8	304	1650	6.43	7480	1760	4.79	2260	0.765J	<0.500U	7780	1130	<0.500U	<2.00U	998
A68(CC48/M34)-95%	3540	<0.500U	<0.500U	21.1	<2.00U	2.41	104000	<1.00U	9.79	19.4	289	1520	5.75	7050	1830	5.14	2020	0.773J	<0.500U	7320	1100	<0.500U	<2.00U	948
A68(CC48/M34)-90%	3040	<0.500U	<0.500U	22.3	<2.00U	2.46	102000	<1.00U	9.47	17.3	285	1510	5.18	6960	1930	4.16	2240	0.781J	<0.500U	7460	1070	<0.500U	<2.00U	965
A68(CC48/M34)-80%	1970	<0.500U	<0.500U	21.7	<2.00U	2.48	97700	<1.00U	8.48	16.2	271	1170	3.52	6590	2110	4.19	1920	1.02J	<0.500U	6980	1010	<0.500U	<2.00U	959
A68(CC48/M34)-75%	1470	<0.500U	<0.500U	22.5	<2.00U	2.53	100000	<1.00U	7.79	13.9	278	1340	2.99	6760	2290	3.94	2100	1.13J	<0.500U	7150	1030	<0.500U	<2.00U	982
A68(CC48/M34)-50%	32.9J	<0.500U	<0.500U	21.9	<2.00U	2.48	87700	<1.00U	5.56	1.92	242	220J	<0.100U	5690	2820	2.70	1320	<0.500U	<0.500U	4170	894	<0.500U	<2.00U	915
A68(CC48/M34)-25%	37.2J	<0.500U	<0.500U	22.9	<2.00U	2.59	80000	<1.00U	3.64	1.95	221	<100U	<0.100U	5070	3640	2.52	1220	1.08J	<0.500U	3610	853	<0.500U	<2.00U	798
Combined sample CC48/M34 serially diluted by hard reconstituted water (HRW)																								
HRW(CC48/M34)-95%	2560	<0.500U	<0.500U	20.2	<2.00U	2.32	103000	<1.00U	10.1	16.0	292	2140	4.52	8480	1650	3.95	2580	<0.500U	<0.500U	10800	1090	<0.500U	<2.00U	909
HRW(CC48/M34)-90%	1110	<0.500U	<0.500U	18.8	<2.00U	2.10	96600	<1.00U	9.89	13.1	280	1970	2.71	9360	1540	4.48	2890	<0.500U	<0.500U	13200	1030	<0.500U	<2.00U	854
HRW(CC48/M34)-75%	30.1J	<0.500U	<0.500U	15.5	<2.00U	1.51	84800	<1.00U	8.03	1.50	265	<100U	<0.100U	12800	1290	3.45	2500	<0.500U	<0.500U	19700	895	<0.500U	<2.00U	523
HRW(CC48/M34)-50%	63.2	<0.500U	<0.500U	10.4	<2.00U	0.655	64200	1.51J	4.89	1.42	235	<100U	<0.100U	18200	842	2.14	3470	<0.500U	<0.500U	33600	643	<0.500U	<2.00U	120
HRW(CC48/M34)-25%	123	<0.500U	<0.500U	5.33J	<2.00U	0.196J	42700	3.24	2.26	1.43	204	<100U	<0.100U	23600	402	1.20	4510	<0.500U	<0.500U	48300	398	<0.500U	<2.00U	43.6
Reference toxicity test																								
Ref. 100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	10800	1.80J	<0.100U	0.668J	77	<100U	<0.100U	12100	<2.00U	<0.500U	1880	0.537J	<0.500U	21700	64.3	<0.500U	<2.00U	1100
Ref. 50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	10700	2.07	<0.100U	0.562J	76	<100U	<0.100U	12000	<2.00U	<0.500U	1860	<0.500U	<0.500U	21600	63.4	<0.500U	<2.00U	571
Ref. 25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	11100	1.93J	<0.100U	<0.500U	79	<100U	<0.100U	12500	<2.00U	<0.500U	1930	<0.500U	<0.500U	22300	64.9	<0.500U	<2.00U	295
Ref. 12.5%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	10800	2.32	<0.100U	0.527J	78	<100U	<0.100U	12400	<2.00U	<0.500U	2180	<0.500U	<0.500U	22300	65.4	<0.500U	<2.00U	182
Ref. 6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	10900	2.48	<0.100U	0.502J	79	<100U	<0.100U	12500	<2.00U	<0.500U	2190	<0.500U	<0.500U	22400	65.5	<0.500U	<2.00U	89.8
Ref. Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	11000	2.99	<0.100U	0.566J	79	<100U	<0.100U	12600	<2.00U	<0.500U	2240	<0.500U	<0.500U	22500	65.5	<0.500U	<2.00U	<10.0U

Table 2.5-4 April 2013 Upper Animas River Surface Water Toxicity Testing Initial Wet Chemistry Results (mg/L)

STATION_ID	Chloride	Dissolved Organic Carbon	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Total Alkalinity (mg CaCO3 / L)
Profile test of the Animas River and Mineral Creek surface water samples						
A68	2.8	1.1	0.8	0.2J	178	34.1
M34	11.4JD	1.3	<1.0U	<2.0U	237D	<5.00U
A72	<10.0U	1.2	<1.0U	<2.0U	264D	<5.00U
A73	<10.0U	1.2	<1.0U	<2.0U	237D	<5.00U
A73B	3.6	1.1	0.5	<0.2U	244	<5.00U
A75B	3.0	1.2	0.5	0.2J	193	11.6
Animas River surface water sample A72 serially diluted by hard reconstituted water (HRW)						
HRW Control	4.8	1.0	<0.1U	<0.2U	206	123
HRW(A72)-88%	10.2JD	1.2	<1.0U	<2.0U	253D	9.14
HRW(A72)-75%	10.7JD	1.1	<1.0U	249D	249D	26.6
HRW(A72)-50%	4.1	1.1	0.5	<0.2U	247	55.4
HRW(A72)-35%	4.3	1.2	0.4	<0.2U	235	76.1
HRW(A72)-25%	4.5	1.0	0.2	<0.2U	227	87.5
HRW(A72)-12%	4.6	1.0	0.2	<0.2U	217	106
Combined sample CC48/M34 serially diluted by Animas River surface water sample A68						
A68(CC48/M34) Control	4.7	1.1	<0.1U	<0.2U	204	120
A68(CC48/M34)-100%	<10.0U	1.3	<1.0U	<2.0U	319D	<5.00U
A68(CC48/M34)-95%	<10.0U	1.2	1.0JD	<2.0U	314D	<5.00U
A68(CC48/M34)-90%	<10.0U	1.2	<1.0U	<2.0U	303D	<5.00U
A68(CC48/M34)-80%	<10.0U	1.2	1.0JD	<2.0U	287D	<5.00U
A68(CC48/M34)-75%	<10.0U	1.2	<1.0U	<2.0U	284D	<5.00U
A68(CC48/M34)-50%	13.6JD	1.1	1.1JD	9.0D	249D	5.36
A68(CC48/M34)-25%	3.0	1.1	0.7	0.3J	221	16.6
Combined sample CC48/M34 serially diluted by hard reconstituted water (HRW)						
HRW(CC48/M34)-95%	10.2JD	1.3	1.0JD	<2.0U	319D	<5.00U
HRW(CC48/M34)-90%	10.2JD	1.3	1.0JD	<2.0U	310D	<5.00U
HRW(CC48/M34)-75%	10.4JD	1.2	<1.0U	<2.0U	293D	12.6
HRW(CC48/M34)-50%	11.0JD	1.1	<1.0U	<2.0U	260D	47.9
HRW(CC48/M34)-25%	11.0JD	1.1	<1.0U	<2.0U	224D	83.5
Reference toxicity test						
Ref. Control	2.4	<1.0U	<0.1U	<0.2U	93.8	56.2
Ref. 100%	2.3	<1.0U	<0.1U	<0.2U	94.6	56.8
Ref. 50%	2.3	<1.0U	<0.1U	<0.2U	94.0	56.9
Ref. 25%	2.3	1.0	<0.1U	<0.2U	93.4	60.4
Ref. 12.5%	2.3	<1.0U	<0.1U	<0.2U	93.4	53.7
Ref. 6.25%	2.4	<1.0U	<0.1U	<0.2U	93.6	55.4

Table 2.5-4 (cont'd) April 2013 Upper Animas River Surface Water Toxicity Testing Final Wet Chemistry Results (mg/L)

STATION_ID	Chloride	Dissolved Organic Carbon	Fluoride	Nitrate as N	Nitrate/Nitrite as N	Nitrite as N	Sulfate as SO4	Total Alkalinity (mg CaCO3 / L)
Profile test of the Animas River and Mineral Creek surface water samples								
A68	2.7	1.5	0.7	0.2J	0.2J	<0.2U	172	38.0
M34	12.5JD	2.5	<1.0U	<2.0U	<2.0U	<2.0U	237D	<5.00U
A72	11.1JD	3.6	<1.0U	<2.0U	<2.0U	<2.0U	265D	<5.00U
A73	10.1JD	1.6	<1.0U	<2.0U	<2.0U	<2.0U	242D	9.98
A73B	3.6	1.6	0.5	0.3J	0.3J	<0.2U	244	8.16
A75B	3.1	1.5	0.5	0.2J	0.2J	<0.2U	195	17.9
Animas River surface water sample A72 serially diluted by hard reconstituted water (HRW)								
HRW Control	4.9	1.2	<0.1U	<0.2U	<0.2U	<0.2U	210	125
HRW(A72)-88%	10.4JD	1.2	<1.0U	<2.0U	<2.0U	<2.0U	262D	12.0
HRW(A72)-75%	10.4JD	1.3	<1.0U	<2.0U	<2.0U	<2.0U	250D	28.8
HRW(A72)-50%	4.3	1.5	0.4	<0.2U	0.2J	<0.2U	248	57.0
HRW(A72)-35%	4.4	1.3	0.3	<0.2U	<0.2U	<0.2U	236	77.9
HRW(A72)-25%	4.6	1.2	0.2	<0.2U	<0.2U	<0.2U	229	90.4
HRW(A72)-12%	4.7	1.4	0.1J	<0.2U	<0.2U	<0.2U	218	104
Combined sample CC48/M34 serially diluted by Animas River surface water sample A68								
A68(CC48/M34)-Control	4.8	1.3	<0.1U	<0.2U	<0.2U	<0.2U	202	122
A68(CC48/M34)-100%	12.5JD	2.4	<1.0U	<2.0U	<2.0U	<2.0U	315D	<5.00U
A68(CC48/M34)-95%	12.8JD	2.3	<1.0U	<2.0U	<2.0U	<2.0U	309D	<5.00U
A68(CC48/M34)-90%	13.4JD	2.6	1.0JD	<2.0U	<2.0U	<2.0U	305D	<5.00U
A68(CC48/M34)-80%	12.9JD	2.1	<1.0U	<2.0U	<2.0U	<2.0U	286D	<5.00U
A68(CC48/M34)-75%	12.9JD	2.3	<1.0U	<2.0U	<2.0U	<2.0U	279D	<5.00U
A68(CC48/M34)-50%	10.9JD	1.6	<1.0U	<2.0U	<2.0U	<2.0U	242D	7.01
A68(CC48/M34)-25%	3.1	1.4	0.8	0.2J	0.2J	<0.2U	220	22.8
Combined sample CC48/M34 serially diluted by hard reconstituted water (HRW)								
HRW(CC48/M34)-95%	13.1JD	2.7	<1.0U	<2.0U	<2.0U	<2.0U	318D	<5.00U
HRW(CC48/M34)-90%	13.6JD	3.1	<1.0U	<2.0U	<2.0U	<2.0U	312D	<5.00U
HRW(CC48/M34)-75%	10.3JD	1.4	<1.0U	<2.0U	<2.0U	<2.0U	298D	13.5
HRW(CC48/M34)-50%	10.6JD	1.2	<1.0U	<2.0U	<2.0U	<2.0U	266D	50.1
HRW(CC48/M34)-25%	11.0JD	1.3	<1.0U	<2.0U	<2.0U	<2.0U	226D	85.0
Reference toxicity test								
Ref. 100%	2.2	1.1	<0.1U	<0.2U	<0.2U	<0.2U	83.6	52.6
Ref. 50%	2.2	1.0	<0.1U	<0.2U	<0.2U	<0.2U	83.3	50.4
Ref. 25%	2.1	1.0	<0.1U	<0.2U	<0.2U	<0.2U	84.2	55.1
Ref. 12.5%	2.2	1.0	<0.1U	<0.2U	<0.2U	<0.2U	84.3	53.1
Ref. 6.25%	2.3	1.3	<0.1U	<0.2U	<0.2U	<0.2U	84.4	55.4
Ref. Control	2.2	1.2	<0.1U	<0.2U	<0.2U	<0.2U	84.6	55.6

Table 2.5-5 April 2013 Upper Animas River Surface Water Toxicity Testing Initial and Final Ammonia Concentrations

Site ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)	Day 4 Measured Ammonia Conc. (mg N/L)[a]	Day 4 Measured pH[a]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)
PROFILE TEST										
A68	0.04941	7.69	0.0511	7.73	9.20	1.279	6.72	1.1385	6.83	27.54
	0.05017	7.80				0.7289	6.82			
	0.05237	7.71				1.456	6.85			
	0.0524	7.71				1.09	6.92			
M34	0.0354	4.82	0.0357	4.98	38.77	0.479	5.30	0.4880	5.22	38.60
	0.03068	4.92				0.5033	5.19			
	0.03706	5.11				0.4492	5.21			
	0.03953	5.05				0.5204	5.19			
A72	0.08822	5.73	0.0880	5.73	37.74	0.5133	5.85	0.6968	5.67	37.89
	0.08951	5.75				0.396	5.59			
	0.0889	5.73				0.5868	5.62			
	0.08529	5.72				1.291	5.63			
A73	0.08014	7.19	0.0804	7.11	21.72	1.668	6.52	1.6413	6.47	32.97
	0.08095	7.15				1.696	6.47			
	0.0802	7.17				1.636	6.45			
	0.08044	6.93				1.565	6.44			
A73B	0.08696	7.50	0.0893	7.52	12.94	1.767	6.56	1.5815	6.52	32.42
	0.0889	7.86				1.615	6.54			
	0.08929	7.40				1.255	6.45			
	0.09208	7.31				1.689	6.51			
A75B	0.07997	7.76	0.0804	7.76	8.66	1.261	6.50	1.4880	6.55	31.97
	0.07763	7.74				1.491	6.54			
	0.08376	7.75				1.754	6.56			
	0.08015	7.80				1.446	6.60			
SERIAL DILUTION OF SAMPLE A72 WITH HRW AS THE DILUENT										
HRW Control	0.03003	7.74	0.0280	7.96	6.03	1.997	7.68	1.7413	7.83	7.72
	0.03007	7.87				1.783	7.77			
	0.02451	8.08				1.545	7.89			
	0.02743	8.16				1.64	7.97			
HRW(A72)-88%	0.0807	6.96	0.0807	6.86	26.93	1.286	7.28	1.4338	7.28	18.00
	0.08067	6.90				1.479	7.26			
	0.0812	6.81				1.46	7.28			
	0.08004	6.77				1.51	7.29			
HRW(A72)-75%	0.07393	7.27	0.0730	7.15	20.78	1.4	7.42	1.4233	7.36	16.20
	0.07544	7.20				1.368	7.32			
	0.07246	7.12				1.424	7.34			
	0.07019	7.02				1.501	7.36			
HRW(A72)-50%	0.06039	7.68	0.0609	7.52	12.84	1.487	7.70	1.4498	7.58	11.70
	0.06181	7.53				1.454	7.56			
	0.0592	7.44				1.458	7.53			
	0.06233	7.44				1.4	7.54			
HRW(A72)-35%	0.0543	7.38	0.0408	7.73	9.12	1.338	7.76	1.4703	7.70	9.69
	0.03561	7.78				1.477	7.72			
	0.03527	8.02				1.539	7.63			
	0.03813	7.75				1.527	7.68			
HRW(A72)-25%	0.1166	7.18	0.1123	7.27	18.28	1.38	7.78	1.5178	7.80	8.14
	0.1113	7.25				1.609	7.88			
	0.1167	7.24				1.653	7.84			
	0.1046	7.39				1.429	7.69			
HRW(A72)-12%	0.08114	7.49	0.0843	7.47	13.94	1.274	7.56	1.4080	7.63	10.84
	0.08043	7.48				1.19	7.60			
	0.08642	7.47				1.609	7.63			
	0.08918	7.43				1.559	7.73			

[a]values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed

Table 2.5-5 (cont'd) April 2013 Upper Animas River Surface Water Toxicity Testing Initial and Final Ammonia Concentrations

Site ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)	Day 4 Measured Ammonia Conc. (mg N/L)[a]	Day 4 Measured pH[a]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)
SERIAL DILUTION OF SAMPLE CC48/M34 WITH A68 AS THE DILUENT										
A68(CC48/M34)-100%	0.0367	4.36	0.0335	4.32	38.95	1.026	4.65	0.9995	4.62	38.90
	0.03023	4.29				1.019	4.65			
	0.03478	4.32				0.9901	4.61			
	0.03231	4.30				0.9628	4.57			
A68(CC48/M34)-95%	0.03432	4.58	0.0325	4.54	38.92	0.8675	4.73	0.8658	4.69	38.88
	0.03149	4.53				0.884	4.67			
	0.03123	4.53				0.819	4.69			
	0.03305	4.52				0.8928	4.66			
A68(CC48/M34)-90%	0.03248	4.65	0.0316	4.64	38.89	0.8809	4.75	0.8549	4.78	38.86
	0.03164	4.63				0.7872	4.85			
	0.03085	4.66				0.8561	4.76			
	0.03152	4.63				0.8954	4.74			
A68(CC48/M34)-80%	0.03313	4.69	0.0330	4.70	38.88	0.944	4.90	0.8448	4.83	38.84
	0.03339	4.74				0.7689	4.84			
	0.03163	4.69				0.849	4.81			
	0.03392	4.67				0.8174	4.78			
A68(CC48/M34)-75%	0.03329	4.95	0.0336	4.89	38.81	0.8131	5.22	0.6163	5.20	38.62
	0.03333	4.93				0.9102	5.43			
	0.03367	4.85				0	5.10			
	0.03429	4.84				0.7418	5.06			
A68(CC48/M34)-50%	0.05944	6.34	0.0612	6.15	35.89	1.366	7.01	1.2235	6.94	25.45
	0.06078	6.22				1.201	6.98			
	0.06331	6.04				1.124	6.92			
	0.06128	5.98				1.203	6.83			
A68(CC48/M34)-25%	0.07063	6.97	0.0756	6.88	26.54	1.45	7.25	1.4978	7.24	18.84
	0.07417	6.89				1.431	7.23			
	0.07907	6.84				1.65	7.24			
	0.07862	6.82				1.46	7.24			
SERIAL DILUTION OF SAMPLE CC48/M34 WITH HRW AS THE DILUENT										
HRW(CC48/M34)-Control	0.06793	7.16	0.0691	7.37	16.04	1.251	7.55	1.3228	7.82	7.79
	0.07062	7.22				1.382	7.84			
	0.06924	7.39				1.298	8.01			
	0.06872	7.70				1.36	7.89			
HRW(CC48/M34)-95%	0.03252	5.15	0.0338	4.69	38.88	0.8979	5.00	0.9327	4.99	38.77
	0.03306	4.58				0.9816	4.95			
	0.03355	4.53				0.8745	5.02			
	0.03617	4.48				0.9767	4.98			
HRW(CC48/M34)-90%	0.03385	5.32	0.0361	5.23	38.60	0.9163	6.36	0.9288	5.79	37.55
	0.03668	5.26				0.9138	5.61			
	0.03605	5.15				0.8061	5.40			
	0.03775	5.17				1.079	5.80			
HRW(CC48/M34)-75%	0.03048	6.69	0.0299	6.53	32.23	1.416	7.50	1.3988	7.40	15.29
	0.03321	6.61				1.468	7.34			
	0.03204	6.38				1.372	7.36			
	0.0237	6.44				1.339	7.41			
HRW(CC48/M34)-50%	0.02571	7.23	0.0277	7.14	21.12	1.539	7.71	1.4723	7.67	10.19
	0.02689	7.16				1.524	7.62			
	0.02764	7.10				1.496	7.61			
	0.03052	7.06				1.33	7.73			
HRW(CC48/M34)-25%	0.03247	7.74	0.0312	7.66	10.27	1.481	7.84	1.6005	7.84	7.58
	0.03215	7.76				1.702	7.76			
	0.02816	7.60				1.554	7.88			
	0.03218	7.55				1.665	7.87			

[a]values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed

Table 2.5-5 (cont'd) April 2013 Upper Animas River Surface Water Toxicity Testing Initial and Final Ammonia Concentrations

Site ID	Day 0 Measured Ammonia Conc. (mg N/L)	Day 0 Measured pH	Day 0 Average Measured Ammonia Conc. (mg N/L)	Day 0 Average Measured pH	Day 0 Ammonia Criterion (mg N/L)	Day 4 Measured Ammonia Conc. (mg N/L)[a]	Day 4 Measured pH[a]	Day 4 Average Measured Ammonia Conc. (mg N/L)	Day 4 Average Measured pH	Day 4 Ammonia Criterion (mg N/L)
REFERENCE TOXICITY TEST										
Laboratory Control	0.09254	7.84	0.0814	7.89	6.92	1.653	7.45	1.5710	7.47	13.84
	0.07788	7.88				1.593	7.37			
	0.07861	7.89				1.583	7.50			
	0.0764	7.94				1.455	7.57			
100%	0.05802	7.84	0.0561	7.80	8.11	0.08906	7.28	0.5487	7.42	14.87
	0.05522	7.79				1.006	7.55			
	0.05446	7.79				0.9963	7.54			
	0.05655	7.78				0.1034	7.32			
50%	0.06034	7.92	0.0619	7.91	6.67	1.31	7.63	0.7637	7.52	12.84
	0.06287	7.88				0.6263	7.32			
	0.06745	7.87				1.076	7.54			
	0.05683	7.96				0.04236	7.60			
25%	0.06223	8.07	0.0649	8.02	5.38	0.1619	7.74	0.3588	7.72	9.32
	0.06625	8.06				0.505	7.61			
	0.0678	7.99				0.5246	7.75			
	0.06319	7.97				0.2438	7.78			
12.50%	0.07566	8.00	0.0728	7.99	5.75	1.686	7.60	1.5048	7.64	10.62
	0.06907	7.98				1.031	7.68			
	0.06867	7.99				1.399	7.65			
	0.07793	7.98				1.903	7.64			
6.25%	0.08101	8.05	0.0780	8.02	5.38	1.429	7.58	1.4925	7.62	11.06
	0.07508	8.02				1.481	7.62			
	0.07711	8.03				1.434	7.65			
	0.07886	7.99				1.626	7.62			

[a]values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed

Figures

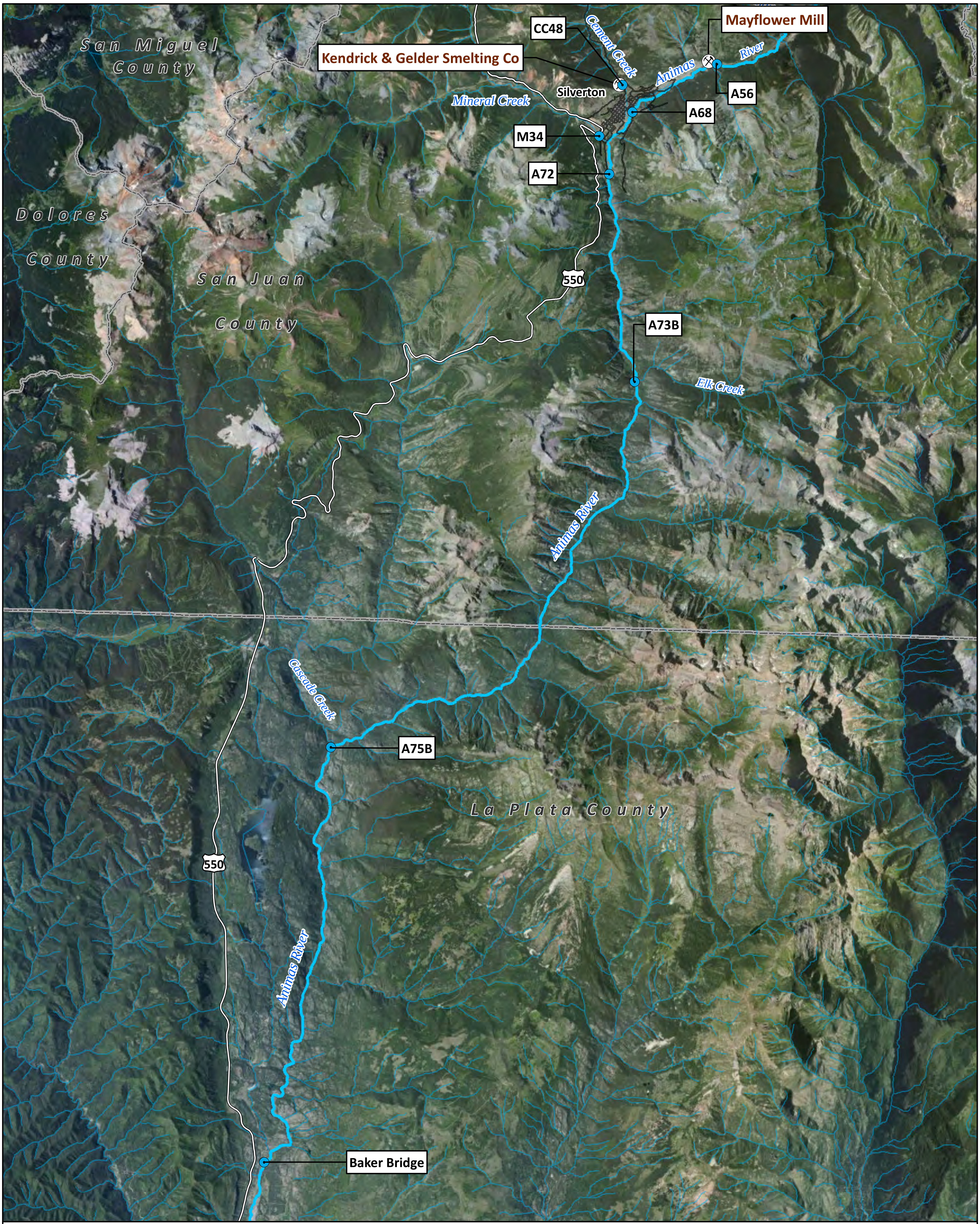


Figure 2.1-1
Upper Animas Mining District
2012 Surface Water Toxicity Test

- Sample Locations
- Mine Locations
- Rivers and Streams
- Roads
- County Boundaries

Date: July 15, 2013

Data Sources:
Sample Locations: U.S. EPA Region 8 and UOS (2013)
Mine Locations: U.S. EPA and ESAT (2012)
Roads: Navteq (2011)
Rivers and Streams: CDOW 1:24k (2004)
County Boundaries: U.S. Census Bureau (2011)
Image: Bing (2013)

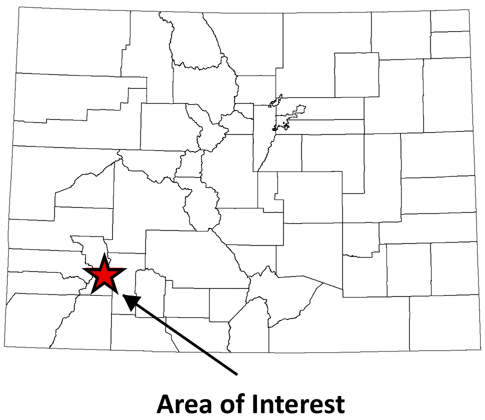
Coordinate System/Projection:
UTM Zone 13 North, NAD 83, Meters

TechLaw

N
W E
S

0 1 2 Miles
0 1 2 Kilometers

Colorado



Area of Interest

Figure 3.1
Survival in juvenile rainbow trout exposed for 96 hours to undiluted Animas River and Mineral Creek surface water (profile test) and A72 surface water serially diluted with HRW

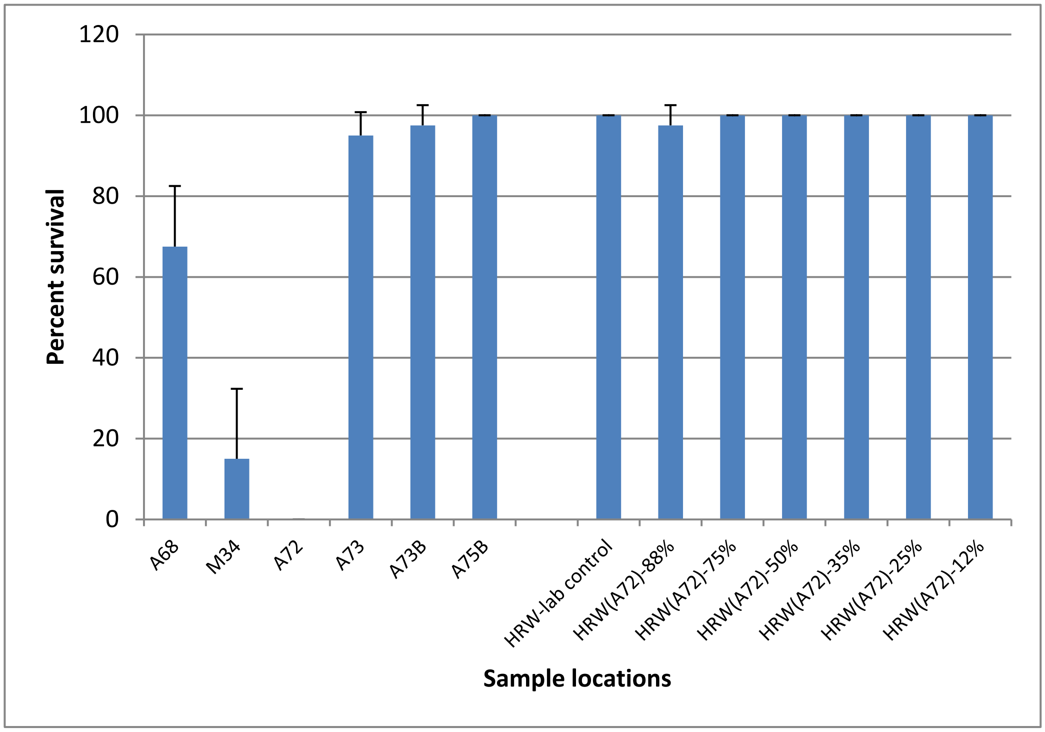


Figure 3.2
Survival in juvenile rainbow trout exposed for 96 hours to mixed CC48/M34 surface water serially diluted with A68 surface water and HRW

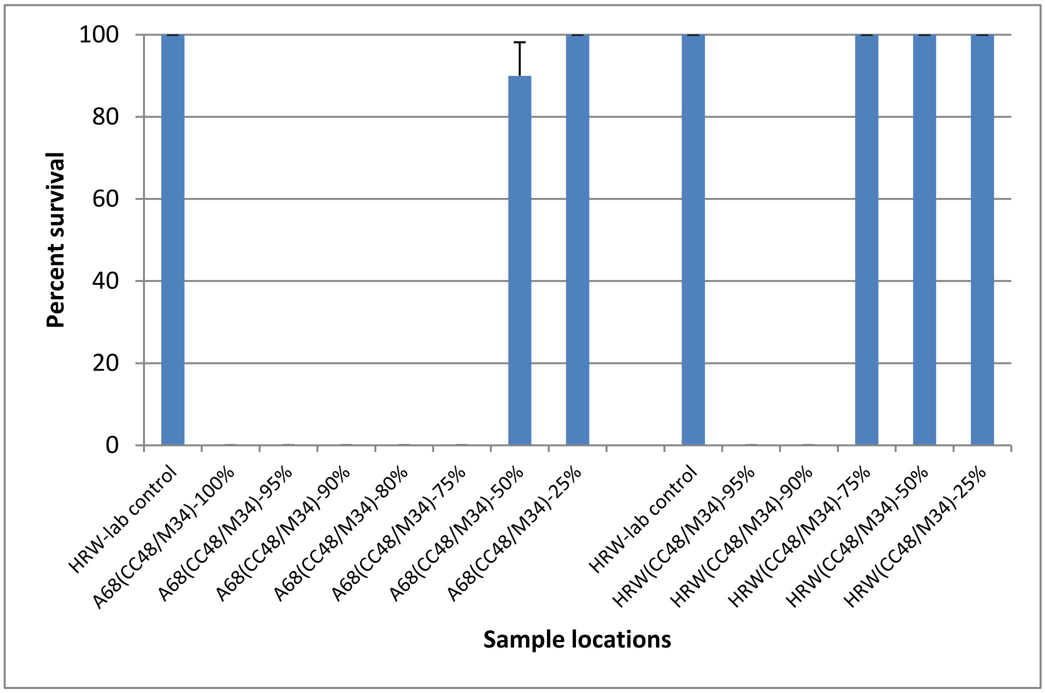


Figure 3.3
Survival in juvenile rainbow trout exposed for 96 hours to a reference toxicant (zinc sulfate heptahydrate)

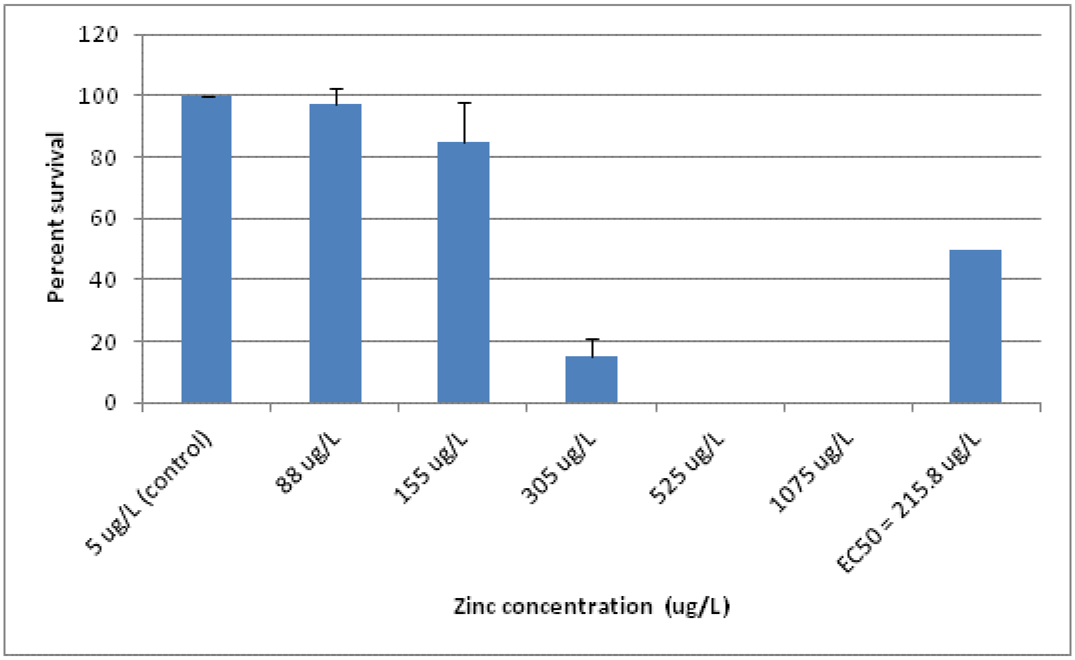
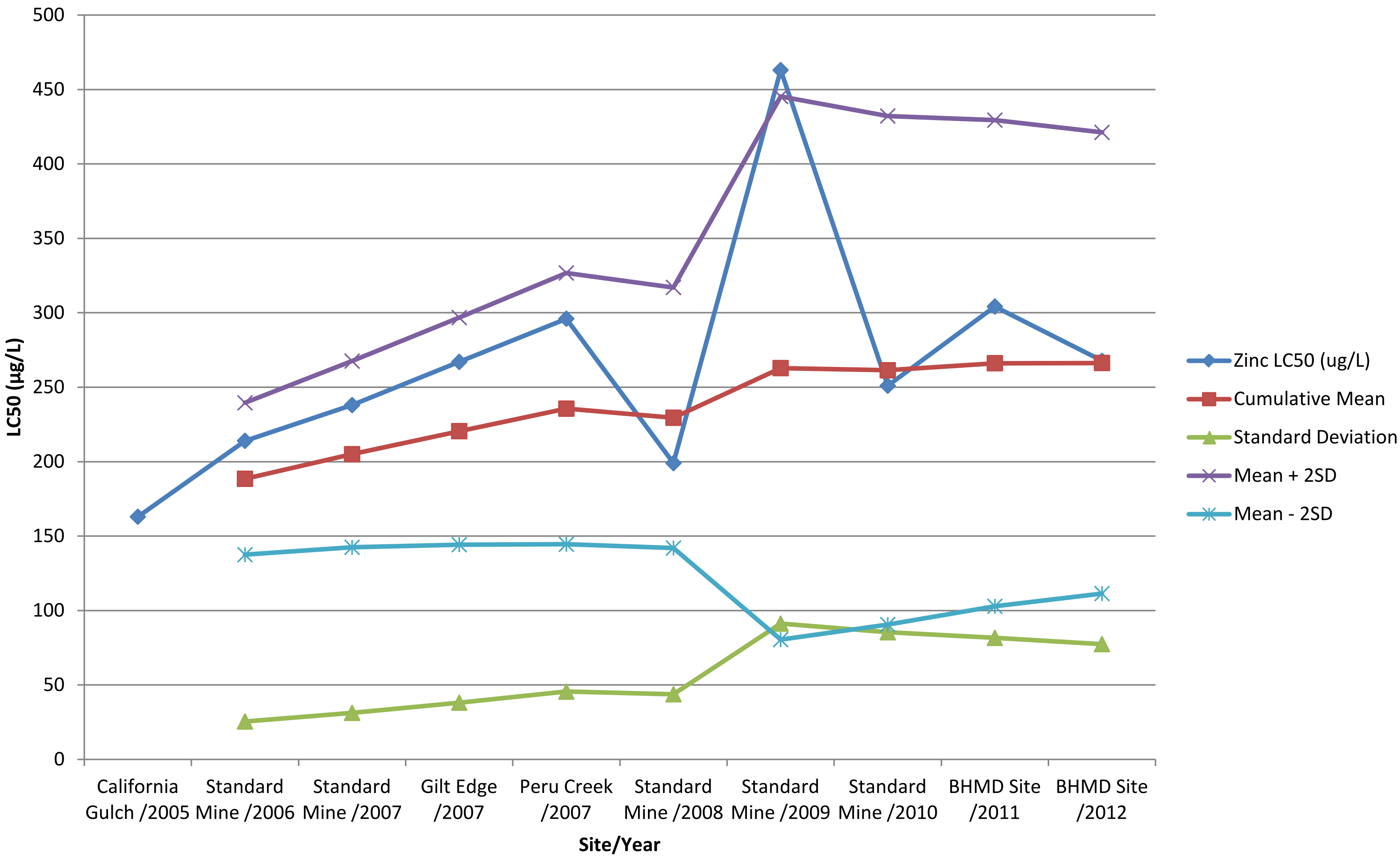


Figure 3.4
Acute reference toxicant control chart for juvenile rainbow trout exposed to zinc at the EPA Region 8 Laboratory



Appendices

APPENDIX A: Test data sheets for the profile test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms 10	
End Date	04/22/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC, NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-01	No. Alive	10	10	9	8	8
A68-01	pH	7.69	7.37	6.76	6.64	6.72
A68-01	Temp (C)	12.22	11.88	11.8	11.79	12.05
A68-01	D.O. (mg/L)	8.62	8.36	8.38	8.46	8.34
A68-01	Conductivity (us/cm)	426	433	441.6	434.9	435
A68-01	Alkalinity	34.1				38.0
A68-01	Hardness	194				191

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-02	No. Alive	10	10	6	5	5
A68-02	pH	7.8	7.35	6.82	6.79	6.82
A68-02	Temp (C)	12.09	11.83	11.79	11.78	12.06
A68-02	D.O. (mg/L)	8.68	7.72	8.38	8.48	8.37
A68-02	Conductivity (us/cm)	426.4	433.7	438.3	431.6	432.5
A68-02	Alkalinity	34.1				38.0
A68-02	Hardness	194				191

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-03	No. Alive	10	10	8	8	8
A68-03	pH	7.71	7.42	6.87	6.78	6.85
A68-03	Temp (C)	12	11.81	11.79	11.76	12.07
A68-03	D.O. (mg/L)	8.72	8.03	8.35	8.43	8.4
A68-03	Conductivity (us/cm)	427.2	434.7	438.9	436.5	436.9
A68-03	Alkalinity	34.1				38
A68-03	Hardness	194				191

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68-04	No. Alive	10	10	9	6	6
A68-04	pH	7.71	7.42	6.92	6.89	6.92
A68-04	Temp (C)	11.98	11.82	11.79	11.77	12.07
A68-04	D.O. (mg/L)	8.73	8.12	8.3	8.35	8.33
A68-04	Conductivity (us/cm)	427.3	433.1	440.1	436.6	434.8
A68-04	Alkalinity	34.1				38
A68-04	Hardness	194				191

APPENDIX A: Test data sheets for the profile test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC, NM

Site I.D.[a]	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-01	No. Alive	10	10	4	3	0
M34-01	pH	4.82	6.02	6.69	6.44	5.3
M34-01	Temp (C)	12.67	11.85	11.83	12.1	12.26
M34-01	D.O. (mg/L)	8.6	8.2	8.53	8.49	8.73
M34-01	Conductivity (us/cm)	521.7	534.6	554.6	543.2	528.2
M34-01	Alkalinity	<5.00U				<5.00U
M34-01	Hardness	227				224

Site I.D.[a]	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-02	No. Alive	10	10	5	4	3
M34-02	pH	4.92	6.03	6.68	6.37	5.19
M34-02	Temp (C)	12.51	11.79	11.85	12.09	12.14
M34-02	D.O. (mg/L)	8.73	8.25	8.54	8.5	8.69
M34-02	Conductivity (us/cm)	523.4	536.5	556.5	543.2	526.8
M34-02	Alkalinity	<5.00U				<5.00U
M34-02	Hardness	227				224

Site I.D.[a]	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-03	No. Alive	10	10	6	4	3
M34-03	pH	5.11	6.05	6.65	6.36	5.21
M34-03	Temp (C)	12.42	11.74	11.82	12.07	12.06
M34-03	D.O. (mg/L)	8.81	8.31	8.53	8.48	8.61
M34-03	Conductivity (us/cm)	522.2	537.3	555.9	544.7	526.7
M34-03	Alkalinity	<5.00U				<5.00U
M34-03	Hardness	227				224

Site I.D.[a]	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
M34-04	No. Alive	10	10	7	5	0
M34-04	pH	5.05	6.04	6.66	6.37	5.19
M34-04	Temp (C)	12.35	11.73	11.83	12.05	12.04
M34-04	D.O. (mg/L)	8.89	8.35	8.5	8.47	8.64
M34-04	Conductivity (us/cm)	524	534.3	551.5	544.6	529.2
M34-04	Alkalinity	<5.00U				<5.00U
M34-04	Hardness	227				224

APPENDIX A: Test data sheets for the profile test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC, NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-01	No. Alive	10	10	3	0	-
A72-01	pH	5.73	6.06	6.3	5.85	-
A72-01	Temp (C)	11.84	11.93	11.89	11.8	-
A72-01	D.O. (mg/L)	8.76	8.29	8.33	8.48	-
A72-01	Conductivity (us/cm)	573.4	581.3	587.7	578.7	-
A72-01	Alkalinity	<5.00U			<5.00U	
A72-01	Hardness	255			265	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-02	No. Alive	10	10	3	0	-
A72-02	pH	5.75	6.21	6.22	5.59	-
A72-02	Temp (C)	11.82	11.87	11.87	11.8	-
A72-02	D.O. (mg/L)	8.76	8.35	8.39	8.53	-
A72-02	Conductivity (us/cm)	575.2	585.7	592.3	576	-
A72-02	Alkalinity	<5.00U			<5.00U	
A72-02	Hardness	255			265	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-03	No. Alive	10	10	4	0	-
A72-03	pH	5.73	6.16	6.25	5.62	-
A72-03	Temp (C)	11.78	11.8	11.85	11.8	-
A72-03	D.O. (mg/L)	8.78	8.4	8.44	8.59	-
A72-03	Conductivity (us/cm)	574.6	583.8	590.1	579.5	-
A72-03	Alkalinity	<5.00U			<5.00U	
A72-03	Hardness	255			265	

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A72-04	No. Alive	10	9	6	0	-
A72-04	pH	5.72	6.2	6.26	5.63	-
A72-04	Temp (C)	11.76	11.82	11.82	11.79	-
A72-04	D.O. (mg/L)	8.77	8.42	8.46	8.63	-
A72-04	Conductivity (us/cm)	574.8	585.2	590.1	583	-
A72-04	Alkalinity	<5.00U			<5.00U	
A72-04	Hardness	255			265	

APPENDIX A: Test data sheets for the profile test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC, NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73-01	No. Alive	10	10	9	9	9
A73-01	pH	7.19	6.56	6.42	6.31	6.52
A73-01	Temp (C)	11.81	12.07	11.89	11.8	12.07
A73-01	D.O. (mg/L)	8.77	8.2	8.27	8.27	8.19
A73-01	Conductivity (us/cm)	531.6	539.6	541.8	537.7	539.2
A73-01	Alkalinity	<5.00U				9.98
A73-01	Hardness	237				238

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73-02	No. Alive	10	10	10	10	10
A73-02	pH	7.15	6.53	6.46	6.31	6.47
A73-02	Temp (C)	11.82	12.02	11.88	11.79	12.07
A73-02	D.O. (mg/L)	8.76	8.3	8.29	8.26	8.15
A73-02	Conductivity (us/cm)	531.8	538.3	540.1	537.8	540.2
A73-02	Alkalinity	<5.00U				9.98
A73-02	Hardness	237				238

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73-03	No. Alive	10	10	10	10	10
A73-03	pH	7.17	6.53	6.5	6.32	6.45
A73-03	Temp (C)	11.8	12	11.89	11.76	12.06
A73-03	D.O. (mg/L)	8.76	8.34	8.25	8.24	8.14
A73-03	Conductivity (us/cm)	531.8	537.5	539.1	538.2	539.2
A73-03	Alkalinity	<5.00U				9.98
A73-03	Hardness	237				238

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73-04	No. Alive	10	10	10	9[b]	9
A73-04	pH	6.93	6.52	6.43	6.3	6.44
A73-04	Temp (C)	11.8	11.99	11.89	11.76	12.07
A73-04	D.O. (mg/L)	8.77	8.28	8.07	8.2	8.15
A73-04	Conductivity (us/cm)	531.8	537.7	539.6	539.1	538.7
A73-04	Alkalinity	<5.00U				9.98
A73-04	Hardness	237				238

APPENDIX A: Test data sheets for the profile test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC, NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73B-01	No. Alive	10	10	10	10	10
A73B-01	pH	7.5	6.74	6.48	6.36	6.56
A73B-01	Temp (C)	11.86	12.14	11.98	11.82	12.05
A73B-01	D.O. (mg/L)	8.77	8.03	8.23	8.29	8
A73B-01	Conductivity (us/cm)	503.6	507.9	510.8	509.7	513.1
A73B-01	Alkalinity	<5.00U				8.16
A73B-01	Hardness	226				226

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73B-02	No. Alive	10	10	10	10	10
A73B-02	pH	7.86	6.67	6.57	6.37	6.54
A73B-02	Temp (C)	11.85	12.04	11.97	11.8	12.05
A73B-02	D.O. (mg/L)	8.75	8.03	8.17	8.25	8.04
A73B-02	Conductivity (us/cm)	503.9	507.8	512.3	511.3	511.6
A73B-02	Alkalinity	<5.00U				8.16
A73B-02	Hardness	226				226

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73B-03	No. Alive	10	10	10	9	9
A73B-03	pH	7.4	6.65	6.51	6.35	6.45
A73B-03	Temp (C)	11.83	12.03	11.94	11.8	12.04
A73B-03	D.O. (mg/L)	8.77	8.15	8.21	8.26	8.07
A73B-03	Conductivity (us/cm)	504.1	507.5	512	510.1	509.2
A73B-03	Alkalinity	<5.00U				8.16
A73B-03	Hardness	226				226

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A73B-04	No. Alive	10	10	10	10	10
A73B-04	pH	7.31	6.61	6.49	6.35	6.51
A73B-04	Temp (C)	11.83	12.06	11.91	11.79	12.05
A73B-04	D.O. (mg/L)	8.76	8.09	8.22	8.25	8.11
A73B-04	Conductivity (us/cm)	503.8	509.1	511.9	510.6	512.2
A73B-04	Alkalinity	<5.00U				8.16
A73B-04	Hardness	226				226

APPENDIX A: Test data sheets for the profile test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC, NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-01	No. Alive	10	10	10	10	10
A75B-01	pH	7.76	7	6.37	6.4	6.5
A75B-01	Temp (C)	11.91	12.21	12.2	12.09	12.36
A75B-01	D.O. (mg/L)	8.73	7.98	8.16	8.14	7.3
A75B-01	Conductivity (us/cm)	416	422.7	427	426.2	428.6
A75B-01	Alkalinity	11.6				17.9
A75B-01	Hardness	184				189

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-02	No. Alive	10	10	10	10	10
A75B-02	pH	7.74	6.91	6.44	6.28	6.54
A75B-02	Temp (C)	11.91	11.93	12.07	12.03	12.15
A75B-02	D.O. (mg/L)	8.75	8.17	8.18	8.17	7.7
A75B-02	Conductivity (us/cm)	416.5	422.9	426.4	425.8	428.1
A75B-02	Alkalinity	11.6				17.9
A75B-02	Hardness	184				189

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-03	No. Alive	10	10	10	10	10
A75B-03	pH	7.75	6.9	6.5	6.32	6.56
A75B-03	Temp (C)	11.87	11.91	12.02	11.83	12.06
A75B-03	D.O. (mg/L)	8.76	7.84	8.3	8.23	7.95
A75B-03	Conductivity (us/cm)	416.8	421.4	428.2	428.8	430.6
A75B-03	Alkalinity	11.6				17.9
A75B-03	Hardness	184				189

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A75B-04	No. Alive	10	10	10	10	10
A75B-04	pH	7.8	6.87	6.56	6.37	6.6
A75B-04	Temp (C)	11.88	11.9	12.01	11.81	12.06
A75B-04	D.O. (mg/L)	8.78	7.57	8.25	8.24	8.05
A75B-04	Conductivity (us/cm)	417.1	421.8	426.9	425.2	427.3
A75B-04	Alkalinity	11.6				17.9
A75B-04	Hardness	184				189

[a] Surface water sample M34 was tested starting 4/19/13

[b] one juvenile rainbow trout jumped out of the test vessel

APPENDIX B: Test data sheet for the serial dilution of A72 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-88%-Rep1	No. Alive	10	10	10	10	10
HRW(A72)-88%-Rep1	pH	6.96	7.23	7.27	7.31	7.28
HRW(A72)-88%-Rep1	Temp (C)	12.65	11.74	12.04	11.75	11.75
HRW(A72)-88%-Rep1	D.O. (mg/L)	8.56	8.13	8.21	8.12	8.29
HRW(A72)-88%-Rep1	Conductivity (us/cm)	578.4	580.9	581.5	583.5	582.3
HRW(A72)-88%-Rep1	Alkalinity	9.14				12.0
HRW(A72)-88%-Rep1	Hardness	251				241

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-88%-Rep2	No. Alive	10	10	10	10	10
HRW(A72)-88%-Rep2	pH	6.9	7.13	7.22	7.28	7.26
HRW(A72)-88%-Rep2	Temp (C)	12.62	11.74	12.04	11.72	11.74
HRW(A72)-88%-Rep2	D.O. (mg/L)	8.63	8.22	8.29	8.18	8.39
HRW(A72)-88%-Rep2	Conductivity (us/cm)	577.1	580.6	581.1	583	583.3
HRW(A72)-88%-Rep2	Alkalinity	9.14				12.0
HRW(A72)-88%-Rep2	Hardness	251				241

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A73)-88%-Rep3	No. Alive	10	10	9	9	9
HRW(A73)-88%-Rep3	pH	6.81	7.17	7.27	7.26	7.28
HRW(A73)-88%-Rep3	Temp (C)	12.59	11.73	12.02	11.7	11.73
HRW(A73)-88%-Rep3	D.O. (mg/L)	8.6	8.26	8.33	8.28	8.43
HRW(A73)-88%-Rep3	Conductivity (us/cm)	578	583.4	583.2	583.2	583.3
HRW(A73)-88%-Rep3	Alkalinity	9.14				12.0
HRW(A73)-88%-Rep3	Hardness	251				241

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-88%-Rep4	No. Alive	10	10	10	10	10
HRW(A72)-88%-Rep4	pH	6.77	7.17	7.24	7.23	7.29
HRW(A72)-88%-Rep4	Temp (C)	12.59	11.72	12.03	11.7	11.72
HRW(A72)-88%-Rep4	D.O. (mg/L)	8.62	8.33	8.33	8.33	8.44
HRW(A72)-88%-Rep4	Conductivity (us/cm)	580.2	581.9	581.5	583.5	583.9
HRW(A72)-88%-Rep4	Alkalinity	9.14				12.0
HRW(A72)-88%-Rep4	Hardness	251				241

APPENDIX B: Test data sheet for the serial dilution of A72 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-75%-Rep1	No. Alive	10	10	10	10	10
HRW(A72)-75%-Rep1	pH	7.27	7.43	7.43	7.53	7.42
HRW(A72)-75%-Rep1	Temp (C)	12.88	11.72	12	11.74	11.73
HRW(A72)-75%-Rep1	D.O. (mg/L)	8.44	7.89	7.91	7.87	8.1
HRW(A72)-75%-Rep1	Conductivity (us/cm)	584.5	590.7	589.4	591.5	591.2
HRW(A72)-75%-Rep1	Alkalinity	26.6				28.8
HRW(A72)-75%-Rep1	Hardness	244				237

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-75%-Rep2	No. Alive	10	10	10	10	10
HRW(A72)-75%-Rep2	pH	7.2	7.39	7.37	7.47	7.32
HRW(A72)-75%-Rep2	Temp (C)	12.94	11.75	12	11.73	11.74
HRW(A72)-75%-Rep2	D.O. (mg/L)	8.45	7.9	7.88	7.87	8.12
HRW(A72)-75%-Rep2	Conductivity (us/cm)	584	588.4	588.7	590.5	590.3
HRW(A72)-75%-Rep2	Alkalinity	26.6				28.8
HRW(A72)-75%-Rep2	Hardness	244				237

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-75%-Rep3	No. Alive	10	10	10	10	10
HRW(A72)-75%-Rep3	pH	7.12	7.34	7.35	7.43	7.34
HRW(A72)-75%-Rep3	Temp (C)	12.74	11.74	11.99	11.72	11.77
HRW(A72)-75%-Rep3	D.O. (mg/L)	8.52	7.97	7.92	7.9	8.21
HRW(A72)-75%-Rep3	Conductivity (us/cm)	585.9	589.1	588.3	590	590.4
HRW(A72)-75%-Rep3	Alkalinity	26.6				28.8
HRW(A72)-75%-Rep3	Hardness	244				237

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-75%-Rep4	No. Alive	10	10	10	10	10
HRW(A72)-75%-Rep4	pH	7.02	7.32	7.34	7.41	7.36
HRW(A72)-75%-Rep4	Temp (C)	12.68	11.75	11.99	11.71	11.74
HRW(A72)-75%-Rep4	D.O. (mg/L)	8.54	7.91	7.97	8.05	8.26
HRW(A72)-75%-Rep4	Conductivity (us/cm)	582.7	589	589.3	591.4	590.8
HRW(A72)-75%-Rep4	Alkalinity	26.6				28.8
HRW(A72)-75%-Rep4	Hardness	244				237

APPENDIX B: Test data sheet for the serial dilution of A72 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-50%-Rep1	No. Alive	10	10	10	10	10
HRW(A72)-50%-Rep1	pH	7.68	7.75	7.56	7.75	7.7
HRW(A72)-50%-Rep1	Temp (C)	13.14	11.76	12.02	11.76	11.76
HRW(A72)-50%-Rep1	D.O. (mg/L)	8.22	8.08	7.91	8.03	8.22
HRW(A72)-50%-Rep1	Conductivity (us/cm)	600.8	608.5	606.6	608.4	607.3
HRW(A72)-50%-Rep1	Alkalinity	55.4				57.0
HRW(A72)-50%-Rep1	Hardness	223				218

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-50%-Rep2	No. Alive	10	10	10	10	10
HRW(A72)-50%-Rep2	pH	7.53	7.67	7.54	7.66	7.56
HRW(A72)-50%-Rep2	Temp (C)	13.22	11.76	12.01	11.74	11.78
HRW(A72)-50%-Rep2	D.O. (mg/L)	8.26	8.05	7.89	8	8.09
HRW(A72)-50%-Rep2	Conductivity (us/cm)	602.6	606	603.4	605.8	606.8
HRW(A72)-50%-Rep2	Alkalinity	55.4				57.0
HRW(A72)-50%-Rep2	Hardness	223				218

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-50%-Rep3	No. Alive	10	10	10	10	10
HRW(A72)-50%-Rep3	pH	7.44	7.58	7.52	7.64	7.53
HRW(A72)-50%-Rep3	Temp (C)	13.12	11.74	11.99	11.72	11.81
HRW(A72)-50%-Rep3	D.O. (mg/L)	8.33	7.92	7.87	7.91	8.01
HRW(A72)-50%-Rep3	Conductivity (us/cm)	601.7	607.5	605.9	606.4	607.6
HRW(A72)-50%-Rep3	Alkalinity	55.4				57.0
HRW(A72)-50%-Rep3	Hardness	223				218

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-50%-Rep4	No. Alive	10	10	10	10	10
HRW(A72)-50%-Rep4	pH	7.44	7.52	7.51	7.61	7.54
HRW(A72)-50%-Rep4	Temp (C)	13.02	11.74	12	11.71	11.76
HRW(A72)-50%-Rep4	D.O. (mg/L)	8.32	7.85	7.82	7.87	7.99
HRW(A72)-50%-Rep4	Conductivity (us/cm)	602.2	607.7	605.3	606.4	606.4
HRW(A72)-50%-Rep4	Alkalinity	55.4				57.0
HRW(A72)-50%-Rep4	Hardness	223				218

APPENDIX B: Test data sheet for the serial dilution of A72 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-35%-Rep1	No. Alive	10	10	10	10	10
HRW(A72)-35%-Rep1	pH	7.38	7.67	7.69	7.82	7.76
HRW(A72)-35%-Rep1	Temp (C)	12.97	11.78	12.01	11.74	11.84
HRW(A72)-35%-Rep1	D.O. (mg/L)	8.34	7.96	8.25	8.21	8.29
HRW(A72)-35%-Rep1	Conductivity (us/cm)	605.2	624.8	616.5	617.6	615.5
HRW(A72)-35%-Rep1	Alkalinity	76.1				77.9
HRW(A72)-35%-Rep1	Hardness	211				201

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-35%-Rep2	No. Alive	10	10	10	10	10
HRW(A72)-35%-Rep2	pH	7.78	7.91	7.7	7.79	7.72
HRW(A72)-35%-Rep2	Temp (C)	13.32	11.77	12.02	11.78	11.81
HRW(A72)-35%-Rep2	D.O. (mg/L)	8.17	8.11	8.24	8.23	8.25
HRW(A72)-35%-Rep2	Conductivity (us/cm)	628.3	628.6	617.1	618.9	617.1
HRW(A72)-35%-Rep2	Alkalinity	76.1				77.9
HRW(A72)-35%-Rep2	Hardness	211				201

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-35%-Rep3	No. Alive	10	10	10	10	10
HRW(A72)-35%-Rep3	pH	8.02	7.92	7.67	7.78	7.63
HRW(A72)-35%-Rep3	Temp (C)	13.59	11.77	12.02	11.78	11.78
HRW(A72)-35%-Rep3	D.O. (mg/L)	8.2	8.15	8.19	8.19	8.27
HRW(A72)-35%-Rep3	Conductivity (us/cm)	627.2	633.9	617.8	618	617.3
HRW(A72)-35%-Rep3	Alkalinity	76.1				77.9
HRW(A72)-35%-Rep3	Hardness	211				201

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-35%-Rep4	No. Alive	10	10	10	10	10
HRW(A72)-35%-Rep4	pH	7.75	7.92	7.67	7.77	7.68
HRW(A72)-35%-Rep4	Temp (C)	13.03	11.76	12.01	11.76	11.7
HRW(A72)-35%-Rep4	D.O. (mg/L)	8.08	8.2	8.07	8.15	8.22
HRW(A72)-35%-Rep4	Conductivity (us/cm)	626.3	636.3	617.5	616.1	618.4
HRW(A72)-35%-Rep4	Alkalinity	76.1				77.9
HRW(A72)-35%-Rep4	Hardness	211				201

APPENDIX B: Test data sheet for the serial dilution of A72 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-25%-Rep1	No. Alive	10	10	10	10	10
HRW(A72)-25%-Rep1	pH	7.18	7.63	7.6	7.86	7.78
HRW(A72)-25%-Rep1	Temp (C)	12.4	11.76	11.98	11.68	11.83
HRW(A72)-25%-Rep1	D.O. (mg/L)	7.56	8.3	8.3	8.29	8.35
HRW(A72)-25%-Rep1	Conductivity (us/cm)	618.9	623.1	622.9	624.9	623.1
HRW(A72)-25%-Rep1	Alkalinity	87.5				90.4
HRW(A72)-25%-Rep1	Hardness	200				182

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-25%-Rep2	No. Alive	10	10	10	10	10
HRW(A72)-25%-Rep2	pH	7.25	7.66	7.62	7.88	7.88
HRW(A72)-25%-Rep2	Temp (C)	12.24	11.73	11.98	11.68	11.79
HRW(A72)-25%-Rep2	D.O. (mg/L)	7.86	8.31	8.35	8.31	8.43
HRW(A72)-25%-Rep2	Conductivity (us/cm)	618.4	624.6	624.2	627.4	624.9
HRW(A72)-25%-Rep2	Alkalinity	87.5				90.4
HRW(A72)-25%-Rep2	Hardness	200				182

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-25%-Rep3	No. Alive	10	10	10	10	10
HRW(A72)-25%-Rep3	pH	7.24	7.69	7.69	7.85	7.84
HRW(A72)-25%-Rep3	Temp (C)	12.21	11.73	11.95	11.67	11.79
HRW(A72)-25%-Rep3	D.O. (mg/L)	7.86	8.31	8.32	8.25	8.28
HRW(A72)-25%-Rep3	Conductivity (us/cm)	616.7	623.8	624.8	624.7	624.8
HRW(A72)-25%-Rep3	Alkalinity	87.5				90.4
HRW(A72)-25%-Rep3	Hardness	200				182

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-25%-Rep4	No. Alive	10	10	10	10	10
HRW(A72)-25%-Rep4	pH	7.39	7.69	7.67	7.8	7.69
HRW(A72)-25%-Rep4	Temp (C)	12.19	11.74	12	11.68	11.77
HRW(A72)-25%-Rep4	D.O. (mg/L)	7.99	8.21	8.07	8.02	8.22
HRW(A72)-25%-Rep4	Conductivity (us/cm)	617.1	620.7	624.7	623	622.6
HRW(A72)-25%-Rep4	Alkalinity	87.5				90.4
HRW(A72)-25%-Rep4	Hardness	200				182

APPENDIX B: Test data sheet for the serial dilution of A72 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-12%-Rep1	No. Alive	10	10	10	10	10
HRW(A72)-12%-Rep1	pH	7.49	7.59	7.28	7.53	7.56
HRW(A72)-12%-Rep1	Temp (C)	12.22	12.44	12.23	12.01	12.01
HRW(A72)-12%-Rep1	D.O. (mg/L)	7.77	7.95	8.11	7.91	8.12
HRW(A72)-12%-Rep1	Conductivity (us/cm)	626.2	627	626.3	628.1	630.3
HRW(A72)-12%-Rep1	Alkalinity	106				104
HRW(A72)-12%-Rep1	Hardness	190				182

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-12%-Rep2	No. Alive	10	10	10	10	10
HRW(A72)-12%-Rep2	pH	7.48	7.65	7.41	7.71	7.6
HRW(A72)-12%-Rep2	Temp (C)	12.23	11.91	12.14	11.88	11.9
HRW(A72)-12%-Rep2	D.O. (mg/L)	7.89	8.09	8.18	7.98	8.26
HRW(A72)-12%-Rep2	Conductivity (us/cm)	630	629.8	628.8	629.7	628.8
HRW(A72)-12%-Rep2	Alkalinity	106				104
HRW(A72)-12%-Rep2	Hardness	190				182

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-12%-Rep3	No. Alive	10	10	10	10	10
HRW(A72)-12%-Rep3	pH	7.47	7.38	7.55	7.87	7.63
HRW(A72)-12%-Rep3	Temp (C)	12.31	11.78	11.99	11.7	11.8
HRW(A72)-12%-Rep3	D.O. (mg/L)	7.9	8.2	8.24	8.2	8.37
HRW(A72)-12%-Rep3	Conductivity (us/cm)	633.6	633.1	630.6	634.6	633.4
HRW(A72)-12%-Rep3	Alkalinity	106				104
HRW(A72)-12%-Rep3	Hardness	190				182

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW(A72)-12%-Rep4	No. Alive	10	10	10	10	10
HRW(A72)-12%-Rep4	pH	7.43	7.5	7.64	7.91	7.73
HRW(A72)-12%-Rep4	Temp (C)	12.32	11.76	11.98	11.67	11.79
HRW(A72)-12%-Rep4	D.O. (mg/L)	8	8.21	8.27	8.29	8.44
HRW(A72)-12%-Rep4	Conductivity (us/cm)	629.9	633	633.7	634.6	632.4
HRW(A72)-12%-Rep4	Alkalinity	106				104
HRW(A72)-12%-Rep4	Hardness	190				182

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-Control-Rep1	No. Alive	10	10	10	10	10
A68/(CC48/M34)-Control-Rep1	pH	7.16	7.15	7.42	7.6	7.55
A68/(CC48/M34)-Control-Rep1	Temp (C)	12.33	12.48	12.01	12.06	12.2
A68/(CC48/M34)-Control-Rep1	D.O. (mg/L)	7.48	7.41	7.76	7.92	7.93
A68/(CC48/M34)-Control-Rep1	Conductivity (us/cm)	631.6	635.6	636.7	638.4	637.7
A68/(CC48/M34)-Control-Rep1	Alkalinity	120				122
A68/(CC48/M34)-Control-Rep1	Hardness	183				179

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-Control-Rep2	No. Alive	10	10	10	10	10
A68/(CC48/M34)-Control-Rep2	pH	7.22	7.35	7.46	7.8	7.84
A68/(CC48/M34)-Control-Rep2	Temp (C)	12.38	12.22	11.94	11.93	12.11
A68/(CC48/M34)-Control-Rep2	D.O. (mg/L)	7.49	7.76	7.85	8.03	8.1
A68/(CC48/M34)-Control-Rep2	Conductivity (us/cm)	632.2	638.6	638.2	637.6	640.2
A68/(CC48/M34)-Control-Rep2	Alkalinity	120				122
A68/(CC48/M34)-Control-Rep2	Hardness	183				179

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-Control-Rep3	No. Alive	10	10	10	10	10
A68/(CC48/M34)-Control-Rep3	pH	7.39	7.61	7.67	7.85	8.01
A68/(CC48/M34)-Control-Rep3	Temp (C)	12.4	12.14	11.86	11.83	12.04
A68/(CC48/M34)-Control-Rep3	D.O. (mg/L)	7.49	7.91	8.06	8.07	8.16
A68/(CC48/M34)-Control-Rep3	Conductivity (us/cm)	630.5	636.4	637.5	636.6	638.3
A68/(CC48/M34)-Control-Rep3	Alkalinity	120				122
A68/(CC48/M34)-Control-Rep3	Hardness	183				179

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-Control-Rep4	No. Alive	10	10	10	10	10
A68/(CC48/M34)-Control-Rep4	pH	7.7	7.75	7.7	7.85	7.89
A68/(CC48/M34)-Control-Rep4	Temp (C)	12.4	12.13	11.83	11.83	12.04
A68/(CC48/M34)-Control-Rep4	D.O. (mg/L)	7.49	7.98	7.97	8.09	8.16
A68/(CC48/M34)-Control-Rep4	Conductivity (us/cm)	630.2	635.2	635.5	637.8	639.3
A68/(CC48/M34)-Control-Rep4	Alkalinity	120				122
A68/(CC48/M34)-Control-Rep4	Hardness	183				179

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-100%-Rep1	No. Alive	10	0	-	-	-
A68/(CC48/M34)-100%-Rep1	pH	4.36	4.65	-	-	-
A68/(CC48/M34)-100%-Rep1	Temp (C)	12.68	11.79	-	-	-
A68/(CC48/M34)-100%-Rep1	D.O. (mg/L)	8.69	8.48	-	-	-
A68/(CC48/M34)-100%-Rep1	Conductivity (us/cm)	687.2	693.7	-	-	-
A68/(CC48/M34)-100%-Rep1	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-100%-Rep1	Hardness	294	304			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-100%-Rep2	No. Alive	10	0	-	-	-
A68/(CC48/M34)-100%-Rep2	pH	4.29	4.65	-	-	-
A68/(CC48/M34)-100%-Rep2	Temp (C)	12.77	11.77	-	-	-
A68/(CC48/M34)-100%-Rep2	D.O. (mg/L)	8.66	8.49	-	-	-
A68/(CC48/M34)-100%-Rep2	Conductivity (us/cm)	689.6	695	-	-	-
A68/(CC48/M34)-100%-Rep2	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-100%-Rep2	Hardness	294	304			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-100%-Rep3	No. Alive	10	0	-	-	-
A68/(CC48/M34)-100%-Rep3	pH	4.32	4.61	-	-	-
A68/(CC48/M34)-100%-Rep3	Temp (C)	12.73	11.78	-	-	-
A68/(CC48/M34)-100%-Rep3	D.O. (mg/L)	8.69	8.52	-	-	-
A68/(CC48/M34)-100%-Rep3	Conductivity (us/cm)	688.3	692.8	-	-	-
A68/(CC48/M34)-100%-Rep3	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-100%-Rep3	Hardness	294	304			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-100%-Rep4	No. Alive	10	0	-	-	-
A68/(CC48/M34)-100%-Rep4	pH	4.3	4.57	-	-	-
A68/(CC48/M34)-100%-Rep4	Temp (C)	12.76	11.79	-	-	-
A68/(CC48/M34)-100%-Rep4	D.O. (mg/L)	8.6	8.53	-	-	-
A68/(CC48/M34)-100%-Rep4	Conductivity (us/cm)	688.9	694.7	-	-	-
A68/(CC48/M34)-100%-Rep4	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-100%-Rep4	Hardness	294	304			

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-95%-Rep1	No. Alive	10	0	-	-	-
A68/(CC48/M34)-95%-Rep1	pH	4.58	4.73	-	-	-
A68/(CC48/M34)-95%-Rep1	Temp (C)	12.69	11.79	-	-	-
A68/(CC48/M34)-95%-Rep1	D.O. (mg/L)	8.72	8.56	-	-	-
A68/(CC48/M34)-95%-Rep1	Conductivity (us/cm)	670	679.7	-	-	-
A68/(CC48/M34)-95%-Rep1	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-95%-Rep1	Hardness	293	289			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-95%-Rep2	No. Alive	10	0	-	-	-
A68/(CC48/M34)-95%-Rep2	pH	4.53	4.67	-	-	-
A68/(CC48/M34)-95%-Rep2	Temp (C)	12.92	11.78	-	-	-
A68/(CC48/M34)-95%-Rep2	D.O. (mg/L)	8.63	8.55	-	-	-
A68/(CC48/M34)-95%-Rep2	Conductivity (us/cm)	668.5	677.9	-	-	-
A68/(CC48/M34)-95%-Rep2	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-95%-Rep2	Hardness	293	289			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-95%-Rep3	No. Alive	10	0	-	-	-
A68/(CC48/M34)-95%-Rep3	pH	4.53	4.69	-	-	-
A68/(CC48/M34)-95%-Rep3	Temp (C)	12.96	11.78	-	-	-
A68/(CC48/M34)-95%-Rep3	D.O. (mg/L)	8.61	8.54	-	-	-
A68/(CC48/M34)-95%-Rep3	Conductivity (us/cm)	668.1	679.4	-	-	-
A68/(CC48/M34)-95%-Rep3	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-95%-Rep3	Hardness	293	289			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-95%-Rep4	No. Alive	10	1	0	-	-
A68/(CC48/M34)-95%-Rep4	pH	4.52	4.66	4.66	-	-
A68/(CC48/M34)-95%-Rep4	Temp (C)	12.85	11.8	12.03	-	-
A68/(CC48/M34)-95%-Rep4	D.O. (mg/L)	8.66	8.52	8.71	-	-
A68/(CC48/M34)-95%-Rep4	Conductivity (us/cm)	668.7	679	672.1	-	-
A68/(CC48/M34)-95%-Rep4	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-95%-Rep4	Hardness	293	289			

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-90%-Rep1	No. Alive	10	0	-	-	-
A68/(CC48/M34)-90%-Rep1	pH	4.65	4.75	-	-	-
A68/(CC48/M34)-90%-Rep1	Temp (C)	12.58	11.79	-	-	-
A68/(CC48/M34)-90%-Rep1	D.O. (mg/L)	8.75	8.57	-	-	-
A68/(CC48/M34)-90%-Rep1	Conductivity (us/cm)	651.8	669.1	-	-	-
A68/(CC48/M34)-90%-Rep1	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-90%-Rep1	Hardness	291	285			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-90%-Rep2	No. Alive	10	0	-	-	-
A68/(CC48/M34)-90%-Rep2	pH	4.63	4.85	-	-	-
A68/(CC48/M34)-90%-Rep2	Temp (C)	12.5	11.76	-	-	-
A68/(CC48/M34)-90%-Rep2	D.O. (mg/L)	8.7	8.59	-	-	-
A68/(CC48/M34)-90%-Rep2	Conductivity (us/cm)	651.5	667.5	-	-	-
A68/(CC48/M34)-90%-Rep2	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-90%-Rep2	Hardness	291	285			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-90%-Rep3	No. Alive	10	0	-	-	-
A68/(CC48/M34)-90%-Rep3	pH	4.66	4.76	-	-	-
A68/(CC48/M34)-90%-Rep3	Temp (C)	12.65	11.78	-	-	-
A68/(CC48/M34)-90%-Rep3	D.O. (mg/L)	8.79	8.59	-	-	-
A68/(CC48/M34)-90%-Rep3	Conductivity (us/cm)	650.6	668	-	-	-
A68/(CC48/M34)-90%-Rep3	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-90%-Rep3	Hardness	291	285			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-90%-Rep4	No. Alive	10	0	-	-	-
A68/(CC48/M34)-90%-Rep4	pH	4.63	4.74	-	-	-
A68/(CC48/M34)-90%-Rep4	Temp (C)	12.64	11.79	-	-	-
A68/(CC48/M34)-90%-Rep4	D.O. (mg/L)	8.78	8.57	-	-	-
A68/(CC48/M34)-90%-Rep4	Conductivity (us/cm)	653.3	666.9	-	-	-
A68/(CC48/M34)-90%-Rep4	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-90%-Rep4	Hardness	291	285			

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-80%-Rep1	No. Alive	10	0	-	-	-
A68/(CC48/M34)-80%-Rep1	pH	4.69	4.9	-	-	-
A68/(CC48/M34)-80%-Rep1	Temp (C)	12.39	11.86	-	-	-
A68/(CC48/M34)-80%-Rep1	D.O. (mg/L)	8.66	8.48	-	-	-
A68/(CC48/M34)-80%-Rep1	Conductivity (us/cm)	622.5	636.5	-	-	-
A68/(CC48/M34)-80%-Rep1	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-80%-Rep1	Hardness	275	271			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-80%-Rep2	No. Alive	10	0	-	-	-
A68/(CC48/M34)-80%-Rep2	pH	4.74	4.84	-	-	-
A68/(CC48/M34)-80%-Rep2	Temp (C)	12.55	11.85	-	-	-
A68/(CC48/M34)-80%-Rep2	D.O. (mg/L)	8.68	8.5	-	-	-
A68/(CC48/M34)-80%-Rep2	Conductivity (us/cm)	625.6	636.7	-	-	-
A68/(CC48/M34)-80%-Rep2	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-80%-Rep2	Hardness	275	271			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-80%-Rep3	No. Alive	10	0	-	-	-
A68/(CC48/M34)-80%-Rep3	pH	4.69	4.81	-	-	-
A68/(CC48/M34)-80%-Rep3	Temp (C)	12.59	11.85	-	-	-
A68/(CC48/M34)-80%-Rep3	D.O. (mg/L)	8.73	8.48	-	-	-
A68/(CC48/M34)-80%-Rep3	Conductivity (us/cm)	623.8	636.6	-	-	-
A68/(CC48/M34)-80%-Rep3	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-80%-Rep3	Hardness	275	271			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-80%-Rep4	No. Alive	10	0	-	-	-
A68/(CC48/M34)-80%-Rep4	pH	4.67	4.78	-	-	-
A68/(CC48/M34)-80%-Rep4	Temp (C)	12.63	11.82	-	-	-
A68/(CC48/M34)-80%-Rep4	D.O. (mg/L)	8.72	8.46	-	-	-
A68/(CC48/M34)-80%-Rep4	Conductivity (us/cm)	625	637	-	-	-
A68/(CC48/M34)-80%-Rep4	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-80%-Rep4	Hardness	275	271			

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-75%-Rep1	No. Alive	10	0	-	-	-
A68/(CC48/M34)-75%-Rep1	pH	4.95	5.22	-	-	-
A68/(CC48/M34)-75%-Rep1	Temp (C)	12.41	11.91	-	-	-
A68/(CC48/M34)-75%-Rep1	D.O. (mg/L)	8.59	8.47	-	-	-
A68/(CC48/M34)-75%-Rep1	Conductivity (us/cm)	608.2	624.7	-	-	-
A68/(CC48/M34)-75%-Rep1	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-75%-Rep1	Hardness	274	278			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-75%-Rep2	No. Alive	10	1	0	-	-
A68/(CC48/M34)-75%-Rep2	pH	4.93	5.09	5.43	-	-
A68/(CC48/M34)-75%-Rep2	Temp (C)	12.45	11.89	11.9	-	-
A68/(CC48/M34)-75%-Rep2	D.O. (mg/L)	8.58	8.45	8.61	-	-
A68/(CC48/M34)-75%-Rep2	Conductivity (us/cm)	604	619.8	623.2	-	-
A68/(CC48/M34)-75%-Rep2	Alkalinity	<5.00U		<5.00U		
A68/(CC48/M34)-75%-Rep2	Hardness	274		278		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-75%-Rep3	No. Alive	10	2	0	-	-
A68/(CC48/M34)-75%-Rep3	pH	4.85	5.15	5.1	-	-
A68/(CC48/M34)-75%-Rep3	Temp (C)	12.42	11.88	11.91	-	-
A68/(CC48/M34)-75%-Rep3	D.O. (mg/L)	8.63	8.44	8.65	-	-
A68/(CC48/M34)-75%-Rep3	Conductivity (us/cm)	612.1	623.7	627.2	-	-
A68/(CC48/M34)-75%-Rep3	Alkalinity	<5.00U		<5.00U		
A68/(CC48/M34)-75%-Rep3	Hardness	274		278		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-75%-Rep4	No. Alive	10	0	-	-	-
A68/(CC48/M34)-75%-Rep4	pH	4.84	5.06	-	-	-
A68/(CC48/M34)-75%-Rep4	Temp (C)	12.57	11.87	-	-	-
A68/(CC48/M34)-75%-Rep4	D.O. (mg/L)	8.71	8.48	-	-	-
A68/(CC48/M34)-75%-Rep4	Conductivity (us/cm)	609.7	626.1	-	-	-
A68/(CC48/M34)-75%-Rep4	Alkalinity	<5.00U	<5.00U			
A68/(CC48/M34)-75%-Rep4	Hardness	274	278			

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-50%-Rep1	No. Alive	10	10	10	10	9
A68/(CC48/M34)-50%-Rep1	pH	6.34	6.95	6.96	7.02	7.01
A68/(CC48/M34)-50%-Rep1	Temp (C)	12.41	12.01	11.81	11.74	12.01
A68/(CC48/M34)-50%-Rep1	D.O. (mg/L)	8.79	8.28	8.29	8.21	8.32
A68/(CC48/M34)-50%-Rep1	Conductivity (us/cm)	542	549.5	550.1	549.2	550.4
A68/(CC48/M34)-50%-Rep1	Alkalinity	5.36				7.01
A68/(CC48/M34)-50%-Rep1	Hardness	244				242

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-50%-Rep2	No. Alive	10	10	10	9	8
A68/(CC48/M34)-50%-Rep2	pH	6.22	6.89	6.98	6.97	6.98
A68/(CC48/M34)-50%-Rep2	Temp (C)	12.32	11.99	11.84	11.72	11.99
A68/(CC48/M34)-50%-Rep2	D.O. (mg/L)	8.76	8.14	8.26	8.22	8.32
A68/(CC48/M34)-50%-Rep2	Conductivity (us/cm)	542.8	548.5	550.8	549.1	548.6
A68/(CC48/M34)-50%-Rep2	Alkalinity	5.36				7.01
A68/(CC48/M34)-50%-Rep2	Hardness	244				242

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-50%-Rep3	No. Alive	10	10	10	10	9
A68/(CC48/M34)-50%-Rep3	pH	6.04	6.84	6.94	6.96	6.92
A68/(CC48/M34)-50%-Rep3	Temp (C)	12.36	12	11.86	11.7	12.02
A68/(CC48/M34)-50%-Rep3	D.O. (mg/L)	8.72	8.13	8.28	8.29	8.28
A68/(CC48/M34)-50%-Rep3	Conductivity (us/cm)	541.7	548.5	548.1	549.5	548.3
A68/(CC48/M34)-50%-Rep3	Alkalinity	5.36				7.01
A68/(CC48/M34)-50%-Rep3	Hardness	244				242

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-50%-Rep4	No. Alive	10	10	10	10	10
A68/(CC48/M34)-50%-Rep4	pH	5.98	6.81	6.92	6.94	6.83
A68/(CC48/M34)-50%-Rep4	Temp (C)	12.43	11.99	11.85	11.72	12.01
A68/(CC48/M34)-50%-Rep4	D.O. (mg/L)	8.7	8.19	8.3	8.36	8.3
A68/(CC48/M34)-50%-Rep4	Conductivity (us/cm)	542.8	548.2	547.6	546.5	547.6
A68/(CC48/M34)-50%-Rep4	Alkalinity	5.36				7.01
A68/(CC48/M34)-50%-Rep4	Hardness	244				242

APPENDIX C: Test data sheet for the serial dilution of CC48/M34 with A68

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-25%-Rep1	No. Alive	10	10	10	10	10
A68/(CC48/M34)-25%-Rep1	pH	6.97	7.14	7.22	7.27	7.25
A68/(CC48/M34)-25%-Rep1	Temp (C)	12.46	12.1	11.82	11.77	12.02
A68/(CC48/M34)-25%-Rep1	D.O. (mg/L)	8.42	8.14	8.43	8.23	8.41
A68/(CC48/M34)-25%-Rep1	Conductivity (us/cm)	483.8	491.4	493.5	495.4	498.1
A68/(CC48/M34)-25%-Rep1	Alkalinity	16.6				22.8
A68/(CC48/M34)-25%-Rep1	Hardness	214				221

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-25%-Rep2	No. Alive	10	10	10	10	10
A68/(CC48/M34)-25%-Rep2	pH	6.89	7.06	7.19	7.26	7.23
A68/(CC48/M34)-25%-Rep2	Temp (C)	12.6	12.05	11.81	11.75	12.01
A68/(CC48/M34)-25%-Rep2	D.O. (mg/L)	8.52	8.21	8.43	8.27	8.4
A68/(CC48/M34)-25%-Rep2	Conductivity (us/cm)	484.2	491.8	495.8	496.3	496.5
A68/(CC48/M34)-25%-Rep2	Alkalinity	16.6				22.8
A68/(CC48/M34)-25%-Rep2	Hardness	214				221

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-25%-Rep3	No. Alive	10	10	10	10	10
A68/(CC48/M34)-25%-Rep3	pH	6.84	7.04	7.16	7.33	7.24
A68/(CC48/M34)-25%-Rep3	Temp (C)	12.58	12.04	11.8	11.75	12.02
A68/(CC48/M34)-25%-Rep3	D.O. (mg/L)	8.65	8.17	8.35	8.23	8.4
A68/(CC48/M34)-25%-Rep3	Conductivity (us/cm)	485.3	490.6	493.4	497.3	495.3
A68/(CC48/M34)-25%-Rep3	Alkalinity	16.6				22.8
A68/(CC48/M34)-25%-Rep3	Hardness	214				221

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
A68/(CC48/M34)-25%-Rep4	No. Alive	10	10	10	10	10
A68/(CC48/M34)-25%-Rep4	pH	6.82	7.02	7.13	7.3	7.24
A68/(CC48/M34)-25%-Rep4	Temp (C)	12.6	12.04	11.81	11.76	12.03
A68/(CC48/M34)-25%-Rep4	D.O. (mg/L)	8.74	8.13	8.28	8.21	8.33
A68/(CC48/M34)-25%-Rep4	Conductivity (us/cm)	481.2	490.9	492..8	493.6	495
A68/(CC48/M34)-25%-Rep4	Alkalinity	16.6				22.8
A68/(CC48/M34)-25%-Rep4	Hardness	214				221

APPENDIX D: Test data sheet for the serial dilution of CC48/M34 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)Control-Rep1	No. Alive	10	10	10	10	10
HRW (CC48/M34)Control-Rep1	pH	7.74	7.65	7.67	7.77	7.68
HRW (CC48/M34)Control-Rep1	Temp (C)	13.25	12.05	12.21	11.93	11.92
HRW (CC48/M34)Control-Rep1	D.O. (mg/L)	8.03	8.02	7.55	7.72	7.89
HRW (CC48/M34)Control-Rep1	Conductivity (us/cm)	627.4	637.8	637.8	642.2	639.4
HRW (CC48/M34)Control-Rep1	Alkalinity	123				125
HRW (CC48/M34)Control-Rep1	Hardness	176				181

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)Control-Rep2	No. Alive	10	10	10	10	10
HRW (CC48/M34)Control-Rep2	pH	7.87	7.76	7.81	7.85	7.77
HRW (CC48/M34)Control-Rep2	Temp (C)	13.18	11.95	12.14	11.88	11.83
HRW (CC48/M34)Control-Rep2	D.O. (mg/L)	8.11	8.1	7.69	7.76	8.13
HRW (CC48/M34)Control-Rep2	Conductivity (us/cm)	634.8	636.5	635.5	638.9	640.1
HRW (CC48/M34)Control-Rep2	Alkalinity	123				125
HRW (CC48/M34)Control-Rep2	Hardness	176				181

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)Control-Rep3	No. Alive	10	10	10	10	10
HRW (CC48/M34)Control-Rep3	pH	8.08	7.85	7.97	7.93	7.89
HRW (CC48/M34)Control-Rep3	Temp (C)	13.12	11.9	12.03	11.79	11.8
HRW (CC48/M34)Control-Rep3	D.O. (mg/L)	8.07	8.24	8	8.03	8.28
HRW (CC48/M34)Control-Rep3	Conductivity (us/cm)	628.6	635.1	638.4	639.7	639
HRW (CC48/M34)Control-Rep3	Alkalinity	123				125
HRW (CC48/M34)Control-Rep3	Hardness	176				181

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)Control-Rep4	No. Alive	10	10	10	10	10
HRW (CC48/M34)Control-Rep4	pH	8.16	7.91	8.03	7.93	7.97
HRW (CC48/M34)Control-Rep4	Temp (C)	13.1	11.89	12.02	11.78	11.79
HRW (CC48/M34)Control-Rep4	D.O. (mg/L)	8.08	8.35	8.16	8.09	8.34
HRW (CC48/M34)Control-Rep4	Conductivity (us/cm)	631.4	644.8	636.9	639.6	642.1
HRW (CC48/M34)Control-Rep4	Alkalinity	123				125
HRW (CC48/M34)Control-Rep4	Hardness	176				181

APPENDIX D: Test data sheet for the serial dilution of CC48/M34 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms 10	
End Date	04/23/13	No. of Replicates 4	
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-95%-Rep1	No. Alive	10	0	-	-	-
HRW (CC48/M34)-95%-Rep1	pH	5.15	5	-	-	-
HRW (CC48/M34)-95%-Rep1	Temp (C)	12.13	11.96	-	-	-
HRW (CC48/M34)-95%-Rep1	D.O. (mg/L)	8.82	8.58	-	-	-
HRW (CC48/M34)-95%-Rep1	Conductivity (us/cm)	672.7	686	-	-	-
HRW (CC48/M34)-95%-Rep1	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-95%-Rep1	Hardness	293	292			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-95%-Rep2	No. Alive	10	0	-	-	-
HRW (CC48/M34)-95%-Rep2	pH	4.58	4.95	-	-	-
HRW (CC48/M34)-95%-Rep2	Temp (C)	12.09	11.96	-	-	-
HRW (CC48/M34)-95%-Rep2	D.O. (mg/L)	8.91	8.5	-	-	-
HRW (CC48/M34)-95%-Rep2	Conductivity (us/cm)	675.1	686.6	-	-	-
HRW (CC48/M34)-95%-Rep2	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-95%-Rep2	Hardness	293	292			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-95%-Rep3	No. Alive	10	0	-	-	-
HRW (CC48/M34)-95%-Rep3	pH	4.53	5.02	-	-	-
HRW (CC48/M34)-95%-Rep3	Temp (C)	12.05	11.96	-	-	-
HRW (CC48/M34)-95%-Rep3	D.O. (mg/L)	8.95	8.51	-	-	-
HRW (CC48/M34)-95%-Rep3	Conductivity (us/cm)	675.6	689.3	-	-	-
HRW (CC48/M34)-95%-Rep3	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-95%-Rep3	Hardness	293	292			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-95%-Rep4	No. Alive	10	0	-	-	-
HRW (CC48/M34)-95%-Rep4	pH	4.48	4.98	-	-	-
HRW (CC48/M34)-95%-Rep4	Temp (C)	12	11.96	-	-	-
HRW (CC48/M34)-95%-Rep4	D.O. (mg/L)	9.01	8.55	-	-	-
HRW (CC48/M34)-95%-Rep4	Conductivity (us/cm)	674.2	688.8	-	-	-
HRW (CC48/M34)-95%-Rep4	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-95%-Rep4	Hardness	293	292			

APPENDIX D: Test data sheet for the serial dilution of CC48/M34 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13
End Date	04/23/13
Organism	RBT (0.38 gram)

No. Organisms	10
No. of Replicates	4
Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-90%-Rep1	No. Alive	10	0	-	-	-
HRW (CC48/M34)-90%-Rep1	pH	5.32	6.36	-	-	-
HRW (CC48/M34)-90%-Rep1	Temp (C)	12.23	11.93	-	-	-
HRW (CC48/M34)-90%-Rep1	D.O. (mg/L)	8.8	8.46	-	-	-
HRW (CC48/M34)-90%-Rep1	Conductivity (us/cm)	658.6	677.4	-	-	-
HRW (CC48/M34)-90%-Rep1	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-90%-Rep1	Hardness	283	280			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-90%-Rep2	No. Alive	10	0	-	-	-
HRW (CC48/M34)-90%-Rep2	pH	5.26	5.61	-	-	-
HRW (CC48/M34)-90%-Rep2	Temp (C)	12.2	11.95	-	-	-
HRW (CC48/M34)-90%-Rep2	D.O. (mg/L)	8.91	8.5	-	-	-
HRW (CC48/M34)-90%-Rep2	Conductivity (us/cm)	657.7	672.6	-	-	-
HRW (CC48/M34)-90%-Rep2	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-90%-Rep2	Hardness	283	280			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-90%-Rep3	No. Alive	10	0	-	-	-
HRW (CC48/M34)-90%-Rep3	pH	5.15	5.4	-	-	-
HRW (CC48/M34)-90%-Rep3	Temp (C)	12.15	11.96	-	-	-
HRW (CC48/M34)-90%-Rep3	D.O. (mg/L)	8.89	8.5	-	-	-
HRW (CC48/M34)-90%-Rep3	Conductivity (us/cm)	659.7	673.1	-	-	-
HRW (CC48/M34)-90%-Rep3	Alkalinity	<5.00U	<5.00U			
HRW (CC48/M34)-90%-Rep3	Hardness	283	280			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-90%-Rep4	No. Alive	10	1	0	-	-
HRW (CC48/M34)-90%-Rep4	pH	5.17	5.36	5.8	-	-
HRW (CC48/M34)-90%-Rep4	Temp (C)	12.09	11.96	11.8	-	-
HRW (CC48/M34)-90%-Rep4	D.O. (mg/L)	8.94	8.54	8.58	-	-
HRW (CC48/M34)-90%-Rep4	Conductivity (us/cm)	657.9	675.7	682.1	-	-
HRW (CC48/M34)-90%-Rep4	Alkalinity	<5.00U		<5.00U		
HRW (CC48/M34)-90%-Rep4	Hardness	283		280		

APPENDIX D: Test data sheet for the serial dilution of CC48/M34 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-75%-Rep1	No. Alive	10	10	10	10	10
HRW (CC48/M34)-75%-Rep1	pH	6.69	7.49	7.51	7.36	7.5
HRW (CC48/M34)-75%-Rep1	Temp (C)	12.44	11.94	11.87	11.77	11.78
HRW (CC48/M34)-75%-Rep1	D.O. (mg/L)	8.57	8.41	8.43	8.43	8.42
HRW (CC48/M34)-75%-Rep1	Conductivity (us/cm)	647	650.6	645.5	648.7	651.9
HRW (CC48/M34)-75%-Rep1	Alkalinity	12.6				13.5
HRW (CC48/M34)-75%-Rep1	Hardness	267				265

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-75%-Rep2	No. Alive	10	10	10	10	10
HRW (CC48/M34)-75%-Rep2	pH	6.61	7.41	7.54	7.31	7.34
HRW (CC48/M34)-75%-Rep2	Temp (C)	12.52	11.94	11.87	11.79	11.78
HRW (CC48/M34)-75%-Rep2	D.O. (mg/L)	8.63	8.32	8.4	8.13	8.33
HRW (CC48/M34)-75%-Rep2	Conductivity (us/cm)	648.2	650.9	648.5	648.5	650.9
HRW (CC48/M34)-75%-Rep2	Alkalinity	12.6				13.5
HRW (CC48/M34)-75%-Rep2	Hardness	267				265

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-75%-Rep3	No. Alive	10	10	10	10	10
HRW (CC48/M34)-75%-Rep3	pH	6.38	7.36	7.38	7.23	7.36
HRW (CC48/M34)-75%-Rep3	Temp (C)	12.32	11.93	11.87	11.8	11.75
HRW (CC48/M34)-75%-Rep3	D.O. (mg/L)	8.66	8.19	8.32	8.12	8.33
HRW (CC48/M34)-75%-Rep3	Conductivity (us/cm)	646.3	649.8	648.9	649.8	650.5
HRW (CC48/M34)-75%-Rep3	Alkalinity	12.6				13.5
HRW (CC48/M34)-75%-Rep3	Hardness	267				265

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-75%-Rep4	No. Alive	10	10	10	10	10
HRW (CC48/M34)-75%-Rep4	pH	6.44	7.33	7.4	7.22	7.41
HRW (CC48/M34)-75%-Rep4	Temp (C)	12.37	11.94	11.85	11.78	11.76
HRW (CC48/M34)-75%-Rep4	D.O. (mg/L)	8.67	8.2	8.28	8.2	8.37
HRW (CC48/M34)-75%-Rep4	Conductivity (us/cm)	646.9	651.3	645	643.9	652
HRW (CC48/M34)-75%-Rep4	Alkalinity	12.6				13.5
HRW (CC48/M34)-75%-Rep4	Hardness	267				265

APPENDIX D: Test data sheet for the serial dilution of CC48/M34 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-50%-Rep1	No. Alive	10	10	10	10	10
HRW (CC48/M34)-50%-Rep1	pH	7.23	7.76	7.8	7.76	7.71
HRW (CC48/M34)-50%-Rep1	Temp (C)	12.79	11.92	11.94	11.75	11.82
HRW (CC48/M34)-50%-Rep1	D.O. (mg/L)	8.34	8.43	8.34	8.31	8.39
HRW (CC48/M34)-50%-Rep1	Conductivity (us/cm)	642.3	645.6	644.1	647.8	648.7
HRW (CC48/M34)-50%-Rep1	Alkalinity	47.9				50.1
HRW (CC48/M34)-50%-Rep1	Hardness	242				235

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-50%-Rep2	No. Alive	10	10	10	10	10
HRW (CC48/M34)-50%-Rep2	pH	7.16	7.75	7.8	7.76	7.62
HRW (CC48/M34)-50%-Rep2	Temp (C)	12.78	11.93	11.92	11.77	11.78
HRW (CC48/M34)-50%-Rep2	D.O. (mg/L)	8.35	8.43	8.26	8.3	8.37
HRW (CC48/M34)-50%-Rep2	Conductivity (us/cm)	640.8	644.2	645.2	646	649.2
HRW (CC48/M34)-50%-Rep2	Alkalinity	47.9				50.1
HRW (CC48/M34)-50%-Rep2	Hardness	242				235

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-50%-Rep3	No. Alive	10	10	10	10	10
HRW (CC48/M34)-50%-Rep3	pH	7.1	7.69	7.79	7.71	7.61
HRW (CC48/M34)-50%-Rep3	Temp (C)	12.62	11.93	11.89	11.76	11.76
HRW (CC48/M34)-50%-Rep3	D.O. (mg/L)	8.34	8.41	8.28	8.24	8.39
HRW (CC48/M34)-50%-Rep3	Conductivity (us/cm)	642.8	646.5	647.2	646.8	648.1
HRW (CC48/M34)-50%-Rep3	Alkalinity	47.9				50.1
HRW (CC48/M34)-50%-Rep3	Hardness	242				235

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-50%-Rep4	No. Alive	10	10	10	10	10
HRW (CC48/M34)-50%-Rep4	pH	7.06	7.66	7.74	7.72	7.73
HRW (CC48/M34)-50%-Rep4	Temp (C)	12.53	11.93	11.88	11.75	11.75
HRW (CC48/M34)-50%-Rep4	D.O. (mg/L)	8.43	8.36	8.3	8.28	8.4
HRW (CC48/M34)-50%-Rep4	Conductivity (us/cm)	639.2	642.2	643.6	642.4	647.1
HRW (CC48/M34)-50%-Rep4	Alkalinity	47.9				50.1
HRW (CC48/M34)-50%-Rep4	Hardness	242				235

APPENDIX D: Test data sheet for the serial dilution of CC48/M34 with HRW

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/19/13	No. Organisms	10
End Date	04/23/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA,BW,LC,NM

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-25%-Rep1	No. Alive	10	10	10	10	10
HRW (CC48/M34)-25%-Rep1	pH	7.74	7.8	7.86	7.85	7.84
HRW (CC48/M34)-25%-Rep1	Temp (C)	13.09	11.92	12.1	11.8	11.79
HRW (CC48/M34)-25%-Rep1	D.O. (mg/L)	8.01	8.14	8.27	8.18	8.4
HRW (CC48/M34)-25%-Rep1	Conductivity (us/cm)	637.1	643.4	646.7	641.5	646.3
HRW (CC48/M34)-25%-Rep1	Alkalinity	83.5				85.0
HRW (CC48/M34)-25%-Rep1	Hardness	210				204

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-25%-Rep2	No. Alive	10	10	10	10	10
HRW (CC48/M34)-25%-Rep2	pH	7.76	7.77	7.87	7.86	7.76
HRW (CC48/M34)-25%-Rep2	Temp (C)	13.22	11.92	12.02	11.78	11.78
HRW (CC48/M34)-25%-Rep2	D.O. (mg/L)	8.08	8.14	8.3	8.21	8.4
HRW (CC48/M34)-25%-Rep2	Conductivity (us/cm)	636.1	641.8	641.8	642.7	646.6
HRW (CC48/M34)-25%-Rep2	Alkalinity	83.5				85.0
HRW (CC48/M34)-25%-Rep2	Hardness	210				204

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-25%-Rep3	No. Alive	10	10	10	10	10
HRW (CC48/M34)-25%-Rep3	pH	7.6	7.88	7.86	7.85	7.88
HRW (CC48/M34)-25%-Rep3	Temp (C)	13.42	11.92	11.96	11.76	11.78
HRW (CC48/M34)-25%-Rep3	D.O. (mg/L)	8.16	8.23	8.33	8.22	8.43
HRW (CC48/M34)-25%-Rep3	Conductivity (us/cm)	636.1	640.3	640.5	641.6	645.6
HRW (CC48/M34)-25%-Rep3	Alkalinity	83.5				85.0
HRW (CC48/M34)-25%-Rep3	Hardness	210				204

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
HRW (CC48/M34)-25%-Rep4	No. Alive	10	10	10	10	10
HRW (CC48/M34)-25%-Rep4	pH	7.55	7.83	7.86	7.85	7.87
HRW (CC48/M34)-25%-Rep4	Temp (C)	13.47	11.91	11.98	11.77	11.81
HRW (CC48/M34)-25%-Rep4	D.O. (mg/L)	8.07	8.28	8.32	8.24	8.46
HRW (CC48/M34)-25%-Rep4	Conductivity (us/cm)	636.8	640.3	642.1	640.3	646.1
HRW (CC48/M34)-25%-Rep4	Alkalinity	83.5				85.0
HRW (CC48/M34)-25%-Rep4	Hardness	210				204

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA, BW, NM, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-01	No. Alive	10	10	10	10	10
Control-01	pH	7.84	7.11	7.04	7.15	7.45
Control-01	Temp (C)	12.54	12.24	12.1	12.17	12.29
Control-01	D.O. (mg/L)	8.49	7.92	8.03	7.98	7.09
Control-01	Conductivity (us/cm)	307.9	318.3	279.6	286.4	290.5
Control-01	Alkalinity	56.2				55.6
Control-01	Hardness	89				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-02	No. Alive	10	10	10	10	10
Control-02	pH	7.88	7.13	7.18	7.28	7.37
Control-02	Temp (C)	12.32	12.19	12.01	12.13	12.08
Control-02	D.O. (mg/L)	8.57	7.94	8.03	7.94	7.28
Control-02	Conductivity (us/cm)	306.3	313.9	279.6	283.5	288.8
Control-02	Alkalinity	56.2				55.6
Control-02	Hardness	89				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-03	No. Alive	10	10	10	10	10
Control-03	pH	7.89	7.15	7.09	7.22	7.5
Control-03	Temp (C)	12.18	12.05	11.86	11.98	11.93
Control-03	D.O. (mg/L)	8.64	8.03	8.06	7.97	7.66
Control-03	Conductivity (us/cm)	306.5	314.5	278.4	283.4	288.2
Control-03	Alkalinity	56.2				55.6
Control-03	Hardness	89				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-04	No. Alive	10	10	10	10	10
Control-04	pH	7.94	7.19	7.12	7.35	7.57
Control-04	Temp (C)	12.13	12.01	11.82	11.84	11.9
Control-04	D.O. (mg/L)	8.63	8.05	8.1	8.01	7.89
Control-04	Conductivity (us/cm)	306.6	314	278.7	283.7	287.4
Control-04	Alkalinity	56.2				55.6
Control-04	Hardness	89				79

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13
End Date	04/22/13
Organism	RBT (0.38 gram)

No. Organisms	10
No. of Replicates	4
Analysts	SA, BW, NM, LC

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13		No. Organisms	10
End Date	04/22/13		No. of Replicates	4
Organism	RBT (0.38 gram)		Analysts	SA, BW, NM, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-01	No. Alive	10	10	9	9	9
6.25%-01	pH	8.05	7.38	7.18	7.49	7.58
6.25%-01	Temp (C)	12.1	12.01	11.86	11.85	11.94
6.25%-01	D.O. (mg/L)	8.66	8.11	8.23	8.32	8.23
6.25%-01	Conductivity (us/cm)	306.6	317.7	280.5	284.6	288.1
6.25%-01	Alkalinity	55.4				55.4
6.25%-01	Hardness	90				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-02	No. Alive	10	10	10	10	10
6.25%-02	pH	8.02	7.47	7.2	7.48	7.62
6.25%-02	Temp (C)	12.11	11.86	11.83	11.82	11.91
6.25%-02	D.O. (mg/L)	8.66	7.3	8.19	8.28	8.28
6.25%-02	Conductivity (us/cm)	306.8	316.2	278.5	284.3	288.5
6.25%-02	Alkalinity	55.4				55.4
6.25%-02	Hardness	90				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-03	No. Alive	10	10	10	10	10
6.25%-03	pH	8.03	7.19	7.21	7.5	7.65
6.25%-03	Temp (C)	12.12	12.02	11.82	11.76	11.84
6.25%-03	D.O. (mg/L)	8.67	7.16	8.17	8.25	8.31
6.25%-03	Conductivity (us/cm)	306.5	314.5	277.5	282.6	286.2
6.25%-03	Alkalinity	55.4				55.4
6.25%-03	Hardness	90				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%-04	No. Alive	10	10	10	10	10
6.25%-04	pH	7.99	7.35	7.23	7.5	7.62
6.25%-04	Temp (C)	12.11	12.02	11.81	11.74	11.82
6.25%-04	D.O. (mg/L)	8.67	7.52	8.22	8.17	8.23
6.25%-04	Conductivity (us/cm)	306.4	315.6	279.1	284	287.3
6.25%-04	Alkalinity	55.4				55.4
6.25%-04	Hardness	90				79

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13
End Date	04/22/13
Organism	RBT (0.38 gram)

No. Organisms	10
No. of Replicates	4
Analysts	SA, BW, NM, LC

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13		No. Organisms	10
End Date	04/22/13		No. of Replicates	4
Organism	RBT (0.38 gram)		Analysts	SA, BW, NM, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-01	No. Alive	10	10	9	9	9
12.5%-01	pH	8	7.19	7.28	7.48	7.66
12.5%-01	Temp (C)	11.94	12.02	11.79	11.77	11.84
12.5%-01	D.O. (mg/L)	8.69	7.5	8.35	8.23	8.23
12.5%-01	Conductivity (us/cm)	307.3	328.3	281.3	286.8	290
12.5%-01	Alkalinity	53.7				53.1
12.5%-01	Hardness	88				78

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-02	No. Alive	10	9	8	7	7
12.5%-02	pH	7.98	7.36	7.14	7.49	7.68
12.5%-02	Temp (C)	11.95	12.03	11.8	11.77	11.83
12.5%-02	D.O. (mg/L)	8.71	7.42	8.4	8.25	8.27
12.5%-02	Conductivity (us/cm)	307.2	316.2	278.4	283.1	284
12.5%-02	Alkalinity	53.7				53.1
12.5%-02	Hardness	88				78

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-03	No. Alive	10	8	8	8	8
12.5%-03	pH	7.99	7.09	7.29	7.52	7.65
12.5%-03	Temp (C)	12.09	12.05	11.8	11.76	11.82
12.5%-03	D.O. (mg/L)	8.68	7.36	8.44	8.24	8.3
12.5%-03	Conductivity (us/cm)	306.5	316.3	279.2	283.2	286.2
12.5%-03	Alkalinity	53.7				53.1
12.5%-03	Hardness	88				78

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-04	No. Alive	10	10	10	10	10
12.5%-04	pH	7.98	7.12	7.53	7.51	7.64
12.5%-04	Temp (C)	12.09	12.03	11.8	11.74	11.81
12.5%-04	D.O. (mg/L)	8.69	7.28	8.45	8.32	8.34
12.5%-04	Conductivity (us/cm)	306.5	320.8	283.2	288.9	288.8
12.5%-04	Alkalinity	53.7				53.1
12.5%-04	Hardness	88				78

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13
End Date	04/22/13
Organism	RBT (0.38 gram)

No. Organisms	10
No. of Replicates	4
Analysts	SA, BW, NM, LC

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13		No. Organisms	10
End Date	04/22/13		No. of Replicates	4
Organism	RBT (0.38 gram)		Analysts	SA, BW, NM, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-01	No. Alive	10	3	1	1	1
25%-01	pH	8.07	7.46	7.4	7.53	7.74
25%-01	Temp (C)	12.13	12.04	11.82	11.71	11.82
25%-01	D.O. (mg/L)	8.67	8.04	8.5	8.53	8.47
25%-01	Conductivity (us/cm)	306.3	317.4	275.8	276	282.4
25%-01	Alkalinity	60.4				55.1
25%-01	Hardness	90				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-02	No. Alive	10	5	3	2	2
25%-02	pH	8.06	7.52	7.35	7.63	7.61
25%-02	Temp (C)	12.12	12.04	11.83	11.73	11.84
25%-02	D.O. (mg/L)	8.68	8.14	8.47	8.57	8.55
25%-02	Conductivity (us/cm)	305.8	320	277.6	278.9	281.3
25%-02	Alkalinity	60.4				55.1
25%-02	Hardness	90				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-03	No. Alive	10	5	2	2	2
25%-03	pH	7.99	7.5	7.37	7.62	7.75
25%-03	Temp (C)	12.05	12.04	11.82	11.75	11.82
25%-03	D.O. (mg/L)	8.7	8.1	8.47	8.57	8.55
25%-03	Conductivity (us/cm)	305.9	320.1	277.8	277.7	280.1
25%-03	Alkalinity	60.4				55.1
25%-03	Hardness	90				79

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-04	No. Alive	10	5	2	1	1
25%-04	pH	7.97	7.55	7.35	7.61	7.78
25%-04	Temp (C)	12.03	12.05	11.82	11.74	11.84
25%-04	D.O. (mg/L)	8.7	8.13	8.49	8.58	8.56
25%-04	Conductivity (us/cm)	306.6	318.5	278	277.2	276.7
25%-04	Alkalinity	60.4				55.1
25%-04	Hardness	90				79

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13
End Date	04/22/13
Organism	RBT (0.38 gram)

No. Organisms	10
No. of Replicates	4
Analysts	SA, BW, NM, LC

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13		No. Organisms	10
End Date	04/22/13		No. of Replicates	4
Organism	RBT (0.38 gram)		Analysts	SA, BW, NM, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-01	No. Alive	10	0	-	-	-
50%-01	pH	7.92	7.63	-	-	-
50%-01	Temp (C)	12.05	12.03	-	-	-
50%-01	D.O. (mg/L)	8.7	8.35	-	-	-
50%-01	Conductivity (us/cm)	306.6	322.1	-	-	-
50%-01	Alkalinity	56.9	50.4			
50%-01	Hardness	89	76			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-02	No. Alive	10	2	0	-	-
50%-02	pH	7.88	7.76	7.32	-	-
50%-02	Temp (C)	12.01	12.04	11.84	-	-
50%-02	D.O. (mg/L)	8.74	8.43	8.6	-	-
50%-02	Conductivity (us/cm)	306.6	321	275.4	-	-
50%-02	Alkalinity	56.9		50.4		
50%-02	Hardness	89		76		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-03	No. Alive	10	0	-	-	-
50%-03	pH	7.87	7.54	-	-	-
50%-03	Temp (C)	11.98	12.03	-	-	-
50%-03	D.O. (mg/L)	8.73	8.47	-	-	-
50%-03	Conductivity (us/cm)	306.6	318.8	-	-	-
50%-03	Alkalinity	56.9	50.4			
50%-03	Hardness	89	76			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-04	No. Alive	10	2	1	0	-
50%-04	pH	7.96	7.53	7.33	7.6	-
50%-04	Temp (C)	11.99	12.02	11.85	11.75	-
50%-04	D.O. (mg/L)	8.74	8.46	8.61	8.66	-
50%-04	Conductivity (us/cm)	306.6	319.1	276.7	275.2	-
50%-04	Alkalinity	56.9			50.4	
50%-04	Hardness	89			76	

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13
End Date	04/22/13
Organism	RBT (0.38 gram)

No. Organisms	10
No. of Replicates	4
Analysts	SA, BW, NM, LC

APPENDIX E: Test data sheet for the reference toxicity test

Upper Animas 2013
Aquatic Toxicity Test

Start Date	04/18/13	No. Organisms	10
End Date	04/22/13	No. of Replicates	4
Organism	RBT (0.38 gram)	Analysts	SA, BW, NM, LC

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-01	No. Alive	10	1	0	-	-
100%-01	pH	7.84	7.61	7.28	-	-
100%-01	Temp (C)	12.06	11.99	11.87	-	-
100%-01	D.O. (mg/L)	8.72	7.98	8.62	-	-
100%-01	Conductivity (us/cm)	306.8	322.6	274.9	-	-
100%-01	Alkalinity	56.8		52.6		
100%-01	Hardness	90		77		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-02	No. Alive	10	0	-	-	-
100%-02	pH	7.79	7.55	-	-	-
100%-02	Temp (C)	12.02	12.01	-	-	-
100%-02	D.O. (mg/L)	8.71	8.16	-	-	-
100%-02	Conductivity (us/cm)	306.6	319	-	-	-
100%-02	Alkalinity	56.8	52.6			
100%-02	Hardness	90	77			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-03	No. Alive	10	0	-	-	-
100%-03	pH	7.79	7.54	-	-	-
100%-03	Temp (C)	12	12.02	-	-	-
100%-03	D.O. (mg/L)	8.73	8.26	-	-	-
100%-03	Conductivity (us/cm)	306.8	321	-	-	-
100%-03	Alkalinity	56.8	52.6			
100%-03	Hardness	90	77			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-04	No. Alive	10	1	0	-	-
100%-04	pH	7.78	7.5	7.32	-	-
100%-04	Temp (C)	11.99	12.02	11.87	-	-
100%-04	D.O. (mg/L)	8.72	8.29	8.63	-	-
100%-04	Conductivity (us/cm)	306.8	321.8	275	-	-
100%-04	Alkalinity	56.8		52.6		
100%-04	Hardness	90		77		

Attachments

Attachment 1:

CETIS analyses of the acute toxicity data for the profile test

CETIS Test Data Worksheet

Report Date: 05 Jun-13 10:31 (p 1 of 1)
Test Code: 20-4898-5532/7A2109BC

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Start Date: 18 Apr-13 **Species:** Oncorhynchus mykiss **Sample Code:** HRW-Lab Control
End Date: 22 Apr-13 **Protocol:** EPA/821/R-02-012 (2002) **Sample Source:** Upper Animas River
Sample Date: 18 Apr-13 **Material:** Lab Control **Sample Station:** Control

Batch Note: Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions)

Sample Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
HRW-Lab Control	1	10	10	10	10	10	10	
HRW-Lab Control	2	11	10	10	10	10	10	
HRW-Lab Control	3	6	10	10	10	10	10	
HRW-Lab Control	4	20	10	10	10	10	10	
A75B	1	27	10	10	10	10	10	
A75B	2	1	10	10	10	10	10	
A75B	3	22	10	10	10	10	10	
A75B	4	5	10	10	10	10	10	
A73B	1	7	10	10	10	10	10	
A73B	2	2	10	10	10	10	10	
A73B	3	25	10	10	10	9	9	
A73B	4	8	10	10	10	10	10	
A73	1	16	10	10	9	9	9	
A73	2	28	10	10	10	10	10	
A73	3	17	10	10	10	10	10	
A73	4	18	9	9	9	9	9	
A72	1	15	10	10	3	0	0	
A72	2	9	10	10	3	0	0	
A72	3	13	10	10	4	0	0	
A72	4	24	10	9	6	0	0	
A68	1	12	10	10	9	8	8	
A68	2	21	10	10	6	5	5	
A68	3	4	10	10	8	8	8	
A68	4	19	10	10	9	6	6	
M34	1	26	10	10	4	3	0	
M34	2	3	10	10	5	4	3	
M34	3	14	10	10	6	4	3	
M34	4	23	10	10	7	5	0	

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	09-0066-7618	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	19 Jun-13 15:41	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample Code	Sample Comments
HRW-Lab Control	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions).
A75B	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions).
A73B	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions).
A73	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions).
A72	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions).
A68	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#1, no dilutions).
M34	Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test #1, no dilutions).

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run					12.7%

Steel Many-One Rank Test

Sample Code	vs	Sample Code	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
HRW-Lab Control		A75B	18	10	6	1	0.8571	Non-Significant Effect
		A73B	16	10	6	1	0.6450	Non-Significant Effect
		A73	16	10	6	1	0.6450	Non-Significant Effect
		A72	10	10	6	0	0.0480	Significant Effect
		A68	10	10	6	0	0.0480	Significant Effect
		M34	10	10	6	0	0.0480	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	6.877513	1.146252	6	81.59	<0.0001	Significant Effect
Error	0.2950439	0.01404971	21			
Total	7.172557	1.160302	27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	12.28	3.812	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8904	0.8975	0.0069	Non-normal Distribution

96h Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
HRW-Lab Control	4	1	1	1	1	1	0	0	0.0%	0.0%
A75B	4	1	1	1	1	1	0	0	0.0%	0.0%
A73B	4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
A73	4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
A72	4	0	0	0	0	0	0	0		100.0%
A68	4	0.675	0.6179	0.7321	0.5	0.8	0.075	0.15	22.22%	32.5%
M34	4	0.15	0.08412	0.2159	0	0.3	0.0866	0.1732	115.5%	85.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
HRW-Lab Control	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A75B	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
A73B	4	1.371	1.34	1.402	1.249	1.412	0.04074	0.08149	5.94%	2.89%
A73	4	1.369	1.339	1.4	1.249	1.412	0.04007	0.08015	5.85%	3.04%
A72	4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
A68	4	0.9714	0.9098	1.033	0.7854	1.107	0.081	0.162	16.68%	31.2%
M34	4	0.3692	0.2768	0.4616	0.1588	0.5796	0.1215	0.243	65.81%	73.85%

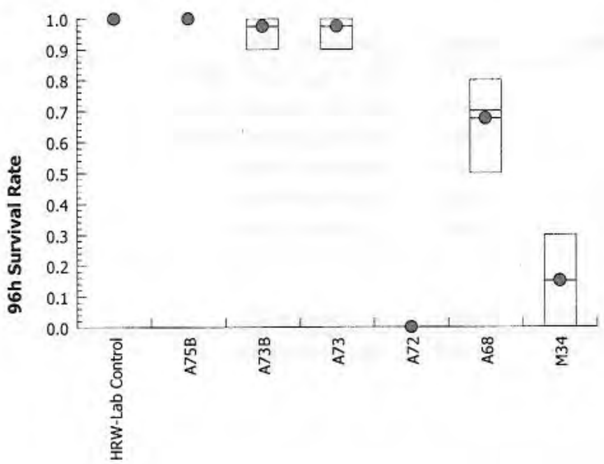
Fish 96-h Acute Survival Test | **U.S. EPA Region 8 Lab**

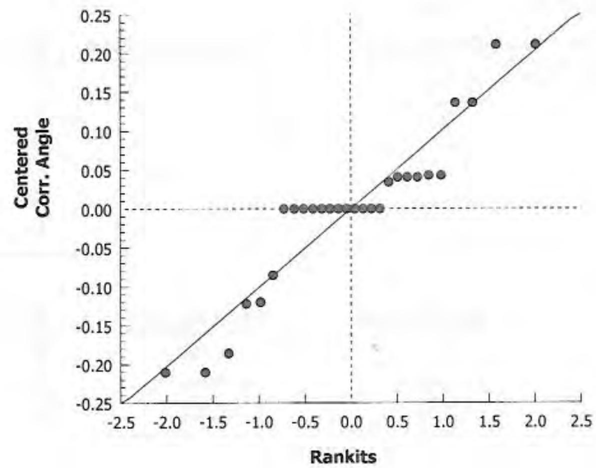
Analysis ID:	09-0066-7618	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	19 Jun-13 15:41	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
HRW-Lab Control	1	1	1	1
A75B	1	1	1	1
A73B	1	1	0.9	1
A73	0.9	1	1	1
A72	0	0	0	0
A68	0.8	0.5	0.8	0.6
M34	0	0.3	0.3	0

Graphics





Attachment 2:

CETIS analyses of the acute toxicity data for the A72 sample diluted with HRW

CETIS Test Data Worksheet

Report Date: 26 Jun-13 11:52 (p 1 of 1)
Test Code: 08-2561-0991/3135D2EF

Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Start Date:	19 Apr-13 14:53	**Species:**	Oncorhynchus mykiss	**Sample Code:**	639A2779
End Date:		**Protocol:**	EPA/821/R-02-012 (2002)	**Sample Source:**	Upper Animas River
Sample Date:	19 Apr-13 14:51	**Material:**	Mining Discharge/Runoff	**Sample Station:**	Control

Batch Note: Region 8: Acute RBT toxicity test using SW from Upper Animas River (Test#2, HRW/A72 dilutions)

Sample Note: Region 8: Acute RBT toxicity test using SW from Upper Animas River (Test#2, HRW/A72 dilutions)

Conc-%	Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
0	L	1	22	10	10	10	10	10	
0	L	2	1	10	10	10	10	10	
0	L	3	3	10	10	10	10	10	
0	L	4	7	10	10	10	10	10	
12		1	12	10	10	10	10	10	
12		2	16	10	10	10	10	10	
12		3	17	10	10	10	10	10	
12		4	26	10	10	10	10	10	
25		1	21	10	10	10	10	10	
25		2	8	10	10	10	10	10	
25		3	20	10	10	10	10	10	
25		4	13	10	10	10	10	10	
35		1	6	10	10	10	10	10	
35		2	24	10	10	10	10	10	
35		3	4	10	10	10	10	10	
35		4	19	10	10	10	10	10	
50		1	5	10	10	10	10	10	
50		2	28	10	10	10	10	10	
50		3	27	10	10	10	10	10	
50		4	2	10	10	10	10	10	
75		1	23	10	10	10	10	10	
75		2	11	10	10	10	10	10	
75		3	9	10	10	10	10	10	
75		4	15	10	10	10	10	10	
88		1	10	10	10	10	10	10	
88		2	25	10	10	10	10	10	
88		3	14	10	10	9	9	9	
88		4	18	10	10	10	10	10	

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	13-6496-9138	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	26 Jun-13 11:48	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run	88	>88	N/A	1.136	4.43%

Steel Many-One Rank Test

Control	vs	Conc-%	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
Lab Water		12	18	10	6	1	0.8571	Non-Significant Effect
		25	18	10	6	1	0.8571	Non-Significant Effect
		35	18	10	6	1	0.8571	Non-Significant Effect
		50	18	10	6	1	0.8571	Non-Significant Effect
		75	18	10	6	1	0.8571	Non-Significant Effect
		88	16	10	6	1	0.6450	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.005691285	0.0009485476	6	1	0.4512	Non-Significant Effect
Error	0.0199195	0.0009485476	21			
Total	0.02561078	0.001897095	27			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	3.812	0.4512	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.4261	0.8975	<0.0001	Non-normal Distribution

96h Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water	4	1	1	1	1	1	0	0	0.0%	0.0%
12		4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	0.0%
35		4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	1	1	1	1	1	0	0	0.0%	0.0%
75		4	1	1	1	1	1	0	0	0.0%	0.0%
88		4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%

Angular (Corrected) Transformed Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
12		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
25		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
35		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
50		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
75		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
88		4	1.371	1.34	1.402	1.249	1.412	0.04074	0.08149	5.94%	2.89%

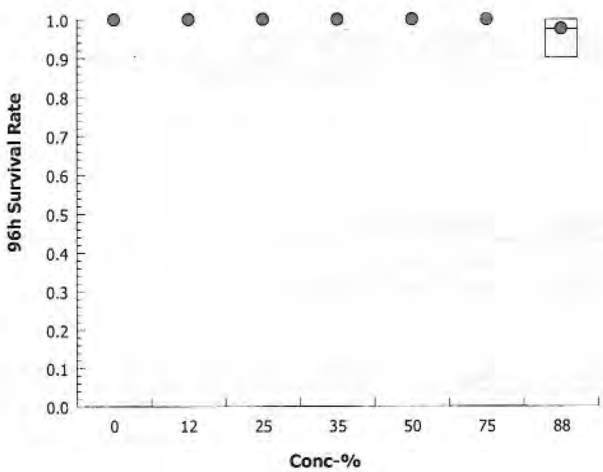
Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

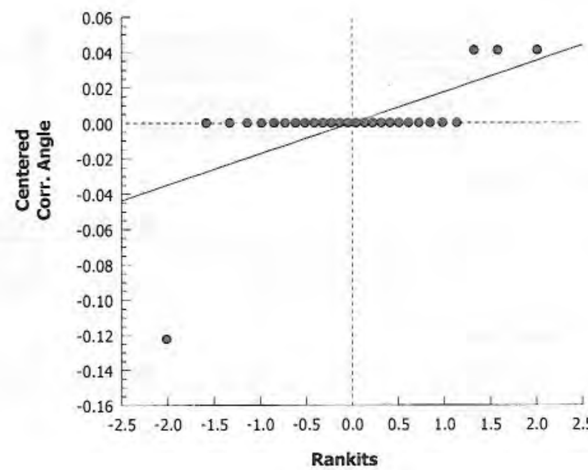
Analysis ID:	13-6496-9138	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	26 Jun-13 11:48	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
12		1	1	1	1
25		1	1	1	1
35		1	1	1	1
50		1	1	1	1
75		1	1	1	1
88		1	1	0.9	1

Graphics





CETIS Analytical Report

Report Date: 26 Jun-13 11:50 (p 1 of 1)
Test Code: 3135D2EF | 08-2561-0991

Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Analysis ID:	03-5627-1896	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	26 Jun-13 11:49	**Analysis:**	Linear Interpolation (ICPIN)	**Official Results:**	Yes

Linear Interpolation Options

X Transform	Y Transform	Seed	Resamples	Exp 95% CL	Method
Log(X+1)	Linear	581076707	200	Yes	Two-Point Interpolation

Point Estimates

Level	%	95% LCL	95% UCL	TU	95% LCL	95% UCL
EC5	>88	N/A	N/A	<1.136	N/A	N/A
EC10	>88	N/A	N/A	<1.136	N/A	N/A
EC15	>88	N/A	N/A	<1.136	N/A	N/A
EC20	>88	N/A	N/A	<1.136	N/A	N/A
EC25	>88	N/A	N/A	<1.136	N/A	N/A
EC40	>88	N/A	N/A	<1.136	N/A	N/A
EC50	>88	N/A	N/A	<1.136	N/A	N/A

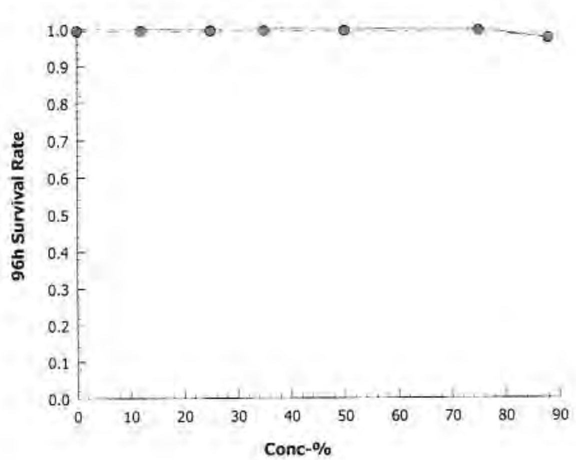
96h Survival Rate Summary

										Calculated Variate(A/B)	
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
12		4	1	1	1	0	0	0.0%	0.0%	40	40
25		4	1	1	1	0	0	0.0%	0.0%	40	40
35		4	1	1	1	0	0	0.0%	0.0%	40	40
50		4	1	1	1	0	0	0.0%	0.0%	40	40
75		4	1	1	1	0	0	0.0%	0.0%	40	40
88		4	0.975	0.9	1	0.025	0.05	5.13%	2.5%	39	40

96h Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
12		1	1	1	1
25		1	1	1	1
35		1	1	1	1
50		1	1	1	1
75		1	1	1	1
88		1	1	0.9	1

Graphics



Attachment 3:

CETIS analyses of the acute toxicity data for the CC48/M34 sample diluted with A68 sample

CETIS Test Data Worksheet

Report Date: 02 Jul-13 09:15 (p 1 of 1)
Test Code: 06-4976-2779/26BA97DB

Fish 96-h Acute Survival Test				U.S. EPA Region 8 Lab

Start Date: 19 Apr-13 12:00 **Species:** Oncorhynchus mykiss **Sample Code:** 6D974FF3
End Date: **Protocol:** EPA/821/R-02-012 (2002) **Sample Source:** Upper Animas River
Sample Date: 19 Apr-13 12:00 **Material:** Mining Discharge/Runoff **Sample Station:** A68/(CC48/M34)

Batch Note: Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#3, CC48/M34 diluted with A68)

Sample Note: Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#3, CC48/M34 diluted with A68)

C-NA	Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
0	L	1	18	10	10	10	10	10	
0	L	2	9	10	10	10	10	10	
0	L	3	25	10	10	10	10	10	
0	L	4	27	10	10	10	10	10	
25		1	16	10	10	10	10	10	
25		2	11	10	10	10	10	10	
25		3	1	10	10	10	10	10	
25		4	14	10	10	10	10	10	
50		1	31	10	10	10	10	9	
50		2	2	10	10	10	9	8	
50		3	7	10	10	10	10	9	
50		4	12	10	10	10	10	10	
75		1	28	10	10	0	0	0	
75		2	19	10	10	1	0	0	
75		3	17	10	10	2	0	0	
75		4	6	10	10	0	0	0	
80		1	30	10	10	0	0	0	
80		2	21	10	10	0	0	0	
80		3	22	10	10	0	0	0	
80		4	10	10	10	0	0	0	
90		1	13	10	10	0	0	0	
90		2	4	10	10	0	0	0	
90		3	26	10	10	0	0	0	
90		4	8	10	10	0	0	0	
95		1	23	10	10	0	0	0	
95		2	15	10	10	0	0	0	
95		3	29	10	10	0	0	0	
95		4	32	10	10	1	0	0	
100		1	20	10	10	0	0	0	
100		2	3	10	10	0	0	0	
100		3	24	10	10	0	0	0	
100		4	5	10	10	0	0	0	

Analyst: BGK QA: EC

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	17-8653-3292	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	02 Jul-13 9:13	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes
Batch ID:	19-1958-6405	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	19 Apr-13 12:00	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Not Applicable
Ending Date:		**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	NA	**Source:**	Trout Lodge Fish Farm	**Age:**	

Data Transform	Zeta	Alt Hyp	Trials	Seed	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	NA	C > T	NA	NA	50	75	61.24		5.42%

Steel Many-One Rank Sum Test

Control	vs	C-NA	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5.4%)
Lab Water		25	18	10	1	6	0.8750	Asymp	Non-Significant Effect
		50	12	10	1	6	0.1755	Asymp	Non-Significant Effect
		75*	10	10	0	6	0.0538	Asymp	Significant Effect
		80*	10	10	0	6	0.0538	Asymp	Significant Effect
		90*	10	10	0	6	0.0538	Asymp	Significant Effect
		95*	10	10	0	6	0.0538	Asymp	Significant Effect
		100*	10	10	0	6	0.0538	Asymp	Significant Effect

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	10.87836	1.554051	7	800.7	<0.0001	Significant Effect
Error	0.04658309	0.001940962	24			
Total	10.92494		31			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	2.972	3.496	0.0216	Equal Variances
Variances	Levene Equality of Variance	3.436	3.496	0.0109	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.3476	0.9081	<0.0001	Non-normal Distribution

96h Survival Rate Summary

C-NA	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Water	4	1	1	1	1	1	1	0	0.0%	0.0%
25		4	1	1	1	1	1	1	0	0.0%	0.0%
50		4	0.9	0.7701	1	0.9	0.8	1	0.04082	9.07%	10.0%
75		4	0	0	0	0	0	0	0		100.0%
80		4	0	0	0	0	0	0	0		100.0%
90		4	0	0	0	0	0	0	0		100.0%
95		4	0	0	0	0	0	0	0		100.0%
100		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-NA	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Lab Water	4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
25		4	1.412	1.412	1.412	1.412	1.412	1.412	0	0.0%	0.0%
50		4	1.254	1.056	1.453	1.249	1.107	1.412	0.06231	9.94%	11.17%
75		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.76%
80		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.76%
90		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.76%
95		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.76%
100		4	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.76%

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID: 17-8653-3292	**Endpoint:** 96h Survival Rate	**CETIS Version:** CETISv1.8.4	
Analyzed: 02 Jul-13 9:13	**Analysis:** Nonparametric-Control vs Treatments	**Official Results:** Yes	

96h Survival Rate Detail

C-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
25		1	1	1	1
50		0.9	0.8	0.9	1
75		0	0	0	0
80		0	0	0	0
90		0	0	0	0
95		0	0	0	0
100		0	0	0	0

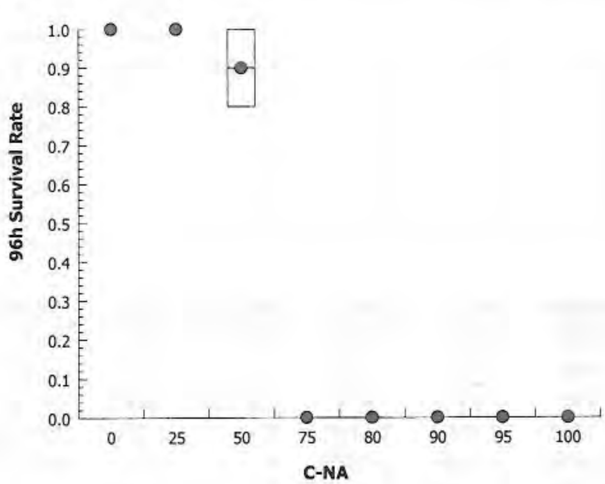
Angular (Corrected) Transformed Detail

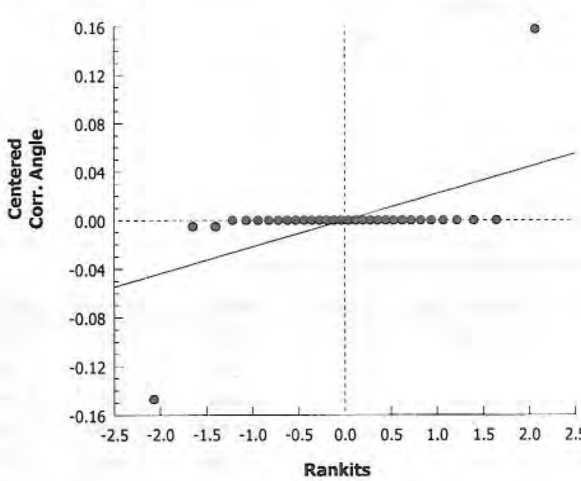
C-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1.412	1.412	1.412	1.412
25		1.412	1.412	1.412	1.412
50		1.249	1.107	1.249	1.412
75		0.1588	0.1588	0.1588	0.1588
80		0.1588	0.1588	0.1588	0.1588
90		0.1588	0.1588	0.1588	0.1588
95		0.1588	0.1588	0.1588	0.1588
100		0.1588	0.1588	0.1588	0.1588

96h Survival Rate Binomials

C-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	10/10	10/10	10/10	10/10
25		10/10	10/10	10/10	10/10
50		9/10	8/10	9/10	10/10
75		0/10	0/10	0/10	0/10
80		0/10	0/10	0/10	0/10
90		0/10	0/10	0/10	0/10
95		0/10	0/10	0/10	0/10
100		0/10	0/10	0/10	0/10

Graphics





CETIS Analytical Report

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	03-4183-4286	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	02 Jul-13 9:13	**Analysis:**	Untrimmed Spearman-Kärber	**Official Results:**	Yes
Batch ID:	19-1958-6405	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	19 Apr-13 12:00	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Not Applicable
Ending Date:		**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	NA	**Source:**	Trout Lodge Fish Farm	**Age:**	

Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	0.00%	1.763	0.01132	57.96	55.02	61.06

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	1	0.9 - NL	Yes	Passes Acceptability Criteria

96h Survival Rate Summary

C-NA	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	Calculated Variate(A/B) A	B
0	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
25		4	1	1	1	0	0	0.0%	0.0%	40	40
50		4	0.9	0.8	1	0.04082	0.08165	9.07%	10.0%	36	40
75		4	0	0	0	0	0		100.0%	0	40
80		4	0	0	0	0	0		100.0%	0	40
90		4	0	0	0	0	0		100.0%	0	40
95		4	0	0	0	0	0		100.0%	0	40
100		4	0	0	0	0	0		100.0%	0	40

96h Survival Rate Detail

C-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
25		1	1	1	1
50		0.9	0.8	0.9	1
75		0	0	0	0
80		0	0	0	0
90		0	0	0	0
95		0	0	0	0
100		0	0	0	0

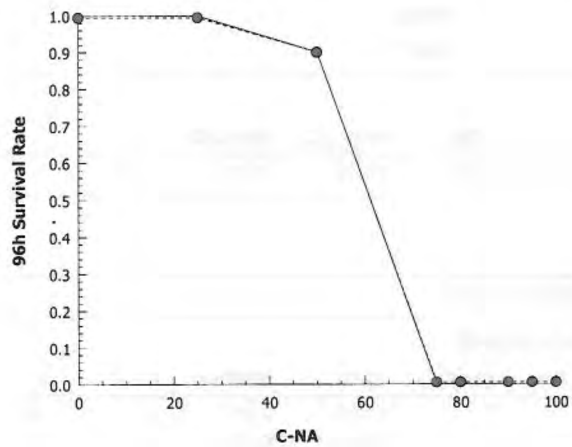
96h Survival Rate Binomials

C-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	10/10	10/10	10/10	10/10
25		10/10	10/10	10/10	10/10
50		9/10	8/10	9/10	10/10
75		0/10	0/10	0/10	0/10
80		0/10	0/10	0/10	0/10
90		0/10	0/10	0/10	0/10
95		0/10	0/10	0/10	0/10
100		0/10	0/10	0/10	0/10

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	03-4183-4286	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.4
Analyzed:	02 Jul-13 9:13	**Analysis:**	Untrimmed Spearman-Kärber	**Official Results:**	Yes

Graphics



Attachment 4:

CETIS analyses of the acute toxicity data for the CC48/M34 sample diluted with HRW

CETIS Test Data Worksheet

Report Date: 26 Jun-13 12:35 (p 1 of 1)
Test Code: 09-8803-2988/3AE42FDC

Fish 96-h Acute Survival Test — U.S. EPA Region 8 Lab

Start Date: 19 Apr-13 12:00
End Date:
Sample Date: 19 Apr-13 12:00
Species: Oncorhynchus mykiss
Protocol: EPA/821/R-02-012 (2002)
Material: Mining Discharge/Runoff
Sample Code: 6E1E3D49
Sample Source: Upper Animas River
Sample Station: HRW/(CC48/M34)

Batch Note: Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#4, CC48/M34 diluted with HRW)

Sample Note: Region 8:Acute RBT toxicity test using SW from Upper Animas River (Test#4, CC48/M34 diluted with HRW)

Conc-NA	Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
0	L	1	8	10	10	10	10	10	
0	L	2	16	10	10	10	10	10	
0	L	3	20	10	10	10	10	10	
0	L	4	17	10	10	10	10	10	
25		1	22	10	10	10	10	10	
25		2	5	10	10	10	10	10	
25		3	24	10	10	10	10	10	
25		4	11	10	10	10	10	10	
50		1	15	10	10	10	10	10	
50		2	6	10	10	10	10	10	
50		3	13	10	10	10	10	10	
50		4	18	10	10	10	10	10	
75		1	23	10	10	10	10	10	
75		2	2	10	10	10	10	10	
75		3	7	10	10	10	10	10	
75		4	21	10	10	10	10	10	
90		1	4	10	0	0	0	0	
90		2	3	10	0	0	0	0	
90		3	1	10	0	0	0	0	
90		4	14	10	1	0	0	0	
95		1	12	10	0	0	0	0	
95		2	10	10	0	0	0	0	
95		3	19	10	0	0	0	0	
95		4	9	10	0	0	0	0	

Analyst: BGK QA: EC

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID: 12-0007-8857 **Endpoint:** 96h Survival Rate **CETIS Version:** CETISv1.8.0
Analyzed: 26 Jun-13 12:35 **Analysis:** Nonparametric-Control vs Treatments **Official Results:** Yes

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run	75	90	82.16		2.5%

Steel Many-One Rank Test

Control	vs	Conc-NA	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
Lab Water		25	18	10	6	1	0.8333	Non-Significant Effect
		50	18	10	6	1	0.8333	Non-Significant Effect
		75	18	10	6	1	0.8333	Non-Significant Effect
		90*	10	10	6	0	0.0417	Significant Effect
		95*	10	10	6	0	0.0417	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	8.376534	1.675307	5	65540	<0.0001	Significant Effect
Error	0	0	18			
Total	8.376534	1.675307	23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	65540	4.248	<0.0001	Unequal Variances

96h Survival Rate Summary

Conc-NA	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water	4	1	1	1	1	1	0	0	0.0%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	0.0%
50		4	1	1	1	1	1	0	0	0.0%	0.0%
75		4	1	1	1	1	1	0	0	0.0%	0.0%
90		4	0	0	0	0	0	0	0		100.0%
95		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Conc-NA	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
25		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
50		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
75		4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
90		4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
95		4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%

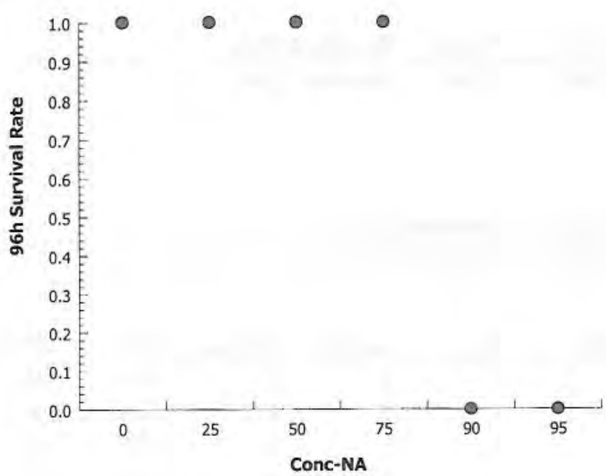
Fish 96-h Acute Survival Test | **U.S. EPA Region 8 Lab**

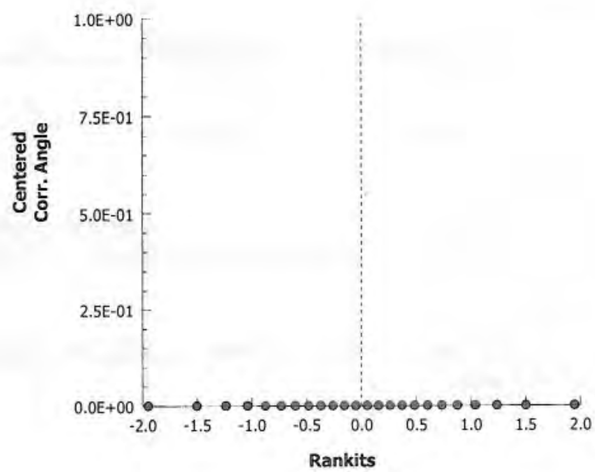
Analysis ID:	12-0007-8857	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	26 Jun-13 12:35	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Conc-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
25		1	1	1	1
50		1	1	1	1
75		1	1	1	1
90		0	0	0	0
95		0	0	0	0

Graphics





CETIS Analytical Report

Report Date:	26 Jun-13 12:36 (p 1 of 1)
Test Code:	3AE42FDC | 09-8803-2988

Fish 96-h Acute Survival Test — **U.S. EPA Region 8 Lab**

Analysis ID:	00-1126-3273	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	26 Jun-13 12:36	**Analysis:**	Binomial Method	**Official Results:**	Yes

Binomial/Graphical Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	0.00%	1.915	0	82.16	79.82	84.56

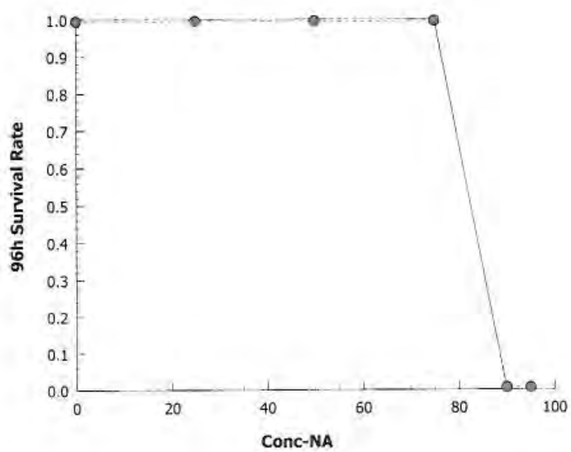
96h Survival Rate Summary — Calculated Variate(A/B)

Conc-NA	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
0	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
25		4	1	1	1	0	0	0.0%	0.0%	40	40
50		4	1	1	1	0	0	0.0%	0.0%	40	40
75		4	1	1	1	0	0	0.0%	0.0%	40	40
90		4	0	0	0	0	0		100.0%	0	40
95		4	0	0	0	0	0		100.0%	0	40

96h Survival Rate Detail

Conc-NA	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water	1	1	1	1
25		1	1	1	1
50		1	1	1	1
75		1	1	1	1
90		0	0	0	0
95		0	0	0	0

Graphics



Spearman-Karber

Attachment 5:

CETIS analyses of the acute toxicity data for the reference toxicity test

CETIS Test Data Worksheet

Report Date: 02 Jul-13 16:15 (p 1 of 1)
Test Code: 04-7609-7282/1C60AB02

Fish 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Start Date: 18 Apr-13 **Species:** Oncorhynchus mykiss **Sample Code:** 0413RBTARTT
End Date: 22 Apr-13 **Protocol:** EPA/821/R-02-012 (2002) **Sample Source:** Reference Toxicant
Sample Date: 18 Apr-13 **Material:** Zinc sulfate **Sample Station:**

Batch Note: Region 8: Concurrent RBT Reference Toxicity Test (Upper Animas River)

Sample Note: Region 8: Concurrent RBT Reference Toxicity Test (Upper Animas River)

Conc-µg/L	Code	Rep	Pos	# Exposed	24h Survival	48h Survival	72h Survival	96h Survival	Notes
5	L	1	7	10	10	10	10	10	
5	L	2	13	10	10	10	10	10	
5	L	3	6	10	10	10	10	10	
5	L	4	24	10	10	10	10	10	
88		1	11	10	10	9	9	9	
88		2	4	10	10	10	10	10	
88		3	16	10	10	10	10	10	
88		4	23	10	10	10	10	10	
155		1	20	10	10	9	9	9	
155		2	5	10	9	8	7	7	
155		3	12	10	8	8	8	8	
155		4	1	10	10	10	10	10	
305		1	18	10	3	1	1	1	
305		2	8	10	5	3	2	2	
305		3	2	10	5	2	2	2	
305		4	3	10	5	2	1	1	
525		1	10	10	0	0	0	0	
525		2	15	10	2	0	0	0	
525		3	19	10	0	0	0	0	
525		4	9	10	2	1	0	0	
1075		1	22	10	1	0	0	0	
1075		2	17	10	0	0	0	0	
1075		3	21	10	0	0	0	0	
1075		4	14	10	1	0	0	0	

Fish 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Analysis ID:	21-0193-1874	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	02 Jul-13 16:25	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch ID:	00-9361-4536	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	18 Apr-13	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Reconstituted Water
Ending Date:	22 Apr-13	**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	96h	**Source:**	Trout Lodge Fish Farm	**Age:**	

Sample ID:	04-0243-6777	**Code:**	0413RBTARTT	**Client:**	ESAT Region 8
Sample Date:	18 Apr-13	**Material:**	Zinc sulfate	**Project:**	Reference Toxicity Test
Receive Date:		**Source:**	Reference Toxicant		
Sample Age:	N/A	**Station:**			

Data Transform	Zeta	Alt Hyp	MC Trials	NOEL	LOEL	TOEL	TU	PMSD
Angular (Corrected)	0	C > T	Not Run	155	305	217.4		9.22%

Steel Many-One Rank Test

Control	vs	Conc-µg/L	Test Stat	Critical	DF	Ties	P-Value	Decision(α:5%)
5		88	16	10	6	1	0.6105	Non-Significant Effect
5		155	12	10	6	1	0.1424	Non-Significant Effect
5		305*	10	10	6	0	0.0417	Significant Effect
5		525*	10	10	6	0	0.0417	Significant Effect
5		1075*	10	10	6	0	0.0417	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	7.355389	1.471078	5	190.2	<0.0001	Significant Effect
Error	0.1392348	0.007735265	18			
Total	7.494623	1.478813	23			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	5.646	4.248	0.0027	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.8662	0.884	0.0044	Non-normal Distribution

96h Survival Rate Summary

Conc-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
5	Lab Water	4	1	1	1	1	1	0	0	0.0%	0.0%
88		4	0.975	0.956	0.994	0.9	1	0.025	0.05	5.13%	2.5%
155		4	0.85	0.8009	0.8991	0.7	1	0.06455	0.1291	15.19%	15.0%
305		4	0.15	0.128	0.172	0.1	0.2	0.02887	0.05774	38.49%	85.0%
525		4	0	0	0	0	0	0	0		100.0%
1075		4	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Conc-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
5	Lab Water	4	1.412	1.412	1.412	1.412	1.412	0	0	0.0%	0.0%
88		4	1.371	1.34	1.402	1.249	1.412	0.04074	0.08149	5.94%	2.89%
155		4	1.19	1.121	1.259	0.9912	1.412	0.09091	0.1818	15.28%	15.73%
305		4	0.3927	0.3615	0.4239	0.3218	0.4636	0.04096	0.08192	20.86%	72.19%
525		4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%
1075		4	0.1588	0.1588	0.1588	0.1588	0.1588	0	0	0.0%	88.76%

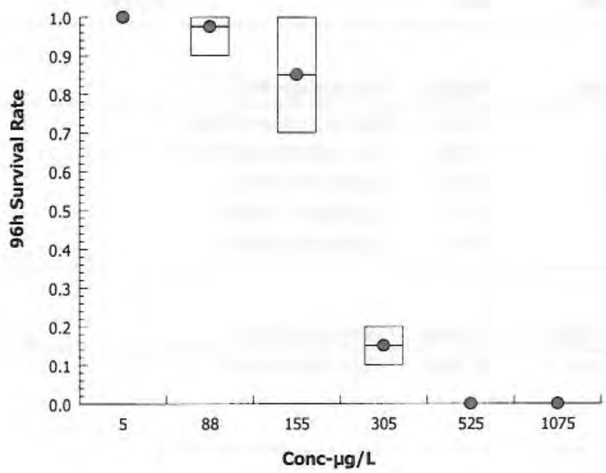
Fish 96-h Acute Survival Test | **U.S. EPA Region I Lab**

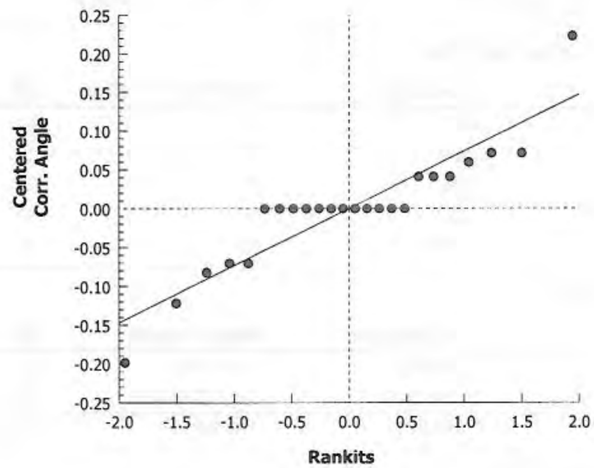
Analysis ID:	21-0193-1874	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	02 Jul-13 16:25	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

96h Survival Rate Detail

Conc-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
5	Lab Water	1	1	1	1
88		0.9	1	1	1
155		0.9	0.7	0.8	1
305		0.1	0.2	0.2	0.1
525		0	0	0	0
1075		0	0	0	0

Graphics





Fish 96-h Acute Survival Test **U.S. EPA Region I Lab**

Analysis ID:	01-0250-5310	**Endpoint:**	96h Survival Rate	**CETIS Version:**	CETISv1.8.0
Analyzed:	02 Jul-13 16:25	**Analysis:**	Trimmed Spearman-Kärber	**Official Results:**	Yes

Batch ID:	00-9361-4536	**Test Type:**	Survival (96h)	**Analyst:**	
Start Date:	18 Apr-13	**Protocol:**	EPA/821/R-02-012 (2002)	**Diluent:**	Reconstituted Water
Ending Date:	22 Apr-13	**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	96h	**Source:**	Trout Lodge Fish Farm	**Age:**	

Sample ID:	04-0243-6777	**Code:**	0413RBTARTT	**Client:**	ESAT Region 8
Sample Date:	18 Apr-13	**Material:**	Zinc sulfate	**Project:**	Reference Toxicity Test
Receive Date:		**Source:**	Reference Toxicant		
Sample Age:	N/A	**Station:**			

Trimmed Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	2.50%	2.334	0.02257	215.8	194.5	239.4

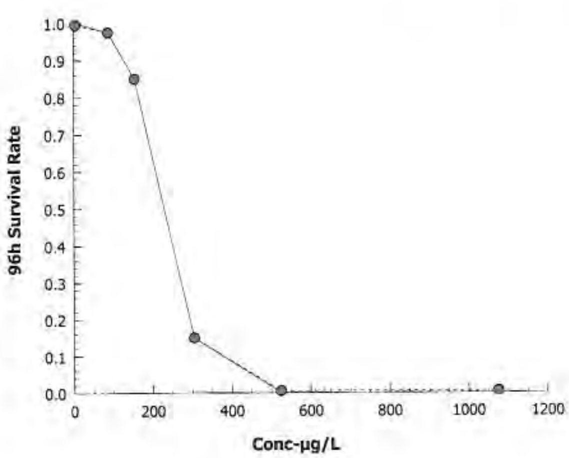
96h Survival Rate Summary

										Calculated Variate(A/B)	
Conc-µg/L	**Control Type**	**Count**	**Mean**	**Min**	**Max**	**Std Err**	**Std Dev**	**CV%**	**%Effect**	**A**	**B**
5	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
88		4	0.975	0.9	1	0.025	0.05	5.13%	2.5%	39	40
155		4	0.85	0.7	1	0.06455	0.1291	15.19%	15.0%	34	40
305		4	0.15	0.1	0.2	0.02887	0.05774	38.49%	85.0%	6	40
525		4	0	0	0	0	0		100.0%	0	40
1075		4	0	0	0	0	0		100.0%	0	40

96h Survival Rate Detail

Conc-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
5	Lab Water	1	1	1	1
88		0.9	1	1	1
155		0.9	0.7	0.8	1
305		0.1	0.2	0.2	0.1
525		0	0	0	0
1075		0	0	0	0

Graphics



Appendix 10a

Animas River
Sediment Toxicity Testing Report
December 2012 Sediment Collection

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Abbreviation/Acronym List

BLM	Bureau of Land Management
ºC	Degrees Celsius
CDPHE	Colorado Department of Public Health and Environment
CETIS	Comprehensive Environmental Toxicity Information System
Control N	Negative laboratory control
Control P	Positive laboratory control
DO	Dissolved Oxygen
EC_{50}	50% Median Effective Concentration
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
g	Grams
gpm	Gallons per minute
kg	Kilogram
LC_{50}	50% Lethal Concentration
MHRW	Moderately Hard Reconstituted Water
mg	Milligram
mL	Milliliter
NH_3	Ammonia
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SGC	Sunnyside Gold Corporation
SOP	Standard Operating Procedure
TAC	Test Acceptability Criterion
YCT	Yeast, Cerophyl, and Trout Chow
$ZnSO_4$	Zinc sulfate heptahydrate

1.0 INTRODUCTION

A 10-day, static-renewal sediment toxicity test using the amphipod, (*Hyalella azteca)*, and sediment from the Animas River (San Juan County, Colorado) was performed at the United States Environmental Protection Agency (EPA) Region 8 Laboratory in December 2012. The purpose of this toxicity test was to determine the toxicity of sediments collected from the Animas River by assessing survival and growth. A 96-hour reference toxicity test was performed concurrently with the Animas River toxicity test as a quality assurance measure. The reference toxicity test consisted of an aqueous stock solution spiked with zinc, with a test endpoint of survival. This report includes a brief background of the Animas Mining District (Section 1.1), materials and methods (Section 2.0), testing results (Section 3.0), a discussion of results (Section 4.0), and supporting references (Section 5.0).

1.1 Background

Information in this section was obtained from the *Final 2012 Sampling and Analysis Plan/Quality Assurance Project Plan, Revision 1, Upper Animas Mining District Gladstone, San Juan County, Colorado*, dated September 2012 (ESAT, 2012).

The discovery of gold and silver brought miners to the Silverton area and Animas Mining District in the early 1870's. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, there were 12 concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down circa 1905, and the mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. After 1907, mining and milling continued throughout the basin whenever prices were relatively favorable. Gladstone, located about eight miles upstream of Silverton on Cement Creek, is the site of an historic mining town developed in the 1880s commensurate with the onset of mining in the surrounding area. The town was the central location and railroad terminus for the milling and shipping of mine ores from the surrounding three-square-mile valley. The town declined in the 1920's and no remnants of the town remain. By the 1970's, the Sunnyside Mine was the only year-round producing mine remaining in the county. This mine ceased production in 1991, and has since undergone reclamation efforts. The Gold King Mine's permit with DRMS is currently in inactive status; however, landowners hope to rehabilitate the mine.

Both the Sunnyside and Gold King properties were partially accessed through the American Tunnel that has its portal in Gladstone. Previously the American Tunnel drained as much as 1,600 gallons per minute (gpm) of water from the mines. A lime feed and settling pond-type treatment facility was constructed in Gladstone in 1979 by Standard Metals Corporation. Water discharging from the American Tunnel was treated as required by the water discharge permit. The facility operations and mine ownership was later transferred to the Sunnyside Gold Corporation (SGC). Under jurisdiction of a court consent decree to terminate their discharge permit, SGC installed several bulkheads within the Sunnyside Mine that greatly reduced the amount of discharge from the American Tunnel. Seventy to one hundred gpm continue to discharge, presumably from near surface groundwater.

In January 2003 the treatment facility, operations, and permit were transferred to the Gold King Mines Corporation. The settling ponds were deeded to the San Juan Corporation by SGC prior to the lease between the Gold King Mines and San Juan Corporations. The treatment facility continued to treat the remaining American Tunnel discharge and the Gold King discharge until September 2004. The San Juan Corporation required SGC to reclaim the four settling ponds (completed in 2005) following termination of the San Juan Corporation and SGC lease. The Gold King Mines Corporation was subsequently evicted and the balance of the Gold King Mines Corporation land was acquired by the San Juan Corporation as the lien holder. The American Tunnel portal reclamation and removal of some out buildings were completed in 2006. The Bureau of Land Management (BLM) manages land associated with the American Tunnel portal and vicinity; however, the San Juan Corporation owns the majority of the land surrounding the portal.

Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, and Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River.

1.2 Objective

The objectives of this toxicity test were to (a) support the yearly monitoring activities at the Animas River, (b) characterize the effects of mine waste-impacted sediment samples on *H. azteca* under subchronic exposure conditions, and (c) generate data to support development of the future Baseline Ecological Risk Assessment and Remedial Investigation.

2.0 MATERIALS AND METHODS

This section outlines the materials and methods used for testing purposes, including sediment collection procedures, water preparation and delivery, test organisms, food preparation, and testing procedures. General test methods following EPA (2000) are discussed below and summarized in **Table 2.0-1**.

2.1 Study Design

The 10-day Animas River sediment toxicity test followed protocols listed in EPA Method 100.1 (EPA, 2000). *H. azteca* survival and growth were measured after the exposure period. The test used a negative laboratory control (Control N; Horsecreek Reservoir control sediment) and a positive laboratory control (Control P; laboratory control sediment spiked with 1,000 milligrams per kilogram [mg/kg] zinc) to help evaluate the overall health of the test organisms and to provide a baseline growth measurement for amphipods exposed to clean sediment. Eight replicates for each sample location and each laboratory control were used during the 10 day toxicity test.

Site sediment was thoroughly homogenized in a stainless steel pan before it was distributed into test chambers one day before the organisms were introduced. 100 milliliters (mL) of sediment was placed in each test replicate chamber before they were placed into a temperature-controlled water bath.

The water bath temperature was held at 23 ± 2ºC for the duration of the test and met the performance criterion. According to EPA Method 100.1 (EPA, 2000), the daily mean test temperature should be ± 1ºC and the instantaneous temperature must always be within ± 3ºC of the target temperature of 23ºC. Moderately Hard Reconstituted Water (MHRW) was added to each test chamber before ten organisms were counted, verified, and introduced. One mL of Yeast, Cerophyl®, and Trout Chow (YCT) feed mixture was added to each test chamber daily and the overlying water was renewed at a rate of two volumes (350 mL) per day for the 10-day test period.

The water quality measurements were collected daily as described in **Exhibit 1** (below). The water quality parameters pH, conductivity, and hardness were checked on test Day 0 and test Day 9. Dissolved Oxygen (DO) and temperature were measured daily. A syringe was used to collect ammonia samples in overlying water from each replicate on the first and last day of the test. On Day 10 of the test, temperature and DO were measured in each test chamber before samples for overlying surface water were collected as a composite sample from all replicates. All overlying water samples collected for ammonia analyses were inspected for the presence of test organisms before the samples were prepared for analysis to ensure no organisms were inadvertently removed from the test chamber.

Exhibit 1: Activities Schedule for a 10-Day Sediment Toxicity Test

Day	Activity
Day -1	Add sediment into test chambers and start renewal of overlying water.
Day 0	Measure surface water quality parameters (pH, temperature, DO, and conductivity) in each replicate. Collect a 10 mL sample from each replicate for ammonia analysis. Obtain hardness measurement by collecting a composite sample from all replicates. Collect pore water samples for dissolved metals analysis from each replicate. Transfer 10 organisms into each test chamber and release them under the surface of the water to avoid entrapment. Add 1.0 mL of YCT into each test chamber. Obtain 80 additional test organisms to measure initial dry weight.
Day 1 through 8	Feed organisms 1.0 mL YCT and measure temperature and DO in each test chamber.
Day 9	Measure surface water quality (pH, temperature, DO, and conductivity) for each replicate. Collect a 10 mL sample from each replicate for ammonia analysis. Collect a composite sample (equal volume from each replicate) for hardness measurement. Add 1.0 mL of YCT into each test chamber.
Day 10	Measure temperature and DO. Collect the surviving organisms from each replicate.

2.2 Sediment Collection

Composite sediment samples were collected in December 2012 from the Animas River, Cement Creek, and Mineral Creek in accordance with the 2012 Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) (ESAT, 2012). Sediment was collected from a depth of 0-2 inches using a Teflon hand trowel. The sample containers were placed on ice until received at the EPA Region 8 laboratory before they were placed in a 4^{o}C cooler for preservation. Sample collection equipment was decontaminated between each sampling location in accordance with procedures outlined in the SAP/QAPP (ESAT, 2012).

2.3 Test Water Preparation and Delivery

MHRW was prepared in accordance with Smith *et al*. (1997) by adding 47.4 grams (g) of calcium sulfate, 122.8 g of magnesium sulfate, 48 g of sodium bicarbonate, and 4 g of potassium chloride to the laboratory stainless steel batch tank containing 1,000 L of deionized water. The batch tank was continuously aerated for the duration of the toxicity test after the MHRW was prepared. Water quality was measured to verify that the following parameters were met: hardness between 90 and 100 milligrams per liter (mg/L), conductivity between 330 and 360 microsiemens/centimeter, and pH between 7.8 and 8.2 standard units (EPA, 2000). **Table 2.3-1** summarizes the parameters for the MHRW used in the test, and the resulting pH and hardness. The MHRW was delivered to each test chamber at a rate of two volumes (approximately 350 mL) of overlying water per day using a glass distribution box similar to the one described in Benoit *et al.* (1983).

Table 2.3-1 Moderately Hard Reconstituted Water Composition and Chemistry

$CaSO_4$	$MgSO_4$-$7H_2O$	$NaHCO_3$	KCl	Final pH*	Final Hardness*
47.4 g/1000 L	122.8 g/1000 L	48 g/1000 L	4 g/1000 L	7.47	73 mg/L

*an average was taken from two batches

2.4 Test Organisms

The juvenile amphipods needed for the sediment toxicity test were obtained from Aquatic Biosystems (Ft. Collins, Colorado). The organisms were kept in their shipping bag after they arrived at the laboratory and placed in a holding tank for about 48 hours for temperature acclimation. Water acclimation was not a concern because the organisms had been cultured and shipped in MHRW. Regardless, the shipping bag was slowly opened to allow a small amount of laboratory MHRW to mix with the shipping water. This procedure was repeated several times through the course of one day until laboratory MHRW and shipping water were well mixed. Test organisms were approximately 7 to 10-days old at the time of testing.

2.5 Test Food Preparation

Organisms were fed a YCT mixture daily (see **Table 2.5-1**). YCT was prepared by adding 5 g of Trout Chow® to 1 L of deionized water, followed by homogenization in a blender (EPA, 2000). The homogenized mixture was poured into a 2-L separatory funnel, aerated, and allowed to digest for one week at room temperature. The aeration apparatus was removed after the digestion period. The solid material settled out for one hour, after which the supernatant was collected using a 110 mesh Nitex screen. Yeast solution was prepared by adding 5 g of dry yeast to 1 L deionized water, followed by mixing. Cerophyl® was prepared by adding 5 g of alfalfa pellets to 1 L of deionized water, followed by homogenization in a blender. Equal parts of yeast, Trout Chow (supernatant), and Cerophyl® solutions were then added to a beaker and homogenized in a blender. The YCT mixture was stored in a freezer or refrigerator until use. Refrigerated YCT was used within two weeks of storage.

2.6 Test Procedures

The following sections describe the procedures used for the site sediment and reference toxicity tests.

2.6.1 Site Sediment Toxicity Test

Sediment samples were collected from six locations along the Animas River (A56, A68, A72, A73B, 75B, and Baker Bridge [Bbridge]), one location on Mineral Creek (M34), and one location on Cement Creek (CC49). The two locations on the Animas River originally selected as references (i.e., A56 and A68) were determined to be impacted by mining activity, and could therefore not be used for that purpose. Testing was also performed on negative and positive control sediment for quality assurance purposes. The positive control was spiked with 1000 mg/kg zinc solution intended to substantially reduce survival and growth while the negative control was not spiked and was used to test the overall health of the organisms. The control sediment consisted of sediment collected from Horsecreek Reservoir, located 5 miles south of Hudson, Colorado.

Eight replicates for each sample location and the lab control samples were used in the test. An initial weight for the *H. azteca* was obtained at the start of the test to verify that the control organisms showed measurable growth after 10 days of exposure (See **Table 2.6-1**). The test chambers, which consisted of 300-mL beakers filled with 100 mL of sediment and 175 mL of overlying MHRW, were placed in a water bath to maintain a constant temperature during the test.

The testing took place over a 10-day period. The quality of the overlying MHRW was measured daily for DO and temperature. Overlying water was measured for hardness, conductivity, ammonia and pH (**Appendix A**) at the start (Day 0) and end (Day 9) of the test. Alkalinity was not measured due to water volume constraints. The amphipods were fed 1 mL of YCT per test chamber per day. The surviving organisms were removed (or "picked") from the sediment using pipettes, a sieve, and/or Nitex screen at the end of the 10-day test period. Personnel involved with picking organisms from the sediment were first required to show proficiency by retrieving at least 90% of organisms placed into "practice" sediment.

2.6.2 Reference Toxicity Test

The 96-hour reference toxicity test followed procedures outlined in EPA Method 100.1 (EPA, 2000) and was carried out concurrently with the site sediment toxicity test. The test chambers consisted of 200-mL beakers, filled with 100 mL of MHRW, and contained Nitex screen at the bottom as an artificial substrate. MHRW was spiked with zinc sulfate heptahydrate ($ZnSO_4$) using a serial dilution approach. $ZnSO_4$ concentrations were reduced by 50% starting with the highest concentration (referred to as 100%) until the lowest dilution (6.25%) was reached. The following values provide the dilutions and average zinc concentrations (taken from the initial and final measured dissolved Zn results): 100% concentration of $ZnSO_4$ was 857.5 µg/L, followed by 50% (477 µg/L), 25% (250 µg/L), 12.5% (119.5 µg/L), 6.25% (59.55 µg/L) and 0% (5 µg/L). The zinc concentration used for 0% is one half the laboratory detection limit of 10 µg/L. Zinc concentrations were verified using EPA Method 200.7/200.8 and are included in **Table 3.1-2**. Survival and growth were the endpoints for the reference test.

2.7 Pore Water Collection Procedures

Pore water was collected from each individual test chamber for analysis at the start of the test. These samples were collected by placing a push-point pore water sampling probe in each test chamber and extracting the water from within the bedded sediment using a 50 mL syringe. The syringe was then fit with a 0.45 micrometer filter, and the sample was transferred to a 10 mL sample container. The sample was labeled, preserved, and stored at 4°C in the Region 8 Laboratory. The initial pore water samples were analyzed for dissolved metals using EPA Method 200.7 (EPA 1994a) and 200.8 (EPA, 1994b). Pore water samples were not collected at the end of the test due to the risk of extracting *H. azteca* from the sediment during the pore water collection.

2.8 Overlying Surface Water Collection Procedure

Samples for overlying water were collected using treatment group dedicated 60 mL syringes and water was extracted from just below the surface in each replicate for a composite sample. Composite samples were collected for total recoverable and dissolved metals samples and a discrete water sample was collected from each replicate for all ammonia samples. After 50 or 60 mL of water was pulled into the syringe a visual observation of the water was made to ensure that no organisms were inadvertently captured during this process.

3.0 RESULTS

This section presents the results for the site sediment and reference toxicity tests and addresses any issues or unforeseen conditions encountered during the test.

3.1 Site Sediment Toxicity Testing

Sediment, pore water, and overlying surface water samples were analyzed for total recoverable metals (sediment & overlying water) and dissolved metals (pore water & overlying water) using EPA Method 200.7/200.8. **Tables 3.1-1** through **3.1-4** provide the results of these analyses.

The conditions in the test chambers generally met the performance criteria (see **Table 2.0-1**). Daily water chemistry is provided in **Appendix A**. The replicates' variability in hardness met performance criteria of 50% at all sample locations except Control N which had an initial hardness of 386 and a final hardness of 127. Alkalinity was not measured. DO was maintained above the performance criterion of 2.5 mg/L throughout the test. The overlying water temperatures did not deviate more than ±2ºC from 23ºC, ranging between 21.0°C and 23.1°C during the 10-day test period.

A discrete sample of the overlying water was obtained from each replicate on Day 0 and Day 9 of the test for ammonia analysis using EPA Method 350.1 (EPA 1993). Ammonia (NH_3-N) concentrations on Day 0 (initial water chemistry) ranged from 0.0053 mg/L in Control-P-04 to 5.916 mg/L NH_3-N in A68-01. On Day 9 (final water chemistry) concentrations ranged from 0.0230 mg/L NH_3-N in Control P-05 to 1.59 mg/L NH_3-N in A68-01 (see **Table 3.1-5**). The average Day 0 and Day 9 ammonia levels measured in the eight replicates of each of the sediment samples used in the toxicity test were compared to pH-dependent acute ammonia criteria. As shown in **Table 3.1-5,** all ammonia levels fell below their respective acute or chronic ammonia criteria. The ammonia criteria were calculated using the “salmonids present” equation, which is provided on p. 54 of the Colorado Department of Public Health and Environment Water Quality Control Commission (CDPHE): Regulation No. 31 (2012).

Surviving *H. azteca* were collected at the end of the 10 day test from each test chamber, counted, placed in aluminum weigh boats, and dried for at least 24 hrs at 80^{o}C. Every effort was made to ensure that sediment particles were not inadvertently added to the weigh boats with the organisms. Pans with dried *H. azteca* were then weighed. All information was recorded on laboratory bench sheets.

Comprehensive Environmental Toxicity Information System (CETIS) statistical software (2011) was used to establish the significance differences between *H. azteca* survival and biomass between groups after 10 days of exposure in the sediment samples (see **Attachment 1**). **Figure 3.1-1** presents the results for survival and **Figure 3.1-2** presents the results for biomass.

Survival Results

Survival results for each replicate and average per location are included in the CETIS worksheets (**Attachment 1**). Control P and Control N both showed an average of 97.5% survival and were therefore indistinguishable from each other. Control N met the minimum performance criterion of >80% survival. Control P had unexpectedly high survival but did not influence the outcome of the toxicity test. Site sample results were only compared to Control N to determine significant survival and growth due to the impacted “reference” locations (A56 and A68). The available analytical data (see **Tables 3.1-1 to 3.1-4**) show that the Zn levels in Control P were consistently similar to those measured in Control N. An error may have occurred with the spiking procedure or perhaps zinc was washed out of the sandy substrate during the daily water exchange procedures.

Locations A56 and A68 showed 62.5 ± 8.2% and 56.3 ± 3.5% survival, respectively. Location A72 had 36.3 + 4.2% survival, location A73B had 5± 1.9% survival, location A75B had 48.8 + 5.2% survival and location M34 had 8.8 ± 3.5% survival. None of the organisms survived at location CC49, whereas location Bbridge showed 76.3 ± 3.75% survival.

Biomass Results

Biomass results for each replicate and average per location are included in the CETIS worksheets (**Attachment 1**). Average biomass for each location was calculated by dividing the total weight of all surviving *H. azteca* per sample location by the total number of *H. azteca* introduced per sample location on Day 0 of the test (i.e. [total weight of *H. azteca* from all eight replicates per sample location] / [8 replicates x 10 *H. azteca* introduced for each sample location]). The results show that Control N had an average biomass of 69.8 $\pm$ 3.5 µg/organism. Locations A56 and A68 had an average biomass of 20.3 $\pm$ 1.9 µg/organism and 22.6 $\pm$ 1.6 µg/organism, respectively. The following values represent the average biomass results for the remaining sample locations: A72 (16.1 $\pm$ 1.7 µg/organism), A73B (4.0 $\pm$ 1.7 µg/organism), 75B (17.8 $\pm$ 1.9 µg/organism), M34 (5.1 $\pm$ 2 µg/organism), and Bbridge (26.2 $\pm$ 1 µg/organism). Sample location CC49 had zero biomass because none of the *H. azteca* survived.

<u>Growth Results</u>

Growth for Control N was analyzed in order to determine if the Test Acceptability Criteria (TAC) of a measurable increase in growth between the start (Day 0) and the end (Day 10) of the test was met. All Control N growth results, along with supplemental growth results for Control P and each sample location are included in **Table 3.1-7**, which also presents the mean weight per survivor in each replicate. The average growth was analyzed for each location with the formula: ([total weight of *H. azteca* from all eight replicates per sample location] / [total surviving *H. azteca* for each sample location at the end of the test]) – initial weight). The initial average organism weight was 22.9 µg/organism (**Table 2.6-1**), whereas the final average organism weight for Control N was 71.7 µg/organism (i.e., +48.63 µg/organism or 212% growth increase). The surviving organisms exposed to sample A56 showed an +11.51 µg/organism increase (50.17% growth increase) and sample A68 showed a +17.18 µg/organism increase (74.9% growth increase).

3.2 Reference Toxicity Test

Overlying water quality parameters were consistent throughout the 96-hour reference toxicity test (see **Appendix B**). The performance criterion for EPA Method 100.1 requires no more than 50% change for alkalinity and hardness, whereas DO must be maintained above 2.5 mg/L. Test chamber temperatures ranged between 21.2°C and 22.7°C during the test period. The variability in hardness was less than 50% within each test chamber, and DO levels ranged between 5.65 mg/L and 7.72 mg/L. Alkalinity was not measured due to water volume constraints.

CETIS used the Trimmed Spearman-Karber method to calculate the EC_{50} 143 ug/L zinc with an UCL of 161 and an LCL of 127 ug/L zinc. These values correspond with historical LC50 values calculated from reference toxicity tests performed at the Region 8 Laboratory. Figure 3.2-2 shows the acute reference toxicant control chart for H. azteca exposed to zinc.

<u>Survival Results</u>

The surviving organisms were collected at the end of the 96-hour reference toxicity test and counted. **Figure 3.2-1** provides the results. The control (5 µg/L Zn) passed the performance criterion of > 80% survival, with average survival of 100%. The following values show the average zinc concentrations and % survivals from the reference toxicity test: 59.55 µg/L zinc = 95% survival, 119.5 µg/L zinc = 72.5% survival, 250 µg/L zinc = 2.5% survival, 477 µg/L zinc = 0% survival and 857.5 µg/L zinc = 0% survival. A 96-hour LC_{50} of 143 µg/L was calculated using the Trimmed Spearman-Karber Estimates (see **Attachment 2**). *Note that CETIS uses the term "EC50" (Median Effective Concentration effecting 50% of the test organisms) instead of* LC_{50}.

A discrete sample of the overlying water was obtained from each replicate on Day 0 and Day 4 of the test for ammonia analysis using EPA Method 350.1 (EPA 1993). Ammonia (NH_3-N) levels on Day 0 (initial water chemistry) ranged from 0.00452 mg/L in the 50%-03 replicate to 0.01380 mg/L NH_3-N in the 100%-04 replicate. On Day 4 (final water chemistry), the ammonia levels ranged from 0.0159 mg/L NH_3-N in the 100%-02 replicate to 0.3176 mg/L NH_3-N in the 12.5%-01 replicate. **Table 3.1-6** provides the ammonia data. The average Day 0 and Day 4 ammonia levels measured in the four replicates of each of the samples used in the reference toxicity test were compared to pH-dependent acute ammonia criteria. None of the measured ammonia levels exceeded their respective criteria. Note that the acute ammonia criteria were calculated using the "salmonids present" equation, provided on p. 54 of the CDPHE (2012).

4.0 DISCUSSION

The survival and biomass results of the Animas River sediment toxicity test were compared to the negative control because the initial "reference" locations (i.e., A56 and A68) were impacted by mining contamination. The results are discussed below.

Survival

The CETIS software was used to perform a Dunnett's Multiple Comparison Test and compare Control N to all the site samples to determine the significance ($p \leq 0.05$) of the observed survival after 10 days of exposure (**Attachment 1**). The survival at all Site locations was statistically different from Control N. Note that one replicate in Control N had 11 *H. azteca* at test termination. The results were entered into CETIS to include 11 organisms exposed for that replicate representing 100% survival.

Biomass

CETIS was used to perform a Steel Many-One Rank Test (for Control N comparisons against all the Site samples) and Steel Many-One Rank Test (for Control N comparison against Site samples) to determine significant ($p \leq 0.05$) difference in observed biomass after 10 days of exposure (**Attachment 1**). Biomass in all the Site samples was statistically lower compared to Control N.

Growth

Control N passed TAC with measurable growth. The final average weight per organism in Control N was 71.7µg. This value represented a growth increase of about 48.63 µg/organism when compared to the initial average weight of *H. azteca* (22.94 µg/organism). Results consistently show that survival and biomass at all site locations are significantly impacted when compared to Control N.

5.0 REFERENCES

CETIS (Comprehensive Environmental Toxicity Information System). 2000-2011. Tidepool Scientific Software, McKinleyville, CA 95519.

Colorado Department of Public Health and Environment (CDPHE), Water Quality Control Commission. 1979-2012. Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31). Amended June 11, 2012.

Environmental Services Assistance Team. 2012. Final 2012 Sampling and Analysis Plan/Quality Assurance Project Plan, Revision 1, Upper Animas Mining District Gladstone, San Juan County, Colorado

EPA. 1980. Sampling and Analysis Method 200.8, EMSL-Cincinnati, OH, Nov.

EPA. 1993. Method 350.1. "Determination of Ammonia Nitrogen by Semi-Automated Colorimetry" Rev 2.0.

EPA. 1994a. Method 200.7. "Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry" Rev 4.4.

EPA. 1994b. Method 200.8. "Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry" Rev 5.4.

EPA. 1994. Standard Operating Procedure for Sediment Sampling, #2016. November, 1994.

EPA. (2000, March). "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates." Method 100.1

EPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, fifth edition (EPA-821-R-02-012). October 2002.

Smith, M.E., Lazorchak, J.M., Herrin, L.E., Brewer-Swartz, S., & Thoney, W.T. (1997). A reformulated, reconstituted water for testing the freshwater amphipod, *Hyalella azteca*. (Method 100.1) *Environ. Toxicol. Chem.* 16: 1229-1233.

Tables

Table 2.0-1 Test Conditions and Acceptability Criteria for 10 Day Sediment Toxicity Testing Using *H. azteca*

Parameter	Conditions
Test Type	Whole sediment toxicity test with renewal of overlying water
Test Duration	10 days
Temperature	Daily Mean Test Temperature 23 +/- 1°C; Instantaneous temperature 23 +/- 3°C
Light Quality	Wide spectrum flourescent lights
Illuminance	100 to 1000 lux
Photoperiod	16 light 8 dark
Test Chamber	300 mL beaker
Sediment Volume	100 mL
Overlying Water Volume	175 mL
Renewal of Overlying Water	2 volumes per day; continuous or intermittent
Age of Organisms	7-14 day old at start of test;1 to 2 day range in age
Number of Organisms/chamber	10
Number of Replicates	8 for whole sediment; 4 for reference test
Feeding	YCT food fed 1.0 mL per day to each test chamber
Aeration	None
Overlying Water	Moderately Hard Reconstituted Water
Test Chamber Cleaning	Clean screens if clogged
Overlying Water Quality	Initial and final measurements of: hardness, alkalinity, conductivity, pH, ammonia (hardness, alkalinity and ammonia should not vary more than 50%) Daily measurements of: temperature and dissolved oxygen
Endpoints	Survival, biomass, and rowth
Test Acceptability	Minimum mean control survival of 80% and measurable growth of test organisms in the control sediment

Table 2.5-1 Initial Feed Weight Data Sheets

December 2012 Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Static Renewal

YCT Dry Weight

Feed Dry Weight Rep #1		
Weigh boat	1.5406	g
Weigh boat + 1 mL wet feed	2.5935	g
1 mL wet feed	1.0529	g
Weight boat + dry feed	1.5432	g
Dry feed	0.0026	g/mL
Dry feed	2.6	g/L

Feed Dry Weight Rep #2		
Weigh boat	1.5271	g
Weigh boat + 1 mL wet feed	2.5548	g
1 mL wet feed	1.0277	g
Weight boat + dry feed	1.53	g
Dry feed	0.0029	g/mL
Dry feed	2.9	g/L

Feed Dry Weight Rep#3		
Weigh boat	1.542	g
Weigh boat + 1 mL wet feed	2.515	g
1 mL wet feed	0.973	g
Weight boat + dry feed	1.5446	g
Dry feed	0.0026	g/mL
Dry feed	2.6	g/L

Table 2.6-1 Initial *H. azteca* Weight Data Sheet
December 2012 Animas River Sediment Toxicity Test
10-Day Static Renewal

Initial Dry Weight: 80 Organisms		
Weigh Boat (empty)	208543.1	µg
Weigh Boat with 80 organisms (dried)	210378.4	µg
Average Organism	22.94	µg

Table 3.1-1
December 2012 Animas River Sediment Toxicity Test Using *H. azteca*
Initial Pore Water Dissolved Metals Results (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Control-P	232	<0.500U	1.14J	26.3	<2.00U	<0.100U	28700	<1.00U	<0.100U	26.4	118	<100U	0.428	12000	4870	0.663J	3910	0.659J	<0.500U	27000	285	<0.500U	<2.00U	33.5
Control-N	32.8J	1.29	5.68	27.1	<2.00U	<0.100U	309000	<1.00U	4.58	12.8	98	<100U	0.203	10300	6180	1.96	4480	<0.500U	<0.500U	24100	289	<0.500U	<2.00U	29.0
A56	57.1	1.71	1.93J	66.2	<2.00U	0.124J	27500	<1.00U	0.362	15.1	182	<100U	8.13	15100	9290	1.62	3130	0.775J	<0.500U	29200	453	<0.500U	<2.00U	27.5
A68	146	<0.500U	3.77	121	<2.00U	0.123J	22200	<1.00U	0.163J	25.6	120	<100U	13.3	13500	14500	1.27	3290	1.13	<0.500U	25300	235	<0.500U	<2.00U	27.6
A72	27.6J	<0.500U	<0.500U	28.3	<2.00U	0.931	47900	<1.00U	0.916	12.1	143	<100U	0.161J	15100	9630	0.662J	5000	1.57	<0.500U	28100	301	<0.500U	<2.00U	26.1
A73B	48.2J	<0.500U	<0.500U	32.4	<2.00U	0.213	25700	<1.00U	3.71	9.54	133	224J	<0.100U	14400	7320	0.545J	4130	0.977J	<0.500U	27700	285	<0.500U	<2.00U	38.0
A75B	47.8J	<0.500U	1.14J	33.2	<2.00U	<0.100U	32500	<1.00U	3.12	5.45	161	820	0.165J	15300	6180	5.67	2790	0.879J	<0.500U	26300	405	<0.500U	<2.00U	516
M-34	38.8J	<0.500U	0.559J	28.5	<2.00U	0.412	36200	<1.00U	14.6	6.06	1150	3680	0.168J	91700	1670	10.5	18500	10.2	<0.500U	267000	1720	<0.500U	<2.00U	13.1J
CC-49	1120	<0.500U	<0.500U	12.9	<2.00U	1.91	39000	<1.00U	31.5	26.4	107	2120	14.5	8670	3.57J	2.20	4120	1.53	<0.500U	26100	217	<0.500U	3.31	13.4J
Bbridge	79.3	<0.500U	0.802J	49.3	<2.00U	<0.100U	29700	<1.00U	2.35	5.93	158	169J	0.140J	16500	8920	2.68	3370	1.53	<0.500U	28200	308	<0.500U	<2.00U	37.9

Qualifiers:
J = estimated
U = non-detect

Table 3.1-2
December 2012 Animas River Sediment Toxicity Test Using *H. azteca*
Overlying Water Dissolved Metals Results

Initial (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Control-P	232	<0.500U	1.14J	26.3	<2.00U	<0.100U	28700	<1.00U	<0.100U	26.4	<100U	0.428	8670	3.57J	2.20	4120	1.53	<0.500U	26100	217	<0.500U	3.31	13.4J
Control-N	<20.0U	1.29	5.68	27.1	<2.00U	<0.100U	101000	<1.00U	4.58	12.8	<100U	0.203	32600	1670	10.5	8410	10.2	<0.500U	103000	567	<0.500U	<2.00U	13.1J
A56	57.1	1.71	1.93J	66.2	<2.00U	0.124J	27500	<1.00U	0.362	15.1	<100U	8.13	12000	4870	0.663J	3910	0.659J	<0.500U	27000	285	<0.500U	<2.00U	33.5
A68	83.6	<0.500U	3.70	74.6	<2.00U	<0.100U	21100	<1.00U	<0.100U	9.63	<100U	2.59	12900	4500	0.637J	4540	2.15	<0.500U	25600	229	<0.500U	<2.00U	22.4
A72	33.0J	<0.500U	<0.500U	20.2	<2.00U	1.12	42400	<1.00U	<0.100U	0.701J	<100U	<0.100U	17000	6250	<0.500U	3120	0.512J	<0.500U	29500	376	<0.500U	<2.00U	<10.0U
A73B	48.2J	<0.500U	<0.500U	32.4	<2.00U	0.213	25700	<1.00U	3.71	9.54	224J	<0.100U	13500	14500	1.27	3290	1.13	<0.500U	25300	235	<0.500U	<2.00U	27.6
A75B	47.8J	<0.500U	1.14J	33.2	<2.00U	<0.100U	32500	<1.00U	3.12	5.45	820	0.165J	15100	9630	0.662J	5000	1.57	<0.500U	28100	301	<0.500U	<2.00U	26.1
M-34	38.8J	<0.500U	0.559J	28.5	<2.00U	0.412	36200	<1.00U	14.6	6.06	3680	0.168J	16500	8920	2.68	3370	1.53	<0.500U	28200	308	<0.500U	<2.00U	37.9
CC-49	1120	<0.500U	<0.500U	12.9	<2.00U	1.91	39000	<1.00U	31.5	26.4	2120	14.5	15300	6180	5.67	2790	0.879J	<0.500U	26300	405	<0.500U	<2.00U	516
Bbridge	79.3	<0.500U	0.802J	49.3	<2.00U	<0.100U	29700	<1.00U	2.35	3.32	169J	<0.100U	14400	7320	<0.500U	4130	1.65	<0.500U	27700	285	<0.500U	<2.00U	38.0

Reference Toxicity Test

100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13700	<1.00U	<0.100U	3.34	<100U	<0.100U	14800	<2.00U	<0.500U	2240	1.13	<0.500U	26300	79.0	<0.500U	<2.00U	881
50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14000	<1.00U	<0.100U	2.39	<100U	0.246	15200	2.07J	<0.500U	2280	0.633J	<0.500U	27000	79.6	<0.500U	<2.00U	466
25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13900	<1.00U	<0.100U	2.27	<100U	<0.100U	15100	<2.00U	<0.500U	2280	<0.500U	<0.500U	27000	79.9	<0.500U	<2.00U	229
12.50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14100	<1.00U	<0.100U	2.18	<100U	<0.100U	15200	<2.00U	<0.500U	2300	<0.500U	<0.500U	27000	80.2	<0.500U	<2.00U	115
6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13900	<1.00U	<0.100U	2.21	<100U	<0.100U	15200	<2.00U	<0.500U	2320	<0.500U	<0.500U	27200	80.3	<0.500U	<2.00U	58.6
Ref. Control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13700	<1.00U	<0.100U	2.55	<100U	<0.100U	14900	<2.00U	<0.500U	2260	<0.500U	<0.500U	26700	79.9	<0.500U	<2.00U	<10.0U

Final (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Control-P	25.6J	<0.500U	<0.500U	10.9	<2.00U	<0.100U	15400	<1.00U	<0.100U	4.29	<100U	2.02	11800	43.2	<0.500U	2280	<0.500U	<0.500U	24700	99.9	<0.500U	<2.00U	<10.0U
Control-N	<20.0U	<0.500U	<0.500U	14.3	<2.00U	<0.100U	23500	<1.00U	<0.100U	2.86	<100U	0.106J	16600	5.39	<0.500U	2970	<0.500U	<0.500U	30600	144	<0.500U	<2.00U	<10.0U
A56	<20.0U	<0.500U	0.633J	11.1	<2.00U	<0.100U	17100	<1.00U	<0.100U	4.06	<100U	0.157J	15600	49.4	<0.500U	3040	<0.500U	<0.500U	29800	125	<0.500U	<2.00U	12.1J
A68	<20.0U	<0.500U	1.13J	24.6	<2.00U	<0.100U	16100	<1.00U	<0.100U	3.19	<100U	0.852	15200	875	<0.500U	2970	<0.500U	<0.500U	28300	130	<0.500U	<2.00U	13.2J
A72	25.7J	<0.500U	<0.500U	10.2	<2.00U	0.179J	18900	<1.00U	<0.100U	3.13	<100U	0.121J	15900	1260	<0.500U	2750	<0.500U	<0.500U	29500	138	<0.500U	<2.00U	<10.0U
A73B	23.2J	<0.500U	<0.500U	7.85J	<2.00U	0.191J	16400	<1.00U	0.342	3.08	<100U	<0.100U	15600	2810	<0.500U	2740	<0.500U	<0.500U	29000	112	<0.500U	<2.00U	11.2J
A75B	<20.0U	<0.500U	<0.500U	6.58J	<2.00U	<0.100U	18000	<1.00U	<0.100U	3.46	<100U	<0.100U	16400	492	<0.500U	3020	0.613J	<0.500U	30300	130	<0.500U	<2.00U	18.1J
M-34	<20.0U	<0.500U	<0.500U	6.48J	<2.00U	<0.100U	16400	1.94J	0.142J	0.613J	<100U	<0.100U	16300	567	<0.500U	2820	<0.500U	<0.500U	29900	107	<0.500U	<2.00U	<10.0U
CC-49	<20.0U	<0.500U	<0.500U	6.74J	<2.00U	0.197J	17000	<1.00U	3.59	3.16	118J	0.222	15500	724	0.562J	2620	<0.500U	<0.500U	28700	125	<0.500U	<2.00U	39.8
Bbridge	<20.0U	<0.500U	<0.500U	7.17J	<2.00U	<0.100U	16700	2.76	<0.100U	0.972J	<100U	<0.100U	15600	26.8	<0.500U	2910	<0.500U	<0.500U	29100	119	<0.500U	<2.00U	<10.0U

Reference Toxicity Test

100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14200	1.55J	<0.100U	3.90	<100U	0.149J	15200	<2.00U	<0.500U	2350	<0.500U	<0.500U	28000	84.4	<0.500U	<2.00U	834
50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15000	1.91J	<0.100U	2.47	<100U	<0.100U	16300	<2.00U	<0.500U	2580	<0.500U	<0.500U	29300	87.4	<0.500U	<2.00U	488
25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	14700	1.59J	<0.100U	2.62	<100U	0.173J	16000	<2.00U	<0.500U	2570	<0.500U	<0.500U	28900	87.2	<0.500U	<2.00U	271
12.50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15500	2.22	<0.100U	2.80	<100U	0.628	16900	4.36J	<0.500U	2760	<0.500U	<0.500U	30300	91.0	<0.500U	<2.00U	124
6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15400	2.14	<0.100U	2.45	<100U	<0.100U	16800	<2.00U	<0.500U	2670	<0.500U	<0.500U	30200	89.2	<0.500U	<2.00U	60.5
Ref. Control	<20.0U	<0.500U	<0.500U	10.3	<2.00U	<0.100U	16000	<1.00U	<0.100U	4.20	<100U	1.91	17300	4.52J	<0.500U	2930	<0.500U	<0.500U	31200	93.1	<0.500U	<2.00U	<10.0U

Qualifiers:
J = estimated
U = non-detect

Table 3.1-3
December 2012 Animas River Sediment Toxicity Test Using *H. azteca*
Pore Water Total Recoverable Metals Results

Initial (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Control-N	554	<2.50U	<2.50U	32.0JD	<2.00U	<0.500U	99700	8.39JD	<0.500U	3.93JD	534	1.06D	31600	66.9	<2.50U	8380	<2.50U	<2.50U	101000	580	<2.50U	<10.0U	16.1J
Control-P	876	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	19200	9.77JD	<0.500U	3.04JD	593	0.797JD	11300	10.6	<2.50U	3150	<2.50U	<2.50U	25000	140	<2.50U	<10.0U	16.0J
A56	131	<2.50U	<2.50U	40.7JD	<2.00U	<0.500U	26100	9.57JD	<0.500U	15.4D	192J	24.8D	13500	2650	<2.50U	3900	<2.50U	<2.50U	27400	256	<2.50U	<10.0U	73.0
A68	150	<2.50U	<2.50U	76.0D	<2.00U	<0.500U	19800	8.58JD	<0.500U	18.5D	265	21.7D	12200	4440	<2.50U	4310	<2.50U	<2.50U	24500	227	<2.50U	<10.0U	49.6
A72	209	<2.50U	<2.50U	<25.0U	<2.00U	1.08D	39400	7.36JD	<0.500U	<2.50U	246J	2.71D	16000	6100	<2.50U	3060	<2.50U	<2.50U	28300	374	<2.50U	<10.0U	15.8J
A73B	81.7	<2.50U	<2.50U	25.1JD	<2.00U	<0.500U	24300	7.83JD	2.45D	<2.50U	<100U	0.632JD	14100	11800	<2.50U	3240	<2.50U	<2.50U	25500	216	<2.50U	<10.0U	24.4
A75B	125	<2.50U	<2.50U	25.2JD	<2.00U	<0.500U	29500	6.42JD	1.94D	2.87JD	169J	1.16D	15500	7930	<2.50U	4750	<2.50U	<2.50U	27700	279	<2.50U	<10.0U	48.0
M-34	651	<2.50U	<2.50U	27.1JD	<2.00U	0.592JD	34600	8.89JD	14.9D	3.01JD	926	0.702JD	16800	8390	<2.50U	3360	<2.50U	<2.50U	28400	300	<2.50U	<10.0U	48.1
CC-49	1170	<2.50U	<2.50U	<25.0U	<2.00U	1.63D	36600	5.36JD	31.0D	25.0D	1170	17.7D	15200	5800	4.69JD	2740	<2.50U	<2.50U	26400	387	<2.50U	<10.0U	455
Bbridge	110	<2.50U	<2.50U	30.6JD	<2.00U	<0.500U	27000	<5.00U	1.30D	3.30JD	123J	1.45D	15000	5210	<2.50U	3840	<2.50U	<2.50U	26800	253	<2.50U	<10.0U	45.6

Reference Toxicity Test

100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12500	6.67JD	<0.500U	<2.50U	<100U	0.603JD	13900	<2.00U	<2.50U	2160	2.57JD	<2.50U	25300	76.8	4.42JD	<10.0U	799
50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12900	8.88JD	<0.500U	<2.50U	<100U	<0.500U	14300	<2.00U	<2.50U	2180	<2.50U	<2.50U	26000	79.1	<2.50U	<10.0U	418
25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12900	6.17JD	<0.500U	<2.50U	<100U	<0.500U	14400	<2.00U	<2.50U	2180	<2.50U	<2.50U	26200	79.8	<2.50U	<10.0U	210
12.50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12600	5.16JD	<0.500U	<2.50U	<100U	<0.500U	14000	<2.00U	<2.50U	2150	<2.50U	<2.50U	25600	77.5	<2.50U	<10.0U	104
6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12700	9.26JD	<0.500U	<2.50U	<100U	<0.500U	14100	<2.00U	<2.50U	2170	<2.50U	<2.50U	25600	77.5	<2.50U	<10.0U	53.8
Ref. Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	9.27JD	<0.500U	<2.50U	<100U	<0.500U	14400	<2.00U	<2.50U	2240	<2.50U	<2.50U	26400	79.0	<2.50U	<10.0U	<10.0U

Final (µg/L)

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
Control-P	416	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	14600	7.14JD	<0.500U	<2.50U	279	0.754JD	11300	48.2	<2.50U	2250	<2.50U	<2.50U	23700	98.4	<2.50U	<10.0U	10.1J
Control-N	43.2J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	22800	6.05JD	<0.500U	<2.50U	<100U	<0.500U	16000	7.76	<2.50U	2930	<2.50U	<2.50U	29800	144	<2.50U	<10.0U	<10.0U
A56	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16300	8.83JD	<0.500U	<2.50U	<100U	1.13D	15000	54.4	<2.50U	3020	<2.50U	<2.50U	28900	125	<2.50U	<10.0U	15.3J
A68	30.7J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	15700	8.84JD	<0.500U	<2.50U	<100U	4.42D	14800	911	<2.50U	2960	<2.50U	<2.50U	27600	131	<2.50U	<10.0U	19.8J
A72	159	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	18600	<5.00U	<0.500U	<2.50U	233J	2.15D	15700	1230	<2.50U	2780	<2.50U	<2.50U	29000	137	<2.50U	<10.0U	<10.0U
A73B	63.0	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	15800	8.06JD	<0.500U	<2.50U	<100U	0.723JD	15200	2890	<2.50U	2720	<2.50U	<2.50U	28200	113	<2.50U	<10.0U	12.9J
A75B	28.5J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	17500	7.80JD	<0.500U	<2.50U	<100U	<0.500U	15800	502	<2.50U	2990	<2.50U	<2.50U	29400	131	<2.50U	<10.0U	20.9
M-34	26.1J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16000	7.84JD	<0.500U	<2.50U	<100U	<0.500U	16000	619	<2.50U	2860	<2.50U	<2.50U	29500	110	<2.50U	<10.0U	<10.0U
CC-49	97.8	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16600	<5.00U	3.56D	<2.50U	5100	3.43D	15000	738	<2.50U	2560	<2.50U	<2.50U	28000	126	<2.50U	<10.0U	47.8
Bbridge	39.4J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16600	8.35JD	<0.500U	<2.50U	<100U	<0.500U	15400	36.8	<2.50U	2950	<2.50U	<2.50U	29000	127	<2.50U	<10.0U	11.9J

Reference Toxicity Test

100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	14500	5.98JD	<0.500U	<2.50U	<100U	0.728JD	15700	<2.00U	<2.50U	2490	<2.50U	<2.50U	28700	87.1	4.97JD	<10.0U	853
50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	14500	7.67JD	<0.500U	<2.50U	<100U	0.541JD	15800	<2.00U	<2.50U	2580	<2.50U	<2.50U	28800	90.3	<2.50U	<10.0U	482
25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	14800	6.56JD	<0.500U	<2.50U	<100U	0.603JD	16200	<2.00U	<2.50U	2660	<2.50U	<2.50U	29300	90.1	<2.50U	<10.0U	268
12.50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	15000	<5.00U	<0.500U	7.70D	<100U	0.513JD	16400	<2.00U	<2.50U	2760	<2.50U	<2.50U	29500	90.7	<2.50U	<10.0U	119
6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	14900	8.88JD	<0.500U	<2.50U	<100U	<0.500U	16300	2.49J	<2.50U	2690	<2.50U	<2.50U	29300	90.1	<2.50U	<10.0U	60.2
Ref. Control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	15500	8.73JD	<0.500U	<2.50U	<100U	0.803JD	16900	3.35J	<2.50U	2910	<2.50U	<2.50U	30900	94.4	<2.50U	<10.0U	10.0J

Qualifiers:
D = diluted sample
J = estimated
U = non-detect

Prepared by: EC 7/15/13
Reviewed by: BGK 7/23/13

Table 3.1-4
December 2012 Animas River Sediment Toxicity Test Using *H. azteca*
Initial Sediment Total Recoverable Metals Results

STATION_ID	ANALYSIS	UNITS	Aluminum	Barium	Beryllium	Calcium	Copper	Iron	Lead	Magnesium	Manganese	Potassium	Sodium	Strontium	Zinc
Control-P	ICPOE Tot. Rec. Metals	mg/kg dry wt	1300D	16.2D	<1.99U	930D	2.19D	2720D	<9.94U	434D	34.3D	347JD	<249U	8.44JD	21.6D
Control-N	ICPOE Tot. Rec. Metals	mg/kg dry wt	1340D	28.7D	<1.96U	2770D	2.78D	2860D	<9.81U	610D	76.6D	420JD	337JD	18.6D	19.8D
A56	ICPOE Tot. Rec. Metals	mg/kg dry wt	9790D	113D	2.76JD	4430D	306D	28700D	2070D	4630D	6020D	900JD	<255U	44.9D	3530D
A68	ICPOE Tot. Rec. Metals	mg/kg dry wt	14500D	190D	5.14D	5330D	605D	43900D	2600D	5040D	12100D	1200D	<250U	75.6D	7630D
A72	ICPOE Tot. Rec. Metals	mg/kg dry wt	24800D	195D	<2.01U	4270D	198D	60600D	704D	6570D	4320D	1420D	<252U	87.9D	968D
A73B	ICPOE Tot. Rec. Metals	mg/kg dry wt	17200D	103D	<1.99U	2880D	232D	48500D	557D	4040D	4430D	567JD	<249U	42.4D	1240D
A75B	ICPOE Tot. Rec. Metals	mg/kg dry wt	47400D	145D	5.63D	6320D	415D	81400D	436D	3980D	4440D	1360D	<251U	99.9D	4980D
M-34	ICPOE Tot. Rec. Metals	mg/kg dry wt	32800D	105D	<1.96U	4290D	91.4D	62300D	152D	5340D	1220D	935JD	<245U	61.4D	323D
CC-49	ICPOE Tot. Rec. Metals	mg/kg dry wt	4140D	55.7D	<1.96U	1200D	57.8D	289000D	206D	1720D	307D	450JD	<245U	17.8D	132D
Bbridge	ICPOE Tot. Rec. Metals	mg/kg dry wt	44800D	206D	5.72D	7890D	377D	78500D	471D	4330D	8790D	1350D	<252U	123D	9060D

STATION_ID	ANALYSIS	UNITS	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Nickel	Selenium	Silver	Thallium	Vanadium
Control-P	ICPMS Tot. Rec. Metals	ug/kg dry wt	<497U	745JD	<99.4U	2830D	1160D	2070D	<497U	<497U	<497U	2170JD
Control-N	ICPMS Tot. Rec. Metals	ug/kg dry wt	<490U	<490U	133JBD	2890D	1790D	2110D	<490U	<490U	<490U	2160JD
A56	ICPMS Tot. Rec. Metals	ug/kg dry wt	9530D	79600D	9220BD	5480D	13100D	8580D	<510U	10300D	<510U	14300D
A68	ICPMS Tot. Rec. Metals	ug/kg dry wt	9340D	82400D	16700BD	8800D	15400D	15200D	1220D	12000D	1160D	18300D
A72	ICPMS Tot. Rec. Metals	ug/kg dry wt	1790D	45600D	3280BD	4660D	21800D	7180D	<503U	3530D	688JD	23200D
A73B	ICPMS Tot. Rec. Metals	ug/kg dry wt	2270D	29100D	5220BD	4700D	21200D	11500D	<498U	3290D	<498U	17300D
A75B	ICPMS Tot. Rec. Metals	ug/kg dry wt	2060D	37500D	10300BD	5420D	29900D	16100D	1110D	2070D	540JD	22900D
M-34	ICPMS Tot. Rec. Metals	ug/kg dry wt	<491U	21000D	1060BD	3640D	14800D	4520D	<491U	558JD	<491U	20500D
CC-49	ICPMS Tot. Rec. Metals	ug/kg dry wt	1510D	66700D	338BD	4710D	2520D	1890D	<490U	1200D	<490U	56200D
Bbridge	ICPMS Tot. Rec. Metals	ug/kg dry wt	2110D	40200D	16900BD	5260D	60800D	31000D	<503U	2200D	547JD	24200D

Qualifiers:
D = diluted sample
J = estimated
U = non-detect

Table 3.1-5: Initial and Final Average Ammonia Results for December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
Control-P-01	0.0230	7.4	0.0085	7.45	14.40	0.0384	6.7	0.0405	6.74	29.08
Control-P-02	0.0061	7.4				0.0547	6.7			
Control-P-03	0.0069	7.5				0.0544	6.7			
Control-P-04	0.0053	7.5				0.0408	6.7			
Control-P-05	0.0062	7.4				0.0230	6.7			
Control-P-06	0.0063	7.5				0.0301	6.8			
Control-P-07	0.0088	7.4				0.0323	6.8			
Control-P-08	0.0054	7.5				0.0501	6.8			
Control-N-01	1.2810	6.9	1.4109	6.97	24.65	0.4570	5.8	0.4732	6.23	35.29
Control-N-02	1.5980	6.9				0.4690	6.0			
Control-N-03	1.3630	7.0				0.5375	6.1			
Control-N-04	1.3190	6.9				0.4327	6.2			
Control-N-05	1.5660	6.9				0.5155	6.4			
Control-N-06	1.2860	7.1				0.3950	6.4			
Control-N-07	1.5280	7.0				0.5453	6.5			
Control-N-08	1.3460	7.1				0.4339	6.5			
A56-01	1.7380	7.1	1.6259	7.24	18.78	0.0422	7.1	0.0427	7.11	21.67
A56-02	1.9840	7.2				0.0450	7.1			
A56-03	1.2580	7.2				0.0340	7.1			
A56-04	1.7850	7.2				0.0375	7.1			
A56-05	1.3480	7.3				0.0463	7.1			
A56-06	1.5650	7.3				0.0376	7.1			
A56-07	1.6000	7.3				0.0528	7.1			
A56-08	1.7290	7.3				0.0465	7.2			
A68-01	5.9160	7.4	5.0698	7.51	13.06	1.5900	7.2	1.2675	7.22	19.25
A68-02	5.0510	7.5				1.1350	7.2			
A68-03	5.0770	7.5				1.1840	7.2			
A68-04	4.8800	7.5				1.5560	7.2			
A68-05	5.0990	7.5				1.2010	7.2			
A68-06	4.5280	7.6				1.1580	7.3			
A68-07	5.1330	7.6				1.2630	7.2			
A68-08	4.8740	7.6				1.0530	7.3			
A72-01	0.2228	7.1	0.2050	7.08	22.44	0.0654	7.0	0.1057	7.01	23.87
A72-02	0.1624	7.1				0.0584	7.0			
A72-03	0.2154	7.1				0.2117	7.0			
A72-04	0.2423	7.1				0.1607	7.0			
A72-05	0.2230	7.1				0.1321	7.0			
A72-06	0.1938	7.1				0.0595	7.0			
A72-07	0.1964	7.0				0.0979	7.0			
A72-08	0.1840	7.1				0.0603	7.0			
A73B-01	1.0890	7.5	0.8890	7.38	15.71	0.0664	7.2	0.0416	7.15	20.76
A73B-02	0.6481	7.4				0.0455	7.2			
A73B-03	0.9262	7.4				0.0338	7.2			
A73B-04	0.8286	7.4				0.0344	7.2			
A73B-05	0.9758	7.4				0.0421	7.1			
A73B-06	0.8755	7.3				0.0399	7.1			
A73B-07	0.9011	7.3				0.0346	7.1			
A73B-08	0.8677	7.3				0.0364	7.1			
A75B-01	1.8390	7.0	1.7875	7.06	22.87	0.0432	7.0	0.0521	6.99	24.23
A75B-02	1.8770	7.0				0.0935	7.0			
A75B-03	1.7820	7.0				0.0393	7.0			
A75B-04	1.5890	7.1				0.0537	7.0			
A75B-05	1.9480	7.1				0.0457	7.0			
A75B-06	1.8490	7.1				0.0415	7.0			
A75B-07	1.7990	7.1				0.0450	7.0			
A75B-08	1.6170	7.1				0.0545	7.0			

Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
M34-01	0.1279	6.2	0.1313	6.27	34.95	0.3956	6.2	0.4178	6.48	32.86
M34-02	0.1294	6.2				0.3824	6.3			
M34-03	0.1302	6.2				0.3438	6.5			
M34-04	0.1424	6.3				0.4928	6.5			
M34-05	0.1385	6.3				0.4676	6.6			
M34-06	0.1294	6.3				0.4916	6.6			
M34-07	0.1335	6.3				0.4146	6.6			
M34-08	0.1187	6.4				0.3536	6.6			
CC49-01	0.1200	7.3	0.1009	6.47	32.98	0.3776	7.1	0.4138	5.09	38.70
CC49-02	0.1235	7.2				0.4361	5.4			
CC49-03	0.1396	6.7				0.4105	4.3			
CC49-04	0.0770	6.4				0.3095	4.9			
CC49-05	0.0956	6.3				0.4655	4.2			
CC49-06	0.0900	6.1				0.5554	4.8			
CC49-07	0.0856	5.9				0.4005	4.8			
CC49-08	0.0756	5.9				0.3551	5.2			
Bbridge-01	2.3670	6.5	2.1519	6.85	27.21	0.0411	6.8	0.0415	6.89	18.31
Bbridge-02	1.6270	6.7				0.0387	6.9			
Bbridge-03	2.3920	6.8				0.0468	6.8			
Bbridge-04	2.1860	6.8				0.0418	6.9			
Bbridge-05	2.3110	6.9				0.0420	6.9			
Bbridge-06	2.2140	7.0				0.0394	6.9			
Bbridge-07	2.0910	7.0				0.0441	7.0			
Bbridge-08	2.0270	7.0				0.0379	7.0			

a The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b]Values shown are either the measurements made at the end of the test (day 10) or earlier if all test organisms died before the 10-day exposure period was completed.

Prepared by: EC 7/19/13
Reviewed by: BGK 7/23/13

Table 3.1-6 Initial and Final Average Ammonia Results for December 2012 Upper Animas River Concurrent Reference Toxicity Test Using *H. azteca*

Replicate ID	Initial Measured Ammonia Conc. (mg N/L)[a]	Initial Measured pH	Initial Average Measured Ammonia Conc. (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)	Final Measured pH	Final Average Measured Ammonia Conc. (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
Ref Control-01	0.00543	7.16	0.0061	7.23	19.17	0.2191	7.35	0.1850	7.16	20.67
Ref Control-02	0.00575	7.20				0.1978	7.38			
Ref Control-03	0.00559	7.25				0.1799	6.84			
Ref Control-04	0.00755	7.29				0.1431	7.06			
6.25%-01	0.00494	7.34	0.0052	7.38	15.77	0.1444	7.00	0.1198	7.05	23.14
6.25%-02	0.00577	7.36				0.1128	7.02			
6.25%-03	0.00533	7.39				0.1045	7.06			
6.25%-04	0.00481	7.43				0.1174	7.10			
12.5%-01	0.00865	7.45	0.0072	7.48	13.63	0.3176	7.14	0.1735	7.20	19.67
12.5%-02	0.00947	7.46				0.1355	7.18			
12.5%-03	0.00519	7.49				0.1141	7.23			
12.5%-04	0.00541	7.53				0.1267	7.26			
25%-01	0.00471	7.53	0.0053	7.54	12.45	0.0949	--	0.0998	7.29	17.73
25%-02	0.00501	7.53				0.0842	--			
25%-03	0.00598	7.54				0.0792	--			
25%-04	0.00560	7.57				0.1408	7.29			
50%-01	0.00568	7.54	0.0050	7.54	12.50	0.0505	--	0.0384	NC	NA
50%-02	0.00510	7.48				0.0313	--			
50%-03	0.00452	7.61				0.0362	--			
50%-04	0.00458	7.53				0.0356	--			
100%-01	0.00493	7.55	0.0075	7.55	12.31	0.0171	--	0.0181	NC	NA
100%-02	0.00471	7.55				0.0159	--			
100%-03	0.00665	7.50				0.0198	--			
100%-04	0.01380	7.60				0.0194	--			

NA = Not available
NC = Not calculated

[a] The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b]Values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed.

Prepared by: EC 7/19/13
Reviewed by: BGK 7/23/13

Table 3.1-7 December 2012 Animas River Sediment Toxicity Test Using *H. azteca*
Weight Data Sheets: 10-Day Static Renewal

Start Date	12/10/12		Drying Time	24 hours
End Date	12/20/12		Oven Temp (°C)	70°C
Weighing Date	01/09/13		Organism	*H. azteca*
No. of Replicates	8		Initial Weight (µg)	22.94
Feed Rate/Type	YCT/Daily		Analysts	SA,LC,CL

Replicate I.D.	Weight of Oven Dried Pan (µg)	Pan + Dried Organisms (µg)	Dry Organisms (µg)	Number of Survivors	Mean Weight per Survivor (µg)	Sample Mean (µg)
Control-P-01	207294.6	207694	399.4	10	39.94	43.71
Control-P-02	207493.7	207886.2	392.5	10	39.25	
Control-P-03	207230.1	207778.4	548.3	10	54.83	
Control-P-04	206113.8	206463.3	349.5	9	38.83	
Control-P-05	209306.2	209611	304.8	10	30.48	
Control-P-06	208216.3	208784.9	568.6	10	56.86	
Control-P-07	208942.2	209243.6	301.4	10	30.14	
Control-P-08	205478.8	206013.1	534.3	9	59.37	
Control-N-01	207119	207723	604	10	60.40	71.57
Control-N-02	206639.5	207242.9	603.4	9	67.04	
Control-N-03	209331.6	210156.3	824.7	11	74.97	
Control-N-04	206219.7	207130.9	911.2	10	91.12	
Control-N-05	207477.6	208092.5	614.9	9	68.32	
Control-N-06	207049.1	207710.5	661.4	10	66.14	
Control-N-07	208251	208904.2	653.2	9	72.58	
Control-N-08	208054	208774.1	720.1	10	72.01	
A56-01	209603.7	209717.5	113.8	3	37.93	34.45
A56-02	209189.1	209456.2	267.1	7	38.16	
A56-03	207747.3	207921.2	173.9	5	34.78	
A56-04	206852.2	207075.9	223.7	8	27.96	
A56-05	209002.3	209244.5	242.2	9	26.91	
A56-06	205403.1	205621.2	218.1	7	31.16	
A56-07	207791.3	207936.4	145.1	3	48.37	
A56-08	208463.9	208706.5	242.6	8	30.33	
A68-01	208033	208234	201	5	40.20	40.12
A68-02	206546.4	206746.1	199.7	6	33.28	
A68-03	205690	205981.9	291.9	7	41.70	
A68-04	206756.1	206977.3	221.2	6	36.87	
A68-05	209336.4	209583.3	246.9	6	41.15	
A68-06	207295.6	207443.7	148.1	4	37.03	
A68-07	208476.6	208705.8	229.2	5	45.84	
A68-08	207653.5	207923.0	269.5	6	44.92	
A72-01	207566.1	207684.6	118.5	2	59.25	45.64
A72-02	207038.5	207180.8	142.3	4	35.57	
A72-03	206675.8	206749.4	73.6	2	36.80	
A72-04	206609.1	206778.9	169.8	3	56.60	
A72-05	207490.5	207677.7	187.2	4	46.80	
A72-06	205252.2	205461.6	209.4	5	41.88	
A72-07	204860	205041.0	181	5	36.20	
A72-08	205829.8	206038.0	208.2	4	52.05	

Table 3.1-7 December 2012 Animas River Sediment Toxicity Test Using *H. azteca*
Weight Data Sheets: 10-Day Static Renewal

Start Date	12/10/12	Drying Time	24 hours
End Date	12/20/12	Oven Temp (^{o}C)	70°C
Weighing Date	01/09/13	Organism	*H. azteca*
No. of Replicates	8	Initial Weight (µg)	22.94
Feed Rate/Type	YCT/Daily	Analysts	SA,LC,CL

Replicate I.D.	Weight of Oven Dried Pan (µg)	Pan + Dried Organisms (µg)	Dry Organisms (µg)	Number of Survivors	Mean Weight per Survivor (µg)	Sample Mean (µg)
A73B-01	208092	--	--	0	--	79.38
A73B-02	205437.5	--	--	0	--	
A73B-03	206460.1	--	--	0	--	
A73B-04	205380.7	205445	64.3	1	64.30	
A73B-05	204644.8	--	--	0	--	
A73B-06	205767.8	205865.9	98.1	1	98.10	
A73B-07	206877.7	206998.2	120.5	1	120.50	
A73B-08	206120.5	206155.1	34.6	1	34.60	
A75B-01	205789.7	205981.8	192.1	6	32.02	37.13
A75B-02	208670.9	208846.4	175.5	6	29.25	
A75B-03	208836.3	208926.6	90.3	3	30.10	
A75B-04	208491.7	208720.8	229.1	5	45.82	
A75B-05	207661.2	207809.1	147.9	5	29.58	
A75B-06	206346.2	206473.2	127	3	42.33	
A75B-07	203809.8	204014.4	204.6	4	51.15	
A75B-08	207994	208251.4	257.4	7	36.77	
M34-01	209594.3	--	--	0	--	61.88
M34-02	206387.3	206533.4	146.1	3	48.70	
M34-03	206176.2	--	--	0	--	
M34-04	207572.2	207686.7	114.5	1	114.50	
M34-05	208422	--	--	0	--	
M34-06	206302.5	206312	9.5	1	9.50	
M34-07	208254.3	208334	79.7	1	79.70	
M34-08	207897.3	207954.3	57	1	57.00	
CC49-01	205074.4	--	--	0	--	#DIV/0!
CC49-02	207328	--	--	0	--	
CC49-03	205978.1	--	--	0	--	
CC49-04	205910.7	--	--	0	--	
CC49-05	204673.6	--	--	0	--	
CC49-06	206851.3	--	--	0	--	
CC49-07	204953.4	--	--	0	--	
CC49-08	207055.2	--	--	0	--	
BBRIDGE-01	205991.7	206249.9	258.2	9	28.69	34.78
BBRIDGE-02	206000.4	206248.9	248.5	8	31.06	
BBRIDGE-03	208297.6	208609.1	311.5	8	38.94	
BBRIDGE-04	205253	205496.6	243.6	8	30.45	
BBRIDGE-05	208943.9	209240.2	296.3	8	37.04	
BBRIDGE-06	208583.4	208820.8	237.4	6	39.57	
BBRIDGE-07	208898	209129.3	231.3	6	38.55	
BBRIDGE-08	208620.5	208892.3	271.8	8	33.97	

Figures

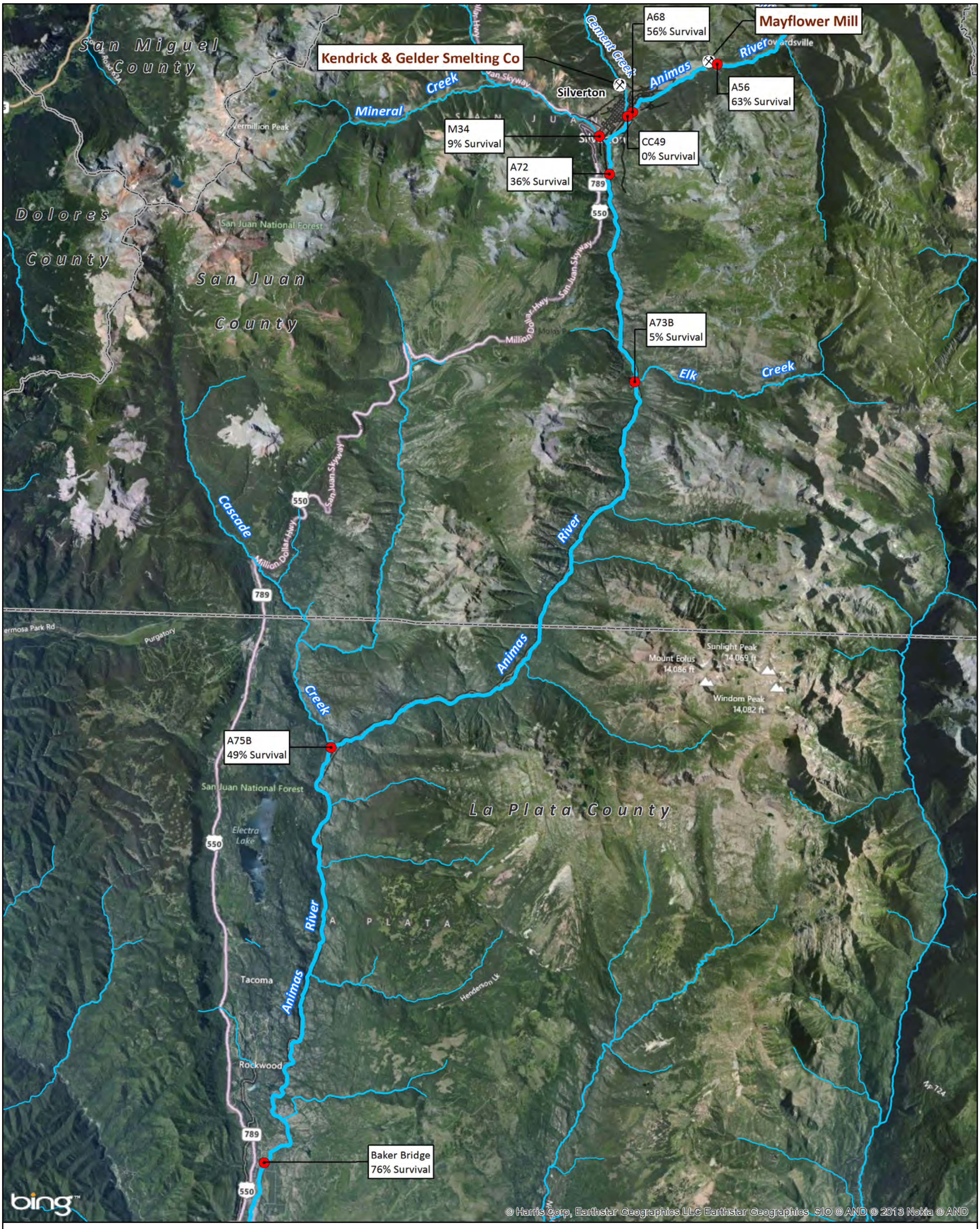
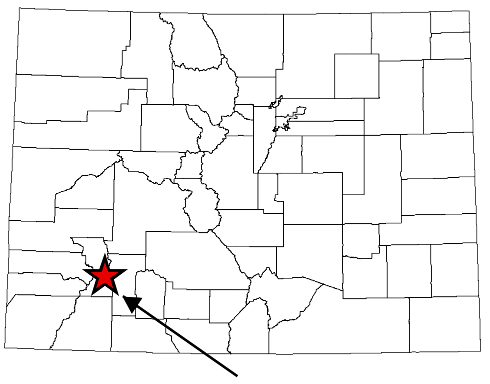


Figure 2.2-1
2012 Upper Animas River
Sediment Toxicity Test Sample Locations



- Sample Locations
- Mine Locations
- Rivers and Streams
- County Boundaries

Date: November 12, 2013

Data Sources:
Sample Locations: U.S. EPA Region 8 (2012)
Mine Locations: U.S. EPA and ESAT (2012)
Rivers and Streams: CDOW 1:24k (2004)
County Boundaries: U.S. Census Bureau (2011)
Imagery: Microsoft Bing Web Service (2013)

Coordinate System/Projection:
UTM Zone 13 North, NAD 83, Meters

0 1 2 Miles
0 1 2 Kilometers

Figure 3.1-1
2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*
Average Percent Survival + 1 SD per Sampling Location

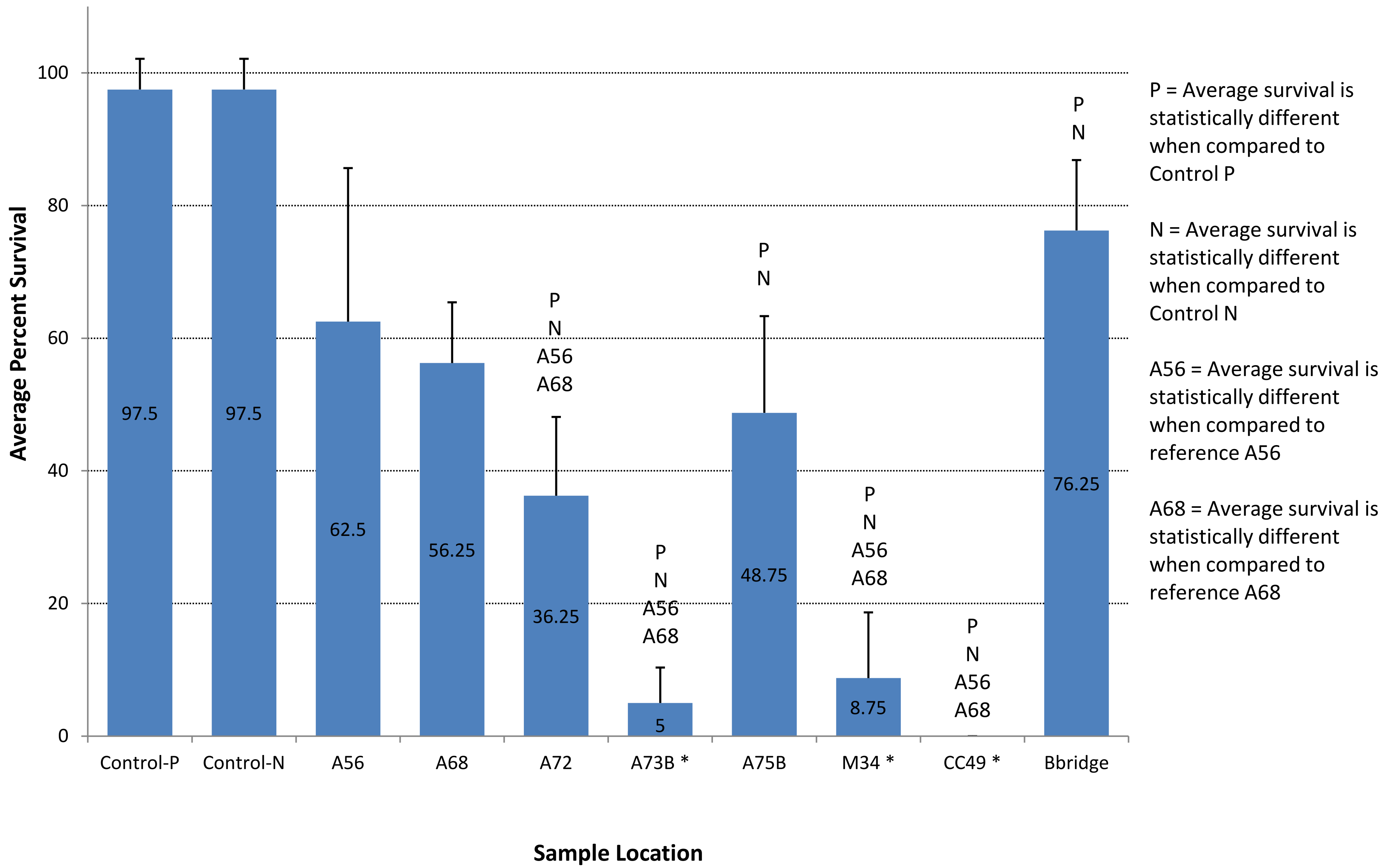


Figure 3.1-2
2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*
Average Biomass + 1 SD per Sampling Location

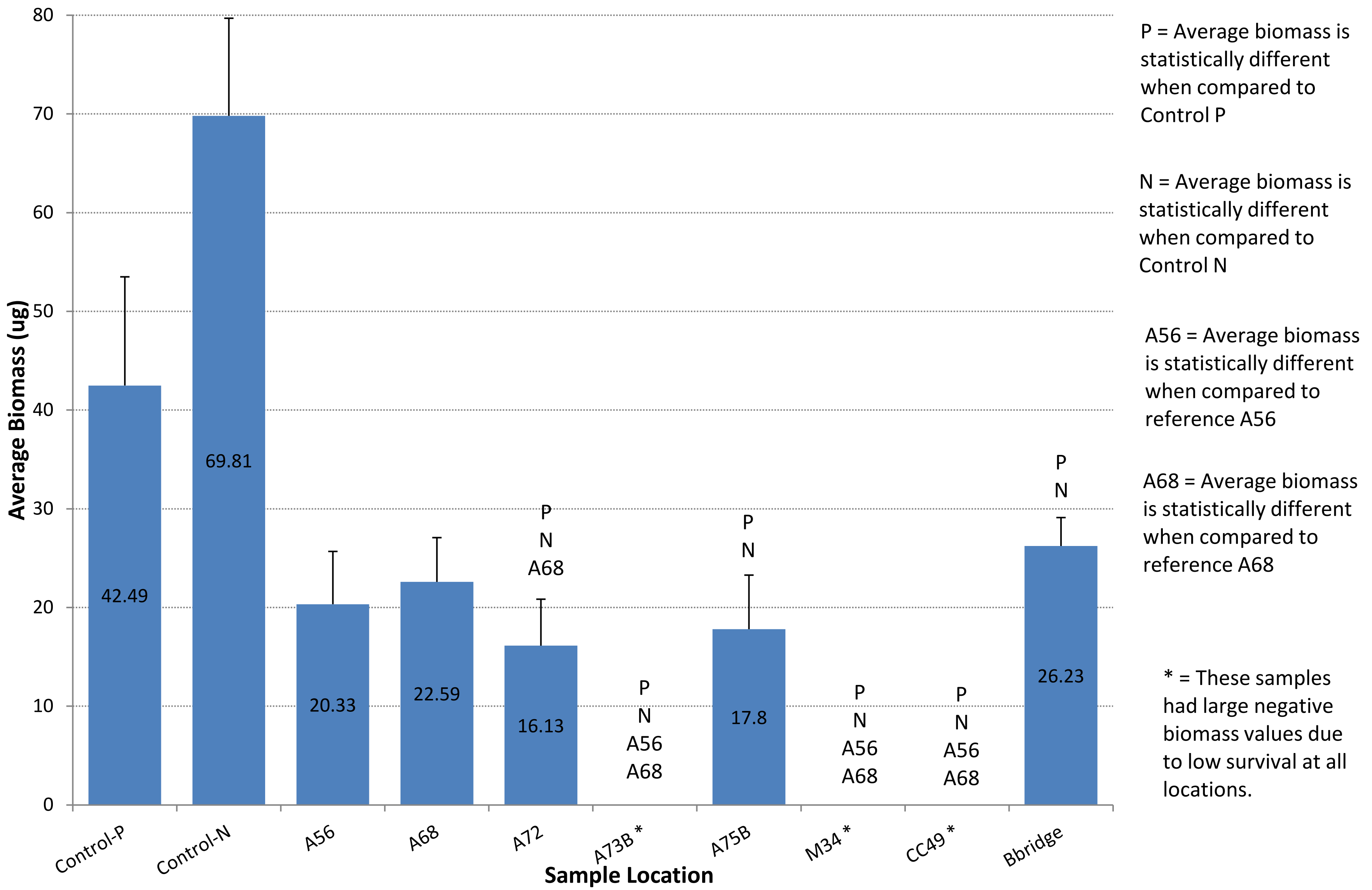
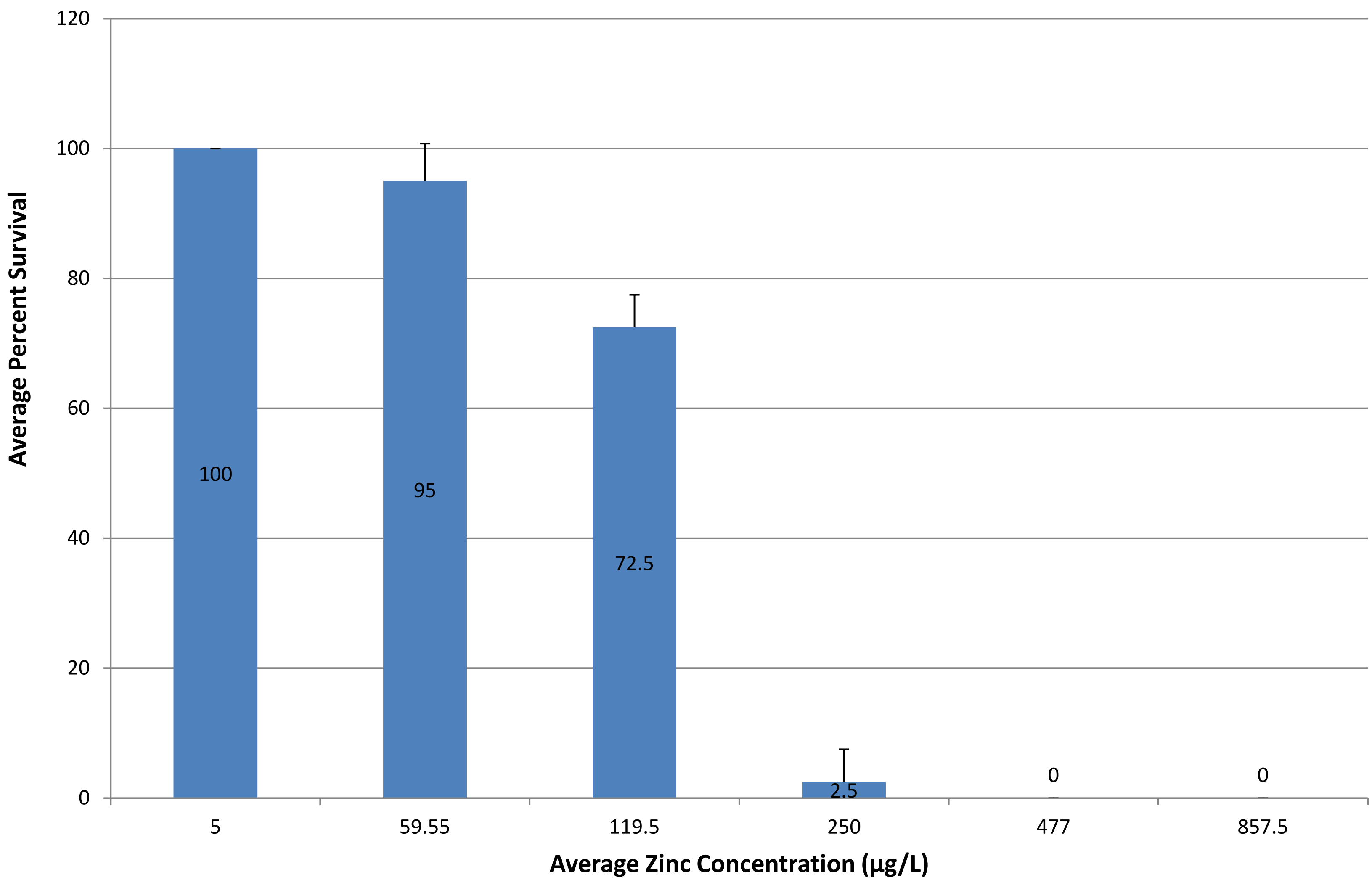
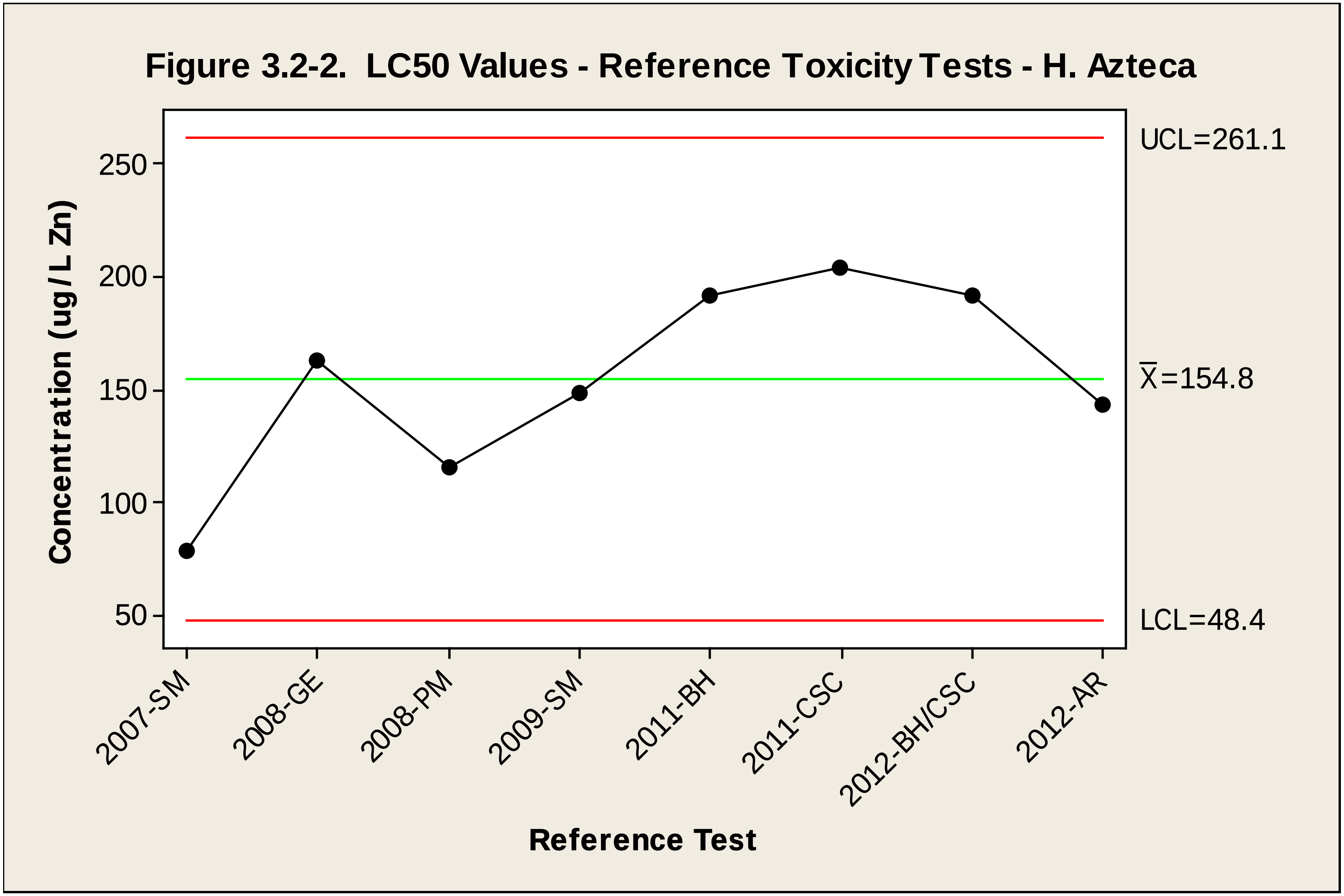


Figure 3.2-1
2012 Upper Animas River Concurrent Acute Reference Toxicity Test using *H.azteca* and Zinc Sulfate ($ZnSO_4$)
Average Percent Survival + 1 SD per Zinc Concentration





UCL = Upper Control Limit Based off of 3 standard deviations
LCL = Lower Control Limit Based off of 3 standard deviations
X = Mean LC50 values across all tests

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12	No. of Replicates	8
End Date	12/20/12	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	80
Analysts	SA, CL, LC		

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Control-P-01	pH	7.4									6.66	
Control-P-01	Conductivity (us/cm)	383.4									307.4	
Control-P-01	D.O. (mg/L)	6.98	4.33	4.74	4.64	5.21	5.41	4.58	4.87	5.06	6.39	4.82
Control-P-01	Temp (C)	22.7	22.7	22.4	22.5	22.5	21.9	22.7	22.3	22.7	22.28	22.8
Control-P-01	Hardness	107										87
Control-P-01	Alkalinity	*										*
Control-P-02	pH	7.36									6.69	
Control-P-02	Conductivity (us/cm)	402									312.8	
Control-P-02	D.O. (mg/L)	7.17	4.37	4.65	4.52	5.72	5.25	4.64	4.76	4.98	6.4	4.64
Control-P-02	Temp (C)	22.6	22.7	22.4	22.7	22.7	22.5	22.6	22.3	22.6	22.31	22.8
Control-P-02	Hardness	107										87
Control-P-02	Alkalinity	*										*
Control-P-03	pH	7.46									6.71	
Control-P-03	Conductivity (us/cm)	395.6									270.1	
Control-P-03	D.O. (mg/L)	6.69	4.4	4.87	5.08	5.51	5.2	4.66	4.8	5.48	6.73	4.83
Control-P-03	Temp (C)	22.7	22.7	22.3	22.7	22.3	22	22.6	22.3	22.7	22.21	22.8
Control-P-03	Hardness	107										87
Control-P-03	Alkalinity	*										*
Control-P-04	pH	7.45									6.74	
Control-P-04	Conductivity (us/cm)	309.7									295	
Control-P-04	D.O. (mg/L)	6.88	4.31	4.65	4.93	5.69	5.01	4.83	4.69	5.29	5.28	4.82
Control-P-04	Temp (C)	22.6	22.7	22.4	22.6	22.2	22	22.3	22.2	22.6	22.02	22.8
Control-P-04	Hardness	107										87
Control-P-04	Alkalinity	*										*
Control-P-05	pH	7.44									6.74	
Control-P-05	Conductivity (us/cm)	383.6									322.9	
Control-P-05	D.O. (mg/L)	7.02	4.25	4.85	4.81	5.2	5.24	3.95	4.55	4.96	5.42	4.64
Control-P-05	Temp (C)	22.6	22.9	22.2	22.8	22.5	22	22.8	22.3	22.8	22.36	22.8
Control-P-05	Hardness	107										87
Control-P-05	Alkalinity	*										*
Control-P-06	pH	7.51									6.8	
Control-P-06	Conductivity (us/cm)	295.1									296.4	
Control-P-06	D.O. (mg/L)	7.2	4.41	4.91	5.01	5.42	5.17	4.17	4.32	4.88	5.71	4.59
Control-P-06	Temp (C)	22.6	23	22.5	22.8	22.8	22.2	22.6	22.5	22.8	22.28	22.8
Control-P-06	Hardness	107										87
Control-P-06	Alkalinity	*										*
Control-P-07	pH	7.44									6.77	
Control-P-07	Conductivity (us/cm)	372.9									319.4	
Control-P-07	D.O. (mg/L)	7.03	4.23	4.64	4.77	5.63	5.23	4.37	4.46	4.73	5.42	4.66
Control-P-07	Temp (C)	22.8	23	22.6	22.9	22.8	22.2	22.6	22.5	23	22.4	23
Control-P-07	Hardness	107										87
Control-P-07	Alkalinity											
Control-P-08	pH	7.5									6.82	
Control-P-08	Conductivity (us/cm)	285.6									277.8	
Control-P-08	D.O. (mg/L)	7.08	4.18	4.73	4.49	5.53	5.12	4.43	4.34	4.83	5.19	4.62
Control-P-08	Temp (C)	22	23.1	22.6	22.7	22.8	22.3	22.9	22.6	22.7	22.32	23
Control-P-08	Hardness	107										87
Control-P-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Control-N-01	pH	6.86									5.75	
Control-N-01	Conductivity (us/cm)	1198									402.5	
Control-N-01	D.O. (mg/L)	7.14	4.11	4.73	5.13	5.3	5.27	4.89	4.85	4.97	6.6	5.26
Control-N-01	Temp (C)	22.5	22.8	22.3	22.6	22.5	22.2	22.6	22.5	22.8	22.2	22.8
Control-N-01	Hardness	386										127
Control-N-01	Alkalinity	*										*
Control-N-02	pH	6.92									5.96	
Control-N-02	Conductivity (us/cm)	1246									401.2	
Control-N-02	D.O. (mg/L)	6.6	4.52	4.85	5.15	5.62	5.14	4.83	4.72	5.08	6.22	4.92
Control-N-02	Temp (C)	22.6	22.8	22.3	22.6	22.5	22.1	22.6	22.4	22.8	22.27	22.8
Control-N-02	Hardness	386										127
Control-N-02	Alkalinity	*										*
Control-N-03	pH	6.96									6.13	
Control-N-03	Conductivity (us/cm)	1107									415.3	
Control-N-03	D.O. (mg/L)	6.68	4.63	4.84	5.18	5.22	5.33	4.76	4.7	5.01	6.37	4.99
Control-N-03	Temp (C)	22.1	22.4	21.9	22.3	22.2	21.5	22.4	22.3	22.4	22.09	22.7
Control-N-03	Hardness	386										127
Control-N-03	Alkalinity	*										*
Control-N-04	pH	6.89									6.22	
Control-N-04	Conductivity (us/cm)	1101									384	
Control-N-04	D.O. (mg/L)	6.44	4.49	4.87	5.05	5.3	5.6	4.74	4.57	5.26	6.03	4.88
Control-N-04	Temp (C)	22.2	22.6	22.1	22.3	22.1	22	22.2	22.1	22.6	22.1	22.6
Control-N-04	Hardness	386										127
Control-N-04	Alkalinity	*										*
Control-N-05	pH	6.94									6.36	
Control-N-05	Conductivity (us/cm)	1230									416.1	
Control-N-05	D.O. (mg/L)	6.52	4.39	4.79	5.21	5.74	5.23	4.63	4.28	5.33	6.46	4.94
Control-N-05	Temp (C)	21.9	22.6	21.6	22	22.2	21.3	22.3	22.2	22.4	21.91	22.6
Control-N-05	Hardness	386										127
Control-N-05	Alkalinity	*										*
Control-N-06	pH	7.05									6.39	
Control-N-06	Conductivity (us/cm)	1045									383.1	
Control-N-06	D.O. (mg/L)	5.88	4.5	4.93	5.2	5.71	5.26	4.61	4.53	4.99	6.31	4.81
Control-N-06	Temp (C)	22.07	22.7	21.6	22.2	22.2	21.1	22.3	22	22.6	21.95	22.6
Control-N-06	Hardness	386										127
Control-N-06	Alkalinity	*										*
Control-N-07	pH	7.04									6.49	
Control-N-07	Conductivity (us/cm)	1296									417.1	
Control-N-07	D.O. (mg/L)	6.41	4.41	4.77	5.15	5.71	5.38	4.66	4.72	4.92	6.48	4.91
Control-N-07	Temp (C)	22.3	22.8	22.1	22.1	22.7	21.6	22.5	22.5	23	22.09	22.8
Control-N-07	Hardness	386										127
Control-N-07	Alkalinity	*										*
Control-N-08	pH	7.13									6.53	
Control-N-08	Conductivity (us/cm)	1072									394.4	
Control-N-08	D.O. (mg/L)	6.63	4.38	4.85	5.16	5.78	5.37	4.81	4.78	4.85	6.01	4.81
Control-N-08	Temp (C)	22.2	22.8	22.3	22.5	22.7	21.6	22.5	22.3	22.6	22.12	22.7
Control-N-08	Hardness	386										127
Control-N-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A56-01	pH	7.13									7.06	
A56-01	Conductivity (us/cm)	400.1									318.4	
A56-01	D.O. (mg/L)	4.75	4.95	4.91	5.38	5.4	5.67	4.76	4.69	5.17	6.11	3.93
A56-01	Temp (C)	21.1	22.3	22.3	22.5	22.2	22.2	22.5	22.3	22.6	22.07	23.1
A56-01	Hardness	118										107
A56-01	Alkalinity	*										*
A56-02	pH	7.19									7.07	
A56-02	Conductivity (us/cm)	412									356	
A56-02	D.O. (mg/L)	5.54	4.58	4.94	5.36	5.56	5.43	4.59	4.56	4.91	4.87	4.11
A56-02	Temp (C)	22.1	22.4	22.1	22.2	22.1	21.6	22.2	22	22.3	22.05	22.8
A56-02	Hardness	118										107
A56-02	Alkalinity	*										*
A56-03	pH	7.21									7.1	
A56-03	Conductivity (us/cm)	399.4									359.1	
A56-03	D.O. (mg/L)	2.59	4.75	4.99	5.57	5.66	5.34	4.6	4.54	5.11	5.52	4.08
A56-03	Temp (C)	22.5	22.3	21.8	22	22.2	21.4	22.8	22.4	22.6	22.18	22.8
A56-03	Hardness	118										107
A56-03	Alkalinity	*										*
A56-04	pH	7.22									7.11	
A56-04	Conductivity (us/cm)	417.4									355.1	
A56-04	D.O. (mg/L)	3.26	4.62	4.86	5.63	5.64	5.27	4.62	4.69	5.05	5.15	4.18
A56-04	Temp (C)	22.5	22.4	22.2	22.2	22.2	21.6	22.5	22.1	22.4	22.03	22.8
A56-04	Hardness	118										107
A56-04	Alkalinity	*										*
A56-05	pH	7.28									7.13	
A56-05	Conductivity (us/cm)	386									352.8	
A56-05	D.O. (mg/L)	3.96	4.61	5.12	5.33	5.58	5.3	4.34	4.55	5.14	5.89	3.78
A56-05	Temp (C)	22.5	22	21.8	21.6	21.3	21.2	22.3	21.7	22.4	21.42	22.6
A56-05	Hardness	118										107
A56-05	Alkalinity	*										*
A56-06	pH	7.29									7.14	
A56-06	Conductivity (us/cm)	391.2									336.5	
A56-06	D.O. (mg/L)	5.05	4.63	5.15	5.66	5.85	5.16	4.5	4.68	5.21	4.46	3.98
A56-06	Temp (C)	22.5	22.5	21.9	22	21.8	21.2	22.2	22.1	22.6	21.95	22.7
A56-06	Hardness	118										107
A56-06	Alkalinity	*										*
A56-07	pH	7.3									7.14	
A56-07	Conductivity (us/cm)	389.2									353.1	
A56-07	D.O. (mg/L)	5.19	4.58	5.23	5.54	5.77	5.26	4.45	4.58	5	5.13	3.67
A56-07	Temp (C)	22.5	22.3	21.7	22	21.8	21.8	22.3	22.2	22.6	21.55	22.5
A56-07	Hardness	118										107
A56-07	Alkalinity	*										*
A56-08	pH	7.32									7.15	
A56-08	Conductivity (us/cm)	390.4									331.4	
A56-08	D.O. (mg/L)	6.02	4.62	4.97	5.48	5.95	5.23	4.51	4.63	5.11	4.58	4.48
A56-08	Temp (C)	22.5	22.8	21.8	22	21.8	22.1	22.6	22.1	22.7	21.89	22.5
A56-08	Hardness	118										107
A56-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12
End Date	12/20/12
Water Type	MHRW
Analysts	SA, CL, LC

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A68-01	pH	7.43									7.15	
A68-01	Conductivity (us/cm)	404									352.6	
A68-01	D.O. (mg/L)	5.86	3.89	4.49	4.81	5.05	4.49	4.42	4.39	4.4	4.67	4.12
A68-01	Temp (C)	21.1	22	22	21.3	22	21.5	22.7	21.9	22.1	21.72	22.5
A68-01	Hardness	106										103
A68-01	Alkalinity	*										*
A68-02	pH	7.46									7.2	
A68-02	Conductivity (us/cm)	377.3									351.7	
A68-02	D.O. (mg/L)	3.19	3.91	4.83	4.98	5.14	4.9	4.29	4.32	4.91	4.83	4.19
A68-02	Temp (C)	22.1	22	22.1	21.8	22.1	21	22.7	22.1	22.3	21.81	22.7
A68-02	Hardness	106										103
A68-02	Alkalinity	*										*
A68-03	pH	7.49									7.21	
A68-03	Conductivity (us/cm)	381.6									349.4	
A68-03	D.O. (mg/L)	4.18	3.95	4.62	4.8	5.23	5.08	4.32	4.32	4.94	4.21	4.24
A68-03	Temp (C)	21.8	22.4	21.5	21.8	21.7	21.2	22.8	21.3	21.8	21.73	22.7
A68-03	Hardness	106										103
A68-03	Alkalinity	*										*
A68-04	pH	7.52									7.23	
A68-04	Conductivity (us/cm)	367.5									359.1	
A68-04	D.O. (mg/L)	3.73	3.92	4.72	4.98	5.22	4.81	4.12	4.24	4.57	4.55	4.09
A68-04	Temp (C)	21.6	21.8	21	21.5	20.8	21.5	22.5	21.5	22.1	21.49	22.6
A68-04	Hardness	106										103
A68-04	Alkalinity	*										*
A68-05	pH	7.54									7.23	
A68-05	Conductivity (us/cm)	385.5									351.3	
A68-05	D.O. (mg/L)	4.19	3.96	4.68	5.16	5.01	4.97	3.98	4.16	4.73	4.79	4.19
A68-05	Temp (C)	21.8	22.2	21.8	22.1	21.4	21.3	22.7	21.7	22.5	21.95	22.8
A68-05	Hardness	106										103
A68-05	Alkalinity	*										*
A68-06	pH	7.55									7.25	
A68-06	Conductivity (us/cm)	373.3									355	
A68-06	D.O. (mg/L)	3.93	4.2	4.75	5.05	5.45	4.95	3.97	4.1	4.65	5.05	3.96
A68-06	Temp (C)	22	22.3	22	22	21.2	21.8	22.6	22	22.5	21.93	22.8
A68-06	Hardness	106										103
A68-06	Alkalinity	*										*
A68-07	pH	7.55									7.23	
A68-07	Conductivity (us/cm)	391.6									349.2	
A68-07	D.O. (mg/L)	4.4	3.84	4.63	4.88	5.21	4.91	4.13	4.22	4.78	4.6	4.07
A68-07	Temp (C)	22	22.3	22.3	22.2	21.8	21.9	22.7	22.2	22.5	22.17	23.1
A68-07	Hardness	106										103
A68-07	Alkalinity	*										*
A68-08	pH	7.55									7.27	
A68-08	Conductivity (us/cm)	382.1									347.1	
A68-08	D.O. (mg/L)	4.77	4.01	4.49	4.91	5.44	5.09	4.48	4.31	5.27	5.1	4.15
A68-08	Temp (C)	22.3	22.4	22	22.2	21.8	21.8	22.7	22	22.6	22.16	23
A68-08	Hardness	106										103
A68-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A72-01	pH	7.13									7.01	
A72-01	Conductivity (us/cm)	517									377.2	
A72-01	D.O. (mg/L)	5.13	5.27	5.6	5.75	6.1	5.8	4.94	5.11	5.55	5.03	4.86
A72-01	Temp (C)	22	22.5	21.8	22	21.2	21.8	22.6	21.7	22.3	21.84	22.2
A72-01	Hardness	176										113
A72-01	Alkalinity	*										*
A72-02	pH	7.11									7.01	
A72-02	Conductivity (us/cm)	496.3									372.4	
A72-02	D.O. (mg/L)	5.57	5.64	5.78	5.95	6.33	5.64	5.26	5.08	5.51	5.53	4.9
A72-02	Temp (C)	22	22.1	21.3	22.4	21.7	21.5	22.5	21.7	22.3	21.67	22.8
A72-02	Hardness	176										113
A72-02	Alkalinity	*										*
A72-03	pH	7.08									7.01	
A72-03	Conductivity (us/cm)	502.9									375.7	
A72-03	D.O. (mg/L)	5.35	5.52	5.85	6.16	5.66	5.82	5.32	5.17	5.74	6.34	5.02
A72-03	Temp (C)	21.7	21.8	21.3	21.9	21.6	21	22	21.7	22.2	21.53	22.5
A72-03	Hardness	176										113
A72-03	Alkalinity	*										*
A72-04	pH	7.07									7.02	
A72-04	Conductivity (us/cm)	511.4									370.9	
A72-04	D.O. (mg/L)	4.84	5.57	5.74	5.99	5.97	5.66	5.49	5.36	5.67	5.14	5.07
A72-04	Temp (C)	21.3	21.9	21.5	21.2	21.2	21.1	21.8	21.4	22.6	21.59	22.7
A72-04	Hardness	176										113
A72-04	Alkalinity	*										*
A72-05	pH	7.06									7.02	
A72-05	Conductivity (us/cm)	500									375.5	
A72-05	D.O. (mg/L)	5.95	5.4	5.57	5.87	6.17	5.82	5.11	5.15	5.48	6.32	4.83
A72-05	Temp (C)	22.1	22.2	21.7	21.3	21.3	21.5	22.2	22.2	22.7	21.72	22.7
A72-05	Hardness	176										113
A72-05	Alkalinity	*										*
A72-06	pH	7.07									7.01	
A72-06	Conductivity (us/cm)	488.6									370	
A72-06	D.O. (mg/L)	6.02	5.38	5.71	5.85	6.03	5.65	5.04	5.19	5.44	6.22	4.77
A72-06	Temp (C)	21.4	22	22.2	21.3	21.3	21.6	22.2	21.9	22.2	21.71	22.8
A72-06	Hardness	176										113
A72-06	Alkalinity	*										*
A72-07	pH	7.04									7.01	
A72-07	Conductivity (us/cm)	518.9									364.9	
A72-07	D.O. (mg/L)	6.97	5.27	5.62	5.92	5.88	5.75	5.4	5.13	5.54	5.49	4.69
A72-07	Temp (C)	22.5	22.8	22	22.1	22.1	21.7	22.3	22.2	22.4	22.19	22.7
A72-07	Hardness	176										113
A72-07	Alkalinity	*										*
A72-08	pH	7.06									7	
A72-08	Conductivity (us/cm)	491.8									370.3	
A72-08	D.O. (mg/L)	6.75	5.06	5.47	5.86	6.27	5.75	5.27	5.3	5.45	5.8	4.14
A72-08	Temp (C)	22	22.7	22.2	22.3	22.1	21.4	22.4	22.1	22.2	22.11	22.7
A72-08	Hardness	176										113
A72-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A73B-01	pH	7.48									7.18	
A73B-01	Conductivity (us/cm)	441									358.3	
A73B-01	D.O. (mg/L)	5.19	4.45	5.04	4.97	4.71	5.01	4.38	4.29	4.89	4.19	4.74
A73B-01	Temp (C)	21.6	22.5	22	22.3	21.9	21.7	22.8	22.3	22.5	21.93	22.7
A73B-01	Hardness	120										105
A73B-01	Alkalinity	*										*
A73B-02	pH	7.44									7.19	
A73B-02	Conductivity (us/cm)	388.7									341.4	
A73B-02	D.O. (mg/L)	4.45	4.49	5.18	5.38	5.37	5.16	4.52	4.58	4.46	4.87	4.33
A73B-02	Temp (C)	22	22.5	22	21.9	21.7	21.6	22.5	22	22.2	21.93	22.7
A73B-02	Hardness	120										105
A73B-02	Alkalinity	*										*
A73B-03	pH	7.41									7.17	
A73B-03	Conductivity (us/cm)	429.7									355.6	
A73B-03	D.O. (mg/L)	4.78	4.71	5.13	5.09	5.82	5.46	4.72	4.5	4.15	5.78	4.5
A73B-03	Temp (C)	21.9	22.3	22	22.2	21.6	21.5	22.6	21.6	22.6	21.77	22.7
A73B-03	Hardness	120										105
A73B-03	Alkalinity	*										*
A73B-04	pH	7.37									7.16	
A73B-04	Conductivity (us/cm)	423.4									354.2	
A73B-04	D.O. (mg/L)	4.77	4.7	5	4.98	5.18	5.31	4.76	4.53	4.46	4.4	4.37
A73B-04	Temp (C)	22	22.1	21.8	21.9	21.9	21.5	22.3	21.5	22.3	21.76	22.6
A73B-04	Hardness	120										105
A73B-04	Alkalinity	*										*
A73B-05	pH	7.36									7.14	
A73B-05	Conductivity (us/cm)	435.8									356.1	
A73B-05	D.O. (mg/L)	6.04	4.52	4.85	5.16	5.44	5.06	4.55	4.43	4.84	4.58	4.47
A73B-05	Temp (C)	22	22.3	22.1	22.3	21.7	22	22.6	22.1	22.5	21.99	22.8
A73B-05	Hardness	120										105
A73B-05	Alkalinity	*										*
A73B-06	pH	7.34									7.14	
A73B-06	Conductivity (us/cm)	423.8									353.1	
A73B-06	D.O. (mg/L)	5.31	4.45	5.06	4.96	5.06	5.21	4.63	4.56	5.01	5.03	4.34
A73B-06	Temp (C)	22.1	22.6	21.7	22.3	21.3	21.1	22.7	22.2	22.5	21.84	22.8
A73B-06	Hardness	120										105
A73B-06	Alkalinity	*										*
A73B-07	pH	7.34									7.12	
A73B-07	Conductivity (us/cm)	432.7									356.5	
A73B-07	D.O. (mg/L)	5.64	4.41	5.01	4.9	5.41	5.08	4.67	4.42	4.77	5.66	4.54
A73B-07	Temp (C)	22	22.7	21.9	22.5	21.8	21.9	22.7	22.5	22.8	22.18	23
A73B-07	Hardness	120										105
A73B-07	Alkalinity	*										*
A73B-08	pH	7.32									7.13	
A73B-08	Conductivity (us/cm)	428.2									315.1	
A73B-08	D.O. (mg/L)	5.97	4.36	4.88	4.91	5.53	5.14	4.7	4.53	4.69	5.87	4.48
A73B-08	Temp (C)	22.6	22.5	22.2	22.3	22	21.8	22.6	22.4	22.7	21.92	23
A73B-08	Hardness	120										105
A73B-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12
End Date	12/20/12
Water Type	MHRW
Analysts	SA, CL, LC

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A75B-01	pH	6.95									6.99	
A75B-01	Conductivity (us/cm)	459									362.1	
A75B-01	D.O. (mg/L)	4.46	5.52	5.42	5.86	6.05	5.71	5.13	5.17	5.13	6.52	4.78
A75B-01	Temp (C)	21.8	22.3	21.7	21.8	21.5	21.7	22.2	21.7	22.2	21.53	22.9
A75B-01	Hardness	143										112
A75B-01	Alkalinity	*										*
A75B-02	pH	7									6.98	
A75B-02	Conductivity (us/cm)	475.5									361.5	
A75B-02	D.O. (mg/L)	5.51	5.68	5.61	5.61	6.21	5.74	4.78	4.62	5.36	6.36	4.85
A75B-02	Temp (C)	21.6	22.1	22.2	22.1	21.9	22.2	22.2	22.5	22.7	21.6	23
A75B-02	Hardness	143										112
A75B-02	Alkalinity	*										*
A75B-03	pH	7.02									6.98	
A75B-03	Conductivity (us/cm)	465.6									363.7	
A75B-03	D.O. (mg/L)	4.64	5.72	5.66	5.87	5.85	5.69	5.03	4.69	5.58	6.25	4.82
A75B-03	Temp (C)	21.5	21.4	21	21.6	20.8	21.8	22.1	22	22.3	21.52	22.1
A75B-03	Hardness	143										112
A75B-03	Alkalinity	*										*
A75B-04	pH	7.08									7	
A75B-04	Conductivity (us/cm)	448.8									358.4	
A75B-04	D.O. (mg/L)	5.4	5.34	5.55	5.93	5.86	5.64	5.2	5.37	5.38	5.39	4.76
A75B-04	Temp (C)	21.5	21.6	21.5	21.5	21.5	21.3	22	21.5	22.1	21.45	22.8
A75B-04	Hardness	143										112
A75B-04	Alkalinity	*										*
A75B-05	pH	7.07									6.99	
A75B-05	Conductivity (us/cm)	460.2									361.7	
A75B-05	D.O. (mg/L)	4.97	5.31	5.56	5.62	5.84	5.49	5.06	5.08	5.53	6.16	4.38
A75B-05	Temp (C)	21.9	21.9	21.8	21.2	21.3	21	22.2	21.4	21.8	21.52	22.6
A75B-05	Hardness	143										112
A75B-05	Alkalinity	*										*
A75B-06	pH	7.1									6.99	
A75B-06	Conductivity (us/cm)	468.5									369	
A75B-06	D.O. (mg/L)	5.45	5.24	5.51	5.75	5.94	5.58	4.87	5.26	5.51	6	4.52
A75B-06	Temp (C)	21.7	22.1	21.8	21.2	21.1	21.1	22.2	21.3	22.3	21.77	22.8
A75B-06	Hardness	143										112
A75B-06	Alkalinity	*										*
A75B-07	pH	7.11									7	
A75B-07	Conductivity (us/cm)	460.9									358.7	
A75B-07	D.O. (mg/L)	5.41	5.39	5.27	5.79	5.93	5.48	4.88	5.02	5.42	5.48	4.67
A75B-07	Temp (C)	21.5	22.8	21.8	21.5	21.3	21.4	22.4	21.7	22.4	21.97	22.8
A75B-07	Hardness	143										112
A75B-07	Alkalinity	*										*
A75B-08	pH	7.13									7.02	
A75B-08	Conductivity (us/cm)	461.3									355.6	
A75B-08	D.O. (mg/L)	5.52	5.42	5.53	5.67	5.84	5.62	5.06	5.07	5.58	5.91	4.73
A75B-08	Temp (C)	21.9	22.5	22.2	21.6	21.3	21.5	22.4	21.7	22.4	22.08	22.7
A75B-08	Hardness	143										112
A75B-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
M34-01	pH	6.17									6.22	
M34-01	Conductivity (us/cm)	499.6									368	
M34-01	D.O. (mg/L)	7.27	6.88	6.1	6.45	6.7	6.41	5.9	6.14	5.29	6.82	5.96
M34-01	Temp (C)	21.3	21.2	21.1	21.7	21.2	22.3	22.4	21.2	21.4	21.19	22.6
M34-01	Hardness	158										108
M34-01	Alkalinity	*										*
M34-02	pH	6.21									6.3	
M34-02	Conductivity (us/cm)	502.7									363.9	
M34-02	D.O. (mg/L)	6.67	6.79	6.26	6.51	6.85	6.1	6.03	6.17	6.14	6.83	5.61
M34-02	Temp (C)	21.4	21.2	21	21.5	21.3	21.2	22.8	21.3	21.7	21.42	22.3
M34-02	Hardness	158										108
M34-02	Alkalinity	*										*
M34-03	pH	6.24									6.48	
M34-03	Conductivity (us/cm)	505.2									359.4	
M34-03	D.O. (mg/L)	6.8	6.72	6.16	6.39	6.66	6.34	5.91	6.14	6.45	6.97	5.53
M34-03	Temp (C)	21.4	21.7	21.1	21.3	21.3	21.2	22.5	21.5	21.3	21.27	22.6
M34-03	Hardness	158										108
M34-03	Alkalinity	*										*
M34-04	pH	6.28									6.51	
M34-04	Conductivity (us/cm)	487.2									368.7	
M34-04	D.O. (mg/L)	5.73	6.44	6.3	6.49	6.85	6.16	5.96	6.12	6.24	6.86	5.57
M34-04	Temp (C)	21.5	21.5	21	21.1	21.5	21.5	22.7	21.6	21.3	21.53	22.6
M34-04	Hardness	158										108
M34-04	Alkalinity	*										*
M34-05	pH	6.28									6.55	
M34-05	Conductivity (us/cm)	518.1									368.2	
M34-05	D.O. (mg/L)	6.44	6.52	6.21	6.29	6.69	5.95	5.87	5.91	6.73	6.97	5.27
M34-05	Temp (C)	21.4	21.7	21.5	21.2	21.7	21.5	22.3	21.6	21.8	21.2	22.3
M34-05	Hardness	158										108
M34-05	Alkalinity	*										*
M34-06	pH	6.32									6.56	
M34-06	Conductivity (us/cm)	488.6									366	
M34-06	D.O. (mg/L)	5.57	6.54	6.13	6.38	6.73	6.17	5.56	5.84	6.32	6.77	5.43
M34-06	Temp (C)	21.7	21.5	21.3	21.7	21.4	21.7	22.5	21.6	21.7	21.68	22.3
M34-06	Hardness	158										108
M34-06	Alkalinity	*										*
M34-07	pH	6.32									6.59	
M34-07	Conductivity (us/cm)	506.9									363.3	
M34-07	D.O. (mg/L)	6.38	6.49	6.03	6.31	6.81	6.23	6.01	5.76	6.29	6.65	5.44
M34-07	Temp (C)	21.9	21.6	21.6	21.9	21.5	21.7	22.5	21.9	21.6	21.92	22.6
M34-07	Hardness	158										108
M34-07	Alkalinity	*										*
M34-08	pH	6.35									6.62	
M34-08	Conductivity (us/cm)	481.4									350.5	
M34-08	D.O. (mg/L)	5.54	6.44	5.93	6.27	6.67	6.19	6.04	5.82	6.25	6.48	5.25
M34-08	Temp (C)	21.2	22.3	22.1	22.2	20.9	21.2	22.5	22	21.1	21.94	22.8
M34-08	Hardness	158										108
M34-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
CC49-01	pH	7.27									7.14	
CC49-01	Conductivity (us/cm)	493.6									366.4	
CC49-01	D.O. (mg/L)	6.8	4.49	4.79	5.23	5.56	5.42	5.02	4.85	4.98	4.72	5.92
CC49-01	Temp (C)	22.3	22.3	22	22.2	21.9	21.5	22.5	22.1	22.6	22.08	22.5
CC49-01	Hardness	161										106
CC49-01	Alkalinity	*										
CC49-02	pH	7.2									5.38	
CC49-02	Conductivity (us/cm)	520.3									321.4	
CC49-02	D.O. (mg/L)	5.59	4.44	4.89	4.6	5.5	5.49	5.09	4.84	4.87	6.24	4.84
CC49-02	Temp (C)	21.5	22.6	22.2	22.5	22.2	21.6	22.5	22.2	22.5	22.05	22.7
CC49-02	Hardness	161										106
CC49-02	Alkalinity	*										*
CC49-03	pH	6.65									4.34	
CC49-03	Conductivity (us/cm)	512.1									371.1	
CC49-03	D.O. (mg/L)	6.46	4.62	5.04	4.97	5.67	5.54	5.01	5.02	5.1	4.34	4.83
CC49-03	Temp (C)	21.8	21.9	21.8	21.8	21.5	21.5	22.3	21.8	22.2	21.93	22.6
CC49-03	Hardness	161										106
CC49-03	Alkalinity	*										*
CC49-04	pH	6.42									4.89	
CC49-04	Conductivity (us/cm)	481.5									364.2	
CC49-04	D.O. (mg/L)	6.95	4.53	5.04	4.78	5.68	5.65	5.07	4.81	5.04	5.52	4.41
CC49-04	Temp (C)	22	22.2	22	22.3	21.5	21.3	22.4	21.8	22.2	21.89	22.7
CC49-04	Hardness	161										106
CC49-04	Alkalinity	*										*
CC49-05	pH	6.27									4.19	
CC49-05	Conductivity (us/cm)	499.5									374.8	
CC49-05	D.O. (mg/L)	7.02	4.44	4.8	4.93	5.1	5.52	4.94	5.06	5.12	3.27	4.69
CC49-05	Temp (C)	21.7	22	22	22	21.7	21.2	22.3	21.8	22.3	21.85	22.6
CC49-05	Hardness	161										106
CC49-05	Alkalinity	*										*
CC49-06	pH	6.07									4.79	
CC49-06	Conductivity (us/cm)	503.7									388	
CC49-06	D.O. (mg/L)	7.05	4.58	4.95	5.17	5.34	5.37	4.86	5.07	4.95	5.19	4.47
CC49-06	Temp (C)	21.5	22.3	21.6	22.1	21.8	21.3	22.2	22.1	22.2	21.67	22.5
CC49-06	Hardness	161										106
CC49-06	Alkalinity	*										*
CC49-07	pH	5.93									4.78	
CC49-07	Conductivity (us/cm)	499									366.7	
CC49-07	D.O. (mg/L)	7.11	4.64	4.94	5.23	5.5	5.41	5.04	4.91	5.07	3.63	4.58
CC49-07	Temp (C)	21.8	22.4	21.9	22.3	22.2	21.6	22.5	22.4	22.8	22.09	22.5
CC49-07	Hardness	161										106
CC49-07	Alkalinity	*										*
CC49-08	pH	5.94									5.24	
CC49-08	Conductivity (us/cm)	466									370.2	
CC49-08	D.O. (mg/L)	6.83	4.64	5.05	5.42	5.27	5.3	5.13	5.01	5.03	5.76	4.77
CC49-08	Temp (C)	22.1	22.7	22.3	22.1	22.5	22.2	22.5	22.2	22.7	21.97	22.8
CC49-08	Hardness	161										106
CC49-08	Alkalinity	*										*

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix A. December 2012 Upper Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	8
End Date	12/20/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	80
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
BBRIDGE-01	pH	6.52									6.78	
BBRIDGE-01	Conductivity (us/cm)	435.7									359.8	
BBRIDGE-01	D.O. (mg/L)	6.27	5.9	5.8	5.94	6.11	5.64	5.27	5.55	5.87	6.64	4.87
BBRIDGE-01	Temp (C)	21.6	22.2	22.1	22	22.1	22	22.2	22.1	21.2	21.56	22.3
BBRIDGE-01	Hardness	133										106
BBRIDGE-01	Alkalinity	*										*
BBRIDGE-02	pH	6.73									6.93	
BBRIDGE-02	Conductivity (us/cm)	403.1									346.4	
BBRIDGE-02	D.O. (mg/L)	6.12	5.93	5.83	6.18	6.49	5.92	5.22	5.61	5.1	6.56	4.83
BBRIDGE-02	Temp (C)	21.4	22.2	21	21.4	21.7	21.5	22.2	22.1	21	21.74	22.7
BBRIDGE-02	Hardness	133										106
BBRIDGE-02	Alkalinity	*										*
BBRIDGE-03	pH	6.8									6.84	
BBRIDGE-03	Conductivity (us/cm)	429.1									359.6	
BBRIDGE-03	D.O. (mg/L)	6.56	5.89	5.75	6.14	6.61	5.82	5.28	5.25	5.76	6.01	4.97
BBRIDGE-03	Temp (C)	21.7	21.9	21.5	21.5	21.6	21	22.1	21.7	21.8	21.44	22.3
BBRIDGE-03	Hardness	133										106
BBRIDGE-03	Alkalinity	*										*
BBRIDGE-04	pH	6.84									6.86	
BBRIDGE-04	Conductivity (us/cm)	433.9									355.1	
BBRIDGE-04	D.O. (mg/L)	6.76	5.82	5.77	5.94	6.5	6.04	5.45	5.23	5.65	5.33	4.82
BBRIDGE-04	Temp (C)	21.3	22.2	21.6	21.3	21.5	21.6	22.1	22	22.2	21.56	22.7
BBRIDGE-04	Hardness	133										106
BBRIDGE-04	Alkalinity	*										*
BBRIDGE-05	pH	6.9									6.88	
BBRIDGE-05	Conductivity (us/cm)	430.6									354.6	
BBRIDGE-05	D.O. (mg/L)	4.82	5.68	5.5	5.68	6.09	5.83	5.24	5.21	5.71	6.29	4.64
BBRIDGE-05	Temp (C)	21.8	22.2	21.8	21.5	21.8	21.8	22.2	21.5	22.1	21.46	22.6
BBRIDGE-05	Hardness	133										106
BBRIDGE-05	Alkalinity	*										*
BBRIDGE-06	pH	6.96									6.91	
BBRIDGE-06	Conductivity (us/cm)	428.8									361	
BBRIDGE-06	D.O. (mg/L)	5.7	5.67	5.62	5.79	6.23	5.66	4.98	5.13	5.75	5.64	4.71
BBRIDGE-06	Temp (C)	21.7	22.1	21.7	21.5	21.8	21.8	22.3	21.4	22.2	21.71	23
BBRIDGE-06	Hardness	133										106
BBRIDGE-06	Alkalinity	*										*
BBRIDGE-07	pH	6.99									6.95	
BBRIDGE-07	Conductivity (us/cm)	419.9									357.8	
BBRIDGE-07	D.O. (mg/L)	6.37	5.55	5.57	5.62	5.59	5.43	5.28	5.02	5.54	5.96	4.57
BBRIDGE-07	Temp (C)	21.8	22.2	22	22	22	21.8	22.4	22.2	22.5	21.63	22.7
BBRIDGE-07	Hardness	133										106
BBRIDGE-07	Alkalinity	*										*
BBRIDGE-08	pH	7.02									6.96	
BBRIDGE-08	Conductivity (us/cm)	413.6									353.2	
BBRIDGE-08	D.O. (mg/L)	6.53	5.68	5.51	5.55	6.07	5.71	5.21	5.34	5.34	6.03	4.79
BBRIDGE-08	Temp (C)	21.6	22.3	21.3	21.9	22	21.1	22.4	22.2	22.5	21.36	23
BBRIDGE-08	Hardness	133										106
BBRIDGE-08	Alkalinity	*										*

*Alkalinity was not analyzed due to water volume constraints.

Prepared by: EC 7/15/13

Reviewed by: BGK 7/24/12

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Appendix B Sediment Reference Toxicity Test

Concurrent with the 2012 Upper Animas River Sediment Toxicity Test

4-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	4
End Date	12/14/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	40
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
Control-01	No. Alive	10	10	10	10	10
Control-01	pH	7.16				7.35
Control-01	Conductivity (us/cm)	320.2				360.7
Control-01	D.O. (mg/L)	7.72	6.1	6.63	5.85	6.85
Control-01	Temp (C)	22.3	22.7	22.3	22.6	22.1
Control-01	Hardness	96				111
Control-01	Alkalinity	*				*

Control-02	No. Alive	10	10	10	10	10
Control-02	pH	7.2				7.38
Control-02	Conductivity (us/cm)	320.3				366.2
Control-02	D.O. (mg/L)	7.66	5.62	6.16	5.63	6.83
Control-02	Temp (C)	22.5	22.8	22.3	22.6	22.3
Control-02	Hardness	96				111
Control-02	Alkalinity	*				*

Control-03	No. Alive	10	10	10	10	10
Control-03	pH	7.25				6.84
Control-03	Conductivity (us/cm)	319.5				361.3
Control-03	D.O. (mg/L)	7.62	5.79	6.49	6.15	6.8
Control-03	Temp (C)	22.4	22.7	22	22.5	22.25
Control-03	Hardness	96				111
Control-03	Alkalinity	*				*

Control-04	No. Alive	10	10	10	10	10
Control-04	pH	7.29				7.06
Control-04	Conductivity (us/cm)	319.5				356.1
Control-04	D.O. (mg/L)	7.61	5.8	6.52	6.14	6.8
Control-04	Temp (C)	22.5	22.7	22	22.5	22.3
Control-04	Hardness	96				111
Control-04	Alkalinity	*				*

Appendix B Sediment Reference Toxicity Test

Concurrent with the 2012 Upper Animas River Sediment Toxicity Test

4-Day Flow Through Data Sheets

Start Date	12/10/12	No. of Replicates	4
End Date	12/14/12	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	40
Analysts	SA, CL, LC		

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
6.25%%-01	No. Alive	10	10	10	9	9
6.25%%-01	pH	7.34				7
6.25%%-01	Conductivity (us/cm)	318.8				353.2
6.25%%-01	D.O. (mg/L)	7.59	5.96	6.32	5.83	6.81
6.25%%-01	Temp (C)	22.4	22.7	21.7	22.2	22.2
6.25%%-01	Hardness	97				108
6.25%%-01	Alkalinity	*				*

6.25%%-02	No. Alive	10	10	10	10	10
6.25%%-02	pH	7.36				7.02
6.25%%-02	Conductivity (us/cm)	318.9				354.3
6.25%%-02	D.O. (mg/L)	7.57	5.74	6.42	5.69	6.82
6.25%%-02	Temp (C)	22.45	22.7	21.7	22.2	22.2
6.25%%-02	Hardness	97				108
6.25%%-02	Alkalinity	*				*

6.25%%-03	No. Alive	10	10	10	9	9
6.25%%-03	pH	7.39				7.06
6.25%%-03	Conductivity (us/cm)	319.6				353.6
6.25%%-03	D.O. (mg/L)	7.55	5.84	6.34	6.19	6.83
6.25%%-03	Temp (C)	22.3	22.7	21.7	22.2	22.2
6.25%%-03	Hardness	97				108
6.25%%-03	Alkalinity	*				*

6.25%%-04	No. Alive	10	10	10	10	10
6.25%%-04	pH	7.43				7.1
6.25%%-04	Conductivity (us/cm)	319.7				351.7
6.25%%-04	D.O. (mg/L)	7.56	6.04	6.57	5.73	6.83
6.25%%-04	Temp (C)	22.5	22.7	21.6	22.3	22.2
6.25%%-04	Hardness	97				108
6.25%%-04	Alkalinity	*				*

Appendix B Sediment Reference Toxicity Test

Concurrent with the 2012 Upper Animas River Sediment Toxicity Test

4-Day Flow Through Data Sheets

Start Date	12/10/12	No. of Replicates	4
End Date	12/14/12	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	40
Analysts	SA, CL, LC		

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
12.5%-01	No. Alive	10	10	10	7	7
12.5%-01	pH	7.45				7.14
12.5%-01	Conductivity (us/cm)	321.1				357.7
12.5%-01	D.O. (mg/L)	7.53	5.71	6.51	5.65	6.76
12.5%-01	Temp (C)	22.5	22.7	22	22.4	22.3
12.5%-01	Hardness	98				108
12.5%-01	Alkalinity	*				*
12.5%-02	No. Alive	10	10	8	7	7
12.5%-02	pH	7.46				7.18
12.5%-02	Conductivity (us/cm)	318.6				352.9
12.5%-02	D.O. (mg/L)	7.58	5.82	6.87	6.24	6.68
12.5%-02	Temp (C)	22.5	22.8	21.8	22.3	22.3
12.5%-02	Hardness	98				108
12.5%-02	Alkalinity	*				*
12.5%-03	No. Alive	10	10	8	8	8
12.5%-03	pH	7.49				7.23
12.5%-03	Conductivity (us/cm)	319.8				350.2
12.5%-03	D.O. (mg/L)	7.59	5.75	6.78	6.3	6.25
12.5%-03	Temp (C)	22.5	22.7	21.6	22.3	22.2
12.5%-03	Hardness	98				108
12.5%-03	Alkalinity	*				*
12.5%-04	No. Alive	10	10	7	7	7
12.5%-04	pH	7.53				7.26
12.5%-04	Conductivity (us/cm)	318.3				355.7
12.5%-04	D.O. (mg/L)	7.59	6.02	6.74	6.2	6.76
12.5%-04	Temp (C)	22.5	22.8	21.6	22.3	22.2
12.5%-04	Hardness	98				108
12.5%-04	Alkalinity	*				*

Appendix B Sediment Reference Toxicity Test

Concurrent with the 2012 Upper Animas River Sediment Toxicity Test

4-Day Flow Through Data Sheets

Start Date	12/10/12	No. of Replicates	4
End Date	12/14/12	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	40
Analysts	SA, CL, LC		

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
25%-01	No. Alive	10	3	1	0	-
25%-01	pH	7.53			-	-
25%-01	Conductivity (us/cm)	318.2			-	-
25%-01	D.O. (mg/L)	7.6	5.77	6.43	5.72	-
25%-01	Temp (C)	22.4	22.6	21.5	22.6	-
25%-01	Hardness	97			103	-
25%-01	Alkalinity	*			*	-

25%-02	No. Alive	10	7	4	0	-
25%-02	pH	7.53			-	-
25%-02	Conductivity (us/cm)	318.7			-	-
25%-02	D.O. (mg/L)	7.6	6.12	6.76	5.53	-
25%-02	Temp (C)	22.4	22.7	21.3	22.6	-
25%-02	Hardness	97			103	-
25%-02	Alkalinity	*			*	-

25%-03	No. Alive	10	2	0	0	-
25%-03	pH	7.54			-	-
25%-03	Conductivity (us/cm)	319			-	-
25%-03	D.O. (mg/L)	7.61	5.84	6.6	5.85	-
25%-03	Temp (C)	22.5	22.7	21.2	22.6	-
25%-03	Hardness	97			103	-
25%-03	Alkalinity	*			*	-

25%-04	No. Alive	10	5	1	1	1
25%-04	pH	7.57				7.29
25%-04	Conductivity (us/cm)	318.8				371.3
25%-04	D.O. (mg/L)	7.6	6.1	6.61	5.72	6.77
25%-04	Temp (C)	22.4	22.7	21.2	22.7	22.27
25%-04	Hardness	97				103
25%-04	Alkalinity	*				*

Appendix B Sediment Reference Toxicity Test

Concurrent with the 2012 Upper Animas River Sediment Toxicity Test

4-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	4
End Date	12/14/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	40
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-01	No. Alive	10	5	0	-	-
50%-01	pH	7.54			-	-
50%-01	Conductivity (us/cm)	295			-	-
50%-01	D.O. (mg/L)	7.57	6.55	6	-	-
50%-01	Temp (C)	22.5	22.8	22.6	-	-
50%-01	Hardness	97		105		
50%-01	Alkalinity	*		*		

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-02	No. Alive	10	1	0	-	-
50%-02	pH	7.48			-	-
50%-02	Conductivity (us/cm)	318.5			-	-
50%-02	D.O. (mg/L)	7.61	6.54	6.32	-	-
50%-02	Temp (C)	22.5	22.7	22.6	-	-
50%-02	Hardness	97		105	-	-
50%-02	Alkalinity	*		*	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-03	No. Alive	10	1	0	-	-
50%-03	pH	7.61			-	-
50%-03	Conductivity (us/cm)	318.2			-	-
50%-03	D.O. (mg/L)	7.61	6.48	6.2	-	-
50%-03	Temp (C)	22.6	22.7	22.5	-	-
50%-03	Hardness	97		105	-	-
50%-03	Alkalinity	*		*	-	-

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
50%-04	No. Alive	10	1	0	-	-
50%-04	pH	7.53			-	-
50%-04	Conductivity (us/cm)	318.1			-	-
50%-04	D.O. (mg/L)	7.63	6.31	6.14	-	-
50%-04	Temp (C)	22.6	22.7	22.5	-	-
50%-04	Hardness	97		105	-	-
50%-04	Alkalinity	*		*	-	-

Appendix B Sediment Reference Toxicity Test

Concurrent with the 2012 Upper Animas River Sediment Toxicity Test

4-Day Flow Through Data Sheets

Start Date	12/10/12		No. of Replicates	4
End Date	12/14/12		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	40
Analysts	SA, CL, LC			

Replicate ID	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4
100%-01	No. Alive	10	0	-	-	-
100%-01	pH	7.55				-
100%-01	Conductivity (us/cm)	319.1				-
100%-01	D.O. (mg/L)	7.63	6.29	-	-	-
100%-01	Temp (C)	22.5	22.6	-	-	-
100%-01	Hardness	95	98	-	-	-
100%-01	Alkalinity	*	*	-	-	-
100%-02	No. Alive	10	0	-	-	-
100%-02	pH	7.55				-
100%-02	Conductivity (us/cm)	319.1				-
100%-02	D.O. (mg/L)	7.62	6.54	-	-	-
100%-02	Temp (C)	22.4	22.6	-	-	-
100%-02	Hardness	95	98	-	-	-
100%-02	Alkalinity	*	*	-	-	-
100%-03	No. Alive	10	0	-	-	-
100%-03	pH	7.5				-
100%-03	Conductivity (us/cm)	318.8				-
100%-03	D.O. (mg/L)	7.65	6.01	-	-	-
100%-03	Temp (C)	22.4	22.7	-	-	-
100%-03	Hardness	95	98	-	-	-
100%-03	Alkalinity	*	*	-	-	-
100%-04	No. Alive	10	0	-	-	-
100%-04	pH	7.6				-
100%-04	Conductivity (us/cm)	320.7				-
100%-04	D.O. (mg/L)	7.6	6.16	-	-	-
100%-04	Temp (C)	22.4	22.7	-	-	-
100%-04	Hardness	95	98	-	-	-
100%-04	Alkalinity	*	*	-	-	-

*Alkalinity was not analyzed due to water volume constraints.

Prepared by: EC 7/15/13

Reviewed by:

Hyalella 10-d Survival and Growth Sediment Test — U.S. EPA Region I Lab

Start Date: 10 Dec-12 | Species: Hyalella azteca | Sample Code: Control-P
End Date: 20 Dec-12 | Protocol: EPA/600/R-99/064 (2000) | Sample Source: Upper Animas River
Sample Date: 10 Dec-12 | Material: Lab Control | Sample Station: positive control

Batch Note: Region 8: Upper Animas River H. azteca 10-day sediment toxicity test

Sample Code	Rep	Pos	# Exposed	# Survived	Total Weight-mg	Tare Weight-mg	Pan Count	Mean Length-mm	Notes
Control-P	1	74	10	10	207.694	207.2946	10		
Control-P	2	18	10	10	207.8862	207.4937	10		
Control-P	3	33	10	10	207.7784	207.2301	10		
Control-P	4	71	10	9	206.4633	206.1138	9		
Control-P	5	50	10	10	209.611	209.3062	10		
Control-P	6	27	10	10	208.7849	208.2163	10		
Control-P	7	52	10	10	209.2436	208.9422	10		
Control-P	8	76	10	9	206.0131	205.4788	9		
Control N	1	30	10	10	207.723	207.119	10		
Control N	2	34	9	9	207.2429	206.6395	9		
Control N	3	12	11	11	210.1563	209.3316	11		
Control N	4	14	10	10	207.1309	206.2197	10		
Control N	5	2	10	9	208.0925	207.4776	9		
Control N	6	7	10	10	207.7105	207.0491	10		
Control N	7	60	10	9	208.9042	208.251	9		
Control N	8	54	10	10	208.7741	208.054	10		
A56	1	38	10	3	209.7175	209.6037	3		
A56	2	37	10	7	209.4562	209.1891	7		
A56	3	10	10	5	207.9212	207.7473	5		
A56	4	80	10	8	207.0759	206.8522	8		
A56	5	64	10	9	209.2445	209.0023	9		
A56	6	73	10	7	205.6212	205.4031	7		
A56	7	79	10	3	207.9364	207.7913	3		
A56	8	41	10	8	208.7065	208.4639	8		
A68	1	5	10	5	208.234	208.033	5		
A68	2	55	10	6	206.7461	206.5464	6		
A68	3	29	10	7	205.9819	205.69	7		
A68	4	69	10	6	206.9773	206.7561	6		
A68	5	67	10	6	209.5833	209.3364	6		
A68	6	9	10	4	207.4437	207.2956	4		
A68	7	36	10	5	208.7058	208.4766	5		
A68	8	28	10	6	207.923	207.6535	6		
A72	1	1	10	2	207.6846	207.5661	2		
A72	2	39	10	4	207.1808	207.0385	4		
A72	3	72	10	2	206.7494	206.6758	2		
A72	4	75	10	3	206.7789	206.6091	3		
A72	5	51	10	4	207.6777	207.4905	4		
A72	6	58	10	5	205.4616	205.2522	5		
A72	7	13	10	5	205.041	204.86	5		
A72	8	44	10	4	206.038	205.8298	4		
A73B	1	66	10	0	0	0	0		
A73B	2	23	10	0	0	0	0		
A73B	3	42	10	0	0	0	0		
A73B	4	25	10	1	205.445	205.3807	1		
A73B	5	68	10	0	0	0	0		
A73B	6	77	10	1	205.8659	205.7678	1		

CETIS Test Data Worksheet

Report Date: 24 Feb-15 09:46 (p 2 of 2)
Test Code: 15-2164-2344/5AB26B68

Sample Code	Rep	Pos	# Exposed	# Survived	Total Weight-mg	Tare Weight-mg	Pan Count	Mean Length-mm	Notes
A73B	7	26	10	1	206.9982	206.8777	1		
A73B	8	59	10	1	206.1551	206.1205	1		
A75B	1	70	10	6	205.9818	205.7897	6		
A75B	2	47	10	6	208.8464	208.6709	6		
A75B	3	8	10	3	208.9266	208.8363	3		
A75B	4	15	10	5	208.7208	208.4917	5		
A75B	5	35	10	5	207.8091	207.6612	5		
A75B	6	49	10	3	206.4732	206.3462	3		
A75B	7	43	10	4	204.0144	203.8098	4		
A75B	8	24	10	7	208.2514	207.994	7		
M34	1	32	10	0	0	0	0		
M34	2	46	10	3	206.5334	206.3873	3		
M34	3	21	10	0	0	0	0		
M34	4	45	10	1	207.6867	207.5722	1		
M34	5	63	10	0	0	0	0		
M34	6	17	10	1	206.312	206.3025	1		
M34	7	53	10	1	208.334	208.2543	1		
M34	8	57	10	1	207.9543	207.8973	1		
CC49	1	20	10	0	0	0	0		
CC49	2	40	10	0	0	0	0		
CC49	3	16	10	0	0	0	0		
CC49	4	31	10	0	0	0	0		
CC49	5	62	10	0	0	0	0		
CC49	6	22	10	0	0	0	0		
CC49	7	56	10	0	0	0	0		
CC49	8	19	10	0	0	0	0		
Bbridge	1	11	10	9	206.2499	205.9917	9		
Bbridge	2	4	10	8	206.2489	206.0004	8		
Bbridge	3	65	10	8	208.6091	208.2976	8		
Bbridge	4	3	10	8	205.4966	205.253	8		
Bbridge	5	6	10	8	209.2402	208.9439	8		
Bbridge	6	61	10	6	208.8208	208.5834	6		
Bbridge	7	48	10	6	209.1293	208.898	6		
Bbridge	8	78	10	8	208.8923	208.6205	8		

Hyalella 10-d Survival and Growth Sediment Test — U.S. EPA Region I Lab

Analysis ID:	00-4242-1801	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-15 9:43	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Batch Note: Region 8: Upper Animas River H. azteca 10-day sediment toxicity test

Sample Code	Sample Notes
Control N	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A56	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A68	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A72	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A73B	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A75B	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
M34	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
CC49	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
Bbridge	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	9.46%	

Steel Many-One Rank Sum Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Control N		A56	36	45	0	14	0.0028	Asymp	Significant Effect
		A68	36	45	0	14	0.0028	Asymp	Significant Effect
		A72	36	45	0	14	0.0028	Asymp	Significant Effect
		A73B	36	45	0	14	0.0028	Asymp	Significant Effect
		A75B	36	45	0	14	0.0028	Asymp	Significant Effect
		M34	36	45	0	14	0.0028	Asymp	Significant Effect
		CC49	36	45	0	14	0.0028	Asymp	Significant Effect
		Bbridge	36	45	0	14	0.0028	Asymp	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.02740658	0.003425822	8	116.5	<0.0001	Significant Effect
Error	0.00185279	2.940936E-05	63			
Total	0.02925937		71			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1.801	2.808	0.0936	Equal Variances
Variances	Levene Equality of Variance	3.302	2.808	0.0033	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9467	0.9538	0.0042	Non-normal Distribution

Mean Dry Biomass-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control N	8	0.06981	0.06154	0.07808	0.06659	0.0604	0.09112	0.003497	14.17%	0.0%
A56	8	0.02033	0.01586	0.0248	0.02209	0.01138	0.02671	0.001891	26.31%	70.88%
A68	8	0.02259	0.01884	0.02634	0.02252	0.01481	0.02919	0.001586	19.86%	67.64%
A72	8	0.01613	0.01219	0.02006	0.01754	0.007361	0.02094	0.001665	29.21%	76.9%
A73B	8	0.003969	-0.00014	0.008074	0.00173	0	0.01205	0.001736	123.7%	94.32%
A75B	8	0.0178	0.01322	0.02238	0.01838	0.00903	0.02574	0.001938	30.79%	74.5%
M34	8	0.005085	0.000245	0.009925	0.003325	0	0.01461	0.002047	113.9%	92.72%
CC49	8	0	0	0	0	0	0	0		100.0%
Bbridge	8	0.02623	0.02383	0.02864	0.02533	0.02313	0.03115	0.001018	10.98%	62.42%

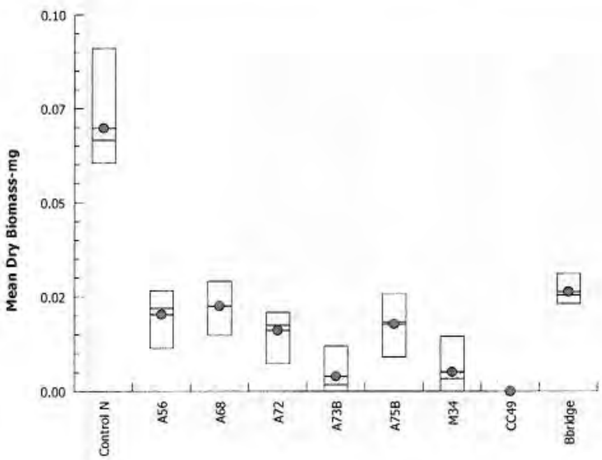
Hyalella 10-d Survival and Growth Sediment Test | **U.S. EPA Region I Lab**

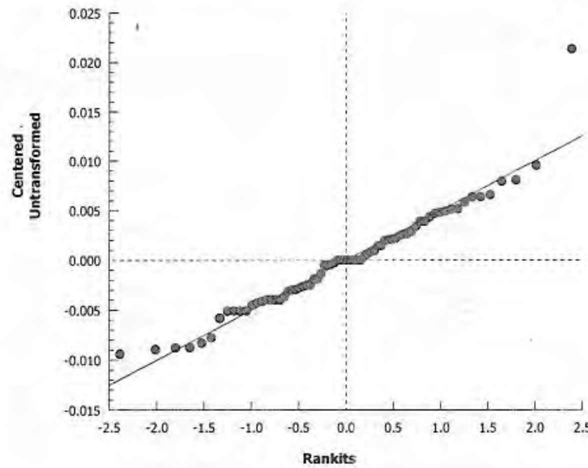
Analysis ID:	00-4242-1801	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-15 9:43	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Mean Dry Biomass-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control N	0.0604	0.06705	0.07497	0.09112	0.06149	0.06614	0.06532	0.07201
A56	0.01138	0.02671	0.01739	0.02237	0.02422	0.02181	0.01451	0.02426
A68	0.0201	0.01997	0.02919	0.02212	0.02469	0.01481	0.02292	0.02695
A72	0.01185	0.01423	0.007361	0.01698	0.01872	0.02094	0.0181	0.02082
A73B	0	0	0	0.00643	0	0.00981	0.01205	0.003461
A75B	0.01921	0.01755	0.00903	0.02291	0.01479	0.0127	0.02046	0.02574
M34	0	0.01461	0	0.01145	0	0.000949	0.00797	0.005701
CC49	0	0	0	0	0	0	0	0
Bbridge	0.02582	0.02485	0.03115	0.02436	0.02963	0.02374	0.02313	0.02718

Graphics





Hyalella 10-d Survival and Growth Sediment Test — **U.S. EPA Region I Lab**

Analysis ID:	00-5869-2302	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-15 9:43	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch Note: Region 8: Upper Animas River H. azteca 10-day sediment toxicity test

Sample Code	Sample Notes
Control N	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A56	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A68	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A72	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A73B	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
A75B	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
M34	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
CC49	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test
Bbridge	Region 8: Upper Animas River H. azteca 10-day sediment toxicity test

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	10.2%	

Dunnett Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control N		A56	6.746	2.436	0.162	14	<0.0001	CDF	Significant Effect
		A68	7.875	2.436	0.162	14	<0.0001	CDF	Significant Effect
		A72	11	2.436	0.162	14	<0.0001	CDF	Significant Effect
		A73B	17.05	2.436	0.162	14	<0.0001	CDF	Significant Effect
		A75B	9.031	2.436	0.162	14	<0.0001	CDF	Significant Effect
		M34	16.26	2.436	0.162	14	<0.0001	CDF	Significant Effect
		CC49	18.28	2.436	0.162	14	<0.0001	CDF	Significant Effect
		Bbridge	4.547	2.436	0.162	14	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	10.70319	1.337899	8	76.06	<0.0001	Significant Effect
Error	1.108184	0.01759022	63			
Total	11.81138		71			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	2.587	2.808	0.0164	Equal Variances
Variances	Levene Equality of Variance	5.134	2.808	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.9559	0.9538	0.0131	Normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control N	8	0.975	0.9363	1	1	0.9	1	0.01637	4.75%	0.0%
A56	8	0.625	0.4315	0.8185	0.7	0.3	0.9	0.08183	37.03%	35.9%
A68	8	0.5625	0.4859	0.6391	0.6	0.4	0.7	0.03239	16.29%	42.31%
A72	8	0.3625	0.2632	0.4618	0.4	0.2	0.5	0.04199	32.77%	62.82%
A73B	8	0.05	0.005313	0.09469	0.05	0	0.1	0.0189	106.9%	94.87%
A75B	8	0.4875	0.3656	0.6094	0.5	0.3	0.7	0.05154	29.9%	50.0%
M34	8	0.0875	0.004648	0.1704	0.1	0	0.3	0.03504	113.3%	91.03%
CC49	8	0	0	0	0	0	0	0		100.0%
Bbridge	8	0.7625	0.6738	0.8512	0.8	0.6	0.9	0.0375	13.91%	21.79%

Hyalella 10-d Survival and Growth Sediment Test — U.S. EPA Region I Lab

Analysis ID:	00-5869-2302	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-15 9:43	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control N	8	1.371	1.308	1.434	1.412	1.249	1.419	0.02668	5.5%	0.0%
A56	8	0.9238	0.7146	1.133	0.9912	0.5796	1.249	0.08845	27.08%	32.63%
A68	8	0.8489	0.771	0.9268	0.8861	0.6847	0.9912	0.03295	10.98%	38.09%
A72	8	0.6415	0.5347	0.7482	0.6847	0.4636	0.7854	0.04514	19.9%	53.21%
A73B	8	0.2403	0.1674	0.3131	0.2403	0.1588	0.3218	0.0308	36.26%	82.48%
A75B	8	0.7723	0.6474	0.8971	0.7854	0.5796	0.9912	0.05279	19.33%	43.68%
M34	8	0.2929	0.1748	0.4109	0.3218	0.1588	0.5796	0.04991	48.2%	78.64%
CC49	8	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0	0.0%	88.42%
Bbridge	8	1.07	0.9664	1.173	1.107	0.8861	1.249	0.04363	11.54%	21.99%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control N	1	1	1	1	0.9	1	0.9	1
A56	0.3	0.7	0.5	0.8	0.9	0.7	0.3	0.8
A68	0.5	0.6	0.7	0.6	0.6	0.4	0.5	0.6
A72	0.2	0.4	0.2	0.3	0.4	0.5	0.5	0.4
A73B	0	0	0	0.1	0	0.1	0.1	0.1
A75B	0.6	0.6	0.3	0.5	0.5	0.3	0.4	0.7
M34	0	0.3	0	0.1	0	0.1	0.1	0.1
CC49	0	0	0	0	0	0	0	0
Bbridge	0.9	0.8	0.8	0.8	0.8	0.6	0.6	0.8

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control N	1.412	1.403	1.419	1.412	1.249	1.412	1.249	1.412
A56	0.5796	0.9912	0.7854	1.107	1.249	0.9912	0.5796	1.107
A68	0.7854	0.8861	0.9912	0.8861	0.8861	0.6847	0.7854	0.8861
A72	0.4636	0.6847	0.4636	0.5796	0.6847	0.7854	0.7854	0.6847
A73B	0.1588	0.1588	0.1588	0.3218	0.1588	0.3218	0.3218	0.3218
A75B	0.8861	0.8861	0.5796	0.7854	0.7854	0.5796	0.6847	0.9912
M34	0.1588	0.5796	0.1588	0.3218	0.1588	0.3218	0.3218	0.3218
CC49	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588	0.1588
Bbridge	1.249	1.107	1.107	1.107	1.107	0.8861	0.8861	1.107

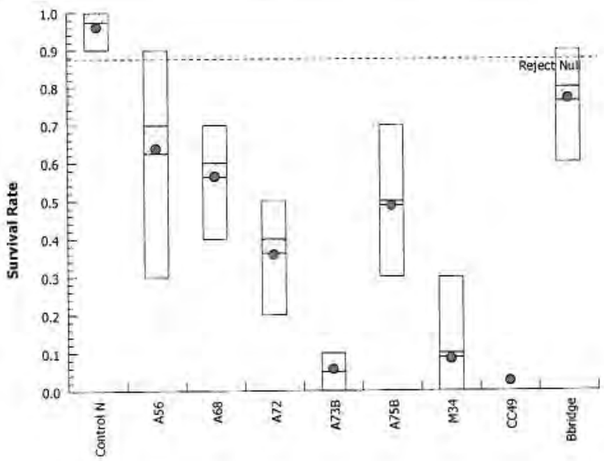
Survival Rate Binomials

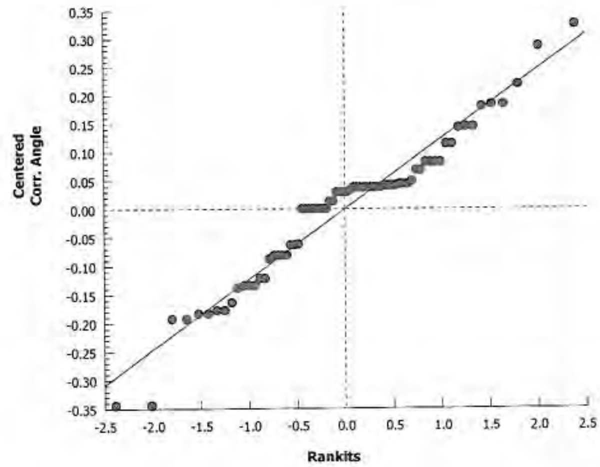
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control N	10/10	9/9	11/11	10/10	9/10	10/10	9/10	10/10
A56	3/10	7/10	5/10	8/10	9/10	7/10	3/10	8/10
A68	5/10	6/10	7/10	6/10	6/10	4/10	5/10	6/10
A72	2/10	4/10	2/10	3/10	4/10	5/10	5/10	4/10
A73B	0/10	0/10	0/10	1/10	0/10	1/10	1/10	1/10
A75B	6/10	6/10	3/10	5/10	5/10	3/10	4/10	7/10
M34	0/10	3/10	0/10	1/10	0/10	1/10	1/10	1/10
CC49	0/10	0/10	0/10	0/10	0/10	0/10	0/10	0/10
Bbridge	9/10	8/10	8/10	8/10	8/10	6/10	6/10	8/10

Hyalella 10-d Survival and Growth Sediment Test | **U.S. EPA Region I Lab**

Analysis ID:	00-5869-2302	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	24 Feb-15 9:43	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Graphics





Appendix 10b

Animas River
Sediment Toxicity Testing Report
November 2015

Prepared for:

United States Environmental Protection Agency, Region 8
Ecosystem Protection and Remediation-Program Support
1595 Wynkoop St.
Denver, CO 80202

Prepared By:

United States Environmental Protection Agency, Region 8
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April 2015

Contract No. EPW-13-028
DCN: EP8-2-1223

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Abbreviation and Acronym List

BLM	Bureau of Land Management
ºC	Degrees Celsius
CDPHE	Colorado Department of Public Health and Environment
CETIS	Comprehensive Environmental Toxicity Information System
Control N	Negative laboratory control
Control P	Positive laboratory control
DO	Dissolved Oxygen
DRMS	Colorado Division of Reclamation, Mining and Safety
EC_{50}	50% Median Effective Concentration
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
g	Grams
gpm	Gallons per minute
kg	Kilogram
LC_{50}	50% Lethal Concentration
MHRW	Moderately Hard Reconstituted Water
mg	Milligram
mL	Milliliter
NH_3	Ammonia
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
SGC	Sunnyside Gold Corporation
SOP	Standard Operating Procedure
TAC	Test Acceptability Criterion
YCT	Yeast, Cerophyl, and Trout Chow
$ZnSO_4$	Zinc sulfate heptahydrate

1.0 INTRODUCTION

A 10-day, static-renewal sediment toxicity test using the amphipod, *Hyalella azteca*, and sediment collected from the Animas River (San Juan County, Colorado) was performed at the United States Environmental Protection Agency (EPA) Region 8 Laboratory in November 2014. The purpose of this toxicity test was to determine the toxicity of sediments collected from the Animas River by assessing survival and growth. A 96-hour reference toxicity test was performed concurrently with the Animas River toxicity test as a quality assurance measure. The reference toxicity test consisted of an aqueous stock solution spiked with zinc, with a test endpoint of survival. This report includes a brief background of the Animas Mining District (Section 1.1), materials and methods (Section 2.0), testing results (Section 3.0), a discussion of results (Section 4.0), and supporting references (Section 5.0).

1.1 Background

Information in this section was obtained from the *Final 2014 Sampling and Analysis Plan/Quality Assurance Project Plan, Revision 1, Upper Animas Mining District Gladstone, San Juan County, Colorado*, dated September 2014 (ESAT, 2014).

The discovery of gold and silver brought miners to the Silverton area and Animas Mining District in the early 1870's. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, there were 12 concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling operations slowed down circa 1905, and the mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. After 1907, mining and milling continued throughout the basin whenever prices were relatively favorable. Gladstone, located about eight miles upstream of Silverton on Cement Creek, is the site of a historic mining town developed in the 1880s commensurate with the onset of mining in the surrounding area. The town was the central location and railroad terminus for the milling and shipping of mine ores from the surrounding three-square-mile valley. The town declined in the 1920's and no remnants of the town remain. By the 1970's, the Sunnyside Mine was the only year-round producing mine remaining in the county. This mine ceased production in 1991, and has since undergone reclamation efforts. The Gold King Mine's permit with Colorado Division of Reclamation, Mining and Safety (DRMS) is currently in inactive status; however, landowners hope to rehabilitate the mine.

Both the Sunnyside and Gold King properties were partially accessed through the American Tunnel that has its portal in Gladstone. Previously the American Tunnel drained as much as 1,600 gallons per minute (gpm) of water from the mines. A lime feed and settling pond-type treatment facility was constructed in Gladstone in 1979 by Standard Metals Corporation. Water discharging from the American Tunnel was treated as required by the water discharge permit. The facility operations and mine ownership was later transferred to the Sunnyside Gold Corporation (SGC). Under jurisdiction of a court consent decree to terminate their discharge permit, SGC installed several bulkheads within the Sunnyside Mine that greatly reduced the amount of discharge from the American Tunnel. Seventy to one hundred gpm continue to discharge, presumably from near surface groundwater.

In January 2003 the treatment facility, operations, and permit were transferred to the Gold King Mines Corporation. The settling ponds were deeded to the San Juan Corporation by SGC prior to the lease between the Gold King Mines and San Juan Corporations. The treatment facility continued to treat the remaining American Tunnel discharge and the Gold King discharge until September 2004. The San Juan Corporation required SGC to reclaim the four settling ponds (completed in 2005) following termination of the San Juan Corporation and SGC lease. The Gold King Mines Corporation was subsequently evicted and the balance of the Gold King Mines Corporation land was acquired by the San Juan Corporation as the lien holder. The American Tunnel portal reclamation and removal of some out buildings were completed in 2006. The Bureau of Land Management (BLM) manages land associated with the American Tunnel portal and vicinity; however, the San Juan Corporation owns the majority of the land surrounding the portal.

Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River.

1.2 Objective

The objectives of this toxicity test were to (a) support the yearly monitoring activities at the Animas River, (b) characterize the effects of mine waste-impacted sediment samples on *H. azteca* under subchronic exposure conditions, and (c) generate data to support development of the future Baseline Ecological Risk Assessment and Remedial Investigation.

2.0 MATERIALS AND METHODS

This section outlines the materials and methods used for testing purposes, including sediment collection procedures, water preparation and delivery, test organisms, food preparation, and testing procedures. General test methods following EPA (2000) are discussed below and summarized in **Table 2.0-1**.

2.1 Study Design

The 10-day Animas River sediment toxicity test followed protocols found in EPA Test Method 100.1 (EPA, 2000). *H. azteca* survival and growth were measured at the end of the exposure period. The test included a negative laboratory control (Control N; Horsecreek Reservoir control sediment) and a positive laboratory control (Control P; laboratory control sediment spiked with 1,000 milligrams per kilogram [mg/kg] zinc wet weight) to help evaluate the overall health of the test organisms and to provide a baseline growth measurement for amphipods exposed to clean sediment. The location on the Animas River originally selected as reference (i.e. A75CC) was determined to be impacted by mining activity, and could therefore not be used for that purpose. Eight replicates for each sample location and each laboratory control were used during the 10 day toxicity test.

Site sediment was thoroughly homogenized in a stainless steel pan before it was distributed into test chambers one day before the organisms were introduced. 100 milliliters (mL) of sediment was placed in each test replicate chamber before they were placed into a temperature-controlled water bath.

The water bath temperature was held at 23 ± 2ºC for the duration of the test and met the performance criterion. According to EPA Test Method 100.1 (EPA, 2000) the daily mean test temperature should be ± 1ºC and the instantaneous temperature must always be within ± 3ºC of the target temperature of 23ºC. Overlying water [175 mL of Moderately Hard Reconstituted Water (MHRW)] was added to each test chamber before ten organisms were counted, verified, and introduced. One mL of Yeast, Cerophyl®, and Trout Chow (YCT) feed mixture was added to each test chamber daily and the overlying water was renewed at a rate of two volumes (350 mL) per day for the 10-day test period.

The water quality measurements were collected daily as described in **Exhibit 1**. The water quality parameters pH, conductivity, and hardness were checked on test Day 0 and test Day 9. Dissolved oxygen (DO) and temperature were measured daily. A syringe was used to collect samples from overlying water from each replicate on the first and last day of the test. On Day 10 of the test, temperature and DO were measured in each test chamber before samples of overlying water from each replicate were collected and pooled for total and dissolved metals analyses. All overlying water samples collected for ammonia analyses were inspected for the presence of test organisms before the samples were prepared for analysis to ensure no organisms were inadvertently removed from the test chamber.

Exhibit 1: Activities Schedule for a 10-Day Sediment Toxicity Test

Day	Activity

Day -1	Add sediment into test chambers and start renewal of overlying water.
Day 0	Measure overlying water quality parameters (pH, temperature, DO, conductivity, and ammonia) in each replicate. Obtain hardness measurement by collecting an overlying water sample from each replicate and pooling for analysis. Collect pore water samples from each replicate and pool for dissolved metals analysis. Transfer 10 organisms into each test chamber and release them under the surface of the water to avoid entrapment. Add 1.0 mL of YCT into each test chamber. Obtain 80 additional test organisms to measure initial dry weight.
Day 1 through 8	Feed organisms 1.0 mL YCT and measure temperature and DO in each test chamber.
Day 9	Measure overlying water quality (pH, temperature, DO, conductivity, and ammonia) for each replicate. Collect an overlying water sample and a pore water sample from each replicate and pool for metals analysis. Add 1.0 mL of YCT into each test chamber.
Day 10	Measure temperature and DO. Collect the surviving organisms from each replicate.

2.2 Sediment Collection

Composite sediment samples were collected in early September 2014 from sample locations on the Animas River, Cement Creek, and Mineral Creek in accordance with the 2014 Sampling and Analysis Plan/Quality Assurance Project Plans (SAP/QAPP) (ESAT, 2014; USFWS, 2012). Sediment was collected from a depth of 0-2 inches using a Teflon hand trowel. The sample containers were placed on ice until received at the EPA Region 8 laboratory before they were placed in a 4^{o}C cooler for preservation. Sample collection equipment was station dedicated, therefore, decontamination of this equipment was not necessary.

2.3 Test Water Preparation and Delivery

MHRW was prepared in accordance with Smith *et al*. (1997) by adding 47.4 grams (g) of calcium sulfate, 123g of magnesium sulfate heptahydrate, 96 g of sodium bicarbonate, and 4 g of potassium chloride to the laboratory stainless steel batch tank containing 1,000 L of deionized water. The batch tank was continuously aerated for the duration of the toxicity test after the MHRW was prepared. Water quality was measured to verify that the following parameters were met: hardness between 90 and 100 milligrams per liter (mg/L), conductivity between 330 and 360 microsiemens/centimeter, and pH between 7.8 and 8.2 standard units (EPA, 2000). **Table 2.3-1** summarizes the chemical constituents for the MHRW used in the test, and the resulting pH and hardness. Hardness and pH fell slightly below the recommended values as stated in Section 7, Water, Formulated Sediment, Reagents, and Standards, of *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*

(EPA, 2000). This slight deviation in water chemistry would not have any substantial effect on the outcome of the toxicity test. The MHRW was delivered to each test chamber at a rate of two volumes (approximately 350 mL) of overlying water per day using a glass distribution box similar to the one described in Benoit *et al.* (1983).

Table 2.3-1 Moderately Hard Reconstituted Water Composition and Chemistry

$CaSO_4$	$MgSO_4$-$7H_2O$	$NaHCO_3$	KCl	Final pH*	Final Hardness*
47.4 g/1000 L	123g/1000 L	96 g/1000 L	4 g/1000 L	6.92	75.4 mg/L

*an average was taken from two batches

2.4 Test Organisms

The juvenile amphipods needed for the sediment toxicity test were obtained from Aquatic Biosystems (Ft. Collins, Colorado). The organisms were kept in their shipping bag after they arrived at the laboratory and placed in a holding tank for about 48 hours for temperature acclimation. Acclimation of the organisms to the laboratory MHRW was not a concern because the organisms had been cultured and shipped in MHRW. Regardless, the shipping bag was slowly opened to allow a small amount of laboratory MHRW to mix with the shipping water. This procedure was repeated several times throughout the course of one day until laboratory MHRW and shipping water were homogenized. Test organisms were 7 to 10-days old at the time of testing.

2.5 Test Food Preparation

Organisms were fed a YCT mixture daily that contained 2.6-2.9 grams of solids per liter (see **Table 2.5-1**). YCT was prepared by adding 5 g of Trout Chow® to 1 L of deionized water, followed by homogenization in a blender (EPA, 2000). The homogenized mixture was poured into a 2-L separatory funnel, aerated, and allowed to digest for one week at room temperature. The aeration apparatus was removed after the digestion period. The solid material settled out for one hour, after which the supernatant was collected using a 110 mesh Nitex screen. Yeast solution was prepared by adding 5 g of dry yeast to 1 L deionized water, followed by mixing. Cerophyl® was prepared by adding 5 g of alfalfa pellets to 1 L of deionized water, followed by homogenization in a blender. Equal parts of yeast, Trout Chow (supernatant), and Cerophyl® solutions were then added to a beaker and homogenized in a blender. The YCT mixture was stored in a freezer or refrigerator until use. Refrigerated YCT was used within two weeks of preparation.

2.6 Test Procedures

The following sections describe the procedures used for the site sediment and reference toxicity tests.

2.6.1 Site Sediment Toxicity Test

Sediment samples were collected from fourteen locations along the Animas River (A55, A56, A60, A68, A72, A73, A75CC, A75D, A75EC, Baker Bridge [Bbridge], James Ranch [Jranch], 32nd St, Lightener Creek [Lcreek] and Purple Cliffs [Pcliffs]). A duplicate was collected at location A68. Location A75CC was designated as the upstream reference location but it was later determined that this location was potentially impacted by mining activity and no longer designated as the reference. Testing was also performed on negative and positive control sediment (i.e., Control N and Control P, respectively) for quality assurance purposes. The positive control was spiked with 1000 mg/kg zinc solution intended to substantially reduce survival and growth while the negative control was not spiked and was used to test the overall health of the organisms. The control sediment consisted of sediment collected from Horsecreek Reservoir, located 5 miles south of Hudson, Colorado.

Eight replicates were tested for each location and the laboratory control samples. Eighty test organisms were collected to be used to determine an initial dry weight per organism to verify that the control organisms showed measureable growth after 10 days of exposure (See **Table 2.6-1**). The test chambers, which consisted of 300-mL beakers filled with 100 mL of sediment and 175 mL of overlying MHRW, were placed in a water bath to maintain a constant temperature during the test.

The testing took place over a 10-day period. The quality of the overlying MHRW was measured daily for DO and temperature. Overlying water was measured for hardness, conductivity, ammonia and pH (**Appendix A**) at the start (Day 0) and end (Day 9) of the test. The amphipods were fed 1 mL of YCT per test chamber per day. The surviving organisms were removed (or “picked”) from the sediment using pipettes, a sieve, and/or Nitex screen at the end of the 10-day test period. Personnel involved with picking organisms from the sediment were required to show proficiency by retrieving at least 90% of organisms placed into “practice” sediment.

2.6.2 Reference Toxicity Test

The 96-hour reference toxicity test followed procedures outlined in Section 9, Quality Assurance and Quality Control, of *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (EPA, 2000) and was carried out concurrently with the site sediment toxicity test. The test chambers consisted of 200-mL beakers, filled with 100 mL of MHRW, and contained Nitex screen at the bottom as an artificial substrate. A stock solution of MHRW with zinc sulfate heptahydrate ($ZnSO_4$) was prepared with resulting zinc concentration of 100 ppm. Using a serial dilution approach, $ZnSO_4$ concentrations were reduced by 50% starting with the highest concentration (referred to as 100%) until the lowest dilution (6.25%) was reached. The following values provide the dilutions and average zinc concentrations (calculated from the initial and final measured dissolved Zn results, Table 3.1-2): 100% concentration of $ZnSO_4$ was 927 µg/L, followed by 50% (464 µg/L), 25% (253.5 µg/L), 12.5% (133 µg/L), 6.25% (66.85 µg/L) and 0% (10.3 µg/L). The zinc concentration used for 0% is and average of one half the laboratory detection limit of 10 μg/L (i.e. 5 μg/L) and the final estimated concentration of 15.6 μg/L. Zinc concentrations were verified using EPA Method 200.7/200.8 and are included in **Table 3.1-2**. Survival was the endpoint for the reference test.

2.7 Pore Water Collection Procedures

Pore water was collected from each individual test chamber for analysis at the start and end of the test. These samples were collected by placing a push-point pore water sampling probe in each test chamber and extracting the water from within the bedded sediment using a 50 mL syringe. The syringe was then fit with a 0.45 micrometer filter, and the sample was transferred to a 10 mL sample container. The sample was labeled, preserved, and stored at 4°C in the Region 8 Laboratory. Initial and final pore water samples were analyzed for dissolved metals using EPA Method 200.7 (EPA 1994a) and 200.8 (EPA, 1994b).

2.8 Overlying Surface Water Collection Procedure

Samples for overlying water were collected using treatment group dedicated 60 mL syringes. Water was collected from just below the surface in each replicate for a sample location composite sample. Composite samples were collected for alkalinity, anions, total recoverable and dissolved metals samples and a discrete water sample was collected from each replicate for all ammonia samples. After approximately 40 mL (5 mL from each replicate) of water was pulled into the syringe a visual observation of the water was made to ensure that no organisms were inadvertently captured during this process.

3.0 RESULTS

This section presents the results for the site sediment and reference toxicity tests and addresses any issues or unforeseen conditions encountered during the test.

3.1 Site Sediment Toxicity Testing

Sediment, pore water, and overlying surface water samples were analyzed for total recoverable metals (sediment & overlying water) and dissolved metals (pore water & overlying water) using EPA Method 200.7/200.8. **Tables 3.1-1** through **3.1-4** provide the results of these analyses. The overlying water was tested for alkalinity, anions, and dissolved organic carbon using EPA Methods 310.1, 300.0, and 415.1, respectively. **Table 3.1-8** provides the results of these analyses.

The conditions in the test chambers generally met the performance criteria (see **Table 2.0-1**). Daily water chemistry is provided in **Appendix A**. The performance criterion for EPA Method 100.1 requires no more than 50% change for alkalinity, hardness and pH whereas DO must be maintained above 2.5 mg/L. The replicates' variability in hardness met performance criteria of 50% at all sample locations except Control N and Control P. Control N had an initial hardness of 356 and a final hardness of 138, making a 61% change. Control P had an initial hardness of 322 and a final hardness of 139, making a 57% change. The replicates' variability in alkalinity met performance criteria of 50% at all sample locations except location A72. A72 had an initial alkalinity of 40.5 and a final alkalinity of 60.7, making a 50% difference. Location A55 and A73 were close to the 50% criteria at 46% and 48%, respectively. DO was generally maintained above the performance criterion of 2.5 mg/L throughout the test. The criterion was not fully met for location A55 (rep 4), location A56 (rep 5, rep 6, rep 7) or location A75-CC (rep 1 – rep 8). The overlying water temperatures deviated slightly more than ±2ºC from 23ºC, ranging between 20.0°C and 23.1°C during the 10-day test period. The only temperature deviations were observed on day 0 of the test when several replicates were slightly below the recommended minimum of 21°C.

A discrete sample of the overlying water was obtained from each replicate on Day 0 and Day 9 of the test for ammonia analysis using EPA Method 350.1 (EPA 1993). Ammonia (NH_3-N) concentrations on Day 0 (initial water chemistry) ranged from 0.02 mg/L NH_3-N in A75CC replicates 3, 4, 6 and 8 to 1.88 mg/L NH_3-N in A55-02 mg/L NH_3-N. On Day 9 (final water chemistry) concentrations ranged from 0.02 mg/L NH_3-N in several locations and replicates to 0.62 mg/L NH_3-N in A55-03 (see **Table 3.1-5**). The average Day 0 and Day 9 ammonia levels measured in the eight replicates of each of the sediment samples used in the toxicity test were compared to pH-dependent acute ammonia criteria. As shown in **Table 3.1-5,** all ammonia levels fell below their respective acute ammonia criteria. The ammonia criteria were calculated using the "salmonids present" equation, which is provided on p. 54 of the Colorado Department of Public Health and Environment Water Quality Control Commission (CDPHE): Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) (CDPHE, 2013).

Surviving *H. azteca* were collected at the end of the 10 day test from each test chamber, counted, placed in aluminum weigh boats, and dried for at least 24 hrs at 80ºC. Every effort was made to ensure that sediment particles were not inadvertently added to the weigh boats with the organisms. Pans with dried *H. azteca* were then weighed. All information was recorded on laboratory bench sheets.

CETIS (Comprehensive Environmental Toxicity Information System) statistical software (2011) was used to establish the significance of differences between *H. azteca* survival and biomass between laboratory controls, upstream reference and site locations after 10 days of exposure in the sediment samples (see **Attachment 1**). **Figure 3.1-1** presents the results for survival and **Figure 3.1-2** presents the results for biomass.

Survival Results

Survival results for each replicate and average per location are included in the CETIS worksheets (**Attachment 1**). Control P and Control N showed an average of 92.5% survival and 91.3% survival, respectively. The survival results were almost indistinguishable from each other. Control N met the minimum performance criterion of ≥80% survival. Control P had unexpectedly high survival but did not influence the outcome of the toxicity test. Site sample results were only compared to Control N to determine significant survival and growth. The available analytical data for pore water, overlying water, and sediment samples (see **Tables 3.1-1 to 3.1-4**) show that the Zn levels in Control P were consistently similar to those measured in Control N.

Control N had 92.5 ± 8.9% survival and Control P had 91.3 ± 13.6% survival. The following values represent the average survival results for the remaining sample locations: A55 (60 ± 16%), A56 (43.8 ± 26.2%), A60 (77.5 ± 18.3%), A68 (70 ± 28.3%), A72 (70 ± 13.1%), A73 (73.8 ± 22%), A75CC (73.8 ± 19.2%), A75D (78.6 ± 21.9%), A75EC (81.3 ± 24.8%), Bbridge (86.3 ± 10.6%), Jranch (66.3± 24.5%), 32nd St (87.5 ± 10.4%), Lcreek (73.8 ± 22%), Pcliffs (31.3 ± 27.5%), A68Dup (70 ± 20%).

Biomass Results

Biomass results for each replicate and average per location are included in the CETIS worksheets (**Attachment 1**). Average biomass for each location was calculated by dividing the total weight of all surviving *H. azteca* per sample location by the total number of *H. azteca* introduced per sample location on Day 0 of the test (i.e. [total weight of *H. azteca* from all eight replicates per sample location] / [8 replicates x 10 *H. azteca* introduced for each sample location]). The results show that Control N had an average biomass of 78.1 ± 11.8 µg/organism and Control P had an average biomass of 51.1 ± 13.1 µg/organism. The following values represent the average biomass results for the remaining sample locations: A55 (21.1 ± 6.8 µg/organism), A56 (14.3 ± 9.1 µg/organism), A60 (23.1 ± 5.5 µg/organism), A68 (23.2 ± 9.2 µg/organism), A72 (27.9 ± 6.9 µg/organism), A73 (21.8 ± 6.2 µg/organism), A75CC (36.6 ± 8.0 µg/organism) A75D (24.9 ± 8.3 µg/organism), A75EC (36.3 ± 11.2 µg/organism), Bbridge (30.8 ± 6.1 µg/organism), Jranch (24.4 ± 8.5 µg/organism), 32nd St (33.4 ± 7.9 µg/organism), Lcreek (24.4 ± 9.6 µg/organism), Pcliffs (11.3 ± 8.1 µg/organism) and A68Dup (23.9 ± 9.2 µg/organism).

Growth Results

Growth was calculated by comparing mean initial dry weight per organism (**Table 2.6-1**; 80 organisms used to determine initial dry weight) to the mean final dry weight per survivors at the end of the test (Day 10). The sample mean for each sample location (**Table 3.1-7**) was calculated by averaging the results of the mean dry weight (µg) per survivor for each replicate. Control N passed acceptability criterion (**Table 2.0-1**), which requires measureable increase in growth in control sediment between the start (Day 0) and the end of the test (Day 10). All Control N growth results, along with supplemental growth results for Control P and each sample location are included in **Table 3.1-7**. The mean weight per survivor in each replicate is presented in **Table 3.1-7**. The initial average organism weight was 22.5 µg/organism (**Table 2.6-1**), whereas the final average organism weight for Control N was 78.1 ± 11.8 µg/organism (269.8% growth increase).

3.2 Reference Toxicity Test

Overlying water quality parameters were consistent throughout the 96-hour reference toxicity test (see **Appendix B**). The performance criterion for EPA Method 100.1

requires no more than 50% change for alkalinity, hardness and pH whereas DO must be maintained above 2.5 mg/L. Test chamber temperatures ranged between 21.9°C and 22.8°C during the test period. The variability in hardness and alkalinity was less than 50% within each test chamber, and DO levels ranged between 3.2 mg/L and 6.01 mg/L.

CETIS used the Trimmed Spearman-Karber method to calculate the EC_{50} of 196.7 ug/L zinc with an UCL of 210.4 and an LCL of 183.8 ug/L zinc. These values correspond with historical EC50 values calculated from reference toxicity tests performed at the Region 8 Laboratory. *Note that CETIS uses the term "EC50" (Median Effective Concentration effecting 50% of the test organisms) instead of* LC_{50}.

Survival Results

The surviving organisms were collected at the end of the 96-hour reference toxicity test and counted. **Figure 3.2-1** provides the results. The control (10.3 µg/L Zn) passed the performance criterion of ≥ 80% survival, with average survival of 100%. The following values show the average zinc concentrations and % survivals from the reference toxicity test: 66.85 µg/L zinc = 97.5% survival, 133 µg/L zinc = 100% survival, 253.5 µg/L zinc = 12.5% survival, 464 µg/L zinc = 0% survival and 927 µg/L zinc = 0% survival. A 96-hour EC_{50} of 196.7 µg/L was calculated using the Trimmed Spearman-Karber Estimates (see **Attachment 2**).

A discrete sample of the overlying water was obtained from each replicate on Day 0 and Day 4 of the test for ammonia analysis using EPA Method 350.1 (EPA 1993). Ammonia (NH_3-N) levels on Day 0 (initial water chemistry) ranged from 0.02 mg/L in 10 replicates to 0.33 mg/L NH_3-N in the Control-04 replicate. On Day 4 (final water chemistry), the ammonia levels ranged from 0.04 mg/L NH_3-N in the 100%-01 replicate to 0.88 mg/L NH_3-N in the 25%-01 replicate. **Table 3.1-6** provides the ammonia data. The average Day 0 and Day 4 ammonia levels measured in the four replicates of each of the samples used in the reference toxicity test were compared to pH-dependent acute ammonia criteria. None of the measured ammonia levels exceeded their respective criteria. Note that the acute ammonia criteria were calculated using the "salmonids present" equation, provided on p. 54 of Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) (CDPHE, 2012).

4.0 DISCUSSION

The survival and biomass results of the Animas River sediment toxicity test were compared to the negative laboratory control. Below is a discussion of the results.

Survival

The CETIS software was used to perform a Bonferroni Adjusted t Test, comparing Control N and Site samples, to determine the significance ($p \leq 0.05$) of the observed survival after 10 days of exposure (**Attachment 1**). Control N had 92.5 % survival. Control N (together with Control P) had the highest survival of all samples in the test. The following sample locations were found not to be statistically different when compared to Control N: A75CC (73.8% survival), Control P (91.3% survival), A60 (77.5% survival), A68 (70% survival), A72 (70% survival), A73 (73.8% survival), A75D (78.6% survival), A75EC (81.3% survival), Bbridge (86.3% survival), 32nd St (87.5% survival), Lcreek (73.8% survival) and A68 Dup (70% survival). The survival of A55 (60%), A56 (43.8%), Jranch (66.3%) and Pcliffs (31.3%) were all statistically different when compared to Control N.

Biomass

CETIS was used to perform Bonferroni Adjusted t Test comparisons of the negative control against Site samples to determine significant ($p \leq 0.05$) difference in observed biomass after 10 days of exposure (**Attachment 1**). Control N had a mean biomass of 78.1 $\pm$ 11.8 µg. When Control N was compared to Site samples, all locations (i.e. A75CC, A55, A56, A60, A68, A72, A73, A75D, A75EC, Bbridge, Jranch, 32nd St, Lcreek, Pcliffs and A68 Dup) were significantly lower. Note that the A75D-01 pan was compromised. It was not possible to run biomass for this pan.

Growth

Control N passed TAC with measurable growth and had a final average weight per organism of 84.4µg. Organisms in Control N had a growth increase of about 61.8 µg/organism when compared to the initial average weight of *H. azteca* (22.5 µg/organism).

Results consistently show that survival and biomass at locations A55, A56, Jranch and Pcliffs are significantly impacted when compared to the negative control. The following sample locations were determined to be significantly impacted for biomass but not survival when compared to the negative control: A75CC, A60, A68, A72, A73, A75D, A75EC, Bbridge, 32nd St, Lcreek, and A68 Dup. A75CC was originally designated as an upstream reference location but later found to be potentially impacted by mining-related contaminants.

5.0 REFERENCES

CETIS (Comprehensive Environmental Toxicity Information System). 2000-2011. Tidepool Scientific Software, McKinleyville, CA 95519.

Colorado Department of Public Health and Environment (CDPHE) 2013, Water Quality Control Commission. 1979-2013. Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31). Amended January 2013.

Environmental Services Assistance Team (ESAT, 2014). *Final 2014 Sampling and Analysis Plan/Quality Assurance Project Plan, Revision 1, Upper Animas Mining District Gladstone, San Juan County, Colorado*, dated September 2014.

Smith, M.E., Lazorchak, J.M., Herrin, L.E., Brewer-Swartz, S., & Thoney, W.T. (1997). A reformulated, reconstituted water for testing the freshwater amphipod, *Hyalella azteca*. (Method 100.1) *Environ. Toxicol. Chem.* 16: 1229-1233.

US EPA. 1980. Sampling and Analysis Method 200.8, EMSL-Cincinnati, OH, Nov.

US EPA. 1993. Method 350.1. "Determination of Ammonia Nitrogen by Semi-Automated Colorimetry" Rev 2.0.

US EPA. 1994a. Method 200.7. "Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry" Rev 4.4.

US EPA. 1994b. Method 200.8. "Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry" Rev 5.4.

US EPA. 1994. Standard Operating Procedure for Sediment Sampling, #2016. November, 1994.

US EPA. (2000, March). "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates." Method 100.1.

US EPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, fifth edition (EPA-821-R-02-012). October 2002.

US Fish and Wildlife Service. 2012. Sampling and Analysis Plan/Quality Assurance Project Plan for Baseline Ecological Risk Assessment Cement Creek and Upper Animas Mining District, San Juan County, Colorado.

Tables

Table 2.0-1 Test Conditions and Acceptability Criteria for 10 Day Sediment Toxicity Testing Using *H. azteca*

Parameter	Conditions
Test Type	Whole sediment toxicity test with renewal of overlying water
Temperature	23 +/- 1°C
Light Quality	Wide spectrum flourescent lights
Illuminance	100 to 1000 lux
Photoperiod	16 light 8 dark
Test Chamber	300 mL beaker
Sediment Volume	100 mL
Overlying Water Volume	175 mL
Renewal of Overlying Water	2 volumes per day
Age of Organisms	7-14 day old at start of test
Number of Organisms/chamber	10
Number of Replicates	8 for whole sediment; 4 for reference test
Feeding	YCT food fed 1.0 mL per day to each test chamber
Aeration	None
Overlying Water	Moderately Hard Reconstituted Water
Test Chamber Cleaning	Clean screens if clogged
Overlying Water Quality	Hardness, Alkalinity, Conductivity, pH, monitored at beginning and end of test, Temperature and Dissolved Oxygen monitored daily
Test Duration	10 days
Endpoints	Survival and growth
Test Acceptability	Minimum mean control survival of 80% and measurable growth of test organisms in the control sediment

Prepared by: BB 2/27/15
Reviewed by:

Table 2.5-1

Initial Feed Weight Data Sheet

November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

10-Day Static Renewal

Feed Dry Weight Rep #1

Weigh boat	1.5561	g
Weigh boat + 1 mL wet feed	2.5158	g
1 mL wet feed	0.9597	g
Weight boat + dry feed	1.5583	g
Dry feed	0.0022	g/mL
Dry feed	2.2	g/L

Feed Dry Weight Rep#2

Weigh boat	1.533	g
Weigh boat + 1 mL wet feed	2.4735	g
1 mL wet feed	0.9405	g
Weight boat + dry feed	1.5351	g
Dry feed	0.0021	g/mL
Dry feed	2.1	g/L

Table 2.6-1

Initial *H. azteca* Weight Data Sheet

2014 November Animas River Sediment Toxicity Test

10-Day Static Renewal

Initial Dry Weight: 80 Organisms		
Weigh Boat (empty)	1.3097	g
Weigh Boat with 80 organisms (dried)	1.3115	g
Average Organism	22.5	μg

Table 3.1-1
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*
Pore Water Dissolved Metals Results (ug/L)

Initial

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
A55	101	0.502J	3.01	106	<2.00U	1.09	49800	15.3	1.32	28.4	156	<100U	8.81	7700	21200	0.658J	3150	1.40J	<0.500U	18600	530	<0.500U	3.95	63.1
A56	136	0.530J	1.50J	72.1	<2.00U	1.62	48800	1.11J	1.07	67.5	155	<100U	8.72	7960	12100	1.13	2940	1.17J	0.636J	17500	500	<0.500U	<2.00U	190
A60	32.4J	0.600J	<0.500U	46.7	<2.00U	6.69	56700	1.27J	0.409	14.7	174	<100U	2.41	7960	3520	1.05	2540	<1.00U	<0.500U	17200	599	<0.500U	<2.00U	588
A68	35.6J	<0.500U	<0.500U	34.8	<2.00U	1.62	56100	<1.00U	0.121J	5.31	170	<100U	0.527	7270	512	<0.500U	2130	<1.00U	<0.500U	15200	587	<0.500U	<2.00U	230
A68Dup	22.5J	<0.500U	<0.500U	27.9	<2.00U	0.812	46100	<1.00U	<0.100U	3.43	140	<100U	0.418	5950	77.4	<0.500U	1800	<1.00U	<0.500U	14600	489	<0.500U	<2.00U	196
A72	23.9J	<0.500U	<0.500U	29.1	<2.00U	2.46	44000	<1.00U	1.21	3.37	143	<100U	0.191J	8130	3430	1.49	2080	<1.00U	<0.500U	19600	438	<0.500U	<2.00U	182
A73	24.4J	<0.500U	<0.500U	35.8	<2.00U	0.634	37400	<1.00U	0.125J	12.8	120	<100U	0.799	6440	55.4	1.04	1730	<1.00U	<0.500U	17800	370	<0.500U	<2.00U	220
A75CC	42.9J	<0.500U	2.45	260	<2.00U	<0.100U	66600	2.69	2.52	1.24	231	<100U	0.116J	15800	3020	1.02	3560	1.43J	<0.500U	21000	421	<0.500U	<2.00U	15.7J
A75D	28.0J	<0.500U	<0.500U	40.9	<2.00U	1.62	39100	<1.00U	0.814	4.05	127	<100U	0.299	7100	2320	0.716J	2780	<1.00U	<0.500U	17300	365	<0.500U	<2.00U	157
A75EC	137	<0.500U	2.92	230	<2.00U	0.121J	26600	1.33J	12.0	1.68	117	<100U	0.196J	12300	11000	19.5	3790	1.87J	<0.500U	15500	191	0.756J	<2.00U	15.0J
Animas@32nd Bridge	56.9	<0.500U	0.964J	70.5	<2.00U	<0.100U	46000	1.21J	0.719	2.10	150	<100U	0.599	8680	3990	<0.500U	3710	<1.00U	<0.500U	20000	460	<0.500U	<2.00U	29.6
Animas@Lightner Creek	40.5J	<0.500U	0.608J	62.1	<2.00U	<0.100U	41000	<1.00U	0.585	1.11	144	<100U	0.207	10200	671	1.22	2700	<1.00U	<0.500U	23100	378	<0.500U	<2.00U	12.6J
Animas@Purple Cliffs	21.8J	<0.500U	0.616J	58.6	<2.00U	<0.100U	36600	1.13J	0.391	1.26	122	<100U	0.152J	7340	219	1.19	2440	<1.00U	<0.500U	19300	322	<0.500U	<2.00U	15.4J
Bbridge	138	<0.500U	0.665J	58.4	<2.00U	1.35	43200	<1.00U	1.19	7.82	145	<100U	0.632	9050	4280	1.16	4030	<1.00U	<0.500U	18500	357	<0.500U	<2.00U	67.8
James Ranch	154	<0.500U	0.965J	50.8	<2.00U	1.28	46900	<1.00U	1.25	7.94	157	141J	0.766	9630	4520	<0.500U	3100	<1.00U	<0.500U	19900	344	<0.500U	<2.00U	59.2
N-Control	83.6	<5.00U	5.01JD	<50.0U	<2.00U	<1.00U	322000	<10.0U	6.45D	16.9D	1240	<100U	<1.00U	105000	822	<5.00U	21000	10.5JD	<5.00U	357000	1730	<5.00U	<20.0U	21.0
P-Control	108	<5.00U	6.86JD	<50.0U	<2.00U	<1.00U	389000	<10.0U	9.65D	22.6D	1550	<100U	<1.00U	140000	1040	10.4D	27600	16.1JD	<5.00U	485000	2140	<5.00U	<20.0U	37.1

Final

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Hardness	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
A55	166	1.08	2.44	118	<2.00U	1.47	29400	2.27	0.536	59.4	99	<100U	33.3	6290	13300	<0.500U	3800	1.19J	<0.500U	24800	372	<0.500U	<2.00U	54.0
A56	64.5	0.552J	1.03J	52.9	<2.00U	1.08	33500	1.82J	0.466	45.5	114	<100U	8.78	7450	8210	<0.500U	3270	1.07J	<0.500U	20400	355	<0.500U	<2.00U	60.7
A60	37.4J	0.554J	1.03J	58.4	<2.00U	12.4	84200	3.11	0.574	11.7	263	<100U	2.51	12700	11700	<0.500U	3590	1.03J	<0.500U	26500	792	<0.500U	<2.00U	1100
A68	<20.0U	<0.500U	<0.500U	35.1	<2.00U	1.12	53600	1.77J	<0.100U	3.84	162	<100U	0.116J	6780	234	<0.500U	2420	<1.00U	<0.500U	23300	588	<0.500U	<2.00U	232
A68 Dup	23.0J	<0.500U	<0.500U	38.8	<2.00U	1.89	62000	1.81J	<0.100U	5.17	186	<100U	0.203	7530	806	<0.500U	2640	<1.00U	<0.500U	22900	658	<0.500U	<2.00U	253
A72	37.7J	<0.500U	<0.500U	40.5	<2.00U	2.58	70300	<1.00U	3.08	3.38	218	281	<0.100U	10400	13100	<0.500U	2940	<1.00U	<0.500U	26900	688	<0.500U	<2.00U	217
A73	21.1J	<0.500U	<0.500U	42.9	<2.00U	0.968	42400	<1.00U	0.125J	2.36	131	<100U	0.170J	6000	158	1.59	2040	<1.00U	<0.500U	23100	435	<0.500U	<2.00U	298
A75CC	45.0J	<2.50U	8.40JD	617D	<2.00U	<0.500U	129000	5.14JD	8.14D	<2.50U	438	8700	<0.500U	28300	9140	<2.50U	9280	<5.00U	<2.50U	27900	856	<2.50U	<10.0U	21.3
A75D	<20.0U	<0.500U	<0.500U	47.1	<2.00U	1.97	49900	<1.00U	0.777	4.26	155	<100U	0.137J	7430	3150	<0.500U	3390	<1.00U	<0.500U	20300	477	<0.500U	<2.00U	191
A75EC	70.9	<0.500U	3.98	334	<2.00U	<0.100U	29600	3.36	17.6	1.57	139	867	<0.100U	15700	21800	9.34	4510	2.48	<0.500U	27200	220	<0.500U	<2.00U	<10.0U
Animas@32nd Bridge	37.0J	<0.500U	0.616J	79.1	<2.00U	0.290	59500	<1.00U	0.685	2.24	192	<100U	0.309	10600	4090	<0.500U	3480	<1.00U	<0.500U	28400	548	<0.500U	<2.00U	33.4
Animas@Lightner Creek	35.8J	<0.500U	1.26J	101	<2.00U	<0.100U	62400	<1.00U	1.32	1.63	223	<100U	0.123J	16400	1760	<0.500U	3480	1.49J	<0.500U	34500	617	<0.500U	<2.00U	18.9J
Animas@Purple Cliffs	22.3J	0.715J	1.39J	131	<2.00U	<0.100U	62200	<1.00U	0.708	2.21	213	<100U	0.159J	14000	324	0.696J	4060	1.02J	<0.500U	32900	526	<0.500U	<2.00U	16.4J
Bbridge	72.4	<0.500U	1.01J	97.6	<2.00U	0.479	53800	<1.00U	1.18	8.89	182	<100U	1.31	11600	4970	<0.500U	6410	1.47J	<0.500U	27300	476	<0.500U	<2.00U	32.7
James Ranch	89.8	<0.500U	2.74	116	<2.00U	0.408	55500	<1.00U	1.73	18.2	187	<100U	0.991	11800	9300	<0.500U	5450	3.33	<0.500U	25400	467	<0.500U	<2.00U	36.4
N-Control	74.6	<5.00U	13.1JD	<50.0U	<2.00U	<1.00U	360000	<10.0U	15.5D	10.6D	1390	4050	1.38JD	120000	7940	19.3D	18600	12.6JD	<5.00U	369000	2040	<5.00U	<20.0U	28.0
P-Control	40.8J	<5.00U	9.72JD	<50.0U	<2.00U	<1.00U	233000	<10.0U	9.54D	6.70JD	857	1260	<1.00U	66600	4760	11.6D	9920	<10.0U	<5.00U	159000	1300	<5.00U	<20.0U	137

Note: Data Qualifier Definitions Listed Below:
D = The analyte was diluted prior to analysis.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Prepared by: B. Belmonte 2/26/15
Reviewed by: E. Seiler 3/5/15

Table 3.1-2
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*
Overlying Water Dissolved Metals-Analytical Results (ug/L)

Initial

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
A55	193	<0.500U	2.51	109	<2.00U	0.663	36700	2.85	1.05	17.9	<100U	8.69	8730	14400	0.736J	2820	1.28J	<0.500U	21700	380	<0.500U	<2.00U	83.4
A56	181	<0.500U	0.593J	58.1	<2.00U	1.96	31800	1.41J	0.693	21.0	<100U	5.48	8970	6640	0.827J	2470	<1.00U	<0.500U	22100	312	<0.500U	<2.00U	117
A60	47.5J	0.669J	<0.500U	27.7	<2.00U	4.35	34700	<1.00U	0.197J	17.9	<100U	2.34	8460	944	0.519J	2220	<1.00U	<0.500U	22100	346	<0.500U	<2.00U	211
A68	64.7	<0.500U	<0.500U	17.5	<2.00U	0.482	31400	1.21J	<0.100U	3.08	<100U	0.561	8750	104	<0.500U	1940	<1.00U	<0.500U	22200	300	<0.500U	<2.00U	47.0
A68 Dup	38.6J	<0.500U	<0.500U	11.2	<2.00U	0.205	22200	1.19J	<0.100U	1.43	<100U	0.292	9380	15.0	<0.500U	1880	<1.00U	<0.500U	23400	194	<0.500U	<2.00U	43.5
A72	26.2J	<0.500U	<0.500U	18.1	<2.00U	1.11	29000	<1.00U	0.543	3.42	<100U	0.192J	9250	1490	0.737J	2010	<1.00U	<0.500U	23400	267	<0.500U	<2.00U	61.3
A73	23.0J	<0.500U	<0.500U	17.3	<2.00U	0.303	24800	<1.00U	<0.100U	4.95	<100U	0.451	9000	13.2	0.560J	1870	<1.00U	<0.500U	23300	212	<0.500U	<2.00U	70.6
A75CC	50.2	<0.500U	1.23J	153	<2.00U	<0.100U	44800	1.09J	0.641	1.21	<100U	<0.100U	12500	43.2	0.759J	2900	<1.00U	<0.500U	22700	281	<0.500U	<2.00U	12.2J
A75D	44.4J	<0.500U	<0.500U	23.6	<2.00U	0.744	25400	<1.00U	0.364	2.55	<100U	0.215	8600	1020	<0.500U	2430	<1.00U	<0.500U	23000	220	<0.500U	<2.00U	40.1
A75EC	249	<0.500U	0.913J	124	<2.00U	0.108J	18700	<1.00U	4.51	1.79	<100U	0.157J	11100	4800	7.31	2770	<1.00U	<0.500U	23100	126	<0.500U	<2.00U	13.3J
Animas@32nd Bridge	58.0	<0.500U	<0.500U	43.5	<2.00U	0.115J	34800	<1.00U	0.138J	2.31	<100U	0.483	8880	247	0.696J	2940	<1.00U	<0.500U	22900	319	<0.500U	<2.00U	24.5
Animas@Lightner Creek	37.8J	<0.500U	0.509J	52.9	<2.00U	<0.100U	38700	1.52J	0.191J	1.09	<100U	<0.100U	10300	135	0.613J	2610	<1.00U	<0.500U	23200	339	<0.500U	<2.00U	<10.0U
Animas@Purple Cliffs	<20.0U	<0.500U	<0.500U	53.3	<2.00U	<0.100U	32700	1.02J	0.110J	0.945J	<100U	<0.100U	7120	12.8	<0.500U	2170	<1.00U	<0.500U	18800	277	<0.500U	<2.00U	11.5J
Bbridge	121	<0.500U	<0.500U	41.4	<2.00U	1.12	31900	<1.00U	0.744	6.58	<100U	0.279	8930	2130	<0.500U	3200	<1.00U	<0.500U	21600	260	<0.500U	<2.00U	43.7
James Ranch	133	<0.500U	0.644J	36.3	<2.00U	1.21	35900	1.08J	0.748	6.44	<100U	0.431	9370	2020	<0.500U	2940	<1.00U	<0.500U	22400	256	<0.500U	<2.00U	43.6
N-Control	29.7J	<2.50U	<2.50U	36.9JD	<2.00U	<0.500U	101000	<5.00U	1.03D	5.83D	<100U	<0.500U	25500	85.7	<2.50U	7670	<5.00U	<2.50U	84300	545	<2.50U	<10.0U	11.9J
P-Control	27.1J	<0.500U	1.35J	30.0	<2.00U	<0.100U	89200	1.03J	1.04	5.02	<100U	<0.100U	24100	94.7	<0.500U	7110	2.22	<0.500U	73700	493	<0.500U	<2.00U	13.1J
Ref 100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12700	1.20J	<0.100U	1.21	<100U	<0.100U	11600	<2.00U	<0.500U	2160	<1.00U	<0.500U	25500	79.4	<0.500U	<2.00U	1000
Ref. 12.5%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12800	1.49J	<0.100U	1.08	<100U	<0.100U	11700	<2.00U	<0.500U	2160	<1.00U	<0.500U	25700	79.9	<0.500U	<2.00U	139
Ref. 25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12800	1.38J	<0.100U	1.19	<100U	<0.100U	11700	<2.00U	<0.500U	2170	<1.00U	<0.500U	25800	79.6	<0.500U	<2.00U	256
Ref. 50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12700	1.27J	<0.100U	1.32	<100U	<0.100U	11600	<2.00U	<0.500U	2130	<1.00U	<0.500U	26000	79.4	<0.500U	<2.00U	489
Ref. 6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	12800	1.60J	<0.100U	1.30	<100U	<0.100U	11700	<2.00U	<0.500U	2170	<1.00U	<0.500U	25700	79.7	<0.500U	<2.00U	77.5
Ref. control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	13100	1.25J	<0.100U	0.957J	<100U	<0.100U	11700	<2.00U	<0.500U	2080	<1.00U	<0.500U	25400	79.1	<0.500U	<2.00U	<10.0U

Final

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
A55	<20.0U	<0.500U	0.572J	16.6	<2.00U	0.101J	18200	<1.00U	<0.100U	4.07	<100U	0.784	11000	434	<0.500U	2720	<1.00U	<0.500U	26600	150	<0.500U	<2.00U	17.7J
A56	<20.0U	<0.500U	<0.500U	14.7	<2.00U	0.126J	19600	1.32J	<0.100U	2.97	<100U	<0.100U	11800	38.7	<0.500U	2730	<1.00U	<0.500U	27500	151	<0.500U	<2.00U	13.5J
A60	<20.0U	<0.500U	<0.500U	12.1	<2.00U	0.186J	19700	1.43J	<0.100U	2.45	<100U	<0.100U	12100	10.8	<0.500U	2590	<1.00U	<0.500U	27600	153	<0.500U	<2.00U	34.4
A68	<20.0U	<0.500U	<0.500U	10.5	<2.00U	<0.100U	19600	<1.00U	<0.100U	2.20	<100U	<0.100U	12100	<2.00U	<0.500U	2510	<1.00U	<0.500U	27400	149	<0.500U	<2.00U	26.4
A68 Dup	<20.0U	<0.500U	<0.500U	9.83J	<2.00U	<0.100U	18200	2.23	<0.100U	3.01	<100U	<0.100U	11400	<2.00U	<0.500U	2420	<1.00U	<0.500U	25900	145	<0.500U	<2.00U	27.4
A72	<20.0U	<0.500U	<0.500U	9.92J	<2.00U	<0.100U	18500	<1.00U	<0.100U	1.50	<100U	<0.100U	11900	13.3	<0.500U	2430	<1.00U	<0.500U	26700	134	<0.500U	<2.00U	10.3J
A73	<20.0U	<0.500U	<0.500U	9.83J	<2.00U	<0.100U	17300	<1.00U	<0.100U	1.79	<100U	<0.100U	12200	3.43J	<0.500U	2510	<1.00U	<0.500U	28300	119	<0.500U	<2.00U	10.8J
A75CC	<20.0U	<0.500U	1.33J	48.4	<2.00U	<0.100U	24000	1.09J	<0.100U	0.560J	<100U	<0.100U	13000	85.2	<0.500U	3120	<1.00U	<0.500U	27300	147	<0.500U	<2.00U	<10.0U
A75D	<20.0U	<0.500U	<0.500U	11.6	<2.00U	<0.100U	17900	1.22J	<0.100U	1.91	<100U	<0.100U	12000	<2.00U	<0.500U	2660	<1.00U	<0.500U	27500	126	<0.500U	<2.00U	11.9J
A75EC	21.4J	<0.500U	<0.500U	36.9	<2.00U	<0.100U	16000	<1.00U	0.188J	1.36	<100U	<0.100U	12300	35.8	0.876J	2600	<1.00U	<0.500U	26700	96.7	<0.500U	<2.00U	<10.0U
Animas@32nd Bridge	<20.0U	<0.500U	<0.500U	21.0	<2.00U	<0.100U	21400	1.24J	<0.100U	1.33	<100U	<0.100U	12100	14.9	<0.500U	2760	<1.00U	<0.500U	28100	153	<0.500U	<2.00U	<10.0U
Animas@Lightner Creek	27.4J	<0.500U	<0.500U	37.8	<2.00U	<0.100U	27800	<1.00U	<0.100U	1.30	<100U	<0.100U	12100	2.01J	<0.500U	2560	<1.00U	<0.500U	27000	196	<0.500U	<2.00U	<10.0U
Animas@Purple Cliffs	<20.0U	<0.500U	0.700J	45.5	<2.00U	<0.100U	26600	<1.00U	<0.100U	1.32	<100U	<0.100U	10700	<2.00U	<0.500U	2310	<1.00U	<0.500U	24200	182	<0.500U	<2.00U	<10.0U
Bbridge	39.1J	<0.500U	<0.500U	19.4	<2.00U	<0.100U	19300	<1.00U	<0.100U	1.94	<100U	<0.100U	11200	<2.00U	<0.500U	2650	<1.00U	<0.500U	24700	135	<0.500U	<2.00U	15.1J
James Ranch	32.8J	<0.500U	<0.500U	17.9	<2.00U	<0.100U	21300	<1.00U	<0.100U	2.10	<100U	<0.100U	12000	<2.00U	<0.500U	2730	<1.00U	<0.500U	26600	140	<0.500U	<2.00U	13.6J
N-Control	<20.0U	<0.500U	0.560J	23.9	<2.00U	<0.100U	30900	<1.00U	0.124J	1.68	<100U	<0.100U	14800	<2.00U	<0.500U	3370	<1.00U	<0.500U	37500	185	<0.500U	<2.00U	<10.0U
P-Control	<20.0U	<0.500U	<0.500U	24.0	<2.00U	<0.100U	30900	<1.00U	0.140J	1.82	<100U	<0.100U	15000	7.71	0.500J	3390	<1.00U	<0.500U	38200	187	<0.500U	<2.00U	315
Ref. control	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15400	1.42J	<0.100U	2.40	<100U	<0.100U	13000	<2.00U	10.7	3340	<1.00U	<0.500U	28800	92.4	<0.500U	<2.00U	15.6J
Ref. 6.25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15900	1.55J	<0.100U	6.23	<100U	<0.100U	12900	<2.00U	2.41	3050	<1.00U	<0.500U	28500	92.8	<0.500U	<2.00U	56.2
Ref. 12.5%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15600	1.13J	<0.100U	3.58	<100U	<0.100U	12600	<2.00U	1.19	2970	<1.00U	<0.500U	28100	93.0	<0.500U	<2.00U	127
Ref. 25%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15900	1.14J	<0.100U	1.60	<100U	0.108J	13000	<2.00U	1.14	3010	<1.00U	<0.500U	28600	92.8	<0.500U	<2.00U	251
Ref. 50%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15100	1.24J	<0.100U	1.86	<100U	<0.100U	12500	<2.00U	1.24	2970	<1.00U	<0.500U	28500	91.6	<0.500U	<2.00U	439
Ref 100%	<20.0U	<0.500U	<0.500U	<5.00U	<2.00U	<0.100U	15000	<1.00U	<0.100U	2.11	<100U	<0.100U	12200	<2.00U	1.13	2770	<1.00U	<0.500U	27700	90.9	<0.500U	<2.00U	854

Note: Data Qualifier Definitions Listed Below:
D = The analyte was diluted prior to analysis.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Prepared by: B. Belmonte 2/26/15
Reviewed by: E. Seiler 3/5/15

Table 3.1-3
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*
Overlying Water Total Metals-Analytical Results (ug/L)

Initial

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
A55	3440	<2.50U	4.41JD	125D	2.15J	3.99D	36100	<5.00U	2.04D	163D	2510	142D	9230	14800	<2.50U	3250	<5.00U	<2.50U	22300	389	10.5D	<10.0U	621
A56	2250	<2.50U	2.95JD	73.8D	<2.00U	3.26D	35400	<5.00U	1.59D	133D	2100	116D	9140	5440	4.11JD	3020	<5.00U	<2.50U	21600	359	<2.50U	<10.0U	582
A60	1510	<2.50U	<2.50U	42.6JD	<2.00U	5.72D	34400	<5.00U	0.723JD	76.3D	1790	117D	8740	1190	<2.50U	2630	<5.00U	<2.50U	22100	349	3.13JD	<10.0U	426
A68	1780	<2.50U	<2.50U	33.2JD	<2.00U	0.871JD	30800	<5.00U	0.610JD	28.0D	2210	48.4D	9010	350	<2.50U	2420	<5.00U	<2.50U	22000	304	<2.50U	<10.0U	269
A68 Dup	4670	<2.50U	7.95JD	59.0D	<2.00U	3.48D	22600	<5.00U	2.56D	85.4D	8420	215D	10400	2860	2.75JD	2950	<5.00U	<2.50U	23100	212	<2.50U	<10.0U	1250
A72	1810	<2.50U	3.14JD	29.4JD	<2.00U	1.45D	28300	<5.00U	1.29D	32.1D	4880	30.6D	9330	1540	<2.50U	2260	<5.00U	<2.50U	23100	268	<2.50U	<10.0U	147
A73	1160	<2.50U	<2.50U	29.7JD	<2.00U	<0.500U	24800	<5.00U	0.907JD	17.9D	3830	29.1D	8990	188	<2.50U	2080	<5.00U	<2.50U	23100	220	<2.50U	<10.0U	128
A75CC	1750	<2.50U	<2.50U	180D	<2.00U	<0.500U	44300	<5.00U	1.86D	4.22JD	1530	2.23D	12900	414	<2.50U	3320	<5.00U	<2.50U	22700	284	<2.50U	<10.0U	24.9
A75D	1440	<2.50U	4.45JD	33.5JD	<2.00U	1.32D	25200	<5.00U	1.18D	19.2D	3050	23.5D	8720	1210	<2.50U	2680	<5.00U	<2.50U	23000	223	<2.50U	<10.0U	172
A75EC	2680	<2.50U	2.65JD	135D	<2.00U	1.48D	18600	<5.00U	10.7D	8.05D	1170	2.42D	11200	4770	17.0D	2910	<5.00U	<2.50U	23100	127	<2.50U	<10.0U	60.3
Animas@32nd Bridge	1810	<2.50U	<2.50U	60.3D	<2.00U	1.84D	35200	7.02JBD	1.53D	31.6D	2400	38.6D	9250	846	<2.50U	3280	<5.00U	<2.50U	23000	327	<2.50U	<10.0U	216
Animas@Lightner Creek	1590	<2.50U	<2.50U	71.2D	<2.00U	<0.500U	40800	<5.00U	1.03D	7.07D	2110	8.58D	10400	267	3.08JD	3020	<5.00U	<2.50U	22400	344	<2.50U	<10.0U	78.3
Animas@Purple Cliffs	2150	<2.50U	<2.50U	87.1D	<2.00U	<0.500U	33800	6.03JBD	0.870JD	4.75JD	2360	5.95D	7650	87.3	<2.50U	2870	<5.00U	<2.50U	19100	289	<2.50U	<10.0U	36.6
Bbridge	5120	<2.50U	5.06JD	64.5D	<2.00U	2.93D	32500	<5.00U	2.40D	53.2D	9070	52.2D	9220	2510	2.54JD	3580	<5.00U	<2.50U	21500	271	10.1D	<10.0U	476
James Ranch	4350	<2.50U	3.31JD	56.7D	<2.00U	2.82D	36100	<5.00U	2.22D	45.8D	7330	46.9D	9800	2400	<2.50U	3170	<5.00U	<2.50U	22700	266	3.08JD	<10.0U	412
N-Control	432	<5.00U	<5.00U	<50.0U	<2.00U	<1.00U	99700	<10.0U	1.33JD	6.35JD	402	25.2D	25300	100	<5.00U	7720	<10.0U	<5.00U	83300	545	<5.00U	<20.0U	13.9J
P-Control	861	<5.00U	9.00JD	<50.0U	<2.00U	<1.00U	88800	<10.0U	1.52JD	6.90JD	986	1.64JD	23900	120	<5.00U	7140	<10.0U	<5.00U	74000	489	<5.00U	<20.0U	23.0
Ref. control	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12900	<5.00U	<0.500U	<2.50U	<100U	<0.500U	11600	<2.00U	<2.50U	2080	<5.00U	<2.50U	25300	79.1	<2.50U	<10.0U	<10.0U
Ref. 6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	13000	6.44JD	<0.500U	<2.50U	<100U	<0.500U	11700	<2.00U	<2.50U	2110	<5.00U	<2.50U	25500	79.6	<2.50U	<10.0U	71.8
Ref. 12.5%	<20.0U	<2.50U	2.88JD	<25.0U	<2.00U	<0.500U	12600	6.05JD	<0.500U	<2.50U	<100U	<0.500U	11300	<2.00U	<2.50U	2060	<5.00U	<2.50U	24900	78.7	<2.50U	<10.0U	134
Ref. 25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12800	5.75JD	<0.500U	<2.50U	<100U	0.954JD	11600	<2.00U	<2.50U	2110	<5.00U	<2.50U	25400	79.0	<2.50U	<10.0U	244
Ref. 50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12800	6.52JD	<0.500U	<2.50U	<100U	<0.500U	11600	<2.00U	<2.50U	2100	<5.00U	<2.50U	25600	79.3	<2.50U	<10.0U	468
Ref 100%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	12900	<5.00U	<0.500U	<2.50U	<100U	<0.500U	11500	<2.00U	<2.50U	2080	<5.00U	<2.50U	25200	78.8	<2.50U	<10.0U	946

Final

STATION_ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Vanadium	Zinc
A55	33.8J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	19600	7.41JD	<0.500U	8.47D	<100U	3.51D	11600	442	<2.50U	2910	<5.00U	<2.50U	28000	157	9.12D	<10.0U	16.2J
A56	223	<2.50U	<2.50U	32.9JD	<2.00U	<0.500U	21000	8.06JD	<0.500U	7.47D	941	83.8D	12300	133	<2.50U	2890	<5.00U	<2.50U	28000	160	2.81JD	<10.0U	34.5
A60	21.3J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	21000	7.74JD	<0.500U	3.58JD	<100U	<0.500U	12600	12.7	<2.50U	2730	<5.00U	<2.50U	28400	159	<2.50U	<10.0U	28.1
A68	29.4J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	20400	5.40JD	<0.500U	2.74JD	<100U	<0.500U	12400	2.41J	<2.50U	2670	<5.00U	<2.50U	27900	154	<2.50U	<10.0U	23.4
A68 Dup	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	19400	5.96JD	<0.500U	<2.50U	<100U	<0.500U	12100	2.46J	<2.50U	2560	<5.00U	<2.50U	27800	149	<2.50U	<10.0U	25.1
A72	30.3J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	19200	6.36JD	<0.500U	<2.50U	<100U	<0.500U	12100	13.6	<2.50U	2520	<5.00U	<2.50U	27300	137	<2.50U	<10.0U	<10.0U
A73	24.7J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	18300	6.96JD	<0.500U	<2.50U	<100U	<0.500U	12400	2.19J	<2.50U	2550	<5.00U	<2.50U	28500	123	<2.50U	<10.0U	<10.0U
A75CC	<20.0U	<2.50U	<2.50U	55.0D	<2.00U	<0.500U	25500	6.82JD	<0.500U	<2.50U	155J	<0.500U	13500	112	<2.50U	3220	<5.00U	<2.50U	27700	153	<2.50U	<10.0U	<10.0U
A75D	25.2J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	19200	7.42JD	<0.500U	2.70JD	<100U	<0.500U	12400	<2.00U	<2.50U	2730	<5.00U	<2.50U	28100	131	<2.50U	<10.0U	12.8J
A75EC	39.6J	<2.50U	<2.50U	36.7JD	<2.00U	<0.500U	17400	7.85JD	<0.500U	<2.50U	<100U	<0.500U	13200	39.3	<2.50U	2780	<5.00U	<2.50U	28500	103	<2.50U	<10.0U	<10.0U
Animas@32nd Bridge	21.7J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	22100	6.22JD	<0.500U	<2.50U	<100U	<0.500U	12800	29.3	<2.50U	3120	<5.00U	<2.50U	29400	158	<2.50U	<10.0U	<10.0U
Animas@Lightner Creek	63.5	<2.50U	<2.50U	32.3JD	<2.00U	<0.500U	28800	5.58JD	<0.500U	<2.50U	<100U	<0.500U	12200	6.24	<2.50U	2560	<5.00U	<2.50U	27000	198	<2.50U	<10.0U	<10.0U
Animas@Purple Cliffs	696	<2.50U	<2.50U	49.3JD	<2.00U	<0.500U	28900	7.43JD	<0.500U	2.78JD	587	1.35D	11500	14.0	<2.50U	2670	<5.00U	<2.50U	25800	194	<2.50U	<10.0U	10.3J
Bbridge	55.9	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	20200	7.55JD	<0.500U	<2.50U	<100U	<0.500U	11500	7.90	<2.50U	2740	<5.00U	<2.50U	25400	138	<2.50U	<10.0U	11.8J
James Ranch	38.9J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	21700	5.74JD	<0.500U	<2.50U	<100U	<0.500U	12000	3.01J	<2.50U	2730	<5.00U	<2.50U	26600	141	9.69D	<10.0U	<10.0U
N-Control	54.0	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	31800	7.02JD	<0.500U	<2.50U	<100U	<0.500U	14900	<2.00U	<2.50U	3340	<5.00U	<2.50U	37600	187	2.84JD	<10.0U	<10.0U
P-Control	63.2	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	31600	7.47JD	<0.500U	<2.50U	<100U	<0.500U	15100	9.26	<2.50U	3350	<5.00U	<2.50U	38600	188	<2.50U	<10.0U	299
Ref. control	<20.0U	<2.50U	3.58JD	<25.0U	<2.00U	<0.500U	15600	<5.00U	<0.500U	<2.50U	<100U	<0.500U	12300	2.36J	<2.50U	2860	<5.00U	<2.50U	28300	93.8	<2.50U	<10.0U	812
Ref. 6.25%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16600	5.59JD	<0.500U	4.38JD	<100U	0.943JD	13100	<2.00U	<2.50U	3070	<5.00U	<2.50U	28700	95.5	<2.50U	<10.0U	126
Ref. 12.5%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16500	6.32JD	<0.500U	<2.50U	<100U	<0.500U	13100	<2.00U	<2.50U	3020	<5.00U	<2.50U	28700	94.9	<2.50U	<10.0U	238
Ref. 25%	25.7J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	15800	7.10JD	<0.500U	<2.50U	<100U	<0.500U	12700	2.31J	<2.50U	2920	<5.00U	<2.50U	28800	94.2	<2.50U	<10.0U	413
Ref. 50%	<20.0U	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	16800	7.48JD	<0.500U	<2.50U	<100U	<0.500U	13300	2.11J	<2.50U	3130	<5.00U	<2.50U	29200	96.9	<2.50U	<10.0U	67.5
Ref 100%	22.2J	<2.50U	<2.50U	<25.0U	<2.00U	<0.500U	15900	7.24JD	<0.500U	<2.50U	<100U	<0.500U	13200	<2.00U	8.62D	3340	<5.00U	<2.50U	29400	94.7	<2.50U	<10.0U	<10.0U

Note: Data Qualifier Definitions Listed Below:
D = The analyte was diluted prior to analysis.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Prepared by: B. Belmonte 2/26/15
Reviewed by: E. Seiler 3/5/15

Table 3.1-4
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*
Initial Total Recoverable Metals Results

Station ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead
	mg/kg dry wt	ug/kg dry wt	ug/kg dry wt	ug/kg dry wt	mg/kg dry wt	ug/kg dry wt	mg/kg dry wt	ug/kg dry wt	ug/kg dry wt	ug/kg dry wt	mg/kg dry wt	ug/kg dry wt
A55	7790D	1670D	18000D	102000D	<1.98U	7660D	2900D	3520D	10800D	203000D	20900D	1230000D
A56	9310D	1640D	20200D	129000D	2.94JD	11600D	3550D	3600D	13200D	244000D	21700D	1180000D
A60	7730D	2190D	20400D	91700D	<2.03U	9550D	2730D	3880D	11000D	262000D	23400D	1610000D
A68	7700D	1760D	17500D	128000D	<1.97U	10800D	3040D	3730D	12100D	216000D	24000D	1240000D
A72	9960D	1390D	26800D	93200D	<2.03U	3030D	1970D	3010D	13600D	133000D	42000D	499000D
A73	6770D	1510D	20500D	92800D	<2.04U	2700D	1870D	3500D	10800D	113000D	36800D	435000D
A75CC	4740D	<500U	3080D	93000D	<2.00U	164JD	5150D	6690D	5670D	7890D	9700D	5210D
A75D	7660D	1220D	17500D	107000D	<2.03U	3730D	2150D	3720D	17200D	103000D	30800D	339000D
A75EC	6560D	<508U	6550D	50700D	<2.03U	714D	952D	7290D	24000D	13000D	14400D	5290D
Animas @32nd Bridge	5210D	644JD	8710D	78500D	<2.03U	2100D	2740D	4440D	8730D	55000D	15300D	186000D
Animas @Lightner Creek	4710D	772JD	10300D	153000D	<2.01U	3200D	71200D	5380D	7440D	41300D	17800D	92400D
Animas @Purple Cliffs	4470D	<494U	6840D	163000D	<1.98U	1100D	32700D	4190D	5150D	19000D	14600D	35500D
Bbridge	8040D	863JD	16200D	119000D	<1.99U	4630D	4070D	4740D	17200D	92000D	27200D	244000D
JamesRanch	10600D	927JD	18900D	128000D	<2.02U	4970D	3830D	4830D	17800D	108000D	29900D	290000D

Station ID	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Thalium	Vanadium	Zinc
	mg/kg dry wt	mg/kg dry wt	mg/kg dry wt	ug/kg dry wt	mg/kg dry wt	ug/kg dry wt	ug/kg dry wt	mg/kg dry wt	mg/kg dry wt	ug/kg dry wt	ug/kg dry wt	mg/kg dry wt
A55	4440D	6660D	0.04D	5650D	432JD	<992U	2990D	<248U	37.6D	<496U	13700D	1920D
A56	4450D	9250D	0.06D	7130D	422JD	<1000U	3620D	<251U	37.5D	1110D	13400D	3220D
A60	4690D	7460D	0.07D	6260D	423JD	<1020U	5960D	<254U	27.2D	<508U	14300D	2130D
A68	4590D	9430D	0.02JD	6560D	423JD	<985U	2900D	<246U	30.5D	<492U	14800D	2480D
A72	3580D	3400D	0.05D	5330D	521JD	<1020U	1830D	<254U	40.6D	<508U	16400D	858D
A73	3610D	2780D	0.02JD	5500D	522JD	<1020U	1240D	<255U	32.9D	<509U	16300D	749D
A75CC	3880D	376D	<0.01U	7310BD	834JD	<1000U	<500U	<250U	17.8D	<500U	11200D	45.3D
A75D	3580D	3750D	<0.02U	8200BD	638JD	<1020U	948JD	<254U	35.0D	1140D	14500D	1080D
A75EC	2460D	708D	<0.02U	37900BD	632JD	<1020U	<508U	<254U	4.73JD	552JD	7780D	142D
Animas @32nd Bridge	2970D	2220D	<0.02U	9770BD	523JD	<1020U	1210D	<254U	23.8D	<508U	11300D	810D
Animas @Lightner Creek	6550D	1150D	0.04D	19500BD	708JD	1180JD	569JD	<252U	260D	<504U	19900D	529D
Animas @Purple Cliffs	6250D	399D	0.04D	10700BD	723JD	<989U	<494U	<247U	121D	<494U	13300D	157D
Bbridge	3640D	3970D	0.02JD	12100BD	741JD	<997U	1020D	<249U	39.6D	<499U	15000D	1700D
JamesRanch	3840D	4250D	0.04D	11900BD	839JD	<1010U	1260D	<252U	39.1D	<504U	15500D	1730D

Note: Data Qualifier Definitions Listed Below:
D = The analyte was diluted prior to analysis.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Prepared by: B. Belmonte 3/4/15
Reviewed by: E. Seiler 3/5/15

Table 3.1-5
Initial and Final Average Ammonia Results
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

Site/ Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. ± SD (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. ± SD (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
Control-N-01	1.11	7.06	1.19 ± 0.22	7.24	18.95	0.48	7.16	0.36 ± 0.07	7.24	18.86
Control-N-02	0.962	7.2				0.443	7.14			
Control-N-03	1.36	7.21				0.392	7.19			
Control-N-04	1.19	7.25				0.305	7.23			
Control-N-05	1.12	7.21				0.34	7.27			
Control-N-06	0.982	7.31				0.262	7.3			
Control-N-07	1.63	7.31				0.36	7.31			
Control-N-08	1.18	7.33				0.299	7.31			
A75CC-01	0.0505	6.99	0.03 ± 0.01	6.78	28.36	0.256	6.97	0.26 ± 0.05	7.06	22.87
A75CC-02	0.0384	7.04				0.308	7.01			
A75CC-03	**0.015**	7.09				0.239	7.04			
A75CC-04	**0.015**	7.12				0.326	7.05			
A75CC-05	0.0305	4.33				0.333	7.1			
A75CC-06	**0.015**	7.21				0.238	7.08			
A75CC-07	0.0333	7.23				0.226	7.11			
A75CC-08	**0.015**	7.25				0.179	7.1			
Control P-01	1.52	7.21	1.17 ± 0.19	7.37	15.95	0.271	7	0.33 ± 0.05	7.37	15.95
Control P-02	1.11	7.33				0.312	7.06			
Control P-03	1.1	7.37				0.299	7.1			
Control P-04	1.1	7.37				0.315	7.11			
Control P-05	1.23	7.42				0.386	7.14			
Control P-06	1.26	7.41				0.268	7.14			
Control P-07	0.865	7.43				0.378	7.14			
Control P-08	1.18	7.43				0.394	7.17			
A55-01	1.71	6.99	1.38 ± 0.45	7.12	21.53	0.496	7.14	0.33 ± 0.23	7.09	22.27
A55-02	1.88	6.99				0.565	7.13			
A55-03	1.39	7.04				0.621	7.1			
A55-04	1.78	7.08				0.318	7.08			
A55-05	0.747	7.18				0.105	7.08			
A55-06	0.696	7.19				0.0597	7.05			
A55-07	1.28	7.25				0.0699	7.05			
A55-08	1.59	7.23				0.367	7.05			
A56-01	0.956	7.32	0.93 ± 0.06	7.31	17.26	**0.015**	7.05	0.02 ± 0.00	7.04	23.25
A56-02	0.95	7.32				**0.015**	7.04			
A56-03	0.898	7.31				**0.015**	7.05			
A56-04	0.975	7.31				**0.015**	7.05			
A56-05	1.02	7.3				**0.015**	7.04			
A56-06	0.874	7.31				**0.015**	7.03			
A56-07	0.899	7.31				**0.015**	7.03			
A56-08	0.841	7.31				**0.015**	7.03			

Table 3.1-5
Initial and Final Average Ammonia Results
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

Site/ Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. ± SD (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. ± SD (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
A60-01	0.193	7.49	0.18 ± 0.03	7.31	17.29	0.0338	7.26	0.02 ± 0.01	7.18	20.14
A60-02	0.148	7.4				**0.015**	7.22			
A60-03	0.176	7.33				0.0308	7.2			
A60-04	0.181	7.29				**0.015**	7.19			
A60-05	0.224	7.26				**0.015**	7.18			
A60-06	0.132	7.24				**0.015**	7.17			
A60-07	0.216	7.24				0.0324	7.1			
A60-08	0.182	7.23				**0.015**	7.13			
A68-01	0.142	7.28	0.14 ± 0.04	7.30	17.45	**0.015**	7.14	0.02 ± 0.01	7.15	20.84
A68-02	0.103	7.29				0.033	7.14			
A68-03	0.154	7.31				**0.015**	7.15			
A68-04	0.115	7.32				0.0305	7.16			
A68-05	0.125	7.32				**0.015**	7.16			
A68-06	0.236	7.3				**0.015**	7.16			
A68-07	0.138	7.3				**0.015**	7.15			
A68-08	0.146	7.3				**0.015**	7.14			
A72-01	0.0521	7.23	0.07 ± 0.02	7.10	21.86	0.0538	7.15	0.06 ± 0.01	7.10	21.94
A72-02	0.0768	7.17				0.0414	7.09			
A72-03	0.0948	7.09				0.0448	7.13			
A72-04	0.0885	7.12				0.0547	7.08			
A72-05	0.0864	7.08				0.0633	7.09			
A72-06	0.0585	7.05				0.0761	7.09			
A72-07	0.06	7.04				0.0676	7.08			
A72-08	0.076	7.05				0.0561	7.09			
A73-01	0.0318	7.24	0.05 ± 0.01	7.16	20.73	0.101	7.19	0.10 ± 0.07	7.15	20.76
A73-02	0.0352	7.19				0.0914	7.18			
A73-03	0.0543	7.18				0.264	7.17			
A73-04	0.0593	7.16				0.0732	7.15			
A73-05	0.0535	7.15				0.0777	7.15			
A73-06	0.0653	7.11				0.0507	7.14			
A73-07	0.0521	7.12				0.0799	7.12			
A73-08	0.0618	7.09				0.087	7.13			
A75D-01	0.0456	7.24	0.05 ± 0.02	7.21	19.42	0.0667	6.99	0.07 ± 0.03	7.13	21.39
A75D-02	0.0544	7.21				0.0441	7.08			
A75D-03	0.0556	7.2				0.0503	7.15			
A75D-04	0.0935	7.17				0.0645	7.13			
A75D-05	0.0387	7.23				0.0867	7.21			
A75D-06	0.0435	7.23				0.134	7.15			
A75D-07	0.0406	7.21				0.0489	7.14			
A75D-08	0.0398	7.22				0.0756	7.15			

Table 3.1-5
Initial and Final Average Ammonia Results
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

Site/ Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. ± SD (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. ± SD (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
A75EC-01	0.263	7.31	0.44 ± 0.27	7.25	18.70	0.0611	7.09	0.08 ± 0.02	7.14	21.03
A75EC-02	0.316	7.26				0.0736	7.12			
A75EC-03	0.303	7.25				0.0894	7.16			
A75EC-04	0.314	7.25				0.0521	7.14			
A75EC-05	0.308	7.24				0.0655	7.16			
A75EC-06	0.315	7.24				0.113	7.15			
A75EC-07	0.76	7.22				0.0995	7.16			
A75EC-08	0.979	7.2				0.0726	7.15			
Bbridge-01	0.739	7.04	0.72 ± 0.41	7.01	23.97	0.0334	7.22	0.02 ± 0.01	7.17	20.45
Bbridge-02	0.55	6.98				0.0378	7.2			
Bbridge-03	0.488	6.96				**0.015**	7.17			
Bbridge-04	0.545	6.97				0.033	7.16			
Bbridge-05	0.614	7				0.0301	7.16			
Bbridge-06	1.73	7.01				**0.015**	7.15			
Bbridge-07	0.561	7.04				**0.015**	7.14			
Bbridge-08	0.563	7.05				**0.015**	7.14			
Jranch-01	0.345	7.08	0.67 ± 0.18	7.13	21.23	**0.015**	7.13	0.03 ± 0.02	7.13	21.28
Jranch-02	0.634	7.1				**0.015**	7.12			
Jranch-03	0.694	7.14				**0.015**	7.11			
Jranch-04	0.608	7.14				**0.015**	7.13			
Jranch-05	0.587	7.14				**0.015**	7.14			
Jranch-06	0.652	7.16				**0.015**	7.13			
Jranch-07	0.933	7.15				0.071	7.16			
Jranch-08	0.868	7.15				0.0427	7.12			
32nd St-01	0.987	6.54	0.96 ± 0.13	6.69	29.90	**0.015**	5.82	0.04 ± 0.02	6.15	35.89
32nd St-02	1.03	6.56				0.0777	5.93			
32nd St-03	0.712	6.63				**0.015**	5.97			
32nd St-04	1.06	6.71				0.0424	6.1			
32nd St-05	0.96	6.76				0.0618	6.25			
32nd St-06	0.85	6.76				0.0302	6.32			
32nd St-07	1.09	6.77				**0.015**	6.39			
32nd St-08	1.02	6.8				0.0326	6.38			
Lcreek-01	0.345	6.84	0.25 ± 0.05	6.90	26.08	0.0359	6.47	0.04 ± 0.01	6.70	29.84
Lcreek-02	0.285	6.86				0.0408	6.13			
Lcreek-03	0.262	6.87				0.0408	6.69			
Lcreek-04	0.161	7.01				0.0605	6.76			
Lcreek-05	0.207	6.88				0.0342	6.8			
Lcreek-06	0.267	6.9				0.0506	6.87			
Lcreek-07	0.266	6.92				0.0346	6.89			
Lcreek-08	0.231	6.95				0.0361	6.95			

Table 3.1-5
Initial and Final Average Ammonia Results
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

Site/ Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. ± SD (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. ± SD (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
Pcliffs-01	0.189	7.01	0.15 ± 0.03	7.05	23.06	0.061	6.98	0.06 ± 0.01	7.10	21.97
Pcliffs-02	0.164	6.99				0.0607	7.04			
Pcliffs-03	0.178	7.03				0.0662	7.08			
Pcliffs-04	0.123	7.12				0.061	7.11			
Pcliffs-05	0.111	7.06				0.0529	7.13			
Pcliffs-06	0.148	7.05				0.0701	7.13			
Pcliffs-07	0.152	7.07				0.0691	7.16			
Pcliffs-08	0.13	7.06				0.0602	7.16			
A68Dup-01	0.0778	7.1	0.07 ± 0.01	7.00	24.13	**0.015**	7.12	0.02 ± 0.00	7.13	21.26
A68Dup-02	0.0698	7.01				**0.015**	7.11			
A68Dup-03	0.0753	6.95				**0.015**	7.14			
A68Dup-04	0.059	6.97				**0.015**	7.12			
A68Dup-05	0.0764	6.99				**0.015**	7.17			
A68Dup-06	0.0598	6.98				**0.015**	7.14			
A68Dup-07	0.071	6.98				**0.015**	7.14			
A68Dup-08	0.0816	7.01				**0.015**	7.11			

a The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).
[b]Values shown are either the measurements made at the end of the test (day 10) or earlier if all test organisms died before the 10-day exposure period was completed.

Bolded values were <0.0300U (less than 0.03 non-detect). The reporting limit was divided in half to create an average numerical value.

Prepared by: B. Belmonte (3/2/15)
Reviewed by: E. Czerepak (3/2/15)

Table 3.1-6
Initial and Final Average Ammonia Results
November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

Site/ Replicate ID	Initial Measured Ammonia Conc. (mg N/L)	Initial Measured pH	Initial Average Measured Ammonia Conc. ± SD (mg N/L)	Initial Average Measured pH	Initial Ammonia Criterion (mg N/L)[a]	Final Measured Ammonia Conc. (mg N/L)[b]	Final Measured pH[b]	Final Average Measured Ammonia Conc. ± SD (mg N/L)	Final Average Measured pH	Final Ammonia Criterion (mg N/L)[a]
Ref Control-01	0.172	6.78	0.213 ± 0.07	6.82	27.63	0.752	6.76	0.772 ± 0.09	6.73	29.31
Ref Control-02	0.17	6.75				0.797	6.71			
Ref Control-03	0.185	6.84				0.662	6.68			
Ref Control-04	0.325	6.92				0.876	6.76			
6.25%-01	0.323	6.96	0.202 ± 0.08	7.05	23.14	0.667	6.87	0.728 ± 0.12	6.93	25.55
6.25%-02	0.14	7.05				0.583	6.89			
6.25%-03	0.161	7.07				0.824	6.95			
6.25%-04	0.184	7.10				0.836	7.01			
12.5%-01	0.17	7.16	0.167 ± 0.00	7.17	20.40	0.7	7.05	0.658 ± 0.05	7.09	22.22
12.5%-02	0.162	7.15				0.692	7.08			
12.5%-03	0.166	7.19				0.631	7.1			
12.5%-04	0.17	7.18				0.608	7.12			
25%-01	0.169	7.24	0.091 ± 0.09	7.25	18.67	0.879	7.12	0.691 ± 0.13	7.13	21.28
25%-02	0.163	7.26				0.65	--			
25%-03	**0.015**	7.24				0.627	7.15			
25%-04	**0.015**	7.25				0.609	7.12			
50%-01	**0.015**	7.23	0.015 ± 0.00	7.25	18.67	0.419	--	0.394 ± 0.06	NC	NA
50%-02	**0.015**	7.25				0.319	--			
50%-03	**0.015**	7.25				0.367	--			
50%-04	**0.015**	7.26				0.469	--			
100%-01	**0.015**	7.26	0.015 ± 0.00	7.25	18.61	0.0426	--	0.073 ± 0.02	NC	NA
100%-02	**0.015**	7.25				0.0747	--			
100%-03	**0.015**	7.25				0.0833	--			
100%-04	**0.015**	7.24				0.0926	--			

NA = Not available
NC = Not calculated

[a] The sample-specific acute ammonia criterion was calculated using the "salmon present" formula on p. 54 of the Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation No. 31: The Basic Standards and Methodologies for Surface Water (5 CCR 1002-31).

[b] Values shown are either the measurements made at the end of the test (day 4) or earlier if all test organisms died before the 4-day exposure period was completed.
Bolded values were <0.0300U (less than 0.03 non-detect). The reporting limit was divided in half to create an average numerical value.

Prepared by: B. Belmonte (3/2/15)
Reviewed by: E. Czerepak (3/2/15)

Table 3.1-7 Upper Animas November 2014
Sediment Toxicity Test
Weight Data Sheets: 10-Day Static Renewal

Start Date	11/10/14	Drying Time	24 hours
End Date	11/20/14	Oven Temp (C)	70°C
Weighing Date	11/24/14	Organism	*H. azteca*
No. of Replicates	8	Initial Weight (µg)	22.5
Feed Rate/Type	YCT/Daily	Analysts	SA,LC, CL

Site I.D.	Weight of Oven Dried Pan (µg)	Pan + Dried Organisms (µg)	Dry Organisms (µg)	Number of Survivors	Mean Weight per Survivor (µg)	Sample Mean (µg)	Growth (ug)	increase in growth (ug)	% increase in growth
Control-P-01	205204.0	205911.9	707.9	10	70.79	54.80	55.99	32.30	140.81
Control-P-02	205998.1	206278.7	280.6	9	31.18				
Control-P-03	206580.9	207127.4	546.5	10	54.65				
Control-P-04	208732.0	209310.6	578.6	9	64.29				
Control-P-05	206416.7	207022.2	605.5	10	60.55				
Control-P-06	206133.4	206595.0	461.6	10	46.16				
Control-P-07	206977.9	207481.9	504.0	9	56.00				
Control-P-08	209186.5	209589.3	402.8	6	67.13				
Control-N-01	207611.3	208342.6	731.3	9	81.26	84.38	84.43	61.88	269.76
Control-N-02	206723.9	207590.8	866.9	9	96.32				
Control-N-03	205511.0	206381.4	870.4	10	87.04				
Control-N-04	205135.5	205828.8	693.3	10	69.33				
Control-N-05	206769.2	207643.2	874.0	10	87.40				
Control-N-06	206171.4	206743.5	572.1	8	71.51				
Control-N-07	204986.0	205895.1	909.1	10	90.91				
Control-N-08	206227.3	206957.7	730.4	8	91.30				
A55-01	207818.7	208074.0	255.3	7	36.47	35.54	35.21	13.04	56.83
A55-02	209379.6	209565.6	186.0	5	37.20				
A55-03	209005.9	209135.4	129.5	5	25.90				
A55-04	208339.0	208532.7	193.7	7	27.67				
A55-05	204645.1	204922.9	277.8	9	30.87				
A55-06	206386.2	206558.3	172.1	5	34.42				
A55-07	208028.5	208354.2	325.7	6	54.28				
A55-08	207144.0	207293.9	149.9	4	37.47				
A56-01	207086.0	207109.1	23.1	1	23.10	31.91	32.72	9.41	41.01
A56-02	208273.0	208454.5	181.5	5	36.30				
A56-03	208368.7	208551.9	183.2	7	26.17				
A56-04	207430.5	N/A	N/A	0	N/A				
A56-05	205378.5	205618.6	240.1	6	40.02				
A56-06	206155.2	206343.8	188.6	7	26.94				
A56-07	208613.0	208715.1	102.1	4	25.53				
A56-08	207257.2	207483.7	226.5	5	45.30				
A60-01	206790.0	207013.2	223.2	8	27.90	30.70	29.86	8.20	35.74
A60-02	206414.0	206651.9	237.9	9	26.43				
A60-03	208917.2	209172.5	255.3	10	25.53				
A60-04	206806.4	206956.8	150.4	7	21.49				
A60-05	205542.7	205828.6	285.9	9	31.77				
A60-06	206630.8	206944.9	314.1	8	39.26				
A60-07	207783.8	207997.6	213.8	7	30.54				
A60-08	209932.7	210103.4	170.7	4	42.67				
A68-01	208094.6	208364.3	269.7	8	33.71	35.14	33.19	12.64	55.10
A68-02	205439.1	205743.5	304.4	9	33.82				
A68-03	208751.2	208801.6	50.4	1	50.40				
A68-04	208901.3	209231.7	330.4	8	41.30				
A68-05	206252.8	206521.7	268.9	8	33.61				
A68-06	208955.4	209124.2	168.8	5	33.76				
A68-07	210559.4	210743.5	184.1	7	26.30				
A68-08	208212.8	208494.9	282.1	10	28.21				

Table 3.1-7 Upper Animas November 2014
Sediment Toxicity Test
Weight Data Sheets: 10-Day Static Renewal

Start Date	11/10/14		Drying Time	24 hours
End Date	11/20/14		Oven Temp (C)	70°C
Weighing Date	11/24/14		Organism	*H. azteca*
No. of Replicates	8		Initial Weight (µg)	22.5
Feed Rate/Type	YCT/Daily		Analysts	SA,LC, CL

Site I.D.	Weight of Oven Dried Pan (µg)	Pan + Dried Organisms (µg)	Dry Organisms (µg)	Number of Survivors	Mean Weight per Survivor (µg)	Sample Mean (µg)	Growth (ug)	increase in growth (ug)	% increase in growth
A72-01	206938.1	207215.4	277.3	6	46.22	40.13	39.89	17.63	76.84
A72-02	209312.9	209655.6	342.7	8	42.84				
A72-03	207023.3	207228.7	205.4	5	41.08				
A72-04	207516.5	207797.2	280.7	7	40.10				
A72-05	207816.7	208105.0	288.3	9	32.03				
A72-06	208817.1	209217.4	400.3	8	50.04				
A72-07	209231.6	209420.3	188.7	7	26.96				
A72-08	207371.2	207621.7	250.5	6	41.75				
A73-01	206998.6	207218.9	220.3	7	31.47	29.97	29.58	7.47	32.56
A73-02	208585.2	208695.1	109.9	4	27.47				
A73-03	206461.8	206742.7	280.9	9	31.21				
A73-04	206770.0	207086.4	316.4	10	31.64				
A73-05	206847.5	207050.9	203.4	6	33.90				
A73-06	205836.1	206013.9	177.8	5	35.56				
A73-07	207168.0	207378.5	210.5	9	23.39				
A73-08	209547.5	209773.4	225.9	9	25.10				
A75D-01	203883.2	N/A	N/A	6	N/A	29.00	28.54	6.50	28.33
A75D-02	208984.3	209241.7	257.4	6	42.90				
A75D-03	204984.3	205278.1	293.8	10	29.38				
A75D-04	207544.2	207687.3	143.1	5	28.62				
A75D-05	205343.0	205629.4	286.4	10	28.64				
A75D-06	207958.4	208118.3	159.9	6	26.65				
A75D-07	206649.4	207032.8	383.4	10	38.34				
A75D-08	206888.1	207105.2	217.1	8	27.14				
A75CC-01	207680.0	208156.8	476.8	8	59.60	50.60	49.62	28.10	122.48
A75CC-02	208567.8	209029.2	461.4	10	46.14				
A75CC-03	207815.8	208164.1	348.3	6	58.05				
A75CC-04	208172.9	208486.6	313.7	6	52.28				
A75CC-05	209923.1	210269.6	346.5	8	43.31				
A75CC-06	206960.1	207340.2	380.1	8	47.51				
A75CC-07	207264.9	207489.0	224.1	4	56.03				
A75CC-08	208633.2	209009.8	376.6	9	41.84				
A75EC-01	206708.9	207063.5	354.6	8	44.33	44.81	44.63	22.31	97.25
A75EC-02	209294.0	209651.4	357.4	7	51.06				
A75EC-03	207678.2	208201.6	523.4	10	52.34				
A75EC-04	207992.1	208383.2	391.1	10	39.11				
A75EC-05	208756.1	209079.2	323.1	7	46.16				
A75EC-06	206331.9	206765.3	433.4	10	43.34				
A75EC-07	207720.1	208107.6	387.5	10	38.75				
A75EC-08	207513.1	207643.3	130.2	3	43.40				
BBRIDGE-01	205181.5	205590.2	408.7	10	40.87	35.68	35.71	13.18	57.46
BBRIDGE-02	206946.6	207246.3	299.7	8	37.46				
BBRIDGE-03	207747.3	208015.9	268.6	9	29.84				
BBRIDGE-04	205770.2	206119.1	348.9	8	43.61				
BBRIDGE-05	206331.8	206599.3	267.5	8	33.44				
BBRIDGE-06	206634.1	206988.3	354.2	9	39.36				
BBRIDGE-07	206511.5	206812.7	301.2	10	30.12				
BBRIDGE-08	209996.5	210211.7	215.2	7	30.74				

Table 3.1-7 Upper Animas November 2014
Sediment Toxicity Test
Weight Data Sheets: 10-Day Static Renewal

Start Date	11/10/14	Drying Time	24 hours
End Date	11/20/14	Oven Temp (C)	70°C
Weighing Date	11/24/14	Organism	*H. azteca*
No. of Replicates	8	Initial Weight (µg)	22.5
Feed Rate/Type	YCT/Daily	Analysts	SA,LC, CL

Site I.D.	Weight of Oven Dried Pan (µg)	Pan + Dried Organisms (µg)	Dry Organisms (µg)	Number of Survivors	Mean Weight per Survivor (µg)	Sample Mean (µg)	Growth (ug)	increase in growth (ug)	% increase in growth
James Ranch-01	207671.3	207895.0	223.7	6	37.28	40.41	36.83	17.91	78.08
James Ranch-02	207839.2	208097.9	258.7	8	32.34				
James Ranch-03	207552.2	207897.2	345.0	9	38.33				
James Ranch-04	205818.6	206136.6	318.0	7	45.43				
James Ranch-05	206494.4	206695.7	201.3	7	28.76				
James Ranch-06	206697.1	206766.9	69.8	1	69.80				
James Ranch-07	206135.2	206381.9	246.7	7	35.24				
James Ranch-08	207520.6	207809.5	288.9	8	36.11				
32nd St-01	206502.5	206965.2	462.7	10	46.27	37.99	38.18	15.49	67.54
32nd St-02	208956.8	209321.4	364.6	10	36.46				
32nd St-03	207666.3	207867.6	201.3	7	28.76				
32nd St-04	206970.0	207325.9	355.9	9	39.54				
32nd St-05	204937.5	205220.5	283.0	9	31.44				
32nd St-06	206236.8	206631.4	394.6	8	49.33				
32nd St-07	204458.0	204768.7	310.7	8	38.84				
32nd St-08	206669.2	206969.0	299.8	9	33.31				
Lightner Creek-01	206090.8	206295.8	205.0	6	34.17	32.87	33.05	10.37	45.19
Lightner Creek-02	207667.8	208046.0	378.2	9	42.02				
Lightner Creek-03	206066.8	206462.9	396.1	10	39.61				
Lightner Creek-04	205190.0	205362.1	172.1	5	34.42				
Lightner Creek-05	206873.7	207135.0	261.3	9	29.03				
Lightner Creek-06	205595.9	205722.0	126.1	4	31.53				
Lightner Creek-07	206112.8	206316.3	203.5	7	29.07				
Lightner Creek-08	204713.6	204921.4	207.8	9	23.09				
Purple Cliffs-01	204240.6	204339.6	99.0	4	24.75	44.87	36.18	22.37	97.52
Purple Cliffs-02	205728.0	205787.7	59.7	1	59.70				
Purple Cliffs-03	207264.9	207458.1	193.2	6	32.20				
Purple Cliffs-04	209212.6	209292.1	79.5	2	39.75				
Purple Cliffs-05	208278.1	208410.6	132.5	3	44.17				
Purple Cliffs-06	205909.4	NA	NA	0	N/A				
Purple Cliffs-07	207631.9	207891.4	259.5	8	32.44				
Purple Cliffs-08	208878.5	208959.6	81.1	1	81.10				
A68 Dup-01	206981.7	207368.9	387.2	10	38.72	33.77	34.15	11.27	49.15
A68 Dup-02	204634.3	204831.4	197.1	6	32.85				
A68 Dup-03	206802.6	207052.2	249.6	7	35.66				
A68 Dup-04	206061.9	206230.5	168.6	7	24.09				
A68 Dup-05	204876.6	204978.7	102.1	3	34.03				
A68 Dup-06	204651.7	204993.6	341.9	8	42.74				
A68 Dup-07	207523.7	207740.1	216.4	7	30.91				
A68 Dup-08	208473.8	208723.4	249.6	8	31.20				

Notes:
A55-02 had 5 living organisms and 2 dead
A55-04 had 7 living organisms and 1 dead
A55-07 had 6 living organisms and 2 dead
A55-08 had 4 living organisms and 1 dead
A56-06 had 7 living organisms and 1 dead
A60-08 had 4 living organisms and 3 dead
A72-06 had 8 living organisms and 1 dead
A72-07 had 7 living organisms and 1 dead
A73-06 had 5 living organisms and 1 dead
Purple Cliffs-05 had 3 living organisms and 1 dead
A68 Dup-03 had 7 living organisms and 1 dead
A75D-01 reported a droped sample

Table 3.1-8

November 2014 Animas River Sediment Toxicity Test Using *H. azteca*

Initial and Final Wet Chemistry Results (mg/L)

Initial

STATION_ID	Chloride	Dissolved Organic Carbon	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Total Alkalinity
A55	1.9J	10.5	0.9	<1.0U	64.1	145
A56	1.8J	2.9	0.6	<1.0U	74.1	106
A60	2.1	1.5	0.7	<1.0U	82.7	86.5
A68	1.8J	<1.0U	0.4	<1.0U	80.6	80.4
A68 Dup	1.7J	<1.0U	0.2	<1.0U	75.8	69.8
A72	1.8J	<1.0U	0.5	<1.0U	118	40.5
A73	1.8J	<1.0U	0.4	<1.0U	104	42.6
A75CC	2.2	10.5	0.9	<1.0U	66.9	146
A75D	1.8J	<1.0U	0.4	<1.0U	87.4	61.9
A75EC	1.8J	2.4	0.1J	<1.0U	68.5	83.3
Animas@32nd Bridge	3.3	1.4	0.4	<1.0U	69.3	109
Animas@Lightner Creek	3.7	1.5	0.2	<1.0U	71.1	140
Animas@Purple Cliffs	1.9J	1.3	0.2	<1.0U	64.8	89.8
Bbridge	2.1	1.4	0.3	<1.0U	79.7	92.6
James Ranch	2.1	1.7	0.3	<1.0U	84.1	100
N-Control	45.2D	5.5	<1.0U	<10.0U	360D	73.3
P-Control	37.3D	5.9	<1.0U	<10.0U	301D	74.5
Ref 100%	1.7J	<1.0U	<0.1U	<1.0U	74.4	61.4
Ref. 12.5%	1.7J	<1.0U	<0.1U	<1.0U	73.8	60.7
Ref. 25%	1.7J	<1.0U	<0.1U	<1.0U	73.9	61.5
Ref. 50%	1.7J	<1.0U	<0.1U	<1.0U	74.1	60.6
Ref. 6.25%	1.7J	<1.0U	<0.1U	<1.0U	73.8	60.6
Ref. control	1.7J	<1.0U	<0.1U	<1.0U	73.5	61.4

Final

STATION_ID	Chloride	Dissolved Organic Carbon	Fluoride	Nitrate/Nitrite as N	Sulfate as SO4	Total Alkalinity
A55	2.1	1.2	0.6	<1.0U	75.6	78.5
A56	2.1	<1.0U	0.3	<1.0U	82.3	75.6
A60	2.1	<1.0U	0.3	<1.0U	84.3	75.8
A68	2.1	<1.0U	0.2	<1.0U	83.9	75.1
A68 Dup	2.1	<1.0U	0.1J	<1.0U	82.8	72.6
A72	2.1	<1.0U	0.3	<1.0U	93.3	60.7
A73	2.1	<1.0U	0.3	<1.0U	88.5	63.2
A75CC	2.1	1.4	<0.1U	<1.0U	73.3	109
A75D	2.1	<1.0U	0.2	<1.0U	84.9	70.2
A75EC	2.1	1.1	<0.1U	<1.0U	79.0	73.5
Animas@32nd Bridge	2.2	1.0	0.2	<1.0U	84.3	81.8
Animas@Lightner Creek	2.3	<1.0U	0.1J	<1.0U	79.8	103
Animas@Purple Cliffs	2.0	<1.0U	<0.1U	<1.0U	77.0	90.8
Bbridge	2.1	<1.0U	0.1J	<1.0U	78.0	72.2
James Ranch	2.1	<1.0U	0.2	<1.0U	84.6	78.6
N-Control	7.8	1.8	<0.1U	<1.0U	134	89.2
P-Control	8.4	1.6	<0.1U	<1.0U	137	87.3
Ref 100%	2.8	2.3	<0.1U	2.1J	81.4	64.6
Ref. 12.5%	2.4	2.5	<0.1U	<1.0U	86.2	74.4
Ref. 25%	2.3	2.6	<0.1U	<1.0U	86.6	75.2
Ref. 50%	2.5	2.4	<0.1U	1.2J	83.2	68.4
Ref. 6.25%	2.4	2.8	<0.1U	<1.0U	87.2	75.6
Ref. control	2.6	3.1	<0.1U	<1.0U	86.7	73.2

Prepared by: B. Belmonte (2/26/15)

Reviewed by: E. Seiler (3/5/15)

Figures

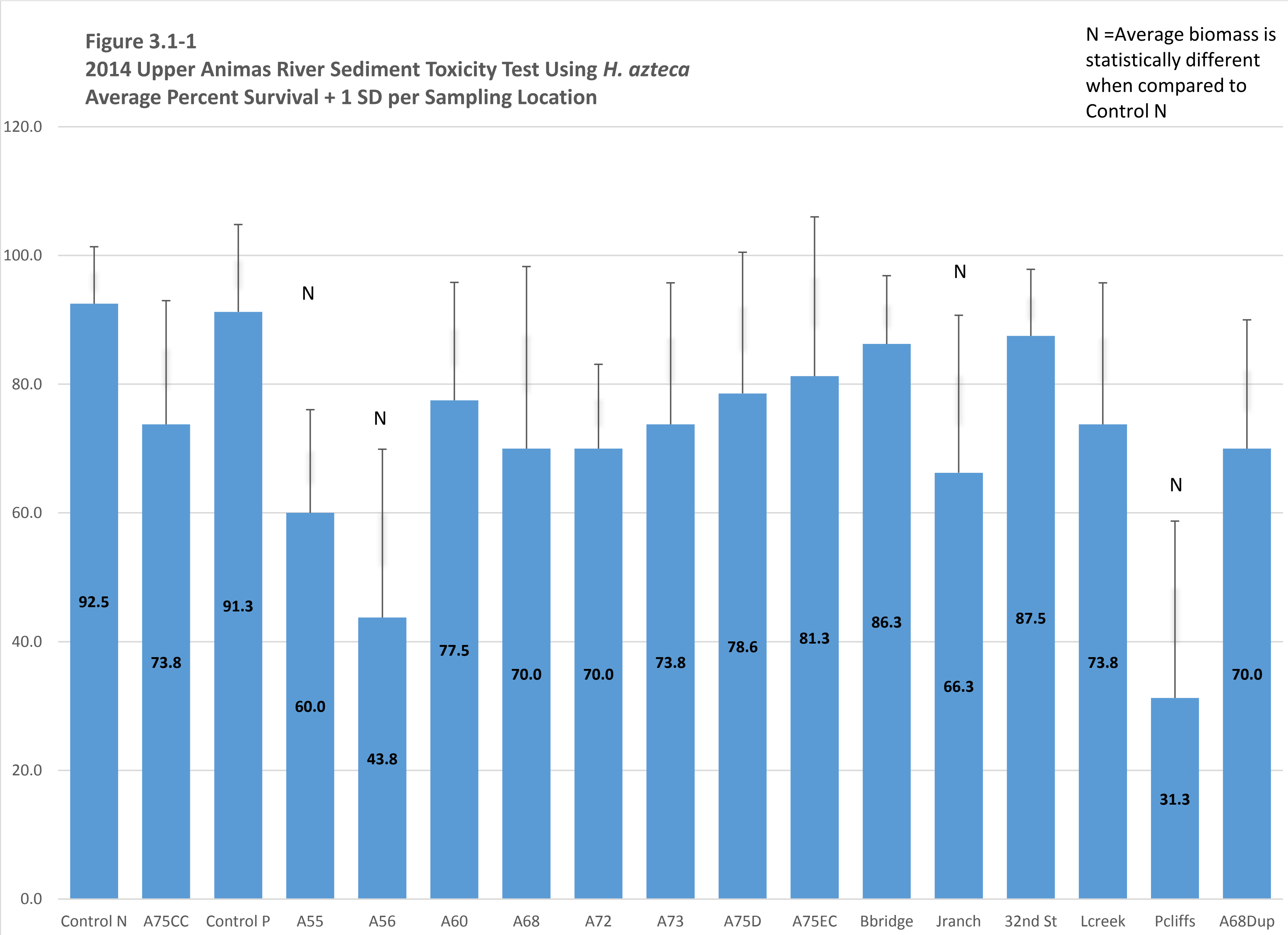


Figure 3.1-1
2014 Upper Animas River Sediment Toxicity Test Using H. azteca
Average Percent Survival + 1 SD per Sampling Location
N =Average biomass is statistically different when compared to Control N
120.0
100.0
80.0
60.0
40.0
20.0
0.0
92.5
73.8
91.3
60.0
43.8
77.5
70.0
70.0
73.8
78.6
81.3
86.3
66.3
87.5
73.8
31.3
70.0
N
N
N
N
Control N
A75CC
Control P
A55
A56
A60
A68
A72
A73
A75D
A75EC
Bbridge
Jranch
32nd St
Lcreek
Pcliffs
A68Dup

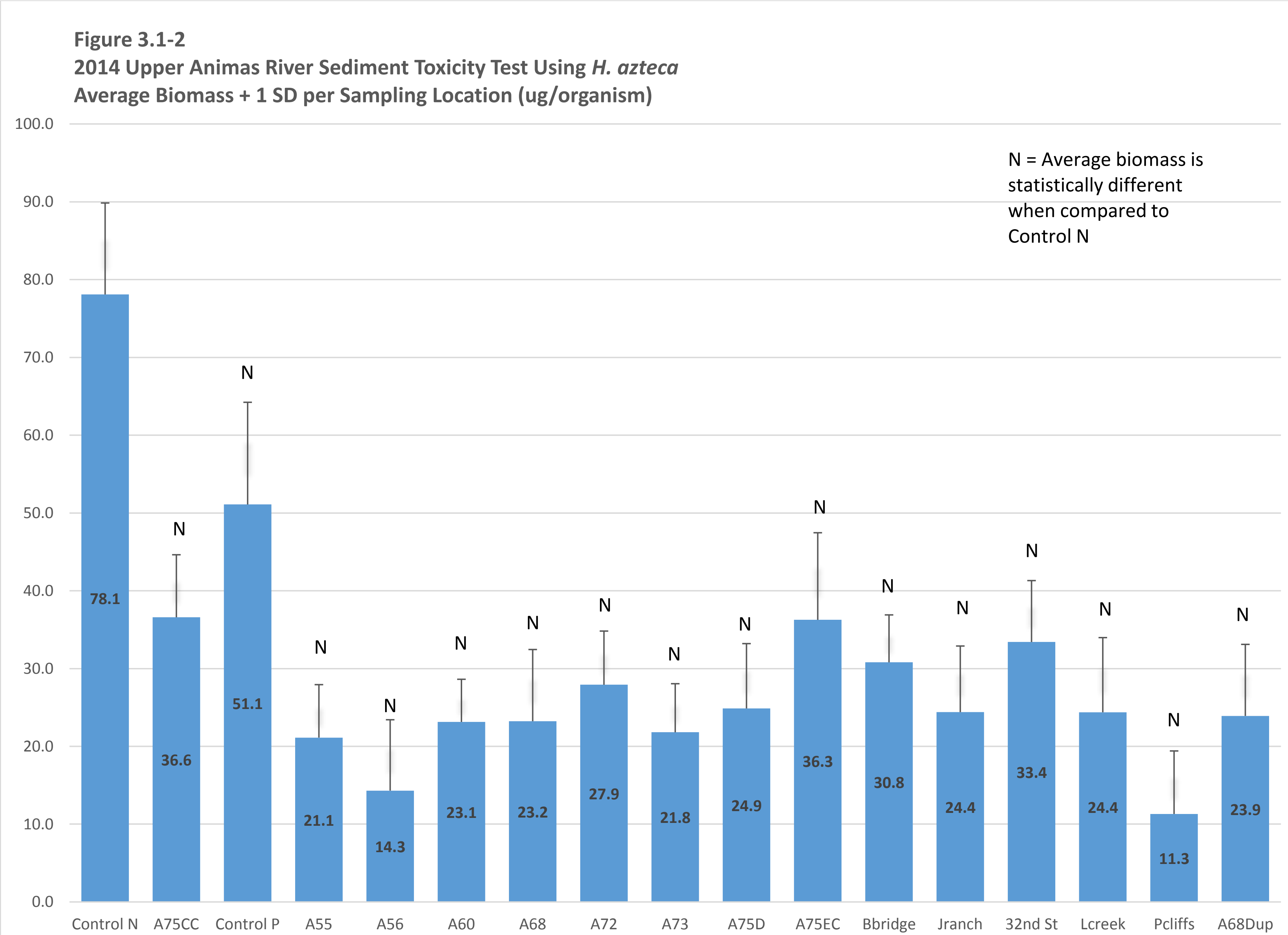
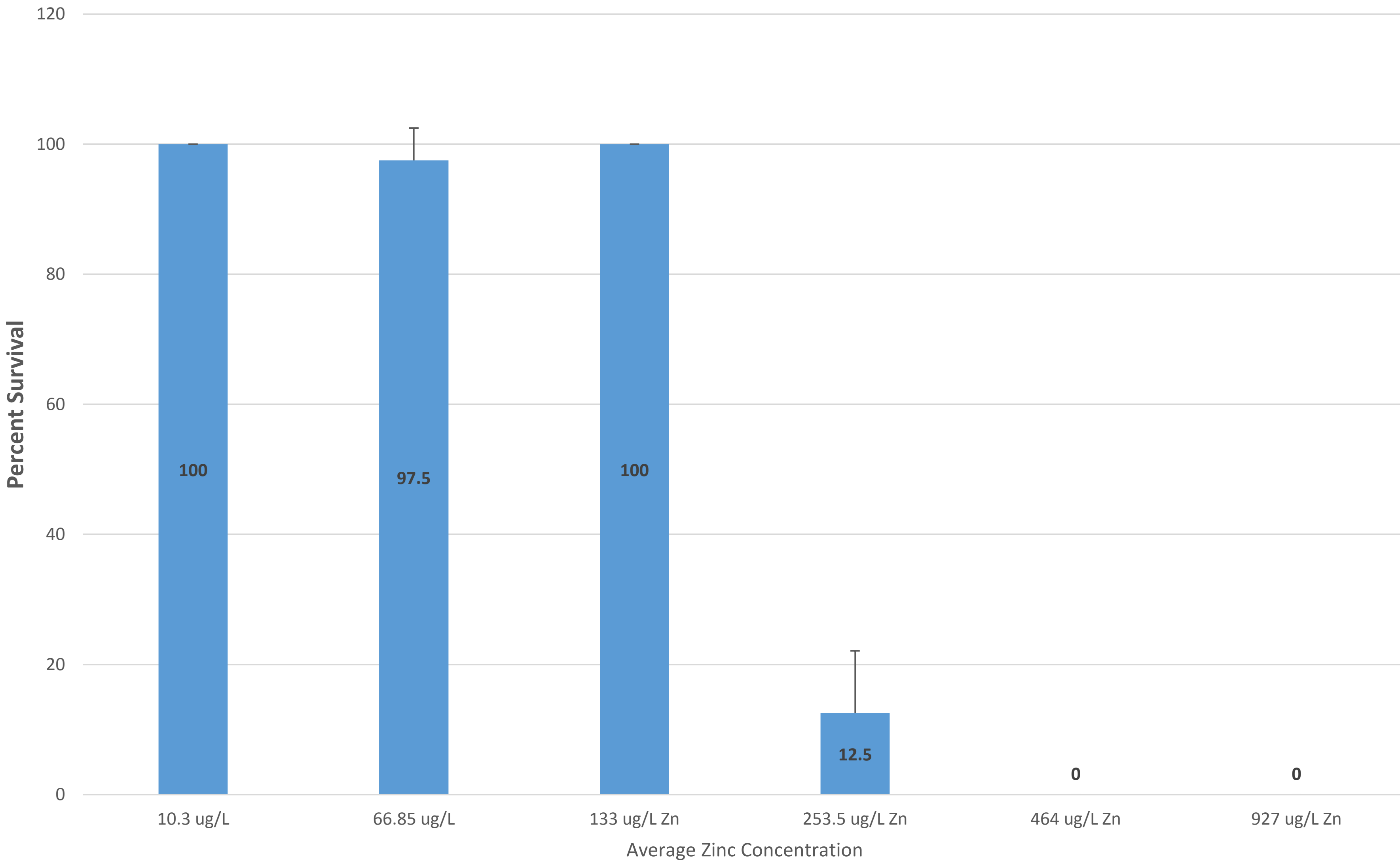


Figure 3.1-2
2014 Upper Animas River Sediment Toxicity Test Using H. azteca
Average Biomass + 1 SD per Sampling Location (ug/organism)
N = Average biomass is statistically different when compared to Control N
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Control N
A75CC
Control P
A55
A56
A60
A68
A72
A73
A75D
A75EC
Bbridge
Jranch
32nd St
Lcreek
Pcliffs
A68Dup
78.1
36.6
51.1
21.1
14.3
23.1
23.2
27.9
21.8
24.9
36.3
30.8
24.4
33.4
24.4
11.3
23.9
N

Figure 3.2-1
2014 Upper Animas River Concurrent Acute Reference Toxicity Test using H.azteca and Zinc Sulfate (ZnSO4)
***H. azteca* Percent Survival + 1 SD per Zinc Concentration**



November 2014 10-day Upper Animas River Sediment Toxicity Test Using *H. azteca*

Location	CETIS avg survival	% survival	CETIS SD	survival %SD	CETIS Avg biomass (mg)	CETIS biomass SD (mg)	Avg biomass (ug)	biomass SD (ug)
Control N	0.925	92.5	0.0886	8.9	0.07809	0.0118	78.1	11.8
A75CC	0.7375	73.8	0.1923	19.2	0.03659	0.0080	36.6	8.0
Control P	0.9125	91.3	0.1356	13.6	0.05109	0.0131	51.1	13.1
A55	0.6	60.0	0.1604	16.0	0.02113	0.0068	21.1	6.8
A56	0.4375	43.8	0.2615	26.2	0.01431	0.0091	14.3	9.1
A60	0.775	77.5	0.1832	18.3	0.02314	0.0055	23.1	5.5
A68	0.7	70.0	0.2828	28.3	0.02323	0.0092	23.2	9.2
A72	0.7	70.0	0.1309	13.1	0.02792	0.0069	27.9	6.9
A73	0.7375	73.8	0.22	22.0	0.02181	0.0062	21.8	6.2
A75D	0.7857	78.6	0.2193	21.9	0.02487	0.0083	24.9	8.3
A75EC	0.8125	81.3	0.2475	24.8	0.03626	0.0112	36.3	11.2
Bbridge	0.8625	86.3	0.1061	10.6	0.0308	0.0061	30.8	6.1
Jranch	0.6625	66.3	0.2446	24.5	0.0244	0.0085	24.4	8.5
32nd St	0.875	87.5	0.1035	10.4	0.03341	0.0079	33.4	7.9
Lcreek	0.7375	73.8	0.22	22.0	0.02438	0.0096	24.4	9.6
Pcliffs	0.3125	31.3	0.2748	27.5	0.01131	0.0081	11.3	8.1
A68Dup	0.7	70.0	0.2	20.0	0.02391	0.0092	23.9	9.2

%Zn (ug/L)	Zn (Dis ug/L)	CETIS survival	% survival	CETIS Surv. SD	%SD
10.3 ug/L	10.3	1	100	0	0
66.85 ug/L	66.85	0.975	97.5	0.05	5
133 ug/L Zn	133	1	100	0	0
253.5 ug/L Zn	253.5	0.125	12.5	0.09574	9.574
464 ug/L Zn	464	0	0	0	0
927 ug/L Zn	927	0	0	0	0

Prepared by: B. Belmonte (2/27/15)
Reviewed by: E. Seiler (3/4/15)

Appendices

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14	No. of Replicates	8
End Date	11/20/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	80
Analysts	SA, LC, CL		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Control-P-01	pH	7.21									7.00	
Control-P-01	Conductivity (us/cm)	1068									427	
Control-P-01	D.O. (mg/L)	6.10	5.13	3.93	3.63	3.76	3.90	3.11	3.68	3.65	5.03	4.16
Control-P-01	Temp (C)	21.13	22.1	22.6	22.5	22.7	22.6	22.7	22.4	22.4	22.67	22.6
Control-P-01	Hardness	322										139
Control-P-01	Alkalinity	74.5										87.3
Control-P-02	pH	7.33									7.06	
Control-P-02	Conductivity (us/cm)	979									448	
Control-P-02	D.O. (mg/L)	5.34	4.71	3.80	3.84	3.64	4.07	4.23	3.91	3.88	5.14	4.40
Control-P-02	Temp (C)	21.01	22.1	22.5	22.3	22.7	22.4	22.8	22.4	22.4	22.64	22.6
Control-P-02	Hardness	322										139
Control-P-02	Alkalinity	74.5										87.3
Control-P-03	pH	7.37									7.10	
Control-P-03	Conductivity (us/cm)	1024									471	
Control-P-03	D.O. (mg/L)	4.72	5.16	3.98	3.86	3.85	4.10	3.76	3.85	3.70	5.22	4.43
Control-P-03	Temp (C)	20.99	22.2	22.3	22.1	22.6	22.4	22.8	22.2	22.4	22.63	22.6
Control-P-03	Hardness	322										139
Control-P-03	Alkalinity	74.5										87.3
Control-P-04	pH	7.37									7.11	
Control-P-04	Conductivity (us/cm)	936									477	
Control-P-04	D.O. (mg/L)	4.64	4.91	3.80	4.11	4.01	3.89	3.89	3.67	3.54	5.23	4.32
Control-P-04	Temp (C)	20.91	22.1	22.3	22.0	22.7	22.4	22.7	22.0	22.3	22.63	22.5
Control-P-04	Hardness	322										139
Control-P-04	Alkalinity	74.5										87.3

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Control-P-05	pH	7.42									7.14	
Control-P-05	Conductivity (us/cm)	920									475	
Control-P-05	D.O. (mg/L)	5.16	4.61	4.05	3.83	4.00	3.89	4.15	3.73	3.47	5.21	4.07
Control-P-05	Temp (C)	20.97	22.1	22.3	22.1	22.6	22.5	22.7	22.0	22.3	22.61	22.5
Control-P-05	Hardness	322										139
Control-P-05	Alkalinity	74.5										87.3
Control-P-06	pH	7.41									7.14	
Control-P-06	Conductivity (us/cm)	985									467	
Control-P-06	D.O. (mg/L)	5.39	4.61	4.05	3.83	4.00	3.89	4.07	3.67	3.44	5.10	4.32
Control-P-06	Temp (C)	20.98	21.9	22.2	22.1	22.6	22.5	22.7	22.0	22.3	22.60	22.4
Control-P-06	Hardness	322										139
Control-P-06	Alkalinity	74.5										87.3
Control-P-07	pH	7.43									7.14	
Control-P-07	Conductivity (us/cm)	835									482	
Control-P-07	D.O. (mg/L)	4.73	4.85	4.02	3.96	3.93	3.78	4.32	4.20	3.26	5.16	4.25
Control-P-07	Temp (C)	20.62	22.0	22.5	22.2	22.6	22.5	22.6	22.0	22.3	22.69	22.4
Control-P-07	Hardness	322										139
Control-P-07	Alkalinity	74.5										87.3
Control-P-08	pH	7.43									7.17	
Control-P-08	Conductivity (us/cm)	968									496	
Control-P-08	D.O. (mg/L)	5.48	4.55	4.20	3.98	3.95	4.09	4.09	4.01	3.33	5.19	3.96
Control-P-08	Temp (C)	20.71	22.1	22.4	22.1	22.6	22.5	22.7	22.0	22.4	22.62	22.6
Control-P-08	Hardness	322										139
Control-P-08	Alkalinity	74.5										87.3

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Control-N-01	pH	7.06									7.16	
Control-N-01	Conductivity (us/cm)	995									460	
Control-N-01	D.O. (mg/L)	5.67	4.33	4.05	3.69	3.73	3.63	3.62	3.39	3.28	5.03	3.58
Control-N-01	Temp (C)	21.57	22.2	22.4	22.8	22.5	22.4	22.6	21.9	22.4	22.76	21.8
Control-N-01	Hardness	356										138
Control-N-01	Alkalinity	73.3										89.2
Control-N-02	pH	7.20									7.14	
Control-N-02	Conductivity (us/cm)	933									472	
Control-N-02	D.O. (mg/L)	5.68	4.49	4.17	3.88	3.59	3.56	3.76	3.81	3.22	4.92	3.96
Control-N-02	Temp (C)	21.56	22.5	22.5	22.6	22.5	22.4	22.6	21.9	22.4	22.75	22.4
Control-N-02	Hardness	356										138
Control-N-02	Alkalinity	73.3										89.2
Control-N-03	pH	7.21									7.19	
Control-N-03	Conductivity (us/cm)	997									464	
Control-N-03	D.O. (mg/L)	5.78	4.63	4.38	3.91	3.81	3.25	3.87	3.50	3.31	4.91	3.87
Control-N-03	Temp (C)	21.42	22.2	22.2	22.6	22.4	22.4	22.6	21.9	22.4	22.67	22.5
Control-N-03	Hardness	356										138
Control-N-03	Alkalinity	73.3										89.2
Control-N-04	pH	7.25									7.23	
Control-N-04	Conductivity (us/cm)	1002									455	
Control-N-04	D.O. (mg/L)	5.86	4.34	4.52	3.96	3.76	3.76	3.87	3.47	3.23	4.99	3.72
Control-N-04	Temp (C)	21.45	22.5	22.3	22.7	22.2	22.3	22.5	21.8	22.4	22.71	22.5
Control-N-04	Hardness	356										138
Control-N-04	Alkalinity	73.3										89.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Control-N-05	pH	7.21									7.27	
Control-N-05	Conductivity (us/cm)	1127									476	
Control-N-05	D.O. (mg/L)	6.20	4.35	3.30	3.88	3.91	3.83	3.96	3.41	3.21	4.94	3.25
Control-N-05	Temp (C)	21.26	22.0	22.4	22.6	22.5	22.4	22.5	21.8	22.3	22.61	22.5
Control-N-05	Hardness	356										138
Control-N-05	Alkalinity	73.3										89.2
Control-N-06	pH	7.31									7.30	
Control-N-06	Conductivity (us/cm)	1002									460	
Control-N-06	D.O. (mg/L)	5.92	4.67	4.51	4.04	3.80	3.63	3.56	3.32	3.29	4.95	3.88
Control-N-06	Temp (C)	21.38	22.5	22.2	22.6	22.5	22.4	22.5	21.8	22.3	22.69	22.5
Control-N-06	Hardness	356										138
Control-N-06	Alkalinity	73.3										89.2
Control-N-07	pH	7.31									7.31	
Control-N-07	Conductivity (us/cm)	1221									458	
Control-N-07	D.O. (mg/L)	5.17	4.35	5.20	4.02	3.91	3.80	3.62	3.47	3.21	4.95	4.22
Control-N-07	Temp (C)	21.41	22.4	22.5	22.8	22.7	22.5	22.6	21.8	22.3	22.75	22.5
Control-N-07	Hardness	356										138
Control-N-07	Alkalinity	73.3										89.2
Control-N-08	pH	7.33									7.31	
Control-N-08	Conductivity (us/cm)	1165									464	
Control-N-08	D.O. (mg/L)	5.08	4.51	4.47	3.94	3.75	3.63	3.79	3.28	3.20	4.93	3.96
Control-N-08	Temp (C)	21.36	22.5	22.5	22.7	22.5	22.5	22.5	21.8	22.4	22.68	22.5
Control-N-08	Hardness	356										138
Control-N-08	Alkalinity	73.3										89.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
A55-01	pH	6.99									7.14	
A55-01	Conductivity (us/cm)	348									325	
A55-01	D.O. (mg/L)	5.04	3.82	3.25	3.47	3.13	3.68	2.69	3.31	2.99	4.78	3.29
A55-01	Temp (C)	21.18	21.7	22.3	22.4	22.7	22.2	22.7	22.2	22.0	22.64	22.4
A55-01	Hardness	128										91
A55-01	Alkalinity	145										78.5
A55-02	pH	6.99									7.13	
A55-02	Conductivity (us/cm)	418									326	
A55-02	D.O. (mg/L)	3.90	3.64	3.46	3.18	3.34	3.61	3.55	3.17	3.09	4.40	3.21
A55-02	Temp (C)	21.23	22	22.5	22.4	22.6	22.2	22.6	22.2	22.3	22.62	22.5
A55-02	Hardness	128										91
A55-02	Alkalinity	145										78.5
A55-03	pH	7.04									7.10	
A55-03	Conductivity (us/cm)	416									326	
A55-03	D.O. (mg/L)	2.38	3.65	3.50	3.14	3.58	2.78	2.62	3.19	2.62	4.09	2.92
A55-03	Temp (C)	21.24	22.2	22.2	22.2	22.5	22.1	22.6	22.0	22.3	22.58	22.6
A55-03	Hardness	128										91
A55-03	Alkalinity	145										78.5
A55-04	pH	7.08									7.08	
A55-04	Conductivity (us/cm)	425									326	
A55-04	D.O. (mg/L)	2.05	3.76	4.00	3.15	3.34	3.55	3.11	3.10	3.08	4.00	3.13
A55-04	Temp (C)	21.15	22.1	22.1	22.0	22.2	22.0	22.6	22.0	22.3	22.54	22.5
A55-04	Hardness	128										91
A55-04	Alkalinity	145										78.5

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14	No. of Replicates	8
End Date	11/20/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	80
Analysts	SA, LC, CL		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A55-05	pH	7.18									7.08	
A55-05	Conductivity (us/cm)	403									330	
A55-05	D.O. (mg/L)	2.79	3.83	3.53	3.21	3.34	3.61	3.46	3.32	2.81	3.45	2.99
A55-05	Temp (C)	21.24	22.1	22.1	22.2	22.2	22.2	22.5	21.9	22.3	22.53	22.4
A55-05	Hardness	128										91
A55-05	Alkalinity	145										78.5
A55-06	pH	7.19									7.05	
A55-06	Conductivity (us/cm)	400									328	
A55-06	D.O. (mg/L)	2.28	3.35	3.86	3.28	3.54	3.83	3.66	3.18	2.90	2.74	2.45
A55-06	Temp (C)	21.20	21.8	22.2	22.0	22.2	22.2	22.5	21.9	22.3	22.57	22.3
A55-06	Hardness	128										91
A55-06	Alkalinity	145										78.5
A55-07	pH	7.25									7.05	
A55-07	Conductivity (us/cm)	401									322	
A55-07	D.O. (mg/L)	2.98	3.94	3.55	3.25	3.15	3.79	3.56	3.15	2.97	3.05	2.74
A55-07	Temp (C)	21.19	21.8	22.2	22.1	22.4	22.3	22.6	21.9	22.3	22.64	22.3
A55-07	Hardness	128										91
A55-07	Alkalinity	145										78.5
A55-08	pH	7.23									7.05	
A55-08	Conductivity (us/cm)	414									329	
A55-08	D.O. (mg/L)	2.93	3.83	3.36	3.18	3.26	4.32	3.34	3.08	3.05	3.25	2.87
A55-08	Temp (C)	21.24	22.2	22.3	22.1	22.2	22.3	22.7	21.9	22.3	22.64	22.5
A55-08	Hardness	128										91
A55-08	Alkalinity	145										78.5

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A56-01	pH	7.32									7.05	
A56-01	Conductivity (us/cm)	368									316	
A56-01	D.O. (mg/L)	4.84	4.36	3.35	3.42	3.54	3.84	3.06	3.01	2.90	4.22	2.44
A56-01	Temp (C)	21.23	21.8	22.1	22.3	22.8	22.4	22.8	22.1	22.2	22.71	22.7
A56-01	Hardness	116										97
A56-01	Alkalinity	106										75.6
A56-02	pH	7.32									7.04	
A56-02	Conductivity (us/cm)	376									328	
A56-02	D.O. (mg/L)	5.12	4.49	3.47	3.19	3.34	3.54	3.03	3.16	2.92	4.15	3.13
A56-02	Temp (C)	21.21	22.1	22.3	22.3	22.8	22.3	22.8	22.1	22.4	22.68	22.7
A56-02	Hardness	116										97
A56-02	Alkalinity	106										75.6
A56-03	pH	7.31									7.05	
A56-03	Conductivity (us/cm)	377									337	
A56-03	D.O. (mg/L)	4.48	4.18	3.48	3.52	3.55	3.52	3.30	3.14	3.03	3.18	3.42
A56-03	Temp (C)	21.15	21.8	22.0	22.1	22.5	22.2	22.7	22.2	22.4	22.57	22.6
A56-03	Hardness	116										97
A56-03	Alkalinity	106										75.6
A56-04	pH	7.31									7.05	
A56-04	Conductivity (us/cm)	366									334	
A56-04	D.O. (mg/L)	4.88	4.37	3.96	3.43	3.48	3.51	3.48	3.21	2.88	30.9	2.98
A56-04	Temp (C)	20.21	21.8	22.2	22.1	22.6	22.2	22.6	21.9	22.5	22.58	22.5
A56-04	Hardness	116										97
A56-04	Alkalinity	106										75.6

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
A56-05	pH	7.30									7.04	
A56-05	Conductivity (us/cm)	377									338	
A56-05	D.O. (mg/L)	4.54	4.36	4.23	3.17	3.35	3.83	3.44	3.51	2.79	2.17	3.24
A56-05	Temp (C)	21.03	22.2	22.2	22.1	22.7	22.2	22.6	21.9	22.3	22.65	22.4
A56-05	Hardness	116										97
A56-05	Alkalinity	106										75.6
A56-06	pH	7.31									7.03	
A56-06	Conductivity (us/cm)	364									336	
A56-06	D.O. (mg/L)	2.94	4.74	4.43	3.35	3.43	3.79	3.29	3.36	2.94	2.13	3.15
A56-06	Temp (C)	20.87	22.1	22.2	22.1	22.7	22.2	22.6	22.0	22.3	22.59	22.5
A56-06	Hardness	116										97
A56-06	Alkalinity	106										75.6
A56-07	pH	7.31									7.03	
A56-07	Conductivity (us/cm)	370									341	
A56-07	D.O. (mg/L)	3.99	4.35	3.46	3.29	3.37	3.55	3.48	3.25	2.91	2.37	3.09
A56-07	Temp (C)	21.27	22.2	22.4	22.1	22.8	22.3	22.6	22.0	22.3	22.70	22.4
A56-07	Hardness	116										97
A56-07	Alkalinity	106										75.6
A56-08	pH	7.31									7.03	
A56-08	Conductivity (us/cm)	349									335	
A56-08	D.O. (mg/L)	4.98	4.76	3.45	3.53	3.24	3.91	3.52	3.44	2.87	3.36	3.2
A56-08	Temp (C)	21.35	21.9	22.3	22.2	22.8	22.4	22.7	23.0	22.5	22.68	22.5
A56-08	Hardness	116										97
A56-08	Alkalinity	106										75.6

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A60-01	pH	7.49									7.26	
A60-01	Conductivity (us/cm)	359									325	
A60-01	D.O. (mg/L)	6.18	4.34	3.41	3.58	3.24	4.21	3.25	3.31	3.10	5.29	2.64
A60-01	Temp (C)	20.84	21.9	22.5	22.5	22.6	22.4	22.6	21.9	22.1	22.55	22.5
A60-01	Hardness	122										99
A60-01	Alkalinity	86.5										75.8
A60-02	pH	7.40									7.22	
A60-02	Conductivity (us/cm)	350									335	
A60-02	D.O. (mg/L)	5.23	4.06	3.47	3.96	3.36	4.13	3.53	2.80	3.44	4.96	3.26
A60-02	Temp (C)	21.21	22.1	22.3	22.3	22.5	22.3	22.7	22.2	22.2	22.63	22.5
A60-02	Hardness	122										99
A60-02	Alkalinity	86.5										75.8
A60-03	pH	7.33									7.20	
A60-03	Conductivity (us/cm)	359									348	
A60-03	D.O. (mg/L)	4.05	4.24	3.37	3.64	3.27	3.54	3.35	2.97	3.17	4.65	2.80
A60-03	Temp (C)	21.17	21.8	22.3	22.3	22.6	22.4	22.7	22.0	22.3	22.53	22.5
A60-03	Hardness	122										99
A60-03	Alkalinity	86.5										75.8
A60-04	pH	7.29									7.19	
A60-04	Conductivity (us/cm)	363									340	
A60-04	D.O. (mg/L)	4.73	4.12	3.45	3.56	3.04	3.71	3.57	2.99	3.13	4.58	3.21
A60-04	Temp (C)	21.17	22.1	22.3	22.3	22.6	22.5	22.6	21.9	22.3	22.58	22.5
A60-04	Hardness	122										99
A60-04	Alkalinity	86.5										75.8

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
A60-05	pH	7.26									7.18	
A60-05	Conductivity (us/cm)	364									338	
A60-05	D.O. (mg/L)	4.94	4.09	3.69	3.42	3.24	3.38	3.84	3.15	3.10	4.47	3.24
A60-05	Temp (C)	21.27	22.1	22.4	22.5	22.6	22.4	22.6	22.0	22.4	22.68	22.5
A60-05	Hardness	122										99
A60-05	Alkalinity	86.5										75.8
A60-06	pH	7.24									7.17	
A60-06	Conductivity (us/cm)	355									337	
A60-06	D.O. (mg/L)	4.10	4.12	3.52	3.80	3.21	3.35	3.56	3.09	2.98	4.38	2.78
A60-06	Temp (C)	21.16	22.1	22.2	22.4	22.5	22.3	22.6	22.0	22.4	22.61	22.6
A60-06	Hardness	122										99
A60-06	Alkalinity	86.5										75.8
A60-07	pH	7.24									7.10	
A60-07	Conductivity (us/cm)	362									336	
A60-07	D.O. (mg/L)	4.63	4.06	3.54	3.59	3.41	3.50	3.68	3.22	2.94	4.30	3.09
A60-07	Temp (C)	21.37	22.1	22.5	22.5	22.6	22.2	22.6	22.0	22.4	22.71	22.6
A60-07	Hardness	122										99
A60-07	Alkalinity	86.5										75.8
A60-08	pH	7.23									7.13	
A60-08	Conductivity (us/cm)	360									335	
A60-08	D.O. (mg/L)	4.92	4.23	3.73	3.53	3.48	3.43	3.79	3.34	3.03	4.11	3.05
A60-08	Temp (C)	21.26	22.3	22.3	22.4	22.5	22	22.7	22.1	22.4	22.67	22.6
A60-08	Hardness	122										99
A60-08	Alkalinity	86.5										75.8

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A68-01	pH	7.28									7.14	
A68-01	Conductivity (us/cm)	339									320	
A68-01	D.O. (mg/L)	5.17	4.68	3.78	3.68	3.53	3.87	3.44	3.25	3.06	4.48	2.85
A68-01	Temp (C)	21.46	22.1	22.3	22.3	22.5	22.20	22.7	22.0	22.4	22.77	22.7
A68-01	Hardness	114										99
A68-01	Alkalinity	80.4										75.1
A68-02	pH	7.29									7.14	
A68-02	Conductivity (us/cm)	338									329	
A68-02	D.O. (mg/L)	5.60	4.56	4.20	3.88	3.40	3.78	3.60	3.34	3.11	4.60	3.45
A68-02	Temp (C)	20.71	22.0	22.5	22.3	22.5	22.4	22.8	22.1	22.4	22.76	22.7
A68-02	Hardness	114										99
A68-02	Alkalinity	80.4										75.1
A68-03	pH	7.31									7.15	
A68-03	Conductivity (us/cm)	345									335	
A68-03	D.O. (mg/L)	5.92	4.67	4.09	3.46	3.45	3.68	3.99	3.30	3.24	4.68	3.51
A68-03	Temp (C)	21.28	21.9	22.4	22.4	22.2	22.4	22.8	22.0	22.4	22.68	22.7
A68-03	Hardness	114										99
A68-03	Alkalinity	80.4										75.1
A68-04	pH	7.32									7.16	
A68-04	Conductivity (us/cm)	339									335	
A68-04	D.O. (mg/L)	6.11	4.63	3.83	3.52	3.49	3.71	4.23	3.37	3.04	4.76	3.67
A68-04	Temp (C)	20.84	21.8	22.3	22.4	22.3	22.4	22.7	21.9	22.4	22.65	22.6
A68-04	Hardness	114										99
A68-04	Alkalinity	80.4										75.1

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A68-05	pH	7.32									7.16	
A68-05	Conductivity (us/cm)	344									334	
A68-05	D.O. (mg/L)	5.75	4.28	4.18	3.64	3.44	3.59	3.80	3.31	3.12	4.76	3.48
A68-05	Temp (C)	21.26	22.1	22.3	22.4	22.2	22.3	22.7	21.9	22.3	22.67	22.5
A68-05	Hardness	114										99
A68-05	Alkalinity	80.4										75.1
A68-06	pH	7.30									7.16	
A68-06	Conductivity (us/cm)	351									337	
A68-06	D.O. (mg/L)	5.74	4.18	4.04	3.83	3.31	3.49	3.56	3.25	3.07	4.59	3.35
A68-06	Temp (C)	20.90	21.9	22.2	22.3	22.3	22.3	22.6	21.9	22.3	22.61	22.6
A68-06	Hardness	114										99
A68-06	Alkalinity	80.4										75.1
A68-07	pH	7.30									7.15	
A68-07	Conductivity (us/cm)	344									332	
A68-07	D.O. (mg/L)	5.60	4.71	4.07	3.65	3.41	3.51	3.57	3.24	2.97	4.54	3.27
A68-07	Temp (C)	21.32	22.0	22.4	22.3	22.3	22.4	22.6	22.0	22.4	22.71	22.2
A68-07	Hardness	114										99
A68-07	Alkalinity	80.4										75.1
A68-08	pH	7.30									7.14	
A68-08	Conductivity (us/cm)	345									334	
A68-08	D.O. (mg/L)	5.54	4.37	3.96	3.88	3.38	3.72	3.55	3.13	3.08	4.61	3.55
A68-08	Temp (C)	21.02	22.0	22.3	22.3	22.3	22.4	22.6	21.9	22.4	22.68	22.4
A68-08	Hardness	114										99
A68-08	Alkalinity	80.4										75.1

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A72-01	pH	7.23									7.15	
A72-01	Conductivity (us/cm)	342									318	
A72-01	D.O. (mg/L)	6.57	4.46	4.00	3.70	3.62	3.67	3.55	3.64	3.08	5.40	3.20
A72-01	Temp (C)	20.67	22.1	22.4	22.3	22.5	22.4	22.6	21.5	22.4	22.68	22.5
A72-01	Hardness	111										95
A72-01	Alkalinity	40.5										60.7
A72-02	pH	7.17									7.09	
A72-02	Conductivity (us/cm)	351									324	
A72-02	D.O. (mg/L)	6.60	4.44	4.51	3.88	3.58	3.64	3.96	3.61	3.24	5.09	3.63
A72-02	Temp (C)	20.70	22.1	22.2	22.2	22.5	22.4	22.6	21.9	22.4	22.67	22.6
A72-02	Hardness	111										95
A72-02	Alkalinity	40.5										60.7
A72-03	pH	7.09									7.13	
A72-03	Conductivity (us/cm)	359									334	
A72-03	D.O. (mg/L)	6.42	4.61	3.99	3.80	3.61	3.66	3.83	3.77	3.19	4.96	3.58
A72-03	Temp (C)	20.94	22.0	22.2	22.2	22.5	22.4	22.6	22.0	22.4	22.66	22.6
A72-03	Hardness	111										95
A72-03	Alkalinity	40.5										60.7
A72-04	pH	7.12									7.08	
A72-04	Conductivity (us/cm)	350									335	
A72-04	D.O. (mg/L)	6.43	4.43	4.08	3.93	3.63	3.79	3.67	3.52	3.12	4.92	3.64
A72-04	Temp (C)	20.50	22.0	22.1	22.1	22.3	22.3	22.6	21.7	22.3	22.57	22.5
A72-04	Hardness	111										95
A72-04	Alkalinity	40.5										60.7

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A72-05	pH	7.08									7.09	
A72-05	Conductivity (us/cm)	363									335	
A72-05	D.O. (mg/L)	6.47	4.63	4.18	3.62	3.71	3.87	3.80	3.82	3.10	4.92	3.55
A72-05	Temp (C)	20.90	21.9	22.2	22.2	22.3	22.4	22.5	21.7	22.3	22.58	22.5
A72-05	Hardness	111										95
A72-05	Alkalinity	40.5										60.7
A72-06	pH	7.05									7.09	
A72-06	Conductivity (us/cm)	352									335	
A72-06	D.O. (mg/L)	6.37	4.58	3.93	3.80	3.57	3.50	3.65	3.81	3.04	4.96	3.61
A72-06	Temp (C)	21.15	21.9	22.2	22.4	22.3	22.4	22.5	21.7	22.4	22.59	22.5
A72-06	Hardness	111										95
A72-06	Alkalinity	40.5										60.7
A72-07	pH	7.04									7.08	
A72-07	Conductivity (us/cm)	345									330	
A72-07	D.O. (mg/L)	6.09	4.61	3.99	4.03	3.68	3.76	3.70	3.76	3.31	4.80	3.74
A72-07	Temp (C)	21.43	22.2	22.5	22.5	22.5	22.4	22.6	21.7	22.4	22.75	22.4
A72-07	Hardness	111										95
A72-07	Alkalinity	40.5										60.7
A72-08	pH	7.05									7.09	
A72-08	Conductivity (us/cm)	356									334	
A72-08	D.O. (mg/L)	6.44	4.56	4.15	3.97	3.82	3.75	3.78	3.75	3.29	4.85	3.40
A72-08	Temp (C)	20.58	22.2	22.2	22.6	22.3	22.3	22.6	21.8	22.4	22.68	22.6
A72-08	Hardness	111										95
A72-08	Alkalinity	40.5										60.7

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A73-01	pH	7.24									7.19	
A73-01	Conductivity (us/cm)	315									323	
A73-01	D.O. (mg/L)	7.00	5.70	4.28	4.18	3.79	3.72	4.20	3.70	3.49	5.13	3.38
A73-01	Temp (C)	20.95	21.8	22.3	22.1	22.6	22.1	22.6	21.9	22.2	22.66	22.3
A73-01	Hardness	99										93
A73-01	Alkalinity	42.6										63.2
A73-02	pH	7.19									7.18	
A73-02	Conductivity (us/cm)	325									323	
A73-02	D.O. (mg/L)	7.20	5.74	4.20	4.32	4.19	3.93	4.21	4.17	3.72	4.98	3.57
A73-02	Temp (C)	20.10	21.8	22.5	22.4	22.5	22.3	22.7	22.0	22.4	22.74	22.4
A73-02	Hardness	99										93
A73-02	Alkalinity	42.6										63.2
A73-03	pH	7.18									7.17	
A73-03	Conductivity (us/cm)	328									326	
A73-03	D.O. (mg/L)	7.01	4.90	4.34	4.32	3.80	3.67	4.23	3.78	3.57	5.05	3.63
A73-03	Temp (C)	20.40	21.9	22.2	22.2	22.3	22.2	22.7	22.0	22.4	22.63	22.5
A73-03	Hardness	99										93
A73-03	Alkalinity	42.6										63.2
A73-04	pH	7.16									7.15	
A73-04	Conductivity (us/cm)	316									324	
A73-04	D.O. (mg/L)	7.02	5.03	4.28	4.19	3.72	4.17	4.34	3.79	3.52	4.87	3.74
A73-04	Temp (C)	21.07	21.9	22.1	22.1	22.2	22.2	22.7	22.0	22.4	22.59	22.5
A73-04	Hardness	99										93
A73-04	Alkalinity	42.6										63.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A73-05	pH	7.15									7.15	
A73-05	Conductivity (us/cm)	328									326	
A73-05	D.O. (mg/L)	7.06	5.24	4.49	3.76	3.92	4.15	4.44	3.74	3.50	5.02	3.32
A73-05	Temp (C)	21.13	21.8	22.3	22.0	22.3	22.2	22.6	22.0	22.4	22.62	22.4
A73-05	Hardness	99										93
A73-05	Alkalinity	42.6										63.2
A73-06	pH	7.11									7.14	
A73-06	Conductivity (us/cm)	325									328	
A73-06	D.O. (mg/L)	7.04	4.41	4.43	3.87	3.90	4.08	4.37	4.18	3.82	5.07	3.18
A73-06	Temp (C)	21.14	21.8	22.3	22.1	22.2	22.2	22.6	22.0	22.4	22.65	22.5
A73-06	Hardness	99										93
A73-06	Alkalinity	42.6										63.2
A73-07	pH	7.12									7.12	
A73-07	Conductivity (us/cm)	331									324	
A73-07	D.O. (mg/L)	6.99	5.24	4.41	4.03	3.84	3.98	4.23	4.01	3.69	4.74	3.66
A73-07	Temp (C)	21.19	22.1	22.4	22.3	22.4	22.6	22.6	22.0	22.4	22.69	22.6
A73-07	Hardness	99										93
A73-07	Alkalinity	42.6										63.2
A73-08	pH	7.09									7.13	
A73-08	Conductivity (us/cm)	328									329	
A73-08	D.O. (mg/L)	6.92	5.28	4.38	4.41	3.75	3.93	4.17	4.12	3.79	4.83	3.81
A73-08	Temp (C)	21.24	22.1	22.4	22.3	22.3	22.3	22.7	22.1	22.4	22.74	22.6
A73-08	Hardness	99										93
A73-08	Alkalinity	42.6										63.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A75D-01	pH	7.24									6.99	
A75D-01	Conductivity (us/cm)	318									315	
A75D-01	D.O. (mg/L)	5.67	4.67	4.07	3.66	3.45	3.59	3.50	3.14	2.73	4.80	3.15
A75D-01	Temp (C)	21.42	22.1	22.3	22.5	22.4	22.4	22.7	21.8	22.4	22.73	22.6
A75D-01	Hardness	99										94
A75D-01	Alkalinity	61.9										70.2
A75D-02	pH	7.21									7.08	
A75D-02	Conductivity (us/cm)	330									325	
A75D-02	D.O. (mg/L)	5.19	4.26	4.07	3.51	3.66	3.63	3.44	3.27	2.94	4.70	3.29
A75D-02	Temp (C)	21.45	22.3	22.4	22.5	22.5	22.5	22.8	22.0	22.5	22.77	22.7
A75D-02	Hardness	99										94
A75D-02	Alkalinity	61.9										70.2
A75D-03	pH	7.20									7.15	
A75D-03	Conductivity (us/cm)	331									330	
A75D-03	D.O. (mg/L)	5.34	4.52	4.13	3.50	3.48	3.83	3.35	3.19	2.97	4.73	3.98
A75D-03	Temp (C)	21.31	22.3	22.2	22.4	22.5	22.3	22.7	21.9	22.4	22.67	22.7
A75D-03	Hardness	99										94
A75D-03	Alkalinity	61.9										70.2
A75D-04	pH	7.17									7.13	
A75D-04	Conductivity (us/cm)	333									332	
A75D-04	D.O. (mg/L)	6.97	4.26	3.94	3.50	3.56	3.93	3.28	3.35	3.04	4.73	3.14
A75D-04	Temp (C)	20.24	22.2	22.3	22.5	22.3	22.3	22.7	21.8	22.4	22.65	22.6
A75D-04	Hardness	99										94
A75D-04	Alkalinity	61.9										70.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A75D-05	pH	7.23									7.21	
A75D-05	Conductivity (us/cm)	319									329	
A75D-05	D.O. (mg/L)	6.22	4.36	3.97	3.55	3.27	3.65	3.56	3.40	2.92	4.96	3.02
A75D-05	Temp (C)	21.14	22.2	22.2	22.7	22.5	22.3	22.6	21.8	22.4	22.64	22.6
A75D-05	Hardness	99										94
A75D-05	Alkalinity	61.9										70.2
A75B-06	pH	7.23									7.15	
A75D-06	Conductivity (us/cm)	321									342	
A75D-06	D.O. (mg/L)	5.74	4.56	4.05	3.82	3.22	3.82	3.66	3.43	3.06	4.72	3.39
A75D-06	Temp (C)	21.18	22.2	22.3	22.7	22.4	22.3	22.6	21.6	22.4	22.65	22.6
A75D-06	Hardness	99										94
A75D-06	Alkalinity	61.9										70.2
A75D-07	pH	7.21									7.14	
A75D-07	Conductivity (us/cm)	331									329	
A75D-07	D.O. (mg/L)	5.88	4.51	3.95	3.71	3.46	3.31	3.72	3.28	3.06	4.70	3.64
A75D-07	Temp (C)	21.34	22.1	22.3	22.7	22.6	22.4	22.6	21.9	22.4	22.71	22.6
A75D-07	Hardness	99										94
A75D-07	Alkalinity	61.9										70.2
A75D-08	pH	7.22									7.15	
A75D-08	Conductivity (us/cm)	322									329	
A75D-08	D.O. (mg/L)	5.74	4.41	3.94	3.64	3.70	3.91	3.92	3.29	3.13	4.77	3.44
A75D-08	Temp (C)	21.38	22.2	22.4	22.6	22.6	22.4	22.6	21.9	22.4	22.74	22.6
A75D-08	Hardness	99										94
A75D-08	Alkalinity	61.9										70.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14	No. of Replicates	8
End Date	11/20/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	80
Analysts	SA, LC, CL		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A75CC-01	pH	6.99									6.97	
A75CC-01	Conductivity (us/cm)	444									358	
A75CC-01	D.O. (mg/L)	5.57	3.41	3.16	2.81	2.84	2.88	2.75	2.32	2.40	4.04	2.64
A75CC-01	Temp (C)	21.55	22.4	22.4	22.5	22.6	22.5	22.5	21.7	22.4	22.69	22.6
A75CC-01	Hardness	163										114
A75CC-01	Alkalinity	146										109
A75CC-02	pH	7.04									7.01	
A75CC-02	Conductivity (us/cm)	431									351	
A75CC-02	D.O. (mg/L)	5.14	2.91	2.75	2.78	2.93	2.73	2.83	2.77	2.47	3.09	2.24
A75CC-02	Temp (C)	20.92	22.4	22.5	22.6	22.4	22.5	22.6	21.8	22.4	22.68	22.7
A75CC-02	Hardness	163										114
A75CC-02	Alkalinity	146										109
A75CC-03	pH	7.09									7.04	
A75CC-03	Conductivity (us/cm)	426									359	
A75CC-03	D.O. (mg/L)	4.68	3.43	2.52	3.03	3.18	2.31	3.07	2.56	2.23	3.03	2.69
A75CC-03	Temp (C)	21.49	22.4	22.2	22.5	22.5	22.5	22.6	21.8	22.4	22.67	22.6
A75CC-03	Hardness	163										114
A75CC-03	Alkalinity	146										109
A75CC-04	pH	7.12									7.05	
A75CC-04	Conductivity (us/cm)	419									366	
A75CC-04	D.O. (mg/L)	4.37	3.67	3.34	2.91	3.03	3.14	2.74	2.44	2.49	3.16	2.84
A75CC-04	Temp (C)	21.45	22.3	22.3	22.2	22.3	22.5	22.6	21.8	22.4	22.63	22.6
A75CC-04	Hardness	163										114
A75CC-04	Alkalinity	146										109

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A75CC-05	pH	7.15									7.10	
A75CC-05	Conductivity (us/cm)	431									360	
A75CC-05	D.O. (mg/L)	4.33	3.60	3.22	3.10	2.91	3.07	2.93	2.61	2.37	3.46	2.57
A75CC-05	Temp (C)	21.43	22.3	22.3	22.5	22.5	22.4	22.5	21.8	22.3	22.61	22.6
A75CC-05	Hardness	163										114
A75CC-05	Alkalinity	146										109
A75CC-06	pH	7.21									7.08	
A75CC-06	Conductivity (us/cm)	422									364	
A75CC-06	D.O. (mg/L)	3.80	3.81	3.36	3.01	2.93	2.93	2.81	2.55	2.31	3.51	2.56
A75CC-06	Temp (C)	21.27	22.3	22.3	22.3	22.1	22.2	22.4	21.7	22.3	22.60	22.4
A75CC-06	Hardness	163										114
A75CC-06	Alkalinity	146										109
A75CC-07	pH	7.23									7.11	
A75CC-07	Conductivity (us/cm)	400									353	
A75CC-07	D.O. (mg/L)	4.15	4.04	3.67	3.23	3.2	2.88	2.98	2.51	2.34	3.46	2.66
A75CC-07	Temp (C)	21.46	22.1	22.3	22.6	22.5	22.3	22.6	22.0	22.4	22.77	22.5
A75CC-07	Hardness	163										114
A75CC-07	Alkalinity	146										109
A75CC-08	pH	7.25									7.10	
A75CC-08	Conductivity (us/cm)	385									353	
A75CC-08	D.O. (mg/L)	4.44	3.85	3.58	3.19	3.21	3.31	3.15	2.59	2.41	3.55	2.84
A75CC-08	Temp (C)	21.44	22.1	22.3	22.5	22.4	22.3	22.6	22.0	22.4	22.70	22.6
A75CC-08	Hardness	163										114
A75CC-08	Alkalinity	146										109

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
A75EC-01	pH	7.31									7.09	
A75EC-01	Conductivity (us/cm)	316									312	
A75EC-01	D.O. (mg/L)	6.03	4.26	3.76	3.62	3.43	3.59	3.84	3.31	3.03	4.89	3.08
A75EC-01	Temp (C)	21.17	22.1	22.4	22.5	22.5	22.5	22.6	21.9	22.3	22.80	22.6
A75EC-01	Hardness	93										91
A75EC-01	Alkalinity	83.3										73.5
A75EC-02	pH	7.26									7.12	
A75EC-02	Conductivity (us/cm)	322									326	
A75EC-02	D.O. (mg/L)	5.93	4.33	3.98	3.46	3.45	3.60	3.73	3.10	2.99	4.73	3.49
A75EC-02	Temp (C)	21.41	22.1	22.4	22.4	22.4	22.4	22.7	22.0	22.4	22.77	22.7
A75EC-02	Hardness	93										91
A75EC-02	Alkalinity	83.3										73.5
A75EC-03	pH	7.25									7.16	
A75EC-03	Conductivity (us/cm)	319									325	
A75EC-03	D.O. (mg/L)	5.85	4.30	4.02	3.81	3.50	3.82	3.46	3.13	3.04	4.62	3.20
A75EC-03	Temp (C)	21.15	22.0	22.3	22.3	22.5	22.4	22.4	21.9	22.4	22.68	22.6
A75EC-03	Hardness	93										91
A75EC-03	Alkalinity	83.3										73.5
A75EC-04	pH	7.25									7.14	
A75EC-04	Conductivity (us/cm)	317									325	
A75EC-04	D.O. (mg/L)	5.53	4.28	3.91	3.74	3.73	3.76	3.41	3.37	3.08	4.57	3.02
A75EC-04	Temp (C)	21.4	22.2	22.4	22.5	22.3	22.4	22.5	21.9	22.4	22.69	22.6
A75EC-04	Hardness	93										91
A75EC-04	Alkalinity	83.3										73.5

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
A75EC-05	pH	7.24									7.16	
A75EC-05	Conductivity (us/cm)	317									316	
A75EC-05	D.O. (mg/L)	5.09	4.44	3.77	3.55	3.55	3.81	3.87	3.14	3.02	4.64	3.10
A75EC-05	Temp (C)	21.46	22.2	22.4	22.4	22.3	22.3	22.7	22.1	22.4	22.71	22.5
A75EC-05	Hardness	93										91
A75EC-05	Alkalinity	83.3										73.5
A75EC-06	pH	7.24									7.15	
A75EC-06	Conductivity (us/cm)	319									316	
A75EC-06	D.O. (mg/L)	5.32	4.16	3.85	4.02	3.34	3.78	3.75	3.43	3.20	4.62	3.27
A75EC-06	Temp (C)	21.47	22.2	22.3	22.5	22.4	22.5	22.7	22.0	22.4	22.76	22.6
A75EC-06	Hardness	93										91
A75EC-06	Alkalinity	83.3										73.5
A75EC-07	pH	7.22									7.16	
A75EC-07	Conductivity (us/cm)	325									320	
A75EC-07	D.O. (mg/L)	5.41	4.14	3.96	3.51	3.13	3.30	3.54	3.17	2.96	4.59	2.88
A75EC-07	Temp (C)	21.53	22.2	22.5	22.5	22.4	22.5	22.7	22.0	22.5	22.83	22.5
A75EC-07	Hardness	93										91
A75EC-07	Alkalinity	83.3										73.5
A75EC-08	pH	7.2									7.15	
A75EC-08	Conductivity (us/cm)	325									319	
A75EC-08	D.O. (mg/L)	5.46	4.15	4.03	3.79	3.25	3.57	3.64	3.19	3.14	4.30	3.15
A75EC-08	Temp (C)	21.31	22.3	22.5	22.3	22.3	22.4	22.7	22.0	22.5	22.84	22.6
A75EC-08	Hardness	93										91
A75EC-08	Alkalinity	83.3										73.5

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Bbridge-01	pH	7.04									7.22	
Bbridge-01	Conductivity (us/cm)	316									317	
Bbridge-01	D.O. (mg/L)	6.64	4.47	3.66	3.89	3.43	4.68	4.21	3.22	3.43	5.00	3.14
Bbridge-01	Temp (C)	20.84	22.1	22.7	22.5	22.6	22.2	22.8	23.1	22.5	22.76	22.5
Bbridge-01	Hardness	117										94
Bbridge-01	Alkalinity	92.6										72.2
Bbridge-02	pH	6.98									7.20	
Bbridge-02	Conductivity (us/cm)	335									317	
Bbridge-02	D.O. (mg/L)	6.21	4.83	3.81	3.60	3.71	4.47	3.95	3.25	3.52	4.74	3.75
Bbridge-02	Temp (C)	21.17	22.1	22.8	22.5	22.6	22.4	22.8	23.1	22.5	22.32	22.3
Bbridge-02	Hardness	117										94
Bbridge-02	Alkalinity	92.6										72.2
Bbridge-03	pH	6.96									7.17	
Bbridge-03	Conductivity (us/cm)	353									329	
Bbridge-03	D.O. (mg/L)	5.96	4.65	4.76	3.28	3.08	3.81	4.13	3.05	3.47	4.54	3.01
Bbridge-03	Temp (C)	21.19	21.9	22.6	22.3	22.4	22.2	22.9	23.0	22.5	22.80	22.6
Bbridge-03	Hardness	117										94
Bbridge-03	Alkalinity	92.6										72.2
Bbridge-04	pH	6.97									7.16	
Bbridge-04	Conductivity (us/cm)	359									328	
Bbridge-04	D.O. (mg/L)	5.85	4.56	4.73	3.56	3.63	4.26	3.96	3.42	3.36	4.48	3.14
Bbridge-04	Temp (C)	21.17	21.8	22.4	22.2	22.3	22.1	22.9	23.0	22.5	22.75	22.6
Bbridge-04	Hardness	117										94
Bbridge-04	Alkalinity	92.6										72.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14	No. of Replicates	8
End Date	11/20/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	80
Analysts	SA, LC, CL		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Bbridge-05	pH	7.00									7.16	
Bbridge-05	Conductivity (us/cm)	369									315	
Bbridge-05	D.O. (mg/L)	5.73	4.54	4.57	3.95	3.68	3.67	3.53	3.23	3.51	4.42	2.98
Bbridge-05	Temp (C)	21.22	21.7	22.5	22.2	22.5	22.2	22.8	22.9	22.5	22.74	22.6
Bbridge-05	Hardness	117										94
Bbridge-05	Alkalinity	92.6										72.2
Bbridge-06	pH	7.01									7.15	
Bbridge-06	Conductivity (us/cm)	365									314	
Bbridge-06	D.O. (mg/L)	5.68	4.41	3.72	3.55	3.59	4.09	3.83	3.30	3.43	4.31	3.16
Bbridge-06	Temp (C)	21.24	21.8	22.5	22.3	22.4	22.3	22.8	22.9	22.4	22.76	22.6
Bbridge-06	Hardness	117										94
Bbridge-06	Alkalinity	92.6										72.2
Bbrigde-07	pH	7.04									7.14	
Bbrigde-07	Conductivity (us/cm)	368									320	
Bbrigde-07	D.O. (mg/L)	5.72	4.32	4.46	3.76	3.48	3.97	4.05	3.29	3.53	4.14	3.10
Bbrigde-07	Temp (C)	21.32	22.0	22.5	22.3	22.4	22.4	22.8	22.9	22.5	22.81	22.6
Bbrigde-07	Hardness	117										94
Bbrigde-07	Alkalinity	92.6										72.2
Bbridge-08	pH	7.05									7.14	
Bbridge-08	Conductivity (us/cm)	369									328	
Bbridge-08	D.O. (mg/L)	5.73	4.62	4.29	3.90	3.73	3.79	4.02	3.25	3.35	4.36	3.40
Bbridge-08	Temp (C)	21.32	22.0	22.6	22.3	22.4	22.4	22.8	22.9	22.5	22.81	22.7
Bbridge-08	Hardness	117										94
Bbridge-08	Alkalinity	92.6										72.2

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
JamesRanch-01	pH	7.08									7.13	
JamesRanch-01	Conductivity (us/cm)	354									329	
JamesRanch-01	D.O. (mg/L)	5.71	4.47	3.74	3.41	3.40	3.96	3.65	3.36	3.27	5.09	3.46
JamesRanch-01	Temp (C)	21.47	22.0	22.7	22.6	22.7	22.4	22.8	23.1	22.4	22.87	22.4
JamesRanch-01	Hardness	128										103
JamesRanch-01	Alkalinity	100										78.6
JamesRanch-02	pH	7.10									7.12	
JamesRanch-02	Conductivity (us/cm)	377									347	
JamesRanch-02	D.O. (mg/L)	5.69	4.31	3.62	3.27	3.55	4.01	3.71	3.63	2.71	4.68	3.44
JamesRanch-02	Temp (C)	21.35	22.0	22.6	22.6	22.6	22.4	22.8	23.1	22.5	22.85	22.6
JamesRanch-02	Hardness	128										103
JamesRanch-02	Alkalinity	100										78.6
JamesRanch-03	pH	7.14									7.11	
JamesRanch-03	Conductivity (us/cm)	378									348	
JamesRanch-03	D.O. (mg/L)	6.50	4.36	3.84	3.44	3.43	3.79	4.03	3.77	3.58	4.52	3.30
JamesRanch-03	Temp (C)	21.24	21.9	22.5	22.5	22.6	22.4	22.9	23.1	22.5	22.78	22.7
JamesRanch-03	Hardness	128										103
JamesRanch-03	Alkalinity	100										78.6
James Ranch-04	pH	7.14									7.13	
James Ranch-04	Conductivity (us/cm)	377									346	
James Ranch-04	D.O. (mg/L)	5.98	4.39	3.61	3.69	3.53	3.86	4.10	3.46	3.45	4.53	3.27
James Ranch-04	Temp (C)	21.31	21.9	22.5	22.4	22.6	22.5	22.9	23.0	22.5	22.80	22.7
James Ranch-04	Hardness	128										103
James Ranch-04	Alkalinity	100										78.6

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
James Ranch-05	pH	7.14									7.14	
James Ranch-05	Conductivity (us/cm)	377									344	
James Ranch-05	D.O. (mg/L)	5.09	4.48	3.85	3.17	3.50	4.10	3.86	3.46	3.43	4.47	3.23
James Ranch-05	Temp (C)	21.25	22.0	22.5	22.3	22.5	22.3	22.9	23.0	22.4	22.71	22.7
James Ranch-05	Hardness	128										103
James Ranch-05	Alkalinity	100										78.6

James Ranch-06	pH	7.16									7.13	
James Ranch-06	Conductivity (us/cm)	377									348	
James Ranch-06	D.O. (mg/L)	5.22	4.35	3.91	3.71	4.04	4.15	4.14	3.44	3.24	4.44	3.36
James Ranch-06	Temp (C)	21.27	21.8	22.5	22.3	22.5	22.3	22.8	22.9	22.4	22.73	22.6
James Ranch-06	Hardness	128										103
James Ranch-06	Alkalinity	100										78.6

JamesRanch-07	pH	7.15									7.16	
JamesRanch-07	Conductivity (us/cm)	388									326	
JamesRanch-07	D.O. (mg/L)	5.13	4.42	3.84	3.36	4.01	4.12	4.20	3.17	3.35	4.42	3.17
JamesRanch-07	Temp (C)	21.23	22.0	22.4	22.3	22.5	22.4	22.8	22.8	22.4	22.78	22.6
JamesRanch-07	Hardness	128										103
JamesRanch-07	Alkalinity	100										78.6

JamesRanch-08	pH	7.15									7.12	
JamesRanch-08	Conductivity (us/cm)	391									338	
JamesRanch-08	D.O. (mg/L)	4.48	4.31	3.73	3.47	3.28	3.78	3.98	3.56	3.32	4.27	3.12
JamesRanch-08	Temp (C)	21.22	22.0	22.5	22.3	22.4	22.3	22.8	22.9	22.4	22.72	22.7
JamesRanch-08	Hardness	128										103
JamesRanch-08	Alkalinity	100										78.6

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
32nd Bridge-01	pH	6.54									5.82	
32nd Bridge-01	Conductivity (us/cm)	365									341	
32nd Bridge-01	D.O. (mg/L)	4.86	4.86	4.70	4.02	4.03	4.25	4.25	3.79	3.58	5.01	3.64
32nd Bridge-01	Temp (C)	20.96	21.84	22.1	22.0	22.1	22.4	22.5	22.5	22.2	22.53	22.7
32nd Bridge-01	Hardness	123										103
32nd Bridge-01	Alkalinity	109										81.8
32nd Bridge-02	pH	6.56									5.93	
32nd Bridge-02	Conductivity (us/cm)	353									342	
32nd Bridge-02	D.O. (mg/L)	3.87	5.05	4.98	4.16	4.01	4.22	3.64	3.76	3.8	5.13	3.17
32nd Bridge-02	Temp (C)	21.04	22.0	22.2	22.0	22.2	22.4	22.6	22.6	22.3	22.14	22.4
32nd Bridge-02	Hardness	123										103
32nd Bridge-02	Alkalinity	109										81.8
32nd Bridge-03	pH	6.63									5.97	
32nd Bridge-03	Conductivity (us/cm)	353									348	
32nd Bridge-03	D.O. (mg/L)	4.28	4.97	5.10	3.65	3.89	4.04	3.67	3.69	3.38	5.28	3.52
32nd Bridge-03	Temp (C)	21.05	21.8	22.3	21.8	22.1	22.4	22.6	22.7	22.4	22.57	22.4
32nd Bridge-03	Hardness	123										103
32nd Bridge-03	Alkalinity	109										81.8
32nd Bridge-04	pH	6.71									6.10	
32nd Bridge-04	Conductivity (us/cm)	366									346	
32nd Bridge-04	D.O. (mg/L)	4.91	4.86	5.01	3.53	4.02	4.16	3.41	3.72	3.74	4.88	3.59
32nd Bridge-04	Temp (C)	21.13	21.8	22.2	22.0	22.2	22.2	22.5	22.5	22.3	22.68	22.5
32nd Bridge-04	Hardness	123										103
32nd Bridge-04	Alkalinity	109										81.8

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
32nd Bridge-05	pH	6.76									6.25	
32nd Bridge-05	Conductivity (us/cm)	370									344	
32nd Bridge-05	D.O. (mg/L)	4.44	4.92	5.02	3.41	3.95	4.15	3.82	3.74	3.63	5.24	3.60
32nd Bridge-05	Temp (C)	21.18	22.0	22.2	22.0	22.1	22.4	22.6	22.6	22.3	22.63	22.6
32nd Bridge-05	Hardness	123										103
32nd Bridge-05	Alkalinity	109										81.8

32nd Bridge-06	pH	6.76									6.32	
32nd Bridge-06	Conductivity (us/cm)	367									346	
32nd Bridge-06	D.O. (mg/L)	3.43	4.68	4.85	3.42	3.75	4.24	3.74	3.60	3.56	4.63	3.37
32nd Bridge-06	Temp (C)	21.22	21.8	22.3	22.2	22.3	22.3	22.6	22.6	22.4	22.71	22.6
32nd Bridge-06	Hardness	123										103
32nd Bridge-06	Alkalinity	109										81.8

32nd Bridge-07	pH	6.77									6.39	
32nd Bridge-07	Conductivity (us/cm)	366									342	
32nd Bridge-07	D.O. (mg/L)	3.19	4.78	4.98	3.46	4.03	4.14	3.94	3.54	3.49	4.57	3.56
32nd Bridge-07	Temp (C)	21.14	21.8	22.3	22.2	22.3	22.3	22.6	22.8	22.4	22.73	22.6
32nd Bridge-07	Hardness	123										103
32nd Bridge-07	Alkalinity	109										81.8

32nd Bridge-08	pH	6.8									6.38	
32nd Bridge-08	Conductivity (us/cm)	369									349	
32nd Bridge-08	D.O. (mg/L)	3.06	4.49	5.05	3.39	3.77	3.88	4.10	3.35	3.54	4.54	3.47
32nd Bridge-08	Temp (C)	21.16	21.8	22.4	22.3	22.3	22.3	22.6	22.8	22.4	22.73	22.7
32nd Bridge-08	Hardness	123										103
32nd Bridge-08	Alkalinity	109										81.8

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Lightner Creek-01	pH	6.84									6.47	
Lightner Creek-01	Conductivity (us/cm)	409									374	
Lightner Creek-01	D.O. (mg/L)	3.81	4.79	4.82	3.63	4.32	4.21	4.01	3.76	3.41	4.74	2.73
Lightner Creek-01	Temp (C)	21.19	22.0	22.6	22.5	22.5	22.0	22.6	22.8	22.4	22.86	22.7
Lightner Creek-01	Hardness	139										119
Lightner Creek-01	Alkalinity	140										103
Lightner Creek-02	pH	6.86									6.13	
Lightner Creek-02	Conductivity (us/cm)	399									364	
Lightner Creek-02	D.O. (mg/L)	4.59	4.94	5.08	3.76	4.03	4.18	4.24	3.71	3.55	4.64	3.35
Lightner Creek-02	Temp (C)	21.37	22.0	22.8	22.7	22.6	22.1	22.8	22.9	22.5	22.92	22.7
Lightner Creek-02	Hardness	139										119
Lightner Creek-02	Alkalinity	140										103
Lightner Creek-03	pH	6.87									6.69	
Lightner Creek-03	Conductivity (us/cm)	397									376	
Lightner Creek-03	D.O. (mg/L)	4.98	4.85	4.99	3.64	4.16	3.96	3.75	3.35	3.46	4.60	3.56
Lightner Creek-03	Temp (C)	21.34	22.0	22.7	22.2	22.3	22.2	22.9	23.1	22.5	22.89	22.8
Lightner Creek-03	Hardness	139										119
Lightner Creek-03	Alkalinity	140										103
Lightner Creek-04	pH	7.01									6.76	
Lightner Creek-04	Conductivity (us/cm)	214									351	
Lightner Creek-04	D.O. (mg/L)	4.67	4.76	5.38	3.59	3.70	4.11	4.24	3.62	3.51	4.42	3.42
Lightner Creek-04	Temp (C)	21.32	21.8	22.6	22.3	22.5	22.2	22.4	23.0	22.5	22.84	22.8
Lightner Creek-04	Hardness	139										119
Lightner Creek-04	Alkalinity	140										103

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Lightner Creek-05	pH	6.88									6.8	
Lightner Creek-05	Conductivity (us/cm)	369									374	
Lightner Creek-05	D.O. (mg/L)	5.29	4.89	5.04	3.72	3.85	4.09	4.00	4.05	3.47	4.61	3.62
Lightner Creek-05	Temp (C)	21.22	21.8	22.4	22.1	22.3	22	22.8	22.9	22.5	22.75	22.8
Lightner Creek-05	Hardness	139										119
Lightner Creek-05	Alkalinity	140										103
Lightner Creek-06	pH	6.90									6.87	
Lightner Creek-06	Conductivity (us/cm)	402									376	
Lightner Creek-06	D.O. (mg/L)	5.36	4.79	4.64	3.53	3.88	3.85	4.26	3.57	3.72	4.65	3.66
Lightner Creek-06	Temp (C)	21.27	21.9	22.5	22.2	22.4	22.0	22.8	22.8	22.4	22.79	22.7
Lightner Creek-06	Hardness	139										119
Lightner Creek-06	Alkalinity	140										103
Lightner Creek-07	pH	6.92									6.89	
Lightner Creek-07	Conductivity (us/cm)	405									373	
Lightner Creek-07	D.O. (mg/L)	5.02	4.88	4.87	3.62	3.90	3.81	4.21	3.73	3.60	4.62	3.48
Lightner Creek-07	Temp (C)	21.25	21.7	22.3	22.2	22.3	22.1	22.7	22.8	22.4	22.67	22.7
Lightner Creek-07	Hardness	139										119
Lightner Creek-07	Alkalinity	140										103
Lightner Creek-08	pH	6.95									6.95	
Lightner Creek-08	Conductivity (us/cm)	404									366	
Lightner Creek-08	D.O. (mg/L)	5.32	4.40	4.86	3.46	4.02	4.17	4.00	3.67	3.44	4.61	3.69
Lightner Creek-08	Temp (C)	21.27	21.8	22.5	22.3	22.4	21.9	22.6	22.8	22.4	22.77	22.6
Lightner Creek-08	Hardness	139										119
Lightner Creek-08	Alkalinity	140										103

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Purple Cliffs-01	pH	7.01									6.98	
Purple Cliffs-01	Conductivity (us/cm)	372									348	
Purple Cliffs-01	D.O. (mg/L)	6.46	4.70	4.09	3.35	3.91	4.11	4.43	3.66	3.63	4.94	3.06
Purple Cliffs-01	Temp (C)	21.20	22.1	22.8	22.6	22.7	22.1	22.7	23.1	22.5	22.66	22.7
Purple Cliffs-01	Hardness	111										111
Purple Cliffs-01	Alkalinity	89.8										90.8
Purple Cliffs-02	pH	6.99									7.04	
Purple Cliffs-02	Conductivity (us/cm)	369									354	
Purple Cliffs-02	D.O. (mg/L)	6.26	4.58	4.26	3.45	3.88	3.91	4.10	3.83	3.72	4.73	3.32
Purple Cliffs-02	Temp (C)	21.35	22.1	22.8	22.6	22.7	22.1	22.8	23.1	22.5	22.88	22.8
Purple Cliffs-02	Hardness	111										111
Purple Cliffs-02	Alkalinity	89.8										90.8
Purple Cliffs-03	pH	7.03									7.08	
Purple Cliffs-03	Conductivity (us/cm)	351									341	
Purple Cliffs-03	D.O. (mg/L)	6.16	4.69	4.16	4.09	3.74	4.18	4.04	3.72	3.56	4.75	2.49
Purple Cliffs-03	Temp (C)	21.32	22.0	22.6	22.4	22.6	22.1	22.4	23.1	22.5	22.83	22.7
Purple Cliffs-03	Hardness	111										111
Purple Cliffs-03	Alkalinity	89.8										90.8
Purple Cliffs-04	pH	7.12									7.11	
Purple Cliffs-04	Conductivity (us/cm)	211									343	
Purple Cliffs-04	D.O. (mg/L)	6.08	4.46	4.35	3.66	3.92	4.13	4.18	3.91	3.52	4.77	3.63
Purple Cliffs-04	Temp (C)	21.35	22.1	22.6	22.3	22.5	22.1	22.9	23.1	22.5	22.84	22.7
Purple Cliffs-04	Hardness	111										111
Purple Cliffs-04	Alkalinity	89.8										90.8

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014

Sediment Toxicity Test

10-Day Static Renewal Data Sheets

Start Date	11/10/14
End Date	11/20/14
Water Type	MHRW
Analysts	SA, LC, CL

No. of Replicates	8
Organism	*H. azteca*
No. of Organisms	80

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
Purple Cliffs-05	pH	7.06									7.13	
Purple Cliffs-05	Conductivity (us/cm)	295									348	
Purple Cliffs-05	D.O. (mg/L)	6.19	4.62	4.49	3.54	3.87	3.93	4.11	3.68	3.49	4.84	3.38
Purple Cliffs-05	Temp (C)	21.26	21.9	22.5	22.3	22.4	21.9	22.9	23	22.5	22.76	22.6
Purple Cliffs-05	Hardness	111										111
Purple Cliffs-05	Alkalinity	89.8										90.8
Purple Cliffs-06	pH	7.05									7.13	
Purple Cliffs-06	Conductivity (us/cm)	321									351	
Purple Cliffs-06	D.O. (mg/L)	6.19	4.49	4.03	3.59	4.05	4.02	4.26	3.50	3.61	4.80	3.44
Purple Cliffs-06	Temp (C)	21.29	22.0	22.5	22.3	22.4	22.0	22.8	23.0	22.4	22.82	22.6
Purple Cliffs-06	Hardness	111										111
Purple Cliffs-06	Alkalinity	89.8										90.8
Purple Cliffs-07	pH	7.07									7.16	
Purple Cliffs-07	Conductivity (us/cm)	325									343	
Purple Cliffs-07	D.O. (mg/L)	6.16	4.75	3.95	3.53	4.14	4.12	4.30	3.59	3.67	4.72	3.42
Purple Cliffs-07	Temp (C)	21.26	21.9	22.5	22.2	22.4	22.0	22.7	23.0	22.5	22.82	22.6
Purple Cliffs-07	Hardness	111										111
Purple Cliffs-07	Alkalinity	89.8										90.8
Purple Cliffs-08	pH	7.06									7.16	
Purple Cliffs-08	Conductivity (us/cm)	286									335	
Purple Cliffs-08	D.O. (mg/L)	6.12	4.6	4.39	3.44	3.74	4.03	4.25	3.67	3.57	4.67	3.67
Purple Cliffs-08	Temp (C)	21.28	21.9	22.6	22.3	22.5	22.1	22.7	23.0	22.5	22.81	22.7
Purple Cliffs-08	Hardness	111										111
Purple Cliffs-08	Alkalinity	89.8										90.8

Note: All final parameter data is collected on Day 9, but reported on Day 10 per the test method.

Upper Animas 11/2014
Sediment Reference Toxicity Test
4-Day Static Renewal Data Sheets

Start Date	11/17/14	No. of Replicates	4
End Date	11/21/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	40
Analysts	SA, CL, LC		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
Control-01	No. Alive	10	10	10	10	10	
Control-01	pH	6.78				6.76	
Control-01	Conductivity (us/cm)	321				343	Diff
Control-01	D.O. (mg/L)	5.68	4.19	4.13	3.48	4.74	min
Control-01	Temp (C)	22.53	22.4	22.5	21.9	21.88	min
Control-01	Hardness	81				92	Diff
Control-01	Alkalinity	61.4				73.2	Diff
Control-02	No. Alive	10	10	10	10	10	
Control-02	pH	6.75				6.71	
Control-02	Conductivity (us/cm)	328				346	Diff
Control-02	D.O. (mg/L)	5.86	4.33	4.17	4.03	5.23	min
Control-02	Temp (C)	22.62	22.5	22.6	22.2	22.28	min
Control-02	Hardness	81				92	Diff
Control-02	Alkalinity	61.4				73.2	Diff
Control-03	No. Alive	10	10	10	10	10	
Control-03	pH	6.84				6.68	
Control-03	Conductivity (us/cm)	343				347	Diff
Control-03	D.O. (mg/L)	5.63	4.26	4.03	3.29	5.48	min
Control-03	Temp (C)	22.61	22.4	22.7	22.4	22.24	min
Control-03	Hardness	81				92	Diff
Control-03	Alkalinity	61.4				73.2	Diff
Control-04	No. Alive	10	10	10	10	10	
Control-04	pH	6.92				6.76	
Control-04	Conductivity (us/cm)	349				347	Diff
Control-04	D.O. (mg/L)	5.08	4.12	3.95	3.81	5.58	min
Control-04	Temp (C)	22.36	22.4	22.7	22.6	22.2	min
Control-04	Hardness	81				92	Diff
Control-04	Alkalinity	61.4				73.2	Diff

Upper Animas 11/2014
Sediment Reference Toxicity Test
4-Day Static Renewal Data Sheets

Start Date	11/17/14		No. of Replicates	4
End Date	11/21/14		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	40
Analysts	SA, CL, LC			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
6.25%%-01	No. Alive	10	10	9	9	9	
6.25%%-01	pH	6.96				6.87	
6.25%%-01	Conductivity (us/cm)	341				342	Diff
6.25%%-01	D.O. (mg/L)	5.65	4.11	3.57	3.79	5.38	min
6.25%%-01	Temp (C)	22.57	22.4	22.7	22.7	22.21	min
6.25%%-01	Hardness	80				93	Diff
6.25%%-01	Alkalinity	60.6				75.6	Diff
6.25%%-02	No. Alive	10	10	10	10	10	
6.25%%-02	pH	7.05				6.89	
6.25%%-02	Conductivity (us/cm)	328				341	Diff
6.25%%-02	D.O. (mg/L)	5.47	4.33	3.83	3.6	5.45	min
6.25%%-02	Temp (C)	22.43	22.4	22.7	22.7	22.14	min
6.25%%-02	Hardness	80				93	Diff
6.25%%-02	Alkalinity	60.6				75.6	Diff
6.25%%-03	No. Alive	10	10	10	10	10	
6.25%%-03	pH	7.07				6.95	
6.25%%-03	Conductivity (us/cm)	315				347	Diff
6.25%%-03	D.O. (mg/L)	5.84	4.00	3.31	3.71	5.52	min
6.25%%-03	Temp (C)	22.42	22.5	22.8	22.8	22.23	min
6.25%%-03	Hardness	80				93	Diff
6.25%%-03	Alkalinity	60.6				75.6	Diff
6.25%%-04	No. Alive	10	10	10	10	10	
6.25%%-04	pH	7.1				7.01	
6.25%%-04	Conductivity (us/cm)	336				346	Diff
6.25%%-04	D.O. (mg/L)	5.76	4.07	3.81	3.67	5.57	min
6.25%%-04	Temp (C)	22.59	22.4	22.8	22.8	22.26	min
6.25%%-04	Hardness	80				93	Diff
6.25%%-04	Alkalinity	60.6				75.6	Diff

Upper Animas 11/2014
Sediment Reference Toxicity Test
4-Day Static Renewal Data Sheets

Start Date	11/17/14	No. of Replicates	4
End Date	11/21/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	40
Analysts	SA, CL, LC		

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
12.5%-01	No. Alive	10	10	10	10	10	
12.5%-01	pH	7.16				7.05	
12.5%-01	Conductivity (us/cm)	325				342	Diff
12.5%-01	D.O. (mg/L)	5.89	4.23	3.22	3.48	5.59	min
12.5%-01	Temp (C)	22.54	22.4	22.8	22.7	22.3	min
12.5%-01	Hardness	80				91	Diff
12.5%-01	Alkalinity	60.7				74.4	Diff
12.5%-02	No. Alive	10	10	10	10	10	
12.5%-02	pH	7.15				7.08	
12.5%-02	Conductivity (us/cm)	318				346	Diff
12.5%-02	D.O. (mg/L)	5.78	4.13	3.36	3.57	5.48	min
12.5%-02	Temp (C)	22.57	22.4	22.8	22.8	22.2	min
12.5%-02	Hardness	80				91	Diff
12.5%-02	Alkalinity	60.7				74.4	Diff
12.5%-03	No. Alive	10	10	10	10	10	
12.5%-03	pH	7.19				7.10	
12.5%-03	Conductivity (us/cm)	326				347	Diff
12.5%-03	D.O. (mg/L)	5.55	4.02	3.29	3.55	5.43	min
12.5%-03	Temp (C)	22.45	22.4	22.8	22.8	22.17	min
12.5%-03	Hardness	80				91	Diff
12.5%-03	Alkalinity	60.7				74.4	Diff
12.5%-04	No. Alive	10	10	10	10	10	
12.5%-04	pH	7.18				7.12	
12.5%-04	Conductivity (us/cm)	321				338	Diff
12.5%-04	D.O. (mg/L)	5.66	4.11	3.44	3.66	5.52	min
12.5%-04	Temp (C)	22.52	22.4	22.8	22.8	22.25	min
12.5%-04	Hardness	80				91	Diff
12.5%-04	Alkalinity	60.7				74.4	Diff

Upper Animas 11/2014
Sediment Reference Toxicity Test
4-Day Static Renewal Data Sheets

Start Date	11/17/14		No. of Replicates	4
End Date	11/21/14		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	40
Analysts	SA, CL, LC			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
25%-01	No. Alive	10	7	2	1	1	
25%-01	pH	7.24				7.12	Diff
25%-01	Conductivity (us/cm)	319				344	Diff
25%-01	D.O. (mg/L)	6.01	4.01	3.52	3.77	5.62	min
25%-01	Temp (C)	22.39	22.4	22.7	22.8	22.18	min
25%-01	Hardness	80				93	Diff
25%-01	Alkalinity	61.5				75.2	Diff
25%-02	No. Alive	10	9	3	0		
25%-02	pH	7.26					
25%-02	Conductivity (us/cm)	315					Diff
25%-02	D.O. (mg/L)	5.89	4.07	3.69	3.62		min
25%-02	Temp (C)	22.52	22.4	22.7	22.8		min
25%-02	Hardness	80			93		Diff
25%-02	Alkalinity	61.5			75.2		Diff
25%-03	No. Alive	10	7	2	2	2	
25%-03	pH	7.24				7.15	Diff
25%-03	Conductivity (us/cm)	329				338	Diff
25%-03	D.O. (mg/L)	5.67	4.13	3.63	3.68	5.62	min
25%-03	Temp (C)	22.51	22.4	22.7	22.8	22.2	min
25%-03	Hardness	80				93	Diff
25%-03	Alkalinity	61.5				75.2	Diff
25%-04	No. Alive	10	10	2	2	2	
25%-04	pH	7.25				7.12	Diff
25%-04	Conductivity (us/cm)	316				341	Diff
25%-04	D.O. (mg/L)	5.83	4.19	3.60	3.22	5.62	min
25%-04	Temp (C)	22.50	22.5	22.7	22.8	22.15	min
25%-04	Hardness	80				93	Diff
25%-04	Alkalinity	61.5				75.2	Diff

Upper Animas 11/2014
Sediment Reference Toxicity Test
4-Day Static Renewal Data Sheets

Start Date	11/17/14	No. of Replicates	4
End Date	11/21/14	Organism	*H. azteca*
Water Type	MHRW	No. of Organisms	40
Analysts	SA, CL, LC		

Site I.D.	**Parameter**	**Day 0**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	
50%-01	No. Alive	10	2	0			
50%-01	pH	7.23					
50%-01	Conductivity (us/cm)	331					Diff
50%-01	D.O. (mg/L)	6.00	3.94	3.40			min
50%-01	Temp (C)	22.51	22.5	22.8			min
50%-01	Hardness	79	89				Diff
50%-01	Alkalinity	60.6	68.4				Diff
50%-02	No. Alive	10	3	0			
50%-02	pH	7.25					
50%-02	Conductivity (us/cm)	330					Diff
50%-02	D.O. (mg/L)	5.96	3.96	3.61			min
50%-02	Temp (C)	22.54	22.4	22.7			min
50%-02	Hardness	79		89			Diff
50%-02	Alkalinity	60.6		68.4			Diff
50%-03	No. Alive	10	5	0			
50%-03	pH	7.25					
50%-03	Conductivity (us/cm)	320					Diff
50%-03	D.O. (mg/L)	5.72	4.04	3.54			min
50%-03	Temp (C)	22.56	22.4	22.7			min
50%-03	Hardness	79		89			Diff
50%-03	Alkalinity	60.6		68.4			Diff
50%-04	No. Alive	10	3	0			
50%-04	pH	7.26					
50%-04	Conductivity (us/cm)	334					Diff
50%-04	D.O. (mg/L)	5.77	3.82	3.58			min
50%-04	Temp (C)	22.59	22.4	22.6			min
50%-04	Hardness	79		89			Diff
50%-04	Alkalinity	60.6		68.4			Diff

Upper Animas 11/2014
Sediment Reference Toxicity Test
4-Day Static Renewal Data Sheets

Start Date	11/17/14		No. of Replicates	4
End Date	11/21/14		Organism	*H. azteca*
Water Type	MHRW		No. of Organisms	40
Analysts	SA, CL, LC			

Site I.D.	Parameter	Day 0	Day 1	Day 2	Day 3	Day 4	
100%-01	No. Alive	10	0				
100%-01	pH	7.26					
100%-01	Conductivity (us/cm)	315					Diff
100%-01	D.O. (mg/L)	5.53	4.40				min
100%-01	Temp (C)	22.56	22.7				min
100%-01	Hardness	80	88				Diff
100%-01	Alkalinity	61.4	64.6				Diff
100%-02	No. Alive	10	0				
100%-02	pH	7.25					
100%-02	Conductivity (us/cm)	322					Diff
100%-02	D.O. (mg/L)	5.79	4.21				min
100%-02	Temp (C)	22.57	22.7				min
100%-02	Hardness	80	88				Diff
100%-02	Alkalinity	61.4	64.6				Diff
100%-03	No. Alive	10	0				
100%-03	pH	7.25					
100%-03	Conductivity (us/cm)	330					Diff
100%-03	D.O. (mg/L)	5.61	4.37				min
100%-03	Temp (C)	22.64	22.7				min
100%-03	Hardness	80	88				Diff
100%-03	Alkalinity	61.4	64.6				Diff
100%-04	No. Alive	10	0				
100%-04	pH	7.24					
100%-04	Conductivity (us/cm)	338					Diff
100%-04	D.O. (mg/L)	5.74	4.23				min
100%-04	Temp (C)	22.55	22.7				min
100%-04	Hardness	80	88				Diff
100%-04	Alkalinity	61.4	64.6				Diff

DO

Finalized by: B. Belmonte (2/26/15) Temp(C)

Reviewed by: E. Czerepak (3/2/15)

CETIS Test Data Worksheet

Hyalella 10-d Survival and Growth Sediment Test — **U.S. EPA Region I Lab**

Start Date: 10 Nov-14 **Species:** Hyalella azteca **Sample Code:** Control-N
End Date: 20 Nov-14 **Protocol:** EPA/600/R-99/064 (2000) **Sample Source:** Upper Animas River
Sample Date: 10 Nov-14 **Material:** Lab Control **Sample Station:** Control-N

Batch Note: Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Sample Code	Rep	Pos	# Exposed	# Survived	Total Weight-mg	Tare Weight-mg	Pan Count	Mean Length-mm	Notes
Control-N	1	23	10	9	208.3426	207.6113	9		
Control-N	2	56	10	9	207.5908	206.7239	9		
Control-N	3	118	10	10	206.3814	205.511	10		
Control-N	4	81	10	10	205.8288	205.1355	10		
Control-N	5	77	10	10	207.6432	206.7692	10		
Control-N	6	94	10	8	206.7435	206.1714	8		
Control-N	7	67	10	10	205.8951	204.986	10		
Control-N	8	5	10	8	206.9577	206.2273	8		
A75CC	1	134	10	8	208.1568	207.68	8		
A75CC	2	4	10	10	209.0292	208.5678	10		
A75CC	3	25	10	6	208.1641	207.8158	6		
A75CC	4	73	10	6	208.4866	208.1729	6		
A75CC	5	68	10	8	210.2696	209.9231	8		
A75CC	6	49	10	8	207.3402	206.9601	8		
A75CC	7	40	10	4	207.489	207.2649	4		
A75CC	8	60	10	9	209.0098	208.6332	9		
Control P	1	15	10	10	205.9119	205.204	10		
Control P	2	50	10	9	206.2787	205.9981	9		
Control P	3	6	10	10	207.1274	206.5809	10		
Control P	4	98	10	9	209.3106	208.732	9		
Control P	5	26	10	10	207.0222	206.4167	10		
Control P	6	8	10	10	206.595	206.1334	10		
Control P	7	130	10	9	207.4819	206.9779	9		
Control P	8	120	10	6	209.5893	209.1865	6		
A55	1	110	10	7	208.074	207.8187	7		
A55	2	37	10	5	209.5656	209.3796	5		
A55	3	74	10	5	209.1354	209.0059	5		
A55	4	9	10	7	208.5327	208.339	7		
A55	5	11	10	9	204.9229	204.6451	9		
A55	6	47	10	5	206.5583	206.3862	5		
A55	7	72	10	6	208.3542	208.0285	6		
A55	8	52	10	4	207.2939	207.144	4		
A56	1	119	10	1	207.1091	207.086	1		
A56	2	79	10	5	208.4545	208.273	5		
A56	3	18	10	7	208.5519	208.3687	7		
A56	4	33	10	0	0	0	0		
A56	5	70	10	6	205.6186	205.3785	6		
A56	6	41	10	7	206.3438	206.1552	7		
A56	7	2	10	4	208.7151	208.613	4		
A56	8	38	10	5	207.4837	207.2572	5		
A60	1	34	10	8	207.0132	206.79	8		
A60	2	114	10	9	206.6519	206.414	9		
A60	3	61	10	10	209.1725	208.9172	10		
A60	4	16	10	7	206.9568	206.8064	7		
A60	5	30	10	9	205.8286	205.5427	9		
A60	6	136	10	8	206.9449	206.6308	8		

CETIS Test Data Worksheet

Sample Code	Rep	Pos	# Exposed	# Survived	Total Weight-mg	Tare Weight-mg	Pan Count	Mean Length-mm	Notes
A60	7	45	10	7	207.9976	207.7838	7		
A60	8	32	10	4	210.1034	209.9327	4		
A68	1	76	10	8	208.3643	208.0946	8		
A68	2	135	10	9	205.7435	205.4391	9		
A68	3	29	10	1	208.8016	208.7512	1		
A68	4	115	10	8	209.2317	208.9013	8		
A68	5	80	10	8	206.5217	206.2528	8		
A68	6	128	10	5	209.1242	208.9554	5		
A68	7	117	10	7	210.7435	210.5594	7		
A68	8	69	10	10	208.4949	208.2128	10		
A72	1	104	10	6	207.2154	206.9381	6		
A72	2	62	10	8	209.6556	209.3129	8		
A72	3	39	10	5	207.2287	207.0233	5		
A72	4	106	10	7	207.7972	207.5165	7		
A72	5	59	10	9	208.105	207.8167	9		
A72	6	131	10	8	209.2174	208.8171	8		
A72	7	126	10	7	209.4203	209.2316	7		
A72	8	103	10	6	207.6217	207.3712	6		
A73	1	51	10	7	207.2189	206.9986	7		
A73	2	78	10	4	208.6951	208.5852	4		
A73	3	92	10	9	206.7427	206.4618	9		
A73	4	66	10	10	207.0864	206.77	10		
A73	5	88	10	6	207.0509	206.8475	6		
A73	6	43	10	5	206.0139	205.8361	5		
A73	7	123	10	9	207.3785	207.168	9		
A73	8	133	10	9	209.7734	209.5475	9		
A75D	1	3	10	6	0	0	6		Pan compromised.
A75D	2	12	10	6	209.2417	208.9843	6		
A75D	3	99	10	10	205.2781	204.9843	10		
A75D	4	1	10	5	207.6873	207.5442	5		
A75D	5	13	10	10	205.6294	205.343	10		
A75D	6	75	10	6	208.1183	207.9584	6		
A75D	7	112	10	10	207.0328	206.6494	10		
A75D	8	24	10	8	207.1052	206.8881	8		
A75EC	1	122	10	8	207.0635	206.7089	8		
A75EC	2	44	10	7	209.6514	209.294	7		
A75EC	3	95	10	10	208.2016	207.6782	10		
A75EC	4	97	10	10	208.3832	207.9921	10		
A75EC	5	85	10	7	209.0792	208.7561	7		
A75EC	6	91	10	10	206.7653	206.3319	10		
A75EC	7	101	10	10	208.1076	207.7201	10		
A75EC	8	19	10	3	207.6433	207.5131	3		
Bbridge	1	89	10	10	205.5902	205.1815	10		
Bbridge	2	35	10	8	207.2463	206.9466	8		
Bbridge	3	10	10	9	208.0159	207.7473	9		
Bbridge	4	27	10	8	206.1191	205.7702	8		
Bbridge	5	22	10	8	206.5993	206.3318	8		
Bbridge	6	111	10	9	206.9883	206.6341	9		
Bbridge	7	113	10	10	206.8127	206.5115	10		
Bbridge	8	83	10	7	210.2117	209.9965	7		
Jranch	1	107	10	6	207.895	207.6713	6		
Jranch	2	63	10	8	208.0979	207.8392	8		

Sample Code	Rep	Pos	# Exposed	# Survived	Total Weight-mg	Tare Weight-mg	Pan Count	Mean Length-mm	Notes
Jranch	3	108	10	9	207.8972	207.5522	9		
Jranch	4	58	10	7	206.1366	205.8186	7		
Jranch	5	84	10	7	206.6957	206.4944	7		
Jranch	6	48	10	1	206.7669	206.6971	1		
Jranch	7	87	10	7	206.3819	206.1352	7		
Jranch	8	116	10	8	207.8095	207.5206	8		
32nd St	1	46	10	10	206.9652	206.5025	10		
32nd St	2	53	10	10	209.3214	208.9568	10		
32nd St	3	100	10	7	207.8676	207.6663	7		
32nd St	4	93	10	9	207.3259	206.97	9		
32nd St	5	28	10	9	205.2205	204.9375	9		
32nd St	6	65	10	8	206.6314	206.2368	8		
32nd St	7	17	10	8	204.7687	204.458	8		
32nd St	8	125	10	9	206.969	206.6692	9		
Lcreek	1	86	10	6	206.2958	206.0908	6		
Lcreek	2	129	10	9	208.046	207.6678	9		
Lcreek	3	31	10	10	206.4629	206.0668	10		
Lcreek	4	124	10	5	205.3621	205.19	5		
Lcreek	5	64	10	9	207.135	206.8737	9		
Lcreek	6	121	10	4	205.722	205.5959	4		
Lcreek	7	57	10	7	206.3163	206.1128	7		
Lcreek	8	127	10	9	204.9214	204.7136	9		
Pcliffs	1	7	10	4	204.3396	204.2406	4		
Pcliffs	2	82	10	1	205.7877	205.728	1		
Pcliffs	3	71	10	6	207.4581	207.2649	6		
Pcliffs	4	55	10	2	209.2921	209.2126	2		
Pcliffs	5	109	10	3	208.4106	208.2781	3		
Pcliffs	6	102	10	0	0	0	0		
Pcliffs	7	54	10	8	207.8914	207.6319	8		
Pcliffs	8	20	10	1	208.9596	208.8785	1		
A68 Dup	1	90	10	10	207.3689	206.9817	10		
A68 Dup	2	96	10	6	204.8314	204.6343	6		
A68 Dup	3	42	10	7	207.0522	206.8026	7		
A68 Dup	4	14	10	7	206.2305	206.0619	7		
A68 Dup	5	21	10	3	204.9787	204.8766	3		
A68 Dup	6	105	10	8	204.9936	204.6517	8		
A68 Dup	7	36	10	7	207.7401	207.5237	7		
A68 Dup	8	132	10	8	208.7234	208.4738	8		

Hyalella 10-d Survival and Growth Sediment Test — **U.S. EPA Region I Lab**

Analysis ID:	19-5339-8603	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:56	**Analysis:**	Parametric-Multiple Comparison	**Official Results:**	Yes

Batch Note: Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Sample Code	Sample Notes
Control-N	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75CC	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Control P	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A55	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A56	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A60	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A68	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A72	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A73	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75D	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75EC	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Bbridge	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Jranch	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
32nd St	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Lcreek	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Pcliffs	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A68 Dup	Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	15.7%	

Bonferroni Adj t Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control-N		A75CC	9.431	2.784	0.012	14	<0.0001	CDF	Significant Effect
		Control P	6.136	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A55	12.95	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A56	14.49	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A60	12.49	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A68	12.47	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A72	11.4	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A73	12.79	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A75D	11.68	2.784	0.013	13	<0.0001	CDF	Significant Effect
		A75EC	9.507	2.784	0.012	14	<0.0001	CDF	Significant Effect
		Bbridge	10.75	2.784	0.012	14	<0.0001	CDF	Significant Effect
		Jranch	12.2	2.784	0.012	14	<0.0001	CDF	Significant Effect
		32nd St	10.16	2.784	0.012	14	<0.0001	CDF	Significant Effect
		Lcreek	12.21	2.784	0.012	14	<0.0001	CDF	Significant Effect
		Pcliffs	15.18	2.784	0.012	14	<0.0001	CDF	Significant Effect
		A68 Dup	12.31	2.784	0.012	14	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.03051157	0.001906973	16	24.62	<0.0001	Significant Effect
Error	0.009139366	7.745225E-05	118			
Total	0.03965093		134			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	12.07	32	0.7391	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9891	0.9736	0.3699	Normal Distribution

Analysis ID:	19-5339-8603	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:56	**Analysis:**	Parametric-Multiple Comparison	**Official Results:**	Yes

Mean Dry Biomass-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control-N	8	0.07809	0.06826	0.08792	0.07991	0.05721	0.09091	0.004157	15.06%	0.0%
A75CC	8	0.03659	0.02987	0.04332	0.03624	0.02241	0.04768	0.002843	21.97%	53.14%
Control P	8	0.05109	0.04011	0.06208	0.05252	0.02806	0.07079	0.004645	25.71%	34.57%
A55	8	0.02113	0.01544	0.02681	0.01898	0.01295	0.03257	0.002405	32.2%	72.95%
A56	8	0.01431	0.006699	0.02193	0.01824	0	0.02401	0.00322	63.64%	81.67%
A60	8	0.02314	0.01856	0.02773	0.02306	0.01504	0.03141	0.001939	23.69%	70.37%
A68	8	0.02323	0.01553	0.03094	0.02693	0.00504	0.03304	0.003259	39.67%	70.25%
A72	8	0.02792	0.02216	0.03369	0.0279	0.01887	0.04003	0.002437	24.68%	64.24%
A73	8	0.02181	0.01659	0.02703	0.02154	0.01099	0.03164	0.002207	28.62%	72.07%
A75D	7	0.02487	0.01716	0.03258	0.02574	0.01431	0.03834	0.003152	33.52%	68.15%
A75EC	8	0.03626	0.02689	0.04563	0.03725	0.01302	0.05234	0.003963	30.92%	53.57%
Bbridge	8	0.0308	0.02572	0.03588	0.03005	0.02152	0.04087	0.002149	19.74%	60.56%
Jranch	8	0.0244	0.0173	0.0315	0.02527	0.006981	0.0345	0.003003	34.81%	68.75%
32nd St	8	0.03341	0.02681	0.04	0.03333	0.02013	0.04627	0.002789	23.62%	57.22%
Lcreek	8	0.02438	0.01632	0.03243	0.02064	0.01261	0.03961	0.003407	39.53%	68.79%
Pcliffs	8	0.01131	0.004513	0.0181	0.009005	0	0.02595	0.002873	71.87%	85.52%
A68 Dup	8	0.02391	0.01625	0.03156	0.0233	0.01021	0.03872	0.003239	38.32%	69.39%

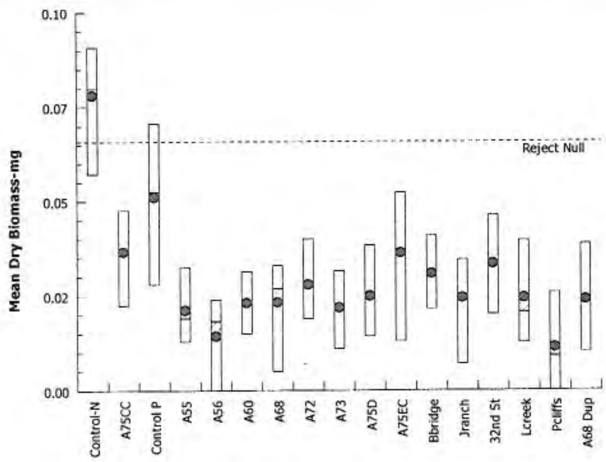
Mean Dry Biomass-mg Detail

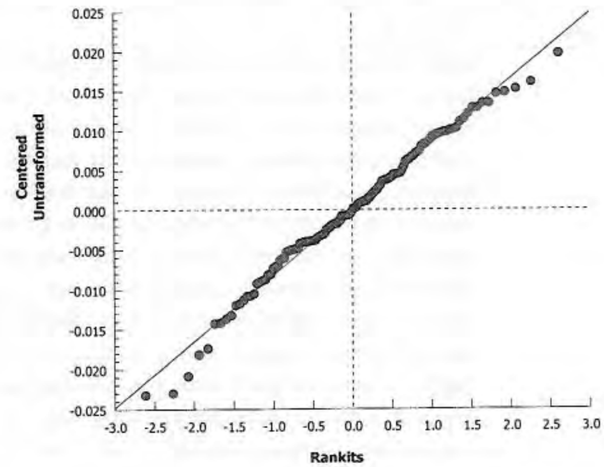
Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	0.07313	0.08669	0.08704	0.06933	0.0874	0.05721	0.09091	0.07304
A75CC	0.04768	0.04614	0.03483	0.03137	0.03465	0.03801	0.02241	0.03766
Control P	0.07079	0.02806	0.05465	0.05786	0.06055	0.04616	0.0504	0.04028
A55	0.02553	0.0186	0.01295	0.01937	0.02778	0.01721	0.03257	0.01499
A56	0.00231	0.01815	0.01832	0	0.02401	0.01886	0.01021	0.02265
A60	0.02232	0.02379	0.02553	0.01504	0.02859	0.03141	0.02138	0.01707
A68	0.02697	0.03044	0.00504	0.03304	0.02689	0.01688	0.01841	0.02821
A72	0.02773	0.03427	0.02054	0.02807	0.02883	0.04003	0.01887	0.02505
A73	0.02203	0.01099	0.02809	0.03164	0.02034	0.01778	0.02105	0.02259
A75D	0.02574	0.02938	0.01431	0.02864	0.01599	0.03834	0.02171	
A75EC	0.03546	0.03574	0.05234	0.03911	0.03231	0.04334	0.03875	0.01302
Bbridge	0.04087	0.02997	0.02686	0.03489	0.02675	0.03542	0.03012	0.02152
Jranch	0.02237	0.02587	0.0345	0.0318	0.02013	0.006981	0.02467	0.02889
32nd St	0.04627	0.03646	0.02013	0.03559	0.0283	0.03946	0.03107	0.02998
Lcreek	0.0205	0.03782	0.03961	0.01721	0.02613	0.01261	0.02035	0.02078
Pcliffs	0.0099	0.005971	0.01932	0.00795	0.01325	0	0.02595	0.00811
A68 Dup	0.03872	0.01971	0.02496	0.01686	0.01021	0.03419	0.02164	0.02496

Hyalella 10-d Survival and Growth Sediment Test — **U.S. EPA Region I Lab**

Analysis ID:	19-5339-8603	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:56	**Analysis:**	Parametric-Multiple Comparison	**Official Results:**	Yes

Graphics





Hyalella 10-d Survival and Growth Sediment Test — U.S. EPA Region I Lab

Analysis ID:	12-4710-3062	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Batch Note: Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Sample Code	Sample Notes
Control-N	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75CC	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Control P	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A55	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A56	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A60	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A68	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A72	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A73	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75D	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75EC	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Bbridge	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Jranch	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
32nd St	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Lcreek	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Pcliffs	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A68 Dup	Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	25.6%	

Dunnett Multiple Comparison Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control-N		A75CC	1.986	2.617	0.317	14	0.1835	CDF	Non-Significant Effect
		Control P	0.08184	2.617	0.317	14	0.9280	CDF	Non-Significant Effect
		A55	3.31	2.617	0.317	14	0.0077	CDF	Significant Effect
		A56	4.916	2.617	0.317	14	<0.0001	CDF	Significant Effect
		A60	1.622	2.617	0.317	14	0.3217	CDF	Non-Significant Effect
		A68	2.356	2.617	0.317	14	0.0899	CDF	Non-Significant Effect
		A72	2.436	2.617	0.317	14	0.0756	CDF	Non-Significant Effect
		A73	1.916	2.617	0.317	14	0.2064	CDF	Non-Significant Effect
		A75D	1.627	2.617	0.317	14	0.3196	CDF	Non-Significant Effect
		A75EC	1.078	2.617	0.317	14	0.5817	CDF	Non-Significant Effect
		Bbridge	0.7501	2.617	0.317	14	0.7312	CDF	Non-Significant Effect
		Jranch	2.807	2.617	0.317	14	0.0313	CDF	Significant Effect
		32nd St	0.6035	2.617	0.317	14	0.7884	CDF	Non-Significant Effect
		Lcreek	1.916	2.617	0.317	14	0.2064	CDF	Non-Significant Effect
		Pcliffs	6.033	2.617	0.317	14	<0.0001	CDF	Significant Effect
		A68 Dup	2.372	2.617	0.317	14	0.0869	CDF	Non-Significant Effect

Hyalella 10-d Survival and Growth Sediment Test — U.S. EPA Region I Lab

Analysis ID:	12-4710-3062	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Test Acceptability Criteria

Attribute	Test Stat	TAC Limits	Overlap	Decision
Control Resp	0.925	0.8 - NL	Yes	Passes Acceptability Criteria

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	4.649254	0.2905784	16	4.967	<0.0001	Significant Effect
Error	6.96171	0.05850177	119			
Total	11.61096		135			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Bartlett Equality of Variance	17.25	32	0.3698	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.9814	0.9738	0.0597	Normal Distribution

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control-N	8	0.925	0.8509	0.9991	0.95	0.8	1	0.03134	9.58%	0.0%
A75CC	8	0.7375	0.5768	0.8982	0.8	0.4	1	0.06797	26.07%	20.27%
Control P	8	0.9125	0.7991	1	0.95	0.6	1	0.04795	14.86%	1.35%
A55	8	0.6	0.4659	0.7341	0.55	0.4	0.9	0.05669	26.73%	35.14%
A56	8	0.4375	0.2189	0.6561	0.5	0	0.7	0.09246	59.78%	52.7%
A60	8	0.775	0.6218	0.9282	0.8	0.4	1	0.06478	23.64%	16.22%
A68	8	0.7	0.4635	0.9365	0.8	0.1	1	0.1	40.41%	24.32%
A72	8	0.7	0.5905	0.8095	0.7	0.5	0.9	0.04629	18.7%	24.32%
A73	8	0.7375	0.5536	0.9214	0.8	0.4	1	0.07778	29.83%	20.27%
A75D	8	0.7625	0.5841	0.9409	0.7	0.5	1	0.07545	27.99%	17.57%
A75EC	8	0.8125	0.6056	1	0.9	0.3	1	0.0875	30.46%	12.16%
Bbridge	8	0.8625	0.7738	0.9512	0.85	0.7	1	0.0375	12.3%	6.76%
Jranch	8	0.6625	0.458	0.867	0.7	0.1	0.9	0.08647	36.92%	28.38%
32nd St	8	0.875	0.7885	0.9615	0.9	0.7	1	0.0366	11.83%	5.41%
Lcreek	8	0.7375	0.5536	0.9214	0.8	0.4	1	0.07778	29.83%	20.27%
Pcliffs	8	0.3125	0.08273	0.5423	0.25	0	0.8	0.09717	87.95%	66.22%
A68 Dup	8	0.7	0.5328	0.8672	0.7	0.3	1	0.07071	28.57%	24.32%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Control-N	8	1.295	1.181	1.409	1.331	1.107	1.412	0.0481	10.51%	0.0%
A75CC	8	1.055	0.8634	1.246	1.107	0.6847	1.412	0.081	21.72%	18.54%
Control P	8	1.285	1.134	1.436	1.331	0.8861	1.412	0.06374	14.03%	0.76%
A55	8	0.8948	0.7452	1.044	0.8357	0.6847	1.249	0.06327	20.0%	30.91%
A56	8	0.7006	0.4448	0.9563	0.7854	0.1588	0.9912	0.1081	43.66%	45.91%
A60	8	1.099	0.9152	1.283	1.107	0.6847	1.412	0.07769	20.0%	15.14%
A68	8	1.01	0.7325	1.288	1.107	0.3218	1.412	0.1174	32.87%	22.0%
A72	8	1	0.8751	1.126	0.9912	0.7854	1.249	0.05297	14.98%	22.75%
A73	8	1.063	0.8439	1.283	1.12	0.6847	1.412	0.0928	24.69%	17.89%
A75D	8	1.098	0.8687	1.328	0.9966	0.7854	1.412	0.09713	25.01%	15.19%
A75EC	8	1.165	0.9098	1.42	1.26	0.5796	1.412	0.1078	26.17%	10.07%
Bbridge	8	1.204	1.076	1.332	1.178	0.9912	1.412	0.05412	12.71%	7.01%
Jranch	8	0.9556	0.7229	1.188	0.9912	0.3218	1.249	0.09842	29.13%	26.21%
32nd St	8	1.222	1.098	1.346	1.249	0.9912	1.412	0.05245	12.14%	5.64%
Lcreek	8	1.063	0.8439	1.283	1.12	0.6847	1.412	0.0928	24.69%	17.89%
Pcliffs	8	0.5654	0.3001	0.8308	0.5216	0.1588	1.107	0.1122	56.13%	56.34%
A68 Dup	8	1.008	0.8129	1.204	0.9912	0.5796	1.412	0.0826	23.17%	22.15%

Hyalella 10-d Survival and Growth Sediment Test — **U.S. EPA Region I Lab**

Analysis ID:	12-4710-3062	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	0.9	0.9	1	1	1	0.8	1	0.8
A75CC	0.8	1	0.6	0.6	0.8	0.8	0.4	0.9
Control P	1	0.9	1	0.9	1	1	0.9	0.6
A55	0.7	0.5	0.5	0.7	0.9	0.5	0.6	0.4
A56	0.1	0.5	0.7	0	0.6	0.7	0.4	0.5
A60	0.8	0.9	1	0.7	0.9	0.8	0.7	0.4
A68	0.8	0.9	0.1	0.8	0.8	0.5	0.7	1
A72	0.6	0.8	0.5	0.7	0.9	0.8	0.7	0.6
A73	0.7	0.4	0.9	1	0.6	0.5	0.9	0.9
A75D	0.6	0.6	1	0.5	1	0.6	1	0.8
A75EC	0.8	0.7	1	1	0.7	1	1	0.3
Bbridge	1	0.8	0.9	0.8	0.8	0.9	1	0.7
Jranch	0.6	0.8	0.9	0.7	0.7	0.1	0.7	0.8
32nd St	1	1	0.7	0.9	0.9	0.8	0.8	0.9
Lcreek	0.6	0.9	1	0.5	0.9	0.4	0.7	0.9
Pcliffs	0.4	0.1	0.6	0.2	0.3	0	0.8	0.1
A68 Dup	1	0.6	0.7	0.7	0.3	0.8	0.7	0.8

Angular (Corrected) Transformed Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	1.249	1.249	1.412	1.412	1.412	1.107	1.412	1.107
A75CC	1.107	1.412	0.8861	0.8861	1.107	1.107	0.6847	1.249
Control P	1.412	1.249	1.412	1.249	1.412	1.412	1.249	0.8861
A55	0.9912	0.7854	0.7854	0.9912	1.249	0.7854	0.8861	0.6847
A56	0.3218	0.7854	0.9912	0.1588	0.8861	0.9912	0.6847	0.7854
A60	1.107	1.249	1.412	0.9912	1.249	1.107	0.9912	0.6847
A68	1.107	1.249	0.3218	1.107	1.107	0.7854	0.9912	1.412
A72	0.8861	1.107	0.7854	0.9912	1.249	1.107	0.9912	0.8861
A73	0.9912	0.6847	1.249	1.412	0.8861	0.7854	1.249	1.249
A75D	0.8861	0.8861	1.412	0.7854	1.412	0.8861	1.412	1.107
A75EC	1.107	0.9912	1.412	1.412	0.9912	1.412	1.412	0.5796
Bbridge	1.412	1.107	1.249	1.107	1.107	1.249	1.412	0.9912
Jranch	0.8861	1.107	1.249	0.9912	0.9912	0.3218	0.9912	1.107
32nd St	1.412	1.412	0.9912	1.249	1.249	1.107	1.107	1.249
Lcreek	0.8861	1.249	1.412	0.7854	1.249	0.6847	0.9912	1.249
Pcliffs	0.6847	0.3218	0.8861	0.4636	0.5796	0.1588	1.107	0.3218
A68 Dup	1.412	0.8861	0.9912	0.9912	0.5796	1.107	0.9912	1.107

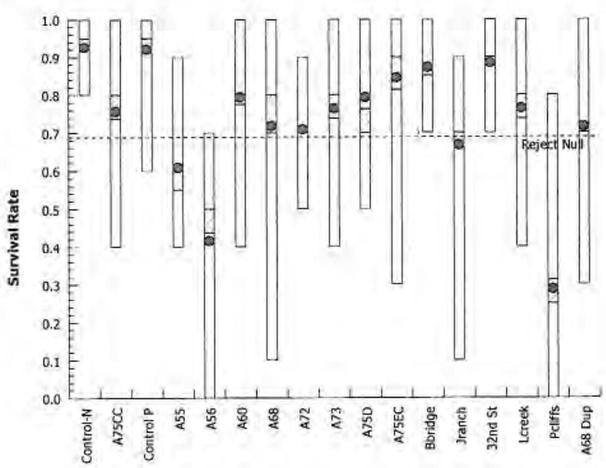
Hyalella 10-d Survival and Growth Sediment Test — **U.S. EPA Region I Lab**

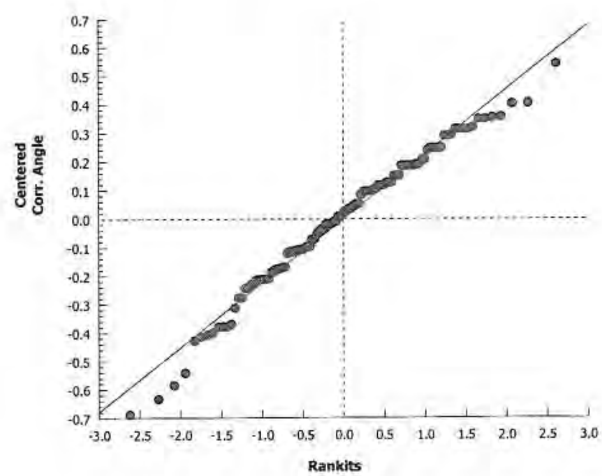
Analysis ID:	12-4710-3062	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	04 Mar-15 14:55	**Analysis:**	Parametric-Control vs Treatments	**Official Results:**	Yes

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	9/10	9/10	10/10	10/10	10/10	8/10	10/10	8/10
A75CC	8/10	10/10	6/10	6/10	8/10	8/10	4/10	9/10
Control P	10/10	9/10	10/10	9/10	10/10	10/10	9/10	6/10
A55	7/10	5/10	5/10	7/10	9/10	5/10	6/10	4/10
A56	1/10	5/10	7/10	0/10	6/10	7/10	4/10	5/10
A60	8/10	9/10	10/10	7/10	9/10	8/10	7/10	4/10
A68	8/10	9/10	1/10	8/10	8/10	5/10	7/10	10/10
A72	6/10	8/10	5/10	7/10	9/10	8/10	7/10	6/10
A73	7/10	4/10	9/10	10/10	6/10	5/10	9/10	9/10
A75D	6/10	10/10	5/10	10/10	6/10	10/10	8/10	
A75EC	8/10	7/10	10/10	10/10	7/10	10/10	10/10	3/10
Bbridge	10/10	8/10	9/10	8/10	8/10	9/10	10/10	7/10
Jranch	6/10	8/10	9/10	7/10	7/10	1/10	7/10	8/10
32nd St	10/10	10/10	7/10	9/10	9/10	8/10	8/10	9/10
Lcreek	6/10	9/10	10/10	5/10	9/10	4/10	7/10	9/10
Pcliffs	4/10	1/10	6/10	2/10	3/10	0/10	8/10	1/10
A68 Dup	10/10	6/10	7/10	7/10	3/10	8/10	7/10	8/10

Graphics





Hyalella 10-d Survival and Growth Sediment Test **U.S. EPA Region I Lab**

Batch Note: Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Sample Code	Sample Notes
Control-N	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75CC	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Control P	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A55	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A56	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A60	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A68	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A72	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A73	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75D	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A75EC	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Bbridge	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Jranch	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
32nd St	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Lcreek	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
Pcliffs	Region 8 Upper Animas H. azteca 10-day Sed Tox Test
A68 Dup	Region 8 Upper Animas H. azteca 10-day Sed Tox Test

Test Acceptability

Analysis ID	Endpoint	Attribute	Test Stat	TAC Limits	Overlap	Decision
12-4710-3062	Survival Rate	Control Resp	0.925	0.8 - NL	Yes	Passes Acceptability Criteria

Hyalella 10-d Survival and Growth Sediment Test — U.S. EPA Region I Lab

Mean Dry Biomass-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control-N	8	0.07809	0.06826	0.08792	0.05721	0.09091	0.004157	0.01176	15.06%	0.0%
A75CC	8	0.03659	0.02987	0.04332	0.02241	0.04768	0.002843	0.00804	21.97%	53.14%
Control P	8	0.05109	0.04011	0.06208	0.02806	0.07079	0.004645	0.01314	25.71%	34.57%
A55	8	0.02113	0.01544	0.02681	0.01295	0.03257	0.002405	0.006803	32.2%	72.95%
A56	8	0.01431	0.006699	0.02193	0	0.02401	0.00322	0.009109	63.64%	81.67%
A60	8	0.02314	0.01856	0.02773	0.01504	0.03141	0.001939	0.005483	23.69%	70.37%
A68	8	0.02323	0.01553	0.03094	0.00504	0.03304	0.003259	0.009218	39.67%	70.25%
A72	8	0.02792	0.02216	0.03369	0.01887	0.04003	0.002437	0.006892	24.68%	64.24%
A73	8	0.02181	0.01659	0.02703	0.01099	0.03164	0.002207	0.006242	28.62%	72.07%
A75D	7	0.02487	0.01716	0.03258	0.01431	0.03834	0.003152	0.008338	33.52%	68.15%
A75EC	8	0.03626	0.02689	0.04563	0.01302	0.05234	0.003963	0.01121	30.92%	53.57%
Bbridge	8	0.0308	0.02572	0.03588	0.02152	0.04087	0.002149	0.006079	19.74%	60.56%
Jranch	8	0.0244	0.0173	0.0315	0.006981	0.0345	0.003003	0.008493	34.81%	68.75%
32nd St	8	0.03341	0.02681	0.04	0.02013	0.04627	0.002789	0.00789	23.62%	57.22%
Lcreek	8	0.02438	0.01632	0.03243	0.01261	0.03961	0.003407	0.009635	39.53%	68.79%
Pcliffs	8	0.01131	0.004513	0.0181	0	0.02595	0.002873	0.008126	71.87%	85.52%
A68 Dup	8	0.02391	0.01625	0.03156	0.01021	0.03872	0.003239	0.00916	38.32%	69.39%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Control-N	8	0.925	0.8509	0.9991	0.8	1	0.03134	0.08864	9.58%	0.0%
A75CC	8	0.7375	0.5768	0.8982	0.4	1	0.06797	0.1923	26.07%	20.27%
Control P	8	0.9125	0.7991	1	0.6	1	0.04795	0.1356	14.86%	1.35%
A55	8	0.6	0.4659	0.7341	0.4	0.9	0.05669	0.1604	26.73%	35.14%
A56	8	0.4375	0.2189	0.6561	0	0.7	0.09246	0.2615	59.78%	52.7%
A60	8	0.775	0.6218	0.9282	0.4	1	0.06478	0.1832	23.64%	16.22%
A68	8	0.7	0.4635	0.9365	0.1	1	0.1	0.2828	40.41%	24.32%
A72	8	0.7	0.5905	0.8095	0.5	0.9	0.04629	0.1309	18.7%	24.32%
A73	8	0.7375	0.5536	0.9214	0.4	1	0.07778	0.22	29.83%	20.27%
A75D	7	0.7857	0.5829	0.9885	0.5	1	0.08289	0.2193	27.91%	15.06%
A75EC	8	0.8125	0.6056	1	0.3	1	0.0875	0.2475	30.46%	12.16%
Bbridge	8	0.8625	0.7738	0.9512	0.7	1	0.0375	0.1061	12.3%	6.76%
Jranch	8	0.6625	0.458	0.867	0.1	0.9	0.08647	0.2446	36.92%	28.38%
32nd St	8	0.875	0.7885	0.9615	0.7	1	0.0366	0.1035	11.83%	5.41%
Lcreek	8	0.7375	0.5536	0.9214	0.4	1	0.07778	0.22	29.83%	20.27%
Pcliffs	8	0.3125	0.08273	0.5423	0	0.8	0.09717	0.2748	87.95%	66.22%
A68 Dup	8	0.7	0.5328	0.8672	0.3	1	0.07071	0.2	28.57%	24.32%

Mean Dry Biomass-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	0.07313	0.08669	0.08704	0.06933	0.0874	0.05721	0.09091	0.07304
A75CC	0.04768	0.04614	0.03483	0.03137	0.03465	0.03801	0.02241	0.03766
Control P	0.07079	0.02806	0.05465	0.05786	0.06055	0.04616	0.0504	0.04028
A55	0.02553	0.0186	0.01295	0.01937	0.02778	0.01721	0.03257	0.01499
A56	0.00231	0.01815	0.01832	0	0.02401	0.01886	0.01021	0.02265
A60	0.02232	0.02379	0.02553	0.01504	0.02859	0.03141	0.02138	0.01707
A68	0.02697	0.03044	0.00504	0.03304	0.02689	0.01688	0.01841	0.02821
A72	0.02773	0.03427	0.02054	0.02807	0.02883	0.04003	0.01887	0.02505
A73	0.02203	0.01099	0.02809	0.03164	0.02034	0.01778	0.02105	0.02259
A75D	0.02574	0.02938	0.01431	0.02864	0.01599	0.03834	0.02171	
A75EC	0.03546	0.03574	0.05234	0.03911	0.03231	0.04334	0.03875	0.01302
Bbridge	0.04087	0.02997	0.02686	0.03489	0.02675	0.03542	0.03012	0.02152
Jranch	0.02237	0.02587	0.0345	0.0318	0.02013	0.006981	0.02467	0.02889
32nd St	0.04627	0.03646	0.02013	0.03559	0.0283	0.03946	0.03107	0.02998
Lcreek	0.0205	0.03782	0.03961	0.01721	0.02613	0.01261	0.02035	0.02078
Pcliffs	0.0099	0.005971	0.01932	0.00795	0.01325	0	0.02595	0.00811
A68 Dup	0.03872	0.01971	0.02496	0.01686	0.01021	0.03419	0.02164	0.02496

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	0.9	0.9	1	1	1	0.8	1	0.8
A75CC	0.8	1	0.6	0.6	0.8	0.8	0.4	0.9
Control P	1	0.9	1	0.9	1	1	0.9	0.6
A55	0.7	0.5	0.5	0.7	0.9	0.5	0.6	0.4
A56	0.1	0.5	0.7	0	0.6	0.7	0.4	0.5
A60	0.8	0.9	1	0.7	0.9	0.8	0.7	0.4
A68	0.8	0.9	0.1	0.8	0.8	0.5	0.7	1
A72	0.6	0.8	0.5	0.7	0.9	0.8	0.7	0.6
A73	0.7	0.4	0.9	1	0.6	0.5	0.9	0.9
A75D	0.6	1	0.5	1	0.6	1	0.8	
A75EC	0.8	0.7	1	1	0.7	1	1	0.3
Bbridge	1	0.8	0.9	0.8	0.8	0.9	1	0.7
Jranch	0.6	0.8	0.9	0.7	0.7	0.1	0.7	0.8
32nd St	1	1	0.7	0.9	0.9	0.8	0.8	0.9
Lcreek	0.6	0.9	1	0.5	0.9	0.4	0.7	0.9
Pcliffs	0.4	0.1	0.6	0.2	0.3	0	0.8	0.1
A68 Dup	1	0.6	0.7	0.7	0.3	0.8	0.7	0.8

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Control-N	9/10	9/10	10/10	10/10	10/10	8/10	10/10	8/10
A75CC	8/10	10/10	6/10	6/10	8/10	8/10	4/10	9/10
Control P	10/10	9/10	10/10	9/10	10/10	10/10	9/10	6/10
A55	7/10	5/10	5/10	7/10	9/10	5/10	6/10	4/10
A56	1/10	5/10	7/10	0/10	6/10	7/10	4/10	5/10
A60	8/10	9/10	10/10	7/10	9/10	8/10	7/10	4/10
A68	8/10	9/10	1/10	8/10	8/10	5/10	7/10	10/10
A72	6/10	8/10	5/10	7/10	9/10	8/10	7/10	6/10
A73	7/10	4/10	9/10	10/10	6/10	5/10	9/10	9/10
A75D	6/10	10/10	5/10	10/10	6/10	10/10	8/10	
A75EC	8/10	7/10	10/10	10/10	7/10	10/10	10/10	3/10
Bbridge	10/10	8/10	9/10	8/10	8/10	9/10	10/10	7/10
Jranch	6/10	8/10	9/10	7/10	7/10	1/10	7/10	8/10
32nd St	10/10	10/10	7/10	9/10	9/10	8/10	8/10	9/10
Lcreek	6/10	9/10	10/10	5/10	9/10	4/10	7/10	9/10
Pcliffs	4/10	1/10	6/10	2/10	3/10	0/10	8/10	1/10
A68 Dup	10/10	6/10	7/10	7/10	3/10	8/10	7/10	8/10

CETIS Test Data Worksheet

Test Code: 18-5161-6814/6E5D6E2E

Reference Toxicant 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Start Date:	17 Nov-14	**Species:**	Hyalella azteca	**Sample Code:**	R81114HAARTT
End Date:	21 Nov-14	**Protocol:**	EPA/600/R-99/064 (2000)	**Sample Source:**	Reference Toxicant
Sample Date:	17 Nov-14	**Material:**	Zinc sulfate	**Sample Station:**	

Batch Note: Region 8: November 2014 Acute Reference Toxicity Test Using H. azteca (Concurrent with Upper Animas River sediment toxicity test)

Sample Note: Region 8: November 2014 Acute Reference Toxicity Test Using H. azteca (Concurrent with Upper Animas River sediment toxicity test)

C-µg/L	Code	Rep	Pos	# Exposed	# Survived	Notes
10.3	L	1	8	10	10	
10.3	L	2	11	10	10	
10.3	L	3	17	10	10	
10.3	L	4	23	10	10	
66.85		1	6	10	9	
66.85		2	15	10	10	
66.85		3	13	10	10	
66.85		4	2	10	10	
133		1	7	10	10	
133		2	4	10	10	
133		3	19	10	10	
133		4	9	10	10	
253.5		1	1	10	1	
253.5		2	18	10	0	
253.5		3	14	10	2	
253.5		4	12	10	2	
464		1	10	10	0	
464		2	20	10	0	
464		3	21	10	0	
464		4	5	10	0	
927		1	3	10	0	
927		2	24	10	0	
927		3	16	10	0	
927		4	22	10	0	

Analyst: BB QA: EC

CETIS Analytical Report

Report Date: 02 Mar-15 14:16 (p 1 of 1)
Test Code: 6E5D6E2E | 18-5161-6814

Reference Toxicant 96-h Acute Survival Test — **U.S. EPA Region I Lab**

Analysis ID: 14-3963-7611 **Endpoint:** Survival Rate **CETIS Version:** CETISv1.8.7
Analyzed: 26 Feb-15 12:34 **Analysis:** Trimmed Spearman-Kärber **Official Results:** Yes

Batch Note: Region 8: November 2014 Acute Reference Toxicity Test Using H. azteca (Concurrent with Upper Animas River sediment toxicity test)

Sample Note: Region 8: November 2014 Acute Reference Toxicity Test Using H. azteca (Concurrent with Upper Animas River sediment toxicity test)

Trimmed Spearman-Kärber Estimates

Threshold Option	Threshold	Trim	Mu	Sigma	EC50	95% LCL	95% UCL
Control Threshold	0	1.25%	2.294	0.0147	196.7	183.8	210.4

Survival Rate Summary

			Calculated Variate(A/B)								
C-µg/L	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	%Effect	A	B
10.3	Lab Water	4	1	1	1	0	0	0.0%	0.0%	40	40
66.85		4	0.975	0.9	1	0.025	0.05	5.13%	2.5%	39	40
133		4	1	1	1	0	0	0.0%	0.0%	40	40
253.5		4	0.125	0	0.2	0.04787	0.09574	76.59%	87.5%	5	40
464		4	0	0	0	0	0		100.0%	0	40
927		4	0	0	0	0	0		100.0%	0	40

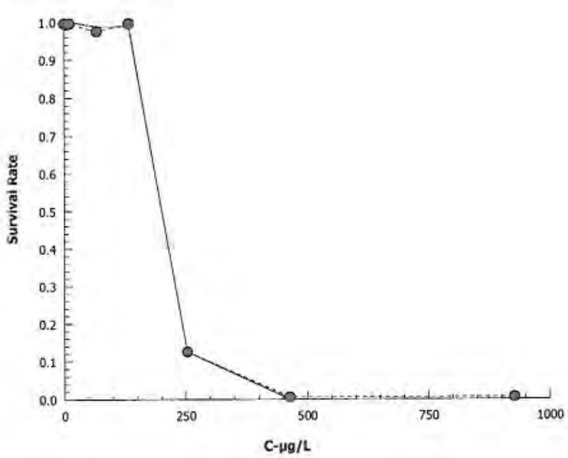
Survival Rate Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
10.3	Lab Water	1	1	1	1
66.85		0.9	1	1	1
133		1	1	1	1
253.5		0.1	0	0.2	0.2
464		0	0	0	0
927		0	0	0	0

Survival Rate Binomials

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
10.3	Lab Water	10/10	10/10	10/10	10/10
66.85		9/10	10/10	10/10	10/10
133		10/10	10/10	10/10	10/10
253.5		1/10	0/10	2/10	2/10
464		0/10	0/10	0/10	0/10
927		0/10	0/10	0/10	0/10

Graphics



Appendix 11

Timberline Aquatics, Inc.

February 6, 2015

Mr. Steve Auer
TechLaw
16194 W. 45th Drive
Denver, CO 80403

Dear Mr. Auer,

Enclosed are the results from fourteen (14) benthic macroinvertebrate samples collected for the Animas River Biomonitoring Project during the fall of 2014. Data are reported as 300-count subsamples (based on protocols for MMI calculation provided by the Colorado Department of Public Health and Environment). Specific information on subsampling has been provided in the enclosed Excel file entitled "Animas 2014 grid data". MMI scores were calculated from benthic data for each site. The MMI results are provided at the end of this report. Please contact me if you have any questions.

Sincerely,

Timberline Aquatics, Inc.

David E. Rees
President

Enc.

/dr

4219 Table Mountain Place, Suite A ◈ Fort Collins, CO 80526
Phone: (970) 266-9222 ◈ Web: http://www.timberlineaquatics.com ◈ E-mail: drees@timberlineaquatics.com

Animas River Macroinvertebrate Data

A53

11 Oct. 2014

		REP 1
INSECTA		
EPHEMEROPTERA		**55**
Baetidae	*Baetis bicaudatus/ tricaudatus*	1
Ephemerellidae	*Drunella doddsi*	11
Heptageniidae	*Epeorus* sp.	2
Heptageniidae	*Rhithrogena* sp.	41
PLECOPTERA		**164**
Capniidae	Capniidae (*Capnia*)	2
Capniidae	Capniidae (*Utacapnia*)	8
Nemouridae	*Zapada oregonensis* group	81
Taeniopterygidae	*Taenionema* sp.	71
Perlodidae	*Megarcys signata*	2
TRICHOPTERA		**22**
Hydropsychidae	*Arctopsyche grandis*	19
Rhyacophilidae	*Rhyacophila brunnea*	1
Rhyacophilidae	*Rhyacophila hyalinata*	2
DIPTERA		
Chironomidae		**47**
Chironomidae	*Cricotopus*/*Orthocladius* sp.	44
Chironomidae	*Heterotrissocladius* sp.	1
Chironomidae	*Pagastia* sp.	2
DIPTERA (other)		**9**
Ceratopogoninae	Ceratopogoninae	7
Empididae	*Metachela*/*Chelifera* sp.	2
ARACHNIDA		
HYDRACARINA		**4**
Lebertiidae	*Lebertia* sp.	4
TURBELLARIA		**2**
Planariidae	*Polycelis coronata*	2

Total Number (#/sample)	303
Number of Taxa	19
Shannon Weaver Diversity (H')	2.97
Hilsenhoff Biotic Index (HBI)	1.75
Total EPT Taxa	12.0
EPT Index (% of total number of taxa)	63.2%
Ephemeroptera Abundance (% of total number)	18.2%

# Ephemeroptera Taxa	4
# Plecoptera Taxa	5
# Trichoptera Taxa	3
% EPT (% of Total Number)	79.5%
# Intolerant Taxa	14
Tolerant Organisms (% of Total Number)	1.3%
Dominant Taxon (% of Total Number)	26.7%
Filterers (% of Total Number)	6.3%
Scrapers (% of Total Number)	41.3%
# Clinger Taxa	9
Clingers (% of Total Number)	53.8%

Animas River Macroinvertebrate Data
A55
24 Sept. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**163**
	Ameletidae	*Ameletus* sp.	2
	Baetidae	*Baetis bicaudatus/ tricaudatus*	35
	Ephemerellidae	*Drunella doddsi*	50
	Heptageniidae	*Epeorus* sp.	10
	Heptageniidae	*Rhithrogena* sp.	66
PLECOPTERA			**93**
	Capniidae	Capniidae (*Utacapnia*)	7
	Nemouridae	*Zapada oregonensis* group	50
	Taeniopterygidae	*Taenionema* sp.	29
	Chloroperlidae	Chloroperlidae	3
	Chloroperlidae	*Sweltsa* sp.	1
	Perlodidae	*Isoperla* sp.	1
	Perlodidae	*Megarcys signata*	2
TRICHOPTERA			**83**
	Hydropsychidae	*Arctopsyche grandis*	61
	Rhyacophilidae	*Rhyacophila brunnea*	7
	Rhyacophilidae	*Rhyacophila hyalinata*	9
	Rhyacophilidae	*Rhyacophila sibirica* group	5
	Rhyacophilidae	*Rhyacophila vofixa* group	1
DIPTERA			
Chironomidae			**8**
	Chironomidae	*Cricotopus*/*Orthocladius* sp.	6
	Chironomidae	*Pagastia* sp.	2
DIPTERA (other)			**28**
	Muscidae	*Lispoides* sp.	1
	Simuliidae	*Simulium* sp.	27
COLEOPTERA			**1**
	Elmidae	*Heterlimnius corpulentus*	1
ARACHNIDA			
HYDRACARINA			**5**
	Lebertiidae	*Lebertia* sp.	4
	Sperchontidae	*Sperchon* sp.	1
TURBELLARIA			**11**
	Planariidae	*Polycelis coronata*	11

NEMATODA			**2**
	Nematoda	Nematoda	2

Total Number (#/sample)	394
Number of Taxa	26
Shannon Weaver Diversity (H')	3.48
Hilsenhoff Biotic Index (HBI)	1.68
Total EPT Taxa	17.0
EPT Index (% of total number of taxa)	65.4%
Ephemeroptera Abundance (% of total number)	41.4%
# Ephemeroptera Taxa	5
# Plecoptera Taxa	7
# Trichoptera Taxa	5
% EPT (% of Total Number)	86.0%
# Intolerant Taxa	18
Tolerant Organisms (% of Total Number)	1.3%
Dominant Taxon (% of Total Number)	16.8%
Filterers (% of Total Number)	22.3%
Scrapers (% of Total Number)	39.3%
# Clinger Taxa	17
Clingers (% of Total Number)	75.9%

Animas River Macroinvertebrate Data
A56
24 Sept. 2014

		REP 1
INSECTA		
EPHEMEROPTERA		**34**
Ameletidae	*Ameletus* sp.	1
Baetidae	*Baetis bicaudatus/ tricaudatus*	13
Ephemerellidae	*Drunella doddsi*	9
Heptageniidae	*Epeorus* sp.	3
Heptageniidae	*Rhithrogena* sp.	8
PLECOPTERA		**39**
Capniidae	Capniidae (*Capnia*)	1
Nemouridae	*Zapada oregonensis* group	26
Taeniopterygidae	*Taenionema* sp.	6
Chloroperlidae	*Sweltsa* sp.	1
Perlodidae	*Isoperla* sp.	3
Perlodidae	*Megarcys signata*	2
TRICHOPTERA		**46**
Hydropsychidae	*Arctopsyche grandis*	44
Rhyacophilidae	*Rhyacophila brunnea*	2
DIPTERA		
Chironomidae		**8**
Chironomidae	*Cricotopus*/*Orthocladius* sp.	5
Chironomidae	*Diamesa* sp.	1
Chironomidae	*Eukiefferiella* sp.	2
DIPTERA (other)		**186**
Simuliidae	*Simulium* sp.	186
ARACHNIDA		
HYDRACARINA		**2**
Lebertiidae	*Lebertia* sp.	2

Total Number (#/sample)	315
Number of Taxa	18
Shannon Weaver Diversity (H')	2.24
Hilsenhoff Biotic Index (HBI)	4.28
Total EPT Taxa	13.0
EPT Index (% of total number of taxa)	72.2%
Ephemeroptera Abundance (% of total number)	10.8%
# Ephemeroptera Taxa	5
# Plecoptera Taxa	6
# Trichoptera Taxa	2
% EPT (% of Total Number)	37.8%

# Intolerant Taxa	12
Tolerant Organisms (% of Total Number)	1.3%
Dominant Taxon (% of Total Number)	59.0%
Filterers (% of Total Number)	73.0%
Scrapers (% of Total Number)	8.3%
# Clinger Taxa	11
Clingers (% of Total Number)	90.8%

Animas River Macroinvertebrate Data
A60
25 Sept. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**43**
	Baetidae	*Baetis bicaudatus/ tricaudatus*	19
	Ephemerellidae	*Drunella doddsi*	6
	Heptageniidae	*Epeorus* sp.	7
	Heptageniidae	*Rhithrogena* sp.	11
PLECOPTERA			**56**
	Nemouridae	*Zapada cinctipes*	1
	Nemouridae	*Zapada oregonensis* group	27
	Taeniopterygidae	*Taenionema* sp.	23
	Chloroperlidae	*Sweltsa* sp.	1
	Perlodidae	*Isoperla* sp.	1
	Perlodidae	*Megarcys signata*	3
TRICHOPTERA			**50**
	Hydropsychidae	*Arctopsyche grandis*	40
	Rhyacophilidae	*Rhyacophila brunnea*	1
	Rhyacophilidae	*Rhyacophila coloradensis* group	8
	Rhyacophilidae	*Rhyacophila hyalinata*	1
DIPTERA			
Chironomidae			**71**
	Chironomidae	*Cricotopus/Orthocladius* sp.	63
	Chironomidae	*Eukiefferiella* sp.	3
	Chironomidae	*Micropsectra* sp.	1
	Chironomidae	*Pagastia* sp.	2
	Chironomidae	*Tvetenia* sp.	2
DIPTERA (other)			**137**
	Ceratopogoninae	Ceratopogoninae	3
	Simuliidae	*Simulium* sp.	131
	Tipulidae	*Dicranota* sp.	3
ARACHNIDA			
HYDRACARINA			**9**
	Lebertiidae	*Lebertia* sp.	9
TURBELLARIA			**5**
	Planariidae	*Polycelis coronata*	5
NEMATODA			**10**
	Nematoda	Nematoda	10

Total Number (#/sample)	381
Number of Taxa	25
Shannon Weaver Diversity (H')	3.21
Hilsenhoff Biotic Index (HBI)	3.67
Total EPT Taxa	14.0
EPT Index (% of total number of taxa)	56.0%
Ephemeroptera Abundance (% of total number)	11.3%
# Ephemeroptera Taxa	4
# Plecoptera Taxa	6
# Trichoptera Taxa	4
% EPT (% of Total Number)	39.1%
# Intolerant Taxa	16
Tolerant Organisms (% of Total Number)	3.4%
Dominant Taxon (% of Total Number)	34.4%
Filterers (% of Total Number)	44.9%
Scrapers (% of Total Number)	12.3%
# Clinger Taxa	14
Clingers (% of Total Number)	64.8%

Animas River Macroinvertebrate Data
A68
25 Sept. 2014

		REP 1
INSECTA		
EPHEMEROPTERA		**51**
Ameletidae	*Ameletus* sp.	1
Baetidae	*Baetis tricaudatus*	31
Heptageniidae	*Epeorus* sp.	7
Heptageniidae	*Rhithrogena* sp.	12
PLECOPTERA		**31**
Capniidae	Capniidae (*Capnia*)	1
Nemouridae	*Zapada oregonensis* group	9
Taeniopterygidae	*Taenionema* sp.	20
Chloroperlidae	Chloroperlidae	1
TRICHOPTERA		**25**
Hydropsychidae	*Arctopsyche grandis*	24
Rhyacophilidae	*Rhyacophila sibirica* group	1
DIPTERA		
Chironomidae		**103**
Chironomidae	*Cricotopus*/*Orthocladius* sp.	95
Chironomidae	*Eukiefferiella* sp.	6
Chironomidae	*Tvetenia* sp.	2
DIPTERA (other)		**113**
Ceratopogoninae	Ceratopogoninae	10
Simuliidae	*Simulium* sp.	103
ARACHNIDA		
HYDRACARINA		**3**
Lebertiidae	*Lebertia* sp.	3
NEMATODA		**2**
Nematoda	Nematoda	2

Total Number (#/sample)	328
Number of Taxa	17
Shannon Weaver Diversity (H')	2.83
Hilsenhoff Biotic Index (HBI)	4.19
Total EPT Taxa	10.0
EPT Index (% of total number of taxa)	58.8%
Ephemeroptera Abundance (% of total number)	15.5%
# Ephemeroptera Taxa	4
# Plecoptera Taxa	4

# Trichoptera Taxa	2
% EPT (% of Total Number)	32.6%
# Intolerant Taxa	9
Tolerant Organisms (% of Total Number)	2.7%
Dominant Taxon (% of Total Number)	31.4%
Filterers (% of Total Number)	38.7%
Scrapers (% of Total Number)	11.9%
# Clinger Taxa	8
Clingers (% of Total Number)	48.8%

Animas River Macroinvertebrate Data
CC49
25 Sept. 2014

		REP 1
INSECTA		
DIPTERA		
Chironomidae		**5**
Chironomidae	*Cricotopus*/*Orthocladius* sp.	4
Chironomidae	*Eukiefferiella* sp.	1

Total Number (#/sample)	5
Number of Taxa	2
Shannon Weaver Diversity (H')	0.72
Hilsenhoff Biotic Index (HBI)	8.00
Total EPT Taxa	0.0
EPT Index (% of total number of taxa)	0.0%
Ephemeroptera Abundance (% of total number)	0.0%
# Ephemeroptera Taxa	0
# Plecoptera Taxa	0
# Trichoptera Taxa	0
% EPT (% of Total Number)	0.0%
# Intolerant Taxa	0
Tolerant Organisms (% of Total Number)	20.0%
Dominant Taxon (% of Total Number)	80.0%
Filterers (% of Total Number)	0.0%
Scrapers (% of Total Number)	0.0%
# Clinger Taxa	0
Clingers (% of Total Number)	0.0%

Animas River Macroinvertebrate Data
M34
25 Sept. 2014

		REP 1
INSECTA		
EPHEMEROPTERA		**2**
Baetidae	*Baetis bicaudatus/ tricaudatus*	1
Heptageniidae	*Epeorus* sp.	1
PLECOPTERA		**11**
Nemouridae	*Zapada oregonensis* group	8
Taeniopterygidae	*Taenionema* sp.	1
Chloroperlidae	*Sweltsa* sp.	1
Perlodidae	*Megarcys signata*	1
TRICHOPTERA		**31**
Hydropsychidae	*Arctopsyche grandis*	31
DIPTERA		
Chironomidae		**5**
Chironomidae	*Cricotopus*/*Orthocladius* sp.	1
Chironomidae	*Eukiefferiella* sp.	1
Chironomidae	*Limnophyes* sp.	3
DIPTERA (other)		**1**
Simuliidae	*Simulium* sp.	1
ARACHNIDA		
HYDRACARINA		**1**
Lebertiidae	*Lebertia* sp.	1

Total Number (#/sample)	51
Number of Taxa	12
Shannon Weaver Diversity (H')	2.10
Hilsenhoff Biotic Index (HBI)	1.66
Total EPT Taxa	7.0
EPT Index (% of total number of taxa)	58.3%
Ephemeroptera Abundance (% of total number)	3.9%
# Ephemeroptera Taxa	2
# Plecoptera Taxa	4
# Trichoptera Taxa	1
% EPT (% of Total Number)	86.3%
# Intolerant Taxa	6
Tolerant Organisms (% of Total Number)	3.9%
Dominant Taxon (% of Total Number)	60.8%
Filterers (% of Total Number)	62.7%
Scrapers (% of Total Number)	3.9%
# Clinger Taxa	7
Clingers (% of Total Number)	86.3%

Animas River Macroinvertebrate Data
A72
25 Sept. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**4**
	Baetidae	*Baetis bicaudatus/ tricaudatus*	4
PLECOPTERA			**15**
	Nemouridae	*Zapada oregonensis* group	14
	Taeniopterygidae	*Taenionema* sp.	1
TRICHOPTERA			**44**
	Hydropsychidae	*Arctopsyche grandis*	44
DIPTERA			
Chironomidae			**48**
	Chironomidae	*Cricotopus*/*Orthocladius* sp.	39
	Chironomidae	*Limnophyes* sp.	9
DIPTERA (other)			**2**
	Simuliidae	*Simulium* sp.	1
	Tipulidae	*Tipula* sp.	1
ARACHNIDA			
HYDRACARINA			**3**
	Lebertiidae	*Lebertia* sp.	3

Total Number (#/sample)	116
Number of Taxa	9
Shannon Weaver Diversity (H')	2.19
Hilsenhoff Biotic Index (HBI)	1.87
Total EPT Taxa	4.0
EPT Index (% of total number of taxa)	44.4%
Ephemeroptera Abundance (% of total number)	3.4%
# Ephemeroptera Taxa	1
# Plecoptera Taxa	2
# Trichoptera Taxa	1
% EPT (% of Total Number)	54.3%
# Intolerant Taxa	3
Tolerant Organisms (% of Total Number)	2.6%
Dominant Taxon (% of Total Number)	37.9%
Filterers (% of Total Number)	38.8%
Scrapers (% of Total Number)	0.9%
# Clinger Taxa	4
Clingers (% of Total Number)	53.4%

Animas River Macroinvertebrate Data
A73
16 Oct. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**5**
	Heptageniidae	*Rhithrogena* sp.	5
PLECOPTERA			**25**
	Nemouridae	*Zapada oregonensis* group	16
	Taeniopterygidae	*Taenionema* sp.	5
	Perlodidae	*Isoperla* sp.	1
	Perlodidae	*Megarcys signata*	3
TRICHOPTERA			**94**
	Hydropsychidae	*Arctopsyche grandis*	92
	Rhyacophilidae	*Rhyacophila sibirica* group	2
DIPTERA (other)			**4**
	Ceratopogoninae	Ceratopogoninae	2
	Empididae	*Neoplasta* sp.	1
	Tipulidae	*Prionocera* sp.	1
TURBELLARIA			**1**
	Planariidae	*Polycelis coronata*	1

Total Number (#/sample)	129
Number of Taxa	11
Shannon Weaver Diversity (H')	1.61
Hilsenhoff Biotic Index (HBI)	1.28
Total EPT Taxa	7.0
EPT Index (% of total number of taxa)	63.6%
Ephemeroptera Abundance (% of total number)	3.9%
# Ephemeroptera Taxa	1
# Plecoptera Taxa	4
# Trichoptera Taxa	2
% EPT (% of Total Number)	96.1%
# Intolerant Taxa	8
Tolerant Organisms (% of Total Number)	0.0%
Dominant Taxon (% of Total Number)	71.3%
Filterers (% of Total Number)	71.3%
Scrapers (% of Total Number)	7.8%
# Clinger Taxa	6
Clingers (% of Total Number)	92.2%

Animas River Macroinvertebrate Data
A75EC
16 Oct. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**61**
	Ameletidae	*Ameletus* sp.	1
	Baetidae	*Baetis bicaudatus/ tricaudatus*	1
	Ephemerellidae	*Drunella doddsi*	30
	Heptageniidae	*Rhithrogena* sp.	29
PLECOPTERA			**249**
	Capniidae	Capniidae (*Utacapnia*)	3
	Capniidae	*Eucapnopsis brevicauda*	2
	Leuctridae	*Paraleuctra*sp.	1
	Nemouridae	*Zapada cinctipes*	1
	Nemouridae	*Zapada oregonensis* group	14
	Taeniopterygidae	*Taenionema* sp.	211
	Chloroperlidae	Chloroperlidae	5
	Chloroperlidae	*Sweltsa* sp.	3
	Perlodidae	*Isoperla* sp.	7
	Perlodidae	*Megarcys signata*	2
TRICHOPTERA			**20**
	Glossosomatidae	*Glossosoma* sp.	1
	Hydropsychidae	*Arctopsyche grandis*	2
	Hydropsychidae	*Parapsyche elsis*	2
	Lepidostomatidae	*Lepidostoma* sp.	1
	Limnephilidae	Limnephilidae (*Hesperophylax*)	1
	Rhyacophilidae	*Rhyacophila brunnea*	1
	Rhyacophilidae	*Rhyacophila coloradensis* group	1
	Rhyacophilidae	*Rhyacophila hyalinata*	1
	Rhyacophilidae	*Rhyacophila sibirica* group	1
	Rhyacophilidae	*Rhyacophila vofixa* group	1
	Uenoidae	*Oligophlebodes*sp.	8
DIPTERA			
Chironomidae			**3**
	Chironomidae	*Diamesa* sp.	1
	Chironomidae	*Eukiefferiella* sp.	1
	Chironomidae	*Limnophyes* sp.	1
DIPTERA (other)			**2**
	Tipulidae	*Dicranota* sp.	1
	Tipulidae	*Tipula* sp.	1
TURBELLARIA			**2**
	Planariidae	*Polycelis coronata*	2

Total Number (#/sample)	337
Number of Taxa	31
Shannon Weaver Diversity (H')	2.28
Hilsenhoff Biotic Index (HBI)	1.58
Total EPT Taxa	25.0
EPT Index (% of total number of taxa)	80.6%
Ephemeroptera Abundance (% of total number)	18.1%
# Ephemeroptera Taxa	4
# Plecoptera Taxa	10
# Trichoptera Taxa	11
% EPT (% of Total Number)	97.9%
# Intolerant Taxa	25
Tolerant Organisms (% of Total Number)	0.3%
Dominant Taxon (% of Total Number)	62.6%
Filterers (% of Total Number)	1.2%
Scrapers (% of Total Number)	82.8%
# Clinger Taxa	17
Clingers (% of Total Number)	32.3%

Animas River Macroinvertebrate Data
A75CC
16 Oct. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**167**
	Baetidae	*Baetis bicaudatus/ tricaudatus*	73
	Ephemerellidae	*Drunella doddsi*	13
	Ephemerellidae	*Drunella grandis*	3
	Ephemerellidae	*Ephemerella dorothea infrequens*	5
	Heptageniidae	*Cinygmula*sp.	22
	Heptageniidae	*Epeorus* sp.	30
	Heptageniidae	*Rhithrogena* sp.	21
PLECOPTERA			**33**
	Capniidae	Capniidae (*Capnia*)	10
	Capniidae	Capniidae (*Utacapnia*)	2
	Taeniopterygidae	*Taenionema* sp.	1
	Chloroperlidae	*Sweltsa* sp.	3
	Perlidae	*Hesperoperla pacifica*	15
	Perlodidae	*Diura knowltoni*	1
	Perlodidae	*Isoperla fulva*	1
TRICHOPTERA			**56**
	Hydropsychidae	*Arctopsyche grandis*	3
	Hydropsychidae	*Hydropsyche* (*oslari*)	44
	Rhyacophilidae	*Rhyacophila coloradensis* group	9
DIPTERA			
Chironomidae			**41**
	Chironomidae	*Cricotopus*/*Orthocladius* sp.	39
	Chironomidae	*Diamesa* sp.	1
	Chironomidae	*Limnophyes* sp.	1
DIPTERA (other)			**4**
	Simuliidae	*Simulium* sp.	3
	Tipulidae	*Hexatoma* sp.	1
ARACHNIDA			
HYDRACARINA			**1**
	Lebertiidae	*Lebertia* sp.	1
ANNELIDA			
OLIGOCHAETA			**1**
	Lumbricidae	Lumbricidae	1
NEMATODA			**1**
	Nematoda	Nematoda	1

Total Number (#/sample)	304
Number of Taxa	25
Shannon Weaver Diversity (H')	3.48
Hilsenhoff Biotic Index (HBI)	2.57
Total EPT Taxa	17.0
EPT Index (% of total number of taxa)	68.0%
Ephemeroptera Abundance (% of total number)	54.9%
# Ephemeroptera Taxa	7
# Plecoptera Taxa	7
# Trichoptera Taxa	3
% EPT (% of Total Number)	84.2%
# Intolerant Taxa	15
Tolerant Organisms (% of Total Number)	0.7%
Dominant Taxon (% of Total Number)	24.0%
Filterers (% of Total Number)	16.4%
Scrapers (% of Total Number)	29.9%
# Clinger Taxa	15
Clingers (% of Total Number)	57.2%

Animas River Macroinvertebrate Data
A75D
16 Oct. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**50**
	Baetidae	*Baetis bicaudatus/ tricaudatus*	24
	Ephemerellidae	*Drunella doddsi*	2
	Heptageniidae	*Rhithrogena* sp.	24
PLECOPTERA			**12**
	Capniidae	Capniidae (*Utacapnia*)	4
	Nemouridae	*Zapada cinctipes*	2
	Taeniopterygidae	*Taenionema* sp.	4
	Perlidae	*Hesperoperla pacifica*	2
TRICHOPTERA			**68**
	Hydropsychidae	*Arctopsyche grandis*	66
	Rhyacophilidae	*Rhyacophila coloradensis* group	2
DIPTERA			
Chironomidae			**33**
	Chironomidae	*Cricotopus*/*Orthocladius* sp.	1
	Chironomidae	*Eukiefferiella* sp.	8
	Chironomidae	*Limnophyes* sp.	23
	Chironomidae	*Pagastia* sp.	1
DIPTERA (other)			**15**
	Athericidae	*Atherix pachypus*	1
	Blephariceridae	*Bibiocephala* sp.	2
	Ceratopogoninae	Ceratopogoninae	1
	Empididae	*Hemerodromia* sp.	2
	Empididae	*Neoplasta* sp.	8
	Tipulidae	*Dicranota* sp.	1
ARACHNIDA			
HYDRACARINA			**24**
	Lebertiidae	*Lebertia* sp.	15
	Sperchontidae	*Sperchon* sp.	9

Total Number (#/sample)	202
Number of Taxa	21
Shannon Weaver Diversity (H')	3.27
Hilsenhoff Biotic Index (HBI)	2.46
Total EPT Taxa	9.0
EPT Index (% of total number of taxa)	42.9%
Ephemeroptera Abundance (% of total number)	24.8%
# Ephemeroptera Taxa	3

# Plecoptera Taxa	4
# Trichoptera Taxa	2
% EPT (% of Total Number)	64.4%
# Intolerant Taxa	12
Tolerant Organisms (% of Total Number)	15.8%
Dominant Taxon (% of Total Number)	32.7%
Filterers (% of Total Number)	32.7%
Scrapers (% of Total Number)	15.8%
# Clinger Taxa	9
Clingers (% of Total Number)	61.4%

Animas River Macroinvertebrate Data
Bbridge
26 Sept. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**118**
	Baetidae	*Baetis bicaudatus/ tricaudatus*	116
	Heptageniidae	*Rhithrogena* sp.	2
PLECOPTERA			**3**
	Capniidae	Capniidae (*Capnia*)	1
	Perlodidae	*Diura knowltoni*	1
	Perlodidae	*Isoperla* sp.	1
TRICHOPTERA			**51**
	Brachycentridae	*Brachycentrus occidentalis*	2
	Hydropsychidae	*Arctopsyche grandis*	25
	Hydropsychidae	*Hydropsyche* (*oslari*)	24
DIPTERA			
Chironomidae			**9**
	Chironomidae	*Cricotopus*/*Orthocladius* sp.	3
	Chironomidae	*Eukiefferiella* sp.	5
	Chironomidae	*Limnophyes* sp.	1
DIPTERA (other)			**40**
	Athericidae	*Atherix pachypus*	5
	Empididae	*Neoplasta* sp.	1
	Simuliidae	*Simulium* sp.	33
	Tipulidae	*Hexatoma* sp.	1
ARACHNIDA			
HYDRACARINA			**1**
	Lebertiidae	*Lebertia* sp.	1
NEMATODA			**1**
	Nematoda	Nematoda	1

Total Number (#/sample)	223
Number of Taxa	17
Shannon Weaver Diversity (H')	2.33
Hilsenhoff Biotic Index (HBI)	3.94
Total EPT Taxa	8.0
EPT Index (% of total number of taxa)	47.1%
Ephemeroptera Abundance (% of total number)	52.9%
# Ephemeroptera Taxa	2
# Plecoptera Taxa	3

# Trichoptera Taxa	3
% EPT (% of Total Number)	77.1%
# Intolerant Taxa	8
Tolerant Organisms (% of Total Number)	2.7%
Dominant Taxon (% of Total Number)	52.0%
Filterers (% of Total Number)	37.7%
Scrapers (% of Total Number)	1.3%
# Clinger Taxa	8
Clingers (% of Total Number)	39.9%

Animas River Macroinvertebrate Data
James Ranch
26 Sept. 2014

			REP 1
INSECTA			
EPHEMEROPTERA			**166**
	Baetidae	*Baetis bicaudatus/ tricaudatus*	163
	Ephemerellidae	*Drunella doddsi*	1
	Heptageniidae	*Rhithrogena* sp.	2
PLECOPTERA			**6**
	Capniidae	Capniidae (*Utacapnia*)	1
	Chloroperlidae	*Sweltsa* sp.	2
	Perlidae	*Hesperoperla pacifica*	2
	Perlodidae	*Megarcys signata*	1
TRICHOPTERA			**73**
	Brachycentridae	*Brachycentrus occidentalis*	18
	Hydropsychidae	*Arctopsyche grandis*	14
	Hydropsychidae	*Hydropsyche* (*oslari*)	41
DIPTERA			
Chironomidae			**34**
	Chironomidae	*Brillia* sp.	1
	Chironomidae	*Eukiefferiella* sp.	4
	Chironomidae	*Limnophyes* sp.	27
	Chironomidae	*Micropsectra* sp.	2
DIPTERA (other)			**79**
	Athericidae	*Atherix pachypus*	2
	Empididae	*Wiedemannia* sp.	1
	Simuliidae	*Simulium* sp.	76
ARACHNIDA			
HYDRACARINA			**5**
	Hygrobatidae	*Hygrobates* sp.	1
	Lebertiidae	*Lebertia* sp.	1
	Sperchontidae	*Sperchon* sp.	3

Total Number (#/sample)	363
Number of Taxa	20
Shannon Weaver Diversity (H')	2.51
Hilsenhoff Biotic Index (HBI)	4.26
Total EPT Taxa	10.0
EPT Index (% of total number of taxa)	50.0%
Ephemeroptera Abundance (% of total number)	45.7%
# Ephemeroptera Taxa	3
# Plecoptera Taxa	4

# Trichoptera Taxa	3
% EPT (% of Total Number)	67.5%
# Intolerant Taxa	9
Tolerant Organisms (% of Total Number)	3.0%
Dominant Taxon (% of Total Number)	44.9%
Filterers (% of Total Number)	41.0%
Scrapers (% of Total Number)	0.8%
# Clinger Taxa	12
Clingers (% of Total Number)	44.6%

Animas River MMI Results - 2014

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A53**	Sample Date:	10/11/2014
Waterbody Name:	**Upper Animas River**		
Location:	Abv. Cunnigham		
Latitude:	37.83641982	Reference Status:	Not Reference or Degraded
Longitude:	-107.59762286	BenSampID: 1	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 44.2

Metric Name	Metric Value	Metric Score
Total Taxa:	18	50.0
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	9	N/A
Chironomidae Pct:	15.5	N/A
Sensitive Plains Fammilies Pct:	33.0	N/A
Predator+ Shredder Taxa:	7	50.0
Clinger Taxa:	7	41.2
Clinger Taxa adjuested with Elevation:	7	N/A
Insect Taxa:	16	N/A
Non-Insct % of taxa:	11.1	N/A
Ephemeroptera Pct:	18.2	25.2
BeckBI:	18.0	54.5
Dominant01 Taxon Pct:	26.7	N/A
Sprawler Pct:	23.8	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A55**	Sample Date:	9/24/2014
Waterbody Name:	**Upper Animas River**		
Location:	Howardsville Gauge		
Latitude:	37.832874	Reference Status:	Not Reference or Degraded
Longitude:	-107.59958648	BenSampID: 2	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 52.5

Metric Name	Metric Value	Metric Score
Total Taxa:	19	52.8
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	10	N/A
Chironomidae Pct:	2.0	N/A
Sensitive Plains Fammilies Pct:	29.9	N/A
Predator+ Shredder Taxa:	6	42.9
Clinger Taxa:	8	47.1
Clinger Taxa adjuested with Elevation:	8	N/A
Insect Taxa:	16	N/A
Non-Insct % of taxa:	15.8	N/A
Ephemeroptera Pct:	40.6	56.3
BeckBI:	21.0	63.6
Dominant01 Taxon Pct:	18.8	N/A
Sprawler Pct:	7.7	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A56**	Sample Date:	9/24/2014
Waterbody Name:	**Upper Animas River**		
Location:	Abv. Arastra		
Latitude:	37.82779502	Reference Status:	Not Reference or Degraded
Longitude:	-107.62379115	BenSampID: 3	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 49.2

Metric Name	Metric Value	Metric Score
Total Taxa:	18	50.0
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	11	N/A
Chironomidae Pct:	2.5	N/A
Sensitive Plains Fammilies Pct:	22.2	N/A
Predator+ Shredder Taxa:	9	64.3
Clinger Taxa:	9	52.9
Clinger Taxa adjuested with Elevation:	9	N/A
Insect Taxa:	17	N/A
Non-Insct % of taxa:	5.6	N/A
Ephemeroptera Pct:	10.8	15.0
BeckBI:	21.0	63.6
Dominant01 Taxon Pct:	59.0	N/A
Sprawler Pct:	2.9	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A60**	Sample Date:	9/25/2014
Waterbody Name:	**Upper Animas River**		
Location:	Blw. Arastra		
Latitude:	37.82719229	Reference Status:	Not Reference or Degraded
Longitude:	-107.6266552	BenSampID: 4	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 52.8

Metric Name	Metric Value	Metric Score
Total Taxa:	22	61.1
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	9	N/A
Chironomidae Pct:	21.2	N/A
Sensitive Plains Fammilies Pct:	20.1	N/A
Predator+ Shredder Taxa:	9	64.3
Clinger Taxa:	10	58.8
Clinger Taxa adjuested with Elevation:	10	N/A
Insect Taxa:	19	N/A
Non-Insct % of taxa:	13.6	N/A
Ephemeroptera Pct:	11.5	15.9
BeckBI:	21.0	63.6
Dominant01 Taxon Pct:	32.3	N/A
Sprawler Pct:	7.6	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A68**	Sample Date:	9/25/2014
Waterbody Name:	**Upper Animas River**		
Location:	14th St. Gauge		
Latitude:	37.81120197	Reference Status:	Not Reference or Degraded
Longitude:	-107.659167	BenSampID: 5	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 39.4

Metric Name	Metric Value	Metric Score
Total Taxa:	17	47.2
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	8	N/A
Chironomidae Pct:	31.4	N/A
Sensitive Plains Fammilies Pct:	10.1	N/A
Predator+ Shredder Taxa:	5	35.7
Clinger Taxa:	7	41.2
Clinger Taxa adjuested with Elevation:	7	N/A
Insect Taxa:	15	N/A
Non-Insct % of taxa:	11.8	N/A
Ephemeroptera Pct:	15.5	21.6
BeckBI:	17.0	51.5
Dominant01 Taxon Pct:	31.4	N/A
Sprawler Pct:	8.5	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**CC49**	Sample Date:	9/25/2014
Waterbody Name:	**Cement Creek**		
Location:	Abv. Animas Confluence		
Latitude:	37.80963817	Reference Status:	Not Reference or Degraded
Longitude:	-107.66067559	BenSampID: 12	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 1.1

Metric Name	Metric Value	Metric Score
Total Taxa:	2	5.6
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	0	N/A
Chironomidae Pct:	100.0	N/A
Sensitive Plains Fammilies Pct:	0.0	N/A
Predator+ Shredder Taxa:	0	0.0
Clinger Taxa:	0	0.0
Clinger Taxa adjuested with Elevation:	0	N/A
Insect Taxa:	2	N/A
Non-Insct % of taxa:	0.0	N/A
Ephemeroptera Pct:	0.0	0.0
BeckBI:	0.0	0.0
Dominant01 Taxon Pct:	80.0	N/A
Sprawler Pct:	20.0	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**M34**	Sample Date:	9/25/2014
Waterbody Name:	**Mineral Creek**		
Location:	at Gauge		
Latitude:	37.8028	Reference Status:	Not Reference or Degraded
Longitude:	-107.6722	BenSampID: 14	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 25.4

Metric Name	Metric Value	Metric Score
Total Taxa:	12	33.3
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	6	N/A
Chironomidae Pct:	9.8	N/A
Sensitive Plains Fammilies Pct:	76.5	N/A
Predator+ Shredder Taxa:	4	28.6
Clinger Taxa:	5	29.4
Clinger Taxa adjuested with Elevation:	5	N/A
Insect Taxa:	11	N/A
Non-Insct % of taxa:	8.3	N/A
Ephemeroptera Pct:	3.9	5.4
BeckBI:	10.0	30.3
Dominant01 Taxon Pct:	60.8	N/A
Sprawler Pct:	3.9	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A72**	Sample Date:	9/25/2014
Waterbody Name:	**Animas River**		
Location:	Blw. Silverton		
Latitude:	37.79027049	Reference Status:	Not Reference or Degraded
Longitude:	-107.66757775	BenSampID: 6	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 16.8

Metric Name	Metric Value	Metric Score
Total Taxa:	9	25.0
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	3	N/A
Chironomidae Pct:	41.4	N/A
Sensitive Plains Fammilies Pct:	50.9	N/A
Predator+ Shredder Taxa:	3	21.4
Clinger Taxa:	3	17.6
Clinger Taxa adjuested with Elevation:	3	N/A
Insect Taxa:	8	N/A
Non-Insct % of taxa:	11.1	N/A
Ephemeroptera Pct:	3.4	4.8
BeckBI:	5.0	15.2
Dominant01 Taxon Pct:	37.9	N/A
Sprawler Pct:	0.9	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A73**	Sample Date:	10/16/2014
Waterbody Name:	**Upper Animas River**		
Location:	Abv. Elk Creek		
Latitude:	37.72215833	Reference Status:	Not Reference or Degraded
Longitude:	-107.65482777	BenSampID: 7	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 30.7

Metric Name	Metric Value	Metric Score
Total Taxa:	11	30.6
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	5	N/A
Chironomidae Pct:	0.0	N/A
Sensitive Plains Fammilies Pct:	84.5	N/A
Predator+ Shredder Taxa:	6	42.9
Clinger Taxa:	7	41.2
Clinger Taxa adjuested with Elevation:	7	N/A
Insect Taxa:	10	N/A
Non-Insct % of taxa:	9.1	N/A
Ephemeroptera Pct:	3.9	5.4
BeckBI:	11.0	33.3
Dominant01 Taxon Pct:	71.3	N/A
Sprawler Pct:	3.9	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A75EC**	Sample Date:	10/16/2014
Waterbody Name:	**Elk Creek**		
Location:	Abv. Animas River		
Latitude:	37.72175555	Reference Status:	Not Reference or Degraded
Longitude:	-107.65443055	BenSampID: 10	RepNum: 1
Biotype:	2		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 66.0

Metric Name	Metric Value	Metric Score
Total Taxa:	25	69.4
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	12	N/A
Chironomidae Pct:	0.9	N/A
Sensitive Plains Fammilies Pct:	6.5	N/A
Predator+ Shredder Taxa:	12	85.7
Clinger Taxa:	9	52.9
Clinger Taxa adjuested with Elevation:	9	N/A
Insect Taxa:	24	N/A
Non-Insct % of taxa:	4.0	N/A
Ephemeroptera Pct:	18.1	25.1
BeckBI:	32.0	97.0
Dominant01 Taxon Pct:	62.6	N/A
Sprawler Pct:	64.4	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A75CC**	Sample Date:	10/16/2014
Waterbody Name:	**Cascade Creek**		
Location:	Abv. Animas		
Latitude:	37.59824909	Reference Status:	Not Reference or Degraded
Longitude:	-107.77610081	BenSampID: 8	RepNum: 1
Biotype:	1		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 63.0

Metric Name	Metric Value	Metric Score
Total Taxa:	24	N/A
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	13	100.0
Chironomidae Pct:	13.5	81.4
Sensitive Plains Fammilies Pct:	15.8	25.5
Predator+ Shredder Taxa:	10	71.4
Clinger Taxa:	11	N/A
Clinger Taxa adjuested with Elevation:	11	44.0
Insect Taxa:	21	N/A
Non-Insct % of taxa:	12.5	55.5
Ephemeroptera Pct:	54.9	N/A
BeckBI:	22.0	N/A
Dominant01 Taxon Pct:	24.0	N/A
Sprawler Pct:	0.7	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**A75D**	Sample Date:	10/16/2014
Waterbody Name:	**Animas River**		
Location:	Abv. Cascade Creek		
Latitude:	37.59793423	Reference Status:	Not Reference or Degraded
Longitude:	-107.77532681	BenSampID: 9	RepNum: 1
Biotype:	1		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 52.8

Metric Name	Metric Value	Metric Score
Total Taxa:	21	N/A
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	7	36.7
Chironomidae Pct:	16.3	77.1
Sensitive Plains Fammilies Pct:	34.2	55.3
Predator+ Shredder Taxa:	10	71.4
Clinger Taxa:	7	N/A
Clinger Taxa adjuested with Elevation:	7	10.4
Insect Taxa:	19	N/A
Non-Insct % of taxa:	9.5	66.1
Ephemeroptera Pct:	24.8	N/A
BeckBI:	18.0	N/A
Dominant01 Taxon Pct:	32.7	N/A
Sprawler Pct:	7.9	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**Bbridge**	Sample Date:	9/26/2014
Waterbody Name:	**Animas River**		
Location:	Bbridge-Durango Resort		
Latitude:	37.4589	Reference Status:	Not Reference or Degraded
Longitude:	-107.79955	BenSampID: 11	RepNum: 1
Biotype:	1		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 51.5

Metric Name	Metric Value	Metric Score
Total Taxa:	17	N/A
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	5	45.6
Chironomidae Pct:	4.0	95.8
Sensitive Plains Fammilies Pct:	22.4	36.3
Predator+ Shredder Taxa:	6	42.9
Clinger Taxa:	6	N/A
Clinger Taxa adjuested with Elevation:	6	30.5
Insect Taxa:	15	N/A
Non-Insct % of taxa:	11.8	58.1
Ephemeroptera Pct:	52.9	N/A
BeckBI:	13.0	N/A
Dominant01 Taxon Pct:	52.0	N/A
Sprawler Pct:	4.5	N/A

Colorado Department of Public Health and Environment

Water Quality Control Division

Benthic Macroinvertebrate Bioassessment Report

StationID:	**James R**	Sample Date:	9/26/2014
Waterbody Name:	**Animas River**		
Location:	James Ranch		
Latitude:	37.422021	Reference Status:	Not Reference or Degraded
Longitude:	-107.810336	BenSampID: 13	RepNum: 1
Biotype:	1		

Predictive Model Results

O/E (p>half):

Model Test:

Multimetric Index Model Results

MMI: 57.5

Metric Name	Metric Value	Metric Score
Total Taxa:	19	N/A
Ephemeroptera + Plecoptera Taxa (adjusted with Elevation):	6	56.9
Chironomidae Pct:	7.9	90.0
Sensitive Plains Fammilies Pct:	16.1	26.0
Predator+ Shredder Taxa:	10	71.4
Clinger Taxa:	9	N/A
Clinger Taxa adjuested with Elevation:	9	56.6
Insect Taxa:	16	N/A
Non-Insct % of taxa:	15.8	43.8
Ephemeroptera Pct:	44.9	N/A
BeckBI:	13.0	N/A
Dominant01 Taxon Pct:	43.8	N/A
Sprawler Pct:	1.7	N/A

Appendix 12

ProUCL calculations for total Al in mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 9:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2160	Mean	4575
Maximum	5950	Median	5095
SD	1674	Std. Error of Mean	836.9
Coefficient of Variation	0.366	Skewness	-1.562

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.863	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.311	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6544	95% Adjusted-CLT UCL (Chen-1995)	5253
		95% Modified-t UCL (Johnson-1978)	6436

Gamma GOF Test

A-D Test Statistic	0.541	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.357	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.432	k star (bias corrected MLE)	2.025
Theta hat (MLE)	615.6	Theta star (bias corrected MLE)	2260
nu hat (MLE)	59.46	nu star (bias corrected)	16.2
MLE Mean (bias corrected)	4575	MLE Sd (bias corrected)	3215
		Approximate Chi Square Value (0.05)	8.102
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9147	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.794	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.355	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.678	Mean of logged Data	8.36
Maximum of Logged Data	8.691	SD of logged Data	0.462

Assuming Lognormal Distribution

95% H-UCL	11990	90% Chebyshev (MVUE) UCL	7776
95% Chebyshev (MVUE) UCL	9205	97.5% Chebyshev (MVUE) UCL	11188
99% Chebyshev (MVUE) UCL	15084		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5952	95% Jackknife UCL	6544
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7086	95% Chebyshev(Mean, Sd) UCL	8223
97.5% Chebyshev(Mean, Sd) UCL	9801	99% Chebyshev(Mean, Sd) UCL	12902

Suggested UCL to Use

95% Student's-t UCL	6544

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al in mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 9:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	665	Mean	1353
Maximum	2610	Median	1130
SD	757.6	Std. Error of Mean	286.3
Coefficient of Variation	0.56	Skewness	1.026

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.846	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.258	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1910	95% Adjusted-CLT UCL (Chen-1995)	1943
		95% Modified-t UCL (Johnson-1978)	1928

Gamma GOF Test

A-D Test Statistic	0.432	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.196	k star (bias corrected MLE)	2.493
Theta hat (MLE)	322.5	Theta star (bias corrected MLE)	542.7
nu hat (MLE)	58.75	nu star (bias corrected)	34.9
MLE Mean (bias corrected)	1353	MLE Sd (bias corrected)	857
		Approximate Chi Square Value (0.05)	22.39
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	19.42

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2110	95% Adjusted Gamma UCL (use when n<50)	2432

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.911	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.189	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.5	Mean of logged Data	7.086
Maximum of Logged Data	7.867	SD of logged Data	0.526

Assuming Lognormal Distribution

95% H-UCL	2358	90% Chebyshev (MVUE) UCL	2150
95% Chebyshev (MVUE) UCL	2515	97.5% Chebyshev (MVUE) UCL	3021
99% Chebyshev (MVUE) UCL	4017		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1824	95% Jackknife UCL	1910
95% Standard Bootstrap UCL	1788	95% Bootstrap-t UCL	2658
95% Hall's Bootstrap UCL	5097	95% Percentile Bootstrap UCL	1848
95% BCA Bootstrap UCL	1871		
90% Chebyshev(Mean, Sd) UCL	2212	95% Chebyshev(Mean, Sd) UCL	2601
97.5% Chebyshev(Mean, Sd) UCL	3141	99% Chebyshev(Mean, Sd) UCL	4202

Suggested UCL to Use

95% Student's-t UCL	1910

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al in mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 9:51
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	563	Mean	2267
Maximum	4590	Median	2480
SD	1132	Std. Error of Mean	314
Coefficient of Variation	0.5	Skewness	0.345

Normal GOF Test			
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.121	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2826	95% Adjusted-CLT UCL (Chen-1995)	2815
		95% Modified-t UCL (Johnson-1978)	2831

Gamma GOF Test			
A-D Test Statistic	0.304	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.175	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.238	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	3.703	k star (bias corrected MLE)	2.899
Theta hat (MLE)	612.2	Theta star (bias corrected MLE)	781.7
nu hat (MLE)	96.27	nu star (bias corrected)	75.39
MLE Mean (bias corrected)	2267	MLE Sd (bias corrected)	1331
		Approximate Chi Square Value (0.05)	56.39
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	54.05

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3030	95% Adjusted Gamma UCL (use when n<50)	3161

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.19	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	6.333	Mean of logged Data	7.585
Maximum of Logged Data	8.432	SD of logged Data	0.593

Assuming Lognormal Distribution			
95% H-UCL	3434	90% Chebyshev (MVUE) UCL	3490
95% Chebyshev (MVUE) UCL	4025	97.5% Chebyshev (MVUE) UCL	4767
99% Chebyshev (MVUE) UCL	6224		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	2783	95% Jackknife UCL	2826
95% Standard Bootstrap UCL	2761	95% Bootstrap-t UCL	2846
95% Hall's Bootstrap UCL	2891	95% Percentile Bootstrap UCL	2789
95% BCA Bootstrap UCL	2776		
90% Chebyshev(Mean, Sd) UCL	3209	95% Chebyshev(Mean, Sd) UCL	3635
97.5% Chebyshev(Mean, Sd) UCL	4228	99% Chebyshev(Mean, Sd) UCL	5391

Suggested UCL to Use

95% Student's-t UCL	2826

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:21
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5020	Mean	7318
Maximum	8610	Median	7820
SD	1593	Std. Error of Mean	796.4
Coefficient of Variation	0.218	Skewness	-1.564

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.306	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9192	95% Adjusted-CLT UCL (Chen-1995)	7962
		95% Modified-t UCL (Johnson-1978)	9088

Gamma GOF Test

A-D Test Statistic	0.498	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.336	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	24.37	k star (bias corrected MLE)	6.259
Theta hat (MLE)	300.3	Theta star (bias corrected MLE)	1169
nu hat (MLE)	194.9	nu star (bias corrected)	50.07
MLE Mean (bias corrected)	7318	MLE Sd (bias corrected)	2925
		Approximate Chi Square Value (0.05)	34.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10521	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.823	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.332	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.521	Mean of logged Data	8.877
Maximum of Logged Data	9.061	SD of logged Data	0.244

Assuming Lognormal Distribution

95% H-UCL	10629	90% Chebyshev (MVUE) UCL	9994
95% Chebyshev (MVUE) UCL	11201	97.5% Chebyshev (MVUE) UCL	12877
99% Chebyshev (MVUE) UCL	16169		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	8627	95% Jackknife UCL	9192
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	9707	95% Chebyshev(Mean, Sd) UCL	10789
97.5% Chebyshev(Mean, Sd) UCL	12291	99% Chebyshev(Mean, Sd) UCL	15241

Suggested UCL to Use

95% Student's-t UCL	9192

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al in mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:21
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	1610	Mean	2389
Maximum	3280	Median	2690
SD	663.7	Std. Error of Mean	250.9
Coefficient of Variation	0.278	Skewness	-0.0355

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.249	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2876	95% Adjusted-CLT UCL (Chen-1995)	2798
		95% Modified-t UCL (Johnson-1978)	2875

Gamma GOF Test

A-D Test Statistic	0.573	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.28	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.52	k star (bias corrected MLE)	8.39
Theta hat (MLE)	164.6	Theta star (bias corrected MLE)	284.7
nu hat (MLE)	203.2	nu star (bias corrected)	117.5
MLE Mean (bias corrected)	2389	MLE Sd (bias corrected)	824.6
		Approximate Chi Square Value (0.05)	93.43
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	86.97

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3003	95% Adjusted Gamma UCL (use when n<50)	3226

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.863	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.274	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.384	Mean of logged Data	7.744
Maximum of Logged Data	8.096	SD of logged Data	0.289

Assuming Lognormal Distribution

95% H-UCL	3110	90% Chebyshev (MVUE) UCL	3174
95% Chebyshev (MVUE) UCL	3529	97.5% Chebyshev (MVUE) UCL	4021
99% Chebyshev (MVUE) UCL	4989		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2801	95% Jackknife UCL	2876
95% Standard Bootstrap UCL	2776	95% Bootstrap-t UCL	2870
95% Hall's Bootstrap UCL	2698	95% Percentile Bootstrap UCL	2770
95% BCA Bootstrap UCL	2757		
90% Chebyshev(Mean, Sd) UCL	3141	95% Chebyshev(Mean, Sd) UCL	3482
97.5% Chebyshev(Mean, Sd) UCL	3955	99% Chebyshev(Mean, Sd) UCL	4885

Suggested UCL to Use

95% Student's-t UCL	2876

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al in mainstem Cement Creek during the post-runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 10:21		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	2710	Mean	6360
Maximum	7930	Median	6930
SD	1584	Std. Error of Mean	423.3
Coefficient of Variation	0.249	Skewness	-1.141
Normal GOF Test			
Shapiro Wilk Test Statistic	0.871	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.245	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7110	95% Adjusted-CLT UCL (Chen-1995)	6918
		95% Modified-t UCL (Johnson-1978)	7088
Gamma GOF Test			
A-D Test Statistic	0.926	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.269	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.39	k star (bias corrected MLE)	10.57
Theta hat (MLE)	474.8	Theta star (bias corrected MLE)	601.6
nu hat (MLE)	375.1	nu star (bias corrected)	296
MLE Mean (bias corrected)	6360	MLE Sd (bias corrected)	1956
		Approximate Chi Square Value (0.05)	257.2
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	252.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7321	95% Adjusted Gamma UCL (use when n<50)	7460
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.801	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.271	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.905	Mean of logged Data	8.72
Maximum of Logged Data	8.978	SD of logged Data	0.307
Assuming Lognormal Distribution			
95% H-UCL	7547	90% Chebyshev (MVUE) UCL	7990
95% Chebyshev (MVUE) UCL	8712	97.5% Chebyshev (MVUE) UCL	9713
99% Chebyshev (MVUE) UCL	11681		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7056	95% Jackknife UCL	7110
95% Standard Bootstrap UCL	7053	95% Bootstrap-t UCL	6994
95% Hall's Bootstrap UCL	6953	95% Percentile Bootstrap UCL	6996
95% BCA Bootstrap UCL	6899		
90% Chebyshev(Mean, Sd) UCL	7630	95% Chebyshev(Mean, Sd) UCL	8205
97.5% Chebyshev(Mean, Sd) UCL	9003	99% Chebyshev(Mean, Sd) UCL	10572
Suggested UCL to Use			
95% Student's-t UCL	7110	or 95% Modified-t UCL	7088

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al in Animas River above mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:28
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	177	Mean	305.4
Maximum	438	Median	275
SD	100.3	Std. Error of Mean	44.85
Coefficient of Variation	0.328	Skewness	0.158

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.968	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.219	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	401	95% Adjusted-CLT UCL (Chen-1995)	382.6
		95% Modified-t UCL (Johnson-1978)	401.6

Gamma GOF Test

A-D Test Statistic	0.246	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.03	k star (bias corrected MLE)	4.543
Theta hat (MLE)	27.7	Theta star (bias corrected MLE)	67.22
nu hat (MLE)	110.3	nu star (bias corrected)	45.43
MLE Mean (bias corrected)	305.4	MLE Sd (bias corrected)	143.3
		Approximate Chi Square Value (0.05)	30.97
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	25.86

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	448	95% Adjusted Gamma UCL (use when n<50)	536.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.208	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.176	Mean of logged Data	5.676
Maximum of Logged Data	6.082	SD of logged Data	0.346

Assuming Lognormal Distribution

95% H-UCL	478.1	90% Chebyshev (MVUE) UCL	447.2
95% Chebyshev (MVUE) UCL	511.3	97.5% Chebyshev (MVUE) UCL	600.2
99% Chebyshev (MVUE) UCL	774.8		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	379.2	95% Jackknife UCL	401
95% Standard Bootstrap UCL	371.6	95% Bootstrap-t UCL	440.3
95% Hall's Bootstrap UCL	501.9	95% Percentile Bootstrap UCL	371.8
95% BCA Bootstrap UCL	363.4		
90% Chebyshev(Mean, Sd) UCL	440	95% Chebyshev(Mean, Sd) UCL	500.9
97.5% Chebyshev(Mean, Sd) UCL	585.5	99% Chebyshev(Mean, Sd) UCL	751.7

Suggested UCL to Use

95% Student's-t UCL	401

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al in Animas River above mainstem Cement Creek during the runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 10:28		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics			
Total Number of Observations	17	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	154	Mean	480.1
Maximum	1010	Median	508
SD	202.5	Std. Error of Mean	49.12
Coefficient of Variation	0.422	Skewness	0.761
Normal GOF Test			
Shapiro Wilk Test Statistic	0.932	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.19	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.215	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	565.8	95% Adjusted-CLT UCL (Chen-1995)	570.5
		95% Modified-t UCL (Johnson-1978)	567.3
Gamma GOF Test			
A-D Test Statistic	0.505	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.149	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.21	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.477	k star (bias corrected MLE)	4.55
Theta hat (MLE)	87.65	Theta star (bias corrected MLE)	105.5
nu hat (MLE)	186.2	nu star (bias corrected)	154.7
MLE Mean (bias corrected)	480.1	MLE Sd (bias corrected)	225.1
		Approximate Chi Square Value (0.05)	126.9
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	124.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	585	95% Adjusted Gamma UCL (use when n<50)	597.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.176	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.215	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.037	Mean of logged Data	6.08
Maximum of Logged Data	6.918	SD of logged Data	0.474
Assuming Lognormal Distribution			
95% H-UCL	620.1	90% Chebyshev (MVUE) UCL	657.6
95% Chebyshev (MVUE) UCL	735.6	97.5% Chebyshev (MVUE) UCL	843.9
99% Chebyshev (MVUE) UCL	1057		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	560.9	95% Jackknife UCL	565.8
95% Standard Bootstrap UCL	557.9	95% Bootstrap-t UCL	570.7
95% Hall's Bootstrap UCL	595.3	95% Percentile Bootstrap UCL	561.4
95% BCA Bootstrap UCL	568.4		
90% Chebyshev(Mean, Sd) UCL	627.4	95% Chebyshev(Mean, Sd) UCL	694.2
97.5% Chebyshev(Mean, Sd) UCL	786.8	99% Chebyshev(Mean, Sd) UCL	968.8
Suggested UCL to Use			
95% Student's-t UCL	565.8		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al in Animas River above mainstem Cement Creek during the post- runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:28
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	18	Number of Distinct Observations	13
Number of Detects	13	Number of Non-Detects	5
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	101	Minimum Non-Detect	100
Maximum Detect	217	Maximum Non-Detect	100
Variance Detects	1081	Percent Non-Detects	27.78%
Mean Detects	153.2	SD Detects	32.87
Median Detects	160	CV Detects	0.215
Skewness Detects	0.191	Kurtosis Detects	-0.402
Mean of Logged Detects	5.01	SD of Logged Detects	0.219

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.97	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.121	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	138.4	Standard Error of Mean	8.808
SD	35.9	95% KM (BCA) UCL	152.8
95% KM (t) UCL	153.8	95% KM (Percentile Bootstrap) UCL	151.9
95% KM (z) UCL	152.9	95% KM Bootstrap t UCL	155.5
90% KM Chebyshev UCL	164.9	95% KM Chebyshev UCL	176.8
97.5% KM Chebyshev UCL	193.4	99% KM Chebyshev UCL	226.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.267	Anderson-Darling GOF Test	
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.148	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.236	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	23.13	k star (bias corrected MLE)	17.85
Theta hat (MLE)	6.623	Theta star (bias corrected MLE)	8.586
nu hat (MLE)	601.5	nu star (bias corrected)	464
MLE Mean (bias corrected)	153.2	MLE Sd (bias corrected)	36.27

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	14.87	nu hat (KM)	535.3
Approximate Chi Square Value (535.34, α)	482.7	Adjusted Chi Square Value (535.34, β)	477.9
95% Gamma Approximate KM-UCL (use when n>=50)	153.5	95% Gamma Adjusted KM-UCL (use when n<50)	155.1

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	60.29	Mean	133.2
Maximum	217	Median	129
SD	43.74	CV	0.328
k hat (MLE)	9.094	k star (bias corrected MLE)	7.616
Theta hat (MLE)	14.65	Theta star (bias corrected MLE)	17.5
nu hat (MLE)	327.4	nu star (bias corrected)	274.2
MLE Mean (bias corrected)	133.2	MLE Sd (bias corrected)	48.29
		Adjusted Level of Significance (β)	0.0357
Approximate Chi Square Value (274.16, α)	236.8	Adjusted Chi Square Value (274.16, β)	233.5
95% Gamma Approximate UCL (use when n>=50)	154.3	95% Gamma Adjusted UCL (use when n<50)	156.5

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.968	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	135.3	Mean in Log Scale	4.863
SD in Original Scale	40.94	SD in Log Scale	0.312
95% t UCL (assumes normality of ROS data)	152.1	95% Percentile Bootstrap UCL	152.3
95% BCA Bootstrap UCL	150.2	95% Bootstrap t UCL	152.8
95% H-UCL (Log ROS)	156.4		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.898	95% H-UCL (KM -Log)	154.9
KM SD (logged)	0.255	95% Critical H Value (KM-Log)	1.822
KM Standard Error of Mean (logged)	0.0625		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	124.6	Mean in Log Scale	4.705
SD in Original Scale	55.01	SD in Log Scale	0.539
95% t UCL (Assumes normality)	147.1	95% H-Stat UCL	167.2

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	153.8	95% KM (Percentile Bootstrap) UCL	151.9

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Al at sampling location A72 in the Animas River below mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:40
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1980	Mean	3455
Maximum	4440	Median	3700
SD	1091	Std. Error of Mean	545.4
Coefficient of Variation	0.316	Skewness	-1.027

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.929	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.22	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4739	95% Adjusted-CLT UCL (Chen-1995)	4053
		95% Modified-t UCL (Johnson-1978)	4692

Gamma GOF Test

A-D Test Statistic	0.365	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.27	k star (bias corrected MLE)	2.985
Theta hat (MLE)	306.5	Theta star (bias corrected MLE)	1158
nu hat (MLE)	90.18	nu star (bias corrected)	23.88
MLE Mean (bias corrected)	3455	MLE Sd (bias corrected)	2000
		Approximate Chi Square Value (0.05)	13.76
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5997	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.882	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.252	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.591	Mean of logged Data	8.103
Maximum of Logged Data	8.398	SD of logged Data	0.363

Assuming Lognormal Distribution

95% H-UCL	6638	90% Chebyshev (MVUE) UCL	5338
95% Chebyshev (MVUE) UCL	6185	97.5% Chebyshev (MVUE) UCL	7360
99% Chebyshev (MVUE) UCL	9669		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4352	95% Jackknife UCL	4739
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5091	95% Chebyshev(Mean, Sd) UCL	5833
97.5% Chebyshev(Mean, Sd) UCL	6861	99% Chebyshev(Mean, Sd) UCL	8882

Suggested UCL to Use

95% Student's-t UCL	4739

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al at sampling location A72 in the Animas River below mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:41
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	585	Mean	1359
Maximum	3060	Median	938
SD	960.6	Std. Error of Mean	363.1
Coefficient of Variation	0.707	Skewness	1.246

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.807	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.28	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2065	95% Adjusted-CLT UCL (Chen-1995)	2139
		95% Modified-t UCL (Johnson-1978)	2093

Gamma GOF Test

A-D Test Statistic	0.53	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.713	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.219	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.8	k star (bias corrected MLE)	1.695
Theta hat (MLE)	485.4	Theta star (bias corrected MLE)	801.8
nu hat (MLE)	39.2	nu star (bias corrected)	23.74
MLE Mean (bias corrected)	1359	MLE Sd (bias corrected)	1044
		Approximate Chi Square Value (0.05)	13.65
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	11.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2364	95% Adjusted Gamma UCL (use when n<50)	2828

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.372	Mean of logged Data	7.026
Maximum of Logged Data	8.026	SD of logged Data	0.641

Assuming Lognormal Distribution

95% H-UCL	2849	90% Chebyshev (MVUE) UCL	2315
95% Chebyshev (MVUE) UCL	2758	97.5% Chebyshev (MVUE) UCL	3372
99% Chebyshev (MVUE) UCL	4580		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1957	95% Jackknife UCL	2065
95% Standard Bootstrap UCL	1910	95% Bootstrap-t UCL	3483
95% Hall's Bootstrap UCL	5705	95% Percentile Bootstrap UCL	1908
95% BCA Bootstrap UCL	2053		
90% Chebyshev(Mean, Sd) UCL	2449	95% Chebyshev(Mean, Sd) UCL	2942
97.5% Chebyshev(Mean, Sd) UCL	3627	99% Chebyshev(Mean, Sd) UCL	4972

Suggested UCL to Use

95% Student's-t UCL	2065

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al at sampling location A72 in the Animas River below mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 10:41
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	597	Mean	1777
Maximum	2750	Median	2070
SD	711.7	Std. Error of Mean	197.4
Coefficient of Variation	0.401	Skewness	-0.305
Normal GOF Test			
Shapiro Wilk Test Statistic	0.932	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2129	95% Adjusted-CLT UCL (Chen-1995)	2084
		95% Modified-t UCL (Johnson-1978)	2126
Gamma GOF Test			
A-D Test Statistic	0.538	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.233	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.466	k star (bias corrected MLE)	4.256
Theta hat (MLE)	325.1	Theta star (bias corrected MLE)	417.5
nu hat (MLE)	142.1	nu star (bias corrected)	110.7
MLE Mean (bias corrected)	1777	MLE Sd (bias corrected)	861.3
		Approximate Chi Square Value (0.05)	87.37
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	84.43
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2250	95% Adjusted Gamma UCL (use when n<50)	2329
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.392	Mean of logged Data	7.388
Maximum of Logged Data	7.919	SD of logged Data	0.483
Assuming Lognormal Distribution			
95% H-UCL	2433	90% Chebyshev (MVUE) UCL	2540
95% Chebyshev (MVUE) UCL	2876	97.5% Chebyshev (MVUE) UCL	3341
99% Chebyshev (MVUE) UCL	4256		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2102	95% Jackknife UCL	2129
95% Standard Bootstrap UCL	2087	95% Bootstrap-t UCL	2094
95% Hall's Bootstrap UCL	2065	95% Percentile Bootstrap UCL	2077
95% BCA Bootstrap UCL	2069		
90% Chebyshev(Mean, Sd) UCL	2369	95% Chebyshev(Mean, Sd) UCL	2637
97.5% Chebyshev(Mean, Sd) UCL	3010	99% Chebyshev(Mean, Sd) UCL	3741
Suggested UCL to Use			
95% Student's-t UCL	2129		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al at sampling location A73 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 10:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	933	Mean	1461
Maximum	2420	Median	1280
SD	597	Std. Error of Mean	267
Coefficient of Variation	0.409	Skewness	1.303

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.219	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2030	95% Adjusted-CLT UCL (Chen-1995)	2066
		95% Modified-t UCL (Johnson-1978)	2056

Gamma GOF Test		
A-D Test Statistic	0.289	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	8.448	k star (bias corrected MLE)	3.513
Theta hat (MLE)	172.9	Theta star (bias corrected MLE)	415.8
nu hat (MLE)	84.48	nu star (bias corrected)	35.13
MLE Mean (bias corrected)	1461	MLE Sd (bias corrected)	779.3
		Approximate Chi Square Value (0.05)	22.57
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.3

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2274	95% Adjusted Gamma UCL (use when n<50)	2804

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.175	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	6.838	Mean of logged Data	7.226
Maximum of Logged Data	7.792	SD of logged Data	0.379

Assuming Lognormal Distribution			
95% H-UCL	2416	90% Chebyshev (MVUE) UCL	2192
95% Chebyshev (MVUE) UCL	2526	97.5% Chebyshev (MVUE) UCL	2989
99% Chebyshev (MVUE) UCL	3898		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	1900	95% Jackknife UCL	2030
95% Standard Bootstrap UCL	1860	95% Bootstrap-t UCL	2776
95% Hall's Bootstrap UCL	4080	95% Percentile Bootstrap UCL	1872
95% BCA Bootstrap UCL	1986		
90% Chebyshev(Mean, Sd) UCL	2262	95% Chebyshev(Mean, Sd) UCL	2624
97.5% Chebyshev(Mean, Sd) UCL	3128	99% Chebyshev(Mean, Sd) UCL	4117

Suggested UCL to Use

95% Student's-t UCL	2030

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al at sampling location A73B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 10:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	612	Mean	974.5
Maximum	1980	Median	653
SD	670.7	Std. Error of Mean	335.3
Coefficient of Variation	0.688	Skewness	1.994

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.661	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.427	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level
Data appear Approximate Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1764	95% Adjusted-CLT UCL (Chen-1995)	1883
		95% Modified-t UCL (Johnson-1978)	1819

Gamma GOF Test		
A-D Test Statistic	0.849	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.447	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.396	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	3.747	k star (bias corrected MLE)	1.103
Theta hat (MLE)	260.1	Theta star (bias corrected MLE)	883.2
nu hat (MLE)	29.98	nu star (bias corrected)	8.827
MLE Mean (bias corrected)	974.5	MLE Sd (bias corrected)	927.7
		Approximate Chi Square Value (0.05)	3.223
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2669	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.687	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.415	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level
Data appear Approximate Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	6.417	Mean of logged Data	6.743
Maximum of Logged Data	7.591	SD of logged Data	0.567

Assuming Lognormal Distribution			
95% H-UCL	3704	90% Chebyshev (MVUE) UCL	1745
95% Chebyshev (MVUE) UCL	2103	97.5% Chebyshev (MVUE) UCL	2600
99% Chebyshev (MVUE) UCL	3577		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	1526	95% Jackknife UCL	1764
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1981	95% Chebyshev(Mean, Sd) UCL	2436
97.5% Chebyshev(Mean, Sd) UCL	3069	99% Chebyshev(Mean, Sd) UCL	4311

Suggested UCL to Use

95% Student's-t UCL	1764

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al at sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 10:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	534	Mean	1255
Maximum	1790	Median	1260
SD	496.2	Std. Error of Mean	221.9
Coefficient of Variation	0.395	Skewness	-0.6

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.175	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1728	95% Adjusted-CLT UCL (Chen-1995)	1556
		95% Modified-t UCL (Johnson-1978)	1718

Gamma GOF Test

A-D Test Statistic	0.308	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.38	k star (bias corrected MLE)	2.685
Theta hat (MLE)	196.7	Theta star (bias corrected MLE)	467.3
nu hat (MLE)	63.8	nu star (bias corrected)	26.85
MLE Mean (bias corrected)	1255	MLE Sd (bias corrected)	765.7
		Approximate Chi Square Value (0.05)	16.04
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	12.53

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2101	95% Adjusted Gamma UCL (use when n<50)	2688

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.895	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.28	Mean of logged Data	7.054
Maximum of Logged Data	7.49	SD of logged Data	0.48

Assuming Lognormal Distribution

95% H-UCL	2594	90% Chebyshev (MVUE) UCL	2077
95% Chebyshev (MVUE) UCL	2444	97.5% Chebyshev (MVUE) UCL	2952
99% Chebyshev (MVUE) UCL	3952		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1620	95% Jackknife UCL	1728
95% Standard Bootstrap UCL	1583	95% Bootstrap-t UCL	1729
95% Hall's Bootstrap UCL	1611	95% Percentile Bootstrap UCL	1580
95% BCA Bootstrap UCL	1507		
90% Chebyshev(Mean, Sd) UCL	1920	95% Chebyshev(Mean, Sd) UCL	2222
97.5% Chebyshev(Mean, Sd) UCL	2641	99% Chebyshev(Mean, Sd) UCL	3463

Suggested UCL to Use

95% Student's-t UCL	1728

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Al at sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 10:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	562	Mean	1021
Maximum	1650	Median	935
SD	463	Std. Error of Mean	231.5
Coefficient of Variation	0.454	Skewness	0.982

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.233	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1565	95% Adjusted-CLT UCL (Chen-1995)	1523
		95% Modified-t UCL (Johnson-1978)	1584

Gamma GOF Test

A-D Test Statistic	0.214	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.746	k star (bias corrected MLE)	1.853
Theta hat (MLE)	151.3	Theta star (bias corrected MLE)	550.6
nu hat (MLE)	53.97	nu star (bias corrected)	14.83
MLE Mean (bias corrected)	1021	MLE Sd (bias corrected)	749.6
		Approximate Chi Square Value (0.05)	7.141
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2119	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.166	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.332	Mean of logged Data	6.852
Maximum of Logged Data	7.409	SD of logged Data	0.45

Assuming Lognormal Distribution

95% H-UCL	2533	90% Chebyshev (MVUE) UCL	1696
95% Chebyshev (MVUE) UCL	2003	97.5% Chebyshev (MVUE) UCL	2429
99% Chebyshev (MVUE) UCL	3265		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1401	95% Jackknife UCL	1565
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1715	95% Chebyshev(Mean, Sd) UCL	2030
97.5% Chebyshev(Mean, Sd) UCL	2466	99% Chebyshev(Mean, Sd) UCL	3324

Suggested UCL to Use

95% Student's-t UCL	1565

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Al at Bakers Bridge in the Animas River below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/23/2015 10:49		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	234	Mean	704
Maximum	1310	Median	734
SD	418.7	Std. Error of Mean	187.3
Coefficient of Variation	0.595	Skewness	0.528

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.17	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1103	95% Adjusted-CLT UCL (Chen-1995)	1059
		95% Modified-t UCL (Johnson-1978)	1111
Gamma GOF Test			
A-D Test Statistic	0.214	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.203	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.182	k star (bias corrected MLE)	1.406
Theta hat (MLE)	221.2	Theta star (bias corrected MLE)	500.6
nu hat (MLE)	31.82	nu star (bias corrected)	14.06
MLE Mean (bias corrected)	704	MLE Sd (bias corrected)	593.7
		Approximate Chi Square Value (0.05)	6.614
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	4.56
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1497	95% Adjusted Gamma UCL (use when n<50)	2171
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.455	Mean of logged Data	6.392
Maximum of Logged Data	7.178	SD of logged Data	0.674
Assuming Lognormal Distribution			
95% H-UCL	2490	90% Chebyshev (MVUE) UCL	1345
95% Chebyshev (MVUE) UCL	1632	97.5% Chebyshev (MVUE) UCL	2030
99% Chebyshev (MVUE) UCL	2812		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1012	95% Jackknife UCL	1103
95% Standard Bootstrap UCL	973.5	95% Bootstrap-t UCL	1161
95% Hall's Bootstrap UCL	1029	95% Percentile Bootstrap UCL	986.2
95% BCA Bootstrap UCL	986.2		
90% Chebyshev(Mean, Sd) UCL	1266	95% Chebyshev(Mean, Sd) UCL	1520
97.5% Chebyshev(Mean, Sd) UCL	1873	99% Chebyshev(Mean, Sd) UCL	2567
Suggested UCL to Use			
95% Student's-t UCL	1103		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Be in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:20
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Be pre run

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	1
Maximum Detect	1.3	Maximum Non-Detect	1
Variance Detects	0.01	Percent Non-Detects	25%
Mean Detects	1.2	SD Detects	0.1
Median Detects	1.2	CV Detects	0.0833
Skewness Detects	1.01E-14	Kurtosis Detects	N/A
Mean of Logged Detects	0.18	SD of Logged Detects	0.0836

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	1	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.175	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.15	Standard Error of Mean	0.0685
SD	0.112	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.311	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.263	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.355	95% KM Chebyshev UCL	1.448
97.5% KM Chebyshev UCL	1.578	99% KM Chebyshev UCL	1.831

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	215.4	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00557	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1292	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	105.8	nu hat (KM)	846.4
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (846.40, α)	779.9	Adjusted Chi Square Value (846.40, β)	744.1
95% Gamma Approximate KM-UCL (use when n>=50)	1.248	95% Gamma Adjusted KM-UCL (use when n<50)	1.308

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.136	Mean in Log Scale	0.12
SD in Original Scale	0.152	SD in Log Scale	0.138
95% t UCL (assumes normality of ROS data)	1.315	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.367		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.135	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0978	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0599		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.025	Mean in Log Scale	-0.0383
SD in Original Scale	0.359	SD in Log Scale	0.442
95% t UCL (Assumes normality)	1.448	95% H-Stat UCL	2.505

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.311	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Be in mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:20
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	14	Number of Distinct Observations	6
Number of Detects	6	Number of Non-Detects	8
Number of Distinct Detects	2	Number of Distinct Non-Detects	4
Minimum Detect	1.1	Minimum Non-Detect	0.2
Maximum Detect	1.2	Maximum Non-Detect	10
Variance Detects	0.00267	Percent Non-Detects	57.14%
Mean Detects	1.133	SD Detects	0.0516
Median Detects	1.1	CV Detects	0.0456
Skewness Detects	0.968	Kurtosis Detects	-1.875
Mean of Logged Detects	0.124	SD of Logged Detects	0.0449

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.64	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.407	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.709	Standard Error of Mean	0.154
SD	0.466	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.982	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.962	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.171	95% KM Chebyshev UCL	1.38
97.5% KM Chebyshev UCL	1.67	99% KM Chebyshev UCL	2.241

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.239	Anderson-Darling GOF Test	
5% A-D Critical Value	0.696	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.427	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.332	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	589	k star (bias corrected MLE)	294.6
Theta hat (MLE)	0.00192	Theta star (bias corrected MLE)	0.00385
nu hat (MLE)	7068	nu star (bias corrected)	3535
MLE Mean (bias corrected)	1.133	MLE Sd (bias corrected)	0.066

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.315	nu hat (KM)	64.82
Approximate Chi Square Value (64.82, α)	47.3	Adjusted Chi Square Value (64.82, β)	45.32
95% Gamma Approximate KM-UCL (use when n>=50)	0.972	95% Gamma Adjusted KM-UCL (use when n<50)	1.014

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.957	Mean	1.074
Maximum	1.2	Median	1.087
SD	0.0711	CV	0.0662
k hat (MLE)	248.2	k star (bias corrected MLE)	195.1
Theta hat (MLE)	0.00433	Theta star (bias corrected MLE)	0.00551
nu hat (MLE)	6950	nu star (bias corrected)	5462
MLE Mean (bias corrected)	1.074	MLE Sd (bias corrected)	0.0769
		Adjusted Level of Significance (β)	0.0312
Approximate Chi Square Value (N/A, α)	5291	Adjusted Chi Square Value (N/A, β)	5269
95% Gamma Approximate UCL (use when n>=50)	1.109	95% Gamma Adjusted UCL (use when n<50)	1.114

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.64	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.407	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.077	Mean in Log Scale	0.0722
SD in Original Scale	0.0684	SD in Log Scale	0.0629
95% t UCL (assumes normality of ROS data)	1.109	95% Percentile Bootstrap UCL	1.107
95% BCA Bootstrap UCL	1.11	95% Bootstrap t UCL	1.114
95% H-UCL (Log ROS)	N/A		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.421	Mean in Log Scale	-0.0793
SD in Original Scale	1.555	SD in Log Scale	0.977
95% t UCL (Assumes normality)	2.158	95% H-Stat UCL	3.143

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.982	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:27
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	1	Mean	1.3
Maximum	2	Median	1.1
SD	0.469	Std. Error of Mean	0.235
Coefficient of Variation	0.361	Skewness	1.938

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.716	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.415	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.852	95% Adjusted-CLT UCL (Chen-1995)	1.929
		95% Modified-t UCL (Johnson-1978)	1.89

Gamma GOF Test

A-D Test Statistic	0.728	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.431	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.24	k star (bias corrected MLE)	3.225
Theta hat (MLE)	0.106	Theta star (bias corrected MLE)	0.403
nu hat (MLE)	97.88	nu star (bias corrected)	25.8
MLE Mean (bias corrected)	1.3	MLE Sd (bias corrected)	0.724
		Approximate Chi Square Value (0.05)	15.23
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.203	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.748	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.404	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0	Mean of logged Data	0.221
Maximum of Logged Data	0.693	SD of logged Data	0.318

Assuming Lognormal Distribution

95% H-UCL	2.211	90% Chebyshev (MVUE) UCL	1.908
95% Chebyshev (MVUE) UCL	2.186	97.5% Chebyshev (MVUE) UCL	2.571
99% Chebyshev (MVUE) UCL	3.328		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.686	95% Jackknife UCL	1.852
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.004	95% Chebyshev(Mean, Sd) UCL	2.322
97.5% Chebyshev(Mean, Sd) UCL	2.765	99% Chebyshev(Mean, Sd) UCL	3.633

Suggested UCL to Use

95% Student's-t UCL	1.852

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:27
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	4
Number of Detects	5	Number of Non-Detects	2
Number of Distinct Detects	3	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	0.2
Maximum Detect	0.6	Maximum Non-Detect	0.5
Variance Detects	0.027	Percent Non-Detects	28.57%
Mean Detects	0.32	SD Detects	0.164
Median Detects	0.3	CV Detects	0.513
Skewness Detects	1.736	Kurtosis Detects	3.251
Mean of Logged Detects	-1.228	SD of Logged Detects	0.449

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.779	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.348	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.291	Standard Error of Mean	0.0572
SD	0.134	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.403	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.386	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.463	95% KM Chebyshev UCL	0.541
97.5% KM Chebyshev UCL	0.649	99% KM Chebyshev UCL	0.861

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.528	Anderson-Darling GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.306	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.837	k star (bias corrected MLE)	2.468
Theta hat (MLE)	0.0548	Theta star (bias corrected MLE)	0.13
nu hat (MLE)	58.37	nu star (bias corrected)	24.68
MLE Mean (bias corrected)	0.32	MLE Sd (bias corrected)	0.204

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.738	nu hat (KM)	66.33
Approximate Chi Square Value (66.33, α)	48.59	Adjusted Chi Square Value (66.33, β)	44.04
95% Gamma Approximate KM-UCL (use when n>=50)	0.398	95% Gamma Adjusted KM-UCL (use when n<50)	0.439

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0421	Mean	0.265
Maximum	0.6	Median	0.214
SD	0.171	CV	0.645
k hat (MLE)	2.403	k star (bias corrected MLE)	1.468
Theta hat (MLE)	0.11	Theta star (bias corrected MLE)	0.181
nu hat (MLE)	33.64	nu star (bias corrected)	20.56
MLE Mean (bias corrected)	0.265	MLE Sd (bias corrected)	0.219
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (20.56, α)	11.26	Adjusted Chi Square Value (20.56, β)	9.259
95% Gamma Approximate UCL (use when n>=50)	0.484	95% Gamma Adjusted UCL (use when n<50)	0.589

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.85	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.279	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.276	Mean in Log Scale	-1.409
SD in Original Scale	0.157	SD in Log Scale	0.519
95% t UCL (assumes normality of ROS data)	0.391	95% Percentile Bootstrap UCL	0.376
95% BCA Bootstrap UCL	0.403	95% Bootstrap t UCL	0.479
95% H-UCL (Log ROS)	0.475		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.313	95% H-UCL (KM -Log)	0.409
KM SD (logged)	0.376	95% Critical H Value (KM-Log)	2.28
KM Standard Error of Mean (logged)	0.163		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.279	Mean in Log Scale	-1.404
SD in Original Scale	0.158	SD in Log Scale	0.543
95% t UCL (Assumes normality)	0.394	95% H-Stat UCL	0.501

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.403	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:27
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	13	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.2	Mean	0.607
Maximum	1	Median	0.7
SD	0.237	Std. Error of Mean	0.0657
Coefficient of Variation	0.39	Skewness	-0.15

Normal GOF Test

Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.191	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.724	95% Adjusted-CLT UCL (Chen-1995)	0.712
		95% Modified-t UCL (Johnson-1978)	0.724

Gamma GOF Test

A-D Test Statistic	0.421	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.227	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.869	k star (bias corrected MLE)	4.566
Theta hat (MLE)	0.103	Theta star (bias corrected MLE)	0.133
nu hat (MLE)	152.6	nu star (bias corrected)	118.7
MLE Mean (bias corrected)	0.607	MLE Sd (bias corrected)	0.284
		Approximate Chi Square Value (0.05)	94.55
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	91.48

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.762	95% Adjusted Gamma UCL (use when n<50)	0.788

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.915	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.609	Mean of logged Data	-0.587
Maximum of Logged Data	0	SD of logged Data	0.465

Assuming Lognormal Distribution

95% H-UCL	0.818	90% Chebyshev (MVUE) UCL	0.857
95% Chebyshev (MVUE) UCL	0.967	97.5% Chebyshev (MVUE) UCL	1.12
99% Chebyshev (MVUE) UCL	1.421		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.715	95% Jackknife UCL	0.724
95% Standard Bootstrap UCL	0.713	95% Bootstrap-t UCL	0.721
95% Hall's Bootstrap UCL	0.714	95% Percentile Bootstrap UCL	0.715
95% BCA Bootstrap UCL	0.707		
90% Chebyshev(Mean, Sd) UCL	0.804	95% Chebyshev(Mean, Sd) UCL	0.893
97.5% Chebyshev(Mean, Sd) UCL	1.017	99% Chebyshev(Mean, Sd) UCL	1.261

Suggested UCL to Use

95% Student's-t UCL	0.724

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cd in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:32
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	4.9	Mean	5.25
Maximum	5.5	Median	5.3
SD	0.252	Std. Error of Mean	0.126
Coefficient of Variation	0.0479	Skewness	-1.129

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.895	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.329	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.546	95% Adjusted-CLT UCL (Chen-1995)	5.381
		95% Modified-t UCL (Johnson-1978)	5.534
Gamma GOF Test			
A-D Test Statistic	0.428	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.345	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	569.1	k star (bias corrected MLE)	142.4
Theta hat (MLE)	0.00923	Theta star (bias corrected MLE)	0.0369
nu hat (MLE)	4553	nu star (bias corrected)	1140
MLE Mean (bias corrected)	5.25	MLE Sd (bias corrected)	0.44
		Approximate Chi Square Value (0.05)	1062
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.632	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.887	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.334	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.589	Mean of logged Data	1.657
Maximum of Logged Data	1.705	SD of logged Data	0.0487
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	5.633
95% Chebyshev (MVUE) UCL	5.807	97.5% Chebyshev (MVUE) UCL	6.047
99% Chebyshev (MVUE) UCL	6.521		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.457	95% Jackknife UCL	5.546
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.627	95% Chebyshev(Mean, Sd) UCL	5.798
97.5% Chebyshev(Mean, Sd) UCL	6.036	99% Chebyshev(Mean, Sd) UCL	6.502

Suggested UCL to Use

95% Student's-t UCL	5.546

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cd in mainstem Cement Creek during the runoff period

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	2/23/2015 11:32
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	2	Mean	2.8
Maximum	3.8	Median	2.9
SD	0.709	Std. Error of Mean	0.268
Coefficient of Variation	0.253	Skewness	0.137

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.321	95% Adjusted-CLT UCL (Chen-1995)	3.256
		95% Modified-t UCL (Johnson-1978)	3.323

Gamma GOF Test

A-D Test Statistic	0.413	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.245	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.92	k star (bias corrected MLE)	10.33
Theta hat (MLE)	0.156	Theta star (bias corrected MLE)	0.271
nu hat (MLE)	250.8	nu star (bias corrected)	144.7
MLE Mean (bias corrected)	2.8	MLE Sd (bias corrected)	0.871
		Approximate Chi Square Value (0.05)	117.9
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	110.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.437	95% Adjusted Gamma UCL (use when n<50)	3.664

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.224	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.693	Mean of logged Data	1.001
Maximum of Logged Data	1.335	SD of logged Data	0.258

Assuming Lognormal Distribution

95% H-UCL	3.512	90% Chebyshev (MVUE) UCL	3.62
95% Chebyshev (MVUE) UCL	3.992	97.5% Chebyshev (MVUE) UCL	4.507
99% Chebyshev (MVUE) UCL	5.52		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.241	95% Jackknife UCL	3.321
95% Standard Bootstrap UCL	3.202	95% Bootstrap-t UCL	3.335
95% Hall's Bootstrap UCL	3.151	95% Percentile Bootstrap UCL	3.229
95% BCA Bootstrap UCL	3.214		
90% Chebyshev(Mean, Sd) UCL	3.604	95% Chebyshev(Mean, Sd) UCL	3.969
97.5% Chebyshev(Mean, Sd) UCL	4.475	99% Chebyshev(Mean, Sd) UCL	5.468

Suggested UCL to Use

95% Student's-t UCL	3.321

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:32
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	14	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	3.1	Mean	5.6
Maximum	7	Median	5.65
SD	1.078	Std. Error of Mean	0.288
Coefficient of Variation	0.192	Skewness	-0.859

Normal GOF Test

Shapiro Wilk Test Statistic	0.936	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.143	Lilliefors GOF Test
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.11	95% Adjusted-CLT UCL (Chen-1995)	6.003
		95% Modified-t UCL (Johnson-1978)	6.099

Gamma GOF Test

A-D Test Statistic	0.47	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.169	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.228	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	25.01	k star (bias corrected MLE)	19.7
Theta hat (MLE)	0.224	Theta star (bias corrected MLE)	0.284
nu hat (MLE)	700.2	nu star (bias corrected)	551.5
MLE Mean (bias corrected)	5.6	MLE Sd (bias corrected)	1.262
		Approximate Chi Square Value (0.05)	498
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	491.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.201	95% Adjusted Gamma UCL (use when n<50)	6.286

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.131	Mean of logged Data	1.703
Maximum of Logged Data	1.946	SD of logged Data	0.218

Assuming Lognormal Distribution

95% H-UCL	6.276	90% Chebyshev (MVUE) UCL	6.594
95% Chebyshev (MVUE) UCL	7.04	97.5% Chebyshev (MVUE) UCL	7.659
99% Chebyshev (MVUE) UCL	8.874		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6.074	95% Jackknife UCL	6.11
95% Standard Bootstrap UCL	6.054	95% Bootstrap-t UCL	6.048
95% Hall's Bootstrap UCL	6.016	95% Percentile Bootstrap UCL	6.029
95% BCA Bootstrap UCL	5.993		
90% Chebyshev(Mean, Sd) UCL	6.464	95% Chebyshev(Mean, Sd) UCL	6.856
97.5% Chebyshev(Mean, Sd) UCL	7.399	99% Chebyshev(Mean, Sd) UCL	8.466

Suggested UCL to Use

95% Student's-t UCL	6.11

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cd in the Animas River above mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:40
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.6	Mean	2.64
Maximum	4.1	Median	2.7
SD	1.006	Std. Error of Mean	0.45
Coefficient of Variation	0.381	Skewness	0.589

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.939	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.198	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.6	95% Adjusted-CLT UCL (Chen-1995)	3.507
		95% Modified-t UCL (Johnson-1978)	3.619

Gamma GOF Test

A-D Test Statistic	0.266	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.228	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.688	k star (bias corrected MLE)	3.609
Theta hat (MLE)	0.304	Theta star (bias corrected MLE)	0.732
nu hat (MLE)	86.88	nu star (bias corrected)	36.09
MLE Mean (bias corrected)	2.64	MLE Sd (bias corrected)	1.39
		Approximate Chi Square Value (0.05)	23.34
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.99

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.082	95% Adjusted Gamma UCL (use when n<50)	5.018

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.201	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.47	Mean of logged Data	0.912
Maximum of Logged Data	1.411	SD of logged Data	0.384

Assuming Lognormal Distribution

95% H-UCL	4.425	90% Chebyshev (MVUE) UCL	3.994
95% Chebyshev (MVUE) UCL	4.607	97.5% Chebyshev (MVUE) UCL	5.458
99% Chebyshev (MVUE) UCL	7.131		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.38	95% Jackknife UCL	3.6
95% Standard Bootstrap UCL	3.306	95% Bootstrap-t UCL	3.779
95% Hall's Bootstrap UCL	3.543	95% Percentile Bootstrap UCL	3.36
95% BCA Bootstrap UCL	3.36		
90% Chebyshev(Mean, Sd) UCL	3.99	95% Chebyshev(Mean, Sd) UCL	4.602
97.5% Chebyshev(Mean, Sd) UCL	5.451	99% Chebyshev(Mean, Sd) UCL	7.119

Suggested UCL to Use

95% Student's-t UCL	3.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in the Animas River above mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:40
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	17	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.7	Mean	1.042
Maximum	1.51	Median	0.9
SD	0.24	Std. Error of Mean	0.0581
Coefficient of Variation	0.23	Skewness	0.758

Normal GOF Test			
Shapiro Wilk Test Statistic	0.851	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.215	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.143	95% Adjusted-CLT UCL (Chen-1995)	1.149
		95% Modified-t UCL (Johnson-1978)	1.145
Gamma GOF Test			
A-D Test Statistic	1.21	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.251	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.209	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	21.46	k star (bias corrected MLE)	17.72
Theta hat (MLE)	0.0485	Theta star (bias corrected MLE)	0.0588
nu hat (MLE)	729.8	nu star (bias corrected)	602.3
MLE Mean (bias corrected)	1.042	MLE Sd (bias corrected)	0.248
		Approximate Chi Square Value (0.05)	546.4
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	540.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.148	95% Adjusted Gamma UCL (use when n<50)	1.16
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.881	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.241	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.215	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.357	Mean of logged Data	0.0174
Maximum of Logged Data	0.412	SD of logged Data	0.22
Assuming Lognormal Distribution			
95% H-UCL	1.152	90% Chebyshev (MVUE) UCL	1.209
95% Chebyshev (MVUE) UCL	1.285	97.5% Chebyshev (MVUE) UCL	1.391
99% Chebyshev (MVUE) UCL	1.599		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.137	95% Jackknife UCL	1.143
95% Standard Bootstrap UCL	1.135	95% Bootstrap-t UCL	1.153
95% Hall's Bootstrap UCL	1.14	95% Percentile Bootstrap UCL	1.138
95% BCA Bootstrap UCL	1.147		
90% Chebyshev(Mean, Sd) UCL	1.216	95% Chebyshev(Mean, Sd) UCL	1.295
97.5% Chebyshev(Mean, Sd) UCL	1.405	99% Chebyshev(Mean, Sd) UCL	1.62

Suggested UCL to Use

95% Student's-t UCL	1.143	or 95% Modified-t UCL	1.145

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in the Animas River above mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:40
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	18	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.8	Mean	1.084
Maximum	1.7	Median	1.1
SD	0.227	Std. Error of Mean	0.0535
Coefficient of Variation	0.209	Skewness	1.112
Normal GOF Test			
Shapiro Wilk Test Statistic	0.909	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.195	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.178	95% Adjusted-CLT UCL (Chen-1995)	1.187
		95% Modified-t UCL (Johnson-1978)	1.18
Gamma GOF Test			
A-D Test Statistic	0.39	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.167	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.203	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	26.18	k star (bias corrected MLE)	21.85
Theta hat (MLE)	0.0414	Theta star (bias corrected MLE)	0.0496
nu hat (MLE)	942.4	nu star (bias corrected)	786.7
MLE Mean (bias corrected)	1.084	MLE Sd (bias corrected)	0.232
		Approximate Chi Square Value (0.05)	722.6
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	716.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.181	95% Adjusted Gamma UCL (use when n<50)	1.19
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.223	Mean of logged Data	0.0618
Maximum of Logged Data	0.531	SD of logged Data	0.199
Assuming Lognormal Distribution			
95% H-UCL	1.183	90% Chebyshev (MVUE) UCL	1.237
95% Chebyshev (MVUE) UCL	1.307	97.5% Chebyshev (MVUE) UCL	1.403
99% Chebyshev (MVUE) UCL	1.592		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.172	95% Jackknife UCL	1.178
95% Standard Bootstrap UCL	1.171	95% Bootstrap-t UCL	1.203
95% Hall's Bootstrap UCL	1.222	95% Percentile Bootstrap UCL	1.172
95% BCA Bootstrap UCL	1.183		
90% Chebyshev(Mean, Sd) UCL	1.245	95% Chebyshev(Mean, Sd) UCL	1.318
97.5% Chebyshev(Mean, Sd) UCL	1.419	99% Chebyshev(Mean, Sd) UCL	1.617
Suggested UCL to Use			
95% Student's-t UCL	1.178		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A72 in the Animas River below mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:46
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2.6	Mean	2.7
Maximum	2.9	Median	2.65
SD	0.141	Std. Error of Mean	0.0707
Coefficient of Variation	0.0524	Skewness	1.414

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.828	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.26	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.866	95% Adjusted-CLT UCL (Chen-1995)	2.87
		95% Modified-t UCL (Johnson-1978)	2.875
Gamma GOF Test			
A-D Test Statistic	0.486	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.294	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	497.5	k star (bias corrected MLE)	124.5
Theta hat (MLE)	0.00543	Theta star (bias corrected MLE)	0.0217
nu hat (MLE)	3980	nu star (bias corrected)	996.3
MLE Mean (bias corrected)	2.7	MLE Sd (bias corrected)	0.242
		Approximate Chi Square Value (0.05)	924
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.911	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.833	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.262	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.956	Mean of logged Data	0.992
Maximum of Logged Data	1.065	SD of logged Data	0.0515
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	2.908
95% Chebyshev (MVUE) UCL	3.003	97.5% Chebyshev (MVUE) UCL	3.134
99% Chebyshev (MVUE) UCL	3.391		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.816	95% Jackknife UCL	2.866
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.912	95% Chebyshev(Mean, Sd) UCL	3.008
97.5% Chebyshev(Mean, Sd) UCL	3.142	99% Chebyshev(Mean, Sd) UCL	3.404

Suggested UCL to Use

95% Student's-t UCL	2.866

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A72 in the Animas River below mainstem Mineral Creek during the runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 11:46		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.6	Mean	0.886
Maximum	1.4	Median	0.8
SD	0.261	Std. Error of Mean	0.0986
Coefficient of Variation	0.295	Skewness	1.399

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.2	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.077	95% Adjusted-CLT UCL (Chen-1995)	1.104
		95% Modified-t UCL (Johnson-1978)	1.086
Gamma GOF Test			
A-D Test Statistic	0.294	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.191	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	15.18	k star (bias corrected MLE)	8.768
Theta hat (MLE)	0.0584	Theta star (bias corrected MLE)	0.101
nu hat (MLE)	212.5	nu star (bias corrected)	122.7
MLE Mean (bias corrected)	0.886	MLE Sd (bias corrected)	0.299
		Approximate Chi Square Value (0.05)	98.16
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	91.53
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.108	95% Adjusted Gamma UCL (use when n<50)	1.188
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.171	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.511	Mean of logged Data	-0.155
Maximum of Logged Data	0.336	SD of logged Data	0.272
Assuming Lognormal Distribution			
95% H-UCL	1.128	90% Chebyshev (MVUE) UCL	1.158
95% Chebyshev (MVUE) UCL	1.282	97.5% Chebyshev (MVUE) UCL	1.453
99% Chebyshev (MVUE) UCL	1.791		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.048	95% Jackknife UCL	1.077
95% Standard Bootstrap UCL	1.036	95% Bootstrap-t UCL	1.199
95% Hall's Bootstrap UCL	1.973	95% Percentile Bootstrap UCL	1.043
95% BCA Bootstrap UCL	1.086		
90% Chebyshev(Mean, Sd) UCL	1.182	95% Chebyshev(Mean, Sd) UCL	1.316
97.5% Chebyshev(Mean, Sd) UCL	1.502	99% Chebyshev(Mean, Sd) UCL	1.867

Suggested UCL to Use

95% Student's-t UCL	1.077

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A72 in the Animas River below mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 11:46
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.7	Mean	1.585
Maximum	2.8	Median	1.7
SD	0.552	Std. Error of Mean	0.153
Coefficient of Variation	0.348	Skewness	0.449
Normal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.194	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.857	95% Adjusted-CLT UCL (Chen-1995)	1.857
		95% Modified-t UCL (Johnson-1978)	1.861
Gamma GOF Test			
A-D Test Statistic	0.388	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.463	k star (bias corrected MLE)	6.561
Theta hat (MLE)	0.187	Theta star (bias corrected MLE)	0.242
nu hat (MLE)	220	nu star (bias corrected)	170.6
MLE Mean (bias corrected)	1.585	MLE Sd (bias corrected)	0.619
		Approximate Chi Square Value (0.05)	141.4
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	137.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.912	95% Adjusted Gamma UCL (use when n<50)	1.965
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.19	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.357	Mean of logged Data	0.4
Maximum of Logged Data	1.03	SD of logged Data	0.372
Assuming Lognormal Distribution			
95% H-UCL	1.977	90% Chebyshev (MVUE) UCL	2.09
95% Chebyshev (MVUE) UCL	2.317	97.5% Chebyshev (MVUE) UCL	2.631
99% Chebyshev (MVUE) UCL	3.249		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.836	95% Jackknife UCL	1.857
95% Standard Bootstrap UCL	1.827	95% Bootstrap-t UCL	1.883
95% Hall's Bootstrap UCL	1.899	95% Percentile Bootstrap UCL	1.831
95% BCA Bootstrap UCL	1.846		
90% Chebyshev(Mean, Sd) UCL	2.044	95% Chebyshev(Mean, Sd) UCL	2.252
97.5% Chebyshev(Mean, Sd) UCL	2.541	99% Chebyshev(Mean, Sd) UCL	3.108
Suggested UCL to Use			
95% Student's-t UCL	1.857		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A73 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 11:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.7	Mean	1.256
Maximum	1.79	Median	1.09
SD	0.47	Std. Error of Mean	0.21
Coefficient of Variation	0.374	Skewness	0.187

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.238	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.704	95% Adjusted-CLT UCL (Chen-1995)	1.621
		95% Modified-t UCL (Johnson-1978)	1.707
Gamma GOF Test			
A-D Test Statistic	0.342	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.252	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.572	k star (bias corrected MLE)	3.562
Theta hat (MLE)	0.147	Theta star (bias corrected MLE)	0.353
nu hat (MLE)	85.72	nu star (bias corrected)	35.62
MLE Mean (bias corrected)	1.256	MLE Sd (bias corrected)	0.665
		Approximate Chi Square Value (0.05)	22.96
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.65
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.948	95% Adjusted Gamma UCL (use when n<50)	2.399
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.357	Mean of logged Data	0.168
Maximum of Logged Data	0.582	SD of logged Data	0.392
Assuming Lognormal Distribution			
95% H-UCL	2.138	90% Chebyshev (MVUE) UCL	1.915
95% Chebyshev (MVUE) UCL	2.212	97.5% Chebyshev (MVUE) UCL	2.625
99% Chebyshev (MVUE) UCL	3.437		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.602	95% Jackknife UCL	1.704
95% Standard Bootstrap UCL	1.561	95% Bootstrap-t UCL	2.075
95% Hall's Bootstrap UCL	2.479	95% Percentile Bootstrap UCL	1.596
95% BCA Bootstrap UCL	1.56		
90% Chebyshev(Mean, Sd) UCL	1.887	95% Chebyshev(Mean, Sd) UCL	2.173
97.5% Chebyshev(Mean, Sd) UCL	2.569	99% Chebyshev(Mean, Sd) UCL	3.348

Suggested UCL to Use

95% Student's-t UCL	1.704

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A73B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 11:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.3	Mean	0.709
Maximum	1.4	Median	0.567
SD	0.478	Std. Error of Mean	0.239
Coefficient of Variation	0.674	Skewness	1.569

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.836	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.364	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.271	95% Adjusted-CLT UCL (Chen-1995)	1.302
		95% Modified-t UCL (Johnson-1978)	1.302
Gamma GOF Test			
A-D Test Statistic	0.393	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.329	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.363	k star (bias corrected MLE)	1.007
Theta hat (MLE)	0.211	Theta star (bias corrected MLE)	0.703
nu hat (MLE)	26.91	nu star (bias corrected)	8.06
MLE Mean (bias corrected)	0.709	MLE Sd (bias corrected)	0.706
		Approximate Chi Square Value (0.05)	2.77
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.062	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.289	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.204	Mean of logged Data	-0.501
Maximum of Logged Data	0.336	SD of logged Data	0.634
Assuming Lognormal Distribution			
95% H-UCL	3.71	90% Chebyshev (MVUE) UCL	1.349
95% Chebyshev (MVUE) UCL	1.642	97.5% Chebyshev (MVUE) UCL	2.049
99% Chebyshev (MVUE) UCL	2.848		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.102	95% Jackknife UCL	1.271
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.425	95% Chebyshev(Mean, Sd) UCL	1.75
97.5% Chebyshev(Mean, Sd) UCL	2.201	99% Chebyshev(Mean, Sd) UCL	3.086

Suggested UCL to Use

95% Student's-t UCL	1.271

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 11:54
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.5	Mean	0.774
Maximum	1.1	Median	0.711
SD	0.274	Std. Error of Mean	0.123
Coefficient of Variation	0.354	Skewness	0.318

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.881	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.215	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.036	95% Adjusted-CLT UCL (Chen-1995)	0.994
		95% Modified-t UCL (Johnson-1978)	1.038

Gamma GOF Test

A-D Test Statistic	0.389	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.245	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.942	k star (bias corrected MLE)	4.11
Theta hat (MLE)	0.0779	Theta star (bias corrected MLE)	0.188
nu hat (MLE)	99.42	nu star (bias corrected)	41.1
MLE Mean (bias corrected)	0.774	MLE Sd (bias corrected)	0.382
		Approximate Chi Square Value (0.05)	27.41
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	22.64

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.161	95% Adjusted Gamma UCL (use when n<50)	1.405

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.219	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.693	Mean of logged Data	-0.307
Maximum of Logged Data	0.0953	SD of logged Data	0.359

Assuming Lognormal Distribution

95% H-UCL	1.238	90% Chebyshev (MVUE) UCL	1.145
95% Chebyshev (MVUE) UCL	1.313	97.5% Chebyshev (MVUE) UCL	1.546
99% Chebyshev (MVUE) UCL	2.004		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.976	95% Jackknife UCL	1.036
95% Standard Bootstrap UCL	0.954	95% Bootstrap-t UCL	1.24
95% Hall's Bootstrap UCL	1.137	95% Percentile Bootstrap UCL	0.964
95% BCA Bootstrap UCL	0.974		
90% Chebyshev(Mean, Sd) UCL	1.142	95% Chebyshev(Mean, Sd) UCL	1.309
97.5% Chebyshev(Mean, Sd) UCL	1.54	99% Chebyshev(Mean, Sd) UCL	1.994

Suggested UCL to Use

95% Student's-t UCL	1.036

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 11:54
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.5	Mean	0.704
Maximum	1.1	Median	0.607
SD	0.278	Std. Error of Mean	0.139
Coefficient of Variation	0.396	Skewness	1.476

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.264	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.031	95% Adjusted-CLT UCL (Chen-1995)	1.042
		95% Modified-t UCL (Johnson-1978)	1.048

Gamma GOF Test

A-D Test Statistic	0.423	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.284	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.674	k star (bias corrected MLE)	2.585
Theta hat (MLE)	0.0727	Theta star (bias corrected MLE)	0.272
nu hat (MLE)	77.39	nu star (bias corrected)	20.68
MLE Mean (bias corrected)	0.704	MLE Sd (bias corrected)	0.438
		Approximate Chi Square Value (0.05)	11.35
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.281	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.254	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.693	Mean of logged Data	-0.404
Maximum of Logged Data	0.0953	SD of logged Data	0.364

Assuming Lognormal Distribution

95% H-UCL	1.345	90% Chebyshev (MVUE) UCL	1.08
95% Chebyshev (MVUE) UCL	1.251	97.5% Chebyshev (MVUE) UCL	1.489
99% Chebyshev (MVUE) UCL	1.957		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.932	95% Jackknife UCL	1.031
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.121	95% Chebyshev(Mean, Sd) UCL	1.31
97.5% Chebyshev(Mean, Sd) UCL	1.573	99% Chebyshev(Mean, Sd) UCL	2.088

Suggested UCL to Use

95% Student's-t UCL	1.031

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd at Bakers Bridge in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 11:54
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.3	Mean	0.461
Maximum	0.7	Median	0.422
SD	0.16	Std. Error of Mean	0.0714
Coefficient of Variation	0.347	Skewness	0.861

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.942	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.196	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.613	95% Adjusted-CLT UCL (Chen-1995)	0.608
		95% Modified-t UCL (Johnson-1978)	0.618

Gamma GOF Test

A-D Test Statistic	0.22	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11	k star (bias corrected MLE)	4.534
Theta hat (MLE)	0.0419	Theta star (bias corrected MLE)	0.102
nu hat (MLE)	110	nu star (bias corrected)	45.34
MLE Mean (bias corrected)	0.461	MLE Sd (bias corrected)	0.216
		Approximate Chi Square Value (0.05)	30.89
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	25.79

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.677	95% Adjusted Gamma UCL (use when n<50)	0.81

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.204	Mean of logged Data	-0.82
Maximum of Logged Data	-0.357	SD of logged Data	0.337

Assuming Lognormal Distribution

95% H-UCL	0.708	90% Chebyshev (MVUE) UCL	0.668
95% Chebyshev (MVUE) UCL	0.761	97.5% Chebyshev (MVUE) UCL	0.892
99% Chebyshev (MVUE) UCL	1.147		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.579	95% Jackknife UCL	0.613
95% Standard Bootstrap UCL	0.567	95% Bootstrap-t UCL	0.728
95% Hall's Bootstrap UCL	1.267	95% Percentile Bootstrap UCL	0.564
95% BCA Bootstrap UCL	0.578		
90% Chebyshev(Mean, Sd) UCL	0.675	95% Chebyshev(Mean, Sd) UCL	0.772
97.5% Chebyshev(Mean, Sd) UCL	0.907	99% Chebyshev(Mean, Sd) UCL	1.172

Suggested UCL to Use

95% Student's-t UCL	0.613

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:33
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	89.1	Mean	106.8
Maximum	119	Median	109.5
SD	12.61	Std. Error of Mean	6.306
Coefficient of Variation	0.118	Skewness	-1.213

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.899	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.32	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	121.6	95% Adjusted-CLT UCL (Chen-1995)	113.1
		95% Modified-t UCL (Johnson-1978)	121

Gamma GOF Test

A-D Test Statistic	0.427	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.342	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	90.32	k star (bias corrected MLE)	22.75
Theta hat (MLE)	1.182	Theta star (bias corrected MLE)	4.694
nu hat (MLE)	722.6	nu star (bias corrected)	182
MLE Mean (bias corrected)	106.8	MLE Sd (bias corrected)	22.39
		Approximate Chi Square Value (0.05)	151.8
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	128	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.334	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.49	Mean of logged Data	4.665
Maximum of Logged Data	4.779	SD of logged Data	0.123

Assuming Lognormal Distribution

95% H-UCL	125.8	90% Chebyshev (MVUE) UCL	126.5
95% Chebyshev (MVUE) UCL	135.5	97.5% Chebyshev (MVUE) UCL	147.9
99% Chebyshev (MVUE) UCL	172.3		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	117.1	95% Jackknife UCL	121.6
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	125.7	95% Chebyshev(Mean, Sd) UCL	134.3
97.5% Chebyshev(Mean, Sd) UCL	146.2	99% Chebyshev(Mean, Sd) UCL	169.5

Suggested UCL to Use

95% Student's-t UCL	121.6

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cu in mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:33
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	55.6	Mean	68.63
Maximum	90.6	Median	65.4
SD	12.88	Std. Error of Mean	4.868
Coefficient of Variation	0.188	Skewness	0.801

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.922	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.17	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	78.09	95% Adjusted-CLT UCL (Chen-1995)	78.21
		95% Modified-t UCL (Johnson-1978)	78.33

Gamma GOF Test

A-D Test Statistic	0.272	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.161	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	34.8	k star (bias corrected MLE)	19.98
Theta hat (MLE)	1.972	Theta star (bias corrected MLE)	3.435
nu hat (MLE)	487.2	nu star (bias corrected)	279.7
MLE Mean (bias corrected)	68.63	MLE Sd (bias corrected)	15.35
		Approximate Chi Square Value (0.05)	242
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	231.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	79.33	95% Adjusted Gamma UCL (use when n<50)	82.98

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.145	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.018	Mean of logged Data	4.214
Maximum of Logged Data	4.506	SD of logged Data	0.182

Assuming Lognormal Distribution

95% H-UCL	79.55	90% Chebyshev (MVUE) UCL	82.74
95% Chebyshev (MVUE) UCL	89.15	97.5% Chebyshev (MVUE) UCL	98.04
99% Chebyshev (MVUE) UCL	115.5		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	76.64	95% Jackknife UCL	78.09
95% Standard Bootstrap UCL	75.98	95% Bootstrap-t UCL	82.98
95% Hall's Bootstrap UCL	80.97	95% Percentile Bootstrap UCL	76.56
95% BCA Bootstrap UCL	77.26		
90% Chebyshev(Mean, Sd) UCL	83.23	95% Chebyshev(Mean, Sd) UCL	89.85
97.5% Chebyshev(Mean, Sd) UCL	99.03	99% Chebyshev(Mean, Sd) UCL	117.1

Suggested UCL to Use

95% Student's-t UCL	78.09

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu in mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:33
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	65.3	Mean	130.2
Maximum	221	Median	139.5
SD	46.09	Std. Error of Mean	12.32
Coefficient of Variation	0.354	Skewness	0.246

Normal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.156	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	152	95% Adjusted-CLT UCL (Chen-1995)	151.3
		95% Modified-t UCL (Johnson-1978)	152.1

Gamma GOF Test			
A-D Test Statistic	0.442	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.191	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	8.11	k star (bias corrected MLE)	6.42
Theta hat (MLE)	16.05	Theta star (bias corrected MLE)	20.28
nu hat (MLE)	227.1	nu star (bias corrected)	179.7
MLE Mean (bias corrected)	130.2	MLE Sd (bias corrected)	51.38
		Approximate Chi Square Value (0.05)	149.7
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	146.1

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	156.3	95% Adjusted Gamma UCL (use when n<50)	160.2

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.929	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	4.179	Mean of logged Data	4.806
Maximum of Logged Data	5.398	SD of logged Data	0.377

Assuming Lognormal Distribution			
95% H-UCL	161.2	90% Chebyshev (MVUE) UCL	170.7
95% Chebyshev (MVUE) UCL	188.9	97.5% Chebyshev (MVUE) UCL	214.2
99% Chebyshev (MVUE) UCL	263.8		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	150.4	95% Jackknife UCL	152
95% Standard Bootstrap UCL	149.9	95% Bootstrap-t UCL	152.4
95% Hall's Bootstrap UCL	152.5	95% Percentile Bootstrap UCL	149.3
95% BCA Bootstrap UCL	152.2		
90% Chebyshev(Mean, Sd) UCL	167.1	95% Chebyshev(Mean, Sd) UCL	183.9
97.5% Chebyshev(Mean, Sd) UCL	207.1	99% Chebyshev(Mean, Sd) UCL	252.8

Suggested UCL to Use

95% Student's-t UCL	152

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu in the Animas River above mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	6	Minimum Non-Detect	3
Maximum Detect	8.3	Maximum Non-Detect	10
Variance Detects	2.645	Percent Non-Detects	60%
Mean Detects	7.15	SD Detects	1.626
Median Detects	7.15	CV Detects	0.227
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.954	SD of Logged Detects	0.229

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	5.075	Standard Error of Mean	1.576
SD	2.229	95% KM (BCA) UCL	N/A
95% KM (t) UCL	8.435	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	7.667	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	9.803	95% KM Chebyshev UCL	11.94
97.5% KM Chebyshev UCL	14.92	99% KM Chebyshev UCL	20.75

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	38.32	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.187	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	153.3	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.185	nu hat (KM)	51.85
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (51.85, α)	36.32	Adjusted Chi Square Value (51.85, β)	30.73
95% Gamma Approximate KM-UCL (use when n>=50)	7.247	95% Gamma Adjusted KM-UCL (use when n<50)	8.563

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.013	Mean in Log Scale	1.531
SD in Original Scale	2.234	SD in Log Scale	0.453
95% t UCL (assumes normality of ROS data)	7.143	95% Percentile Bootstrap UCL	6.433
95% BCA Bootstrap UCL	6.695	95% Bootstrap t UCL	8.184
95% H-UCL (Log ROS)	9.66		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.46	Mean in Log Scale	1.266
SD in Original Scale	2.955	SD in Log Scale	0.806
95% t UCL (Assumes normality)	7.277	95% H-Stat UCL	25.46

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	8.435	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu in the Animas River above mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	17	Number of Distinct Observations	16
Number of Detects	15	Number of Non-Detects	2
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	3.7	Minimum Non-Detect	10
Maximum Detect	16.5	Maximum Non-Detect	10
Variance Detects	15.21	Percent Non-Detects	11.76%
Mean Detects	9.96	SD Detects	3.9
Median Detects	9.6	CV Detects	0.392
Skewness Detects	-0.125	Kurtosis Detects	-0.802
Mean of Logged Detects	2.21	SD of Logged Detects	0.463

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.119	Lilliefors GOF Test
5% Lilliefors Critical Value	0.229	Detected Data appear Normal at 5% Significance Level
Detected Data appear Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	9.618	Standard Error of Mean	0.966
SD	3.745	95% KM (BCA) UCL	11.18
95% KM (t) UCL	11.3	95% KM (Percentile Bootstrap) UCL	11.14
95% KM (z) UCL	11.21	95% KM Bootstrap t UCL	11.22
90% KM Chebyshev UCL	12.51	95% KM Chebyshev UCL	13.83
97.5% KM Chebyshev UCL	15.65	99% KM Chebyshev UCL	19.23

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.478	Anderson-Darling GOF Test
5% A-D Critical Value	0.738	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.222	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	5.822	k star (bias corrected MLE)	4.702
Theta hat (MLE)	1.711	Theta star (bias corrected MLE)	2.118
nu hat (MLE)	174.7	nu star (bias corrected)	141.1
MLE Mean (bias corrected)	9.96	MLE Sd (bias corrected)	4.593

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.595	nu hat (KM)	224.2
Approximate Chi Square Value (224.23, α)	190.6	Adjusted Chi Square Value (224.23, β)	187.3
95% Gamma Approximate KM-UCL (use when n>=50)	11.32	95% Gamma Adjusted KM-UCL (use when n<50)	11.51

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.7	Mean	9.622
Maximum	16.5	Median	9.1
SD	3.787	CV	0.394
k hat (MLE)	6.072	k star (bias corrected MLE)	5.04
Theta hat (MLE)	1.585	Theta star (bias corrected MLE)	1.909
nu hat (MLE)	206.4	nu star (bias corrected)	171.3
MLE Mean (bias corrected)	9.622	MLE Sd (bias corrected)	4.286
		Adjusted Level of Significance (β)	0.0346
Approximate Chi Square Value (171.35, α)	142.1	Adjusted Chi Square Value (171.35, β)	139.3
95% Gamma Approximate UCL (use when n>=50)	11.6	95% Gamma Adjusted UCL (use when n<50)	11.84

Lognormal GOF Test on Detected Observations Only		
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.881	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors GOF Test
5% Lilliefors Critical Value	0.229	Detected Data appear Lognormal at 5% Significance Level
Detected Data appear Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.577	Mean in Log Scale	2.173
SD in Original Scale	3.82	SD in Log Scale	0.448
95% t UCL (assumes normality of ROS data)	11.19	95% Percentile Bootstrap UCL	11.06
95% BCA Bootstrap UCL	11.05	95% Bootstrap t UCL	11.13
95% H-UCL (Log ROS)	12.13		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.173	95% H-UCL (KM -Log)	12.16
KM SD (logged)	0.451	95% Critical H Value (KM-Log)	1.987
KM Standard Error of Mean (logged)	0.119		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	9.376	Mean in Log Scale	2.14
SD in Original Scale	4.003	SD in Log Scale	0.477
95% t UCL (Assumes normality)	11.07	95% H-Stat UCL	12.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	11.3	95% KM (Percentile Bootstrap) UCL	11.14

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu in the Animas River above mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	18	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	11
Number of Distinct Detects	6	Number of Distinct Non-Detects	4
Minimum Detect	2.7	Minimum Non-Detect	3
Maximum Detect	3.5	Maximum Non-Detect	20
Variance Detects	0.112	Percent Non-Detects	61.11%
Mean Detects	3.171	SD Detects	0.335
Median Detects	3.3	CV Detects	0.106
Skewness Detects	-0.471	Kurtosis Detects	-1.867
Mean of Logged Detects	1.149	SD of Logged Detects	0.108

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.872	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.221	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.018	Standard Error of Mean	0.106
SD	0.321	95% KM (BCA) UCL	3.25
95% KM (t) UCL	3.203	95% KM (Percentile Bootstrap) UCL	3.223
95% KM (z) UCL	3.193	95% KM Bootstrap t UCL	3.213
90% KM Chebyshev UCL	3.336	95% KM Chebyshev UCL	3.48
97.5% KM Chebyshev UCL	3.68	99% KM Chebyshev UCL	4.073

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.486	Anderson-Darling GOF Test	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.24	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	101.4	k star (bias corrected MLE)	58.05
Theta hat (MLE)	0.0313	Theta star (bias corrected MLE)	0.0546
nu hat (MLE)	1420	nu star (bias corrected)	812.7
MLE Mean (bias corrected)	3.171	MLE Sd (bias corrected)	0.416

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	88.18	nu hat (KM)	3174
Approximate Chi Square Value (N/A, α)	3045	Adjusted Chi Square Value (N/A, β)	3032
95% Gamma Approximate KM-UCL (use when n>=50)	3.147	95% Gamma Adjusted KM-UCL (use when n<50)	3.16

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	2.542	Mean	3.016
Maximum	3.5	Median	2.972
SD	0.297	CV	0.0984
k hat (MLE)	110.4	k star (bias corrected MLE)	92.05
Theta hat (MLE)	0.0273	Theta star (bias corrected MLE)	0.0328
nu hat (MLE)	3975	nu star (bias corrected)	3314
MLE Mean (bias corrected)	3.016	MLE Sd (bias corrected)	0.314
		Adjusted Level of Significance (β)	0.0357
Approximate Chi Square Value (N/A, α)	3181	Adjusted Chi Square Value (N/A, β)	3168
95% Gamma Approximate UCL (use when n>=50)	3.142	95% Gamma Adjusted UCL (use when n<50)	3.155

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.869	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.232	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.015	Mean in Log Scale	1.099
SD in Original Scale	0.295	SD in Log Scale	0.097
95% t UCL (assumes normality of ROS data)	3.136	95% Percentile Bootstrap UCL	3.126
95% BCA Bootstrap UCL	3.135	95% Bootstrap t UCL	3.147
95% H-UCL (Log ROS)	N/A		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.099	95% H-UCL (KM -Log)	3.153
KM SD (logged)	0.104	95% Critical H Value (KM-Log)	1.735
KM Standard Error of Mean (logged)	0.0346		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.289	Mean in Log Scale	1.215
SD in Original Scale	3.272	SD in Log Scale	0.693
95% t UCL (Assumes normality)	5.63	95% H-Stat UCL	6.23

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.203	95% KM (Percentile Bootstrap) UCL	3.223

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu at sampling location A72 in the Animas River below mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	19.2	Mean	28.88
Maximum	35.9	Median	30.2
SD	8.093	Std. Error of Mean	4.046
Coefficient of Variation	0.28	Skewness	-0.447

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.881	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	38.4	95% Adjusted-CLT UCL (Chen-1995)	34.56
		95% Modified-t UCL (Johnson-1978)	38.25

Gamma GOF Test

A-D Test Statistic	0.4	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.315	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	15.75	k star (bias corrected MLE)	4.103
Theta hat (MLE)	1.834	Theta star (bias corrected MLE)	7.038
nu hat (MLE)	126	nu star (bias corrected)	32.82
MLE Mean (bias corrected)	28.88	MLE Sd (bias corrected)	14.26
		Approximate Chi Square Value (0.05)	20.73
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	45.73	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.883	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.28	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.955	Mean of logged Data	3.331
Maximum of Logged Data	3.581	SD of logged Data	0.299

Assuming Lognormal Distribution

95% H-UCL	47.16	90% Chebyshev (MVUE) UCL	41.77
95% Chebyshev (MVUE) UCL	47.6	97.5% Chebyshev (MVUE) UCL	55.69
99% Chebyshev (MVUE) UCL	71.57		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	35.53	95% Jackknife UCL	38.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	41.01	95% Chebyshev(Mean, Sd) UCL	46.51
97.5% Chebyshev(Mean, Sd) UCL	54.14	99% Chebyshev(Mean, Sd) UCL	69.13

Suggested UCL to Use

95% Student's-t UCL	38.4

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cu at sampling location A72 in the Animas River below mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 12:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	2
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	3.6	Minimum Non-Detect	10
Maximum Detect	7.6	Maximum Non-Detect	10
Variance Detects	2.863	Percent Non-Detects	28.57%
Mean Detects	5.24	SD Detects	1.692
Median Detects	4.5	CV Detects	0.323
Skewness Detects	0.723	Kurtosis Detects	-1.587
Mean of Logged Detects	1.616	SD of Logged Detects	0.314

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.269	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	5.24	Standard Error of Mean	0.757
SD	1.513	95% KM (BCA) UCL	6.42
95% KM (t) UCL	6.71	95% KM (Percentile Bootstrap) UCL	6.417
95% KM (z) UCL	6.485	95% KM Bootstrap t UCL	10.02
90% KM Chebyshev UCL	7.51	95% KM Chebyshev UCL	8.538
97.5% KM Chebyshev UCL	9.966	99% KM Chebyshev UCL	12.77

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.347	Anderson-Darling GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	12.59	k star (bias corrected MLE)	5.17
Theta hat (MLE)	0.416	Theta star (bias corrected MLE)	1.014
nu hat (MLE)	125.9	nu star (bias corrected)	51.7
MLE Mean (bias corrected)	5.24	MLE Sd (bias corrected)	2.305

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	11.99	nu hat (KM)	167.8
Approximate Chi Square Value (167.83, α)	138.9	Adjusted Chi Square Value (167.83, β)	130.9
95% Gamma Approximate KM-UCL (use when n>=50)	6.333	95% Gamma Adjusted KM-UCL (use when n<50)	6.718

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	3.6	Mean	5.224
Maximum	7.6	Median	4.5
SD	1.485	CV	0.284
k hat (MLE)	15.07	k star (bias corrected MLE)	8.709
Theta hat (MLE)	0.347	Theta star (bias corrected MLE)	0.6
nu hat (MLE)	211	nu star (bias corrected)	121.9
MLE Mean (bias corrected)	5.224	MLE Sd (bias corrected)	1.77
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (121.93, α)	97.43	Adjusted Chi Square Value (121.93, β)	90.82
95% Gamma Approximate UCL (use when n>=50)	6.538	95% Gamma Adjusted UCL (use when n<50)	7.014

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.239	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.203	Mean in Log Scale	1.616
SD in Original Scale	1.475	SD in Log Scale	0.276
95% t UCL (assumes normality of ROS data)	6.287	95% Percentile Bootstrap UCL	6.086
95% BCA Bootstrap UCL	6.243	95% Bootstrap t UCL	6.707
95% H-UCL (Log ROS)	6.66		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.616	95% H-UCL (KM -Log)	6.71
KM SD (logged)	0.281	95% Critical H Value (KM-Log)	2.163
KM Standard Error of Mean (logged)	0.14		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	5.171	Mean in Log Scale	1.614
SD in Original Scale	1.386	SD in Log Scale	0.256
95% t UCL (Assumes normality)	6.19	95% H-Stat UCL	6.471

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	6.71	95% KM (Percentile Bootstrap) UCL	6.417

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu at sampling location A72 in the Animas River below mainstem Mineral Creek during the post-runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 12:53		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	13	Number of Distinct Observations	10
Number of Detects	8	Number of Non-Detects	5
Number of Distinct Detects	8	Number of Distinct Non-Detects	2
Minimum Detect	3	Minimum Non-Detect	10
Maximum Detect	36.9	Maximum Non-Detect	20
Variance Detects	109	Percent Non-Detects	38.46%
Mean Detects	14.23	SD Detects	10.44
Median Detects	13.75	CV Detects	0.734
Skewness Detects	1.561	Kurtosis Detects	3.428
Mean of Logged Detects	2.414	SD of Logged Detects	0.78
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.852	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	12.38	Standard Error of Mean	2.776
SD	8.602	95% KM (BCA) UCL	17.27
95% KM (t) UCL	17.32	95% KM (Percentile Bootstrap) UCL	17.03
95% KM (z) UCL	16.94	95% KM Bootstrap t UCL	18.51
90% KM Chebyshev UCL	20.71	95% KM Chebyshev UCL	24.48
97.5% KM Chebyshev UCL	29.71	99% KM Chebyshev UCL	40
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.301	Anderson-Darling GOF Test	
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	2.225	k star (bias corrected MLE)	1.474
Theta hat (MLE)	6.393	Theta star (bias corrected MLE)	9.651
nu hat (MLE)	35.6	nu star (bias corrected)	23.58
MLE Mean (bias corrected)	14.23	MLE Sd (bias corrected)	11.72
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	2.07	nu hat (KM)	53.83
Approximate Chi Square Value (53.83, α)	37.97	Adjusted Chi Square Value (53.83, β)	36.08
95% Gamma Approximate KM-UCL (use when n>=50)	17.55	95% Gamma Adjusted KM-UCL (use when n<50)	18.46
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	3	Mean	12.3
Maximum	36.9	Median	11.84
SD	8.935	CV	0.727
k hat (MLE)	2.389	k star (bias corrected MLE)	1.889
Theta hat (MLE)	5.147	Theta star (bias corrected MLE)	6.509
nu hat (MLE)	62.12	nu star (bias corrected)	49.12
MLE Mean (bias corrected)	12.3	MLE Sd (bias corrected)	8.947
		Adjusted Level of Significance (β)	0.0301
Approximate Chi Square Value (49.12, α)	34.03	Adjusted Chi Square Value (49.12, β)	32.25
95% Gamma Approximate UCL (use when n>=50)	17.75	95% Gamma Adjusted UCL (use when n<50)	18.73
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.202	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	12.14	Mean in Log Scale	2.283
SD in Original Scale	8.84	SD in Log Scale	0.684
95% t UCL (assumes normality of ROS data)	16.51	95% Percentile Bootstrap UCL	15.94
95% BCA Bootstrap UCL	17.21	95% Bootstrap t UCL	18.95
95% H-UCL (Log ROS)	19.69		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	2.278	95% H-UCL (KM -Log)	20.7
KM SD (logged)	0.716	95% Critical H Value (KM-Log)	2.395
KM Standard Error of Mean (logged)	0.256		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	12.22	Mean in Log Scale	2.318
SD in Original Scale	8.501	SD in Log Scale	0.635
95% t UCL (Assumes normality)	16.42	95% H-Stat UCL	18.86
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	17.32	95% KM (Percentile Bootstrap) UCL	17.03

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu at sampling location A73 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:03
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.9	Mean	3.72
Maximum	5	Median	4.3
SD	1.429	Std. Error of Mean	0.639
Coefficient of Variation	0.384	Skewness	-0.558

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.853	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.258	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.082	95% Adjusted-CLT UCL (Chen-1995)	4.601
		95% Modified-t UCL (Johnson-1978)	5.056

Gamma GOF Test

A-D Test Statistic	0.503	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.299	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.241	k star (bias corrected MLE)	3.03
Theta hat (MLE)	0.514	Theta star (bias corrected MLE)	1.228
nu hat (MLE)	72.41	nu star (bias corrected)	30.3
MLE Mean (bias corrected)	3.72	MLE Sd (bias corrected)	2.137
		Approximate Chi Square Value (0.05)	18.73
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	14.89

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.018	95% Adjusted Gamma UCL (use when n<50)	7.568

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.289	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.642	Mean of logged Data	1.243
Maximum of Logged Data	1.609	SD of logged Data	0.438

Assuming Lognormal Distribution

95% H-UCL	6.986	90% Chebyshev (MVUE) UCL	5.924
95% Chebyshev (MVUE) UCL	6.914	97.5% Chebyshev (MVUE) UCL	8.287
99% Chebyshev (MVUE) UCL	10.98		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4.771	95% Jackknife UCL	5.082
95% Standard Bootstrap UCL	4.651	95% Bootstrap-t UCL	4.868
95% Hall's Bootstrap UCL	4.29	95% Percentile Bootstrap UCL	4.7
95% BCA Bootstrap UCL	4.44		
90% Chebyshev(Mean, Sd) UCL	5.637	95% Chebyshev(Mean, Sd) UCL	6.506
97.5% Chebyshev(Mean, Sd) UCL	7.711	99% Chebyshev(Mean, Sd) UCL	10.08

Suggested UCL to Use

95% Student's-t UCL	5.082

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cu at sampling location A73B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.4	Mean	2.575
Maximum	3.8	Median	2.55
SD	1.078	Std. Error of Mean	0.539
Coefficient of Variation	0.419	Skewness	0.0908

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.203	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.844	95% Adjusted-CLT UCL (Chen-1995)	3.488
		95% Modified-t UCL (Johnson-1978)	3.848
Gamma GOF Test			
A-D Test Statistic	0.255	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.237	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.122	k star (bias corrected MLE)	1.947
Theta hat (MLE)	0.362	Theta star (bias corrected MLE)	1.322
nu hat (MLE)	56.98	nu star (bias corrected)	15.58
MLE Mean (bias corrected)	2.575	MLE Sd (bias corrected)	1.845
		Approximate Chi Square Value (0.05)	7.665
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.233	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.217	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.336	Mean of logged Data	0.874
Maximum of Logged Data	1.335	SD of logged Data	0.447
Assuming Lognormal Distribution			
95% H-UCL	6.363	90% Chebyshev (MVUE) UCL	4.286
95% Chebyshev (MVUE) UCL	5.059	97.5% Chebyshev (MVUE) UCL	6.131
99% Chebyshev (MVUE) UCL	8.238		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.462	95% Jackknife UCL	3.844
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4.192	95% Chebyshev(Mean, Sd) UCL	4.925
97.5% Chebyshev(Mean, Sd) UCL	5.942	99% Chebyshev(Mean, Sd) UCL	7.939

Suggested UCL to Use

95% Student's-t UCL	3.844

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu at sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.6	Mean	2.5
Maximum	4.2	Median	2.1
SD	1.454	Std. Error of Mean	0.65
Coefficient of Variation	0.582	Skewness	-0.0675

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.208	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.887	95% Adjusted-CLT UCL (Chen-1995)	3.549
		95% Modified-t UCL (Johnson-1978)	3.883

Gamma GOF Test

A-D Test Statistic	0.321	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.683	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.213	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.746	k star (bias corrected MLE)	1.232
Theta hat (MLE)	0.91	Theta star (bias corrected MLE)	2.03
nu hat (MLE)	27.46	nu star (bias corrected)	12.32
MLE Mean (bias corrected)	2.5	MLE Sd (bias corrected)	2.253
		Approximate Chi Square Value (0.05)	5.436
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	3.621

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.664	95% Adjusted Gamma UCL (use when n<50)	8.503

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.258	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.511	Mean of logged Data	0.723
Maximum of Logged Data	1.435	SD of logged Data	0.771

Assuming Lognormal Distribution

95% H-UCL	12.7	90% Chebyshev (MVUE) UCL	5.212
95% Chebyshev (MVUE) UCL	6.398	97.5% Chebyshev (MVUE) UCL	8.045
99% Chebyshev (MVUE) UCL	11.28		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.57	95% Jackknife UCL	3.887
95% Standard Bootstrap UCL	3.445	95% Bootstrap-t UCL	4.586
95% Hall's Bootstrap UCL	4.864	95% Percentile Bootstrap UCL	3.38
95% BCA Bootstrap UCL	3.38		
90% Chebyshev(Mean, Sd) UCL	4.451	95% Chebyshev(Mean, Sd) UCL	5.335
97.5% Chebyshev(Mean, Sd) UCL	6.562	99% Chebyshev(Mean, Sd) UCL	8.971

Suggested UCL to Use

95% Student's-t UCL	3.887

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cu at sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.7	Mean	2.625
Maximum	4.1	Median	2.85
SD	1.573	Std. Error of Mean	0.787
Coefficient of Variation	0.599	Skewness	-0.501

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.253	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.476	95% Adjusted-CLT UCL (Chen-1995)	3.709
		95% Modified-t UCL (Johnson-1978)	4.444

Gamma GOF Test

A-D Test Statistic	0.36	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.286	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.641	k star (bias corrected MLE)	0.827
Theta hat (MLE)	0.994	Theta star (bias corrected MLE)	3.175
nu hat (MLE)	21.13	nu star (bias corrected)	6.615
MLE Mean (bias corrected)	2.625	MLE Sd (bias corrected)	2.887
		Approximate Chi Square Value (0.05)	1.962
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8.852	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.249	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.357	Mean of logged Data	0.764
Maximum of Logged Data	1.411	SD of logged Data	0.812

Assuming Lognormal Distribution

95% H-UCL	39	90% Chebyshev (MVUE) UCL	5.867
95% Chebyshev (MVUE) UCL	7.294	97.5% Chebyshev (MVUE) UCL	9.274
99% Chebyshev (MVUE) UCL	13.16		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.919	95% Jackknife UCL	4.476
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4.985	95% Chebyshev(Mean, Sd) UCL	6.054
97.5% Chebyshev(Mean, Sd) UCL	7.538	99% Chebyshev(Mean, Sd) UCL	10.45

Suggested UCL to Use

95% Student's-t UCL	4.476

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Cu at Bakers Bridge in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:05
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.9	Minimum Non-Detect	0.5
Maximum Detect	3.7	Maximum Non-Detect	0.5
Variance Detects	0.72	Percent Non-Detects	20%
Mean Detects	2.9	SD Detects	0.849
Median Detects	3	CV Detects	0.293
Skewness Detects	-0.367	Kurtosis Detects	-3.438
Mean of Logged Detects	1.03	SD of Logged Detects	0.311

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.26	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.42	Standard Error of Mean	0.601
SD	1.163	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.701	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.408	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.222	95% KM Chebyshev UCL	5.039
97.5% KM Chebyshev UCL	6.172	99% KM Chebyshev UCL	8.398

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.348	Anderson-Darling GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.295	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	14.49	k star (bias corrected MLE)	3.789
Theta hat (MLE)	0.2	Theta star (bias corrected MLE)	0.765
nu hat (MLE)	115.9	nu star (bias corrected)	30.32
MLE Mean (bias corrected)	2.9	MLE Sd (bias corrected)	1.49

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.327	nu hat (KM)	43.27
Approximate Chi Square Value (43.27, α)	29.18	Adjusted Chi Square Value (43.27, β)	24.24
95% Gamma Approximate KM-UCL (use when n>=50)	3.588	95% Gamma Adjusted KM-UCL (use when n<50)	4.319

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.98	Mean	2.516
Maximum	3.7	Median	2.5
SD	1.13	CV	0.449
k hat (MLE)	5.019	k star (bias corrected MLE)	2.141
Theta hat (MLE)	0.501	Theta star (bias corrected MLE)	1.175
nu hat (MLE)	50.19	nu star (bias corrected)	21.41
MLE Mean (bias corrected)	2.516	MLE Sd (bias corrected)	1.719
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (21.41, α)	11.9	Adjusted Chi Square Value (21.41, β)	8.959
95% Gamma Approximate UCL (use when n>=50)	4.528	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.91	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.263	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.571	Mean in Log Scale	0.869
SD in Original Scale	1.04	SD in Log Scale	0.449
95% t UCL (assumes normality of ROS data)	3.562	95% Percentile Bootstrap UCL	3.22
95% BCA Bootstrap UCL	3.14	95% Bootstrap t UCL	3.694
95% H-UCL (Log ROS)	4.937		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.685	95% H-UCL (KM -Log)	10.3
KM SD (logged)	0.73	95% Critical H Value (KM-Log)	3.78
KM Standard Error of Mean (logged)	0.377		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.37	Mean in Log Scale	0.547
SD in Original Scale	1.394	SD in Log Scale	1.114
95% t UCL (Assumes normality)	3.699	95% H-Stat UCL	64.87

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.701	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:18
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4180	Mean	5868
Maximum	6830	Median	6230
SD	1166	Std. Error of Mean	583.2
Coefficient of Variation	0.199	Skewness	-1.583

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.858	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.322	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7240	95% Adjusted-CLT UCL (Chen-1995)	6333
		95% Modified-t UCL (Johnson-1978)	7163

Gamma GOF Test

A-D Test Statistic	0.508	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.351	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	29.62	k star (bias corrected MLE)	7.571
Theta hat (MLE)	198.1	Theta star (bias corrected MLE)	775
nu hat (MLE)	236.9	nu star (bias corrected)	60.57
MLE Mean (bias corrected)	5868	MLE Sd (bias corrected)	2132
		Approximate Chi Square Value (0.05)	43.67
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8138	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.822	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.344	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.338	Mean of logged Data	8.66
Maximum of Logged Data	8.829	SD of logged Data	0.22

Assuming Lognormal Distribution

95% H-UCL	8139	90% Chebyshev (MVUE) UCL	7805
95% Chebyshev (MVUE) UCL	8680	97.5% Chebyshev (MVUE) UCL	9895
99% Chebyshev (MVUE) UCL	12280		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6827	95% Jackknife UCL	7240
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7617	95% Chebyshev(Mean, Sd) UCL	8410
97.5% Chebyshev(Mean, Sd) UCL	9510	99% Chebyshev(Mean, Sd) UCL	11671

Suggested UCL to Use

95% Student's-t UCL	7240

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Fe in mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:18
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	1040	Mean	2664
Maximum	6330	Median	2130
SD	1980	Std. Error of Mean	748.5
Coefficient of Variation	0.743	Skewness	1.231

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.848	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4119	95% Adjusted-CLT UCL (Chen-1995)	4268
		95% Modified-t UCL (Johnson-1978)	4177

Gamma GOF Test

A-D Test Statistic	0.399	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.714	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.242	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.315	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.386	k star (bias corrected MLE)	1.458
Theta hat (MLE)	1117	Theta star (bias corrected MLE)	1827
nu hat (MLE)	33.4	nu star (bias corrected)	20.42
MLE Mean (bias corrected)	2664	MLE Sd (bias corrected)	2206
		Approximate Chi Square Value (0.05)	11.16
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	9.166

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4875	95% Adjusted Gamma UCL (use when n<50)	5935

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.9	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.227	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.947	Mean of logged Data	7.664
Maximum of Logged Data	8.753	SD of logged Data	0.715

Assuming Lognormal Distribution

95% H-UCL	6487	90% Chebyshev (MVUE) UCL	4788
95% Chebyshev (MVUE) UCL	5762	97.5% Chebyshev (MVUE) UCL	7115
99% Chebyshev (MVUE) UCL	9772		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3895	95% Jackknife UCL	4119
95% Standard Bootstrap UCL	3780	95% Bootstrap-t UCL	5341
95% Hall's Bootstrap UCL	10257	95% Percentile Bootstrap UCL	3946
95% BCA Bootstrap UCL	4149		
90% Chebyshev(Mean, Sd) UCL	4910	95% Chebyshev(Mean, Sd) UCL	5927
97.5% Chebyshev(Mean, Sd) UCL	7339	99% Chebyshev(Mean, Sd) UCL	10112

Suggested UCL to Use

95% Student's-t UCL	4119

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:18
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	754	Mean	3339
Maximum	8290	Median	3340
SD	1976	Std. Error of Mean	548.1
Coefficient of Variation	0.592	Skewness	1.176

Normal GOF Test		
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.148	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4316	95% Adjusted-CLT UCL (Chen-1995)	4431
		95% Modified-t UCL (Johnson-1978)	4345

Gamma GOF Test		
A-D Test Statistic	0.226	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.238	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	3.063	k star (bias corrected MLE)	2.407
Theta hat (MLE)	1090	Theta star (bias corrected MLE)	1387
nu hat (MLE)	79.63	nu star (bias corrected)	62.59
MLE Mean (bias corrected)	3339	MLE Sd (bias corrected)	2152
		Approximate Chi Square Value (0.05)	45.39
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	43.31

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4604	95% Adjusted Gamma UCL (use when n<50)	4825

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.176	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	6.625	Mean of logged Data	7.941
Maximum of Logged Data	9.023	SD of logged Data	0.642

Assuming Lognormal Distribution			
95% H-UCL	5279	90% Chebyshev (MVUE) UCL	5274
95% Chebyshev (MVUE) UCL	6127	97.5% Chebyshev (MVUE) UCL	7311
99% Chebyshev (MVUE) UCL	9637		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	4240	95% Jackknife UCL	4316
95% Standard Bootstrap UCL	4198	95% Bootstrap-t UCL	4585
95% Hall's Bootstrap UCL	5081	95% Percentile Bootstrap UCL	4242
95% BCA Bootstrap UCL	4385		
90% Chebyshev(Mean, Sd) UCL	4983	95% Chebyshev(Mean, Sd) UCL	5728
97.5% Chebyshev(Mean, Sd) UCL	6761	99% Chebyshev(Mean, Sd) UCL	8792

Suggested UCL to Use

95% Student's-t UCL	4316

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:26
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	12700	Mean	17150
Maximum	21700	Median	17100
SD	4127	Std. Error of Mean	2063
Coefficient of Variation	0.241	Skewness	0.0426

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.215	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22006	95% Adjusted-CLT UCL (Chen-1995)	20591
		95% Modified-t UCL (Johnson-1978)	22013
Gamma GOF Test			
A-D Test Statistic	0.289	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.248	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	22.59	k star (bias corrected MLE)	5.815
Theta hat (MLE)	759.1	Theta star (bias corrected MLE)	2949
nu hat (MLE)	180.7	nu star (bias corrected)	46.52
MLE Mean (bias corrected)	17150	MLE Sd (bias corrected)	7112
		Approximate Chi Square Value (0.05)	31.87
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	25034	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.224	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	9.449	Mean of logged Data	9.727
Maximum of Logged Data	9.985	SD of logged Data	0.245
Assuming Lognormal Distribution			
95% H-UCL	24966	90% Chebyshev (MVUE) UCL	23436
95% Chebyshev (MVUE) UCL	26282	97.5% Chebyshev (MVUE) UCL	30233
99% Chebyshev (MVUE) UCL	37993		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	20544	95% Jackknife UCL	22006
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	23340	95% Chebyshev(Mean, Sd) UCL	26144
97.5% Chebyshev(Mean, Sd) UCL	30036	99% Chebyshev(Mean, Sd) UCL	37680

Suggested UCL to Use

95% Student's-t UCL	22006

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:26
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	3610	Mean	8067
Maximum	17200	Median	4440
SD	6108	Std. Error of Mean	2309
Coefficient of Variation	0.757	Skewness	1.14

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.713	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.315	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12554	95% Adjusted-CLT UCL (Chen-1995)	12928
		95% Modified-t UCL (Johnson-1978)	12719

Gamma GOF Test

A-D Test Statistic	0.897	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.714	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.307	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.467	k star (bias corrected MLE)	1.505
Theta hat (MLE)	3271	Theta star (bias corrected MLE)	5361
nu hat (MLE)	34.53	nu star (bias corrected)	21.07
MLE Mean (bias corrected)	8067	MLE Sd (bias corrected)	6576
		Approximate Chi Square Value (0.05)	11.64
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	9.597

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14599	95% Adjusted Gamma UCL (use when n<50)	17708

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.783	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.284	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.191	Mean of logged Data	8.779
Maximum of Logged Data	9.753	SD of logged Data	0.679

Assuming Lognormal Distribution

95% H-UCL	18040	90% Chebyshev (MVUE) UCL	13986
95% Chebyshev (MVUE) UCL	16752	97.5% Chebyshev (MVUE) UCL	20591
99% Chebyshev (MVUE) UCL	28131		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11865	95% Jackknife UCL	12554
95% Standard Bootstrap UCL	11654	95% Bootstrap-t UCL	25139
95% Hall's Bootstrap UCL	44220	95% Percentile Bootstrap UCL	11697
95% BCA Bootstrap UCL	11856		
90% Chebyshev(Mean, Sd) UCL	14994	95% Chebyshev(Mean, Sd) UCL	18131
97.5% Chebyshev(Mean, Sd) UCL	22486	99% Chebyshev(Mean, Sd) UCL	31039

Suggested UCL to Use

95% Student's-t UCL	12554

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:26
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	5230	Mean	10801
Maximum	18600	Median	11150
SD	4066	Std. Error of Mean	1087
Coefficient of Variation	0.376	Skewness	0.219
Normal GOF Test			
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.111	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12725	95% Adjusted-CLT UCL (Chen-1995)	12656
		95% Modified-t UCL (Johnson-1978)	12736
Gamma GOF Test			
A-D Test Statistic	0.306	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.121	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.117	k star (bias corrected MLE)	5.64
Theta hat (MLE)	1517	Theta star (bias corrected MLE)	1915
nu hat (MLE)	199.3	nu star (bias corrected)	157.9
MLE Mean (bias corrected)	10801	MLE Sd (bias corrected)	4548
		Approximate Chi Square Value (0.05)	129.9
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	126.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	13134	95% Adjusted Gamma UCL (use when n<50)	13484
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.142	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.562	Mean of logged Data	9.215
Maximum of Logged Data	9.831	SD of logged Data	0.404
Assuming Lognormal Distribution			
95% H-UCL	13628	90% Chebyshev (MVUE) UCL	14420
95% Chebyshev (MVUE) UCL	16041	97.5% Chebyshev (MVUE) UCL	18292
99% Chebyshev (MVUE) UCL	22714		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	12588	95% Jackknife UCL	12725
95% Standard Bootstrap UCL	12493	95% Bootstrap-t UCL	12842
95% Hall's Bootstrap UCL	12530	95% Percentile Bootstrap UCL	12559
95% BCA Bootstrap UCL	12601		
90% Chebyshev(Mean, Sd) UCL	14061	95% Chebyshev(Mean, Sd) UCL	15538
97.5% Chebyshev(Mean, Sd) UCL	17588	99% Chebyshev(Mean, Sd) UCL	21614
Suggested UCL to Use			
95% Student's-t UCL	12725		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in the Animas River above of the confluence with mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:28
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	208	Mean	259
Maximum	334	Median	235
SD	52.71	Std. Error of Mean	23.57
Coefficient of Variation	0.204	Skewness	0.783

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.276	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	309.3	95% Adjusted-CLT UCL (Chen-1995)	306.6
		95% Modified-t UCL (Johnson-1978)	310.6
Gamma GOF Test			
A-D Test Statistic	0.359	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.284	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	31.57	k star (bias corrected MLE)	12.76
Theta hat (MLE)	8.204	Theta star (bias corrected MLE)	20.29
nu hat (MLE)	315.7	nu star (bias corrected)	127.6
MLE Mean (bias corrected)	259	MLE Sd (bias corrected)	72.5
		Approximate Chi Square Value (0.05)	102.5
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	92.69
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	322.4	95% Adjusted Gamma UCL (use when n<50)	356.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.26	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.338	Mean of logged Data	5.541
Maximum of Logged Data	5.811	SD of logged Data	0.197
Assuming Lognormal Distribution			
95% H-UCL	322.8	90% Chebyshev (MVUE) UCL	327.4
95% Chebyshev (MVUE) UCL	358.4	97.5% Chebyshev (MVUE) UCL	401.5
99% Chebyshev (MVUE) UCL	486.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	297.8	95% Jackknife UCL	309.3
95% Standard Bootstrap UCL	294.5	95% Bootstrap-t UCL	402.3
95% Hall's Bootstrap UCL	700	95% Percentile Bootstrap UCL	295.8
95% BCA Bootstrap UCL	297.8		
90% Chebyshev(Mean, Sd) UCL	329.7	95% Chebyshev(Mean, Sd) UCL	361.8
97.5% Chebyshev(Mean, Sd) UCL	406.2	99% Chebyshev(Mean, Sd) UCL	493.6

Suggested UCL to Use

95% Student's-t UCL	309.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in the Animas River above of the confluence with mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:28
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	17	Number of Distinct Observations	17
Number of Detects	16	Number of Non-Detects	1
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	111	Minimum Non-Detect	100
Maximum Detect	1100	Maximum Non-Detect	100
Variance Detects	60866	Percent Non-Detects	5.88%
Mean Detects	469	SD Detects	246.7
Median Detects	432	CV Detects	0.526
Skewness Detects	0.86	Kurtosis Detects	1.684
Mean of Logged Detects	6	SD of Logged Detects	0.61

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.936	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.131	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.222	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	447.3	Standard Error of Mean	61.99
SD	247.5	95% KM (BCA) UCL	548.5
95% KM (t) UCL	555.5	95% KM (Percentile Bootstrap) UCL	541.9
95% KM (z) UCL	549.3	95% KM Bootstrap t UCL	567.6
90% KM Chebyshev UCL	633.3	95% KM Chebyshev UCL	717.5
97.5% KM Chebyshev UCL	834.4	99% KM Chebyshev UCL	1064

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.367	Anderson-Darling GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.165	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only

k hat (MLE)	3.469	k star (bias corrected MLE)	2.86
Theta hat (MLE)	135.2	Theta star (bias corrected MLE)	164
nu hat (MLE)	111	nu star (bias corrected)	91.52
MLE Mean (bias corrected)	469	MLE Sd (bias corrected)	277.3

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.267	nu hat (KM)	111.1
Approximate Chi Square Value (111.07, α)	87.75	Adjusted Chi Square Value (111.07, β)	85.57
95% Gamma Approximate KM-UCL (use when n>=50)	566.2	95% Gamma Adjusted KM-UCL (use when n<50)	580.6

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	52.46	Mean	444.5
Maximum	1100	Median	427
SD	259.4	CV	0.583
k hat (MLE)	2.454	k star (bias corrected MLE)	2.061
Theta hat (MLE)	181.1	Theta star (bias corrected MLE)	215.7
nu hat (MLE)	83.45	nu star (bias corrected)	70.06
MLE Mean (bias corrected)	444.5	MLE Sd (bias corrected)	309.7
		Adjusted Level of Significance (β)	0.0346
Approximate Chi Square Value (70.06, α)	51.79	Adjusted Chi Square Value (70.06, β)	50.14
95% Gamma Approximate UCL (use when n>=50)	601.3	95% Gamma Adjusted UCL (use when n<50)	621

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.926	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.204	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.222	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	447	Mean in Log Scale	5.915
SD in Original Scale	255.5	SD in Log Scale	0.686
95% t UCL (assumes normality of ROS data)	555.2	95% Percentile Bootstrap UCL	545.8
95% BCA Bootstrap UCL	553.8	95% Bootstrap t UCL	571.6
95% H-UCL (Log ROS)	689		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	5.918	95% H-UCL (KM -Log)	665.7
KM SD (logged)	0.661	95% Critical H Value (KM-Log)	2.211
KM Standard Error of Mean (logged)	0.165		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	444.4	Mean in Log Scale	5.877
SD in Original Scale	259.6	SD in Log Scale	0.778
95% t UCL (Assumes normality)	554.3	95% H-Stat UCL	760.6

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	555.5	95% KM (Percentile Bootstrap) UCL	541.9

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.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe in the Animas River above of the confluence with mainstem Cement Creek during the post-runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 13:28		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	18	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	8
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	111	Minimum Non-Detect	100
Maximum Detect	234	Maximum Non-Detect	500
Variance Detects	1504	Percent Non-Detects	44.44%
Mean Detects	154.1	SD Detects	38.79
Median Detects	154.5	CV Detects	0.252
Skewness Detects	0.829	Kurtosis Detects	0.544
Mean of Logged Detects	5.01	SD of Logged Detects	0.243
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.28	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	131.8	Standard Error of Mean	9.919
SD	38.8	95% KM (BCA) UCL	147.2
95% KM (t) UCL	149.1	95% KM (Percentile Bootstrap) UCL	149.3
95% KM (z) UCL	148.1	95% KM Bootstrap t UCL	154
90% KM Chebyshev UCL	161.6	95% KM Chebyshev UCL	175.1
97.5% KM Chebyshev UCL	193.8	99% KM Chebyshev UCL	230.5
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.317	Anderson-Darling GOF Test	
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.162	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	18.59	k star (bias corrected MLE)	13.08
Theta hat (MLE)	8.291	Theta star (bias corrected MLE)	11.78
nu hat (MLE)	371.7	nu star (bias corrected)	261.6
MLE Mean (bias corrected)	154.1	MLE Sd (bias corrected)	42.61
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	11.54	nu hat (KM)	415.6
Approximate Chi Square Value (415.58, α)	369.3	Adjusted Chi Square Value (415.58, β)	365.1
95% Gamma Approximate KM-UCL (use when n>=50)	148.3	95% Gamma Adjusted KM-UCL (use when n<50)	150
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	22.74	Mean	115.6
Maximum	234	Median	113.6
SD	55.65	CV	0.482
k hat (MLE)	3.768	k star (bias corrected MLE)	3.177
Theta hat (MLE)	30.67	Theta star (bias corrected MLE)	36.38
nu hat (MLE)	135.6	nu star (bias corrected)	114.4
MLE Mean (bias corrected)	115.6	MLE Sd (bias corrected)	64.84
		Adjusted Level of Significance (β)	0.0357
Approximate Chi Square Value (114.37, α)	90.68	Adjusted Chi Square Value (114.37, β)	88.66
95% Gamma Approximate UCL (use when n>=50)	145.8	95% Gamma Adjusted UCL (use when n<50)	149.1
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	122.5	Mean in Log Scale	4.738
SD in Original Scale	47.52	SD in Log Scale	0.389
95% t UCL (assumes normality of ROS data)	142	95% Percentile Bootstrap UCL	141.1
95% BCA Bootstrap UCL	143.1	95% Bootstrap t UCL	145.7
95% H-UCL (Log ROS)	147.6		
UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed			
KM Mean (logged)	4.844	95% H-UCL (KM -Log)	148
KM SD (logged)	0.267	95% Critical H Value (KM-Log)	1.83
KM Standard Error of Mean (logged)	0.0682		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	118.9	Mean in Log Scale	4.612
SD in Original Scale	67.01	SD in Log Scale	0.612
95% t UCL (Assumes normality)	146.4	95% H-Stat UCL	166.8
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	149.1	95% KM (Percentile Bootstrap) UCL	149.3

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4190	Mean	6018
Maximum	7710	Median	6085
SD	1657	Std. Error of Mean	828.3
Coefficient of Variation	0.275	Skewness	-0.124

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.241	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7967	95% Adjusted-CLT UCL (Chen-1995)	7325
		95% Modified-t UCL (Johnson-1978)	7958

Gamma GOF Test

A-D Test Statistic	0.334	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.28	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	16.91	k star (bias corrected MLE)	4.393
Theta hat (MLE)	356	Theta star (bias corrected MLE)	1370
nu hat (MLE)	135.2	nu star (bias corrected)	35.14
MLE Mean (bias corrected)	6018	MLE Sd (bias corrected)	2871
		Approximate Chi Square Value (0.05)	22.58
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9365	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.251	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.34	Mean of logged Data	8.673
Maximum of Logged Data	8.95	SD of logged Data	0.285

Assuming Lognormal Distribution

95% H-UCL	9535	90% Chebyshev (MVUE) UCL	8583
95% Chebyshev (MVUE) UCL	9743	97.5% Chebyshev (MVUE) UCL	11354
99% Chebyshev (MVUE) UCL	14519		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7380	95% Jackknife UCL	7967
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	8502	95% Chebyshev(Mean, Sd) UCL	9628
97.5% Chebyshev(Mean, Sd) UCL	11190	99% Chebyshev(Mean, Sd) UCL	14259

Suggested UCL to Use

95% Student's-t UCL	7967

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Fe at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	948	Mean	2905
Maximum	7200	Median	1950
SD	2427	Std. Error of Mean	917.2
Coefficient of Variation	0.835	Skewness	1.195

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.826	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.251	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4687	95% Adjusted-CLT UCL (Chen-1995)	4856
		95% Modified-t UCL (Johnson-1978)	4756

Gamma GOF Test

A-D Test Statistic	0.419	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.716	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.315	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.902	k star (bias corrected MLE)	1.182
Theta hat (MLE)	1527	Theta star (bias corrected MLE)	2458
nu hat (MLE)	26.62	nu star (bias corrected)	16.55
MLE Mean (bias corrected)	2905	MLE Sd (bias corrected)	2672
		Approximate Chi Square Value (0.05)	8.35
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	6.669

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5757	95% Adjusted Gamma UCL (use when n<50)	7208

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.854	Mean of logged Data	7.689
Maximum of Logged Data	8.882	SD of logged Data	0.805

Assuming Lognormal Distribution

95% H-UCL	8547	90% Chebyshev (MVUE) UCL	5481
95% Chebyshev (MVUE) UCL	6670	97.5% Chebyshev (MVUE) UCL	8319
99% Chebyshev (MVUE) UCL	11560		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4413	95% Jackknife UCL	4687
95% Standard Bootstrap UCL	4291	95% Bootstrap-t UCL	7615
95% Hall's Bootstrap UCL	13393	95% Percentile Bootstrap UCL	4449
95% BCA Bootstrap UCL	4605		
90% Chebyshev(Mean, Sd) UCL	5656	95% Chebyshev(Mean, Sd) UCL	6903
97.5% Chebyshev(Mean, Sd) UCL	8633	99% Chebyshev(Mean, Sd) UCL	12031

Suggested UCL to Use

95% Student's-t UCL	4687

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the post- runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	787	Mean	2701
Maximum	5490	Median	2740
SD	1432	Std. Error of Mean	397.3
Coefficient of Variation	0.53	Skewness	0.424
Normal GOF Test			
Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.137	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3409	95% Adjusted-CLT UCL (Chen-1995)	3404
		95% Modified-t UCL (Johnson-1978)	3416
Gamma GOF Test			
A-D Test Statistic	0.282	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.145	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.238	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.477	k star (bias corrected MLE)	2.726
Theta hat (MLE)	776.6	Theta star (bias corrected MLE)	990.6
nu hat (MLE)	90.41	nu star (bias corrected)	70.88
MLE Mean (bias corrected)	2701	MLE Sd (bias corrected)	1636
		Approximate Chi Square Value (0.05)	52.5
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	50.25
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3646	95% Adjusted Gamma UCL (use when n<50)	3809
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.164	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.668	Mean of logged Data	7.751
Maximum of Logged Data	8.611	SD of logged Data	0.6
Assuming Lognormal Distribution			
95% H-UCL	4093	90% Chebyshev (MVUE) UCL	4151
95% Chebyshev (MVUE) UCL	4792	97.5% Chebyshev (MVUE) UCL	5681
99% Chebyshev (MVUE) UCL	7428		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3354	95% Jackknife UCL	3409
95% Standard Bootstrap UCL	3337	95% Bootstrap-t UCL	3461
95% Hall's Bootstrap UCL	3466	95% Percentile Bootstrap UCL	3337
95% BCA Bootstrap UCL	3378		
90% Chebyshev(Mean, Sd) UCL	3892	95% Chebyshev(Mean, Sd) UCL	4432
97.5% Chebyshev(Mean, Sd) UCL	5182	99% Chebyshev(Mean, Sd) UCL	6653
Suggested UCL to Use			
95% Student's-t UCL	3409		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe at sampling location A73 in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:47
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1080	Mean	2986
Maximum	4210	Median	3210
SD	1234	Std. Error of Mean	551.9
Coefficient of Variation	0.413	Skewness	-0.998

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.935	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.172	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4163	95% Adjusted-CLT UCL (Chen-1995)	3631
		95% Modified-t UCL (Johnson-1978)	4122
Gamma GOF Test			
A-D Test Statistic	0.418	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.229	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.231	k star (bias corrected MLE)	2.226
Theta hat (MLE)	570.9	Theta star (bias corrected MLE)	1342
nu hat (MLE)	52.31	nu star (bias corrected)	22.26
MLE Mean (bias corrected)	2986	MLE Sd (bias corrected)	2002
		Approximate Chi Square Value (0.05)	12.53
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	9.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5304	95% Adjusted Gamma UCL (use when n<50)	6995
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.838	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.265	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.985	Mean of logged Data	7.903
Maximum of Logged Data	8.345	SD of logged Data	0.547
Assuming Lognormal Distribution			
95% H-UCL	7328	90% Chebyshev (MVUE) UCL	5248
95% Chebyshev (MVUE) UCL	6247	97.5% Chebyshev (MVUE) UCL	7634
99% Chebyshev (MVUE) UCL	10359		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3894	95% Jackknife UCL	4163
95% Standard Bootstrap UCL	3794	95% Bootstrap-t UCL	3892
95% Hall's Bootstrap UCL	3695	95% Percentile Bootstrap UCL	3740
95% BCA Bootstrap UCL	3666		
90% Chebyshev(Mean, Sd) UCL	4642	95% Chebyshev(Mean, Sd) UCL	5392
97.5% Chebyshev(Mean, Sd) UCL	6433	99% Chebyshev(Mean, Sd) UCL	8478

Suggested UCL to Use

95% Student's-t UCL	4163

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Fe at sampling location A73B in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:48
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	569	Mean	1570
Maximum	2790	Median	1460
SD	916.8	Std. Error of Mean	458.4
Coefficient of Variation	0.584	Skewness	0.7

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.272	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2649	95% Adjusted-CLT UCL (Chen-1995)	2495
		95% Modified-t UCL (Johnson-1978)	2675

Gamma GOF Test

A-D Test Statistic	0.28	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.237	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.569	k star (bias corrected MLE)	1.059
Theta hat (MLE)	439.8	Theta star (bias corrected MLE)	1482
nu hat (MLE)	28.55	nu star (bias corrected)	8.472
MLE Mean (bias corrected)	1570	MLE Sd (bias corrected)	1525
		Approximate Chi Square Value (0.05)	3.011
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4416	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.27	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.344	Mean of logged Data	7.212
Maximum of Logged Data	7.934	SD of logged Data	0.655

Assuming Lognormal Distribution

95% H-UCL	9338	90% Chebyshev (MVUE) UCL	3094
95% Chebyshev (MVUE) UCL	3777	97.5% Chebyshev (MVUE) UCL	4726
99% Chebyshev (MVUE) UCL	6589		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2324	95% Jackknife UCL	2649
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2945	95% Chebyshev(Mean, Sd) UCL	3568
97.5% Chebyshev(Mean, Sd) UCL	4433	99% Chebyshev(Mean, Sd) UCL	6131

Suggested UCL to Use

95% Student's-t UCL	2649

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe at sampling location A75D in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:48
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	580	Mean	2556
Maximum	4610	Median	2530
SD	1432	Std. Error of Mean	640.5
Coefficient of Variation	0.56	Skewness	0.134

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.252	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3922	95% Adjusted-CLT UCL (Chen-1995)	3651
		95% Modified-t UCL (Johnson-1978)	3928
Gamma GOF Test			
A-D Test Statistic	0.453	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.683	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.319	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.843	k star (bias corrected MLE)	1.271
Theta hat (MLE)	899.1	Theta star (bias corrected MLE)	2012
nu hat (MLE)	28.43	nu star (bias corrected)	12.71
MLE Mean (bias corrected)	2556	MLE Sd (bias corrected)	2268
		Approximate Chi Square Value (0.05)	5.695
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	3.826
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5702	95% Adjusted Gamma UCL (use when n<50)	8488
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.84	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.348	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.363	Mean of logged Data	7.66
Maximum of Logged Data	8.436	SD of logged Data	0.773
Assuming Lognormal Distribution			
95% H-UCL	13153	90% Chebyshev (MVUE) UCL	5374
95% Chebyshev (MVUE) UCL	6599	97.5% Chebyshev (MVUE) UCL	8299
99% Chebyshev (MVUE) UCL	11638		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3610	95% Jackknife UCL	3922
95% Standard Bootstrap UCL	3499	95% Bootstrap-t UCL	3827
95% Hall's Bootstrap UCL	3998	95% Percentile Bootstrap UCL	3428
95% BCA Bootstrap UCL	3402		
90% Chebyshev(Mean, Sd) UCL	4478	95% Chebyshev(Mean, Sd) UCL	5348
97.5% Chebyshev(Mean, Sd) UCL	6556	99% Chebyshev(Mean, Sd) UCL	8929

Suggested UCL to Use

95% Student's-t UCL	3922

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe at sampling location A75B in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:48
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	585	Mean	2224
Maximum	4810	Median	1750
SD	1895	Std. Error of Mean	947.6
Coefficient of Variation	0.852	Skewness	1.11

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.912	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4454	95% Adjusted-CLT UCL (Chen-1995)	4344
		95% Modified-t UCL (Johnson-1978)	4541

Gamma GOF Test

A-D Test Statistic	0.238	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.233	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.799	k star (bias corrected MLE)	0.616
Theta hat (MLE)	1236	Theta star (bias corrected MLE)	3608
nu hat (MLE)	14.39	nu star (bias corrected)	4.931
MLE Mean (bias corrected)	2224	MLE Sd (bias corrected)	2832
		Approximate Chi Square Value (0.05)	1.121
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	9786	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.182	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.372	Mean of logged Data	7.404
Maximum of Logged Data	8.478	SD of logged Data	0.925

Assuming Lognormal Distribution

95% H-UCL	69069	90% Chebyshev (MVUE) UCL	5119
95% Chebyshev (MVUE) UCL	6430	97.5% Chebyshev (MVUE) UCL	8251
99% Chebyshev (MVUE) UCL	11826		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3782	95% Jackknife UCL	4454
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5067	95% Chebyshev(Mean, Sd) UCL	6354
97.5% Chebyshev(Mean, Sd) UCL	8141	99% Chebyshev(Mean, Sd) UCL	11652

Suggested UCL to Use

95% Student's-t UCL	4454

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Fe at Bakers Bridge in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 13:48
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	317	Minimum Non-Detect	500
Maximum Detect	3560	Maximum Non-Detect	500
Variance Detects	1819222	Percent Non-Detects	20%
Mean Detects	1717	SD Detects	1349
Median Detects	1495	CV Detects	0.786
Skewness Detects	0.95	Kurtosis Detects	1.998
Mean of Logged Detects	7.139	SD of Logged Detects	1.007

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.92	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.305	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1437	Standard Error of Mean	612.1
SD	1185	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2742	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2444	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3273	95% KM Chebyshev UCL	4105
97.5% KM Chebyshev UCL	5259	99% KM Chebyshev UCL	7527

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.318	Anderson-Darling GOF Test
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.269	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.765	k star (bias corrected MLE)	0.608
Theta hat (MLE)	972.7	Theta star (bias corrected MLE)	2824
nu hat (MLE)	14.12	nu star (bias corrected)	4.863
MLE Mean (bias corrected)	1717	MLE Sd (bias corrected)	2202

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.469	nu hat (KM)	14.69
Approximate Chi Square Value (14.69, α)	7.048	Adjusted Chi Square Value (14.69, β)	4.912
95% Gamma Approximate KM-UCL (use when n>=50)	2995	95% Gamma Adjusted KM-UCL (use when n<50)	4298

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	162.3	Mean	1406
Maximum	3560	Median	1460
SD	1359	CV	0.967
k hat (MLE)	1.099	k star (bias corrected MLE)	0.573
Theta hat (MLE)	1279	Theta star (bias corrected MLE)	2453
nu hat (MLE)	10.99	nu star (bias corrected)	5.731
MLE Mean (bias corrected)	1406	MLE Sd (bias corrected)	1857
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (5.73, α)	1.504	Adjusted Chi Square Value (5.73, β)	0.749
95% Gamma Approximate UCL (use when n>=50)	5357	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.308	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1441	Mean in Log Scale	6.877
SD in Original Scale	1320	SD in Log Scale	1.051
95% t UCL (assumes normality of ROS data)	2700	95% Percentile Bootstrap UCL	2314
95% BCA Bootstrap UCL	2496	95% Bootstrap t UCL	3585
95% H-UCL (Log ROS)	24854		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	6.863	95% H-UCL (KM -Log)	14357
KM SD (logged)	0.956	95% Critical H Value (KM-Log)	4.714
KM Standard Error of Mean (logged)	0.493		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1423	Mean in Log Scale	6.815
SD in Original Scale	1340	SD in Log Scale	1.133
95% t UCL (Assumes normality)	2701	95% H-Stat UCL	38709

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2742	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Pb in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:56
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	13.2	Mean	14.2
Maximum	15.1	Median	14.25
SD	0.779	Std. Error of Mean	0.389
Coefficient of Variation	0.0549	Skewness	-0.381

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.961	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.25	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15.12	95% Adjusted-CLT UCL (Chen-1995)	14.76
		95% Modified-t UCL (Johnson-1978)	15.1

Gamma GOF Test

A-D Test Statistic	0.291	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.256	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	439.3	k star (bias corrected MLE)	110
Theta hat (MLE)	0.0323	Theta star (bias corrected MLE)	0.129
nu hat (MLE)	3514	nu star (bias corrected)	879.9
MLE Mean (bias corrected)	14.2	MLE Sd (bias corrected)	1.354
		Approximate Chi Square Value (0.05)	812
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	15.39	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.58	Mean of logged Data	2.652
Maximum of Logged Data	2.715	SD of logged Data	0.0552

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	15.38
95% Chebyshev (MVUE) UCL	15.91	97.5% Chebyshev (MVUE) UCL	16.65
99% Chebyshev (MVUE) UCL	18.1		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	14.84	95% Jackknife UCL	15.12
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	15.37	95% Chebyshev(Mean, Sd) UCL	15.9
97.5% Chebyshev(Mean, Sd) UCL	16.63	99% Chebyshev(Mean, Sd) UCL	18.07

Suggested UCL to Use

95% Student's-t UCL	15.12

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Pb in mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:56
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	4.2	Mean	8.4
Maximum	13.1	Median	8
SD	2.711	Std. Error of Mean	1.025
Coefficient of Variation	0.323	Skewness	0.33

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.186	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10.39	95% Adjusted-CLT UCL (Chen-1995)	10.22
		95% Modified-t UCL (Johnson-1978)	10.41
Gamma GOF Test			
A-D Test Statistic	0.293	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.193	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.44	k star (bias corrected MLE)	6.062
Theta hat (MLE)	0.804	Theta star (bias corrected MLE)	1.386
nu hat (MLE)	146.2	nu star (bias corrected)	84.87
MLE Mean (bias corrected)	8.4	MLE Sd (bias corrected)	3.412
		Approximate Chi Square Value (0.05)	64.63
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	59.33
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	11.03	95% Adjusted Gamma UCL (use when n<50)	12.02
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.937	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.214	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.435	Mean of logged Data	2.08
Maximum of Logged Data	2.573	SD of logged Data	0.348
Assuming Lognormal Distribution			
95% H-UCL	11.73	90% Chebyshev (MVUE) UCL	11.76
95% Chebyshev (MVUE) UCL	13.27	97.5% Chebyshev (MVUE) UCL	15.37
99% Chebyshev (MVUE) UCL	19.49		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	10.09	95% Jackknife UCL	10.39
95% Standard Bootstrap UCL	9.961	95% Bootstrap-t UCL	10.52
95% Hall's Bootstrap UCL	10.97	95% Percentile Bootstrap UCL	10.01
95% BCA Bootstrap UCL	10.01		
90% Chebyshev(Mean, Sd) UCL	11.47	95% Chebyshev(Mean, Sd) UCL	12.87
97.5% Chebyshev(Mean, Sd) UCL	14.8	99% Chebyshev(Mean, Sd) UCL	18.6

Suggested UCL to Use

95% Student's-t UCL	10.39

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Pb in mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:56
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	8.5	Mean	15.45
Maximum	21.4	Median	16.5
SD	3.539	Std. Error of Mean	0.946
Coefficient of Variation	0.229	Skewness	-0.378
Normal GOF Test			
Shapiro Wilk Test Statistic	0.972	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	17.12	95% Adjusted-CLT UCL (Chen-1995)	16.9
		95% Modified-t UCL (Johnson-1978)	17.11
Gamma GOF Test			
A-D Test Statistic	0.364	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.183	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.228	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	18.43	k star (bias corrected MLE)	14.53
Theta hat (MLE)	0.838	Theta star (bias corrected MLE)	1.063
nu hat (MLE)	516	nu star (bias corrected)	406.8
MLE Mean (bias corrected)	15.45	MLE Sd (bias corrected)	4.053
		Approximate Chi Square Value (0.05)	361
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	355.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	17.41	95% Adjusted Gamma UCL (use when n<50)	17.69
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.189	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.14	Mean of logged Data	2.71
Maximum of Logged Data	3.063	SD of logged Data	0.251
Assuming Lognormal Distribution			
95% H-UCL	17.65	90% Chebyshev (MVUE) UCL	18.62
95% Chebyshev (MVUE) UCL	20.04	97.5% Chebyshev (MVUE) UCL	22.01
99% Chebyshev (MVUE) UCL	25.89		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	17.01	95% Jackknife UCL	17.12
95% Standard Bootstrap UCL	16.96	95% Bootstrap-t UCL	17.07
95% Hall's Bootstrap UCL	16.9	95% Percentile Bootstrap UCL	16.89
95% BCA Bootstrap UCL	16.98		
90% Chebyshev(Mean, Sd) UCL	18.29	95% Chebyshev(Mean, Sd) UCL	19.57
97.5% Chebyshev(Mean, Sd) UCL	21.36	99% Chebyshev(Mean, Sd) UCL	24.86
Suggested UCL to Use			
95% Student's-t UCL	17.12		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Pb in the Animas River above of the confluence with mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	17	Number of Distinct Observations	8
Number of Detects	13	Number of Non-Detects	4
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.6	Minimum Non-Detect	1
Maximum Detect	1.5	Maximum Non-Detect	1
Variance Detects	0.0703	Percent Non-Detects	23.53%
Mean Detects	1.023	SD Detects	0.265
Median Detects	1	CV Detects	0.259
Skewness Detects	0.0554	Kurtosis Detects	-0.608
Mean of Logged Detects	-0.0101	SD of Logged Detects	0.272

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.972	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.119	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.961	Standard Error of Mean	0.0675
SD	0.256	95% KM (BCA) UCL	1.065
95% KM (t) UCL	1.079	95% KM (Percentile Bootstrap) UCL	1.076
95% KM (z) UCL	1.072	95% KM Bootstrap t UCL	1.088
90% KM Chebyshev UCL	1.164	95% KM Chebyshev UCL	1.255
97.5% KM Chebyshev UCL	1.383	99% KM Chebyshev UCL	1.633

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.255	Anderson-Darling GOF Test
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.136	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.236	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	15.34	k star (bias corrected MLE)	11.85
Theta hat (MLE)	0.0667	Theta star (bias corrected MLE)	0.0863
nu hat (MLE)	398.8	nu star (bias corrected)	308.1
MLE Mean (bias corrected)	1.023	MLE Sd (bias corrected)	0.297

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	14.12	nu hat (KM)	480
Approximate Chi Square Value (480.05, α)	430.2	Adjusted Chi Square Value (480.05, β)	425.3
95% Gamma Approximate KM-UCL (use when n>=50)	1.072	95% Gamma Adjusted KM-UCL (use when n<50)	1.085

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.6	Mean	0.96
Maximum	1.5	Median	0.9
SD	0.262	CV	0.273
k hat (MLE)	14.4	k star (bias corrected MLE)	11.9
Theta hat (MLE)	0.0667	Theta star (bias corrected MLE)	0.0807
nu hat (MLE)	489.7	nu star (bias corrected)	404.6
MLE Mean (bias corrected)	0.96	MLE Sd (bias corrected)	0.278
		Adjusted Level of Significance (β)	0.0346
Approximate Chi Square Value (404.61, α)	359	Adjusted Chi Square Value (404.61, β)	354.5
95% Gamma Approximate UCL (use when n>=50)	1.082	95% Gamma Adjusted UCL (use when n<50)	1.096

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.96	Mean in Log Scale	-0.0753
SD in Original Scale	0.261	SD in Log Scale	0.272
95% t UCL (assumes normality of ROS data)	1.071	95% Percentile Bootstrap UCL	1.068
95% BCA Bootstrap UCL	1.058	95% Bootstrap t UCL	1.085
95% H-UCL (Log ROS)	1.091		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.0753	95% H-UCL (KM -Log)	1.088
KM SD (logged)	0.268	95% Critical H Value (KM-Log)	1.838
KM Standard Error of Mean (logged)	0.0726		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.9	Mean in Log Scale	-0.171
SD in Original Scale	0.324	SD in Log Scale	0.381
95% t UCL (Assumes normality)	1.037	95% H-Stat UCL	1.088

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.079	95% KM (Percentile Bootstrap) UCL	1.076

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Pb in the Animas River above of the confluence with mainstem Cement Creek during the post-runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 13:58		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	18	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	11
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	0.1	Minimum Non-Detect	0.2
Maximum Detect	0.436	Maximum Non-Detect	1
Variance Detects	0.0112	Percent Non-Detects	61.11%
Mean Detects	0.308	SD Detects	0.106
Median Detects	0.322	CV Detects	0.344
Skewness Detects	-1.27	Kurtosis Detects	2.635
Mean of Logged Detects	-1.257	SD of Logged Detects	0.485
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.905	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.253	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.262	Standard Error of Mean	0.044
SD	0.122	95% KM (BCA) UCL	0.351
95% KM (t) UCL	0.338	95% KM (Percentile Bootstrap) UCL	0.339
95% KM (z) UCL	0.334	95% KM Bootstrap t UCL	0.323
90% KM Chebyshev UCL	0.394	95% KM Chebyshev UCL	0.454
97.5% KM Chebyshev UCL	0.537	99% KM Chebyshev UCL	0.7
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.687	Anderson-Darling GOF Test	
5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.315	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.313	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	6.479	k star (bias corrected MLE)	3.797
Theta hat (MLE)	0.0475	Theta star (bias corrected MLE)	0.0811
nu hat (MLE)	90.7	nu star (bias corrected)	53.16
MLE Mean (bias corrected)	0.308	MLE Sd (bias corrected)	0.158
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	4.581	nu hat (KM)	164.9
Approximate Chi Square Value (164.92, α)	136.2	Adjusted Chi Square Value (164.92, β)	133.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.317	95% Gamma Adjusted KM-UCL (use when n<50)	0.323
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.1	Mean	0.273
Maximum	0.456	Median	0.287
SD	0.108	CV	0.395
k hat (MLE)	5.892	k star (bias corrected MLE)	4.947
Theta hat (MLE)	0.0463	Theta star (bias corrected MLE)	0.0551
nu hat (MLE)	212.1	nu star (bias corrected)	178.1
MLE Mean (bias corrected)	0.273	MLE Sd (bias corrected)	0.123
		Adjusted Level of Significance (β)	0.0357
Approximate Chi Square Value (178.09, α)	148.2	Adjusted Chi Square Value (178.09, β)	145.6
95% Gamma Approximate UCL (use when n>=50)	0.328	95% Gamma Adjusted UCL (use when n<50)	0.334
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.755	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.344	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.268	Mean in Log Scale	-1.425
SD in Original Scale	0.121	SD in Log Scale	0.5
95% t UCL (assumes normality of ROS data)	0.318	95% Percentile Bootstrap UCL	0.314
95% BCA Bootstrap UCL	0.315	95% Bootstrap t UCL	0.322
95% H-UCL (Log ROS)	0.348		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.381	Mean in Log Scale	-1.091
SD in Original Scale	0.151	SD in Log Scale	0.592
95% t UCL (Assumes normality)	0.443	95% H-Stat UCL	0.542
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Detected Data appear Normal Distributed at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	0.338	95% KM (Percentile Bootstrap) UCL	0.339

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:06
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3040	Mean	4618
Maximum	5290	Median	5070
SD	1062	Std. Error of Mean	531
Coefficient of Variation	0.23	Skewness	-1.887

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.747	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.369	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5867	95% Adjusted-CLT UCL (Chen-1995)	4956
		95% Modified-t UCL (Johnson-1978)	5784

Gamma GOF Test

A-D Test Statistic	0.716	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.4	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.06	k star (bias corrected MLE)	5.432
Theta hat (MLE)	219.2	Theta star (bias corrected MLE)	850.1
nu hat (MLE)	168.5	nu star (bias corrected)	43.46
MLE Mean (bias corrected)	4618	MLE Sd (bias corrected)	1981
		Approximate Chi Square Value (0.05)	29.34
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6839	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.723	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.385	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.02	Mean of logged Data	8.414
Maximum of Logged Data	8.574	SD of logged Data	0.264

Assuming Lognormal Distribution

95% H-UCL	7002	90% Chebyshev (MVUE) UCL	6452
95% Chebyshev (MVUE) UCL	7279	97.5% Chebyshev (MVUE) UCL	8426
99% Chebyshev (MVUE) UCL	10680		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5491	95% Jackknife UCL	5867
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6211	95% Chebyshev(Mean, Sd) UCL	6932
97.5% Chebyshev(Mean, Sd) UCL	7934	99% Chebyshev(Mean, Sd) UCL	9901

Suggested UCL to Use

95% Student's-t UCL	5867

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Mn in mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:06
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	731	Mean	1268
Maximum	1770	Median	1440
SD	479.1	Std. Error of Mean	181.1
Coefficient of Variation	0.378	Skewness	-0.207

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.81	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1620	95% Adjusted-CLT UCL (Chen-1995)	1551
		95% Modified-t UCL (Johnson-1978)	1618

Gamma GOF Test

A-D Test Statistic	0.75	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.709	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.272	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.437	k star (bias corrected MLE)	4.345
Theta hat (MLE)	170.5	Theta star (bias corrected MLE)	291.9
nu hat (MLE)	104.1	nu star (bias corrected)	60.83
MLE Mean (bias corrected)	1268	MLE Sd (bias corrected)	608.4
		Approximate Chi Square Value (0.05)	43.89
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	39.59

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1758	95% Adjusted Gamma UCL (use when n<50)	1949

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.795	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.594	Mean of logged Data	7.077
Maximum of Logged Data	7.479	SD of logged Data	0.411

Assuming Lognormal Distribution

95% H-UCL	1893	90% Chebyshev (MVUE) UCL	1866
95% Chebyshev (MVUE) UCL	2136	97.5% Chebyshev (MVUE) UCL	2509
99% Chebyshev (MVUE) UCL	3244		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1566	95% Jackknife UCL	1620
95% Standard Bootstrap UCL	1548	95% Bootstrap-t UCL	1620
95% Hall's Bootstrap UCL	1465	95% Percentile Bootstrap UCL	1545
95% BCA Bootstrap UCL	1514		
90% Chebyshev(Mean, Sd) UCL	1812	95% Chebyshev(Mean, Sd) UCL	2058
97.5% Chebyshev(Mean, Sd) UCL	2399	99% Chebyshev(Mean, Sd) UCL	3070

Suggested UCL to Use

95% Student's-t UCL	1620

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Mn in mainstem Cement Creek during the post- runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:06
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	710	Mean	4112
Maximum	5300	Median	4855
SD	1449	Std. Error of Mean	387.3
Coefficient of Variation	0.352	Skewness	-1.408
Normal GOF Test			
Shapiro Wilk Test Statistic	0.793	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.28	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4798	95% Adjusted-CLT UCL (Chen-1995)	4594
		95% Modified-t UCL (Johnson-1978)	4774
Gamma GOF Test			
A-D Test Statistic	1.628	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.303	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.838	k star (bias corrected MLE)	3.849
Theta hat (MLE)	850	Theta star (bias corrected MLE)	1068
nu hat (MLE)	135.5	nu star (bias corrected)	107.8
MLE Mean (bias corrected)	4112	MLE Sd (bias corrected)	2096
		Approximate Chi Square Value (0.05)	84.8
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	82.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5225	95% Adjusted Gamma UCL (use when n<50)	5397
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.675	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.295	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.565	Mean of logged Data	8.215
Maximum of Logged Data	8.575	SD of logged Data	0.57
Assuming Lognormal Distribution			
95% H-UCL	6087	90% Chebyshev (MVUE) UCL	6322
95% Chebyshev (MVUE) UCL	7242	97.5% Chebyshev (MVUE) UCL	8519
99% Chebyshev (MVUE) UCL	11027		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4749	95% Jackknife UCL	4798
95% Standard Bootstrap UCL	4718	95% Bootstrap-t UCL	4683
95% Hall's Bootstrap UCL	4605	95% Percentile Bootstrap UCL	4673
95% BCA Bootstrap UCL	4614		
90% Chebyshev(Mean, Sd) UCL	5274	95% Chebyshev(Mean, Sd) UCL	5801
97.5% Chebyshev(Mean, Sd) UCL	6531	99% Chebyshev(Mean, Sd) UCL	7966
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	5801		

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Mn in the Animas River above of the confluence with mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:09
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	2710	Mean	3300
Maximum	3730	Median	3340
SD	394.3	Std. Error of Mean	176.3
Coefficient of Variation	0.119	Skewness	-0.754

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.161	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3676	95% Adjusted-CLT UCL (Chen-1995)	3526
		95% Modified-t UCL (Johnson-1978)	3666
Gamma GOF Test			
A-D Test Statistic	0.246	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.17	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	83.63	k star (bias corrected MLE)	33.59
Theta hat (MLE)	39.46	Theta star (bias corrected MLE)	98.25
nu hat (MLE)	836.3	nu star (bias corrected)	335.9
MLE Mean (bias corrected)	3300	MLE Sd (bias corrected)	569.4
		Approximate Chi Square Value (0.05)	294.4
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	277.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3765	95% Adjusted Gamma UCL (use when n<50)	3998
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.181	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.905	Mean of logged Data	8.096
Maximum of Logged Data	8.224	SD of logged Data	0.124
Assuming Lognormal Distribution			
95% H-UCL	3758	90% Chebyshev (MVUE) UCL	3849
95% Chebyshev (MVUE) UCL	4097	97.5% Chebyshev (MVUE) UCL	4442
99% Chebyshev (MVUE) UCL	5119		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3590	95% Jackknife UCL	3676
95% Standard Bootstrap UCL	3559	95% Bootstrap-t UCL	3640
95% Hall's Bootstrap UCL	3513	95% Percentile Bootstrap UCL	3548
95% BCA Bootstrap UCL	3504		
90% Chebyshev(Mean, Sd) UCL	3829	95% Chebyshev(Mean, Sd) UCL	4069
97.5% Chebyshev(Mean, Sd) UCL	4401	99% Chebyshev(Mean, Sd) UCL	5054

Suggested UCL to Use

95% Student's-t UCL	3676

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Mn in the Animas River above of the confluence with mainstem Cement Creek during the runoff period

User Selected Options			
Date/Time of Computation	2/23/2015 14:09		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics			
Total Number of Observations	17	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	153	Mean	514.3
Maximum	1220	Median	415
SD	279.8	Std. Error of Mean	67.87
Coefficient of Variation	0.544	Skewness	0.894
Normal GOF Test			
Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.2	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.215	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	632.8	95% Adjusted-CLT UCL (Chen-1995)	641.7
		95% Modified-t UCL (Johnson-1978)	635.2
Gamma GOF Test			
A-D Test Statistic	0.466	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.194	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.21	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.62	k star (bias corrected MLE)	3.02
Theta hat (MLE)	142.1	Theta star (bias corrected MLE)	170.3
nu hat (MLE)	123.1	nu star (bias corrected)	102.7
MLE Mean (bias corrected)	514.3	MLE Sd (bias corrected)	295.9
		Approximate Chi Square Value (0.05)	80.3
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	78.23
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	657.6	95% Adjusted Gamma UCL (use when n<50)	675.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.215	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.03	Mean of logged Data	6.098
Maximum of Logged Data	7.107	SD of logged Data	0.569
Assuming Lognormal Distribution			
95% H-UCL	705.9	90% Chebyshev (MVUE) UCL	740.7
95% Chebyshev (MVUE) UCL	841.7	97.5% Chebyshev (MVUE) UCL	982
99% Chebyshev (MVUE) UCL	1257		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	625.9	95% Jackknife UCL	632.8
95% Standard Bootstrap UCL	624.5	95% Bootstrap-t UCL	649.5
95% Hall's Bootstrap UCL	658.4	95% Percentile Bootstrap UCL	627.8
95% BCA Bootstrap UCL	637.7		
90% Chebyshev(Mean, Sd) UCL	717.9	95% Chebyshev(Mean, Sd) UCL	810.1
97.5% Chebyshev(Mean, Sd) UCL	938.1	99% Chebyshev(Mean, Sd) UCL	1190
Suggested UCL to Use			
95% Student's-t UCL	632.8		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn in the Animas River above of the confluence with mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:09
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	416	Mean	1031
Maximum	2380	Median	843
SD	527.2	Std. Error of Mean	124.3
Coefficient of Variation	0.511	Skewness	1.035

Normal GOF Test

Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.183	Lilliefors GOF Test
5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1247	95% Adjusted-CLT UCL (Chen-1995)	1268
		95% Modified-t UCL (Johnson-1978)	1252

Gamma GOF Test

A-D Test Statistic	0.396	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.204	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.412	k star (bias corrected MLE)	3.714
Theta hat (MLE)	233.6	Theta star (bias corrected MLE)	277.6
nu hat (MLE)	158.8	nu star (bias corrected)	133.7
MLE Mean (bias corrected)	1031	MLE Sd (bias corrected)	534.9
		Approximate Chi Square Value (0.05)	108
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	105.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1276	95% Adjusted Gamma UCL (use when n<50)	1303

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.031	Mean of logged Data	6.82
Maximum of Logged Data	7.775	SD of logged Data	0.498

Assuming Lognormal Distribution

95% H-UCL	1324	90% Chebyshev (MVUE) UCL	1404
95% Chebyshev (MVUE) UCL	1574	97.5% Chebyshev (MVUE) UCL	1810
99% Chebyshev (MVUE) UCL	2273		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1235	95% Jackknife UCL	1247
95% Standard Bootstrap UCL	1227	95% Bootstrap-t UCL	1295
95% Hall's Bootstrap UCL	1311	95% Percentile Bootstrap UCL	1224
95% BCA Bootstrap UCL	1274		
90% Chebyshev(Mean, Sd) UCL	1404	95% Chebyshev(Mean, Sd) UCL	1572
97.5% Chebyshev(Mean, Sd) UCL	1807	99% Chebyshev(Mean, Sd) UCL	2267

Suggested UCL to Use

95% Student's-t UCL	1247

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:34
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1770	Mean	2435
Maximum	2920	Median	2525
SD	504	Std. Error of Mean	252
Coefficient of Variation	0.207	Skewness	-0.833

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3028	95% Adjusted-CLT UCL (Chen-1995)	2737
		95% Modified-t UCL (Johnson-1978)	3011

Gamma GOF Test

A-D Test Statistic	0.297	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.241	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	28.69	k star (bias corrected MLE)	7.338
Theta hat (MLE)	84.88	Theta star (bias corrected MLE)	331.8
nu hat (MLE)	229.5	nu star (bias corrected)	58.71
MLE Mean (bias corrected)	2435	MLE Sd (bias corrected)	898.9
		Approximate Chi Square Value (0.05)	42.09
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3396	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.927	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.213	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.479	Mean of logged Data	7.78
Maximum of Logged Data	7.979	SD of logged Data	0.221

Assuming Lognormal Distribution

95% H-UCL	3383	90% Chebyshev (MVUE) UCL	3242
95% Chebyshev (MVUE) UCL	3606	97.5% Chebyshev (MVUE) UCL	4112
99% Chebyshev (MVUE) UCL	5106		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2850	95% Jackknife UCL	3028
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3191	95% Chebyshev(Mean, Sd) UCL	3533
97.5% Chebyshev(Mean, Sd) UCL	4009	99% Chebyshev(Mean, Sd) UCL	4942

Suggested UCL to Use

95% Student's-t UCL	3028

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Mn at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:34
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	219	Mean	426.7
Maximum	823	Median	450
SD	206	Std. Error of Mean	77.86
Coefficient of Variation	0.483	Skewness	1.209

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	578	95% Adjusted-CLT UCL (Chen-1995)	592.8
		95% Modified-t UCL (Johnson-1978)	583.9

Gamma GOF Test

A-D Test Statistic	0.348	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.197	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.313	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.53	k star (bias corrected MLE)	3.255
Theta hat (MLE)	77.17	Theta star (bias corrected MLE)	131.1
nu hat (MLE)	77.42	nu star (bias corrected)	45.57
MLE Mean (bias corrected)	426.7	MLE Sd (bias corrected)	236.5
		Approximate Chi Square Value (0.05)	31.08
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	27.52

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	625.6	95% Adjusted Gamma UCL (use when n<50)	706.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.196	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.389	Mean of logged Data	5.963
Maximum of Logged Data	6.713	SD of logged Data	0.462

Assuming Lognormal Distribution

95% H-UCL	677.8	90% Chebyshev (MVUE) UCL	649.4
95% Chebyshev (MVUE) UCL	750.8	97.5% Chebyshev (MVUE) UCL	891.6
99% Chebyshev (MVUE) UCL	1168		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	554.8	95% Jackknife UCL	578
95% Standard Bootstrap UCL	544.2	95% Bootstrap-t UCL	643.6
95% Hall's Bootstrap UCL	690.9	95% Percentile Bootstrap UCL	549.9
95% BCA Bootstrap UCL	582.9		
90% Chebyshev(Mean, Sd) UCL	660.3	95% Chebyshev(Mean, Sd) UCL	766.1
97.5% Chebyshev(Mean, Sd) UCL	913	99% Chebyshev(Mean, Sd) UCL	1201

Suggested UCL to Use

95% Student's-t UCL	578

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/23/2015 14:34
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	405	Mean	1242
Maximum	2490	Median	1290
SD	552.1	Std. Error of Mean	153.1
Coefficient of Variation	0.445	Skewness	0.622

Normal GOF Test		
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.131	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1514	95% Adjusted-CLT UCL (Chen-1995)	1522
		95% Modified-t UCL (Johnson-1978)	1519

Gamma GOF Test		
A-D Test Statistic	0.231	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.131	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	5.113	k star (bias corrected MLE)	3.985
Theta hat (MLE)	242.8	Theta star (bias corrected MLE)	311.6
nu hat (MLE)	132.9	nu star (bias corrected)	103.6
MLE Mean (bias corrected)	1242	MLE Sd (bias corrected)	622
		Approximate Chi Square Value (0.05)	81.11
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	78.28

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1586	95% Adjusted Gamma UCL (use when n<50)	1643

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.156	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	6.004	Mean of logged Data	7.023
Maximum of Logged Data	7.82	SD of logged Data	0.489

Assuming Lognormal Distribution			
95% H-UCL	1701	90% Chebyshev (MVUE) UCL	1774
95% Chebyshev (MVUE) UCL	2011	97.5% Chebyshev (MVUE) UCL	2339
99% Chebyshev (MVUE) UCL	2984		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	1493	95% Jackknife UCL	1514
95% Standard Bootstrap UCL	1480	95% Bootstrap-t UCL	1544
95% Hall's Bootstrap UCL	1606	95% Percentile Bootstrap UCL	1491
95% BCA Bootstrap UCL	1500		
90% Chebyshev(Mean, Sd) UCL	1701	95% Chebyshev(Mean, Sd) UCL	1909
97.5% Chebyshev(Mean, Sd) UCL	2198	99% Chebyshev(Mean, Sd) UCL	2765

Suggested UCL to Use

95% Student's-t UCL	1514

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at sampling location A73 in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	341	Mean	1009
Maximum	1830	Median	811
SD	611	Std. Error of Mean	273.3
Coefficient of Variation	0.605	Skewness	0.492

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1592	95% Adjusted-CLT UCL (Chen-1995)	1523
		95% Modified-t UCL (Johnson-1978)	1602

Gamma GOF Test

A-D Test Statistic	0.224	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.204	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.155	k star (bias corrected MLE)	1.395
Theta hat (MLE)	319.9	Theta star (bias corrected MLE)	723.2
nu hat (MLE)	31.55	nu star (bias corrected)	13.95
MLE Mean (bias corrected)	1009	MLE Sd (bias corrected)	854.3
		Approximate Chi Square Value (0.05)	6.54
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	4.501

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2153	95% Adjusted Gamma UCL (use when n<50)	3129

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.967	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.182	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.832	Mean of logged Data	6.75
Maximum of Logged Data	7.512	SD of logged Data	0.67

Assuming Lognormal Distribution

95% H-UCL	3512	90% Chebyshev (MVUE) UCL	1917
95% Chebyshev (MVUE) UCL	2324	97.5% Chebyshev (MVUE) UCL	2889
99% Chebyshev (MVUE) UCL	4000		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1459	95% Jackknife UCL	1592
95% Standard Bootstrap UCL	1414	95% Bootstrap-t UCL	2149
95% Hall's Bootstrap UCL	5349	95% Percentile Bootstrap UCL	1433
95% BCA Bootstrap UCL	1433		
90% Chebyshev(Mean, Sd) UCL	1829	95% Chebyshev(Mean, Sd) UCL	2200
97.5% Chebyshev(Mean, Sd) UCL	2716	99% Chebyshev(Mean, Sd) UCL	3728

Suggested UCL to Use

95% Student's-t UCL	1592

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at sampling location A73B in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	109	Mean	508
Maximum	1210	Median	356.5
SD	485	Std. Error of Mean	242.5
Coefficient of Variation	0.955	Skewness	1.589

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.857	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.323	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1079	95% Adjusted-CLT UCL (Chen-1995)	1113
		95% Modified-t UCL (Johnson-1978)	1111
Gamma GOF Test			
A-D Test Statistic	0.253	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.662	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.564	k star (bias corrected MLE)	0.558
Theta hat (MLE)	324.9	Theta star (bias corrected MLE)	911.1
nu hat (MLE)	12.51	nu star (bias corrected)	4.46
MLE Mean (bias corrected)	508	MLE Sd (bias corrected)	680.3
		Approximate Chi Square Value (0.05)	0.912
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2486	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.992	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.186	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.691	Mean of logged Data	5.878
Maximum of Logged Data	7.098	SD of logged Data	0.993
Assuming Lognormal Distribution			
95% H-UCL	26175	90% Chebyshev (MVUE) UCL	1204
95% Chebyshev (MVUE) UCL	1520	97.5% Chebyshev (MVUE) UCL	1960
99% Chebyshev (MVUE) UCL	2823		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	906.9	95% Jackknife UCL	1079
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1236	95% Chebyshev(Mean, Sd) UCL	1565
97.5% Chebyshev(Mean, Sd) UCL	2022	99% Chebyshev(Mean, Sd) UCL	2921

Suggested UCL to Use

95% Student's-t UCL	1079

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at sampling location A75D in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	232	Mean	589.6
Maximum	1090	Median	408
SD	362.4	Std. Error of Mean	162.1
Coefficient of Variation	0.615	Skewness	0.702

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.292	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	935.1	95% Adjusted-CLT UCL (Chen-1995)	910.5
		95% Modified-t UCL (Johnson-1978)	943.6
Gamma GOF Test			
A-D Test Statistic	0.336	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.682	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.272	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.359	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.333	k star (bias corrected MLE)	1.466
Theta hat (MLE)	176.9	Theta star (bias corrected MLE)	402.1
nu hat (MLE)	33.33	nu star (bias corrected)	14.66
MLE Mean (bias corrected)	589.6	MLE Sd (bias corrected)	486.9
		Approximate Chi Square Value (0.05)	7.028
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	4.895
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1230	95% Adjusted Gamma UCL (use when n<50)	1766
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.447	Mean of logged Data	6.222
Maximum of Logged Data	6.994	SD of logged Data	0.633
Assuming Lognormal Distribution			
95% H-UCL	1812	90% Chebyshev (MVUE) UCL	1082
95% Chebyshev (MVUE) UCL	1305	97.5% Chebyshev (MVUE) UCL	1615
99% Chebyshev (MVUE) UCL	2224		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	856.2	95% Jackknife UCL	935.1
95% Standard Bootstrap UCL	826.3	95% Bootstrap-t UCL	1737
95% Hall's Bootstrap UCL	4124	95% Percentile Bootstrap UCL	849
95% BCA Bootstrap UCL	849		
90% Chebyshev(Mean, Sd) UCL	1076	95% Chebyshev(Mean, Sd) UCL	1296
97.5% Chebyshev(Mean, Sd) UCL	1602	99% Chebyshev(Mean, Sd) UCL	2202

Suggested UCL to Use

95% Student's-t UCL	935.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at sampling location A75B in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	233	Mean	461.5
Maximum	856	Median	378.5
SD	272.1	Std. Error of Mean	136
Coefficient of Variation	0.59	Skewness	1.595

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.845	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.348	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	781.7	95% Adjusted-CLT UCL (Chen-1995)	801.2
		95% Modified-t UCL (Johnson-1978)	799.8

Gamma GOF Test		
A-D Test Statistic	0.373	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.316	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	4.472	k star (bias corrected MLE)	1.285
Theta hat (MLE)	103.2	Theta star (bias corrected MLE)	359.3
nu hat (MLE)	35.77	nu star (bias corrected)	10.28
MLE Mean (bias corrected)	461.5	MLE Sd (bias corrected)	407.2
		Approximate Chi Square Value (0.05)	4.115
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1152	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.281	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	5.451	Mean of logged Data	6.019
Maximum of Logged Data	6.752	SD of logged Data	0.541

Assuming Lognormal Distribution			
95% H-UCL	1595	90% Chebyshev (MVUE) UCL	820.7
95% Chebyshev (MVUE) UCL	985.2	97.5% Chebyshev (MVUE) UCL	1214
99% Chebyshev (MVUE) UCL	1662		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	685.3	95% Jackknife UCL	781.7
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	869.6	95% Chebyshev(Mean, Sd) UCL	1055
97.5% Chebyshev(Mean, Sd) UCL	1311	99% Chebyshev(Mean, Sd) UCL	1815

Suggested UCL to Use

95% Student's-t UCL	781.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn at Bakers Bridge in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	149	Mean	355.8
Maximum	584	Median	254
SD	195.9	Std. Error of Mean	87.59
Coefficient of Variation	0.55	Skewness	0.418

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.852	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.298	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	542.5	95% Adjusted-CLT UCL (Chen-1995)	517.4
		95% Modified-t UCL (Johnson-1978)	545.3

Gamma GOF Test

A-D Test Statistic	0.44	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.279	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.989	k star (bias corrected MLE)	1.729
Theta hat (MLE)	89.19	Theta star (bias corrected MLE)	205.8
nu hat (MLE)	39.89	nu star (bias corrected)	17.29
MLE Mean (bias corrected)	355.8	MLE Sd (bias corrected)	270.6
		Approximate Chi Square Value (0.05)	8.88
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	6.417

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	692.8	95% Adjusted Gamma UCL (use when n<50)	958.7

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.896	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.239	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.004	Mean of logged Data	5.744
Maximum of Logged Data	6.37	SD of logged Data	0.581

Assuming Lognormal Distribution

95% H-UCL	942.3	90% Chebyshev (MVUE) UCL	630.8
95% Chebyshev (MVUE) UCL	755.1	97.5% Chebyshev (MVUE) UCL	927.7
99% Chebyshev (MVUE) UCL	1267		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	499.9	95% Jackknife UCL	542.5
95% Standard Bootstrap UCL	485.8	95% Bootstrap-t UCL	883.2
95% Hall's Bootstrap UCL	2996	95% Percentile Bootstrap UCL	501.2
95% BCA Bootstrap UCL	493.6		
90% Chebyshev(Mean, Sd) UCL	618.6	95% Chebyshev(Mean, Sd) UCL	737.6
97.5% Chebyshev(Mean, Sd) UCL	902.8	99% Chebyshev(Mean, Sd) UCL	1227

Suggested UCL to Use

95% Student's-t UCL	542.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn in mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 8:52
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	292	Mean	357.8
Maximum	499	Median	320
SD	95.31	Std. Error of Mean	47.66
Coefficient of Variation	0.266	Skewness	1.857

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.771	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.373	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	469.9	95% Adjusted-CLT UCL (Chen-1995)	483.4
		95% Modified-t UCL (Johnson-1978)	477.3

Gamma GOF Test

A-D Test Statistic	0.59	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.377	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.45	k star (bias corrected MLE)	5.529
Theta hat (MLE)	16.68	Theta star (bias corrected MLE)	64.7
nu hat (MLE)	171.6	nu star (bias corrected)	44.23
MLE Mean (bias corrected)	357.8	MLE Sd (bias corrected)	152.1
		Approximate Chi Square Value (0.05)	29.98
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	527.8	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.806	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.353	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.677	Mean of logged Data	5.856
Maximum of Logged Data	6.213	SD of logged Data	0.242

Assuming Lognormal Distribution

95% H-UCL	516.7	90% Chebyshev (MVUE) UCL	486.4
95% Chebyshev (MVUE) UCL	544.9	97.5% Chebyshev (MVUE) UCL	626.2
99% Chebyshev (MVUE) UCL	785.7		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	436.1	95% Jackknife UCL	469.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	500.7	95% Chebyshev(Mean, Sd) UCL	565.5
97.5% Chebyshev(Mean, Sd) UCL	655.4	99% Chebyshev(Mean, Sd) UCL	831.9

Suggested UCL to Use

95% Student's-t UCL	469.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn in mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 8:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	1
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	48.1	Minimum Non-Detect	50
Maximum Detect	146	Maximum Non-Detect	50
Variance Detects	1202	Percent Non-Detects	14.29%
Mean Detects	83.9	SD Detects	34.66
Median Detects	70.55	CV Detects	0.413
Skewness Detects	1.36	Kurtosis Detects	1.854
Mean of Logged Detects	4.366	SD of Logged Detects	0.382

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.868	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.296	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	78.79	Standard Error of Mean	13.19
SD	31.86	95% KM (BCA) UCL	99.61
95% KM (t) UCL	104.4	95% KM (Percentile Bootstrap) UCL	100.4
95% KM (z) UCL	100.5	95% KM Bootstrap t UCL	133.3
90% KM Chebyshev UCL	118.4	95% KM Chebyshev UCL	136.3
97.5% KM Chebyshev UCL	161.2	99% KM Chebyshev UCL	210

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.387	Anderson-Darling GOF Test
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.279	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	8.029	k star (bias corrected MLE)	4.126
Theta hat (MLE)	10.45	Theta star (bias corrected MLE)	20.34
nu hat (MLE)	96.35	nu star (bias corrected)	49.51
MLE Mean (bias corrected)	83.9	MLE Sd (bias corrected)	41.31

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.114	nu hat (KM)	85.6
Approximate Chi Square Value (85.60, α)	65.27	Adjusted Chi Square Value (85.60, β)	59.94
95% Gamma Approximate KM-UCL (use when n>=50)	103.3	95% Gamma Adjusted KM-UCL (use when n<50)	112.5

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	36.76	Mean	77.17
Maximum	146	Median	68.6
SD	36.31	CV	0.471
k hat (MLE)	5.799	k star (bias corrected MLE)	3.409
Theta hat (MLE)	13.31	Theta star (bias corrected MLE)	22.64
nu hat (MLE)	81.19	nu star (bias corrected)	47.73
MLE Mean (bias corrected)	77.17	MLE Sd (bias corrected)	41.79
		Adjusted Level of Significance (β)	0.0158
Approximate Chi Square Value (47.73, α)	32.87	Adjusted Chi Square Value (47.73, β)	29.2
95% Gamma Approximate UCL (use when n>=50)	112	95% Gamma Adjusted UCL (use when n<50)	126.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.938	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.252	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	78.26	Mean in Log Scale	4.284
SD in Original Scale	34.99	SD in Log Scale	0.41
95% t UCL (assumes normality of ROS data)	104	95% Percentile Bootstrap UCL	99.34
95% BCA Bootstrap UCL	104.4	95% Bootstrap t UCL	130.5
95% H-UCL (Log ROS)	115.9		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.296	95% H-UCL (KM -Log)	110.2
KM SD (logged)	0.366	95% Critical H Value (KM-Log)	2.277
KM Standard Error of Mean (logged)	0.151		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	75.49	Mean in Log Scale	4.202
SD in Original Scale	38.69	SD in Log Scale	0.556
95% t UCL (Assumes normality)	103.9	95% H-Stat UCL	140.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	104.4	95% KM (Percentile Bootstrap) UCL	100.4

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn in mainstem Mineral Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 8:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	54.4	Mean	159.5
Maximum	317	Median	170
SD	69.3	Std. Error of Mean	19.22
Coefficient of Variation	0.434	Skewness	0.772

Normal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.153	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	193.8	95% Adjusted-CLT UCL (Chen-1995)	195.5
		95% Modified-t UCL (Johnson-1978)	194.5

Gamma GOF Test

A-D Test Statistic	0.213	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.736	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.591	k star (bias corrected MLE)	4.352
Theta hat (MLE)	28.53	Theta star (bias corrected MLE)	36.66
nu hat (MLE)	145.4	nu star (bias corrected)	113.2
MLE Mean (bias corrected)	159.5	MLE Sd (bias corrected)	76.47
		Approximate Chi Square Value (0.05)	89.6
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	86.62

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	201.5	95% Adjusted Gamma UCL (use when n<50)	208.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.17	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.996	Mean of logged Data	4.98
Maximum of Logged Data	5.759	SD of logged Data	0.462

Assuming Lognormal Distribution

95% H-UCL	213.3	90% Chebyshev (MVUE) UCL	223.5
95% Chebyshev (MVUE) UCL	252.1	97.5% Chebyshev (MVUE) UCL	291.8
99% Chebyshev (MVUE) UCL	369.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	191.1	95% Jackknife UCL	193.8
95% Standard Bootstrap UCL	189.8	95% Bootstrap-t UCL	201.5
95% Hall's Bootstrap UCL	205.3	95% Percentile Bootstrap UCL	188.3
95% BCA Bootstrap UCL	194.1		
90% Chebyshev(Mean, Sd) UCL	217.2	95% Chebyshev(Mean, Sd) UCL	243.3
97.5% Chebyshev(Mean, Sd) UCL	279.6	99% Chebyshev(Mean, Sd) UCL	350.8

Suggested UCL to Use

95% Student's-t UCL	193.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn in mainstem Cement Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 9:02
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1600	Mean	2303
Maximum	2670	Median	2470
SD	489.4	Std. Error of Mean	244.7
Coefficient of Variation	0.213	Skewness	-1.54

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.281	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2878	95% Adjusted-CLT UCL (Chen-1995)	2504
		95% Modified-t UCL (Johnson-1978)	2847

Gamma GOF Test

A-D Test Statistic	0.51	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.309	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	25.73	k star (bias corrected MLE)	6.599
Theta hat (MLE)	89.49	Theta star (bias corrected MLE)	348.9
nu hat (MLE)	205.8	nu star (bias corrected)	52.79
MLE Mean (bias corrected)	2303	MLE Sd (bias corrected)	896.3
		Approximate Chi Square Value (0.05)	37.1
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3276	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.813	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.31	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.378	Mean of logged Data	7.722
Maximum of Logged Data	7.89	SD of logged Data	0.237

Assuming Lognormal Distribution

95% H-UCL	3298	90% Chebyshev (MVUE) UCL	3120
95% Chebyshev (MVUE) UCL	3489	97.5% Chebyshev (MVUE) UCL	4002
99% Chebyshev (MVUE) UCL	5008		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2705	95% Jackknife UCL	2878
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3037	95% Chebyshev(Mean, Sd) UCL	3369
97.5% Chebyshev(Mean, Sd) UCL	3831	99% Chebyshev(Mean, Sd) UCL	4737

Suggested UCL to Use

95% Student's-t UCL	2878

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Zn in mainstem Cement Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 9:03
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	611	Mean	929.3
Maximum	1310	Median	1070
SD	292.7	Std. Error of Mean	110.6
Coefficient of Variation	0.315	Skewness	-0.0879

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.848	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.256	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1144	95% Adjusted-CLT UCL (Chen-1995)	1107
		95% Modified-t UCL (Johnson-1978)	1144

Gamma GOF Test

A-D Test Statistic	0.674	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.291	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.12	k star (bias corrected MLE)	6.449
Theta hat (MLE)	83.58	Theta star (bias corrected MLE)	144.1
nu hat (MLE)	155.7	nu star (bias corrected)	90.28
MLE Mean (bias corrected)	929.3	MLE Sd (bias corrected)	365.9
		Approximate Chi Square Value (0.05)	69.38
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	63.86

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1209	95% Adjusted Gamma UCL (use when n<50)	1314

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.824	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.285	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.415	Mean of logged Data	6.789
Maximum of Logged Data	7.178	SD of logged Data	0.332

Assuming Lognormal Distribution

95% H-UCL	1272	90% Chebyshev (MVUE) UCL	1281
95% Chebyshev (MVUE) UCL	1440	97.5% Chebyshev (MVUE) UCL	1660
99% Chebyshev (MVUE) UCL	2094		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1111	95% Jackknife UCL	1144
95% Standard Bootstrap UCL	1096	95% Bootstrap-t UCL	1154
95% Hall's Bootstrap UCL	1058	95% Percentile Bootstrap UCL	1100
95% BCA Bootstrap UCL	1096		
90% Chebyshev(Mean, Sd) UCL	1261	95% Chebyshev(Mean, Sd) UCL	1411
97.5% Chebyshev(Mean, Sd) UCL	1620	99% Chebyshev(Mean, Sd) UCL	2030

Suggested UCL to Use

95% Student's-t UCL	1144

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Zn in mainstem Cement Creek during the post-runoff period

User Selected Options			
Date/Time of Computation	2/24/2015 9:03		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	394	Mean	2190
Maximum	2890	Median	2500
SD	723	Std. Error of Mean	193.2
Coefficient of Variation	0.33	Skewness	-1.519

Normal GOF Test

Shapiro Wilk Test Statistic	0.817	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.257	Lilliefors GOF Test
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2533	95% Adjusted-CLT UCL (Chen-1995)	2424
		95% Modified-t UCL (Johnson-1978)	2519

Gamma GOF Test

A-D Test Statistic	1.553	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.283	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.464	k star (bias corrected MLE)	4.341
Theta hat (MLE)	400.9	Theta star (bias corrected MLE)	504.6
nu hat (MLE)	153	nu star (bias corrected)	121.5
MLE Mean (bias corrected)	2190	MLE Sd (bias corrected)	1051
		Approximate Chi Square Value (0.05)	97.08
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	94.18

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2742	95% Adjusted Gamma UCL (use when n<50)	2826

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.666	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.278	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.976	Mean of logged Data	7.597
Maximum of Logged Data	7.969	SD of logged Data	0.537

Assuming Lognormal Distribution

95% H-UCL	3130	90% Chebyshev (MVUE) UCL	3288
95% Chebyshev (MVUE) UCL	3746	97.5% Chebyshev (MVUE) UCL	4382
99% Chebyshev (MVUE) UCL	5632		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	2508	95% Jackknife UCL	2533
95% Standard Bootstrap UCL	2495	95% Bootstrap-t UCL	2477
95% Hall's Bootstrap UCL	2424	95% Percentile Bootstrap UCL	2472
95% BCA Bootstrap UCL	2435		
90% Chebyshev(Mean, Sd) UCL	2770	95% Chebyshev(Mean, Sd) UCL	3033
97.5% Chebyshev(Mean, Sd) UCL	3397	99% Chebyshev(Mean, Sd) UCL	4113

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	3033

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Zn in the Animas River above of the confluence with mainstem Cement Creek during the pre-runoff period

User Selected Options			
Date/Time of Computation	2/24/2015 9:05		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	610	Mean	840.2
Maximum	1030	Median	874
SD	180.4	Std. Error of Mean	80.69
Coefficient of Variation	0.215	Skewness	-0.349

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.927	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.189	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1012	95% Adjusted-CLT UCL (Chen-1995)	959.5
		95% Modified-t UCL (Johnson-1978)	1010

Gamma GOF Test			
A-D Test Statistic	0.32	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.214	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	25.74	k star (bias corrected MLE)	10.43
Theta hat (MLE)	32.65	Theta star (bias corrected MLE)	80.58
nu hat (MLE)	257.4	nu star (bias corrected)	104.3
MLE Mean (bias corrected)	840.2	MLE Sd (bias corrected)	260.2
		Approximate Chi Square Value (0.05)	81.71
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	73.01

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1072	95% Adjusted Gamma UCL (use when n<50)	1200

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.204	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	6.413	Mean of logged Data	6.714
Maximum of Logged Data	6.937	SD of logged Data	0.224

Assuming Lognormal Distribution			
95% H-UCL	1087	90% Chebyshev (MVUE) UCL	1093
95% Chebyshev (MVUE) UCL	1208	97.5% Chebyshev (MVUE) UCL	1366
99% Chebyshev (MVUE) UCL	1678		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	972.9	95% Jackknife UCL	1012
95% Standard Bootstrap UCL	956.1	95% Bootstrap-t UCL	984.1
95% Hall's Bootstrap UCL	934.8	95% Percentile Bootstrap UCL	955.4
95% BCA Bootstrap UCL	946.4		
90% Chebyshev(Mean, Sd) UCL	1082	95% Chebyshev(Mean, Sd) UCL	1192
97.5% Chebyshev(Mean, Sd) UCL	1344	99% Chebyshev(Mean, Sd) UCL	1643

Suggested UCL to Use

95% Student's-t UCL	1012

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for dissolved Zn in the Animas River above of the confluence with mainstem Cement Creek during the runoff period

User Selected Options				
Date/Time of Computation	2/24/2015 9:05			
From File	WorkSheet.xls			
Full Precision	OFF			
Confidence Coefficient	95%			
Number of Bootstrap Operations	2000			

General Statistics

Total Number of Observations	17	Number of Distinct Observations	17
		Number of Missing Observations	0
Minimum	242	Mean	344.2
Maximum	509	Median	296
SD	85.41	Std. Error of Mean	20.71
Coefficient of Variation	0.248	Skewness	0.771
Normal GOF Test			
Shapiro Wilk Test Statistic	0.84	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.265	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.215	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	380.3	95% Adjusted-CLT UCL (Chen-1995)	382.4
		95% Modified-t UCL (Johnson-1978)	381
Gamma GOF Test			
A-D Test Statistic	1.192	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.256	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.209	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	18.64	k star (bias corrected MLE)	15.39
Theta hat (MLE)	18.46	Theta star (bias corrected MLE)	22.36
nu hat (MLE)	633.8	nu star (bias corrected)	523.3
MLE Mean (bias corrected)	344.2	MLE Sd (bias corrected)	87.73
		Approximate Chi Square Value (0.05)	471.3
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	466.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	382.2	95% Adjusted Gamma UCL (use when n<50)	386.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.215	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.489	Mean of logged Data	5.814
Maximum of Logged Data	6.232	SD of logged Data	0.236
Assuming Lognormal Distribution			
95% H-UCL	383.3	90% Chebyshev (MVUE) UCL	403.3
95% Chebyshev (MVUE) UCL	430.2	97.5% Chebyshev (MVUE) UCL	467.5
99% Chebyshev (MVUE) UCL	540.9		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	378.2	95% Jackknife UCL	380.3
95% Standard Bootstrap UCL	376.9	95% Bootstrap-t UCL	382.6
95% Hall's Bootstrap UCL	376.1	95% Percentile Bootstrap UCL	377.8
95% BCA Bootstrap UCL	380.2		
90% Chebyshev(Mean, Sd) UCL	406.3	95% Chebyshev(Mean, Sd) UCL	434.5
97.5% Chebyshev(Mean, Sd) UCL	473.5	99% Chebyshev(Mean, Sd) UCL	550.3

Suggested UCL to Use

95% Student's-t UCL	380.3	or 95% Modified-t UCL	381

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn in the Animas River above of the confluence with mainstem Cement Creek during the post-runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 9:05
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	237	Mean	327.1
Maximum	567	Median	296.5
SD	85.54	Std. Error of Mean	20.16
Coefficient of Variation	0.262	Skewness	1.478

Normal GOF Test			
Shapiro Wilk Test Statistic	0.845	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.897	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.186	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	362.1	95% Adjusted-CLT UCL (Chen-1995)	367.7
		95% Modified-t UCL (Johnson-1978)	363.3
Gamma GOF Test			
A-D Test Statistic	0.78	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.739	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.167	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.203	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	18.05	k star (bias corrected MLE)	15.08
Theta hat (MLE)	18.12	Theta star (bias corrected MLE)	21.69
nu hat (MLE)	649.7	nu star (bias corrected)	542.7
MLE Mean (bias corrected)	327.1	MLE Sd (bias corrected)	84.23
		Approximate Chi Square Value (0.05)	489.7
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	484.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	362.5	95% Adjusted Gamma UCL (use when n<50)	366.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.904	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.153	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.468	Mean of logged Data	5.762
Maximum of Logged Data	6.34	SD of logged Data	0.235
Assuming Lognormal Distribution			
95% H-UCL	362.6	90% Chebyshev (MVUE) UCL	381.2
95% Chebyshev (MVUE) UCL	406.1	97.5% Chebyshev (MVUE) UCL	440.5
99% Chebyshev (MVUE) UCL	508.2		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	360.2	95% Jackknife UCL	362.1
95% Standard Bootstrap UCL	358.4	95% Bootstrap-t UCL	373.3
95% Hall's Bootstrap UCL	374.7	95% Percentile Bootstrap UCL	361.7
95% BCA Bootstrap UCL	368.7		
90% Chebyshev(Mean, Sd) UCL	387.5	95% Chebyshev(Mean, Sd) UCL	414.9
97.5% Chebyshev(Mean, Sd) UCL	453	99% Chebyshev(Mean, Sd) UCL	527.7

Suggested UCL to Use

95% Student's-t UCL	362.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the pre-runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 9:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	864	Mean	1044
Maximum	1230	Median	1041
SD	159.7	Std. Error of Mean	79.86
Coefficient of Variation	0.153	Skewness	0.0846

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.986	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.174	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1232	95% Adjusted-CLT UCL (Chen-1995)	1179
		95% Modified-t UCL (Johnson-1978)	1233
Gamma GOF Test			
A-D Test Statistic	0.215	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	56.59	k star (bias corrected MLE)	14.31
Theta hat (MLE)	18.45	Theta star (bias corrected MLE)	72.93
nu hat (MLE)	452.7	nu star (bias corrected)	114.5
MLE Mean (bias corrected)	1044	MLE Sd (bias corrected)	275.9
		Approximate Chi Square Value (0.05)	90.81
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1317	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.986	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.176	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.762	Mean of logged Data	6.942
Maximum of Logged Data	7.115	SD of logged Data	0.154
Assuming Lognormal Distribution			
95% H-UCL	1290	90% Chebyshev (MVUE) UCL	1285
95% Chebyshev (MVUE) UCL	1394	97.5% Chebyshev (MVUE) UCL	1546
99% Chebyshev (MVUE) UCL	1843		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1175	95% Jackknife UCL	1232
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1284	95% Chebyshev(Mean, Sd) UCL	1392
97.5% Chebyshev(Mean, Sd) UCL	1543	99% Chebyshev(Mean, Sd) UCL	1839

Suggested UCL to Use

95% Student's-t UCL	1232

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the runoff period

User Selected Options	
Date/Time of Computation	2/24/2015 9:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	133	Mean	273
Maximum	453	Median	249
SD	107.7	Std. Error of Mean	40.69
Coefficient of Variation	0.394	Skewness	0.652

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.174	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	352.1	95% Adjusted-CLT UCL (Chen-1995)	350.6
		95% Modified-t UCL (Johnson-1978)	353.7
Gamma GOF Test			
A-D Test Statistic	0.181	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.53	k star (bias corrected MLE)	4.398
Theta hat (MLE)	36.25	Theta star (bias corrected MLE)	62.07
nu hat (MLE)	105.4	nu star (bias corrected)	61.57
MLE Mean (bias corrected)	273	MLE Sd (bias corrected)	130.2
		Approximate Chi Square Value (0.05)	44.53
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	40.19
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	377.5	95% Adjusted Gamma UCL (use when n<50)	418.3
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.982	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.89	Mean of logged Data	5.542
Maximum of Logged Data	6.116	SD of logged Data	0.403
Assuming Lognormal Distribution			
95% H-UCL	402.9	90% Chebyshev (MVUE) UCL	398.6
95% Chebyshev (MVUE) UCL	455.4	97.5% Chebyshev (MVUE) UCL	534.2
99% Chebyshev (MVUE) UCL	688.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	339.9	95% Jackknife UCL	352.1
95% Standard Bootstrap UCL	336.5	95% Bootstrap-t UCL	399.2
95% Hall's Bootstrap UCL	435.4	95% Percentile Bootstrap UCL	337.4
95% BCA Bootstrap UCL	344.4		
90% Chebyshev(Mean, Sd) UCL	395.1	95% Chebyshev(Mean, Sd) UCL	450.4
97.5% Chebyshev(Mean, Sd) UCL	527.1	99% Chebyshev(Mean, Sd) UCL	677.9

Suggested UCL to Use

95% Student's-t UCL	352.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A72 in the Animas River below the confluence with mainstem Mineral Creek during the post-runoff period

User Selected Options			
Date/Time of Computation	2/24/2015 9:44		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	228	Mean	578.7
Maximum	1120	Median	590
SD	237.1	Std. Error of Mean	65.77
Coefficient of Variation	0.41	Skewness	0.695
Normal GOF Test			
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.143	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	695.9	95% Adjusted-CLT UCL (Chen-1995)	700.4
		95% Modified-t UCL (Johnson-1978)	698
Gamma GOF Test			
A-D Test Statistic	0.203	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.12	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.309	k star (bias corrected MLE)	4.905
Theta hat (MLE)	91.72	Theta star (bias corrected MLE)	118
nu hat (MLE)	164	nu star (bias corrected)	127.5
MLE Mean (bias corrected)	578.7	MLE Sd (bias corrected)	261.3
		Approximate Chi Square Value (0.05)	102.4
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	99.24
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	720.4	95% Adjusted Gamma UCL (use when n<50)	743.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.972	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.142	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.429	Mean of logged Data	6.279
Maximum of Logged Data	7.021	SD of logged Data	0.431
Assuming Lognormal Distribution			
95% H-UCL	754.2	90% Chebyshev (MVUE) UCL	793.5
95% Chebyshev (MVUE) UCL	889.8	97.5% Chebyshev (MVUE) UCL	1023
99% Chebyshev (MVUE) UCL	1286		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	686.9	95% Jackknife UCL	695.9
95% Standard Bootstrap UCL	682.8	95% Bootstrap-t UCL	710.5
95% Hall's Bootstrap UCL	724.6	95% Percentile Bootstrap UCL	680.2
95% BCA Bootstrap UCL	699.7		
90% Chebyshev(Mean, Sd) UCL	776	95% Chebyshev(Mean, Sd) UCL	865.4
97.5% Chebyshev(Mean, Sd) UCL	989.4	99% Chebyshev(Mean, Sd) UCL	1233
Suggested UCL to Use			
95% Student's-t UCL	695.9		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A73 in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/24/2015 9:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	242	Mean	463.2
Maximum	701	Median	364
SD	213.2	Std. Error of Mean	95.33
Coefficient of Variation	0.46	Skewness	0.413

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.84	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.279	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	666.4	95% Adjusted-CLT UCL (Chen-1995)	638.8
		95% Modified-t UCL (Johnson-1978)	669.4
Gamma GOF Test			
A-D Test Statistic	0.458	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.272	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.88	k star (bias corrected MLE)	2.485
Theta hat (MLE)	78.78	Theta star (bias corrected MLE)	186.4
nu hat (MLE)	58.8	nu star (bias corrected)	24.85
MLE Mean (bias corrected)	463.2	MLE Sd (bias corrected)	293.8
		Approximate Chi Square Value (0.05)	14.5
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	11.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	794	95% Adjusted Gamma UCL (use when n<50)	1028
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.885	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.244	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.489	Mean of logged Data	6.051
Maximum of Logged Data	6.553	SD of logged Data	0.47
Assuming Lognormal Distribution			
95% H-UCL	927	90% Chebyshev (MVUE) UCL	752.8
95% Chebyshev (MVUE) UCL	884	97.5% Chebyshev (MVUE) UCL	1066
99% Chebyshev (MVUE) UCL	1424		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	620	95% Jackknife UCL	666.4
95% Standard Bootstrap UCL	603	95% Bootstrap-t UCL	1055
95% Hall's Bootstrap UCL	3148	95% Percentile Bootstrap UCL	614.8
95% BCA Bootstrap UCL	614.8		
90% Chebyshev(Mean, Sd) UCL	749.2	95% Chebyshev(Mean, Sd) UCL	878.7
97.5% Chebyshev(Mean, Sd) UCL	1059	99% Chebyshev(Mean, Sd) UCL	1412

Suggested UCL to Use

95% Student's-t UCL	666.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A73B in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/24/2015 9:54
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	79	Mean	249.5
Maximum	561	Median	179
SD	213	Std. Error of Mean	106.5
Coefficient of Variation	0.854	Skewness	1.696

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.378	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	500.1	95% Adjusted-CLT UCL (Chen-1995)	521.1
		95% Modified-t UCL (Johnson-1978)	515.1
Gamma GOF Test			
A-D Test Statistic	0.405	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.336	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.144	k star (bias corrected MLE)	0.703
Theta hat (MLE)	116.4	Theta star (bias corrected MLE)	355.1
nu hat (MLE)	17.15	nu star (bias corrected)	5.621
MLE Mean (bias corrected)	249.5	MLE Sd (bias corrected)	297.6
		Approximate Chi Square Value (0.05)	1.449
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	967.6	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.369	Mean of logged Data	5.268
Maximum of Logged Data	6.33	SD of logged Data	0.806
Assuming Lognormal Distribution			
95% H-UCL	3389	90% Chebyshev (MVUE) UCL	527
95% Chebyshev (MVUE) UCL	654.8	97.5% Chebyshev (MVUE) UCL	832.1
99% Chebyshev (MVUE) UCL	1180		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	424.6	95% Jackknife UCL	500.1
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	568.9	95% Chebyshev(Mean, Sd) UCL	713.6
97.5% Chebyshev(Mean, Sd) UCL	914.4	99% Chebyshev(Mean, Sd) UCL	1309

Suggested UCL to Use

95% Student's-t UCL	500.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A75D in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/24/2015 9:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	140	Mean	260.6
Maximum	427	Median	217
SD	129.7	Std. Error of Mean	57.99
Coefficient of Variation	0.498	Skewness	0.515

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.232	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	384.2	95% Adjusted-CLT UCL (Chen-1995)	370.2
		95% Modified-t UCL (Johnson-1978)	386.4
Gamma GOF Test			
A-D Test Statistic	0.394	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.232	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.088	k star (bias corrected MLE)	2.169
Theta hat (MLE)	51.22	Theta star (bias corrected MLE)	120.2
nu hat (MLE)	50.88	nu star (bias corrected)	21.69
MLE Mean (bias corrected)	260.6	MLE Sd (bias corrected)	177
		Approximate Chi Square Value (0.05)	12.1
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	9.135
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	466.9	95% Adjusted Gamma UCL (use when n<50)	618.7
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.21	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.942	Mean of logged Data	5.462
Maximum of Logged Data	6.057	SD of logged Data	0.505
Assuming Lognormal Distribution			
95% H-UCL	565.1	90% Chebyshev (MVUE) UCL	435
95% Chebyshev (MVUE) UCL	514.1	97.5% Chebyshev (MVUE) UCL	624
99% Chebyshev (MVUE) UCL	839.7		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	356	95% Jackknife UCL	384.2
95% Standard Bootstrap UCL	345	95% Bootstrap-t UCL	541.9
95% Hall's Bootstrap UCL	530.7	95% Percentile Bootstrap UCL	348
95% BCA Bootstrap UCL	357.6		
90% Chebyshev(Mean, Sd) UCL	434.6	95% Chebyshev(Mean, Sd) UCL	513.4
97.5% Chebyshev(Mean, Sd) UCL	622.7	99% Chebyshev(Mean, Sd) UCL	837.6

Suggested UCL to Use

95% Student's-t UCL	384.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at sampling location A75B in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/24/2015 9:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	140	Mean	235.3
Maximum	442	Median	179.5
SD	141.3	Std. Error of Mean	70.65
Coefficient of Variation	0.601	Skewness	1.729

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.321	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	401.5	95% Adjusted-CLT UCL (Chen-1995)	416.7
		95% Modified-t UCL (Johnson-1978)	411.7
Gamma GOF Test			
A-D Test Statistic	0.48	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.281	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.521	k star (bias corrected MLE)	1.297
Theta hat (MLE)	52.03	Theta star (bias corrected MLE)	181.4
nu hat (MLE)	36.17	nu star (bias corrected)	10.38
MLE Mean (bias corrected)	235.3	MLE Sd (bias corrected)	206.6
		Approximate Chi Square Value (0.05)	4.178
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	584.2	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.859	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.249	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.942	Mean of logged Data	5.346
Maximum of Logged Data	6.091	SD of logged Data	0.528
Assuming Lognormal Distribution			
95% H-UCL	768.9	90% Chebyshev (MVUE) UCL	412.6
95% Chebyshev (MVUE) UCL	494.2	97.5% Chebyshev (MVUE) UCL	607.5
99% Chebyshev (MVUE) UCL	830.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	351.5	95% Jackknife UCL	401.5
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	447.2	95% Chebyshev(Mean, Sd) UCL	543.2
97.5% Chebyshev(Mean, Sd) UCL	676.5	99% Chebyshev(Mean, Sd) UCL	938.2

Suggested UCL to Use

95% Student's-t UCL	401.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn at Bakers Bridge in the Animas River below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/24/2015 9:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	66.5	Mean	136
Maximum	241	Median	111
SD	71.16	Std. Error of Mean	31.83
Coefficient of Variation	0.523	Skewness	0.863

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.238	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	203.9	95% Adjusted-CLT UCL (Chen-1995)	201.5
		95% Modified-t UCL (Johnson-1978)	205.9

Gamma GOF Test		
A-D Test Statistic	0.244	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	4.788	k star (bias corrected MLE)	2.049
Theta hat (MLE)	28.41	Theta star (bias corrected MLE)	66.41
nu hat (MLE)	47.88	nu star (bias corrected)	20.49
MLE Mean (bias corrected)	136	MLE Sd (bias corrected)	95.05
		Approximate Chi Square Value (0.05)	11.21
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	8.374

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	248.6	95% Adjusted Gamma UCL (use when n<50)	332.8

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.969	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	4.197	Mean of logged Data	4.805
Maximum of Logged Data	5.485	SD of logged Data	0.519

Assuming Lognormal Distribution			
95% H-UCL	304.6	90% Chebyshev (MVUE) UCL	229.2
95% Chebyshev (MVUE) UCL	271.6	97.5% Chebyshev (MVUE) UCL	330.4
99% Chebyshev (MVUE) UCL	445.8		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	188.4	95% Jackknife UCL	203.9
95% Standard Bootstrap UCL	182.8	95% Bootstrap-t UCL	287.9
95% Hall's Bootstrap UCL	613.6	95% Percentile Bootstrap UCL	183.5
95% BCA Bootstrap UCL	188.2		
90% Chebyshev(Mean, Sd) UCL	231.5	95% Chebyshev(Mean, Sd) UCL	274.8
97.5% Chebyshev(Mean, Sd) UCL	334.8	99% Chebyshev(Mean, Sd) UCL	452.7

Suggested UCL to Use

95% Student's-t UCL	203.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in mainstem Mineral Creek during the Pre-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 11:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Mineral Creek

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	150	Mean	253.5
Maximum	309	Median	277.5
SD	74.84	Std. Error of Mean	37.42
Coefficient of Variation	0.295	Skewness	-1.234

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.85	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.267	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	341.6	95% Adjusted-CLT UCL (Chen-1995)	290.4
		95% Modified-t UCL (Johnson-1978)	337.7

Gamma GOF Test		
A-D Test Statistic	0.487	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.292	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	12.82	k star (bias corrected MLE)	3.373
Theta hat (MLE)	19.77	Theta star (bias corrected MLE)	75.17
nu hat (MLE)	102.6	nu star (bias corrected)	26.98
MLE Mean (bias corrected)	253.5	MLE Sd (bias corrected)	138
		Approximate Chi Square Value (0.05)	16.14
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	423.9	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.266	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	5.011	Mean of logged Data	5.496
Maximum of Logged Data	5.733	SD of logged Data	0.34

Assuming Lognormal Distribution			
95% H-UCL	458.6	90% Chebyshev (MVUE) UCL	383
95% Chebyshev (MVUE) UCL	441.3	97.5% Chebyshev (MVUE) UCL	522.2
99% Chebyshev (MVUE) UCL	681		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	315.1	95% Jackknife UCL	341.6
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	365.8	95% Chebyshev(Mean, Sd) UCL	416.6
97.5% Chebyshev(Mean, Sd) UCL	487.2	99% Chebyshev(Mean, Sd) UCL	625.8

Suggested UCL to Use

95% Student's-t UCL	341.6

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in mainstem Cement Creek during the Pre-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 11:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Cement Creek

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	301	Mean	476.5
Maximum	571	Median	517
SD	121.3	Std. Error of Mean	60.67
Coefficient of Variation	0.255	Skewness	-1.601

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.304	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	619.3	95% Adjusted-CLT UCL (Chen-1995)	524.4
		95% Modified-t UCL (Johnson-1978)	611.2

Gamma GOF Test

A-D Test Statistic	0.526	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.338	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.19	k star (bias corrected MLE)	4.465
Theta hat (MLE)	27.71	Theta star (bias corrected MLE)	106.7
nu hat (MLE)	137.6	nu star (bias corrected)	35.72
MLE Mean (bias corrected)	476.5	MLE Sd (bias corrected)	225.5
		Approximate Chi Square Value (0.05)	23.05
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	738.6	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.806	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.336	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.707	Mean of logged Data	6.137
Maximum of Logged Data	6.347	SD of logged Data	0.293

Assuming Lognormal Distribution

95% H-UCL	769.5	90% Chebyshev (MVUE) UCL	686.4
95% Chebyshev (MVUE) UCL	780.9	97.5% Chebyshev (MVUE) UCL	912.1
99% Chebyshev (MVUE) UCL	1170		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	576.3	95% Jackknife UCL	619.3
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	658.5	95% Chebyshev(Mean, Sd) UCL	740.9
97.5% Chebyshev(Mean, Sd) UCL	855.4	99% Chebyshev(Mean, Sd) UCL	1080

Suggested UCL to Use

95% Student's-t UCL	619.3

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in the Animas River above the confluence with mainstem Mineral Creek during the Pre-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 11:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Above Min Creek

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	148	Mean	170.4
Maximum	202	Median	172
SD	22.1	Std. Error of Mean	9.882
Coefficient of Variation	0.13	Skewness	0.527

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.21	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	191.5	95% Adjusted-CLT UCL (Chen-1995)	189.1
		95% Modified-t UCL (Johnson-1978)	191.9

Gamma GOF Test

A-D Test Statistic	0.292	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.239	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	75.69	k star (bias corrected MLE)	30.41
Theta hat (MLE)	2.251	Theta star (bias corrected MLE)	5.604
nu hat (MLE)	756.9	nu star (bias corrected)	304.1
MLE Mean (bias corrected)	170.4	MLE Sd (bias corrected)	30.9
		Approximate Chi Square Value (0.05)	264.7
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	248.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	195.8	95% Adjusted Gamma UCL (use when n<50)	208.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.214	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.997	Mean of logged Data	5.132
Maximum of Logged Data	5.308	SD of logged Data	0.128

Assuming Lognormal Distribution

95% H-UCL	195	90% Chebyshev (MVUE) UCL	199.7
95% Chebyshev (MVUE) UCL	212.9	97.5% Chebyshev (MVUE) UCL	231.3
99% Chebyshev (MVUE) UCL	267.5		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	186.7	95% Jackknife UCL	191.5
95% Standard Bootstrap UCL	185.1	95% Bootstrap-t UCL	195.4
95% Hall's Bootstrap UCL	188.8	95% Percentile Bootstrap UCL	185.8
95% BCA Bootstrap UCL	186.8		
90% Chebyshev(Mean, Sd) UCL	200	95% Chebyshev(Mean, Sd) UCL	213.5
97.5% Chebyshev(Mean, Sd) UCL	232.1	99% Chebyshev(Mean, Sd) UCL	268.7

Suggested UCL to Use

95% Student's-t UCL	191.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in the Animas River at sampling location A72 below the confluence with mainstem Mineral Creek during the Pre-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 11:51
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A72

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	177	Mean	284.8
Maximum	352	Median	305
SD	79.58	Std. Error of Mean	39.79
Coefficient of Variation	0.279	Skewness	-1.066

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.244	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	378.4	95% Adjusted-CLT UCL (Chen-1995)	327.5
		95% Modified-t UCL (Johnson-1978)	374.9
Gamma GOF Test			
A-D Test Statistic	0.394	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.274	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.75	k star (bias corrected MLE)	3.855
Theta hat (MLE)	19.3	Theta star (bias corrected MLE)	73.87
nu hat (MLE)	118	nu star (bias corrected)	30.84
MLE Mean (bias corrected)	284.8	MLE Sd (bias corrected)	145
		Approximate Chi Square Value (0.05)	19.15
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	458.5	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.87	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.241	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.176	Mean of logged Data	5.617
Maximum of Logged Data	5.864	SD of logged Data	0.314
Assuming Lognormal Distribution			
95% H-UCL	483.1	90% Chebyshev (MVUE) UCL	419.1
95% Chebyshev (MVUE) UCL	479.6	97.5% Chebyshev (MVUE) UCL	563.6
99% Chebyshev (MVUE) UCL	728.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	350.2	95% Jackknife UCL	378.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	404.1	95% Chebyshev(Mean, Sd) UCL	458.2
97.5% Chebyshev(Mean, Sd) UCL	533.3	99% Chebyshev(Mean, Sd) UCL	680.7

Suggested UCL to Use

95% Student's-t UCL	378.4

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in mainstem Mineral Creek during the Runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Mineral Creek

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	49	Mean	67.71
Maximum	92	Median	72
SD	16.51	Std. Error of Mean	6.24
Coefficient of Variation	0.244	Skewness	0.157

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.899	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.242	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	79.84	95% Adjusted-CLT UCL (Chen-1995)	78.37
		95% Modified-t UCL (Johnson-1978)	79.9

Gamma GOF Test

A-D Test Statistic	0.473	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.26	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	19.39	k star (bias corrected MLE)	11.18
Theta hat (MLE)	3.491	Theta star (bias corrected MLE)	6.058
nu hat (MLE)	271.5	nu star (bias corrected)	156.5
MLE Mean (bias corrected)	67.71	MLE Sd (bias corrected)	20.25
		Approximate Chi Square Value (0.05)	128.6
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	120.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	82.42	95% Adjusted Gamma UCL (use when n<50)	87.63

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.24	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.892	Mean of logged Data	4.189
Maximum of Logged Data	4.522	SD of logged Data	0.248

Assuming Lognormal Distribution

95% H-UCL	83.97	90% Chebyshev (MVUE) UCL	86.76
95% Chebyshev (MVUE) UCL	95.39	97.5% Chebyshev (MVUE) UCL	107.4
99% Chebyshev (MVUE) UCL	130.9		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	77.98	95% Jackknife UCL	79.84
95% Standard Bootstrap UCL	77.18	95% Bootstrap-t UCL	80.38
95% Hall's Bootstrap UCL	76.14	95% Percentile Bootstrap UCL	77.29
95% BCA Bootstrap UCL	77.14		
90% Chebyshev(Mean, Sd) UCL	86.43	95% Chebyshev(Mean, Sd) UCL	94.91
97.5% Chebyshev(Mean, Sd) UCL	106.7	99% Chebyshev(Mean, Sd) UCL	129.8

Suggested UCL to Use

95% Student's-t UCL	79.84

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in mainstem Cement Creek during the Runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Cement Creek

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	76	**Mean**	**123.7**
Maximum	189	Median	126
SD	45.66	Std. Error of Mean	17.26
Coefficient of Variation	0.369	Skewness	0.484

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.886	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	157.3	95% Adjusted-CLT UCL (Chen-1995)	155.5
		95% Modified-t UCL (Johnson-1978)	157.8
Gamma GOF Test			
A-D Test Statistic	0.403	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.227	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.714	k star (bias corrected MLE)	5.075
Theta hat (MLE)	14.2	Theta star (bias corrected MLE)	24.38
nu hat (MLE)	122	nu star (bias corrected)	71.05
MLE Mean (bias corrected)	123.7	MLE Sd (bias corrected)	54.92
		Approximate Chi Square Value (0.05)	52.64
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	47.89
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	167	95% Adjusted Gamma UCL (use when n<50)	183.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.9	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.331	Mean of logged Data	4.76
Maximum of Logged Data	5.242	SD of logged Data	0.369
Assuming Lognormal Distribution			
95% H-UCL	176.1	90% Chebyshev (MVUE) UCL	175.6
95% Chebyshev (MVUE) UCL	199.2	97.5% Chebyshev (MVUE) UCL	231.8
99% Chebyshev (MVUE) UCL	296		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	152.1	95% Jackknife UCL	157.3
95% Standard Bootstrap UCL	149.2	95% Bootstrap-t UCL	165.4
95% Hall's Bootstrap UCL	163.4	95% Percentile Bootstrap UCL	151.6
95% BCA Bootstrap UCL	152.3		
90% Chebyshev(Mean, Sd) UCL	175.5	95% Chebyshev(Mean, Sd) UCL	198.9
97.5% Chebyshev(Mean, Sd) UCL	231.5	99% Chebyshev(Mean, Sd) UCL	295.4

Suggested UCL to Use

95% Student's-t UCL	157.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in the Animas River Above the confluence with mainstem Mineral Creek during the Runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Above Min Creek

General Statistics			
Total Number of Observations	17	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	49	Mean	69.29
Maximum	87	Median	71
SD	11.25	Std. Error of Mean	2.728
Coefficient of Variation	0.162	Skewness	-0.489
Normal GOF Test			
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.136	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.215	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	74.06	95% Adjusted-CLT UCL (Chen-1995)	73.44
		95% Modified-t UCL (Johnson-1978)	74
Gamma GOF Test			
A-D Test Statistic	0.609	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.148	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.209	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	37.57	k star (bias corrected MLE)	30.98
Theta hat (MLE)	1.844	Theta star (bias corrected MLE)	2.237
nu hat (MLE)	1277	nu star (bias corrected)	1053
MLE Mean (bias corrected)	69.29	MLE Sd (bias corrected)	12.45
		Approximate Chi Square Value (0.05)	979
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	971.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	74.56	95% Adjusted Gamma UCL (use when n<50)	75.13
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.905	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.892	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.148	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.215	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.892	Mean of logged Data	4.225
Maximum of Logged Data	4.466	SD of logged Data	0.172
Assuming Lognormal Distribution			
95% H-UCL	74.9	90% Chebyshev (MVUE) UCL	78.04
95% Chebyshev (MVUE) UCL	81.99	97.5% Chebyshev (MVUE) UCL	87.46
99% Chebyshev (MVUE) UCL	98.22		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	73.78	95% Jackknife UCL	74.06
95% Standard Bootstrap UCL	73.58	95% Bootstrap-t UCL	73.61
95% Hall's Bootstrap UCL	73.47	95% Percentile Bootstrap UCL	73.41
95% BCA Bootstrap UCL	73.29		
90% Chebyshev(Mean, Sd) UCL	77.48	95% Chebyshev(Mean, Sd) UCL	81.18
97.5% Chebyshev(Mean, Sd) UCL	86.33	99% Chebyshev(Mean, Sd) UCL	96.43
Suggested UCL to Use			
95% Student's-t UCL	74.06		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in the Animas River from sampling location A72 below the confluence with mainstem Mineral Creek during the Runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A72

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	45	Mean	71.86
Maximum	103	Median	78
SD	20.96	Std. Error of Mean	7.921
Coefficient of Variation	0.292	Skewness	0.113

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.935	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	87.25	95% Adjusted-CLT UCL (Chen-1995)	85.25
		95% Modified-t UCL (Johnson-1978)	87.3
Gamma GOF Test			
A-D Test Statistic	0.365	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.228	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.26	k star (bias corrected MLE)	7.672
Theta hat (MLE)	5.419	Theta star (bias corrected MLE)	9.366
nu hat (MLE)	185.6	nu star (bias corrected)	107.4
MLE Mean (bias corrected)	71.86	MLE Sd (bias corrected)	25.94
		Approximate Chi Square Value (0.05)	84.49
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	78.37
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	91.35	95% Adjusted Gamma UCL (use when n<50)	98.49
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.928	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.807	Mean of logged Data	4.236
Maximum of Logged Data	4.635	SD of logged Data	0.302
Assuming Lognormal Distribution			
95% H-UCL	95.19	90% Chebyshev (MVUE) UCL	96.61
95% Chebyshev (MVUE) UCL	107.8	97.5% Chebyshev (MVUE) UCL	123.3
99% Chebyshev (MVUE) UCL	153.8		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	84.89	95% Jackknife UCL	87.25
95% Standard Bootstrap UCL	83.62	95% Bootstrap-t UCL	87.9
95% Hall's Bootstrap UCL	83.18	95% Percentile Bootstrap UCL	84
95% BCA Bootstrap UCL	83.86		
90% Chebyshev(Mean, Sd) UCL	95.62	95% Chebyshev(Mean, Sd) UCL	106.4
97.5% Chebyshev(Mean, Sd) UCL	121.3	99% Chebyshev(Mean, Sd) UCL	150.7

Suggested UCL to Use

95% Student's-t UCL	87.25

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in mainstem Mineral Creek during the Post-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:56
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Mineral Creek

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	65	Mean	161
Maximum	238	Median	156
SD	53.3	Std. Error of Mean	14.78
Coefficient of Variation	0.331	Skewness	-0.305
Normal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.142	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	187.3	95% Adjusted-CLT UCL (Chen-1995)	184
		95% Modified-t UCL (Johnson-1978)	187.1
Gamma GOF Test			
A-D Test Statistic	0.328	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.168	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.364	k star (bias corrected MLE)	6.485
Theta hat (MLE)	19.25	Theta star (bias corrected MLE)	24.82
nu hat (MLE)	217.5	nu star (bias corrected)	168.6
MLE Mean (bias corrected)	161	MLE Sd (bias corrected)	63.22
		Approximate Chi Square Value (0.05)	139.6
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	135.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	194.5	95% Adjusted Gamma UCL (use when n<50)	199.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.921	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.165	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.174	Mean of logged Data	5.02
Maximum of Logged Data	5.472	SD of logged Data	0.384
Assuming Lognormal Distribution			
95% H-UCL	203.1	90% Chebyshev (MVUE) UCL	214.6
95% Chebyshev (MVUE) UCL	238.4	97.5% Chebyshev (MVUE) UCL	271.4
99% Chebyshev (MVUE) UCL	336.3		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	185.3	95% Jackknife UCL	187.3
95% Standard Bootstrap UCL	183.9	95% Bootstrap-t UCL	186
95% Hall's Bootstrap UCL	184.2	95% Percentile Bootstrap UCL	183.3
95% BCA Bootstrap UCL	182.8		
90% Chebyshev(Mean, Sd) UCL	205.4	95% Chebyshev(Mean, Sd) UCL	225.4
97.5% Chebyshev(Mean, Sd) UCL	253.3	99% Chebyshev(Mean, Sd) UCL	308.1
Suggested UCL to Use			
95% Student's-t UCL	187.3		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in mainstem Cement Creek during the Post-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:56
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Cement Creek

General Statistics			
Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	67	Mean	408.6
Maximum	545	Median	468.5
SD	139.5	Std. Error of Mean	37.28
Coefficient of Variation	0.341	Skewness	-1.475
Normal GOF Test			
Shapiro Wilk Test Statistic	0.83	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	474.7	95% Adjusted-CLT UCL (Chen-1995)	454.3
		95% Modified-t UCL (Johnson-1978)	472.2
Gamma GOF Test			
A-D Test Statistic	1.504	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.257	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.998	k star (bias corrected MLE)	3.975
Theta hat (MLE)	81.76	Theta star (bias corrected MLE)	102.8
nu hat (MLE)	139.9	nu star (bias corrected)	111.3
MLE Mean (bias corrected)	408.6	MLE Sd (bias corrected)	205
		Approximate Chi Square Value (0.05)	87.94
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	85.19
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	517.2	95% Adjusted Gamma UCL (use when n<50)	533.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.67	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.268	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.205	Mean of logged Data	5.909
Maximum of Logged Data	6.301	SD of logged Data	0.567
Assuming Lognormal Distribution			
95% H-UCL	604.1	90% Chebyshev (MVUE) UCL	628.2
95% Chebyshev (MVUE) UCL	719.3	97.5% Chebyshev (MVUE) UCL	845.7
99% Chebyshev (MVUE) UCL	1094		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	470	95% Jackknife UCL	474.7
95% Standard Bootstrap UCL	468.8	95% Bootstrap-t UCL	464.7
95% Hall's Bootstrap UCL	456.6	95% Percentile Bootstrap UCL	464.5
95% BCA Bootstrap UCL	457.2		
90% Chebyshev(Mean, Sd) UCL	520.5	95% Chebyshev(Mean, Sd) UCL	571.1
97.5% Chebyshev(Mean, Sd) UCL	641.5	99% Chebyshev(Mean, Sd) UCL	779.6

Suggested UCL to Use

95% Student's-t UCL	474.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in the Animas River above the confluence with mainstem Mineral Creek during the Post-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:56
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Above Mineral Creek

General Statistics

Total Number of Observations	18	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	66	Mean	124.3
Maximum	174	Median	118.5
SD	27.56	Std. Error of Mean	6.497
Coefficient of Variation	0.222	Skewness	-0.138

Normal GOF Test

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.897	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.148	Lilliefors GOF Test
5% Lilliefors Critical Value	0.209	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	135.6	95% Adjusted-CLT UCL (Chen-1995)	134.8
		95% Modified-t UCL (Johnson-1978)	135.6

Gamma GOF Test

A-D Test Statistic	0.348	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.203	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	19.83	k star (bias corrected MLE)	16.56
Theta hat (MLE)	6.272	Theta star (bias corrected MLE)	7.509
nu hat (MLE)	713.7	nu star (bias corrected)	596.1
MLE Mean (bias corrected)	124.3	MLE Sd (bias corrected)	30.56
		Approximate Chi Square Value (0.05)	540.5
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	535.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	137.1	95% Adjusted Gamma UCL (use when n<50)	138.4

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.94	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.209	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.19	Mean of logged Data	4.798
Maximum of Logged Data	5.159	SD of logged Data	0.239

Assuming Lognormal Distribution

95% H-UCL	138.5	90% Chebyshev (MVUE) UCL	145.7
95% Chebyshev (MVUE) UCL	155.3	97.5% Chebyshev (MVUE) UCL	168.7
99% Chebyshev (MVUE) UCL	194.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	135	95% Jackknife UCL	135.6
95% Standard Bootstrap UCL	134.3	95% Bootstrap-t UCL	135.7
95% Hall's Bootstrap UCL	134.9	95% Percentile Bootstrap UCL	134.4
95% BCA Bootstrap UCL	134.8		
90% Chebyshev(Mean, Sd) UCL	143.8	95% Chebyshev(Mean, Sd) UCL	152.7
97.5% Chebyshev(Mean, Sd) UCL	164.9	99% Chebyshev(Mean, Sd) UCL	189

Suggested UCL to Use

95% Student's-t UCL	135.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in the Animas River from sampling location A72 below the confluence with mainstem Mineral Creek during the Post-runoff period

User Selected Options	
Date/Time of Computation	3/4/2015 12:57
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A72

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	75	**Mean**	**189.4**
Maximum	296	Median	199
SD	63.04	Std. Error of Mean	17.48
Coefficient of Variation	0.333	Skewness	-0.172
Normal GOF Test			
Shapiro Wilk Test Statistic	0.99	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0991	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	220.5	95% Adjusted-CLT UCL (Chen-1995)	217.3
		95% Modified-t UCL (Johnson-1978)	220.4
Gamma GOF Test			
A-D Test Statistic	0.233	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.141	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.372	k star (bias corrected MLE)	6.492
Theta hat (MLE)	22.62	Theta star (bias corrected MLE)	29.17
nu hat (MLE)	217.7	nu star (bias corrected)	168.8
MLE Mean (bias corrected)	189.4	MLE Sd (bias corrected)	74.33
		Approximate Chi Square Value (0.05)	139.7
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	136
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	228.7	95% Adjusted Gamma UCL (use when n<50)	235.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.152	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.317	Mean of logged Data	5.183
Maximum of Logged Data	5.69	SD of logged Data	0.383
Assuming Lognormal Distribution			
95% H-UCL	238.9	90% Chebyshev (MVUE) UCL	252.4
95% Chebyshev (MVUE) UCL	280.3	97.5% Chebyshev (MVUE) UCL	319.2
99% Chebyshev (MVUE) UCL	395.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	218.1	95% Jackknife UCL	220.5
95% Standard Bootstrap UCL	216.4	95% Bootstrap-t UCL	219.9
95% Hall's Bootstrap UCL	219.6	95% Percentile Bootstrap UCL	215.5
95% BCA Bootstrap UCL	215.7		
90% Chebyshev(Mean, Sd) UCL	241.8	95% Chebyshev(Mean, Sd) UCL	265.6
97.5% Chebyshev(Mean, Sd) UCL	298.6	99% Chebyshev(Mean, Sd) UCL	363.4
Suggested UCL to Use			
95% Student's-t UCL	220.5		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Hardness in the Animas River from sampling location A73 below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/4/2015 13:14
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A73

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	71	Mean	146.8
Maximum	251	Median	142
SD	73.01	Std. Error of Mean	32.65
Coefficient of Variation	0.497	Skewness	0.574

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.95	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.19	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	216.4	95% Adjusted-CLT UCL (Chen-1995)	209.5
		95% Modified-t UCL (Johnson-1978)	217.8
Gamma GOF Test			
A-D Test Statistic	0.229	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.215	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.968	k star (bias corrected MLE)	2.12
Theta hat (MLE)	29.55	Theta star (bias corrected MLE)	69.23
nu hat (MLE)	49.68	nu star (bias corrected)	21.2
MLE Mean (bias corrected)	146.8	MLE Sd (bias corrected)	100.8
		Approximate Chi Square Value (0.05)	11.74
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	8.828
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	265.1	95% Adjusted Gamma UCL (use when n<50)	352.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.185	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.263	Mean of logged Data	4.885
Maximum of Logged Data	5.525	SD of logged Data	0.517
Assuming Lognormal Distribution			
95% H-UCL	328.8	90% Chebyshev (MVUE) UCL	248
95% Chebyshev (MVUE) UCL	293.7	97.5% Chebyshev (MVUE) UCL	357.3
99% Chebyshev (MVUE) UCL	482		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	200.5	95% Jackknife UCL	216.4
95% Standard Bootstrap UCL	195.6	95% Bootstrap-t UCL	234.9
95% Hall's Bootstrap UCL	236.6	95% Percentile Bootstrap UCL	196.6
95% BCA Bootstrap UCL	196.6		
90% Chebyshev(Mean, Sd) UCL	244.8	95% Chebyshev(Mean, Sd) UCL	289.1
97.5% Chebyshev(Mean, Sd) UCL	350.7	99% Chebyshev(Mean, Sd) UCL	471.7

Suggested UCL to Use

95% Student's-t UCL	216.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in the Animas River from sampling location A73B below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/4/2015 13:14
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A73B

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	37	Mean	97.75
Maximum	217	Median	68.5
SD	81.74	Std. Error of Mean	40.87
Coefficient of Variation	0.836	Skewness	1.69

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.322	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	193.9	95% Adjusted-CLT UCL (Chen-1995)	201.9
		95% Modified-t UCL (Johnson-1978)	199.7
Gamma GOF Test			
A-D Test Statistic	0.344	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.257	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.301	k star (bias corrected MLE)	0.742
Theta hat (MLE)	42.48	Theta star (bias corrected MLE)	131.7
nu hat (MLE)	18.41	nu star (bias corrected)	5.935
MLE Mean (bias corrected)	97.75	MLE Sd (bias corrected)	113.5
		Approximate Chi Square Value (0.05)	1.607
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	361	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.952	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.214	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.611	Mean of logged Data	4.35
Maximum of Logged Data	5.38	SD of logged Data	0.762
Assuming Lognormal Distribution			
95% H-UCL	1011	90% Chebyshev (MVUE) UCL	199.9
95% Chebyshev (MVUE) UCL	247.3	97.5% Chebyshev (MVUE) UCL	312.9
99% Chebyshev (MVUE) UCL	442		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	165	95% Jackknife UCL	193.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	220.4	95% Chebyshev(Mean, Sd) UCL	275.9
97.5% Chebyshev(Mean, Sd) UCL	353	99% Chebyshev(Mean, Sd) UCL	504.4

Suggested UCL to Use

95% Student's-t UCL	193.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in the Animas River from sampling location A75D below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/4/2015 13:14
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A75D

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	60	Mean	110.4
Maximum	191	Median	92
SD	52.61	Std. Error of Mean	23.53
Coefficient of Variation	0.476	Skewness	1.031

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.237	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	160.6	95% Adjusted-CLT UCL (Chen-1995)	160.7
		95% Modified-t UCL (Johnson-1978)	162.4
Gamma GOF Test			
A-D Test Statistic	0.244	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.215	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.961	k star (bias corrected MLE)	2.518
Theta hat (MLE)	18.52	Theta star (bias corrected MLE)	43.85
nu hat (MLE)	59.61	nu star (bias corrected)	25.18
MLE Mean (bias corrected)	110.4	MLE Sd (bias corrected)	69.57
		Approximate Chi Square Value (0.05)	14.75
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	11.41
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	188.5	95% Adjusted Gamma UCL (use when n<50)	243.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.183	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.094	Mean of logged Data	4.618
Maximum of Logged Data	5.252	SD of logged Data	0.459
Assuming Lognormal Distribution			
95% H-UCL	214.9	90% Chebyshev (MVUE) UCL	177.3
95% Chebyshev (MVUE) UCL	207.8	97.5% Chebyshev (MVUE) UCL	250.1
99% Chebyshev (MVUE) UCL	333.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	149.1	95% Jackknife UCL	160.6
95% Standard Bootstrap UCL	145	95% Bootstrap-t UCL	233
95% Hall's Bootstrap UCL	428.5	95% Percentile Bootstrap UCL	144.8
95% BCA Bootstrap UCL	148		
90% Chebyshev(Mean, Sd) UCL	181	95% Chebyshev(Mean, Sd) UCL	212.9
97.5% Chebyshev(Mean, Sd) UCL	257.3	99% Chebyshev(Mean, Sd) UCL	344.5

Suggested UCL to Use

95% Student's-t UCL	160.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in the Animas River from sampling location A75B below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/4/2015 13:14
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness A75B

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	61	Mean	102.3
Maximum	193	Median	77.5
SD	61.3	Std. Error of Mean	30.65
Coefficient of Variation	0.6	Skewness	1.848

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.771	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.361	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	174.4	95% Adjusted-CLT UCL (Chen-1995)	182.9
		95% Modified-t UCL (Johnson-1978)	179.1

Gamma GOF Test

A-D Test Statistic	0.523	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.341	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.655	k star (bias corrected MLE)	1.33
Theta hat (MLE)	21.97	Theta star (bias corrected MLE)	76.86
nu hat (MLE)	37.24	nu star (bias corrected)	10.64
MLE Mean (bias corrected)	102.3	MLE Sd (bias corrected)	88.65
		Approximate Chi Square Value (0.05)	4.348
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	250.3	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.85	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.307	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.111	Mean of logged Data	4.516
Maximum of Logged Data	5.263	SD of logged Data	0.516

Assuming Lognormal Distribution

95% H-UCL	318.5	90% Chebyshev (MVUE) UCL	177.4
95% Chebyshev (MVUE) UCL	212.1	97.5% Chebyshev (MVUE) UCL	260.2
99% Chebyshev (MVUE) UCL	354.8		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	152.7	95% Jackknife UCL	174.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	194.2	95% Chebyshev(Mean, Sd) UCL	235.9
97.5% Chebyshev(Mean, Sd) UCL	293.7	99% Chebyshev(Mean, Sd) UCL	407.2

Suggested UCL to Use

95% Student's-t UCL	174.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in the Animas River from sampling location Bakers Bridge below the confluence with mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/4/2015 13:15
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Hardness Baker Bridge

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	58	Mean	108
Maximum	183	Median	99
SD	49.48	Std. Error of Mean	22.13
Coefficient of Variation	0.458	Skewness	0.895

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.172	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	155.2	95% Adjusted-CLT UCL (Chen-1995)	153.9
		95% Modified-t UCL (Johnson-1978)	156.6

Gamma GOF Test

A-D Test Statistic	0.199	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.183	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.245	k star (bias corrected MLE)	2.631
Theta hat (MLE)	17.29	Theta star (bias corrected MLE)	41.04
nu hat (MLE)	62.45	nu star (bias corrected)	26.31
MLE Mean (bias corrected)	108	MLE Sd (bias corrected)	66.58
		Approximate Chi Square Value (0.05)	15.62
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	12.17

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	181.9	95% Adjusted Gamma UCL (use when n<50)	233.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.984	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.06	Mean of logged Data	4.6
Maximum of Logged Data	5.209	SD of logged Data	0.452

Assuming Lognormal Distribution

95% H-UCL	207.5	90% Chebyshev (MVUE) UCL	172.8
95% Chebyshev (MVUE) UCL	202.2	97.5% Chebyshev (MVUE) UCL	243.1
99% Chebyshev (MVUE) UCL	323.3		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	144.4	95% Jackknife UCL	155.2
95% Standard Bootstrap UCL	140.8	95% Bootstrap-t UCL	183.7
95% Hall's Bootstrap UCL	180.4	95% Percentile Bootstrap UCL	141.2
95% BCA Bootstrap UCL	144.2		
90% Chebyshev(Mean, Sd) UCL	174.4	95% Chebyshev(Mean, Sd) UCL	204.4
97.5% Chebyshev(Mean, Sd) UCL	246.2	99% Chebyshev(Mean, Sd) UCL	328.2

Suggested UCL to Use

95% Student's-t UCL	155.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Appendix 13

ProUCL calculations for total Cd in the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	40	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	0.8	Mean	1.382
Maximum	4	Median	1.3
SD	0.632	Std. Error of Mean	0.1
Coefficient of Variation	0.458	Skewness	2.637

Normal GOF Test			
Shapiro Wilk Test Statistic	0.719	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.238	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.55	95% Adjusted-CLT UCL (Chen-1995)	1.591
		95% Modified-t UCL (Johnson-1978)	1.557
Gamma GOF Test			
A-D Test Statistic	1.681	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.175	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.296	k star (bias corrected MLE)	6.766
Theta hat (MLE)	0.189	Theta star (bias corrected MLE)	0.204
nu hat (MLE)	583.7	nu star (bias corrected)	541.3
MLE Mean (bias corrected)	1.382	MLE Sd (bias corrected)	0.531
		Approximate Chi Square Value (0.05)	488.3
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	486.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.532	95% Adjusted Gamma UCL (use when n<50)	1.538
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.896	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.144	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.14	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.223	Mean of logged Data	0.253
Maximum of Logged Data	1.386	SD of logged Data	0.351
Assuming Lognormal Distribution			
95% H-UCL	1.518	90% Chebyshev (MVUE) UCL	1.601
95% Chebyshev (MVUE) UCL	1.707	97.5% Chebyshev (MVUE) UCL	1.853
99% Chebyshev (MVUE) UCL	2.142		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.546	95% Jackknife UCL	1.55
95% Standard Bootstrap UCL	1.546	95% Bootstrap-t UCL	1.64
95% Hall's Bootstrap UCL	1.733	95% Percentile Bootstrap UCL	1.552
95% BCA Bootstrap UCL	1.587		
90% Chebyshev(Mean, Sd) UCL	1.682	95% Chebyshev(Mean, Sd) UCL	1.818
97.5% Chebyshev(Mean, Sd) UCL	2.006	99% Chebyshev(Mean, Sd) UCL	2.377

Suggested UCL to Use

95% Student's-t UCL	1.55	or 95% Modified-t UCL	1.557

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cu in the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	31
Number of Detects	32	Number of Non-Detects	8
Number of Distinct Detects	29	Number of Distinct Non-Detects	3
Minimum Detect	3.9	Minimum Non-Detect	4
Maximum Detect	33.5	Maximum Non-Detect	20
Variance Detects	120.4	Percent Non-Detects	20%
Mean Detects	15.53	SD Detects	10.97
Median Detects	12.8	CV Detects	0.707
Skewness Detects	0.274	Kurtosis Detects	-1.67
Mean of Logged Detects	2.436	SD of Logged Detects	0.835
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.24	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.157	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	13.43	Standard Error of Mean	1.705
SD	10.57	95% KM (BCA) UCL	16.2
95% KM (t) UCL	16.3	95% KM (Percentile Bootstrap) UCL	16.4
95% KM (z) UCL	16.23	95% KM Bootstrap t UCL	16.41
90% KM Chebyshev UCL	18.54	95% KM Chebyshev UCL	20.86
97.5% KM Chebyshev UCL	24.07	99% KM Chebyshev UCL	30.39
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.253	Anderson-Darling GOF Test	
5% A-D Critical Value	0.761	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.225	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.158	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	1.78	k star (bias corrected MLE)	1.634
Theta hat (MLE)	8.72	Theta star (bias corrected MLE)	9.499
nu hat (MLE)	113.9	nu star (bias corrected)	104.6
MLE Mean (bias corrected)	15.53	MLE Sd (bias corrected)	12.14
Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	1.613	nu hat (KM)	129.1
Approximate Chi Square Value (129.05, α)	103.8	Adjusted Chi Square Value (129.05, β)	103
95% Gamma Approximate KM-UCL (use when n>=50)	16.69	95% Gamma Adjusted KM-UCL (use when n<50)	16.83
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.632	Mean	13.49
Maximum	33.5	Median	7.958
SD	10.73	CV	0.796
k hat (MLE)	1.458	k star (bias corrected MLE)	1.366
Theta hat (MLE)	9.249	Theta star (bias corrected MLE)	9.877
nu hat (MLE)	116.7	nu star (bias corrected)	109.2
MLE Mean (bias corrected)	13.49	MLE Sd (bias corrected)	11.54
		Adjusted Level of Significance (β)	0.044
Approximate Chi Square Value (109.24, α)	86.12	Adjusted Chi Square Value (109.24, β)	85.35
95% Gamma Approximate UCL (use when n>=50)	17.11	95% Gamma Adjusted UCL (use when n<50)	17.26
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.819	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.219	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.157	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	13.43	Mean in Log Scale	2.248
SD in Original Scale	10.72	SD in Log Scale	0.87
95% t UCL (assumes normality of ROS data)	16.29	95% Percentile Bootstrap UCL	16.25
95% BCA Bootstrap UCL	16.1	95% Bootstrap t UCL	16.49
95% H-UCL (Log ROS)	18.95		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	13.77	Mean in Log Scale	2.294
SD in Original Scale	10.52	SD in Log Scale	0.852
95% t UCL (Assumes normality)	16.57	95% H-Stat UCL	19.37
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
95% KM (BCA) UCL	16.2		

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Pb in the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	1.4	Mean	11.57
Maximum	52.3	Median	2.85
SD	15.03	Std. Error of Mean	2.376
Coefficient of Variation	1.299	Skewness	1.732
Normal GOF Test			
Shapiro Wilk Test Statistic	0.69	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15.57	95% Adjusted-CLT UCL (Chen-1995)	16.17
		95% Modified-t UCL (Johnson-1978)	15.68
Gamma GOF Test			
A-D Test Statistic	2.903	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.787	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.252	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.145	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.796	k star (bias corrected MLE)	0.753
Theta hat (MLE)	14.53	Theta star (bias corrected MLE)	15.36
nu hat (MLE)	63.69	nu star (bias corrected)	60.25
MLE Mean (bias corrected)	11.57	MLE Sd (bias corrected)	13.33
		Approximate Chi Square Value (0.05)	43.4
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	42.86
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	16.06	95% Adjusted Gamma UCL (use when n<50)	16.26
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.841	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.14	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.336	Mean of logged Data	1.703
Maximum of Logged Data	3.957	SD of logged Data	1.21
Assuming Lognormal Distribution			
95% H-UCL	19.12	90% Chebyshev (MVUE) UCL	18.84
95% Chebyshev (MVUE) UCL	22.37	97.5% Chebyshev (MVUE) UCL	27.25
99% Chebyshev (MVUE) UCL	36.85		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.48	95% Jackknife UCL	15.57
95% Standard Bootstrap UCL	15.41	95% Bootstrap-t UCL	16.6
95% Hall's Bootstrap UCL	15.85	95% Percentile Bootstrap UCL	15.66
95% BCA Bootstrap UCL	16.02		
90% Chebyshev(Mean, Sd) UCL	18.7	95% Chebyshev(Mean, Sd) UCL	21.93
97.5% Chebyshev(Mean, Sd) UCL	26.41	99% Chebyshev(Mean, Sd) UCL	35.22
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	21.93		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn in the Animas River above mainstem Cement Creek

User Selected Options			
Date/Time of Computation	2/19/2015 9:04		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	252	Mean	432
Maximum	1180	Median	382
SD	202.5	Std. Error of Mean	32.01
Coefficient of Variation	0.469	Skewness	2.21
Normal GOF Test			
Shapiro Wilk Test Statistic	0.755	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	485.9	95% Adjusted-CLT UCL (Chen-1995)	496.6
		95% Modified-t UCL (Johnson-1978)	487.8
Gamma GOF Test			
A-D Test Statistic	1.516	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.144	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.606	k star (bias corrected MLE)	6.127
Theta hat (MLE)	65.4	Theta star (bias corrected MLE)	70.51
nu hat (MLE)	528.4	nu star (bias corrected)	490.1
MLE Mean (bias corrected)	432	MLE Sd (bias corrected)	174.5
		Approximate Chi Square Value (0.05)	439.8
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	438
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	481.4	95% Adjusted Gamma UCL (use when n<50)	483.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.9	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.529	Mean of logged Data	5.991
Maximum of Logged Data	7.073	SD of logged Data	0.373
Assuming Lognormal Distribution			
95% H-UCL	478	90% Chebyshev (MVUE) UCL	505.4
95% Chebyshev (MVUE) UCL	540.6	97.5% Chebyshev (MVUE) UCL	589.4
99% Chebyshev (MVUE) UCL	685.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	484.6	95% Jackknife UCL	485.9
95% Standard Bootstrap UCL	484.3	95% Bootstrap-t UCL	507.2
95% Hall's Bootstrap UCL	511.2	95% Percentile Bootstrap UCL	483.4
95% BCA Bootstrap UCL	494.5		
90% Chebyshev(Mean, Sd) UCL	528	95% Chebyshev(Mean, Sd) UCL	571.5
97.5% Chebyshev(Mean, Sd) UCL	631.9	99% Chebyshev(Mean, Sd) UCL	750.5
Suggested UCL to Use			
95% Student's-t UCL	485.9	or 95% Modified-t UCL	487.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cd from sampling location A72 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:12
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	24	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	0.8	Mean	1.648
Maximum	2.9	Median	1.675
SD	0.683	Std. Error of Mean	0.139
Coefficient of Variation	0.415	Skewness	0.494
Normal GOF Test			
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.136	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.887	95% Adjusted-CLT UCL (Chen-1995)	1.892
		95% Modified-t UCL (Johnson-1978)	1.889
Gamma GOF Test			
A-D Test Statistic	0.539	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.138	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.178	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.085	k star (bias corrected MLE)	5.353
Theta hat (MLE)	0.271	Theta star (bias corrected MLE)	0.308
nu hat (MLE)	292.1	nu star (bias corrected)	256.9
MLE Mean (bias corrected)	1.648	MLE Sd (bias corrected)	0.712
		Approximate Chi Square Value (0.05)	220.8
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	218.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.917	95% Adjusted Gamma UCL (use when n<50)	1.938
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.928	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.14	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.223	Mean of logged Data	0.415
Maximum of Logged Data	1.065	SD of logged Data	0.424
Assuming Lognormal Distribution			
95% H-UCL	1.963	90% Chebyshev (MVUE) UCL	2.092
95% Chebyshev (MVUE) UCL	2.292	97.5% Chebyshev (MVUE) UCL	2.569
99% Chebyshev (MVUE) UCL	3.114		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.877	95% Jackknife UCL	1.887
95% Standard Bootstrap UCL	1.868	95% Bootstrap-t UCL	1.901
95% Hall's Bootstrap UCL	1.883	95% Percentile Bootstrap UCL	1.881
95% BCA Bootstrap UCL	1.898		
90% Chebyshev(Mean, Sd) UCL	2.066	95% Chebyshev(Mean, Sd) UCL	2.256
97.5% Chebyshev(Mean, Sd) UCL	2.519	99% Chebyshev(Mean, Sd) UCL	3.036
Suggested UCL to Use			
95% Student's-t UCL	1.887		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cu from sampling location A72 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:13
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	24	Number of Distinct Observations	24
Number of Detects	23	Number of Non-Detects	1
Number of Distinct Detects	23	Number of Distinct Non-Detects	1
Minimum Detect	10.3	Minimum Non-Detect	20
Maximum Detect	46.7	Maximum Non-Detect	20
Variance Detects	117	Percent Non-Detects	4.17%
Mean Detects	27.36	SD Detects	10.82
Median Detects	28.8	CV Detects	0.395
Skewness Detects	-0.0118	Kurtosis Detects	-1.226
Mean of Logged Detects	3.222	SD of Logged Detects	0.446

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.15	Lilliefors GOF Test
5% Lilliefors Critical Value	0.185	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	26.84	Standard Error of Mean	2.229
SD	10.66	95% KM (BCA) UCL	30.43
95% KM (t) UCL	30.66	95% KM (Percentile Bootstrap) UCL	30.38
95% KM (z) UCL	30.51	95% KM Bootstrap t UCL	30.67
90% KM Chebyshev UCL	33.53	95% KM Chebyshev UCL	36.56
97.5% KM Chebyshev UCL	40.76	99% KM Chebyshev UCL	49.02

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.594	Anderson-Darling GOF Test
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.898	k star (bias corrected MLE)	5.158
Theta hat (MLE)	4.638	Theta star (bias corrected MLE)	5.304
nu hat (MLE)	271.3	nu star (bias corrected)	237.3
MLE Mean (bias corrected)	27.36	MLE Sd (bias corrected)	12.05

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.342	nu hat (KM)	304.4
Approximate Chi Square Value (304.43, α)	265	Adjusted Chi Square Value (304.43, β)	262.4
95% Gamma Approximate KM-UCL (use when n>=50)	30.84	95% Gamma Adjusted KM-UCL (use when n<50)	31.14

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	10.3	Mean	26.92
Maximum	46.7	Median	27.4
SD	10.79	CV	0.401
k hat (MLE)	5.867	k star (bias corrected MLE)	5.162
Theta hat (MLE)	4.588	Theta star (bias corrected MLE)	5.215
nu hat (MLE)	281.6	nu star (bias corrected)	247.8
MLE Mean (bias corrected)	26.92	MLE Sd (bias corrected)	11.85
		Adjusted Level of Significance (β)	0.0392
Approximate Chi Square Value (247.76, α)	212.3	Adjusted Chi Square Value (247.76, β)	210
95% Gamma Approximate UCL (use when n>=50)	31.41	95% Gamma Adjusted UCL (use when n<50)	31.75

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.928	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.177	Lilliefors GOF Test
5% Lilliefors Critical Value	0.185	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	26.89	Mean in Log Scale	3.203
SD in Original Scale	10.82	SD in Log Scale	0.445
95% t UCL (assumes normality of ROS data)	30.68	95% Percentile Bootstrap UCL	30.28
95% BCA Bootstrap UCL	30.62	95% Bootstrap t UCL	30.81
95% H-UCL (Log ROS)	32.52		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.2	95% H-UCL (KM -Log)	32.29
KM SD (logged)	0.441	95% Critical H Value (KM-Log)	1.93
KM Standard Error of Mean (logged)	0.0926		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	26.63	Mean in Log Scale	3.183
SD in Original Scale	11.16	SD in Log Scale	0.474
95% t UCL (Assumes normality)	30.54	95% H-Stat UCL	32.78

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	30.66	95% KM (Percentile Bootstrap) UCL	30.38

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Pb from sampling location A72 in the Animas River below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/19/2015 9:13		
From File	WorkSheet_a.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	24	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	3.3	Mean	12.77
Maximum	99.8	Median	5.9
SD	19.88	Std. Error of Mean	4.057
Coefficient of Variation	1.556	Skewness	3.983
Normal GOF Test			
Shapiro Wilk Test Statistic	0.465	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.321	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.73	95% Adjusted-CLT UCL (Chen-1995)	22.97
		95% Modified-t UCL (Johnson-1978)	20.27
Gamma GOF Test			
A-D Test Statistic	2.5	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.28	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.182	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.22	k star (bias corrected MLE)	1.095
Theta hat (MLE)	10.47	Theta star (bias corrected MLE)	11.66
nu hat (MLE)	58.56	nu star (bias corrected)	52.57
MLE Mean (bias corrected)	12.77	MLE Sd (bias corrected)	12.2
		Approximate Chi Square Value (0.05)	36.91
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	35.99
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	18.19	95% Adjusted Gamma UCL (use when n<50)	18.65
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.181	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.194	Mean of logged Data	2.084
Maximum of Logged Data	4.603	SD of logged Data	0.812
Assuming Lognormal Distribution			
95% H-UCL	16.51	90% Chebyshev (MVUE) UCL	16.97
95% Chebyshev (MVUE) UCL	19.68	97.5% Chebyshev (MVUE) UCL	23.44
99% Chebyshev (MVUE) UCL	30.82		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.45	95% Jackknife UCL	19.73
95% Standard Bootstrap UCL	19.14	95% Bootstrap-t UCL	33.29
95% Hall's Bootstrap UCL	41.1	95% Percentile Bootstrap UCL	20.29
95% BCA Bootstrap UCL	24.4		
90% Chebyshev(Mean, Sd) UCL	24.94	95% Chebyshev(Mean, Sd) UCL	30.46
97.5% Chebyshev(Mean, Sd) UCL	38.11	99% Chebyshev(Mean, Sd) UCL	53.14

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	30.46

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Ni from sampling location A72 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:13
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	24	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	15
Number of Distinct Detects	8	Number of Distinct Non-Detects	4
Minimum Detect	2	Minimum Non-Detect	0.7
Maximum Detect	7	Maximum Non-Detect	4
Variance Detects	2.893	Percent Non-Detects	62.50%
Mean Detects	4.967	SD Detects	1.701
Median Detects	5.2	CV Detects	0.342
Skewness Detects	-0.416	Kurtosis Detects	-0.606
Mean of Logged Detects	1.538	SD of Logged Detects	0.407

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.117	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.559	Standard Error of Mean	0.519
SD	2.219	95% KM (BCA) UCL	3.864
95% KM (t) UCL	3.449	95% KM (Percentile Bootstrap) UCL	3.713
95% KM (z) UCL	3.413	95% KM Bootstrap t UCL	3.397
90% KM Chebyshev UCL	4.116	95% KM Chebyshev UCL	4.822
97.5% KM Chebyshev UCL	5.801	99% KM Chebyshev UCL	7.724

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.298	Anderson-Darling GOF Test
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	7.879	k star (bias corrected MLE)	5.327
Theta hat (MLE)	0.63	Theta star (bias corrected MLE)	0.932
nu hat (MLE)	141.8	nu star (bias corrected)	95.88
MLE Mean (bias corrected)	4.967	MLE Sd (bias corrected)	2.152

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.331	nu hat (KM)	63.87
Approximate Chi Square Value (63.87, α)	46.48	Adjusted Chi Square Value (63.87, β)	45.44
95% Gamma Approximate KM-UCL (use when n>=50)	3.516	95% Gamma Adjusted KM-UCL (use when n<50)	3.597

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2.633
Maximum	7	Median	2.056
SD	2.25	CV	0.854
k hat (MLE)	0.714	k star (bias corrected MLE)	0.652
Theta hat (MLE)	3.69	Theta star (bias corrected MLE)	4.038
nu hat (MLE)	34.25	nu star (bias corrected)	31.3
MLE Mean (bias corrected)	2.633	MLE Sd (bias corrected)	3.261
		Adjusted Level of Significance (β)	0.0392
Approximate Chi Square Value (31.30, α)	19.52	Adjusted Chi Square Value (31.30, β)	18.87
95% Gamma Approximate UCL (use when n>=50)	4.222	95% Gamma Adjusted UCL (use when n<50)	4.369

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.163	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.959	Mean in Log Scale	0.89
SD in Original Scale	1.945	SD in Log Scale	0.632
95% t UCL (assumes normality of ROS data)	3.639	95% Percentile Bootstrap UCL	3.589
95% BCA Bootstrap UCL	3.68	95% Bootstrap t UCL	3.771
95% H-UCL (Log ROS)	3.926		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.526	95% H-UCL (KM -Log)	4.152
KM SD (logged)	0.924	95% Critical H Value (KM-Log)	2.444
KM Standard Error of Mean (logged)	0.238		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.794	Mean in Log Scale	0.772
SD in Original Scale	2.035	SD in Log Scale	0.751
95% t UCL (Assumes normality)	3.506	95% H-Stat UCL	4.07

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.449	95% KM (Percentile Bootstrap) UCL	3.713

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.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn from sampling location A72 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 9:13
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	24	Number of Distinct Observations	24
		Number of Missing Observations	0
Minimum	221	Mean	599.7
Maximum	1320	Median	531
SD	319.3	Std. Error of Mean	65.17
Coefficient of Variation	0.532	Skewness	0.766
Normal GOF Test			
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.136	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	711.4	95% Adjusted-CLT UCL (Chen-1995)	717.8
		95% Modified-t UCL (Johnson-1978)	713.1
Gamma GOF Test			
A-D Test Statistic	0.379	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.129	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.179	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.824	k star (bias corrected MLE)	3.373
Theta hat (MLE)	156.8	Theta star (bias corrected MLE)	177.8
nu hat (MLE)	183.5	nu star (bias corrected)	161.9
MLE Mean (bias corrected)	599.7	MLE Sd (bias corrected)	326.5
		Approximate Chi Square Value (0.05)	133.5
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	131.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	727.4	95% Adjusted Gamma UCL (use when n<50)	737.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.916	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.398	Mean of logged Data	6.26
Maximum of Logged Data	7.185	SD of logged Data	0.539
Assuming Lognormal Distribution			
95% H-UCL	758.5	90% Chebyshev (MVUE) UCL	808.1
95% Chebyshev (MVUE) UCL	902	97.5% Chebyshev (MVUE) UCL	1032
99% Chebyshev (MVUE) UCL	1288		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	706.9	95% Jackknife UCL	711.4
95% Standard Bootstrap UCL	708	95% Bootstrap-t UCL	729
95% Hall's Bootstrap UCL	716.9	95% Percentile Bootstrap UCL	705.5
95% BCA Bootstrap UCL	720.9		
90% Chebyshev(Mean, Sd) UCL	795.2	95% Chebyshev(Mean, Sd) UCL	883.8
97.5% Chebyshev(Mean, Sd) UCL	1007	99% Chebyshev(Mean, Sd) UCL	1248

Suggested UCL to Use	
95% Student's-t UCL	711.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cd from sampling location A73 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:09
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.97	Mean	1.524
Maximum	2.2	Median	1.27
SD	0.619	Std. Error of Mean	0.277
Coefficient of Variation	0.406	Skewness	0.458

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.114	95% Adjusted-CLT UCL (Chen-1995)	2.04
		95% Modified-t UCL (Johnson-1978)	2.124
Gamma GOF Test			
A-D Test Statistic	0.579	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.28	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.731	k star (bias corrected MLE)	3.226
Theta hat (MLE)	0.197	Theta star (bias corrected MLE)	0.472
nu hat (MLE)	77.31	nu star (bias corrected)	32.26
MLE Mean (bias corrected)	1.524	MLE Sd (bias corrected)	0.849
		Approximate Chi Square Value (0.05)	20.27
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	16.26
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.425	95% Adjusted Gamma UCL (use when n<50)	3.023
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.817	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.252	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.0305	Mean of logged Data	0.355
Maximum of Logged Data	0.788	SD of logged Data	0.405
Assuming Lognormal Distribution			
95% H-UCL	2.656	90% Chebyshev (MVUE) UCL	2.344
95% Chebyshev (MVUE) UCL	2.717	97.5% Chebyshev (MVUE) UCL	3.234
99% Chebyshev (MVUE) UCL	4.249		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.979	95% Jackknife UCL	2.114
95% Standard Bootstrap UCL	1.933	95% Bootstrap-t UCL	3.187
95% Hall's Bootstrap UCL	2.885	95% Percentile Bootstrap UCL	1.95
95% BCA Bootstrap UCL	1.956		
90% Chebyshev(Mean, Sd) UCL	2.355	95% Chebyshev(Mean, Sd) UCL	2.731
97.5% Chebyshev(Mean, Sd) UCL	3.253	99% Chebyshev(Mean, Sd) UCL	4.279

Suggested UCL to Use

95% Student's-t UCL	2.114

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cu from sampling location A73 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:09
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	8.3	Mean	17.76
Maximum	22.8	Median	19.3
SD	5.983	Std. Error of Mean	2.676
Coefficient of Variation	0.337	Skewness	-1.196

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.881	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.202	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	23.46	95% Adjusted-CLT UCL (Chen-1995)	20.63
		95% Modified-t UCL (Johnson-1978)	23.23
Gamma GOF Test			
A-D Test Statistic	0.483	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.24	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.447	k star (bias corrected MLE)	3.512
Theta hat (MLE)	2.102	Theta star (bias corrected MLE)	5.057
nu hat (MLE)	84.47	nu star (bias corrected)	35.12
MLE Mean (bias corrected)	17.76	MLE Sd (bias corrected)	9.477
		Approximate Chi Square Value (0.05)	22.56
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.29
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	27.65	95% Adjusted Gamma UCL (use when n<50)	34.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.817	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.252	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.116	Mean of logged Data	2.817
Maximum of Logged Data	3.127	SD of logged Data	0.418
Assuming Lognormal Distribution			
95% H-UCL	32.07	90% Chebyshev (MVUE) UCL	27.89
95% Chebyshev (MVUE) UCL	32.41	97.5% Chebyshev (MVUE) UCL	38.68
99% Chebyshev (MVUE) UCL	51.01		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	22.16	95% Jackknife UCL	23.46
95% Standard Bootstrap UCL	21.83	95% Bootstrap-t UCL	21.74
95% Hall's Bootstrap UCL	20.58	95% Percentile Bootstrap UCL	21.34
95% BCA Bootstrap UCL	20.66		
90% Chebyshev(Mean, Sd) UCL	25.79	95% Chebyshev(Mean, Sd) UCL	29.42
97.5% Chebyshev(Mean, Sd) UCL	34.47	99% Chebyshev(Mean, Sd) UCL	44.38

Suggested UCL to Use

95% Student's-t UCL	23.46

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Pb from sampling location A73 in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:09
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	2.6	Mean	11.14
Maximum	33.7	Median	6.3
SD	12.87	Std. Error of Mean	5.756
Coefficient of Variation	1.155	Skewness	2.022

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.73	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.357	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	23.41	95% Adjusted-CLT UCL (Chen-1995)	26.17
		95% Modified-t UCL (Johnson-1978)	24.28
Gamma GOF Test			
A-D Test Statistic	0.419	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.688	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.363	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.291	k star (bias corrected MLE)	0.65
Theta hat (MLE)	8.628	Theta star (bias corrected MLE)	17.14
nu hat (MLE)	12.91	nu star (bias corrected)	6.498
MLE Mean (bias corrected)	11.14	MLE Sd (bias corrected)	13.82
		Approximate Chi Square Value (0.05)	1.899
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	1.005
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	38.11	95% Adjusted Gamma UCL (use when n<50)	72.03
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.199	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.956	Mean of logged Data	1.976
Maximum of Logged Data	3.517	SD of logged Data	0.989
Assuming Lognormal Distribution			
95% H-UCL	129.8	90% Chebyshev (MVUE) UCL	23.7
95% Chebyshev (MVUE) UCL	29.71	97.5% Chebyshev (MVUE) UCL	38.06
99% Chebyshev (MVUE) UCL	54.45		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	20.61	95% Jackknife UCL	23.41
95% Standard Bootstrap UCL	19.58	95% Bootstrap-t UCL	66.03
95% Hall's Bootstrap UCL	61.76	95% Percentile Bootstrap UCL	22
95% BCA Bootstrap UCL	22.6		
90% Chebyshev(Mean, Sd) UCL	28.41	95% Chebyshev(Mean, Sd) UCL	36.23
97.5% Chebyshev(Mean, Sd) UCL	47.08	99% Chebyshev(Mean, Sd) UCL	68.41

Suggested UCL to Use

95% Student's-t UCL	23.41

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn in surface water from A73 on the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:09
From File	WorkSheet_b.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	352	Mean	520.6
Maximum	768	Median	426
SD	192.2	Std. Error of Mean	85.93
Coefficient of Variation	0.369	Skewness	0.626

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.289	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	703.8	95% Adjusted-CLT UCL (Chen-1995)	687.7
		95% Modified-t UCL (Johnson-1978)	707.8

Gamma GOF Test

A-D Test Statistic	0.503	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.289	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.607	k star (bias corrected MLE)	3.976
Theta hat (MLE)	54.19	Theta star (bias corrected MLE)	130.9
nu hat (MLE)	96.07	nu star (bias corrected)	39.76
MLE Mean (bias corrected)	520.6	MLE Sd (bias corrected)	261.1
		Approximate Chi Square Value (0.05)	26.31
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	21.66

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	786.6	95% Adjusted Gamma UCL (use when n<50)	955.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.854	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.864	Mean of logged Data	6.202
Maximum of Logged Data	6.644	SD of logged Data	0.36

Assuming Lognormal Distribution

95% H-UCL	833.3	90% Chebyshev (MVUE) UCL	769.8
95% Chebyshev (MVUE) UCL	883.1	97.5% Chebyshev (MVUE) UCL	1040
99% Chebyshev (MVUE) UCL	1349		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	661.9	95% Jackknife UCL	703.8
95% Standard Bootstrap UCL	645	95% Bootstrap-t UCL	1256
95% Hall's Bootstrap UCL	2521	95% Percentile Bootstrap UCL	651.6
95% BCA Bootstrap UCL	666.4		
90% Chebyshev(Mean, Sd) UCL	778.4	95% Chebyshev(Mean, Sd) UCL	895.2
97.5% Chebyshev(Mean, Sd) UCL	1057	99% Chebyshev(Mean, Sd) UCL	1376

Suggested UCL to Use

95% Student's-t UCL	703.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cu from sampling location A73B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:23
From File	WorkSheet_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4.3	Mean	9.425
Maximum	13.1	Median	10.15
SD	3.927	Std. Error of Mean	1.964
Coefficient of Variation	0.417	Skewness	-0.797

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.942	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.227	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.05	95% Adjusted-CLT UCL (Chen-1995)	11.82
		95% Modified-t UCL (Johnson-1978)	13.92

Gamma GOF Test

A-D Test Statistic	0.346	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.262	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.149	k star (bias corrected MLE)	1.704
Theta hat (MLE)	1.533	Theta star (bias corrected MLE)	5.532
nu hat (MLE)	49.19	nu star (bias corrected)	13.63
MLE Mean (bias corrected)	9.425	MLE Sd (bias corrected)	7.221
		Approximate Chi Square Value (0.05)	6.319
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	20.33	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.459	Mean of logged Data	2.16
Maximum of Logged Data	2.573	SD of logged Data	0.502

Assuming Lognormal Distribution

95% H-UCL	28.53	90% Chebyshev (MVUE) UCL	16.55
95% Chebyshev (MVUE) UCL	19.74	97.5% Chebyshev (MVUE) UCL	24.16
99% Chebyshev (MVUE) UCL	32.85		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	12.65	95% Jackknife UCL	14.05
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	15.32	95% Chebyshev(Mean, Sd) UCL	17.98
97.5% Chebyshev(Mean, Sd) UCL	21.69	99% Chebyshev(Mean, Sd) UCL	28.96

Suggested UCL to Use

95% Student's-t UCL	14.05

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Pb from sampling location A73B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:23
From File	WorkSheet_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.7	Mean	5.45
Maximum	11.7	Median	4.2
SD	4.392	Std. Error of Mean	2.196
Coefficient of Variation	0.806	Skewness	1.428

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.282	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10.62	95% Adjusted-CLT UCL (Chen-1995)	10.74
		95% Modified-t UCL (Johnson-1978)	10.88
Gamma GOF Test			
A-D Test Statistic	0.236	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.199	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.216	k star (bias corrected MLE)	0.721
Theta hat (MLE)	2.459	Theta star (bias corrected MLE)	7.562
nu hat (MLE)	17.73	nu star (bias corrected)	5.766
MLE Mean (bias corrected)	5.45	MLE Sd (bias corrected)	6.42
		Approximate Chi Square Value (0.05)	1.521
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	20.66	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.997	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.164	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.531	Mean of logged Data	1.453
Maximum of Logged Data	2.46	SD of logged Data	0.809
Assuming Lognormal Distribution			
95% H-UCL	76.22	90% Chebyshev (MVUE) UCL	11.65
95% Chebyshev (MVUE) UCL	14.48	97.5% Chebyshev (MVUE) UCL	18.41
99% Chebyshev (MVUE) UCL	26.12		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.062	95% Jackknife UCL	10.62
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	12.04	95% Chebyshev(Mean, Sd) UCL	15.02
97.5% Chebyshev(Mean, Sd) UCL	19.16	99% Chebyshev(Mean, Sd) UCL	27.3

Suggested UCL to Use

95% Student's-t UCL	10.62

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn from sampling location A73B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:23
From File	WorkSheet_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	119	Mean	265.3
Maximum	557	Median	192.5
SD	197.8	Std. Error of Mean	98.89
Coefficient of Variation	0.746	Skewness	1.799

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.372	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	498	95% Adjusted-CLT UCL (Chen-1995)	523
		95% Modified-t UCL (Johnson-1978)	512.8

Gamma GOF Test

A-D Test Statistic	0.446	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.344	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.996	k star (bias corrected MLE)	0.916
Theta hat (MLE)	88.55	Theta star (bias corrected MLE)	289.7
nu hat (MLE)	23.97	nu star (bias corrected)	7.325
MLE Mean (bias corrected)	265.3	MLE Sd (bias corrected)	277.2
		Approximate Chi Square Value (0.05)	2.35
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	826.6	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.303	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.779	Mean of logged Data	5.405
Maximum of Logged Data	6.323	SD of logged Data	0.654

Assuming Lognormal Distribution

95% H-UCL	1521	90% Chebyshev (MVUE) UCL	506.8
95% Chebyshev (MVUE) UCL	618.7	97.5% Chebyshev (MVUE) UCL	774
99% Chebyshev (MVUE) UCL	1079		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	427.9	95% Jackknife UCL	498
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	561.9	95% Chebyshev(Mean, Sd) UCL	696.3
97.5% Chebyshev(Mean, Sd) UCL	882.8	99% Chebyshev(Mean, Sd) UCL	1249

Suggested UCL to Use

95% Student's-t UCL	498

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cd from sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options
Date/Time of Computation	2/19/2015 10:41
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.51	Mean	1.013
Maximum	1.43	Median	0.924
SD	0.364	Std. Error of Mean	0.163
Coefficient of Variation	0.359	Skewness	-0.285

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.196	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution
		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.36	95% Adjusted-CLT UCL (Chen-1995)	1.258
		95% Modified-t UCL (Johnson-1978)	1.356

Gamma GOF Test
A-D Test Statistic	0.316	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.213	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics
k hat (MLE)	8.461	k star (bias corrected MLE)	3.518
Theta hat (MLE)	0.12	Theta star (bias corrected MLE)	0.288
nu hat (MLE)	84.61	nu star (bias corrected)	35.18
MLE Mean (bias corrected)	1.013	MLE Sd (bias corrected)	0.54
		Approximate Chi Square Value (0.05)	22.61
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.33

Assuming Gamma Distribution
95% Approximate Gamma UCL (use when n>=50))	1.576	95% Adjusted Gamma UCL (use when n<50)	1.943

Lognormal GOF Test
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics
Minimum of Logged Data	-0.673	Mean of logged Data	-0.0475
Maximum of Logged Data	0.358	SD of logged Data	0.405

Assuming Lognormal Distribution
95% H-UCL	1.776	90% Chebyshev (MVUE) UCL	1.567
95% Chebyshev (MVUE) UCL	1.816	97.5% Chebyshev (MVUE) UCL	2.162
99% Chebyshev (MVUE) UCL	2.841		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs
95% CLT UCL	1.281	95% Jackknife UCL	1.36
95% Standard Bootstrap UCL	1.255	95% Bootstrap-t UCL	1.437
95% Hall's Bootstrap UCL	1.486	95% Percentile Bootstrap UCL	1.251
95% BCA Bootstrap UCL	1.228		
90% Chebyshev(Mean, Sd) UCL	1.501	95% Chebyshev(Mean, Sd) UCL	1.722
97.5% Chebyshev(Mean, Sd) UCL	2.029	99% Chebyshev(Mean, Sd) UCL	2.632

Suggested UCL to Use
95% Student's-t UCL	1.36

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Cu from sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/19/2015 10:41		
From File	WorkSheet_d.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	4.4	Mean	13.8
Maximum	20.6	Median	13.5
SD	6.183	Std. Error of Mean	2.765
Coefficient of Variation	0.448	Skewness	-0.791

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.7	95% Adjusted-CLT UCL (Chen-1995)	17.3
		95% Modified-t UCL (Johnson-1978)	19.53
Gamma GOF Test			
A-D Test Statistic	0.42	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.681	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.29	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.36	k star (bias corrected MLE)	1.877
Theta hat (MLE)	3.165	Theta star (bias corrected MLE)	7.352
nu hat (MLE)	43.6	nu star (bias corrected)	18.77
MLE Mean (bias corrected)	13.8	MLE Sd (bias corrected)	10.07
		Approximate Chi Square Value (0.05)	9.951
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	7.311
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	26.03	95% Adjusted Gamma UCL (use when n<50)	35.43
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.838	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.318	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.482	Mean of logged Data	2.506
Maximum of Logged Data	3.025	SD of logged Data	0.607
Assuming Lognormal Distribution			
95% H-UCL	40.22	90% Chebyshev (MVUE) UCL	25.5
95% Chebyshev (MVUE) UCL	30.65	97.5% Chebyshev (MVUE) UCL	37.79
99% Chebyshev (MVUE) UCL	51.82		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	18.35	95% Jackknife UCL	19.7
95% Standard Bootstrap UCL	17.84	95% Bootstrap-t UCL	19.07
95% Hall's Bootstrap UCL	18.42	95% Percentile Bootstrap UCL	17.76
95% BCA Bootstrap UCL	17.04		
90% Chebyshev(Mean, Sd) UCL	22.1	95% Chebyshev(Mean, Sd) UCL	25.85
97.5% Chebyshev(Mean, Sd) UCL	31.07	99% Chebyshev(Mean, Sd) UCL	41.31

Suggested UCL to Use

95% Student's-t UCL	19.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Pb from sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:41
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.6	Mean	11.22
Maximum	32.6	Median	5.5
SD	12.44	Std. Error of Mean	5.562
Coefficient of Variation	1.108	Skewness	1.837

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.786	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	23.08	95% Adjusted-CLT UCL (Chen-1995)	25.25
		95% Modified-t UCL (Johnson-1978)	23.84

Gamma GOF Test

A-D Test Statistic	0.306	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.689	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.246	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.363	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.196	k star (bias corrected MLE)	0.612
Theta hat (MLE)	9.379	Theta star (bias corrected MLE)	18.34
nu hat (MLE)	11.96	nu star (bias corrected)	6.119
MLE Mean (bias corrected)	11.22	MLE Sd (bias corrected)	14.34
		Approximate Chi Square Value (0.05)	1.701
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	0.875

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	40.36	95% Adjusted Gamma UCL (use when n<50)	78.47

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.47	Mean of logged Data	1.945
Maximum of Logged Data	3.484	SD of logged Data	1.108

Assuming Lognormal Distribution

95% H-UCL	253.8	90% Chebyshev (MVUE) UCL	26.6
95% Chebyshev (MVUE) UCL	33.64	97.5% Chebyshev (MVUE) UCL	43.42
99% Chebyshev (MVUE) UCL	62.64		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	20.37	95% Jackknife UCL	23.08
95% Standard Bootstrap UCL	19.31	95% Bootstrap-t UCL	58.77
95% Hall's Bootstrap UCL	76.93	95% Percentile Bootstrap UCL	20.92
95% BCA Bootstrap UCL	22.9		
90% Chebyshev(Mean, Sd) UCL	27.9	95% Chebyshev(Mean, Sd) UCL	35.46
97.5% Chebyshev(Mean, Sd) UCL	45.95	99% Chebyshev(Mean, Sd) UCL	66.56

Suggested UCL to Use

95% Student's-t UCL	23.08

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn from sampling location A75D in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:41
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	181	Mean	360.6
Maximum	545	Median	306
SD	149.6	Std. Error of Mean	66.89
Coefficient of Variation	0.415	Skewness	0.22

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.933	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	503.2	95% Adjusted-CLT UCL (Chen-1995)	477.7
		95% Modified-t UCL (Johnson-1978)	504.3
Gamma GOF Test			
A-D Test Statistic	0.292	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.224	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.865	k star (bias corrected MLE)	2.879
Theta hat (MLE)	52.53	Theta star (bias corrected MLE)	125.2
nu hat (MLE)	68.65	nu star (bias corrected)	28.79
MLE Mean (bias corrected)	360.6	MLE Sd (bias corrected)	212.5
		Approximate Chi Square Value (0.05)	17.55
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	13.85
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	591.7	95% Adjusted Gamma UCL (use when n<50)	749.5
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.197	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.198	Mean of logged Data	5.813
Maximum of Logged Data	6.301	SD of logged Data	0.442
Assuming Lognormal Distribution			
95% H-UCL	680.2	90% Chebyshev (MVUE) UCL	574.3
95% Chebyshev (MVUE) UCL	670.7	97.5% Chebyshev (MVUE) UCL	804.4
99% Chebyshev (MVUE) UCL	1067		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	470.6	95% Jackknife UCL	503.2
95% Standard Bootstrap UCL	458.1	95% Bootstrap-t UCL	607.3
95% Hall's Bootstrap UCL	828.2	95% Percentile Bootstrap UCL	459.8
95% BCA Bootstrap UCL	449.4		
90% Chebyshev(Mean, Sd) UCL	561.3	95% Chebyshev(Mean, Sd) UCL	652.2
97.5% Chebyshev(Mean, Sd) UCL	778.3	99% Chebyshev(Mean, Sd) UCL	1026

Suggested UCL to Use

95% Student's-t UCL	503.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cd from sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options

Date/Time of Computation	2/19/2015 10:47
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.51	Mean	0.877
Maximum	1.1	Median	0.948
SD	0.258	Std. Error of Mean	0.129
Coefficient of Variation	0.295	Skewness	-1.402

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.895	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.28	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.18	95% Adjusted-CLT UCL (Chen-1995)	0.992
		95% Modified-t UCL (Johnson-1978)	1.165

Gamma GOF Test

A-D Test Statistic	0.455	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.318	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.62	k star (bias corrected MLE)	3.322
Theta hat (MLE)	0.0695	Theta star (bias corrected MLE)	0.264
nu hat (MLE)	101	nu star (bias corrected)	26.57
MLE Mean (bias corrected)	0.877	MLE Sd (bias corrected)	0.481
		Approximate Chi Square Value (0.05)	15.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.472	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.322	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.673	Mean of logged Data	-0.172
Maximum of Logged Data	0.0953	SD of logged Data	0.345

Assuming Lognormal Distribution

95% H-UCL	1.605	90% Chebyshev (MVUE) UCL	1.331
95% Chebyshev (MVUE) UCL	1.535	97.5% Chebyshev (MVUE) UCL	1.819
99% Chebyshev (MVUE) UCL	2.375		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.089	95% Jackknife UCL	1.18
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.264	95% Chebyshev(Mean, Sd) UCL	1.439
97.5% Chebyshev(Mean, Sd) UCL	1.683	99% Chebyshev(Mean, Sd) UCL	2.161

Suggested UCL to Use

95% Student's-t UCL	1.18

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for total Cu from sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:47
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4.1	Mean	12.18
Maximum	21.5	Median	11.55
SD	8.824	Std. Error of Mean	4.412
Coefficient of Variation	0.725	Skewness	0.129

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.85	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.285	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.56	95% Adjusted-CLT UCL (Chen-1995)	19.74
		95% Modified-t UCL (Johnson-1978)	22.61
Gamma GOF Test			
A-D Test Statistic	0.484	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.305	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.182	k star (bias corrected MLE)	0.712
Theta hat (MLE)	5.579	Theta star (bias corrected MLE)	17.09
nu hat (MLE)	17.46	nu star (bias corrected)	5.698
MLE Mean (bias corrected)	12.18	MLE Sd (bias corrected)	14.43
		Approximate Chi Square Value (0.05)	1.488
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	46.63	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.848	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.273	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.411	Mean of logged Data	2.253
Maximum of Logged Data	3.068	SD of logged Data	0.844
Assuming Lognormal Distribution			
95% H-UCL	217.4	90% Chebyshev (MVUE) UCL	27.01
95% Chebyshev (MVUE) UCL	33.68	97.5% Chebyshev (MVUE) UCL	42.95
99% Chebyshev (MVUE) UCL	61.15		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	19.43	95% Jackknife UCL	22.56
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	25.41	95% Chebyshev(Mean, Sd) UCL	31.41
97.5% Chebyshev(Mean, Sd) UCL	39.73	99% Chebyshev(Mean, Sd) UCL	56.07

Suggested UCL to Use

95% Student's-t UCL	22.56

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Pb from sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:47
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.5	Mean	12.13
Maximum	34.5	Median	6.25
SD	15.46	Std. Error of Mean	7.73
Coefficient of Variation	1.275	Skewness	1.622

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.294	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	30.32	95% Adjusted-CLT UCL (Chen-1995)	31.54
		95% Modified-t UCL (Johnson-1978)	31.36
Gamma GOF Test			
A-D Test Statistic	0.354	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.67	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.293	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.404	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.804	k star (bias corrected MLE)	0.368
Theta hat (MLE)	15.08	Theta star (bias corrected MLE)	32.98
nu hat (MLE)	6.432	nu star (bias corrected)	2.941
MLE Mean (bias corrected)	12.13	MLE Sd (bias corrected)	20
		Approximate Chi Square Value (0.05)	0.355
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	100.4	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.92	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.257	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.405	Mean of logged Data	1.758
Maximum of Logged Data	3.541	SD of logged Data	1.458
Assuming Lognormal Distribution			
95% H-UCL	54710	90% Chebyshev (MVUE) UCL	33.59
95% Chebyshev (MVUE) UCL	43.52	97.5% Chebyshev (MVUE) UCL	57.3
99% Chebyshev (MVUE) UCL	84.37		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	24.84	95% Jackknife UCL	30.32
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	35.31	95% Chebyshev(Mean, Sd) UCL	45.82
97.5% Chebyshev(Mean, Sd) UCL	60.4	99% Chebyshev(Mean, Sd) UCL	89.04

Suggested UCL to Use

95% Student's-t UCL	30.32

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn from sampling location A75B in the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:47
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	183	Mean	301.8
Maximum	445	Median	289.5
SD	108	Std. Error of Mean	54.01
Coefficient of Variation	0.358	Skewness	0.665

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.271	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	428.9	95% Adjusted-CLT UCL (Chen-1995)	409.8
		95% Modified-t UCL (Johnson-1978)	431.9
Gamma GOF Test			
A-D Test Statistic	0.281	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.233	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.42	k star (bias corrected MLE)	2.771
Theta hat (MLE)	28.96	Theta star (bias corrected MLE)	108.9
nu hat (MLE)	83.35	nu star (bias corrected)	22.17
MLE Mean (bias corrected)	301.8	MLE Sd (bias corrected)	181.3
		Approximate Chi Square Value (0.05)	12.47
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	536.6	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.233	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.209	Mean of logged Data	5.661
Maximum of Logged Data	6.098	SD of logged Data	0.363
Assuming Lognormal Distribution			
95% H-UCL	578.3	90% Chebyshev (MVUE) UCL	464.7
95% Chebyshev (MVUE) UCL	538.5	97.5% Chebyshev (MVUE) UCL	640.9
99% Chebyshev (MVUE) UCL	842		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	390.6	95% Jackknife UCL	428.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	463.8	95% Chebyshev(Mean, Sd) UCL	537.2
97.5% Chebyshev(Mean, Sd) UCL	639.1	99% Chebyshev(Mean, Sd) UCL	839.2

Suggested UCL to Use

95% Student's-t UCL	428.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Cd from Baker Bridge on the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:55
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.601	Minimum Non-Detect	0.5
Maximum Detect	0.8	Maximum Non-Detect	0.5
Variance Detects	0.00663	Percent Non-Detects	20%
Mean Detects	0.698	SD Detects	0.0814
Median Detects	0.695	CV Detects	0.117
Skewness Detects	0.219	Kurtosis Detects	1.436
Mean of Logged Detects	-0.365	SD of Logged Detects	0.117

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.238	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	95% UCLs (Adjusted for Skewness)	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.658	Standard Error of Mean	0.0522
SD	0.101	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.769	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.744	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.815	95% KM Chebyshev UCL	0.886
97.5% KM Chebyshev UCL	0.984	99% KM Chebyshev UCL	1.177

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.275	Anderson-Darling GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	97.81	k star (bias corrected MLE)	24.62
Theta hat (MLE)	0.00713	Theta star (bias corrected MLE)	0.0283
nu hat (MLE)	782.5	nu star (bias corrected)	197
MLE Mean (bias corrected)	0.698	MLE Sd (bias corrected)	0.141

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	42.36	nu hat (KM)	423.6
Approximate Chi Square Value (423.63, α)	376.9	Adjusted Chi Square Value (423.63, β)	357.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.74	95% Gamma Adjusted KM-UCL (use when n<50)	0.78

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.494	Mean	0.657
Maximum	0.8	Median	0.689
SD	0.115	CV	0.175
k hat (MLE)	38.64	k star (bias corrected MLE)	15.59
Theta hat (MLE)	0.017	Theta star (bias corrected MLE)	0.0421
nu hat (MLE)	386.4	nu star (bias corrected)	155.9
MLE Mean (bias corrected)	0.657	MLE Sd (bias corrected)	0.166
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (155.89, α)	128	Adjusted Chi Square Value (155.89, β)	117
95% Gamma Approximate UCL (use when n>=50)	0.8	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.967	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.66	Mean in Log Scale	-0.427
SD in Original Scale	0.109	SD in Log Scale	0.171
95% t UCL (assumes normality of ROS data)	0.764	95% Percentile Bootstrap UCL	0.736
95% BCA Bootstrap UCL	0.72	95% Bootstrap t UCL	0.765
95% H-UCL (Log ROS)	0.795		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.431	95% H-UCL (KM -Log)	0.78
KM SD (logged)	0.159	95% Critical H Value (KM-Log)	2.127
KM Standard Error of Mean (logged)	0.0823		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.608	Mean in Log Scale	-0.57
SD in Original Scale	0.212	SD in Log Scale	0.468
95% t UCL (Assumes normality)	0.81	95% H-Stat UCL	1.228

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.769	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Cu from Baker Bridge on the Animas River below mainstem Mineral Creek

User Selected Options

Date/Time of Computation	2/19/2015 10:55
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	2.8	Minimum Non-Detect	2.5
Maximum Detect	16.3	Maximum Non-Detect	2.5
Variance Detects	31.98	Percent Non-Detects	20%
Mean Detects	9.5	SD Detects	5.655
Median Detects	9.45	CV Detects	0.595
Skewness Detects	0.0477	Kurtosis Detects	0.0745
Mean of Logged Detects	2.071	SD of Logged Detects	0.755

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	N/A	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.145	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	95% UCLs (Adjusted for Skewness)

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	8.1	Standard Error of Mean	2.685
SD	5.199	95% KM (BCA) UCL	N/A
95% KM (t) UCL	13.82	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	12.52	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	16.15	95% KM Chebyshev UCL	19.8
97.5% KM Chebyshev UCL	24.87	99% KM Chebyshev UCL	34.81

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.244	Anderson-Darling GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.207	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.935	k star (bias corrected MLE)	0.9
Theta hat (MLE)	3.236	Theta star (bias corrected MLE)	10.55
nu hat (MLE)	23.48	nu star (bias corrected)	7.204
MLE Mean (bias corrected)	9.5	MLE Sd (bias corrected)	10.01

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.427	nu hat (KM)	24.27
Approximate Chi Square Value (24.27, α)	14.06	Adjusted Chi Square Value (24.27, β)	10.81
95% Gamma Approximate KM-UCL (use when n>=50)	13.99	95% Gamma Adjusted KM-UCL (use when n<50)	18.18

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.602
Maximum	16.3	Median	7.9
SD	6.481	CV	0.852
k hat (MLE)	0.493	k star (bias corrected MLE)	0.33
Theta hat (MLE)	15.43	Theta star (bias corrected MLE)	23.01
nu hat (MLE)	4.926	nu star (bias corrected)	3.304
MLE Mean (bias corrected)	7.602	MLE Sd (bias corrected)	13.23
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (3.30, α)	0.468	Adjusted Chi Square Value (3.30, β)	0.178
95% Gamma Approximate UCL (use when n>=50)	53.68	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.937	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.248	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.829	Mean in Log Scale	1.684
SD in Original Scale	6.161	SD in Log Scale	1.086
95% t UCL (assumes normality of ROS data)	13.7	95% Percentile Bootstrap UCL	11.88
95% BCA Bootstrap UCL	11.92	95% Bootstrap t UCL	14.32
95% H-UCL (Log ROS)	170.3		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	1.84	95% H-UCL (KM -Log)	34.78
KM SD (logged)	0.745	95% Critical H Value (KM-Log)	3.84
KM Standard Error of Mean (logged)	0.385		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	7.85	Mean in Log Scale	1.702
SD in Original Scale	6.132	SD in Log Scale	1.054
95% t UCL (Assumes normality)	13.7	95% H-Stat UCL	143.2

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	13.82	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for total Pb from Baker Bridge on the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:55
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	0.6	Mean	7.78
Maximum	26	Median	5.4
SD	10.45	Std. Error of Mean	4.673
Coefficient of Variation	1.343	Skewness	1.961

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.739	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.379	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	17.74	95% Adjusted-CLT UCL (Chen-1995)	19.85
		95% Modified-t UCL (Johnson-1978)	18.43
Gamma GOF Test			
A-D Test Statistic	0.331	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.367	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.765	k star (bias corrected MLE)	0.439
Theta hat (MLE)	10.17	Theta star (bias corrected MLE)	17.71
nu hat (MLE)	7.652	nu star (bias corrected)	4.394
MLE Mean (bias corrected)	7.78	MLE Sd (bias corrected)	11.74
		Approximate Chi Square Value (0.05)	0.883
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	0.382
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	38.7	95% Adjusted Gamma UCL (use when n<50)	89.41
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.511	Mean of logged Data	1.271
Maximum of Logged Data	3.258	SD of logged Data	1.475
Assuming Lognormal Distribution			
95% H-UCL	1856	90% Chebyshev (MVUE) UCL	21.5
95% Chebyshev (MVUE) UCL	27.75	97.5% Chebyshev (MVUE) UCL	36.42
99% Chebyshev (MVUE) UCL	53.45		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.47	95% Jackknife UCL	17.74
95% Standard Bootstrap UCL	14.71	95% Bootstrap-t UCL	36.7
95% Hall's Bootstrap UCL	53.89	95% Percentile Bootstrap UCL	16.08
95% BCA Bootstrap UCL	17.76		
90% Chebyshev(Mean, Sd) UCL	21.8	95% Chebyshev(Mean, Sd) UCL	28.15
97.5% Chebyshev(Mean, Sd) UCL	36.97	99% Chebyshev(Mean, Sd) UCL	54.28

Suggested UCL to Use

95% Student's-t UCL	17.74

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for total Zn from Baker Bridge on the Animas River below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 10:55
From File	WorkSheet_d.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	126	Mean	215.8
Maximum	273	Median	221
SD	59.41	Std. Error of Mean	26.57
Coefficient of Variation	0.275	Skewness	-0.862

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.926	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.191	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	272.4	95% Adjusted-CLT UCL (Chen-1995)	248.6
		95% Modified-t UCL (Johnson-1978)	270.7
Gamma GOF Test			
A-D Test Statistic	0.35	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.208	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.14	k star (bias corrected MLE)	5.789
Theta hat (MLE)	15.26	Theta star (bias corrected MLE)	37.28
nu hat (MLE)	141.4	nu star (bias corrected)	57.89
MLE Mean (bias corrected)	215.8	MLE Sd (bias corrected)	89.69
		Approximate Chi Square Value (0.05)	41.4
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	35.39
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	301.8	95% Adjusted Gamma UCL (use when n<50)	353
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.884	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.217	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.836	Mean of logged Data	5.339
Maximum of Logged Data	5.609	SD of logged Data	0.312
Assuming Lognormal Distribution			
95% H-UCL	319.5	90% Chebyshev (MVUE) UCL	306.8
95% Chebyshev (MVUE) UCL	347.7	97.5% Chebyshev (MVUE) UCL	404.5
99% Chebyshev (MVUE) UCL	516.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	259.5	95% Jackknife UCL	272.4
95% Standard Bootstrap UCL	254.5	95% Bootstrap-t UCL	262.4
95% Hall's Bootstrap UCL	256.4	95% Percentile Bootstrap UCL	252.2
95% BCA Bootstrap UCL	245.2		
90% Chebyshev(Mean, Sd) UCL	295.5	95% Chebyshev(Mean, Sd) UCL	331.6
97.5% Chebyshev(Mean, Sd) UCL	381.7	99% Chebyshev(Mean, Sd) UCL	480.2

Suggested UCL to Use

95% Student's-t UCL	272.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Appendix 14

Sediment data for Pro UCL

Sample Location	Arsenic		Beryllium		Cadmium		Copper		Lead		Manganese		Mercury		Selenium		Silver		Zinc		Cr		Ni		
Animas River above mainstem cement creek																									
A60	24.4	1	2.01	0	14.7	1	286	1	2100	1	12600	1			0.502	0	4.05	1	3180	1	4.97	1	8.95	1	May-12
A61	44.0	1.0	2.53	1	11.3	1	466	1	2120	1	11000	1			0.505	0	7.34	1	2840	1	5.69	1	16.5	1	Oct-12
A64	44.2	1	2.77	1	11.9	1	336	1	1770	1	9670	1			0.905	1	7.14	1	3470	1	4.86	1	7.58	1	May-13
A65	30.3	1	2.02	0	10.3	1	328	1	1840	1	12900	1			0.504	0	5.53	1	2590	1	4.71	1	7.19	1	
A66	26.9	1	1.99	0	8.44	1	257	1	1750	1	7830	1			0.497	0	5.06	1	1950	1	4.42	1	7.2	1	
A68	26.3	1	2.01	0	13.7	1	352	1	2180	1	10300	1			0.501	0	9.22	1	2830	1	4.76	1	6.68	1	
A68	25.9	1	2.01	0	13.4	1	374	1	1890	1	12200	1	0.081	D	1.29	1	7.09	1	3030	1	5.68	1	5.92	1	
A68	89.5	1	6.77	1	24.2	1	745	1	3030	1	22300	1	0.19	D	2.86	1	13.3	1	11500	1	5.21	1	8.76	1	
A60	16.4	1	2.01	0	5.84	1	166	1	554	1	3400	1	0.033	D	1.0	0	3.48	1	1530	1	6.35	1	9.62	1	Apr-14
A61	19.8	1	2.99	1	9.02	1	638	1	891	1	6400	1	0.091	D	1.1	1	4.28	1	2530	1	5.28	1	8.56	1	
A64	18.8	1	2.02	0	6.25	1	199	1	1050	1	4920	1	0.053	D	1.01	0	3.59	1	1950	1	5.15	1	7.44	1	
A65	21.8	1	2.16	1	10.2	1	331	1	900	1	10300	1	0.073	D	1.01	0	3.87	1	2890	1	5.49	1	9.9	1	
A66	18.3	1	2.24	1	18.3	1	378	1	1230	1	20500	1	0.06	D	1.0	0	4.13	1	4380	1	4.07	1	10.1	1	
A68	19.1	1	2.82	1	15.7	1	390	1	1080	1	19700	1	0.056	D	0.998	0	4.35	1	4890	1	4.21	1	10.3	1	
A60	20.4	1	2.03	0	9.55	1	262	1	1610	1	7460	1	0.07	D	1.02	0	5.96	1	2130	1	3.88	1	6.26	1	Sep-14
A61	20.5	1	2.1	1	4.95	1	286	1	1400	1	8210	1	0.05	D	0.995	0	5.23	1	2330	1	3.55	1	6.52	1	
A64	21.3	1	3.0	1	7.93	1	264	1	1120	1	6850	1	0.13	D	1.01	0	4.88	1	2730	1	3.55	1	6.84	1	
A65	19.4	1	1.99	0	6.82	1	271	1	1220	1	8180	1	0.03	D	0.997	0	3.61	1	1700	1	3.76	1	6.49	1	
A66	23.7	1	2.03	0	9.17	1	243	1	1190	1	8190	1	0.05	D	1.01	0	4.81	1	2500	1	3.7	1	7.11	1	
A68	17.5	1	1.97	0	10.8	1	216	1	1240	1	9430	1	0.02	JD	0.985	0	2.9	1	2480	1	3.73	1	6.56	1	
count	20		20		20		20		20		20		14		20		20		20						
Max	89.5	1	6.77	1	24.2	1	745	1	3030	1	22300	1	0.19	0	2.86	1	13.3	1	11500						
Min	16.4	1	1.97	0	4.95	1	166	1	554	1	3400	1	0.02	0	0.497	0	2.9	1	1530						

		aluminum		arsenic		beryllium		cadmium		copper		lead		manganese		nickel		selenium		silver		Zinc		Hg		Cr	
Animas River downstream of mainstem Mineral Creek																											
A72	May-12	12200	1	40.6	1	1.97	0	2.8	1	152	1	581	1	2710	1	6.38	1	2.03	1	1.99	1	748	1	0.072	1	6.1	1
A72	Oct-12	21500	1	36.3	1	2	0	1.81	1	179	1	542	1	1470	1	4.79	1	1.83	1	2.76	1	646	1	0.06	1	4.05	1
A72	May-13	11800	1	26.1	1	1.97	0	1.15	1	77.8	1	299	1	1210	1	4.88	1	1.04	1	1.3	1	386	1			6.41	1
A72	Apr-14	18900	1	37	1	2.0	0	1.7	1	145	1	470	1	1710	1	4.33	1	1.05	1	1.68	1	616	1	0.039	1	3.45	1
A72	Sep-14	9960	1	26.8	1	2.03	0	3.03	1	133	1	499	1	3400	1	5.33	1	1.02	0	1.83	1	858	1	0.05	1	3.01	1
A73	Oct-12	11800	1	25.5	1	1.97	0	3.64	1	223	1	729	1	4140	1	6.84	1	1.43	1	2.32	1	1000	1	0.05	1	4.02	1
A73	May-13	9220	1	31.9	1	2.02	0	4.1	1	176	1	591	1	3320	1	6.07	1	0.717	1	2.78	1	998	1	0.036	1	5.6	1
A73	Apr-14	40700	1	33.8	1	4.2	1	5.6	1	284	1	297	1	7120	1	7.19	1	1.0	0	1.35	1	1450	1			2.83	1
A73	Sep-14	6770	1	20.5	1	2.04	0	2.7	1	113		435	1	2780	1	5.5	1	1.02	0	1.24	1	749	1	0.02	1	3.5	1
A73B	Oct-12	31900	1	39.4	1	3.24	1	4.24	1	292	1	468	1	2610	1	12.1	1	2.89	1	3.09	1	1720	1	0.09	1	5.02	1
A73B	May-13	10600	1	30.4	1	2	0	3.56	1	140	1	593	1	4340	1	9.78	1	0.5	0	1.65	1	964	1			4.72	1
A73B	Sep-14	6620	1	19.9	1	2.03	0	2.72	1	98.8	1	540	1	2480	1	8.16	1	1.01	0	1.25	1	659	1	0.04	1	3.68	1
A75B	Oct-12	48600	1	37.2	1	5.98	1	10.5	1	413	1	435	1	3820	1	16.5	1	3.26	1	2.18	1	5320	1	0.07	1	5.16	1
A75B	May-13	7220	1	13.3	1	1.99	0	2.65	1	82.7	1	354	1	2340	1	5.93	1	0.588	1	1.51	1	672	1			5.45	1
A75B	Sep-14	6640	1	9.22	1	1.99	0	1.99	1	67	1	98	1	2070	1	6.71	1	0.994	0	0.512	1	578	1	0.01	0	5.01	1
A75D	Oct-12	15600	1	13.2	1	1.97	0	4.87	1	152	1	231	1	3010	1	9.09	1	1.4	1	0.724	1	1930	1	0.04	1	3.73	1
A75D	May-13	8550	1	18.2	1	1.99	0	3.88	1	108	1	367	1	3730	1	7.27	1	0.498	0	1.37	1	1030	1	0.038	1	4.99	1
A75D	Apr-14	29900	1	28.5	1	3.66	1	6.75	1	223	1	261	1	6900	1	13.1	1	1.06	1	1.27	1	2910	1			4.39	1
A75D	Sep-14	7660	1	17.5	1	2.03	0	3.73	1	103	1	339	1	3750	1	8.2	1	1.02	0	0.948	1	1080	1	0.02	0	3.72	1
Bakers Bridge	Oct-12	37400	1	29.7	1	4.85	1	18.6	1	357	1	378	1	10500	1	31.6	1	3.1	1	1.71	1	8670	1	0.06	1	5.21	1
Bakers Bridge	May-13	7360	1	15.9	1	1.98	0	2.46	1	116	1	328	1	2130	1	7.36	1	0.496	0	1.08	1	2080	1			7.38	1
Bakers Bridge	Apr-14	27300	1	25.9	1	3.51	1	14.6	1	199	1	248	1	13100	1	22	1	1.16	1	1.33	1	6030	1	0.043	1	4.28	1
Bakers Bridge	Sep-14	8040	1	16.2	1	1.99	0	4.63	1	92	1	244	1	3970	1	12.1	1	0.997	0	1.02	1	1700	1	0.02	1	4.74	1

shaded = ND

ProUCL calculations for As in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 10:36
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	16.4	Mean	27.43
Maximum	89.5	Median	21.55
SD	16.51	Std. Error of Mean	3.692
Coefficient of Variation	0.602	Skewness	3.144
Normal GOF Test			
Shapiro Wilk Test Statistic	0.593	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.313	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	33.81	95% Adjusted-CLT UCL (Chen-1995)	36.27
		95% Modified-t UCL (Johnson-1978)	34.24
Gamma GOF Test			
A-D Test Statistic	1.88	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.259	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.168	k star (bias corrected MLE)	4.426
Theta hat (MLE)	5.307	Theta star (bias corrected MLE)	6.197
nu hat (MLE)	206.7	nu star (bias corrected)	177
MLE Mean (bias corrected)	27.43	MLE Sd (bias corrected)	13.04
		Approximate Chi Square Value (0.05)	147.3
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	145.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	32.97	95% Adjusted Gamma UCL (use when n<50)	33.46
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.79	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.797	Mean of logged Data	3.212
Maximum of Logged Data	4.494	SD of logged Data	0.405
Assuming Lognormal Distribution			
95% H-UCL	32.25	90% Chebyshev (MVUE) UCL	34.29
95% Chebyshev (MVUE) UCL	37.68	97.5% Chebyshev (MVUE) UCL	42.38
99% Chebyshev (MVUE) UCL	51.6		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	33.5	95% Jackknife UCL	33.81
95% Standard Bootstrap UCL	33.45	95% Bootstrap-t UCL	42.98
95% Hall's Bootstrap UCL	53.96	95% Percentile Bootstrap UCL	33.73
95% BCA Bootstrap UCL	37.12		
90% Chebyshev(Mean, Sd) UCL	38.5	95% Chebyshev(Mean, Sd) UCL	43.52
97.5% Chebyshev(Mean, Sd) UCL	50.48	99% Chebyshev(Mean, Sd) UCL	64.16
Suggested UCL to Use			
95% Student's-t UCL	33.81	or 95% Modified-t UCL	34.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Be in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 10:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	14
Number of Detects	9	Number of Non-Detects	11
Number of Distinct Detects	9	Number of Distinct Non-Detects	5
Minimum Detect	2.1	Minimum Non-Detect	1.97
Maximum Detect	6.77	Maximum Non-Detect	2.03
Variance Detects	2.075	Percent Non-Detects	55%
Mean Detects	3.042	SD Detects	1.44
Median Detects	2.77	CV Detects	0.473
Skewness Detects	2.668	Kurtosis Detects	7.565
Mean of Logged Detects	1.045	SD of Logged Detects	0.353

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.616	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.401	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.453	Standard Error of Mean	0.25
SD	1.056	95% KM (BCA) UCL	2.95
95% KM (t) UCL	2.885	95% KM (Percentile Bootstrap) UCL	2.9
95% KM (z) UCL	2.864	95% KM Bootstrap t UCL	3.482
90% KM Chebyshev UCL	3.204	95% KM Chebyshev UCL	3.544
97.5% KM Chebyshev UCL	4.016	99% KM Chebyshev UCL	4.944

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.129	Anderson-Darling GOF Test
5% A-D Critical Value	0.722	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.356	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.28	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	7.606	k star (bias corrected MLE)	5.145
Theta hat (MLE)	0.4	Theta star (bias corrected MLE)	0.591
nu hat (MLE)	136.9	nu star (bias corrected)	92.61
MLE Mean (bias corrected)	3.042	MLE Sd (bias corrected)	1.341

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.398	nu hat (KM)	215.9
Approximate Chi Square Value (215.90, α)	182.9	Adjusted Chi Square Value (215.90, β)	180.5
95% Gamma Approximate KM-UCL (use when n>=5(	2.895	95% Gamma Adjusted KM-UCL (use when n<50)	2.934

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.492
Maximum	6.77	Median	0.625
SD	1.727	CV	1.158
k hat (MLE)	0.43	k star (bias corrected MLE)	0.399
Theta hat (MLE)	3.466	Theta star (bias corrected MLE)	3.738
nu hat (MLE)	17.22	nu star (bias corrected)	15.97
MLE Mean (bias corrected)	1.492	MLE Sd (bias corrected)	2.361
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (15.97, α)	7.939	Adjusted Chi Square Value (15.97, β)	7.493
95% Gamma Approximate UCL (use when n>=50)	3.001	95% Gamma Adjusted UCL (use when n<50)	3.179

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.748	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.329	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.979	Mean in Log Scale	0.515
SD in Original Scale	1.37	SD in Log Scale	0.566
95% t UCL (assumes normality of ROS data)	2.508	95% Percentile Bootstrap UCL	2.502
95% BCA Bootstrap UCL	2.657	95% Bootstrap t UCL	2.861
95% H-UCL (Log ROS)	2.575		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.921	Mean in Log Scale	0.473
SD in Original Scale	1.398	SD in Log Scale	0.579
95% t UCL (Assumes normality)	2.462	95% H-Stat UCL	2.507

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.885	95% KM (% Bootstrap) UCL	2.9

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River above mainstem Cement Creek

User Selected Options			
Date/Time of Computation		2/18/2015 10:50	
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	4.95	Mean	11.12
Maximum	24.2	Median	10.25
SD	4.627	Std. Error of Mean	1.035
Coefficient of Variation	0.416	Skewness	1.254

Normal GOF Test		
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.135	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.91	95% Adjusted-CLT UCL (Chen-1995)	13.14
		95% Modified-t UCL (Johnson-1978)	12.96

Gamma GOF Test		
A-D Test Statistic	0.156	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0828	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	6.801	k star (bias corrected MLE)	5.814
Theta hat (MLE)	1.635	Theta star (bias corrected MLE)	1.913
nu hat (MLE)	272.1	nu star (bias corrected)	232.6
MLE Mean (bias corrected)	11.12	MLE Sd (bias corrected)	4.613
		Approximate Chi Square Value (0.05)	198.3
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	195.8

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	13.05	95% Adjusted Gamma UCL (use when n<50)	13.21

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.992	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.067	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	1.599	Mean of logged Data	2.334
Maximum of Logged Data	3.186	SD of logged Data	0.395

Assuming Lognormal Distribution			
95% H-UCL	13.28	90% Chebyshev (MVUE) UCL	14.12
95% Chebyshev (MVUE) UCL	15.49	97.5% Chebyshev (MVUE) UCL	17.39
99% Chebyshev (MVUE) UCL	21.11		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	12.83	95% Jackknife UCL	12.91
95% Standard Bootstrap UCL	12.84	95% Bootstrap-t UCL	13.35
95% Hall's Bootstrap UCL	13.78	95% Percentile Bootstrap UCL	12.89
95% BCA Bootstrap UCL	13.13		
90% Chebyshev(Mean, Sd) UCL	14.23	95% Chebyshev(Mean, Sd) UCL	15.63
97.5% Chebyshev(Mean, Sd) UCL	17.58	99% Chebyshev(Mean, Sd) UCL	21.42

Suggested UCL to Use

95% Student's-t UCL	12.91

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River above mainstem Cement Creek

User Selected Options			
Date/Time of Computation	2/18/2015 10:56		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Cu

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	166	Mean	339.4
Maximum	745	Median	307
SD	141.1	Std. Error of Mean	31.56
Coefficient of Variation	0.416	Skewness	1.722

Normal GOF Test

Shapiro Wilk Test Statistic	0.832	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.21	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	394	95% Adjusted-CLT UCL (Chen-1995)	404.3
		95% Modified-t UCL (Johnson-1978)	396

Gamma GOF Test

A-D Test Statistic	0.578	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	7.596	k star (bias corrected MLE)	6.49
Theta hat (MLE)	44.68	Theta star (bias corrected MLE)	52.3
nu hat (MLE)	303.8	nu star (bias corrected)	259.6
MLE Mean (bias corrected)	339.4	MLE Sd (bias corrected)	133.2
		Approximate Chi Square Value (0.05)	223.3
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	220.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	394.6	95% Adjusted Gamma UCL (use when n<50)	399.3

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.135	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	5.112	Mean of logged Data	5.76
Maximum of Logged Data	6.613	SD of logged Data	0.363

Assuming Lognormal Distribution

95% H-UCL	396.9	90% Chebyshev (MVUE) UCL	421.5
95% Chebyshev (MVUE) UCL	459.5	97.5% Chebyshev (MVUE) UCL	512.2
99% Chebyshev (MVUE) UCL	615.7		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	391.3	95% Jackknife UCL	394
95% Standard Bootstrap UCL	389.5	95% Bootstrap-t UCL	422
95% Hall's Bootstrap UCL	516.4	95% Percentile Bootstrap UCL	392.5
95% BCA Bootstrap UCL	398.8		
90% Chebyshev(Mean, Sd) UCL	434.1	95% Chebyshev(Mean, Sd) UCL	477
97.5% Chebyshev(Mean, Sd) UCL	536.5	99% Chebyshev(Mean, Sd) UCL	653.4

Suggested UCL to Use

95% Adjusted Gamma UCL	399.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/23/2015 8:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	3.55	Mean	4.651
Maximum	6.35	Median	4.735
SD	0.827	Std. Error of Mean	0.185
Coefficient of Variation	0.178	Skewness	0.261
Normal GOF Test			
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.971	95% Adjusted-CLT UCL (Chen-1995)	4.967
		95% Modified-t UCL (Johnson-1978)	4.973
Gamma GOF Test			
A-D Test Statistic	0.422	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.131	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	33.44	k star (bias corrected MLE)	28.45
Theta hat (MLE)	0.139	Theta star (bias corrected MLE)	0.163
nu hat (MLE)	1337	nu star (bias corrected)	1138
MLE Mean (bias corrected)	4.651	MLE Sd (bias corrected)	0.872
		Approximate Chi Square Value (0.05)	1061
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	1055
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4.99	95% Adjusted Gamma UCL (use when n<50)	5.018
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.267	Mean of logged Data	1.522
Maximum of Logged Data	1.848	SD of logged Data	0.178
Assuming Lognormal Distribution			
95% H-UCL	5.004	90% Chebyshev (MVUE) UCL	5.209
95% Chebyshev (MVUE) UCL	5.462	97.5% Chebyshev (MVUE) UCL	5.813
99% Chebyshev (MVUE) UCL	6.503		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.955	95% Jackknife UCL	4.971
95% Standard Bootstrap UCL	4.944	95% Bootstrap-t UCL	4.983
95% Hall's Bootstrap UCL	4.967	95% Percentile Bootstrap UCL	4.941
95% BCA Bootstrap UCL	4.984		
90% Chebyshev(Mean, Sd) UCL	5.206	95% Chebyshev(Mean, Sd) UCL	5.457
97.5% Chebyshev(Mean, Sd) UCL	5.806	99% Chebyshev(Mean, Sd) UCL	6.491

Suggested UCL to Use

95% Student's-t UCL	4.971

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:01
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.02	Mean	0.0705
Maximum	0.19	Median	0.058
SD	0.0442	Std. Error of Mean	0.0118
Coefficient of Variation	0.627	Skewness	1.715

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.192	Lilliefors GOF Test
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0914	95% Adjusted-CLT UCL (Chen-1995)	0.0957
		95% Modified-t UCL (Johnson-1978)	0.0923

Gamma GOF Test

A-D Test Statistic	0.292	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.129	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.23	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.322	k star (bias corrected MLE)	2.657
Theta hat (MLE)	0.0212	Theta star (bias corrected MLE)	0.0265
nu hat (MLE)	93	nu star (bias corrected)	74.41
MLE Mean (bias corrected)	0.0705	MLE Sd (bias corrected)	0.0432
		Approximate Chi Square Value (0.05)	55.54
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	53.38

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0944	95% Adjusted Gamma UCL (use when n<50)	0.0983

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.16	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.912	Mean of logged Data	-2.81
Maximum of Logged Data	-1.661	SD of logged Data	0.581

Assuming Lognormal Distribution

95% H-UCL	0.101	90% Chebyshev (MVUE) UCL	0.104
95% Chebyshev (MVUE) UCL	0.12	97.5% Chebyshev (MVUE) UCL	0.141
99% Chebyshev (MVUE) UCL	0.183		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0899	95% Jackknife UCL	0.0914
95% Standard Bootstrap UCL	0.0891	95% Bootstrap-t UCL	0.106
95% Hall's Bootstrap UCL	0.204	95% Percentile Bootstrap UCL	0.0911
95% BCA Bootstrap UCL	0.0951		
90% Chebyshev(Mean, Sd) UCL	0.106	95% Chebyshev(Mean, Sd) UCL	0.122
97.5% Chebyshev(Mean, Sd) UCL	0.144	99% Chebyshev(Mean, Sd) UCL	0.188

Suggested UCL to Use

95% Student's-t UCL	0.0914

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 10:57
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	554	Mean	1508
Maximum	3030	Median	1320
SD	582	Std. Error of Mean	130.1
Coefficient of Variation	0.386	Skewness	0.809

Normal GOF Test			
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.178	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1733	95% Adjusted-CLT UCL (Chen-1995)	1747
		95% Modified-t UCL (Johnson-1978)	1737
Gamma GOF Test			
A-D Test Statistic	0.281	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.149	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.178	k star (bias corrected MLE)	6.134
Theta hat (MLE)	210.1	Theta star (bias corrected MLE)	245.9
nu hat (MLE)	287.1	nu star (bias corrected)	245.4
MLE Mean (bias corrected)	1508	MLE Sd (bias corrected)	609
		Approximate Chi Square Value (0.05)	210.1
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	207.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1761	95% Adjusted Gamma UCL (use when n<50)	1783
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.973	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.317	Mean of logged Data	7.247
Maximum of Logged Data	8.016	SD of logged Data	0.394
Assuming Lognormal Distribution			
95% H-UCL	1807	90% Chebyshev (MVUE) UCL	1921
95% Chebyshev (MVUE) UCL	2106	97.5% Chebyshev (MVUE) UCL	2364
99% Chebyshev (MVUE) UCL	2869		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1722	95% Jackknife UCL	1733
95% Standard Bootstrap UCL	1718	95% Bootstrap-t UCL	1766
95% Hall's Bootstrap UCL	1765	95% Percentile Bootstrap UCL	1711
95% BCA Bootstrap UCL	1744		
90% Chebyshev(Mean, Sd) UCL	1899	95% Chebyshev(Mean, Sd) UCL	2076
97.5% Chebyshev(Mean, Sd) UCL	2321	99% Chebyshev(Mean, Sd) UCL	2803

Suggested UCL to Use

95% Student's-t UCL	1733

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Mn in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:00
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	3400	Mean	10617
Maximum	22300	Median	9550
SD	5041	Std. Error of Mean	1127
Coefficient of Variation	0.475	Skewness	1.162

Normal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.175	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12566	95% Adjusted-CLT UCL (Chen-1995)	12784
		95% Modified-t UCL (Johnson-1978)	12615

Gamma GOF Test

A-D Test Statistic	0.449	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.159	k star (bias corrected MLE)	4.418
Theta hat (MLE)	2058	Theta star (bias corrected MLE)	2403
nu hat (MLE)	206.3	nu star (bias corrected)	176.7
MLE Mean (bias corrected)	10617	MLE Sd (bias corrected)	5051
		Approximate Chi Square Value (0.05)	147
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	144.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12766	95% Adjusted Gamma UCL (use when n<50)	12954

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.111	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.132	Mean of logged Data	9.17
Maximum of Logged Data	10.01	SD of logged Data	0.461

Assuming Lognormal Distribution

95% H-UCL	13172	90% Chebyshev (MVUE) UCL	14006
95% Chebyshev (MVUE) UCL	15540	97.5% Chebyshev (MVUE) UCL	17668
99% Chebyshev (MVUE) UCL	21850		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	12471	95% Jackknife UCL	12566
95% Standard Bootstrap UCL	12438	95% Bootstrap-t UCL	13047
95% Hall's Bootstrap UCL	12981	95% Percentile Bootstrap UCL	12460
95% BCA Bootstrap UCL	12792		
90% Chebyshev(Mean, Sd) UCL	13999	95% Chebyshev(Mean, Sd) UCL	15530
97.5% Chebyshev(Mean, Sd) UCL	17657	99% Chebyshev(Mean, Sd) UCL	21833

Suggested UCL to Use

95% Student's-t UCL	12566

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/23/2015 8:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	5.92	Mean	8.224
Maximum	16.5	Median	7.32
SD	2.39	Std. Error of Mean	0.534
Coefficient of Variation	0.291	Skewness	2.335
Normal GOF Test			
Shapiro Wilk Test Statistic	0.758	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.148	95% Adjusted-CLT UCL (Chen-1995)	9.401
		95% Modified-t UCL (Johnson-1978)	9.195
Gamma GOF Test			
A-D Test Statistic	0.919	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.741	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.13	k star (bias corrected MLE)	13.74
Theta hat (MLE)	0.51	Theta star (bias corrected MLE)	0.599
nu hat (MLE)	645	nu star (bias corrected)	549.6
MLE Mean (bias corrected)	8.224	MLE Sd (bias corrected)	2.219
		Approximate Chi Square Value (0.05)	496.2
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	492.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	9.109	95% Adjusted Gamma UCL (use when n<50)	9.183
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.872	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.182	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.778	Mean of logged Data	2.076
Maximum of Logged Data	2.803	SD of logged Data	0.243
Assuming Lognormal Distribution			
95% H-UCL	9.084	90% Chebyshev (MVUE) UCL	9.547
95% Chebyshev (MVUE) UCL	10.16	97.5% Chebyshev (MVUE) UCL	11.01
99% Chebyshev (MVUE) UCL	12.67		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.103	95% Jackknife UCL	9.148
95% Standard Bootstrap UCL	9.073	95% Bootstrap-t UCL	9.687
95% Hall's Bootstrap UCL	12.83	95% Percentile Bootstrap UCL	9.099
95% BCA Bootstrap UCL	9.488		
90% Chebyshev(Mean, Sd) UCL	9.827	95% Chebyshev(Mean, Sd) UCL	10.55
97.5% Chebyshev(Mean, Sd) UCL	11.56	99% Chebyshev(Mean, Sd) UCL	13.54
Suggested UCL to Use			
95% Student's-t UCL	9.148	or 95% Modified-t UCL	9.195

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:02
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	16
Number of Detects	4	Number of Non-Detects	16
Number of Distinct Detects	4	Number of Distinct Non-Detects	12
Minimum Detect	0.905	Minimum Non-Detect	0.497
Maximum Detect	2.86	Maximum Non-Detect	1.02
Variance Detects	0.801	Percent Non-Detects	80%
Mean Detects	1.539	SD Detects	0.895
Median Detects	1.195	CV Detects	0.581
Skewness Detects	1.817	Kurtosis Detects	3.401
Mean of Logged Detects	0.325	SD of Logged Detects	0.505

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.788	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.359	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.743	Standard Error of Mean	0.148
SD	0.54	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.998	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.986	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.186	95% KM Chebyshev UCL	1.387
97.5% KM Chebyshev UCL	1.666	99% KM Chebyshev UCL	2.214

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.486	Anderson-Darling GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.339	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.889	k star (bias corrected MLE)	1.389
Theta hat (MLE)	0.315	Theta star (bias corrected MLE)	1.108
nu hat (MLE)	39.12	nu star (bias corrected)	11.11
MLE Mean (bias corrected)	1.539	MLE Sd (bias corrected)	1.306

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.889	nu hat (KM)	75.57
Approximate Chi Square Value (75.57, α)	56.55	Adjusted Chi Square Value (75.57, β)	55.25
95% Gamma Approximate KM-UCL (use when n>=50)	0.993	95% Gamma Adjusted KM-UCL (use when n<50)	1.016

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.321
Maximum	2.86	Median	0.01
SD	0.719	CV	2.241
k hat (MLE)	0.293	k star (bias corrected MLE)	0.283
Theta hat (MLE)	1.095	Theta star (bias corrected MLE)	1.136
nu hat (MLE)	11.73	nu star (bias corrected)	11.3
MLE Mean (bias corrected)	0.321	MLE Sd (bias corrected)	0.604
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (11.30, α)	4.77	Adjusted Chi Square Value (11.30, β)	4.438
95% Gamma Approximate UCL (use when n>=50)	0.76	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.306	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.525	Mean in Log Scale	-1.024
SD in Original Scale	0.636	SD in Log Scale	0.782
95% t UCL (assumes normality of ROS data)	0.771	95% Percentile Bootstrap UCL	0.78
95% BCA Bootstrap UCL	0.859	95% Bootstrap t UCL	1.086
95% H-UCL (Log ROS)	0.741		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.439	95% H-UCL (KM -Log)	0.885
KM SD (logged)	0.462	95% Critical H Value (KM-Log)	1.983
KM Standard Error of Mean (logged)	0.139		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.646	Mean in Log Scale	-0.66
SD in Original Scale	0.589	SD in Log Scale	0.619
95% t UCL (Assumes normality)	0.874	95% H-Stat UCL	0.848

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.998	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:03
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	2.9	Mean	5.491
Maximum	13.3	Median	4.845
SD	2.429	Std. Error of Mean	0.543
Coefficient of Variation	0.442	Skewness	2

Normal GOF Test

Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.43	95% Adjusted-CLT UCL (Chen-1995)	6.644
		95% Modified-t UCL (Johnson-1978)	6.471

Gamma GOF Test

A-D Test Statistic	0.642	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.105	k star (bias corrected MLE)	6.072
Theta hat (MLE)	0.773	Theta star (bias corrected MLE)	0.904
nu hat (MLE)	284.2	nu star (bias corrected)	242.9
MLE Mean (bias corrected)	5.491	MLE Sd (bias corrected)	2.228
		Approximate Chi Square Value (0.05)	207.8
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	205.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.418	95% Adjusted Gamma UCL (use when n<50)	6.498

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.065	Mean of logged Data	1.631
Maximum of Logged Data	2.588	SD of logged Data	0.37

Assuming Lognormal Distribution

95% H-UCL	6.43	90% Chebyshev (MVUE) UCL	6.831
95% Chebyshev (MVUE) UCL	7.457	97.5% Chebyshev (MVUE) UCL	8.324
99% Chebyshev (MVUE) UCL	10.03		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6.384	95% Jackknife UCL	6.43
95% Standard Bootstrap UCL	6.373	95% Bootstrap-t UCL	6.957
95% Hall's Bootstrap UCL	9.672	95% Percentile Bootstrap UCL	6.436
95% BCA Bootstrap UCL	6.694		
90% Chebyshev(Mean, Sd) UCL	7.121	95% Chebyshev(Mean, Sd) UCL	7.859
97.5% Chebyshev(Mean, Sd) UCL	8.883	99% Chebyshev(Mean, Sd) UCL	10.9

Suggested UCL to Use

95% Student's-t UCL	6.43

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River above mainstem Cement Creek

User Selected Options			
Date/Time of Computation	2/18/2015 11:04		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1530	Mean	3172
Maximum	11500	Median	2660
SD	2124	Std. Error of Mean	474.9
Coefficient of Variation	0.67	Skewness	3.481
Normal GOF Test			
Shapiro Wilk Test Statistic	0.577	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.298	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3993	95% Adjusted-CLT UCL (Chen-1995)	4348
		95% Modified-t UCL (Johnson-1978)	4054
Gamma GOF Test			
A-D Test Statistic	1.438	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.235	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.47	k star (bias corrected MLE)	3.833
Theta hat (MLE)	709.6	Theta star (bias corrected MLE)	827.5
nu hat (MLE)	178.8	nu star (bias corrected)	153.3
MLE Mean (bias corrected)	3172	MLE Sd (bias corrected)	1620
		Approximate Chi Square Value (0.05)	125.7
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	123.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3868	95% Adjusted Gamma UCL (use when n<50)	3930
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.854	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.193	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.333	Mean of logged Data	7.946
Maximum of Logged Data	9.35	SD of logged Data	0.436
Assuming Lognormal Distribution			
95% H-UCL	3777	90% Chebyshev (MVUE) UCL	4017
95% Chebyshev (MVUE) UCL	4438	97.5% Chebyshev (MVUE) UCL	5021
99% Chebyshev (MVUE) UCL	6168		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3953	95% Jackknife UCL	3993
95% Standard Bootstrap UCL	3935	95% Bootstrap-t UCL	5347
95% Hall's Bootstrap UCL	7080	95% Percentile Bootstrap UCL	4031
95% BCA Bootstrap UCL	4441		
90% Chebyshev(Mean, Sd) UCL	4596	95% Chebyshev(Mean, Sd) UCL	5242
97.5% Chebyshev(Mean, Sd) UCL	6137	99% Chebyshev(Mean, Sd) UCL	7897
Suggested UCL to Use			
95% Student's-t UCL	3993	or 95% Modified-t UCL	4054

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:37
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	9960	Mean	14872
Maximum	21500	Median	12200
SD	5021	Std. Error of Mean	2246
Coefficient of Variation	0.338	Skewness	0.625

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.303	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19659	95% Adjusted-CLT UCL (Chen-1995)	19237
		95% Modified-t UCL (Johnson-1978)	19764
Gamma GOF Test			
A-D Test Statistic	0.437	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.308	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	11.42	k star (bias corrected MLE)	4.702
Theta hat (MLE)	1302	Theta star (bias corrected MLE)	3163
nu hat (MLE)	114.2	nu star (bias corrected)	47.02
MLE Mean (bias corrected)	14872	MLE Sd (bias corrected)	6858
		Approximate Chi Square Value (0.05)	32.28
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	27.06
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	21660	95% Adjusted Gamma UCL (use when n<50)	25846
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.894	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.279	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	9.206	Mean of logged Data	9.563
Maximum of Logged Data	9.976	SD of logged Data	0.33
Assuming Lognormal Distribution			
95% H-UCL	22609	90% Chebyshev (MVUE) UCL	21419
95% Chebyshev (MVUE) UCL	24392	97.5% Chebyshev (MVUE) UCL	28518
99% Chebyshev (MVUE) UCL	36622		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	18566	95% Jackknife UCL	19659
95% Standard Bootstrap UCL	18189	95% Bootstrap-t UCL	31997
95% Hall's Bootstrap UCL	72144	95% Percentile Bootstrap UCL	18520
95% BCA Bootstrap UCL	18520		
90% Chebyshev(Mean, Sd) UCL	21609	95% Chebyshev(Mean, Sd) UCL	24661
97.5% Chebyshev(Mean, Sd) UCL	28896	99% Chebyshev(Mean, Sd) UCL	37216

Suggested UCL to Use

95% Student's-t UCL	19659

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:39
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	26.1	Mean	33.36
Maximum	40.6	Median	36.3
SD	6.52	Std. Error of Mean	2.916
Coefficient of Variation	0.195	Skewness	-0.318

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.274	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	39.58	95% Adjusted-CLT UCL (Chen-1995)	37.71
		95% Modified-t UCL (Johnson-1978)	39.51

Gamma GOF Test

A-D Test Statistic	0.522	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	31.44	k star (bias corrected MLE)	12.71
Theta hat (MLE)	1.061	Theta star (bias corrected MLE)	2.625
nu hat (MLE)	314.4	nu star (bias corrected)	127.1
MLE Mean (bias corrected)	33.36	MLE Sd (bias corrected)	9.358
		Approximate Chi Square Value (0.05)	102
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	92.23

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	41.55	95% Adjusted Gamma UCL (use when n<50)	45.96

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.845	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.29	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.262	Mean of logged Data	3.491
Maximum of Logged Data	3.704	SD of logged Data	0.202

Assuming Lognormal Distribution

95% H-UCL	41.86	90% Chebyshev (MVUE) UCL	42.4
95% Chebyshev (MVUE) UCL	46.5	97.5% Chebyshev (MVUE) UCL	52.18
99% Chebyshev (MVUE) UCL	63.33		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	38.16	95% Jackknife UCL	39.58
95% Standard Bootstrap UCL	37.76	95% Bootstrap-t UCL	39.89
95% Hall's Bootstrap UCL	36.05	95% Percentile Bootstrap UCL	37.58
95% BCA Bootstrap UCL	37.12		
90% Chebyshev(Mean, Sd) UCL	42.11	95% Chebyshev(Mean, Sd) UCL	46.07
97.5% Chebyshev(Mean, Sd) UCL	51.57	99% Chebyshev(Mean, Sd) UCL	62.37

Suggested UCL to Use

95% Student's-t UCL	39.58

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	2/18/2015 11:46
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.15	Mean	2.098
Maximum	3.03	Median	1.81
SD	0.791	Std. Error of Mean	0.354
Coefficient of Variation	0.377	Skewness	0.182

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.852	95% Adjusted-CLT UCL (Chen-1995)	2.711
		95% Modified-t UCL (Johnson-1978)	2.857
Gamma GOF Test			
A-D Test Statistic	0.321	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.239	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.413	k star (bias corrected MLE)	3.499
Theta hat (MLE)	0.249	Theta star (bias corrected MLE)	0.6
nu hat (MLE)	84.13	nu star (bias corrected)	34.99
MLE Mean (bias corrected)	2.098	MLE Sd (bias corrected)	1.122
		Approximate Chi Square Value (0.05)	22.45
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3.269	95% Adjusted Gamma UCL (use when n<50)	4.034
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.14	Mean of logged Data	0.68
Maximum of Logged Data	1.109	SD of logged Data	0.396
Assuming Lognormal Distribution			
95% H-UCL	3.603	90% Chebyshev (MVUE) UCL	3.212
95% Chebyshev (MVUE) UCL	3.715	97.5% Chebyshev (MVUE) UCL	4.413
99% Chebyshev (MVUE) UCL	5.784		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.68	95% Jackknife UCL	2.852
95% Standard Bootstrap UCL	2.626	95% Bootstrap-t UCL	3.551
95% Hall's Bootstrap UCL	4.181	95% Percentile Bootstrap UCL	2.626
95% BCA Bootstrap UCL	2.602		
90% Chebyshev(Mean, Sd) UCL	3.159	95% Chebyshev(Mean, Sd) UCL	3.64
97.5% Chebyshev(Mean, Sd) UCL	4.307	99% Chebyshev(Mean, Sd) UCL	5.617

Suggested UCL to Use

95% Student's-t UCL	2.852

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:47
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	77.8	Mean	137.4
Maximum	179	Median	145
SD	37.33	Std. Error of Mean	16.69
Coefficient of Variation	0.272	Skewness	-1.086

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.926	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.254	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	172.9	95% Adjusted-CLT UCL (Chen-1995)	156.2
		95% Modified-t UCL (Johnson-1978)	171.6

Gamma GOF Test

A-D Test Statistic	0.437	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.01	k star (bias corrected MLE)	5.738
Theta hat (MLE)	9.803	Theta star (bias corrected MLE)	23.94
nu hat (MLE)	140.1	nu star (bias corrected)	57.38
MLE Mean (bias corrected)	137.4	MLE Sd (bias corrected)	57.34
		Approximate Chi Square Value (0.05)	40.97
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	35

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	192.4	95% Adjusted Gamma UCL (use when n<50)	225.2

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.856	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.305	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.354	Mean of logged Data	4.886
Maximum of Logged Data	5.187	SD of logged Data	0.317

Assuming Lognormal Distribution

95% H-UCL	205	90% Chebyshev (MVUE) UCL	196.2
95% Chebyshev (MVUE) UCL	222.7	97.5% Chebyshev (MVUE) UCL	259.4
99% Chebyshev (MVUE) UCL	331.4		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	164.8	95% Jackknife UCL	172.9
95% Standard Bootstrap UCL	162	95% Bootstrap-t UCL	160.5
95% Hall's Bootstrap UCL	156.7	95% Percentile Bootstrap UCL	160
95% BCA Bootstrap UCL	153.8		
90% Chebyshev(Mean, Sd) UCL	187.4	95% Chebyshev(Mean, Sd) UCL	210.1
97.5% Chebyshev(Mean, Sd) UCL	241.6	99% Chebyshev(Mean, Sd) UCL	303.5

Suggested UCL to Use

95% Student's-t UCL	172.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	3/2/2015 12:44		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	3.01	Mean	4.604
Maximum	6.41	Median	4.05
SD	1.556	Std. Error of Mean	0.696
Coefficient of Variation	0.338	Skewness	0.385

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.239	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.087	95% Adjusted-CLT UCL (Chen-1995)	5.876
		95% Modified-t UCL (Johnson-1978)	6.107
Gamma GOF Test			
A-D Test Statistic	0.411	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	11.06	k star (bias corrected MLE)	4.557
Theta hat (MLE)	0.416	Theta star (bias corrected MLE)	1.01
nu hat (MLE)	110.6	nu star (bias corrected)	45.57
MLE Mean (bias corrected)	4.604	MLE Sd (bias corrected)	2.157
		Approximate Chi Square Value (0.05)	31.09
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	25.97
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.75	95% Adjusted Gamma UCL (use when n<50)	8.08
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.233	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.102	Mean of logged Data	1.481
Maximum of Logged Data	1.858	SD of logged Data	0.339
Assuming Lognormal Distribution			
95% H-UCL	7.101	90% Chebyshev (MVUE) UCL	6.684
95% Chebyshev (MVUE) UCL	7.627	97.5% Chebyshev (MVUE) UCL	8.936
99% Chebyshev (MVUE) UCL	11.51		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.748	95% Jackknife UCL	6.087
95% Standard Bootstrap UCL	5.617	95% Bootstrap-t UCL	8.093
95% Hall's Bootstrap UCL	7.589	95% Percentile Bootstrap UCL	5.73
95% BCA Bootstrap UCL	5.694		
90% Chebyshev(Mean, Sd) UCL	6.691	95% Chebyshev(Mean, Sd) UCL	7.636
97.5% Chebyshev(Mean, Sd) UCL	8.948	99% Chebyshev(Mean, Sd) UCL	11.53

Suggested UCL to Use

95% Student's-t UCL	6.087

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:09
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.039	Mean	0.0553
Maximum	0.072	Median	0.055
SD	0.0141	Std. Error of Mean	0.00704
Coefficient of Variation	0.255	Skewness	0.0886

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.997	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.145	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0718	95% Adjusted-CLT UCL (Chen-1995)	0.0672
		95% Modified-t UCL (Johnson-1978)	0.0719
Gamma GOF Test			
A-D Test Statistic	0.197	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.173	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	19.99	k star (bias corrected MLE)	5.164
Theta hat (MLE)	0.00276	Theta star (bias corrected MLE)	0.0107
nu hat (MLE)	159.9	nu star (bias corrected)	41.32
MLE Mean (bias corrected)	0.0553	MLE Sd (bias corrected)	0.0243
		Approximate Chi Square Value (0.05)	27.58
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.0828	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.993	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.16	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.244	Mean of logged Data	-2.921
Maximum of Logged Data	-2.631	SD of logged Data	0.262
Assuming Lognormal Distribution			
95% H-UCL	0.0832	90% Chebyshev (MVUE) UCL	0.0769
95% Chebyshev (MVUE) UCL	0.0866	97.5% Chebyshev (MVUE) UCL	0.1
99% Chebyshev (MVUE) UCL	0.127		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0668	95% Jackknife UCL	0.0718
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0764	95% Chebyshev(Mean, Sd) UCL	0.0859
97.5% Chebyshev(Mean, Sd) UCL	0.0992	99% Chebyshev(Mean, Sd) UCL	0.125

Suggested UCL to Use

95% Student's-t UCL	0.0718

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	299	Mean	478.2
Maximum	581	Median	499
SD	108.7	Std. Error of Mean	48.61
Coefficient of Variation	0.227	Skewness	-1.428

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.27	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	581.8	95% Adjusted-CLT UCL (Chen-1995)	525
		95% Modified-t UCL (Johnson-1978)	576.6
Gamma GOF Test			
A-D Test Statistic	0.487	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.299	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	20.27	k star (bias corrected MLE)	8.242
Theta hat (MLE)	23.59	Theta star (bias corrected MLE)	58.02
nu hat (MLE)	202.7	nu star (bias corrected)	82.42
MLE Mean (bias corrected)	478.2	MLE Sd (bias corrected)	166.6
		Approximate Chi Square Value (0.05)	62.49
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	54.97
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	630.6	95% Adjusted Gamma UCL (use when n<50)	717
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.312	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.7	Mean of logged Data	6.145
Maximum of Logged Data	6.365	SD of logged Data	0.261
Assuming Lognormal Distribution			
95% H-UCL	653.4	90% Chebyshev (MVUE) UCL	647
95% Chebyshev (MVUE) UCL	722.9	97.5% Chebyshev (MVUE) UCL	828.3
99% Chebyshev (MVUE) UCL	1035		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	558.1	95% Jackknife UCL	581.8
95% Standard Bootstrap UCL	548.5	95% Bootstrap-t UCL	555.4
95% Hall's Bootstrap UCL	529.1	95% Percentile Bootstrap UCL	541.2
95% BCA Bootstrap UCL	531.8		
90% Chebyshev(Mean, Sd) UCL	624	95% Chebyshev(Mean, Sd) UCL	690.1
97.5% Chebyshev(Mean, Sd) UCL	781.7	99% Chebyshev(Mean, Sd) UCL	961.8

Suggested UCL to Use

95% Student's-t UCL	581.8

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1210	Mean	2100
Maximum	3400	Median	1710
SD	922.4	Std. Error of Mean	412.5
Coefficient of Variation	0.439	Skewness	0.748

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.905	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.264	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2979	95% Adjusted-CLT UCL (Chen-1995)	2926
		95% Modified-t UCL (Johnson-1978)	3002

Gamma GOF Test

A-D Test Statistic	0.32	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.251	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.801	k star (bias corrected MLE)	2.854
Theta hat (MLE)	308.8	Theta star (bias corrected MLE)	735.9
nu hat (MLE)	68.01	nu star (bias corrected)	28.54
MLE Mean (bias corrected)	2100	MLE Sd (bias corrected)	1243
		Approximate Chi Square Value (0.05)	17.35
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	13.68

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3455	95% Adjusted Gamma UCL (use when n<50)	4381

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.219	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.098	Mean of logged Data	7.574
Maximum of Logged Data	8.132	SD of logged Data	0.431

Assuming Lognormal Distribution

95% H-UCL	3853	90% Chebyshev (MVUE) UCL	3299
95% Chebyshev (MVUE) UCL	3844	97.5% Chebyshev (MVUE) UCL	4601
99% Chebyshev (MVUE) UCL	6087		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2779	95% Jackknife UCL	2979
95% Standard Bootstrap UCL	2696	95% Bootstrap-t UCL	4698
95% Hall's Bootstrap UCL	9488	95% Percentile Bootstrap UCL	2724
95% BCA Bootstrap UCL	2738		
90% Chebyshev(Mean, Sd) UCL	3338	95% Chebyshev(Mean, Sd) UCL	3898
97.5% Chebyshev(Mean, Sd) UCL	4676	99% Chebyshev(Mean, Sd) UCL	6204

Suggested UCL to Use

95% Student's-t UCL	2979

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:52
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	4.33	Mean	5.142
Maximum	6.38	Median	4.88
SD	0.778	Std. Error of Mean	0.348
Coefficient of Variation	0.151	Skewness	1.157

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.232	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.884	95% Adjusted-CLT UCL (Chen-1995)	5.907
		95% Modified-t UCL (Johnson-1978)	5.914

Gamma GOF Test

A-D Test Statistic	0.3	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.237	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	57.71	k star (bias corrected MLE)	23.22
Theta hat (MLE)	0.0891	Theta star (bias corrected MLE)	0.221
nu hat (MLE)	577.1	nu star (bias corrected)	232.2
MLE Mean (bias corrected)	5.142	MLE Sd (bias corrected)	1.067
		Approximate Chi Square Value (0.05)	197.9
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	184

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.032	95% Adjusted Gamma UCL (use when n<50)	6.489

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.466	Mean of logged Data	1.629
Maximum of Logged Data	1.853	SD of logged Data	0.146

Assuming Lognormal Distribution

95% H-UCL	6.004	90% Chebyshev (MVUE) UCL	6.144
95% Chebyshev (MVUE) UCL	6.599	97.5% Chebyshev (MVUE) UCL	7.229
99% Chebyshev (MVUE) UCL	8.468		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5.714	95% Jackknife UCL	5.884
95% Standard Bootstrap UCL	5.643	95% Bootstrap-t UCL	6.52
95% Hall's Bootstrap UCL	9.599	95% Percentile Bootstrap UCL	5.67
95% BCA Bootstrap UCL	5.78		
90% Chebyshev(Mean, Sd) UCL	6.186	95% Chebyshev(Mean, Sd) UCL	6.658
97.5% Chebyshev(Mean, Sd) UCL	7.314	99% Chebyshev(Mean, Sd) UCL	8.603

Suggested UCL to Use

95% Student's-t UCL	5.884

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.04	Minimum Non-Detect	1.02
Maximum Detect	2.03	Maximum Non-Detect	1.02
Variance Detects	0.268	Percent Non-Detects	20%
Mean Detects	1.488	SD Detects	0.517
Median Detects	1.44	CV Detects	0.348
Skewness Detects	0.127	Kurtosis Detects	-5.265
Mean of Logged Detects	0.35	SD of Logged Detects	0.356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.819	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.394	Standard Error of Mean	0.228
SD	0.442	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.881	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.77	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.079	95% KM Chebyshev UCL	2.39
97.5% KM Chebyshev UCL	2.82	99% KM Chebyshev UCL	3.667

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.56	Anderson-Darling GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.336	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	10.8	k star (bias corrected MLE)	2.867
Theta hat (MLE)	0.138	Theta star (bias corrected MLE)	0.519
nu hat (MLE)	86.41	nu star (bias corrected)	22.94
MLE Mean (bias corrected)	1.488	MLE Sd (bias corrected)	0.879

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	9.934	nu hat (KM)	99.34
Approximate Chi Square Value (99.34, α)	77.34	Adjusted Chi Square Value (99.34, β)	68.89
95% Gamma Approximate KM-UCL (use when n>=5C	1.79	95% Gamma Adjusted KM-UCL (use when n<50)	2.01

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.364	Mean	1.263
Maximum	2.03	Median	1.05
SD	0.673	CV	0.533
k hat (MLE)	3.378	k star (bias corrected MLE)	1.485
Theta hat (MLE)	0.374	Theta star (bias corrected MLE)	0.851
nu hat (MLE)	33.78	nu star (bias corrected)	14.85
MLE Mean (bias corrected)	1.263	MLE Sd (bias corrected)	1.036
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (14.85, α)	7.154	Adjusted Chi Square Value (14.85, β)	4.997
95% Gamma Approximate UCL (use when n>=50)	2.621	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.804	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.301	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.306	Mean in Log Scale	0.172
SD in Original Scale	0.604	SD in Log Scale	0.504
95% t UCL (assumes normality of ROS data)	1.882	95% Percentile Bootstrap UCL	1.714
95% BCA Bootstrap UCL	1.66	95% Bootstrap t UCL	2.339
95% H-UCL (Log ROS)	2.842		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.284	95% H-UCL (KM -Log)	2.014
KM SD (logged)	0.306	95% Critical H Value (KM-Log)	2.415
KM Standard Error of Mean (logged)	0.158		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.292	Mean in Log Scale	0.145
SD in Original Scale	0.626	SD in Log Scale	0.552
95% t UCL (Assumes normality)	1.889	95% H-Stat UCL	3.183

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.881	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:55
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.3	Mean	1.912
Maximum	2.76	Median	1.83
SD	0.539	Std. Error of Mean	0.241
Coefficient of Variation	0.282	Skewness	0.982

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.425	95% Adjusted-CLT UCL (Chen-1995)	2.421
		95% Modified-t UCL (Johnson-1978)	2.443
Gamma GOF Test			
A-D Test Statistic	0.238	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.203	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.62	k star (bias corrected MLE)	6.782
Theta hat (MLE)	0.115	Theta star (bias corrected MLE)	0.282
nu hat (MLE)	166.2	nu star (bias corrected)	67.82
MLE Mean (bias corrected)	1.912	MLE Sd (bias corrected)	0.734
		Approximate Chi Square Value (0.05)	49.87
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	43.21
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.6	95% Adjusted Gamma UCL (use when n<50)	3.001
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.979	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.262	Mean of logged Data	0.618
Maximum of Logged Data	1.015	SD of logged Data	0.274
Assuming Lognormal Distribution			
95% H-UCL	2.653	90% Chebyshev (MVUE) UCL	2.61
95% Chebyshev (MVUE) UCL	2.927	97.5% Chebyshev (MVUE) UCL	3.367
99% Chebyshev (MVUE) UCL	4.23		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.308	95% Jackknife UCL	2.425
95% Standard Bootstrap UCL	2.267	95% Bootstrap-t UCL	2.572
95% Hall's Bootstrap UCL	4.682	95% Percentile Bootstrap UCL	2.298
95% BCA Bootstrap UCL	2.39		
90% Chebyshev(Mean, Sd) UCL	2.635	95% Chebyshev(Mean, Sd) UCL	2.962
97.5% Chebyshev(Mean, Sd) UCL	3.416	99% Chebyshev(Mean, Sd) UCL	4.309

Suggested UCL to Use

95% Student's-t UCL	2.425

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:56
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	386	Mean	650.8
Maximum	858	Median	646
SD	175.9	Std. Error of Mean	78.66
Coefficient of Variation	0.27	Skewness	-0.674

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.222	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	818.5	95% Adjusted-CLT UCL (Chen-1995)	754.9
		95% Modified-t UCL (Johnson-1978)	814.5

Gamma GOF Test

A-D Test Statistic	0.309	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.251	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.95	k star (bias corrected MLE)	6.112
Theta hat (MLE)	43.54	Theta star (bias corrected MLE)	106.5
nu hat (MLE)	149.5	nu star (bias corrected)	61.12
MLE Mean (bias corrected)	650.8	MLE Sd (bias corrected)	263.2
		Approximate Chi Square Value (0.05)	44.14
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	37.92

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	901.1	95% Adjusted Gamma UCL (use when n<50)	1049

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.912	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.272	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.956	Mean of logged Data	6.444
Maximum of Logged Data	6.755	SD of logged Data	0.302

Assuming Lognormal Distribution

95% H-UCL	947.9	90% Chebyshev (MVUE) UCL	916.4
95% Chebyshev (MVUE) UCL	1036	97.5% Chebyshev (MVUE) UCL	1202
99% Chebyshev (MVUE) UCL	1528		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	780.2	95% Jackknife UCL	818.5
95% Standard Bootstrap UCL	763.8	95% Bootstrap-t UCL	797.7
95% Hall's Bootstrap UCL	794	95% Percentile Bootstrap UCL	765.6
95% BCA Bootstrap UCL	745.2		
90% Chebyshev(Mean, Sd) UCL	886.8	95% Chebyshev(Mean, Sd) UCL	993.7
97.5% Chebyshev(Mean, Sd) UCL	1142	99% Chebyshev(Mean, Sd) UCL	1433

Suggested UCL to Use

95% Student's-t UCL	818.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Al in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:25
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	6770	Mean	17123
Maximum	40700	Median	10510
SD	15852	Std. Error of Mean	7926
Coefficient of Variation	0.926	Skewness	1.9

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.748	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.381	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35775	95% Adjusted-CLT UCL (Chen-1995)	38205
		95% Modified-t UCL (Johnson-1978)	37030

Gamma GOF Test

A-D Test Statistic	0.515	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.353	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.05	k star (bias corrected MLE)	0.679
Theta hat (MLE)	8354	Theta star (bias corrected MLE)	25214
nu hat (MLE)	16.4	nu star (bias corrected)	5.433
MLE Mean (bias corrected)	17123	MLE Sd (bias corrected)	20778
		Approximate Chi Square Value (0.05)	1.357
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	68540	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.305	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.82	Mean of logged Data	9.485
Maximum of Logged Data	10.61	SD of logged Data	0.786

Assuming Lognormal Distribution

95% H-UCL	201468	90% Chebyshev (MVUE) UCL	34933
95% Chebyshev (MVUE) UCL	43315	97.5% Chebyshev (MVUE) UCL	54949
99% Chebyshev (MVUE) UCL	77801		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	30160	95% Jackknife UCL	35775
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	40900	95% Chebyshev(Mean, Sd) UCL	51671
97.5% Chebyshev(Mean, Sd) UCL	66620	99% Chebyshev(Mean, Sd) UCL	95985

Suggested UCL to Use

95% Student's-t UCL	35775

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:26
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	20.5	Mean	27.93
Maximum	33.8	Median	28.7
SD	6.092	Std. Error of Mean	3.046
Coefficient of Variation	0.218	Skewness	-0.466

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35.09	95% Adjusted-CLT UCL (Chen-1995)	32.18
		95% Modified-t UCL (Johnson-1978)	34.97

Gamma GOF Test

A-D Test Statistic	0.31	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.278	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	26.51	k star (bias corrected MLE)	6.794
Theta hat (MLE)	1.053	Theta star (bias corrected MLE)	4.11
nu hat (MLE)	212.1	nu star (bias corrected)	54.35
MLE Mean (bias corrected)	27.93	MLE Sd (bias corrected)	10.71
		Approximate Chi Square Value (0.05)	38.41
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	39.51	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.928	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.247	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.02	Mean of logged Data	3.311
Maximum of Logged Data	3.52	SD of logged Data	0.228

Assuming Lognormal Distribution

95% H-UCL	39.34	90% Chebyshev (MVUE) UCL	37.47
95% Chebyshev (MVUE) UCL	41.79	97.5% Chebyshev (MVUE) UCL	47.79
99% Chebyshev (MVUE) UCL	59.56		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	32.94	95% Jackknife UCL	35.09
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	37.06	95% Chebyshev(Mean, Sd) UCL	41.2
97.5% Chebyshev(Mean, Sd) UCL	46.95	99% Chebyshev(Mean, Sd) UCL	58.23

Suggested UCL to Use

95% Student's-t UCL	35.09

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:30
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2.7	Mean	4.01
Maximum	5.6	Median	3.87
SD	1.21	Std. Error of Mean	0.605
Coefficient of Variation	0.302	Skewness	0.649

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.976	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.22	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.433	95% Adjusted-CLT UCL (Chen-1995)	5.214
		95% Modified-t UCL (Johnson-1978)	5.466
Gamma GOF Test			
A-D Test Statistic	0.213	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.182	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.85	k star (bias corrected MLE)	3.88
Theta hat (MLE)	0.27	Theta star (bias corrected MLE)	1.034
nu hat (MLE)	118.8	nu star (bias corrected)	31.04
MLE Mean (bias corrected)	4.01	MLE Sd (bias corrected)	2.036
		Approximate Chi Square Value (0.05)	19.31
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.445	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.995	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.176	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.993	Mean of logged Data	1.355
Maximum of Logged Data	1.723	SD of logged Data	0.302
Assuming Lognormal Distribution			
95% H-UCL	6.588	90% Chebyshev (MVUE) UCL	5.812
95% Chebyshev (MVUE) UCL	6.629	97.5% Chebyshev (MVUE) UCL	7.762
99% Chebyshev (MVUE) UCL	9.988		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.005	95% Jackknife UCL	5.433
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.824	95% Chebyshev(Mean, Sd) UCL	6.646
97.5% Chebyshev(Mean, Sd) UCL	7.787	99% Chebyshev(Mean, Sd) UCL	10.03

Suggested UCL to Use

95% Student's-t UCL	5.433

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:36
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	113	Mean	199
Maximum	284	Median	199.5
SD	72.4	Std. Error of Mean	36.2
Coefficient of Variation	0.364	Skewness	-0.0356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	1	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.133	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	284.2	95% Adjusted-CLT UCL (Chen-1995)	257.9
		95% Modified-t UCL (Johnson-1978)	284.1

Gamma GOF Test

A-D Test Statistic	0.208	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.178	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.288	k star (bias corrected MLE)	2.489
Theta hat (MLE)	21.43	Theta star (bias corrected MLE)	79.97
nu hat (MLE)	74.3	nu star (bias corrected)	19.91
MLE Mean (bias corrected)	199	MLE Sd (bias corrected)	126.1
		Approximate Chi Square Value (0.05)	10.78
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	367.4	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.181	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.727	Mean of logged Data	5.239
Maximum of Logged Data	5.649	SD of logged Data	0.393

Assuming Lognormal Distribution

95% H-UCL	415.1	90% Chebyshev (MVUE) UCL	315.6
95% Chebyshev (MVUE) UCL	368.3	97.5% Chebyshev (MVUE) UCL	441.3
99% Chebyshev (MVUE) UCL	584.8		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	258.5	95% Jackknife UCL	284.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	307.6	95% Chebyshev(Mean, Sd) UCL	356.8
97.5% Chebyshev(Mean, Sd) UCL	425.1	99% Chebyshev(Mean, Sd) UCL	559.2

Suggested UCL to Use

95% Student's-t UCL	284.2

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2.83	Mean	3.988
Maximum	5.6	Median	3.76
SD	1.18	Std. Error of Mean	0.59
Coefficient of Variation	0.296	Skewness	1.024

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.239	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.376	95% Adjusted-CLT UCL (Chen-1995)	5.281
		95% Modified-t UCL (Johnson-1978)	5.427
Gamma GOF Test			
A-D Test Statistic	0.238	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.09	k star (bias corrected MLE)	4.19
Theta hat (MLE)	0.248	Theta star (bias corrected MLE)	0.952
nu hat (MLE)	128.7	nu star (bias corrected)	33.52
MLE Mean (bias corrected)	3.988	MLE Sd (bias corrected)	1.948
		Approximate Chi Square Value (0.05)	21.28
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.281	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.985	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.195	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.04	Mean of logged Data	1.352
Maximum of Logged Data	1.723	SD of logged Data	0.286
Assuming Lognormal Distribution			
95% H-UCL	6.323	90% Chebyshev (MVUE) UCL	5.685
95% Chebyshev (MVUE) UCL	6.456	97.5% Chebyshev (MVUE) UCL	7.525
99% Chebyshev (MVUE) UCL	9.626		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.958	95% Jackknife UCL	5.376
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.758	95% Chebyshev(Mean, Sd) UCL	6.56
97.5% Chebyshev(Mean, Sd) UCL	7.673	99% Chebyshev(Mean, Sd) UCL	9.859

Suggested UCL to Use

95% Student's-t UCL	5.376

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:15
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.02	Mean	0.0353
Maximum	0.05	Median	0.036
SD	0.015	Std. Error of Mean	0.00867
Coefficient of Variation	0.425	Skewness	-0.199

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0606	95% Adjusted-CLT UCL (Chen-1995)	0.0485
		95% Modified-t UCL (Johnson-1978)	0.0605

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	7.544	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00468	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	45.27	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.241	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.912	Mean of logged Data	-3.411
Maximum of Logged Data	-2.996	SD of logged Data	0.464

Assuming Lognormal Distribution

95% H-UCL	0.265	90% Chebyshev (MVUE) UCL	0.0632
95% Chebyshev (MVUE) UCL	0.0758	97.5% Chebyshev (MVUE) UCL	0.0932
99% Chebyshev (MVUE) UCL	0.127		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0496	95% Jackknife UCL	0.0606
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0613	95% Chebyshev(Mean, Sd) UCL	0.0731
97.5% Chebyshev(Mean, Sd) UCL	0.0895	99% Chebyshev(Mean, Sd) UCL	0.122

Suggested UCL to Use

95% Student's-t UCL	0.0606

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:39
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation:	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	297	Mean	513
Maximum	729	Median	513
SD	187.5	Std. Error of Mean	93.75
Coefficient of Variation	0.366	Skewness	0

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.989	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.161	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	733.6	95% Adjusted-CLT UCL (Chen-1995)	667.2
		95% Modified-t UCL (Johnson-1978)	733.6

Gamma GOF Test

A-D Test Statistic	0.217	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.209	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.315	k star (bias corrected MLE)	2.496
Theta hat (MLE)	55.07	Theta star (bias corrected MLE)	205.6
nu hat (MLE)	74.52	nu star (bias corrected)	19.96
MLE Mean (bias corrected)	513	MLE Sd (bias corrected)	324.7
		Approximate Chi Square Value (0.05)	10.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	946.1	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.192	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.694	Mean of logged Data	6.186
Maximum of Logged Data	6.592	SD of logged Data	0.391

Assuming Lognormal Distribution

95% H-UCL	1063	90% Chebyshev (MVUE) UCL	811.6
95% Chebyshev (MVUE) UCL	946.5	97.5% Chebyshev (MVUE) UCL	1134
99% Chebyshev (MVUE) UCL	1501		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	667.2	95% Jackknife UCL	733.6
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	794.3	95% Chebyshev(Mean, Sd) UCL	921.7
97.5% Chebyshev(Mean, Sd) UCL	1098	99% Chebyshev(Mean, Sd) UCL	1446

Suggested UCL to Use

95% Student's-t UCL	733.6

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:40
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2780	Mean	4340
Maximum	7120	Median	3730
SD	1936	Std. Error of Mean	967.9
Coefficient of Variation	0.446	Skewness	1.527

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.291	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6618	95% Adjusted-CLT UCL (Chen-1995)	6722
		95% Modified-t UCL (Johnson-1978)	6741
Gamma GOF Test			
A-D Test Statistic	0.345	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.254	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.696	k star (bias corrected MLE)	2.091
Theta hat (MLE)	563.9	Theta star (bias corrected MLE)	2076
nu hat (MLE)	61.57	nu star (bias corrected)	16.73
MLE Mean (bias corrected)	4340	MLE Sd (bias corrected)	3001
		Approximate Chi Square Value (0.05)	8.477
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8563	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.231	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.93	Mean of logged Data	8.309
Maximum of Logged Data	8.871	SD of logged Data	0.408
Assuming Lognormal Distribution			
95% H-UCL	9408	90% Chebyshev (MVUE) UCL	6932
95% Chebyshev (MVUE) UCL	8115	97.5% Chebyshev (MVUE) UCL	9757
99% Chebyshev (MVUE) UCL	12983		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5932	95% Jackknife UCL	6618
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7244	95% Chebyshev(Mean, Sd) UCL	8559
97.5% Chebyshev(Mean, Sd) UCL	10385	99% Chebyshev(Mean, Sd) UCL	13971

Suggested UCL to Use

95% Student's-t UCL	6618

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5.5	Mean	6.4
Maximum	7.19	Median	6.455
SD	0.761	Std. Error of Mean	0.38
Coefficient of Variation	0.119	Skewness	-0.283

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.218	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.295	95% Adjusted-CLT UCL (Chen-1995)	6.968
		95% Modified-t UCL (Johnson-1978)	7.286

Gamma GOF Test

A-D Test Statistic	0.268	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	92.73	k star (bias corrected MLE)	23.35
Theta hat (MLE)	0.069	Theta star (bias corrected MLE)	0.274
nu hat (MLE)	741.9	nu star (bias corrected)	186.8
MLE Mean (bias corrected)	6.4	MLE Sd (bias corrected)	1.324
		Approximate Chi Square Value (0.05)	156.2
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.655	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.224	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.705	Mean of logged Data	1.851
Maximum of Logged Data	1.973	SD of logged Data	0.121

Assuming Lognormal Distribution

95% H-UCL	7.507	90% Chebyshev (MVUE) UCL	7.557
95% Chebyshev (MVUE) UCL	8.08	97.5% Chebyshev (MVUE) UCL	8.808
99% Chebyshev (MVUE) UCL	10.24		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7.026	95% Jackknife UCL	7.295
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.541	95% Chebyshev(Mean, Sd) UCL	8.058
97.5% Chebyshev(Mean, Sd) UCL	8.776	99% Chebyshev(Mean, Sd) UCL	10.19

Suggested UCL to Use

95% Student's-t UCL	7.295

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Se in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:43
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.717	Minimum Non-Detect	1
Maximum Detect	1.43	Maximum Non-Detect	1.02
Variance Detects	0.254	Percent Non-Detects	50%
Mean Detects	1.074	SD Detects	0.504
Median Detects	1.074	CV Detects	0.47
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.0125	SD of Logged Detects	0.488

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.895	Standard Error of Mean	0.218
SD	0.309	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.409	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.254	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.55	95% KM Chebyshev UCL	1.847
97.5% KM Chebyshev UCL	2.259	99% KM Chebyshev UCL	3.067

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	8.721	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.123	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	34.88	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	8.408	nu hat (KM)	67.27
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (67.27, α)	49.39	Adjusted Chi Square Value (67.27, β)	41.13
95% Gamma Approximate KM-UCL (use when n>=50	1.219	95% Gamma Adjusted KM-UCL (use when n<50)	1.464

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.895	Mean in Log Scale	-0.16
SD in Original Scale	0.357	SD in Log Scale	0.345
95% t UCL (assumes normality of ROS data)	1.315	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.627		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.789	Mean in Log Scale	-0.335
SD in Original Scale	0.439	SD in Log Scale	0.491
95% t UCL (Assumes normality)	1.305	95% H-Stat UCL	2.243

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.409	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:45
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.24	Mean	1.923
Maximum	2.78	Median	1.835
SD	0.75	Std. Error of Mean	0.375
Coefficient of Variation	0.39	Skewness	0.297

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.884	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.277	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.805	95% Adjusted-CLT UCL (Chen-1995)	2.599
		95% Modified-t UCL (Johnson-1978)	2.814

Gamma GOF Test

A-D Test Statistic	0.418	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.307	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.664	k star (bias corrected MLE)	2.333
Theta hat (MLE)	0.222	Theta star (bias corrected MLE)	0.824
nu hat (MLE)	69.31	nu star (bias corrected)	18.66
MLE Mean (bias corrected)	1.923	MLE Sd (bias corrected)	1.259
		Approximate Chi Square Value (0.05)	9.871
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.635	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.271	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.215	Mean of logged Data	0.595
Maximum of Logged Data	1.022	SD of logged Data	0.398

Assuming Lognormal Distribution

95% H-UCL	4.059	90% Chebyshev (MVUE) UCL	3.056
95% Chebyshev (MVUE) UCL	3.569	97.5% Chebyshev (MVUE) UCL	4.282
99% Chebyshev (MVUE) UCL	5.682		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.539	95% Jackknife UCL	2.805
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.047	95% Chebyshev(Mean, Sd) UCL	3.557
97.5% Chebyshev(Mean, Sd) UCL	4.264	99% Chebyshev(Mean, Sd) UCL	5.653

Suggested UCL to Use

95% Student's-t UCL	2.805

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:46
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	749	Mean	1049
Maximum	1450	Median	999
SD	292	Std. Error of Mean	146
Coefficient of Variation	0.278	Skewness	0.992

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.317	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1393	95% Adjusted-CLT UCL (Chen-1995)	1367
		95% Modified-t UCL (Johnson-1978)	1405
Gamma GOF Test			
A-D Test Statistic	0.354	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.299	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	18.06	k star (bias corrected MLE)	4.682
Theta hat (MLE)	58.09	Theta star (bias corrected MLE)	224.1
nu hat (MLE)	144.5	nu star (bias corrected)	37.46
MLE Mean (bias corrected)	1049	MLE Sd (bias corrected)	484.9
		Approximate Chi Square Value (0.05)	24.44
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1608	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.28	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.619	Mean of logged Data	6.928
Maximum of Logged Data	7.279	SD of logged Data	0.271
Assuming Lognormal Distribution			
95% H-UCL	1609	90% Chebyshev (MVUE) UCL	1472
95% Chebyshev (MVUE) UCL	1664	97.5% Chebyshev (MVUE) UCL	1930
99% Chebyshev (MVUE) UCL	2454		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1289	95% Jackknife UCL	1393
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1487	95% Chebyshev(Mean, Sd) UCL	1686
97.5% Chebyshev(Mean, Sd) UCL	1961	99% Chebyshev(Mean, Sd) UCL	2502

Suggested UCL to Use

95% Student's-t UCL	1393

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 13:09		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	6620	Mean	16373
Maximum	31900	Median	10600
SD	13593	Std. Error of Mean	7848
Coefficient of Variation	0.83	Skewness	1.566

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.331	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	39289	95% Adjusted-CLT UCL (Chen-1995)	36866
		95% Modified-t UCL (Johnson-1978)	40472

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	2.381	k star (bias corrected MLE)	N/A
Theta hat (MLE)	6877	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	14.29	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.269	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.798	Mean of logged Data	9.479
Maximum of Logged Data	10.37	SD of logged Data	0.807

Assuming Lognormal Distribution

95% H-UCL	7347437	90% Chebyshev (MVUE) UCL	36910
95% Chebyshev (MVUE) UCL	46345	97.5% Chebyshev (MVUE) UCL	59441
99% Chebyshev (MVUE) UCL	85165		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	29282	95% Jackknife UCL	39289
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	39917	95% Chebyshev(Mean, Sd) UCL	50581
97.5% Chebyshev(Mean, Sd) UCL	65383	99% Chebyshev(Mean, Sd) UCL	94459

Suggested UCL to Use

95% Student's-t UCL	39289

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:10
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	19.9	Mean	29.9
Maximum	39.4	Median	30.4
SD	9.76	Std. Error of Mean	5.635
Coefficient of Variation	0.326	Skewness	-0.23

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.187	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	46.35	95% Adjusted-CLT UCL (Chen-1995)	38.37
		95% Modified-t UCL (Johnson-1978)	46.23

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	13.25	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.257	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	79.49	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.23	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.991	Mean of logged Data	3.36
Maximum of Logged Data	3.674	SD of logged Data	0.345

Assuming Lognormal Distribution

95% H-UCL	93.07	90% Chebyshev (MVUE) UCL	47.55
95% Chebyshev (MVUE) UCL	55.52	97.5% Chebyshev (MVUE) UCL	66.6
99% Chebyshev (MVUE) UCL	88.35		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	39.17	95% Jackknife UCL	46.35
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	46.8	95% Chebyshev(Mean, Sd) UCL	54.46
97.5% Chebyshev(Mean, Sd) UCL	65.09	99% Chebyshev(Mean, Sd) UCL	85.96

Suggested UCL to Use

95% Student's-t UCL	46.35

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:10
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2.72	Mean	3.507
Maximum	4.24	Median	3.56
SD	0.761	Std. Error of Mean	0.44
Coefficient of Variation	0.217	Skewness	-0.314

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.996	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.195	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.79	95% Adjusted-CLT UCL (Chen-1995)	4.145
		95% Modified-t UCL (Johnson-1978)	4.777
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	30.75	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.114	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	184.5	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.985	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.001	Mean of logged Data	1.238
Maximum of Logged Data	1.445	SD of logged Data	0.224
Assuming Lognormal Distribution			
95% H-UCL	6.116	90% Chebyshev (MVUE) UCL	4.858
95% Chebyshev (MVUE) UCL	5.469	97.5% Chebyshev (MVUE) UCL	6.318
99% Chebyshev (MVUE) UCL	7.986		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.23	95% Jackknife UCL	4.79
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4.825	95% Chebyshev(Mean, Sd) UCL	5.423
97.5% Chebyshev(Mean, Sd) UCL	6.252	99% Chebyshev(Mean, Sd) UCL	7.881

Suggested UCL to Use

95% Student's-t UCL	4.79

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	3.68	Mean	4.473
Maximum	5.02	Median	4.72
SD	0.703	Std. Error of Mean	0.406
Coefficient of Variation	0.157	Skewness	-1.384

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.304	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.659	95% Adjusted-CLT UCL (Chen-1995)	4.794
		95% Modified-t UCL (Johnson-1978)	5.605
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	57.31	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0781	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	343.9	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.315	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.303	Mean of logged Data	1.489
Maximum of Logged Data	1.613	SD of logged Data	0.164
Assuming Lognormal Distribution			
95% H-UCL	6.422	90% Chebyshev (MVUE) UCL	5.744
95% Chebyshev (MVUE) UCL	6.319	97.5% Chebyshev (MVUE) UCL	7.118
99% Chebyshev (MVUE) UCL	8.686		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.141	95% Jackknife UCL	5.659
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.691	95% Chebyshev(Mean, Sd) UCL	6.243
97.5% Chebyshev(Mean, Sd) UCL	7.009	99% Chebyshev(Mean, Sd) UCL	8.513

Suggested UCL to Use

95% Student's-t UCL	5.659

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:10
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	98.8	Mean	176.9
Maximum	292	Median	140
SD	101.8	Std. Error of Mean	58.75
Coefficient of Variation	0.575	Skewness	1.418

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.308	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	348.5	95% Adjusted-CLT UCL (Chen-1995)	325
		95% Modified-t UCL (Johnson-1978)	356.5

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	4.91	k star (bias corrected MLE)	N/A
Theta hat (MLE)	36.04	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	29.46	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.593	Mean of logged Data	5.07
Maximum of Logged Data	5.677	SD of logged Data	0.553

Assuming Lognormal Distribution

95% H-UCL	3088	90% Chebyshev (MVUE) UCL	338.4
95% Chebyshev (MVUE) UCL	411.9	97.5% Chebyshev (MVUE) UCL	514
99% Chebyshev (MVUE) UCL	714.6		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	273.6	95% Jackknife UCL	348.5
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	353.2	95% Chebyshev(Mean, Sd) UCL	433
97.5% Chebyshev(Mean, Sd) UCL	543.8	99% Chebyshev(Mean, Sd) UCL	761.5

Suggested UCL to Use

95% Student's-t UCL	348.5

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:11
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	468	Mean	533.7
Maximum	593	Median	540
SD	62.74	Std. Error of Mean	36.22
Coefficient of Variation	0.118	Skewness	-0.45

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.992	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.207	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	639.4	95% Adjusted-CLT UCL (Chen-1995)	583.2
		95% Modified-t UCL (Johnson-1978)	637.9

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	106.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	5.002	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	640.1	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.986	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.148	Mean of logged Data	6.275
Maximum of Logged Data	6.385	SD of logged Data	0.119

Assuming Lognormal Distribution

95% H-UCL	679.3	90% Chebyshev (MVUE) UCL	643.7
95% Chebyshev (MVUE) UCL	693.5	97.5% Chebyshev (MVUE) UCL	762.7
99% Chebyshev (MVUE) UCL	898.5		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	593.2	95% Jackknife UCL	639.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	642.3	95% Chebyshev(Mean, Sd) UCL	691.6
97.5% Chebyshev(Mean, Sd) UCL	759.9	99% Chebyshev(Mean, Sd) UCL	894.1

Suggested UCL to Use

95% Student's-t UCL	639.4

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:11
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2480	Mean	3143
Maximum	4340	Median	2610
SD	1038	Std. Error of Mean	599.5
Coefficient of Variation	0.33	Skewness	1.702

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.802	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4894	95% Adjusted-CLT UCL (Chen-1995)	4759
		95% Modified-t UCL (Johnson-1978)	4992

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	15.11	k star (bias corrected MLE)	N/A
Theta hat (MLE)	208	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	90.66	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.818	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.356	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.816	Mean of logged Data	8.02
Maximum of Logged Data	8.376	SD of logged Data	0.309

Assuming Lognormal Distribution

95% H-UCL	7994	90% Chebyshev (MVUE) UCL	4799
95% Chebyshev (MVUE) UCL	5552	97.5% Chebyshev (MVUE) UCL	6597
99% Chebyshev (MVUE) UCL	8649		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4129	95% Jackknife UCL	4894
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4942	95% Chebyshev(Mean, Sd) UCL	5757
97.5% Chebyshev(Mean, Sd) UCL	6887	99% Chebyshev(Mean, Sd) UCL	9108

Suggested UCL to Use

95% Student's-t UCL	4894

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:11
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	8.16	Mean	10.01
Maximum	12.1	Median	9.78
SD	1.98	Std. Error of Mean	1.143
Coefficient of Variation	0.198	Skewness	0.523

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.99	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.214	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13.35	95% Adjusted-CLT UCL (Chen-1995)	12.26
		95% Modified-t UCL (Johnson-1978)	13.41

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	38.66	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.259	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	232	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.188	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.099	Mean of logged Data	2.291
Maximum of Logged Data	2.493	SD of logged Data	0.197

Assuming Lognormal Distribution

95% H-UCL	15.91	90% Chebyshev (MVUE) UCL	13.42
95% Chebyshev (MVUE) UCL	14.96	97.5% Chebyshev (MVUE) UCL	17.1
99% Chebyshev (MVUE) UCL	21.3		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11.89	95% Jackknife UCL	13.35
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.44	95% Chebyshev(Mean, Sd) UCL	15
97.5% Chebyshev(Mean, Sd) UCL	17.15	99% Chebyshev(Mean, Sd) UCL	21.39

Suggested UCL to Use

95% Student's-t UCL	13.35

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:12
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	1.25	Mean	1.997
Maximum	3.09	Median	1.65
SD	0.968	Std. Error of Mean	0.559
Coefficient of Variation	0.485	Skewness	1.405

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.904	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.307	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.628	95% Adjusted-CLT UCL (Chen-1995)	3.4
		95% Modified-t UCL (Johnson-1978)	3.704

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	6.909	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.289	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	41.45	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.266	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.223	Mean of logged Data	0.617
Maximum of Logged Data	1.128	SD of logged Data	0.464

Assuming Lognormal Distribution

95% H-UCL	14.82	90% Chebyshev (MVUE) UCL	3.545
95% Chebyshev (MVUE) UCL	4.25	97.5% Chebyshev (MVUE) UCL	5.229
99% Chebyshev (MVUE) UCL	7.15		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.916	95% Jackknife UCL	3.628
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.673	95% Chebyshev(Mean, Sd) UCL	4.432
97.5% Chebyshev(Mean, Sd) UCL	5.486	99% Chebyshev(Mean, Sd) UCL	7.556

Suggested UCL to Use

95% Student's-t UCL	3.628

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:12
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	659	Mean	1114
Maximum	1720	Median	964
SD	546.2	Std. Error of Mean	315.4
Coefficient of Variation	0.49	Skewness	1.145

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.275	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2035	95% Adjusted-CLT UCL (Chen-1995)	1856
		95% Modified-t UCL (Johnson-1978)	2070

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	6.514	k star (bias corrected MLE)	N/A
Theta hat (MLE)	171.1	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	39.09	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.986	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.491	Mean of logged Data	6.937
Maximum of Logged Data	7.45	SD of logged Data	0.483

Assuming Lognormal Distribution

95% H-UCL	9849	90% Chebyshev (MVUE) UCL	2016
95% Chebyshev (MVUE) UCL	2425	97.5% Chebyshev (MVUE) UCL	2994
99% Chebyshev (MVUE) UCL	4110		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1633	95% Jackknife UCL	2035
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2060	95% Chebyshev(Mean, Sd) UCL	2489
97.5% Chebyshev(Mean, Sd) UCL	3084	99% Chebyshev(Mean, Sd) UCL	4252

Suggested UCL to Use

95% Student's-t UCL	2035

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options		
Date/Time of Computation		2/18/2015 13:57
From File	WorkSheet.xls	
Full Precision	OFF	
Confidence Coefficient	95%	
Number of Bootstrap Operations	2000	

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	6640	Mean	20820
Maximum	48600	Median	7220
SD	24060	Std. Error of Mean	13891
Coefficient of Variation	1.156	Skewness	1.731

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.76	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.381	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	61382	95% Adjusted-CLT UCL (Chen-1995)	58502
		95% Modified-t UCL (Johnson-1978)	63695

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.248	k star (bias corrected MLE)	N/A
Theta hat (MLE)	16682	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7.488	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.781	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.372	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	8.801	Mean of logged Data	9.492
Maximum of Logged Data	10.79	SD of logged Data	1.126

Assuming Lognormal Distribution

95% H-UCL	3.02E+09	90% Chebyshev (MVUE) UCL	52502
95% Chebyshev (MVUE) UCL	67461	97.5% Chebyshev (MVUE) UCL	88224
99% Chebyshev (MVUE) UCL	129007		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	43669	95% Jackknife UCL	61382
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	62493	95% Chebyshev(Mean, Sd) UCL	81370
97.5% Chebyshev(Mean, Sd) UCL	107569	99% Chebyshev(Mean, Sd) UCL	159034

Suggested UCL to Use

95% Student's-t UCL	61382

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:57
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	9.22	Mean	19.91
Maximum	37.2	Median	13.3
SD	15.11	Std. Error of Mean	8.727
Coefficient of Variation	0.759	Skewness	1.591

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.857	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	45.39	95% Adjusted-CLT UCL (Chen-1995)	42.83
		95% Modified-t UCL (Johnson-1978)	46.72

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	2.895	k star (bias corrected MLE)	N/A
Theta hat (MLE)	6.877	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.37	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.221	Mean of logged Data	2.808
Maximum of Logged Data	3.616	SD of logged Data	0.723

Assuming Lognormal Distribution

95% H-UCL	2668	90% Chebyshev (MVUE) UCL	42.69
95% Chebyshev (MVUE) UCL	53.14	97.5% Chebyshev (MVUE) UCL	67.65
99% Chebyshev (MVUE) UCL	96.16		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	34.26	95% Jackknife UCL	45.39
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	46.09	95% Chebyshev(Mean, Sd) UCL	57.94
97.5% Chebyshev(Mean, Sd) UCL	74.4	99% Chebyshev(Mean, Sd) UCL	106.7

Suggested UCL to Use

95% Student's-t UCL	45.39

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:57
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	1.99	Mean	5.047
Maximum	10.5	Median	2.65
SD	4.734	Std. Error of Mean	2.733
Coefficient of Variation	0.938	Skewness	1.694

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.36	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13.03	95% Adjusted-CLT UCL (Chen-1995)	12.4
		95% Modified-t UCL (Johnson-1978)	13.47

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.931	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.613	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.59	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.325	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.688	Mean of logged Data	1.338
Maximum of Logged Data	2.351	SD of logged Data	0.889

Assuming Lognormal Distribution

95% H-UCL	8316	90% Chebyshev (MVUE) UCL	11.75
95% Chebyshev (MVUE) UCL	14.86	97.5% Chebyshev (MVUE) UCL	19.18
99% Chebyshev (MVUE) UCL	27.66		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.543	95% Jackknife UCL	13.03
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.25	95% Chebyshev(Mean, Sd) UCL	16.96
97.5% Chebyshev(Mean, Sd) UCL	22.12	99% Chebyshev(Mean, Sd) UCL	32.24

Suggested UCL to Use

95% Student's-t UCL	13.03

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:57
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	67	Mean	187.6
Maximum	413	Median	82.7
SD	195.4	Std. Error of Mean	112.8
Coefficient of Variation	1.042	Skewness	1.719

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.784	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.371	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	517	95% Adjusted-CLT UCL (Chen-1995)	492.8
		95% Modified-t UCL (Johnson-1978)	535.6

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.562	k star (bias corrected MLE)	N/A
Theta hat (MLE)	120.1	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	9.373	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.836	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.347	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.205	Mean of logged Data	4.881
Maximum of Logged Data	6.023	SD of logged Data	0.995

Assuming Lognormal Distribution

95% H-UCL	2000919	90% Chebyshev (MVUE) UCL	454.7
95% Chebyshev (MVUE) UCL	579.6	97.5% Chebyshev (MVUE) UCL	752.9
99% Chebyshev (MVUE) UCL	1093		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	373.1	95% Jackknife UCL	517
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	526	95% Chebyshev(Mean, Sd) UCL	679.3
97.5% Chebyshev(Mean, Sd) UCL	892.1	99% Chebyshev(Mean, Sd) UCL	1310

Suggested UCL to Use

95% Student's-t UCL	517

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5.01	Mean	5.207
Maximum	5.45	Median	5.16
SD	0.224	Std. Error of Mean	0.129
Coefficient of Variation	0.043	Skewness	0.898

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.967	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.249	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.584	95% Adjusted-CLT UCL (Chen-1995)	5.491
		95% Modified-t UCL (Johnson-1978)	5.595

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics			
k hat (MLE)	819.2	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00636	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4915	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.245	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	1.611	Mean of logged Data	1.649
Maximum of Logged Data	1.696	SD of logged Data	0.0427

Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	5.592
95% Chebyshev (MVUE) UCL	5.766	97.5% Chebyshev (MVUE) UCL	6.008
99% Chebyshev (MVUE) UCL	6.484		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	5.419	95% Jackknife UCL	5.584
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.594	95% Chebyshev(Mean, Sd) UCL	5.77
97.5% Chebyshev(Mean, Sd) UCL	6.013	99% Chebyshev(Mean, Sd) UCL	6.492

Suggested UCL to Use

95% Student's-t UCL	5.584

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	98	Mean	295.7
Maximum	435	Median	354
SD	175.9	Std. Error of Mean	101.6
Coefficient of Variation	0.595	Skewness	-1.328

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.297	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	592.2	95% Adjusted-CLT UCL (Chen-1995)	379.5
		95% Modified-t UCL (Johnson-1978)	579.2

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	2.944	k star (bias corrected MLE)	N/A
Theta hat (MLE)	100.4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.66	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.339	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.585	Mean of logged Data	5.51
Maximum of Logged Data	6.075	SD of logged Data	0.808

Assuming Lognormal Distribution

95% H-UCL	139915	90% Chebyshev (MVUE) UCL	697.6
95% Chebyshev (MVUE) UCL	876	97.5% Chebyshev (MVUE) UCL	1124
99% Chebyshev (MVUE) UCL	1610		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	462.7	95% Jackknife UCL	592.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	600.4	95% Chebyshev(Mean, Sd) UCL	738.4
97.5% Chebyshev(Mean, Sd) UCL	929.9	99% Chebyshev(Mean, Sd) UCL	1306

Suggested UCL to Use

95% Student's-t UCL	592.2

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2070	Mean	2743
Maximum	3820	Median	2340
SD	942.1	Std. Error of Mean	543.9
Coefficient of Variation	0.343	Skewness	1.573

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.863	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.332	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4332	95% Adjusted-CLT UCL (Chen-1995)	4166
		95% Modified-t UCL (Johnson-1978)	4414
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	13.85	k star (bias corrected MLE)	N/A
Theta hat (MLE)	198	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	83.13	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.314	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.635	Mean of logged Data	7.88
Maximum of Logged Data	8.248	SD of logged Data	0.324
Assuming Lognormal Distribution			
95% H-UCL	7558	90% Chebyshev (MVUE) UCL	4256
95% Chebyshev (MVUE) UCL	4944	97.5% Chebyshev (MVUE) UCL	5898
99% Chebyshev (MVUE) UCL	7773		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3638	95% Jackknife UCL	4332
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4375	95% Chebyshev(Mean, Sd) UCL	5114
97.5% Chebyshev(Mean, Sd) UCL	6140	99% Chebyshev(Mean, Sd) UCL	8156

Suggested UCL to Use

95% Student's-t UCL	4332

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5.93	Mean	9.713
Maximum	16.5	Median	6.71
SD	5.89	Std. Error of Mean	3.401
Coefficient of Variation	0.606	Skewness	1.698

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.362	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.64	95% Adjusted-CLT UCL (Chen-1995)	18.87
		95% Modified-t UCL (Johnson-1978)	20.2

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	4.658	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.085	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	27.95	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.839	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.345	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.78	Mean of logged Data	2.162
Maximum of Logged Data	2.803	SD of logged Data	0.559

Assuming Lognormal Distribution

95% H-UCL	178.7	90% Chebyshev (MVUE) UCL	18.58
95% Chebyshev (MVUE) UCL	22.64	97.5% Chebyshev (MVUE) UCL	28.27
99% Chebyshev (MVUE) UCL	39.34		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	15.31	95% Jackknife UCL	19.64
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	19.92	95% Chebyshev(Mean, Sd) UCL	24.54
97.5% Chebyshev(Mean, Sd) UCL	30.95	99% Chebyshev(Mean, Sd) UCL	43.55

Suggested UCL to Use

95% Student's-t UCL	19.64

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.588	Minimum Non-Detect	0.994
Maximum Detect	3.26	Maximum Non-Detect	0.994
Variance Detects	3.57	Percent Non-Detects	33.33%
Mean Detects	1.924	SD Detects	1.889
Median Detects	1.924	CV Detects	0.982
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.325	SD of Logged Detects	1.211

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.479	Standard Error of Mean	1.028
SD	1.26	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.482	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.17	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.564	95% KM Chebyshev UCL	5.962
97.5% KM Chebyshev UCL	7.901	99% KM Chebyshev UCL	11.71

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.667	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.154	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.667	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.378	nu hat (KM)	8.269
		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (8.27, α)	2.892	Adjusted Chi Square Value (8.27, β)	1.019
95% Gamma Approximate KM-UCL (use when n>=50	4.228	95% Gamma Adjusted KM-UCL (use when n<50)	11.99

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.479	Mean in Log Scale	0.0399
SD in Original Scale	1.543	SD in Log Scale	0.989
95% t UCL (assumes normality of ROS data)	4.079	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	14069		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.448	Mean in Log Scale	-0.0162
SD in Original Scale	1.57	SD in Log Scale	1.041
95% t UCL (Assumes normality)	4.094	95% H-Stat UCL	37170

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	7.901

Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.512	Mean	1.401
Maximum	2.18	Median	1.51
SD	0.839	Std. Error of Mean	0.485
Coefficient of Variation	0.599	Skewness	-0.576

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.987	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.816	95% Adjusted-CLT UCL (Chen-1995)	2.026
		95% Modified-t UCL (Johnson-1978)	2.789

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	3.226	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.434	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	19.35	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.291	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.669	Mean of logged Data	0.174
Maximum of Logged Data	0.779	SD of logged Data	0.753

Assuming Lognormal Distribution

95% H-UCL	294.6	90% Chebyshev (MVUE) UCL	3.166
95% Chebyshev (MVUE) UCL	3.954	97.5% Chebyshev (MVUE) UCL	5.048
99% Chebyshev (MVUE) UCL	7.196		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.198	95% Jackknife UCL	2.816
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.854	95% Chebyshev(Mean, Sd) UCL	3.513
97.5% Chebyshev(Mean, Sd) UCL	4.427	99% Chebyshev(Mean, Sd) UCL	6.222

Suggested UCL to Use

95% Student's-t UCL	2.816

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	578	Mean	2190
Maximum	5320	Median	672
SD	2711	Std. Error of Mean	1565
Coefficient of Variation	1.238	Skewness	1.73

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.765	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.379	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6760	95% Adjusted-CLT UCL (Chen-1995)	6435
		95% Modified-t UCL (Johnson-1978)	7021

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.058	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2070	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.349	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.801	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.364	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.36	Mean of logged Data	7.15
Maximum of Logged Data	8.579	SD of logged Data	1.24

Assuming Lognormal Distribution

95% H-UCL	4.08E+09	90% Chebyshev (MVUE) UCL	5684
95% Chebyshev (MVUE) UCL	7345	97.5% Chebyshev (MVUE) UCL	9652
99% Chebyshev (MVUE) UCL	14182		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4765	95% Jackknife UCL	6760
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6886	95% Chebyshev(Mean, Sd) UCL	9013
97.5% Chebyshev(Mean, Sd) UCL	11965	99% Chebyshev(Mean, Sd) UCL	17764

Suggested UCL to Use

95% Student's-t UCL	6760

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7660	Mean	15428
Maximum	29900	Median	12075
SD	10281	Std. Error of Mean	5141
Coefficient of Variation	0.666	Skewness	1.372

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.855	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	27525	95% Adjusted-CLT UCL (Chen-1995)	27653
		95% Modified-t UCL (Johnson-1978)	28113
Gamma GOF Test			
A-D Test Statistic	0.369	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.396	k star (bias corrected MLE)	1.016
Theta hat (MLE)	4542	Theta star (bias corrected MLE)	15188
nu hat (MLE)	27.17	nu star (bias corrected)	8.126
MLE Mean (bias corrected)	15428	MLE Sd (bias corrected)	15307
		Approximate Chi Square Value (0.05)	2.808
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	44642	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.944	Mean of logged Data	9.49
Maximum of Logged Data	10.31	SD of logged Data	0.627
Assuming Lognormal Distribution			
95% H-UCL	78329	90% Chebyshev (MVUE) UCL	29207
95% Chebyshev (MVUE) UCL	35525	97.5% Chebyshev (MVUE) UCL	44293
99% Chebyshev (MVUE) UCL	61516		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	23883	95% Jackknife UCL	27525
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	30849	95% Chebyshev(Mean, Sd) UCL	37835
97.5% Chebyshev(Mean, Sd) UCL	47531	99% Chebyshev(Mean, Sd) UCL	66576

Suggested UCL to Use

95% Student's-t UCL	27525

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	13.2	Mean	19.35
Maximum	28.5	Median	17.85
SD	6.488	Std. Error of Mean	3.244
Coefficient of Variation	0.335	Skewness	1.283

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.895	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.32	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	26.98	95% Adjusted-CLT UCL (Chen-1995)	26.91
		95% Modified-t UCL (Johnson-1978)	27.33
Gamma GOF Test			
A-D Test Statistic	0.343	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.3	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	12.9	k star (bias corrected MLE)	3.392
Theta hat (MLE)	1.5	Theta star (bias corrected MLE)	5.705
nu hat (MLE)	103.2	nu star (bias corrected)	27.14
MLE Mean (bias corrected)	19.35	MLE Sd (bias corrected)	10.51
		Approximate Chi Square Value (0.05)	16.26
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	32.3	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.278	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.58	Mean of logged Data	2.923
Maximum of Logged Data	3.35	SD of logged Data	0.318
Assuming Lognormal Distribution			
95% H-UCL	33	90% Chebyshev (MVUE) UCL	28.47
95% Chebyshev (MVUE) UCL	32.62	97.5% Chebyshev (MVUE) UCL	38.38
99% Chebyshev (MVUE) UCL	49.68		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	24.69	95% Jackknife UCL	26.98
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	29.08	95% Chebyshev(Mean, Sd) UCL	33.49
97.5% Chebyshev(Mean, Sd) UCL	39.61	99% Chebyshev(Mean, Sd) UCL	51.63
Suggested UCL to Use			
95% Student's-t UCL	26.98		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.73	Mean	4.808
Maximum	6.75	Median	4.375
SD	1.39	Std. Error of Mean	0.695
Coefficient of Variation	0.289	Skewness	1.31

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.866	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.443	95% Adjusted-CLT UCL (Chen-1995)	6.437
		95% Modified-t UCL (Johnson-1978)	6.519

Gamma GOF Test

A-D Test Statistic	0.387	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.283	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	17.43	k star (bias corrected MLE)	4.525
Theta hat (MLE)	0.276	Theta star (bias corrected MLE)	1.063
nu hat (MLE)	139.5	nu star (bias corrected)	36.2
MLE Mean (bias corrected)	4.808	MLE Sd (bias corrected)	2.26
		Approximate Chi Square Value (0.05)	23.43
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.428	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.894	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.252	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.316	Mean of logged Data	1.541
Maximum of Logged Data	1.91	SD of logged Data	0.272

Assuming Lognormal Distribution

95% H-UCL	7.388	90% Chebyshev (MVUE) UCL	6.751
95% Chebyshev (MVUE) UCL	7.634	97.5% Chebyshev (MVUE) UCL	8.86
99% Chebyshev (MVUE) UCL	11.27		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5.951	95% Jackknife UCL	6.443
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6.893	95% Chebyshev(Mean, Sd) UCL	7.838
97.5% Chebyshev(Mean, Sd) UCL	9.149	99% Chebyshev(Mean, Sd) UCL	11.72

Suggested UCL to Use

95% Student's-t UCL	6.443

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	3/2/2015 12:45		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.72	Mean	4.208
Maximum	4.99	Median	4.06
SD	0.609	Std. Error of Mean	0.304
Coefficient of Variation	0.145	Skewness	0.77

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.87	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.924	95% Adjusted-CLT UCL (Chen-1995)	4.833
		95% Modified-t UCL (Johnson-1978)	4.943
Gamma GOF Test			
A-D Test Statistic	0.421	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.32	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	65.57	k star (bias corrected MLE)	16.56
Theta hat (MLE)	0.0642	Theta star (bias corrected MLE)	0.254
nu hat (MLE)	524.6	nu star (bias corrected)	132.5
MLE Mean (bias corrected)	4.208	MLE Sd (bias corrected)	1.034
		Approximate Chi Square Value (0.05)	106.9
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.215	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.87	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.314	Mean of logged Data	1.429
Maximum of Logged Data	1.607	SD of logged Data	0.142
Assuming Lognormal Distribution			
95% H-UCL	5.097	90% Chebyshev (MVUE) UCL	5.101
95% Chebyshev (MVUE) UCL	5.505	97.5% Chebyshev (MVUE) UCL	6.067
99% Chebyshev (MVUE) UCL	7.171		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.708	95% Jackknife UCL	4.924
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.12	95% Chebyshev(Mean, Sd) UCL	5.534
97.5% Chebyshev(Mean, Sd) UCL	6.108	99% Chebyshev(Mean, Sd) UCL	7.235
Suggested UCL to Use			
95% Student's-t UCL	4.924		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 14:19		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	103	Mean	146.5
Maximum	223	Median	130
SD	55.55	Std. Error of Mean	27.77
Coefficient of Variation	0.379	Skewness	1.2

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.872	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	211.9	95% Adjusted-CLT UCL (Chen-1995)	210
		95% Modified-t UCL (Johnson-1978)	214.6
Gamma GOF Test			
A-D Test Statistic	0.377	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.293	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.15	k star (bias corrected MLE)	2.705
Theta hat (MLE)	14.43	Theta star (bias corrected MLE)	54.15
nu hat (MLE)	81.23	nu star (bias corrected)	21.64
MLE Mean (bias corrected)	146.5	MLE Sd (bias corrected)	89.07
		Approximate Chi Square Value (0.05)	12.07
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	262.7	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.262	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.635	Mean of logged Data	4.937
Maximum of Logged Data	5.407	SD of logged Data	0.358
Assuming Lognormal Distribution			
95% H-UCL	276.2	90% Chebyshev (MVUE) UCL	223.9
95% Chebyshev (MVUE) UCL	259.2	97.5% Chebyshev (MVUE) UCL	308.1
99% Chebyshev (MVUE) UCL	404.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	192.2	95% Jackknife UCL	211.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	229.8	95% Chebyshev(Mean, Sd) UCL	267.6
97.5% Chebyshev(Mean, Sd) UCL	320	99% Chebyshev(Mean, Sd) UCL	422.9

Suggested UCL to Use

95% Student's-t UCL	211.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:17
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.038	Minimum Non-Detect	0.02
Maximum Detect	0.04	Maximum Non-Detect	0.02
Variance Detects	2.00E-06	Percent Non-Detects	33.33%
Mean Detects	0.039	SD Detects	0.00141
Median Detects	0.039	CV Detects	0.0363
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.245	SD of Logged Detects	0.0363

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0327	Standard Error of Mean	0.00734
SD	0.00899	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0541	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0447	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0547	95% KM Chebyshev UCL	0.0647
97.5% KM Chebyshev UCL	0.0785	99% KM Chebyshev UCL	0.106

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1521	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.56E-05	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6083	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	13.19	nu hat (KM)	79.15
		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (79.15, α)	59.66	Adjusted Chi Square Value (79.15, β)	46.69
95% Gamma Approximate KM-UCL (use when n>=50)	0.0433	95% Gamma Adjusted KM-UCL (use when n<50)	0.0554

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0376	Mean in Log Scale	-3.283
SD in Original Scale	0.00268	SD in Log Scale	0.072
95% t UCL (assumes normality of ROS data)	0.0421	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0293	Mean in Log Scale	-3.698
SD in Original Scale	0.0168	SD in Log Scale	0.786
95% t UCL (Assumes normality)	0.0576	95% H-Stat UCL	10.03

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	231	Mean	299.5
Maximum	367	Median	300
SD	64.01	Std. Error of Mean	32
Coefficient of Variation	0.214	Skewness	-0.0237

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.231	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	374.8	95% Adjusted-CLT UCL (Chen-1995)	351.7
		95% Modified-t UCL (Johnson-1978)	374.8
Gamma GOF Test			
A-D Test Statistic	0.334	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.27	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	28.67	k star (bias corrected MLE)	7.335
Theta hat (MLE)	10.45	Theta star (bias corrected MLE)	40.83
nu hat (MLE)	229.4	nu star (bias corrected)	58.68
MLE Mean (bias corrected)	299.5	MLE Sd (bias corrected)	110.6
		Approximate Chi Square Value (0.05)	42.07
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	417.8	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.442	Mean of logged Data	5.685
Maximum of Logged Data	5.905	SD of logged Data	0.217
Assuming Lognormal Distribution			
95% H-UCL	413.1	90% Chebyshev (MVUE) UCL	396.9
95% Chebyshev (MVUE) UCL	441	97.5% Chebyshev (MVUE) UCL	502.2
99% Chebyshev (MVUE) UCL	622.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	352.1	95% Jackknife UCL	374.8
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	395.5	95% Chebyshev(Mean, Sd) UCL	439
97.5% Chebyshev(Mean, Sd) UCL	499.4	99% Chebyshev(Mean, Sd) UCL	617.9

Suggested UCL to Use

95% Student's-t UCL	374.8

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3010	Mean	4348
Maximum	6900	Median	3740
SD	1736	Std. Error of Mean	868.1
Coefficient of Variation	0.399	Skewness	1.757

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.385	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6390	95% Adjusted-CLT UCL (Chen-1995)	6590
		95% Modified-t UCL (Johnson-1978)	6517

Gamma GOF Test

A-D Test Statistic	0.537	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.385	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.836	k star (bias corrected MLE)	2.626
Theta hat (MLE)	442	Theta star (bias corrected MLE)	1656
nu hat (MLE)	78.69	nu star (bias corrected)	21.01
MLE Mean (bias corrected)	4348	MLE Sd (bias corrected)	2683
		Approximate Chi Square Value (0.05)	11.6
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7876	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.356	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.01	Mean of logged Data	8.326
Maximum of Logged Data	8.839	SD of logged Data	0.357

Assuming Lognormal Distribution

95% H-UCL	8164	90% Chebyshev (MVUE) UCL	6628
95% Chebyshev (MVUE) UCL	7669	97.5% Chebyshev (MVUE) UCL	9114
99% Chebyshev (MVUE) UCL	11953		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5775	95% Jackknife UCL	6390
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6952	95% Chebyshev(Mean, Sd) UCL	8131
97.5% Chebyshev(Mean, Sd) UCL	9769	99% Chebyshev(Mean, Sd) UCL	12985

Suggested UCL to Use

95% Student's-t UCL	6390

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 14:20		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7.27	Mean	9.415
Maximum	13.1	Median	8.645
SD	2.567	Std. Error of Mean	1.283
Coefficient of Variation	0.273	Skewness	1.512

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.874	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.3	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.44	95% Adjusted-CLT UCL (Chen-1995)	12.56
		95% Modified-t UCL (Johnson-1978)	12.6
Gamma GOF Test			
A-D Test Statistic	0.365	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.282	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	19.86	k star (bias corrected MLE)	5.132
Theta hat (MLE)	0.474	Theta star (bias corrected MLE)	1.834
nu hat (MLE)	158.9	nu star (bias corrected)	41.06
MLE Mean (bias corrected)	9.415	MLE Sd (bias corrected)	4.156
		Approximate Chi Square Value (0.05)	27.37
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	14.12	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.919	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.265	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.984	Mean of logged Data	2.217
Maximum of Logged Data	2.573	SD of logged Data	0.254
Assuming Lognormal Distribution			
95% H-UCL	13.93	90% Chebyshev (MVUE) UCL	12.97
95% Chebyshev (MVUE) UCL	14.58	97.5% Chebyshev (MVUE) UCL	16.83
99% Chebyshev (MVUE) UCL	21.23		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	11.53	95% Jackknife UCL	12.44
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.26	95% Chebyshev(Mean, Sd) UCL	15.01
97.5% Chebyshev(Mean, Sd) UCL	17.43	99% Chebyshev(Mean, Sd) UCL	22.18

Suggested UCL to Use

95% Student's-t UCL	12.44

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation:	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	1.06	Minimum Non-Detect	0.498
Maximum Detect	1.4	Maximum Non-Detect	1.02
Variance Detects	0.0578	Percent Non-Detects	50%
Mean Detects	1.23	SD Detects	0.24
Median Detects	1.23	CV Detects	0.195
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.197	SD of Logged Detects	0.197

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.864	Standard Error of Mean	0.272
SD	0.385	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.505	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.312	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.681	95% KM Chebyshev UCL	2.051
97.5% KM Chebyshev UCL	2.565	99% KM Chebyshev UCL	3.574

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	52.01	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0236	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	208.1	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.03	nu hat (KM)	40.24
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (40.24, α)	26.71	Adjusted Chi Square Value (40.24, β)	20.87
95% Gamma Approximate KM-UCL (use when n>=50)	1.302	95% Gamma Adjusted KM-UCL (use when n<50)	1.666

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.914	Mean in Log Scale	-0.159
SD in Original Scale	0.391	SD in Log Scale	0.426
95% t UCL (assumes normality of ROS data)	1.373	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	2.103		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.805	Mean in Log Scale	-0.417
SD in Original Scale	0.521	SD in Log Scale	0.776
95% t UCL (Assumes normality)	1.418	95% H-Stat UCL	9.42

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.505	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.724	Mean	1.078
Maximum	1.37	Median	1.109
SD	0.297	Std. Error of Mean	0.148
Coefficient of Variation	0.275	Skewness	-0.372

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.241	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.427	95% Adjusted-CLT UCL (Chen-1995)	1.293
		95% Modified-t UCL (Johnson-1978)	1.423
Gamma GOF Test			
A-D Test Statistic	0.309	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.278	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.43	k star (bias corrected MLE)	4.274
Theta hat (MLE)	0.0656	Theta star (bias corrected MLE)	0.252
nu hat (MLE)	131.4	nu star (bias corrected)	34.19
MLE Mean (bias corrected)	1.078	MLE Sd (bias corrected)	0.521
		Approximate Chi Square Value (0.05)	21.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.689	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.929	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.323	Mean of logged Data	0.0444
Maximum of Logged Data	0.315	SD of logged Data	0.292
Assuming Lognormal Distribution			
95% H-UCL	1.733	90% Chebyshev (MVUE) UCL	1.548
95% Chebyshev (MVUE) UCL	1.761	97.5% Chebyshev (MVUE) UCL	2.056
99% Chebyshev (MVUE) UCL	2.636		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.322	95% Jackknife UCL	1.427
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.523	95% Chebyshev(Mean, Sd) UCL	1.725
97.5% Chebyshev(Mean, Sd) UCL	2.005	99% Chebyshev(Mean, Sd) UCL	2.555

Suggested UCL to Use

95% Student's-t UCL	1.427

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1030	Mean	1738
Maximum	2910	Median	1505
SD	884.1	Std. Error of Mean	442
Coefficient of Variation	0.509	Skewness	0.946

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.271	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2778	95% Adjusted-CLT UCL (Chen-1995)	2688
		95% Modified-t UCL (Johnson-1978)	2813

Gamma GOF Test

A-D Test Statistic	0.39	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.311	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.458	k star (bias corrected MLE)	1.531
Theta hat (MLE)	318.3	Theta star (bias corrected MLE)	1135
nu hat (MLE)	43.66	nu star (bias corrected)	12.25
MLE Mean (bias corrected)	1738	MLE Sd (bias corrected)	1404
		Approximate Chi Square Value (0.05)	5.392
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3947	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.278	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.937	Mean of logged Data	7.366
Maximum of Logged Data	7.976	SD of logged Data	0.497

Assuming Lognormal Distribution

95% H-UCL	5086	90% Chebyshev (MVUE) UCL	2999
95% Chebyshev (MVUE) UCL	3572	97.5% Chebyshev (MVUE) UCL	4369
99% Chebyshev (MVUE) UCL	5934		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2465	95% Jackknife UCL	2778
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3064	95% Chebyshev(Mean, Sd) UCL	3664
97.5% Chebyshev(Mean, Sd) UCL	4498	99% Chebyshev(Mean, Sd) UCL	6136

Suggested UCL to Use

95% Student's-t UCL	2778

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7360	Mean	20025
Maximum	37400	Median	17670
SD	14820	Std. Error of Mean	7410
Coefficient of Variation	0.74	Skewness	0.385

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.291	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	37463	95% Adjusted-CLT UCL (Chen-1995)	33735
		95% Modified-t UCL (Johnson-1978)	37700

Gamma GOF Test

A-D Test Statistic	0.477	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.325	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.195	k star (bias corrected MLE)	0.715
Theta hat (MLE)	9122	Theta star (bias corrected MLE)	27988
nu hat (MLE)	17.56	nu star (bias corrected)	5.724
MLE Mean (bias corrected)	20025	MLE Sd (bias corrected)	23674
		Approximate Chi Square Value (0.05)	1.5
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	76391	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.289	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.904	Mean of logged Data	9.66
Maximum of Logged Data	10.53	SD of logged Data	0.833

Assuming Lognormal Distribution

95% H-UCL	330609	90% Chebyshev (MVUE) UCL	43920
95% Chebyshev (MVUE) UCL	54715	97.5% Chebyshev (MVUE) UCL	69699
99% Chebyshev (MVUE) UCL	99131		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	32213	95% Jackknife UCL	37463
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	42254	95% Chebyshev(Mean, Sd) UCL	52323
97.5% Chebyshev(Mean, Sd) UCL	66299	99% Chebyshev(Mean, Sd) UCL	93751

Suggested UCL to Use

95% Student's-t UCL	37463

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation:	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	15.9	Mean	21.93
Maximum	29.7	Median	21.05
SD	6.96	Std. Error of Mean	3.48
Coefficient of Variation	0.317	Skewness	0.25

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.295	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	30.11	95% Adjusted-CLT UCL (Chen-1995)	28.11
		95% Modified-t UCL (Johnson-1978)	30.19
Gamma GOF Test			
A-D Test Statistic	0.494	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.329	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.17	k star (bias corrected MLE)	3.459
Theta hat (MLE)	1.665	Theta star (bias corrected MLE)	6.339
nu hat (MLE)	105.4	nu star (bias corrected)	27.67
MLE Mean (bias corrected)	21.93	MLE Sd (bias corrected)	11.79
		Approximate Chi Square Value (0.05)	16.67
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	36.39	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.836	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.295	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.766	Mean of logged Data	3.049
Maximum of Logged Data	3.391	SD of logged Data	0.321
Assuming Lognormal Distribution			
95% H-UCL	37.68	90% Chebyshev (MVUE) UCL	32.39
95% Chebyshev (MVUE) UCL	37.13	97.5% Chebyshev (MVUE) UCL	43.71
99% Chebyshev (MVUE) UCL	56.64		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	27.65	95% Jackknife UCL	30.11
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	32.37	95% Chebyshev(Mean, Sd) UCL	37.09
97.5% Chebyshev(Mean, Sd) UCL	43.66	99% Chebyshev(Mean, Sd) UCL	56.55

Suggested UCL to Use

95% Student's-t UCL	30.11

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Be in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	3.51	Minimum Non-Detect	1.98
Maximum Detect	4.85	Maximum Non-Detect	1.99
Variance Detects	0.898	Percent Non-Detects	50%
Mean Detects	4.18	SD Detects	0.948
Median Detects	4.18	CV Detects	0.227
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.417	SD of Logged Detects	0.229

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.08	Standard Error of Mean	0.847
SD	1.198	95% KM (BCA) UCL	N/A
95% KM (t) UCL	5.073	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.473	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	5.621	95% KM Chebyshev UCL	6.772
97.5% KM Chebyshev UCL	8.369	99% KM Chebyshev UCL	11.51

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	38.59	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	154.3	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.613	nu hat (KM)	52.91
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (52.91, α)	37.2	Adjusted Chi Square Value (52.91, β)	30.15
95% Gamma Approximate KM-UCL (use when n>=50)	4.381	95% Gamma Adjusted KM-UCL (use when n<50)	5.405

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.992	Mean in Log Scale	1.004
SD in Original Scale	1.477	SD in Log Scale	0.496
95% t UCL (assumes normality of ROS data)	4.73	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	8.731		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.586	Mean in Log Scale	0.705
SD in Original Scale	1.92	SD in Log Scale	0.833
95% t UCL (Assumes normality)	4.845	95% H-Stat UCL	42.74

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	5.073	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2.46	Mean	10.07
Maximum	18.6	Median	9.615
SD	7.763	Std. Error of Mean	3.881
Coefficient of Variation	0.771	Skewness	0.158

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.258	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.21	95% Adjusted-CLT UCL (Chen-1995)	16.78
		95% Modified-t UCL (Johnson-1978)	19.26

Gamma GOF Test

A-D Test Statistic	0.355	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.281	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.812	k star (bias corrected MLE)	0.62
Theta hat (MLE)	5.558	Theta star (bias corrected MLE)	16.25
nu hat (MLE)	14.5	nu star (bias corrected)	4.958
MLE Mean (bias corrected)	10.07	MLE Sd (bias corrected)	12.79
		Approximate Chi Square Value (0.05)	1.133
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	44.08	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.9	Mean of logged Data	2.009
Maximum of Logged Data	2.923	SD of logged Data	0.956

Assuming Lognormal Distribution

95% H-UCL	401.9	90% Chebyshev (MVUE) UCL	24.09
95% Chebyshev (MVUE) UCL	30.34	97.5% Chebyshev (MVUE) UCL	39.01
99% Chebyshev (MVUE) UCL	56.05		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	16.46	95% Jackknife UCL	19.21
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	21.72	95% Chebyshev(Mean, Sd) UCL	26.99
97.5% Chebyshev(Mean, Sd) UCL	34.31	99% Chebyshev(Mean, Sd) UCL	48.69

Suggested UCL to Use

95% Student's-t UCL	19.21

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	92	Mean	191
Maximum	357	Median	157.5
SD	119.8	Std. Error of Mean	59.89
Coefficient of Variation	0.627	Skewness	1.234

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	331.9	95% Adjusted-CLT UCL (Chen-1995)	329
		95% Modified-t UCL (Johnson-1978)	338.1
Gamma GOF Test			
A-D Test Statistic	0.295	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.713	k star (bias corrected MLE)	1.095
Theta hat (MLE)	51.44	Theta star (bias corrected MLE)	174.4
nu hat (MLE)	29.7	nu star (bias corrected)	8.759
MLE Mean (bias corrected)	191	MLE Sd (bias corrected)	182.5
		Approximate Chi Square Value (0.05)	3.182
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	525.7	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.522	Mean of logged Data	5.112
Maximum of Logged Data	5.878	SD of logged Data	0.604
Assuming Lognormal Distribution			
95% H-UCL	873	90% Chebyshev (MVUE) UCL	356.9
95% Chebyshev (MVUE) UCL	432.7	97.5% Chebyshev (MVUE) UCL	537.8
99% Chebyshev (MVUE) UCL	744.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	289.5	95% Jackknife UCL	331.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	370.7	95% Chebyshev(Mean, Sd) UCL	452.1
97.5% Chebyshev(Mean, Sd) UCL	565	99% Chebyshev(Mean, Sd) UCL	786.9

Suggested UCL to Use

95% Student's-t UCL	331.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	3/2/2015 12:45		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4.28	Mean	5.403
Maximum	7.38	Median	4.975
SD	1.372	Std. Error of Mean	0.686
Coefficient of Variation	0.254	Skewness	1.554

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.864	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.306	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.017	95% Adjusted-CLT UCL (Chen-1995)	7.1
		95% Modified-t UCL (Johnson-1978)	7.106
Gamma GOF Test			
A-D Test Statistic	0.387	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.291	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	22.87	k star (bias corrected MLE)	5.883
Theta hat (MLE)	0.236	Theta star (bias corrected MLE)	0.918
nu hat (MLE)	182.9	nu star (bias corrected)	47.07
MLE Mean (bias corrected)	5.403	MLE Sd (bias corrected)	2.227
		Approximate Chi Square Value (0.05)	32.32
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.867	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.906	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.274	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.454	Mean of logged Data	1.665
Maximum of Logged Data	1.999	SD of logged Data	0.237
Assuming Lognormal Distribution			
95% H-UCL	7.721	90% Chebyshev (MVUE) UCL	7.304
95% Chebyshev (MVUE) UCL	8.168	97.5% Chebyshev (MVUE) UCL	9.368
99% Chebyshev (MVUE) UCL	11.72		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.531	95% Jackknife UCL	7.017
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.46	95% Chebyshev(Mean, Sd) UCL	8.393
97.5% Chebyshev(Mean, Sd) UCL	9.686	99% Chebyshev(Mean, Sd) UCL	12.23
Suggested UCL to Use			
95% Student's-t UCL	7.017		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.02	Mean	0.041
Maximum	0.06	Median	0.043
SD	0.0201	Std. Error of Mean	0.0116
Coefficient of Variation	0.49	Skewness	-0.444

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.993	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0748	95% Adjusted-CLT UCL (Chen-1995)	0.0569
		95% Modified-t UCL (Johnson-1978)	0.0743
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	5.344	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00767	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	32.06	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.951	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.268	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-3.291
Maximum of Logged Data	-2.813	SD of logged Data	0.563
Assuming Lognormal Distribution			
95% H-UCL	0.806	90% Chebyshev (MVUE) UCL	0.08
95% Chebyshev (MVUE) UCL	0.0976	97.5% Chebyshev (MVUE) UCL	0.122
99% Chebyshev (MVUE) UCL	0.17		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0601	95% Jackknife UCL	0.0748
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0758	95% Chebyshev(Mean, Sd) UCL	0.0915
97.5% Chebyshev(Mean, Sd) UCL	0.113	99% Chebyshev(Mean, Sd) UCL	0.156

Suggested UCL to Use

95% Student's-t UCL	0.0748

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Pb in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	244	Mean	299.5
Maximum	378	Median	288
SD	65.08	Std. Error of Mean	32.54
Coefficient of Variation	0.217	Skewness	0.482

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.876	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	376.1	95% Adjusted-CLT UCL (Chen-1995)	361.4
		95% Modified-t UCL (Johnson-1978)	377.4
Gamma GOF Test			
A-D Test Statistic	0.426	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.321	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	28.76	k star (bias corrected MLE)	7.356
Theta hat (MLE)	10.42	Theta star (bias corrected MLE)	40.72
nu hat (MLE)	230.1	nu star (bias corrected)	58.85
MLE Mean (bias corrected)	299.5	MLE Sd (bias corrected)	110.4
		Approximate Chi Square Value (0.05)	42.21
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	417.6	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.871	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.497	Mean of logged Data	5.685
Maximum of Logged Data	5.935	SD of logged Data	0.215
Assuming Lognormal Distribution			
95% H-UCL	411.2	90% Chebyshev (MVUE) UCL	395.7
95% Chebyshev (MVUE) UCL	439.3	97.5% Chebyshev (MVUE) UCL	499.9
99% Chebyshev (MVUE) UCL	618.8		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	353	95% Jackknife UCL	376.1
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	397.1	95% Chebyshev(Mean, Sd) UCL	441.3
97.5% Chebyshev(Mean, Sd) UCL	502.7	99% Chebyshev(Mean, Sd) UCL	623.3

Suggested UCL to Use

95% Student's-t UCL	376.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Mn in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2130	Mean	7425
Maximum	13100	Median	7235
SD	5216	Std. Error of Mean	2608
Coefficient of Variation	0.703	Skewness	0.104

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13563	95% Adjusted-CLT UCL (Chen-1995)	11860
		95% Modified-t UCL (Johnson-1978)	13586

Gamma GOF Test

A-D Test Statistic	0.336	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.279	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.235	k star (bias corrected MLE)	0.725
Theta hat (MLE)	3323	Theta star (bias corrected MLE)	10237
nu hat (MLE)	17.88	nu star (bias corrected)	5.803
MLE Mean (bias corrected)	7425	MLE Sd (bias corrected)	8718
		Approximate Chi Square Value (0.05)	1.54
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	27980	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.664	Mean of logged Data	8.672
Maximum of Logged Data	9.48	SD of logged Data	0.849

Assuming Lognormal Distribution

95% H-UCL	138250	90% Chebyshev (MVUE) UCL	16668
95% Chebyshev (MVUE) UCL	20798	97.5% Chebyshev (MVUE) UCL	26529
99% Chebyshev (MVUE) UCL	37787		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11715	95% Jackknife UCL	13563
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	15250	95% Chebyshev(Mean, Sd) UCL	18794
97.5% Chebyshev(Mean, Sd) UCL	23713	99% Chebyshev(Mean, Sd) UCL	33377

Suggested UCL to Use

95% Student's-t UCL	13563

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7.36	Mean	18.27
Maximum	31.6	Median	17.05
SD	10.78	Std. Error of Mean	5.391
Coefficient of Variation	0.59	Skewness	0.475

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.216	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	30.95	95% Adjusted-CLT UCL (Chen-1995)	28.5
		95% Modified-t UCL (Johnson-1978)	31.16
Gamma GOF Test			
A-D Test Statistic	0.232	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.207	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.568	k star (bias corrected MLE)	1.059
Theta hat (MLE)	5.119	Theta star (bias corrected MLE)	17.25
nu hat (MLE)	28.55	nu star (bias corrected)	8.47
MLE Mean (bias corrected)	18.27	MLE Sd (bias corrected)	17.75
		Approximate Chi Square Value (0.05)	3.01
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	51.4	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.197	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.996	Mean of logged Data	2.758
Maximum of Logged Data	3.453	SD of logged Data	0.644
Assuming Lognormal Distribution			
95% H-UCL	102.2	90% Chebyshev (MVUE) UCL	35.53
95% Chebyshev (MVUE) UCL	43.31	97.5% Chebyshev (MVUE) UCL	54.12
99% Chebyshev (MVUE) UCL	75.34		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	27.13	95% Jackknife UCL	30.95
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	34.44	95% Chebyshev(Mean, Sd) UCL	41.76
97.5% Chebyshev(Mean, Sd) UCL	51.93	99% Chebyshev(Mean, Sd) UCL	71.9

Suggested UCL to Use

95% Student's-t UCL	30.95

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.02	Mean	1.285
Maximum	1.71	Median	1.205
SD	0.314	Std. Error of Mean	0.157
Coefficient of Variation	0.244	Skewness	1.074

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.654	95% Adjusted-CLT UCL (Chen-1995)	1.633
		95% Modified-t UCL (Johnson-1978)	1.668
Gamma GOF Test			
A-D Test Statistic	0.33	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.275	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	23.81	k star (bias corrected MLE)	6.118
Theta hat (MLE)	0.054	Theta star (bias corrected MLE)	0.21
nu hat (MLE)	190.5	nu star (bias corrected)	48.95
MLE Mean (bias corrected)	1.285	MLE Sd (bias corrected)	0.52
		Approximate Chi Square Value (0.05)	33.89
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.856	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.0198	Mean of logged Data	0.23
Maximum of Logged Data	0.536	SD of logged Data	0.234
Assuming Lognormal Distribution			
95% H-UCL	1.829	90% Chebyshev (MVUE) UCL	1.733
95% Chebyshev (MVUE) UCL	1.937	97.5% Chebyshev (MVUE) UCL	2.219
99% Chebyshev (MVUE) UCL	2.774		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.543	95% Jackknife UCL	1.654
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.755	95% Chebyshev(Mean, Sd) UCL	1.968
97.5% Chebyshev(Mean, Sd) UCL	2.264	99% Chebyshev(Mean, Sd) UCL	2.845

Suggested UCL to Use

95% Student's-t UCL	1.654

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	1.16	Minimum Non-Detect	0.496
Maximum Detect	3.1	Maximum Non-Detect	0.997
Variance Detects	1.882	Percent Non-Detects	50%
Mean Detects	2.13	SD Detects	1.372
Median Detects	2.13	CV Detects	0.644
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.64	SD of Logged Detects	0.695

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.313	Standard Error of Mean	0.754
SD	1.067	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.088	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.554	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3.576	95% KM Chebyshev UCL	4.601
97.5% KM Chebyshev UCL	6.024	99% KM Chebyshev UCL	8.818

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	4.462	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.477	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.85	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.515	nu hat (KM)	12.12
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (12.12, α)	5.306	Adjusted Chi Square Value (12.12, β)	3.132
95% Gamma Approximate KM-UCL (use when n>=50)	2.999	95% Gamma Adjusted KM-UCL (use when n<50)	5.08

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.142	Mean in Log Scale	-0.618
SD in Original Scale	1.389	SD in Log Scale	1.507
95% t UCL (assumes normality of ROS data)	2.776	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	9381		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.252	Mean in Log Scale	-0.203
SD in Original Scale	1.291	SD in Log Scale	1.09
95% t UCL (Assumes normality)	2.771	95% H-Stat UCL	141.3

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.088	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 11:31
From File	WorkSheet_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1700	Mean	4620
Maximum	8670	Median	4055
SD	3335	Std. Error of Mean	1668
Coefficient of Variation	0.722	Skewness	0.502

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.891	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.277	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8544	95% Adjusted-CLT UCL (Chen-1995)	7810
		95% Modified-t UCL (Johnson-1978)	8614
Gamma GOF Test			
A-D Test Statistic	0.397	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.304	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.371	k star (bias corrected MLE)	0.759
Theta hat (MLE)	1949	Theta star (bias corrected MLE)	6084
nu hat (MLE)	18.97	nu star (bias corrected)	6.075
MLE Mean (bias corrected)	4620	MLE Sd (bias corrected)	5302
		Approximate Chi Square Value (0.05)	1.678
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	16724	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.887	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.264	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.438	Mean of logged Data	8.213
Maximum of Logged Data	9.068	SD of logged Data	0.796
Assuming Lognormal Distribution			
95% H-UCL	60185	90% Chebyshev (MVUE) UCL	9897
95% Chebyshev (MVUE) UCL	12284	97.5% Chebyshev (MVUE) UCL	15597
99% Chebyshev (MVUE) UCL	22105		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7363	95% Jackknife UCL	8544
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	9623	95% Chebyshev(Mean, Sd) UCL	11889
97.5% Chebyshev(Mean, Sd) UCL	15034	99% Chebyshev(Mean, Sd) UCL	21212

Suggested UCL to Use

95% Student's-t UCL	8544

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Sediment data for Pro UCL

Sample Location	Arsenic		Beryllium		Cadmium		Copper		Lead		Manganese		Mercury		Selenium		Silver		Zinc		Cr		Ni		
Animas River above mainstem cement creek																									
A60	24.4	1	2.01	0	14.7	1	286	1	2100	1	12600	1			0.502	0	4.05	1	3180	1	4.97	1	8.95	1	May-12
A61	44.0	1.0	2.53	1	11.3	1	466	1	2120	1	11000	1			0.505	0	7.34	1	2840	1	5.69	1	16.5	1	Oct-12
A64	44.2	1	2.77	1	11.9	1	336	1	1770	1	9670	1			0.905	1	7.14	1	3470	1	4.86	1	7.58	1	May-13
A65	30.3	1	2.02	0	10.3	1	328	1	1840	1	12900	1			0.504	0	5.53	1	2590	1	4.71	1	7.19	1	
A66	26.9	1	1.99	0	8.44	1	257	1	1750	1	7830	1			0.497	0	5.06	1	1950	1	4.42	1	7.2	1	
A68	26.3	1	2.01	0	13.7	1	352	1	2180	1	10300	1			0.501	0	9.22	1	2830	1	4.76	1	6.68	1	
A68	25.9	1	2.01	0	13.4	1	374	1	1890	1	12200	1	0.081	D	1.29	1	7.09	1	3030	1	5.68	1	5.92	1	
A68	89.5	1	6.77	1	24.2	1	745	1	3030	1	22300	1	0.19	D	2.86	1	13.3	1	11500	1	5.21	1	8.76	1	
A60	16.4	1	2.01	0	5.84	1	166	1	554	1	3400	1	0.033	D	1.0	0	3.48	1	1530	1	6.35	1	9.62	1	Apr-14
A61	19.8	1	2.99	1	9.02	1	638	1	891	1	6400	1	0.091	D	1.1	1	4.28	1	2530	1	5.28	1	8.56	1	
A64	18.8	1	2.02	0	6.25	1	199	1	1050	1	4920	1	0.053	D	1.01	0	3.59	1	1950	1	5.15	1	7.44	1	
A65	21.8	1	2.16	1	10.2	1	331	1	900	1	10300	1	0.073	D	1.01	0	3.87	1	2890	1	5.49	1	9.9	1	
A66	18.3	1	2.24	1	18.3	1	378	1	1230	1	20500	1	0.06	D	1.0	0	4.13	1	4380	1	4.07	1	10.1	1	
A68	19.1	1	2.82	1	15.7	1	390	1	1080	1	19700	1	0.056	D	0.998	0	4.35	1	4890	1	4.21	1	10.3	1	
A60	20.4	1	2.03	0	9.55	1	262	1	1610	1	7460	1	0.07	D	1.02	0	5.96	1	2130	1	3.88	1	6.26	1	Sep-14
A61	20.5	1	2.1	1	4.95	1	286	1	1400	1	8210	1	0.05	D	0.995	0	5.23	1	2330	1	3.55	1	6.52	1	
A64	21.3	1	3.0	1	7.93	1	264	1	1120	1	6850	1	0.13	D	1.01	0	4.88	1	2730	1	3.55	1	6.84	1	
A65	19.4	1	1.99	0	6.82	1	271	1	1220	1	8180	1	0.03	D	0.997	0	3.61	1	1700	1	3.76	1	6.49	1	
A66	23.7	1	2.03	0	9.17	1	243	1	1190	1	8190	1	0.05	D	1.01	0	4.81	1	2500	1	3.7	1	7.11	1	
A68	17.5	1	1.97	0	10.8	1	216	1	1240	1	9430	1	0.02	JD	0.985	0	2.9	1	2480	1	3.73	1	6.56	1	
count	20		20		20		20		20		20		14		20		20		20						
Max	89.5	1	6.77	1	24.2	1	745	1	3030	1	22300	1	0.19	0	2.86	1	13.3	1	11500						
Min	16.4	1	1.97	0	4.95	1	166	1	554	1	3400	1	0.02	0	0.497	0	2.9	1	1530						

		aluminum		arsenic		beryllium		cadmium		copper		lead		manganese		nickel		selenium		silver		Zinc		Hg		Cr	
Animas River downstream of mainstem Mineral Creek																											
A72	May-12	12200	1	40.6	1	1.97	0	2.8	1	152	1	581	1	2710	1	6.38	1	2.03	1	1.99	1	748	1	0.072	1	6.1	1
A72	Oct-12	21500	1	36.3	1	2	0	1.81	1	179	1	542	1	1470	1	4.79	1	1.83	1	2.76	1	646	1	0.06	1	4.05	1
A72	May-13	11800	1	26.1	1	1.97	0	1.15	1	77.8	1	299	1	1210	1	4.88	1	1.04	1	1.3	1	386	1			6.41	1
A72	Apr-14	18900	1	37	1	2.0	0	1.7	1	145	1	470	1	1710	1	4.33	1	1.05	1	1.68	1	616	1	0.039	1	3.45	1
A72	Sep-14	9960	1	26.8	1	2.03	0	3.03	1	133	1	499	1	3400	1	5.33	1	1.02	0	1.83	1	858	1	0.05	1	3.01	1
A73	Oct-12	11800	1	25.5	1	1.97	0	3.64	1	223	1	729	1	4140	1	6.84	1	1.43	1	2.32	1	1000	1	0.05	1	4.02	1
A73	May-13	9220	1	31.9	1	2.02	0	4.1	1	176	1	591	1	3320	1	6.07	1	0.717	1	2.78	1	998	1	0.036	1	5.6	1
A73	Apr-14	40700	1	33.8	1	4.2	1	5.6	1	284	1	297	1	7120	1	7.19	1	1.0	0	1.35	1	1450	1			2.83	1
A73	Sep-14	6770	1	20.5	1	2.04	0	2.7	1	113		435	1	2780	1	5.5	1	1.02	0	1.24	1	749	1	0.02	1	3.5	1
A73B	Oct-12	31900	1	39.4	1	3.24	1	4.24	1	292	1	468	1	2610	1	12.1	1	2.89	1	3.09	1	1720	1	0.09	1	5.02	1
A73B	May-13	10600	1	30.4	1	2	0	3.56	1	140	1	593	1	4340	1	9.78	1	0.5	0	1.65	1	964	1			4.72	1
A73B	Sep-14	6620	1	19.9	1	2.03	0	2.72	1	98.8	1	540	1	2480	1	8.16	1	1.01	0	1.25	1	659	1	0.04	1	3.68	1
A75B	Oct-12	48600	1	37.2	1	5.98	1	10.5	1	413	1	435	1	3820	1	16.5	1	3.26	1	2.18	1	5320	1	0.07	1	5.16	1
A75B	May-13	7220	1	13.3	1	1.99	0	2.65	1	82.7	1	354	1	2340	1	5.93	1	0.588	1	1.51	1	672	1			5.45	1
A75B	Sep-14	6640	1	9.22	1	1.99	0	1.99	1	67	1	98	1	2070	1	6.71	1	0.994	0	0.512	1	578	1	0.01	0	5.01	1
A75D	Oct-12	15600	1	13.2	1	1.97	0	4.87	1	152	1	231	1	3010	1	9.09	1	1.4	1	0.724	1	1930	1	0.04	1	3.73	1
A75D	May-13	8550	1	18.2	1	1.99	0	3.88	1	108	1	367	1	3730	1	7.27	1	0.498	0	1.37	1	1030	1	0.038	1	4.99	1
A75D	Apr-14	29900	1	28.5	1	3.66	1	6.75	1	223	1	261	1	6900	1	13.1	1	1.06	1	1.27	1	2910	1			4.39	1
A75D	Sep-14	7660	1	17.5	1	2.03	0	3.73	1	103	1	339	1	3750	1	8.2	1	1.02	0	0.948	1	1080	1	0.02	0	3.72	1
Bakers Bridge	Oct-12	37400	1	29.7	1	4.85	1	18.6	1	357	1	378	1	10500	1	31.6	1	3.1	1	1.71	1	8670	1	0.06	1	5.21	1
Bakers Bridge	May-13	7360	1	15.9	1	1.98	0	2.46	1	116	1	328	1	2130	1	7.36	1	0.496	0	1.08	1	2080	1			7.38	1
Bakers Bridge	Apr-14	27300	1	25.9	1	3.51	1	14.6	1	199	1	248	1	13100	1	22	1	1.16	1	1.33	1	6030	1	0.043	1	4.28	1
Bakers Bridge	Sep-14	8040	1	16.2	1	1.99	0	4.63	1	92	1	244	1	3970	1	12.1	1	0.997	0	1.02	1	1700	1	0.02	1	4.74	1

shaded = ND

ProUCL calculations for As in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 10:36
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	16.4	Mean	27.43
Maximum	89.5	Median	21.55
SD	16.51	Std. Error of Mean	3.692
Coefficient of Variation	0.602	Skewness	3.144
Normal GOF Test			
Shapiro Wilk Test Statistic	0.593	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.313	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	33.81	95% Adjusted-CLT UCL (Chen-1995)	36.27
		95% Modified-t UCL (Johnson-1978)	34.24
Gamma GOF Test			
A-D Test Statistic	1.88	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.259	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.168	k star (bias corrected MLE)	4.426
Theta hat (MLE)	5.307	Theta star (bias corrected MLE)	6.197
nu hat (MLE)	206.7	nu star (bias corrected)	177
MLE Mean (bias corrected)	27.43	MLE Sd (bias corrected)	13.04
		Approximate Chi Square Value (0.05)	147.3
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	145.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	32.97	95% Adjusted Gamma UCL (use when n<50)	33.46
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.79	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.797	Mean of logged Data	3.212
Maximum of Logged Data	4.494	SD of logged Data	0.405
Assuming Lognormal Distribution			
95% H-UCL	32.25	90% Chebyshev (MVUE) UCL	34.29
95% Chebyshev (MVUE) UCL	37.68	97.5% Chebyshev (MVUE) UCL	42.38
99% Chebyshev (MVUE) UCL	51.6		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	33.5	95% Jackknife UCL	33.81
95% Standard Bootstrap UCL	33.45	95% Bootstrap-t UCL	42.98
95% Hall's Bootstrap UCL	53.96	95% Percentile Bootstrap UCL	33.73
95% BCA Bootstrap UCL	37.12		
90% Chebyshev(Mean, Sd) UCL	38.5	95% Chebyshev(Mean, Sd) UCL	43.52
97.5% Chebyshev(Mean, Sd) UCL	50.48	99% Chebyshev(Mean, Sd) UCL	64.16
Suggested UCL to Use			
95% Student's-t UCL	33.81	or 95% Modified-t UCL	34.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Be in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 10:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	14
Number of Detects	9	Number of Non-Detects	11
Number of Distinct Detects	9	Number of Distinct Non-Detects	5
Minimum Detect	2.1	Minimum Non-Detect	1.97
Maximum Detect	6.77	Maximum Non-Detect	2.03
Variance Detects	2.075	Percent Non-Detects	55%
Mean Detects	3.042	SD Detects	1.44
Median Detects	2.77	CV Detects	0.473
Skewness Detects	2.668	Kurtosis Detects	7.565
Mean of Logged Detects	1.045	SD of Logged Detects	0.353

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.616	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.401	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.453	Standard Error of Mean	0.25
SD	1.056	95% KM (BCA) UCL	2.95
95% KM (t) UCL	2.885	95% KM (Percentile Bootstrap) UCL	2.9
95% KM (z) UCL	2.864	95% KM Bootstrap t UCL	3.482
90% KM Chebyshev UCL	3.204	95% KM Chebyshev UCL	3.544
97.5% KM Chebyshev UCL	4.016	99% KM Chebyshev UCL	4.944

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.129	Anderson-Darling GOF Test
5% A-D Critical Value	0.722	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.356	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.28	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	7.606	k star (bias corrected MLE)	5.145
Theta hat (MLE)	0.4	Theta star (bias corrected MLE)	0.591
nu hat (MLE)	136.9	nu star (bias corrected)	92.61
MLE Mean (bias corrected)	3.042	MLE Sd (bias corrected)	1.341

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.398	nu hat (KM)	215.9
Approximate Chi Square Value (215.90, α)	182.9	Adjusted Chi Square Value (215.90, β)	180.5
95% Gamma Approximate KM-UCL (use when n>=5(	2.895	95% Gamma Adjusted KM-UCL (use when n<50)	2.934

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.492
Maximum	6.77	Median	0.625
SD	1.727	CV	1.158
k hat (MLE)	0.43	k star (bias corrected MLE)	0.399
Theta hat (MLE)	3.466	Theta star (bias corrected MLE)	3.738
nu hat (MLE)	17.22	nu star (bias corrected)	15.97
MLE Mean (bias corrected)	1.492	MLE Sd (bias corrected)	2.361
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (15.97, α)	7.939	Adjusted Chi Square Value (15.97, β)	7.493
95% Gamma Approximate UCL (use when n>=50)	3.001	95% Gamma Adjusted UCL (use when n<50)	3.179

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.748	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.329	Lilliefors GOF Test
5% Lilliefors Critical Value	0.295	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.979	Mean in Log Scale	0.515
SD in Original Scale	1.37	SD in Log Scale	0.566
95% t UCL (assumes normality of ROS data)	2.508	95% Percentile Bootstrap UCL	2.502
95% BCA Bootstrap UCL	2.657	95% Bootstrap t UCL	2.861
95% H-UCL (Log ROS)	2.575		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.921	Mean in Log Scale	0.473
SD in Original Scale	1.398	SD in Log Scale	0.579
95% t UCL (Assumes normality)	2.462	95% H-Stat UCL	2.507

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.885	95% KM (% Bootstrap) UCL	2.9

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.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River above mainstem Cement Creek

User Selected Options			
Date/Time of Computation		2/18/2015 10:50	
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	4.95	Mean	11.12
Maximum	24.2	Median	10.25
SD	4.627	Std. Error of Mean	1.035
Coefficient of Variation	0.416	Skewness	1.254

Normal GOF Test

Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.135	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.91	95% Adjusted-CLT UCL (Chen-1995)	13.14
		95% Modified-t UCL (Johnson-1978)	12.96

Gamma GOF Test

A-D Test Statistic	0.156	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0828	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.801	k star (bias corrected MLE)	5.814
Theta hat (MLE)	1.635	Theta star (bias corrected MLE)	1.913
nu hat (MLE)	272.1	nu star (bias corrected)	232.6
MLE Mean (bias corrected)	11.12	MLE Sd (bias corrected)	4.613
		Approximate Chi Square Value (0.05)	198.3
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	195.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	13.05	95% Adjusted Gamma UCL (use when n<50)	13.21

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.992	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.067	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.599	Mean of logged Data	2.334
Maximum of Logged Data	3.186	SD of logged Data	0.395

Assuming Lognormal Distribution

95% H-UCL	13.28	90% Chebyshev (MVUE) UCL	14.12
95% Chebyshev (MVUE) UCL	15.49	97.5% Chebyshev (MVUE) UCL	17.39
99% Chebyshev (MVUE) UCL	21.11		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	12.83	95% Jackknife UCL	12.91
95% Standard Bootstrap UCL	12.84	95% Bootstrap-t UCL	13.35
95% Hall's Bootstrap UCL	13.78	95% Percentile Bootstrap UCL	12.89
95% BCA Bootstrap UCL	13.13		
90% Chebyshev(Mean, Sd) UCL	14.23	95% Chebyshev(Mean, Sd) UCL	15.63
97.5% Chebyshev(Mean, Sd) UCL	17.58	99% Chebyshev(Mean, Sd) UCL	21.42

Suggested UCL to Use

95% Student's-t UCL	12.91

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River above mainstem Cement Creek

User Selected Options		
Date/Time of Computation		2/18/2015 10:56
From File	WorkSheet.xls	
Full Precision	OFF	
Confidence Coefficient	95%	
Number of Bootstrap Operation:	2000	

Cu

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	166	Mean	339.4
Maximum	745	Median	307
SD	141.1	Std. Error of Mean	31.56
Coefficient of Variation	0.416	Skewness	1.722
Normal GOF Test			
Shapiro Wilk Test Statistic	0.832	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.21	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	394	95% Adjusted-CLT UCL (Chen-1995)	404.3
		95% Modified-t UCL (Johnson-1978)	396
Gamma GOF Test			
A-D Test Statistic	0.578	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.596	k star (bias corrected MLE)	6.49
Theta hat (MLE)	44.68	Theta star (bias corrected MLE)	52.3
nu hat (MLE)	303.8	nu star (bias corrected)	259.6
MLE Mean (bias corrected)	339.4	MLE Sd (bias corrected)	133.2
		Approximate Chi Square Value (0.05)	223.3
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	220.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	394.6	95% Adjusted Gamma UCL (use when n<50)	399.3
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.135	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.112	Mean of logged Data	5.76
Maximum of Logged Data	6.613	SD of logged Data	0.363
Assuming Lognormal Distribution			
95% H-UCL	396.9	90% Chebyshev (MVUE) UCL	421.5
95% Chebyshev (MVUE) UCL	459.5	97.5% Chebyshev (MVUE) UCL	512.2
99% Chebyshev (MVUE) UCL	615.7		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	391.3	95% Jackknife UCL	394
95% Standard Bootstrap UCL	389.5	95% Bootstrap-t UCL	422
95% Hall's Bootstrap UCL	516.4	95% Percentile Bootstrap UCL	392.5
95% BCA Bootstrap UCL	398.8		
90% Chebyshev(Mean, Sd) UCL	434.1	95% Chebyshev(Mean, Sd) UCL	477
97.5% Chebyshev(Mean, Sd) UCL	536.5	99% Chebyshev(Mean, Sd) UCL	653.4
Suggested UCL to Use			
95% Adjusted Gamma UCL	399.3		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/23/2015 8:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	3.55	Mean	4.651
Maximum	6.35	Median	4.735
SD	0.827	Std. Error of Mean	0.185
Coefficient of Variation	0.178	Skewness	0.261
Normal GOF Test			
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.971	95% Adjusted-CLT UCL (Chen-1995)	4.967
		95% Modified-t UCL (Johnson-1978)	4.973
Gamma GOF Test			
A-D Test Statistic	0.422	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.131	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	33.44	k star (bias corrected MLE)	28.45
Theta hat (MLE)	0.139	Theta star (bias corrected MLE)	0.163
nu hat (MLE)	1337	nu star (bias corrected)	1138
MLE Mean (bias corrected)	4.651	MLE Sd (bias corrected)	0.872
		Approximate Chi Square Value (0.05)	1061
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	1055
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4.99	95% Adjusted Gamma UCL (use when n<50)	5.018
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.267	Mean of logged Data	1.522
Maximum of Logged Data	1.848	SD of logged Data	0.178
Assuming Lognormal Distribution			
95% H-UCL	5.004	90% Chebyshev (MVUE) UCL	5.209
95% Chebyshev (MVUE) UCL	5.462	97.5% Chebyshev (MVUE) UCL	5.813
99% Chebyshev (MVUE) UCL	6.503		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.955	95% Jackknife UCL	4.971
95% Standard Bootstrap UCL	4.944	95% Bootstrap-t UCL	4.983
95% Hall's Bootstrap UCL	4.967	95% Percentile Bootstrap UCL	4.941
95% BCA Bootstrap UCL	4.984		
90% Chebyshev(Mean, Sd) UCL	5.206	95% Chebyshev(Mean, Sd) UCL	5.457
97.5% Chebyshev(Mean, Sd) UCL	5.806	99% Chebyshev(Mean, Sd) UCL	6.491

Suggested UCL to Use	
95% Student's-t UCL	4.971

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:01
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.02	Mean	0.0705
Maximum	0.19	Median	0.058
SD	0.0442	Std. Error of Mean	0.0118
Coefficient of Variation	0.627	Skewness	1.715

Normal GOF Test			
Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.192	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.237	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0914	95% Adjusted-CLT UCL (Chen-1995)	0.0957
		95% Modified-t UCL (Johnson-1978)	0.0923

Gamma GOF Test		
A-D Test Statistic	0.292	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.129	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.23	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	3.322	k star (bias corrected MLE)	2.657
Theta hat (MLE)	0.0212	Theta star (bias corrected MLE)	0.0265
nu hat (MLE)	93	nu star (bias corrected)	74.41
MLE Mean (bias corrected)	0.0705	MLE Sd (bias corrected)	0.0432
		Approximate Chi Square Value (0.05)	55.54
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	53.38

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.0944	95% Adjusted Gamma UCL (use when n<50)	0.0983

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.16	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.237	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-2.81
Maximum of Logged Data	-1.661	SD of logged Data	0.581

Assuming Lognormal Distribution			
95% H-UCL	0.101	90% Chebyshev (MVUE) UCL	0.104
95% Chebyshev (MVUE) UCL	0.12	97.5% Chebyshev (MVUE) UCL	0.141
99% Chebyshev (MVUE) UCL	0.183		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0899	95% Jackknife UCL	0.0914
95% Standard Bootstrap UCL	0.0891	95% Bootstrap-t UCL	0.106
95% Hall's Bootstrap UCL	0.204	95% Percentile Bootstrap UCL	0.0911
95% BCA Bootstrap UCL	0.0951		
90% Chebyshev(Mean, Sd) UCL	0.106	95% Chebyshev(Mean, Sd) UCL	0.122
97.5% Chebyshev(Mean, Sd) UCL	0.144	99% Chebyshev(Mean, Sd) UCL	0.188

Suggested UCL to Use

95% Student's-t UCL	0.0914

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 10:57
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	554	Mean	1508
Maximum	3030	Median	1320
SD	582	Std. Error of Mean	130.1
Coefficient of Variation	0.386	Skewness	0.809

Normal GOF Test		
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1733	95% Adjusted-CLT UCL (Chen-1995)	1747
		95% Modified-t UCL (Johnson-1978)	1737

Gamma GOF Test		
A-D Test Statistic	0.281	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	7.178	k star (bias corrected MLE)	6.134
Theta hat (MLE)	210.1	Theta star (bias corrected MLE)	245.9
nu hat (MLE)	287.1	nu star (bias corrected)	245.4
MLE Mean (bias corrected)	1508	MLE Sd (bias corrected)	609
		Approximate Chi Square Value (0.05)	210.1
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	207.5

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1761	95% Adjusted Gamma UCL (use when n<50)	1783

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.973	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.124	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	6.317	Mean of logged Data	7.247
Maximum of Logged Data	8.016	SD of logged Data	0.394

Assuming Lognormal Distribution			
95% H-UCL	1807	90% Chebyshev (MVUE) UCL	1921
95% Chebyshev (MVUE) UCL	2106	97.5% Chebyshev (MVUE) UCL	2364
99% Chebyshev (MVUE) UCL	2869		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	1722	95% Jackknife UCL	1733
95% Standard Bootstrap UCL	1718	95% Bootstrap-t UCL	1766
95% Hall's Bootstrap UCL	1765	95% Percentile Bootstrap UCL	1711
95% BCA Bootstrap UCL	1744		
90% Chebyshev(Mean, Sd) UCL	1899	95% Chebyshev(Mean, Sd) UCL	2076
97.5% Chebyshev(Mean, Sd) UCL	2321	99% Chebyshev(Mean, Sd) UCL	2803

Suggested UCL to Use

95% Student's-t UCL	1733

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Mn in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:00
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	3400	Mean	10617
Maximum	22300	Median	9550
SD	5041	Std. Error of Mean	1127
Coefficient of Variation	0.475	Skewness	1.162

Normal GOF Test

Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.175	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12566	95% Adjusted-CLT UCL (Chen-1995)	12784
		95% Modified-t UCL (Johnson-1978)	12615

Gamma GOF Test

A-D Test Statistic	0.449	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.159	k star (bias corrected MLE)	4.418
Theta hat (MLE)	2058	Theta star (bias corrected MLE)	2403
nu hat (MLE)	206.3	nu star (bias corrected)	176.7
MLE Mean (bias corrected)	10617	MLE Sd (bias corrected)	5051
		Approximate Chi Square Value (0.05)	147
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	144.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12766	95% Adjusted Gamma UCL (use when n<50)	12954

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.111	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.132	Mean of logged Data	9.17
Maximum of Logged Data	10.01	SD of logged Data	0.461

Assuming Lognormal Distribution

95% H-UCL	13172	90% Chebyshev (MVUE) UCL	14006
95% Chebyshev (MVUE) UCL	15540	97.5% Chebyshev (MVUE) UCL	17668
99% Chebyshev (MVUE) UCL	21850		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	12471	95% Jackknife UCL	12566
95% Standard Bootstrap UCL	12438	95% Bootstrap-t UCL	13047
95% Hall's Bootstrap UCL	12981	95% Percentile Bootstrap UCL	12460
95% BCA Bootstrap UCL	12792		
90% Chebyshev(Mean, Sd) UCL	13999	95% Chebyshev(Mean, Sd) UCL	15530
97.5% Chebyshev(Mean, Sd) UCL	17657	99% Chebyshev(Mean, Sd) UCL	21833

Suggested UCL to Use

95% Student's-t UCL	12566

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/23/2015 8:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	5.92	Mean	8.224
Maximum	16.5	Median	7.32
SD	2.39	Std. Error of Mean	0.534
Coefficient of Variation	0.291	Skewness	2.335
Normal GOF Test			
Shapiro Wilk Test Statistic	0.758	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.206	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.148	95% Adjusted-CLT UCL (Chen-1995)	9.401
		95% Modified-t UCL (Johnson-1978)	9.195
Gamma GOF Test			
A-D Test Statistic	0.919	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.741	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.194	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.13	k star (bias corrected MLE)	13.74
Theta hat (MLE)	0.51	Theta star (bias corrected MLE)	0.599
nu hat (MLE)	645	nu star (bias corrected)	549.6
MLE Mean (bias corrected)	8.224	MLE Sd (bias corrected)	2.219
		Approximate Chi Square Value (0.05)	496.2
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	492.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	9.109	95% Adjusted Gamma UCL (use when n<50)	9.183
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.872	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.182	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.778	Mean of logged Data	2.076
Maximum of Logged Data	2.803	SD of logged Data	0.243
Assuming Lognormal Distribution			
95% H-UCL	9.084	90% Chebyshev (MVUE) UCL	9.547
95% Chebyshev (MVUE) UCL	10.16	97.5% Chebyshev (MVUE) UCL	11.01
99% Chebyshev (MVUE) UCL	12.67		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.103	95% Jackknife UCL	9.148
95% Standard Bootstrap UCL	9.073	95% Bootstrap-t UCL	9.687
95% Hall's Bootstrap UCL	12.83	95% Percentile Bootstrap UCL	9.099
95% BCA Bootstrap UCL	9.488		
90% Chebyshev(Mean, Sd) UCL	9.827	95% Chebyshev(Mean, Sd) UCL	10.55
97.5% Chebyshev(Mean, Sd) UCL	11.56	99% Chebyshev(Mean, Sd) UCL	13.54
Suggested UCL to Use			
95% Student's-t UCL	9.148	or 95% Modified-t UCL	9.195

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:02
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	16
Number of Detects	4	Number of Non-Detects	16
Number of Distinct Detects	4	Number of Distinct Non-Detects	12
Minimum Detect	0.905	Minimum Non-Detect	0.497
Maximum Detect	2.86	Maximum Non-Detect	1.02
Variance Detects	0.801	Percent Non-Detects	80%
Mean Detects	1.539	SD Detects	0.895
Median Detects	1.195	CV Detects	0.581
Skewness Detects	1.817	Kurtosis Detects	3.401
Mean of Logged Detects	0.325	SD of Logged Detects	0.505

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.788	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.359	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.743	Standard Error of Mean	0.148
SD	0.54	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.998	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.986	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.186	95% KM Chebyshev UCL	1.387
97.5% KM Chebyshev UCL	1.666	99% KM Chebyshev UCL	2.214

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.486	Anderson-Darling GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.339	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.889	k star (bias corrected MLE)	1.389
Theta hat (MLE)	0.315	Theta star (bias corrected MLE)	1.108
nu hat (MLE)	39.12	nu star (bias corrected)	11.11
MLE Mean (bias corrected)	1.539	MLE Sd (bias corrected)	1.306

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.889	nu hat (KM)	75.57
Approximate Chi Square Value (75.57, α)	56.55	Adjusted Chi Square Value (75.57, β)	55.25
95% Gamma Approximate KM-UCL (use when n>=50)	0.993	95% Gamma Adjusted KM-UCL (use when n<50)	1.016

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.321
Maximum	2.86	Median	0.01
SD	0.719	CV	2.241
k hat (MLE)	0.293	k star (bias corrected MLE)	0.283
Theta hat (MLE)	1.095	Theta star (bias corrected MLE)	1.136
nu hat (MLE)	11.73	nu star (bias corrected)	11.3
MLE Mean (bias corrected)	0.321	MLE Sd (bias corrected)	0.604
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (11.30, α)	4.77	Adjusted Chi Square Value (11.30, β)	4.438
95% Gamma Approximate UCL (use when n>=50)	0.76	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.306	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.525	Mean in Log Scale	-1.024
SD in Original Scale	0.636	SD in Log Scale	0.782
95% t UCL (assumes normality of ROS data)	0.771	95% Percentile Bootstrap UCL	0.78
95% BCA Bootstrap UCL	0.859	95% Bootstrap t UCL	1.086
95% H-UCL (Log ROS)	0.741		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.439	95% H-UCL (KM -Log)	0.885
KM SD (logged)	0.462	95% Critical H Value (KM-Log)	1.983
KM Standard Error of Mean (logged)	0.139		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.646	Mean in Log Scale	-0.66
SD in Original Scale	0.589	SD in Log Scale	0.619
95% t UCL (Assumes normality)	0.874	95% H-Stat UCL	0.848

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.998	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:03
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	2.9	Mean	5.491
Maximum	13.3	Median	4.845
SD	2.429	Std. Error of Mean	0.543
Coefficient of Variation	0.442	Skewness	2

Normal GOF Test

Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.194	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.43	95% Adjusted-CLT UCL (Chen-1995)	6.644
		95% Modified-t UCL (Johnson-1978)	6.471

Gamma GOF Test

A-D Test Statistic	0.642	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.151	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.105	k star (bias corrected MLE)	6.072
Theta hat (MLE)	0.773	Theta star (bias corrected MLE)	0.904
nu hat (MLE)	284.2	nu star (bias corrected)	242.9
MLE Mean (bias corrected)	5.491	MLE Sd (bias corrected)	2.228
		Approximate Chi Square Value (0.05)	207.8
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	205.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.418	95% Adjusted Gamma UCL (use when n<50)	6.498

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.065	Mean of logged Data	1.631
Maximum of Logged Data	2.588	SD of logged Data	0.37

Assuming Lognormal Distribution

95% H-UCL	6.43	90% Chebyshev (MVUE) UCL	6.831
95% Chebyshev (MVUE) UCL	7.457	97.5% Chebyshev (MVUE) UCL	8.324
99% Chebyshev (MVUE) UCL	10.03		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6.384	95% Jackknife UCL	6.43
95% Standard Bootstrap UCL	6.373	95% Bootstrap-t UCL	6.957
95% Hall's Bootstrap UCL	9.672	95% Percentile Bootstrap UCL	6.436
95% BCA Bootstrap UCL	6.694		
90% Chebyshev(Mean, Sd) UCL	7.121	95% Chebyshev(Mean, Sd) UCL	7.859
97.5% Chebyshev(Mean, Sd) UCL	8.883	99% Chebyshev(Mean, Sd) UCL	10.9

Suggested UCL to Use

95% Student's-t UCL	6.43

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River above mainstem Cement Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:04
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1530	Mean	3172
Maximum	11500	Median	2660
SD	2124	Std. Error of Mean	474.9
Coefficient of Variation	0.67	Skewness	3.481

Normal GOF Test

Shapiro Wilk Test Statistic	0.577	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.298	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3993	95% Adjusted-CLT UCL (Chen-1995)	4348
		95% Modified-t UCL (Johnson-1978)	4054

Gamma GOF Test

A-D Test Statistic	1.438	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.235	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.47	k star (bias corrected MLE)	3.833
Theta hat (MLE)	709.6	Theta star (bias corrected MLE)	827.5
nu hat (MLE)	178.8	nu star (bias corrected)	153.3
MLE Mean (bias corrected)	3172	MLE Sd (bias corrected)	1620
		Approximate Chi Square Value (0.05)	125.7
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	123.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3868	95% Adjusted Gamma UCL (use when n<50)	3930

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.854	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.193	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.333	Mean of logged Data	7.946
Maximum of Logged Data	9.35	SD of logged Data	0.436

Assuming Lognormal Distribution

95% H-UCL	3777	90% Chebyshev (MVUE) UCL	4017
95% Chebyshev (MVUE) UCL	4438	97.5% Chebyshev (MVUE) UCL	5021
99% Chebyshev (MVUE) UCL	6168		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3953	95% Jackknife UCL	3993
95% Standard Bootstrap UCL	3935	95% Bootstrap-t UCL	5347
95% Hall's Bootstrap UCL	7080	95% Percentile Bootstrap UCL	4031
95% BCA Bootstrap UCL	4441		
90% Chebyshev(Mean, Sd) UCL	4596	95% Chebyshev(Mean, Sd) UCL	5242
97.5% Chebyshev(Mean, Sd) UCL	6137	99% Chebyshev(Mean, Sd) UCL	7897

Suggested UCL to Use

95% Student's-t UCL	3993	or 95% Modified-t UCL	4054

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:37
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	9960	Mean	14872
Maximum	21500	Median	12200
SD	5021	Std. Error of Mean	2246
Coefficient of Variation	0.338	Skewness	0.625

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.873	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.303	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19659	95% Adjusted-CLT UCL (Chen-1995)	19237
		95% Modified-t UCL (Johnson-1978)	19764

Gamma GOF Test

A-D Test Statistic	0.437	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.308	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.42	k star (bias corrected MLE)	4.702
Theta hat (MLE)	1302	Theta star (bias corrected MLE)	3163
nu hat (MLE)	114.2	nu star (bias corrected)	47.02
MLE Mean (bias corrected)	14872	MLE Sd (bias corrected)	6858
		Approximate Chi Square Value (0.05)	32.28
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	27.06

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	21660	95% Adjusted Gamma UCL (use when n<50)	25846

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.894	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.279	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	9.206	Mean of logged Data	9.563
Maximum of Logged Data	9.976	SD of logged Data	0.33

Assuming Lognormal Distribution

95% H-UCL	22609	90% Chebyshev (MVUE) UCL	21419
95% Chebyshev (MVUE) UCL	24392	97.5% Chebyshev (MVUE) UCL	28518
99% Chebyshev (MVUE) UCL	36622		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	18566	95% Jackknife UCL	19659
95% Standard Bootstrap UCL	18189	95% Bootstrap-t UCL	31997
95% Hall's Bootstrap UCL	72144	95% Percentile Bootstrap UCL	18520
95% BCA Bootstrap UCL	18520		
90% Chebyshev(Mean, Sd) UCL	21609	95% Chebyshev(Mean, Sd) UCL	24661
97.5% Chebyshev(Mean, Sd) UCL	28896	99% Chebyshev(Mean, Sd) UCL	37216

Suggested UCL to Use

95% Student's-t UCL	19659

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:39
From File	WorkSheet_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	26.1	Mean	33.36
Maximum	40.6	Median	36.3
SD	6.52	Std. Error of Mean	2.916
Coefficient of Variation	0.195	Skewness	-0.318

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	39.58	95% Adjusted-CLT UCL (Chen-1995)	37.71
		95% Modified-t UCL (Johnson-1978)	39.51

Gamma GOF Test

A-D Test Statistic	0.522	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.305	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	31.44	k star (bias corrected MLE)	12.71
Theta hat (MLE)	1.061	Theta star (bias corrected MLE)	2.625
nu hat (MLE)	314.4	nu star (bias corrected)	127.1
MLE Mean (bias corrected)	33.36	MLE Sd (bias corrected)	9.358
		Approximate Chi Square Value (0.05)	102
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	92.23

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	41.55	95% Adjusted Gamma UCL (use when n<50)	45.96

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.845	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.29	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.262	Mean of logged Data	3.491
Maximum of Logged Data	3.704	SD of logged Data	0.202

Assuming Lognormal Distribution

95% H-UCL	41.86	90% Chebyshev (MVUE) UCL	42.4
95% Chebyshev (MVUE) UCL	46.5	97.5% Chebyshev (MVUE) UCL	52.18
99% Chebyshev (MVUE) UCL	63.33		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	38.16	95% Jackknife UCL	39.58
95% Standard Bootstrap UCL	37.76	95% Bootstrap-t UCL	39.89
95% Hall's Bootstrap UCL	36.05	95% Percentile Bootstrap UCL	37.58
95% BCA Bootstrap UCL	37.12		
90% Chebyshev(Mean, Sd) UCL	42.11	95% Chebyshev(Mean, Sd) UCL	46.07
97.5% Chebyshev(Mean, Sd) UCL	51.57	99% Chebyshev(Mean, Sd) UCL	62.37

Suggested UCL to Use

95% Student's-t UCL	39.58

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	2/18/2015 11:46
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.15	Mean	2.098
Maximum	3.03	Median	1.81
SD	0.791	Std. Error of Mean	0.354
Coefficient of Variation	0.377	Skewness	0.182

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.852	95% Adjusted-CLT UCL (Chen-1995)	2.711
		95% Modified-t UCL (Johnson-1978)	2.857
Gamma GOF Test			
A-D Test Statistic	0.321	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.239	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.413	k star (bias corrected MLE)	3.499
Theta hat (MLE)	0.249	Theta star (bias corrected MLE)	0.6
nu hat (MLE)	84.13	nu star (bias corrected)	34.99
MLE Mean (bias corrected)	2.098	MLE Sd (bias corrected)	1.122
		Approximate Chi Square Value (0.05)	22.45
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	18.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3.269	95% Adjusted Gamma UCL (use when n<50)	4.034
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.211	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.14	Mean of logged Data	0.68
Maximum of Logged Data	1.109	SD of logged Data	0.396
Assuming Lognormal Distribution			
95% H-UCL	3.603	90% Chebyshev (MVUE) UCL	3.212
95% Chebyshev (MVUE) UCL	3.715	97.5% Chebyshev (MVUE) UCL	4.413
99% Chebyshev (MVUE) UCL	5.784		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.68	95% Jackknife UCL	2.852
95% Standard Bootstrap UCL	2.626	95% Bootstrap-t UCL	3.551
95% Hall's Bootstrap UCL	4.181	95% Percentile Bootstrap UCL	2.626
95% BCA Bootstrap UCL	2.602		
90% Chebyshev(Mean, Sd) UCL	3.159	95% Chebyshev(Mean, Sd) UCL	3.64
97.5% Chebyshev(Mean, Sd) UCL	4.307	99% Chebyshev(Mean, Sd) UCL	5.617

Suggested UCL to Use

95% Student's-t UCL	2.852

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:47
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	77.8	Mean	137.4
Maximum	179	Median	145
SD	37.33	Std. Error of Mean	16.69
Coefficient of Variation	0.272	Skewness	-1.086

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.926	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.254	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	172.9	95% Adjusted-CLT UCL (Chen-1995)	156.2
		95% Modified-t UCL (Johnson-1978)	171.6
Gamma GOF Test			
A-D Test Statistic	0.437	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.01	k star (bias corrected MLE)	5.738
Theta hat (MLE)	9.803	Theta star (bias corrected MLE)	23.94
nu hat (MLE)	140.1	nu star (bias corrected)	57.38
MLE Mean (bias corrected)	137.4	MLE Sd (bias corrected)	57.34
		Approximate Chi Square Value (0.05)	40.97
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	35
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	192.4	95% Adjusted Gamma UCL (use when n<50)	225.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.856	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.305	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.354	Mean of logged Data	4.886
Maximum of Logged Data	5.187	SD of logged Data	0.317
Assuming Lognormal Distribution			
95% H-UCL	205	90% Chebyshev (MVUE) UCL	196.2
95% Chebyshev (MVUE) UCL	222.7	97.5% Chebyshev (MVUE) UCL	259.4
99% Chebyshev (MVUE) UCL	331.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	164.8	95% Jackknife UCL	172.9
95% Standard Bootstrap UCL	162	95% Bootstrap-t UCL	160.5
95% Hall's Bootstrap UCL	156.7	95% Percentile Bootstrap UCL	160
95% BCA Bootstrap UCL	153.8		
90% Chebyshev(Mean, Sd) UCL	187.4	95% Chebyshev(Mean, Sd) UCL	210.1
97.5% Chebyshev(Mean, Sd) UCL	241.6	99% Chebyshev(Mean, Sd) UCL	303.5

Suggested UCL to Use

95% Student's-t UCL	172.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	3.01	Mean	4.604
Maximum	6.41	Median	4.05
SD	1.556	Std. Error of Mean	0.696
Coefficient of Variation	0.338	Skewness	0.385

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.239	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.087	95% Adjusted-CLT UCL (Chen-1995)	5.876
		95% Modified-t UCL (Johnson-1978)	6.107
Gamma GOF Test			
A-D Test Statistic	0.411	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	11.06	k star (bias corrected MLE)	4.557
Theta hat (MLE)	0.416	Theta star (bias corrected MLE)	1.01
nu hat (MLE)	110.6	nu star (bias corrected)	45.57
MLE Mean (bias corrected)	4.604	MLE Sd (bias corrected)	2.157
		Approximate Chi Square Value (0.05)	31.09
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	25.97
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.75	95% Adjusted Gamma UCL (use when n<50)	8.08
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.233	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.102	Mean of logged Data	1.481
Maximum of Logged Data	1.858	SD of logged Data	0.339
Assuming Lognormal Distribution			
95% H-UCL	7.101	90% Chebyshev (MVUE) UCL	6.684
95% Chebyshev (MVUE) UCL	7.627	97.5% Chebyshev (MVUE) UCL	8.936
99% Chebyshev (MVUE) UCL	11.51		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.748	95% Jackknife UCL	6.087
95% Standard Bootstrap UCL	5.617	95% Bootstrap-t UCL	8.093
95% Hall's Bootstrap UCL	7.589	95% Percentile Bootstrap UCL	5.73
95% BCA Bootstrap UCL	5.694		
90% Chebyshev(Mean, Sd) UCL	6.691	95% Chebyshev(Mean, Sd) UCL	7.636
97.5% Chebyshev(Mean, Sd) UCL	8.948	99% Chebyshev(Mean, Sd) UCL	11.53

Suggested UCL to Use

95% Student's-t UCL	6.087

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/23/2015 9:09		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.039	Mean	0.0553
Maximum	0.072	Median	0.055
SD	0.0141	Std. Error of Mean	0.00704
Coefficient of Variation	0.255	Skewness	0.0886

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.997	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.145	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0718	95% Adjusted-CLT UCL (Chen-1995)	0.0672
		95% Modified-t UCL (Johnson-1978)	0.0719

Gamma GOF Test		
A-D Test Statistic	0.197	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	19.99	k star (bias corrected MLE)	5.164
Theta hat (MLE)	0.00276	Theta star (bias corrected MLE)	0.0107
nu hat (MLE)	159.9	nu star (bias corrected)	41.32
MLE Mean (bias corrected)	0.0553	MLE Sd (bias corrected)	0.0243
		Approximate Chi Square Value (0.05)	27.58
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	0.0828	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.993	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.16	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	-3.244	Mean of logged Data	-2.921
Maximum of Logged Data	-2.631	SD of logged Data	0.262

Assuming Lognormal Distribution			
95% H-UCL	0.0832	90% Chebyshev (MVUE) UCL	0.0769
95% Chebyshev (MVUE) UCL	0.0866	97.5% Chebyshev (MVUE) UCL	0.1
99% Chebyshev (MVUE) UCL	0.127		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0668	95% Jackknife UCL	0.0718
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0764	95% Chebyshev(Mean, Sd) UCL	0.0859
97.5% Chebyshev(Mean, Sd) UCL	0.0992	99% Chebyshev(Mean, Sd) UCL	0.125

Suggested UCL to Use

95% Student's-t UCL	0.0718

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:49
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	299	Mean	478.2
Maximum	581	Median	499
SD	108.7	Std. Error of Mean	48.61
Coefficient of Variation	0.227	Skewness	-1.428

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	581.8	95% Adjusted-CLT UCL (Chen-1995)	525
		95% Modified-t UCL (Johnson-1978)	576.6

Gamma GOF Test

A-D Test Statistic	0.487	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.299	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	20.27	k star (bias corrected MLE)	8.242
Theta hat (MLE)	23.59	Theta star (bias corrected MLE)	58.02
nu hat (MLE)	202.7	nu star (bias corrected)	82.42
MLE Mean (bias corrected)	478.2	MLE Sd (bias corrected)	166.6
		Approximate Chi Square Value (0.05)	62.49
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	54.97

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	630.6	95% Adjusted Gamma UCL (use when n<50)	717

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.312	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.7	Mean of logged Data	6.145
Maximum of Logged Data	6.365	SD of logged Data	0.261

Assuming Lognormal Distribution

95% H-UCL	653.4	90% Chebyshev (MVUE) UCL	647
95% Chebyshev (MVUE) UCL	722.9	97.5% Chebyshev (MVUE) UCL	828.3
99% Chebyshev (MVUE) UCL	1035		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	558.1	95% Jackknife UCL	581.8
95% Standard Bootstrap UCL	548.5	95% Bootstrap-t UCL	555.4
95% Hall's Bootstrap UCL	529.1	95% Percentile Bootstrap UCL	541.2
95% BCA Bootstrap UCL	531.8		
90% Chebyshev(Mean, Sd) UCL	624	95% Chebyshev(Mean, Sd) UCL	690.1
97.5% Chebyshev(Mean, Sd) UCL	781.7	99% Chebyshev(Mean, Sd) UCL	961.8

Suggested UCL to Use

95% Student's-t UCL	581.8

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:50
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1210	Mean	2100
Maximum	3400	Median	1710
SD	922.4	Std. Error of Mean	412.5
Coefficient of Variation	0.439	Skewness	0.748

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.905	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.264	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2979	95% Adjusted-CLT UCL (Chen-1995)	2926
		95% Modified-t UCL (Johnson-1978)	3002
Gamma GOF Test			
A-D Test Statistic	0.32	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.251	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.801	k star (bias corrected MLE)	2.854
Theta hat (MLE)	308.8	Theta star (bias corrected MLE)	735.9
nu hat (MLE)	68.01	nu star (bias corrected)	28.54
MLE Mean (bias corrected)	2100	MLE Sd (bias corrected)	1243
		Approximate Chi Square Value (0.05)	17.35
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	13.68
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3455	95% Adjusted Gamma UCL (use when n<50)	4381
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.219	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.098	Mean of logged Data	7.574
Maximum of Logged Data	8.132	SD of logged Data	0.431
Assuming Lognormal Distribution			
95% H-UCL	3853	90% Chebyshev (MVUE) UCL	3299
95% Chebyshev (MVUE) UCL	3844	97.5% Chebyshev (MVUE) UCL	4601
99% Chebyshev (MVUE) UCL	6087		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2779	95% Jackknife UCL	2979
95% Standard Bootstrap UCL	2696	95% Bootstrap-t UCL	4698
95% Hall's Bootstrap UCL	9488	95% Percentile Bootstrap UCL	2724
95% BCA Bootstrap UCL	2738		
90% Chebyshev(Mean, Sd) UCL	3338	95% Chebyshev(Mean, Sd) UCL	3898
97.5% Chebyshev(Mean, Sd) UCL	4676	99% Chebyshev(Mean, Sd) UCL	6204

Suggested UCL to Use

95% Student's-t UCL	2979

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:52
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	4.33	Mean	5.142
Maximum	6.38	Median	4.88
SD	0.778	Std. Error of Mean	0.348
Coefficient of Variation	0.151	Skewness	1.157

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.232	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.884	95% Adjusted-CLT UCL (Chen-1995)	5.907
		95% Modified-t UCL (Johnson-1978)	5.914
Gamma GOF Test			
A-D Test Statistic	0.3	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.237	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	57.71	k star (bias corrected MLE)	23.22
Theta hat (MLE)	0.0891	Theta star (bias corrected MLE)	0.221
nu hat (MLE)	577.1	nu star (bias corrected)	232.2
MLE Mean (bias corrected)	5.142	MLE Sd (bias corrected)	1.067
		Approximate Chi Square Value (0.05)	197.9
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	184
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.032	95% Adjusted Gamma UCL (use when n<50)	6.489
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.466	Mean of logged Data	1.629
Maximum of Logged Data	1.853	SD of logged Data	0.146
Assuming Lognormal Distribution			
95% H-UCL	6.004	90% Chebyshev (MVUE) UCL	6.144
95% Chebyshev (MVUE) UCL	6.599	97.5% Chebyshev (MVUE) UCL	7.229
99% Chebyshev (MVUE) UCL	8.468		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.714	95% Jackknife UCL	5.884
95% Standard Bootstrap UCL	5.643	95% Bootstrap-t UCL	6.52
95% Hall's Bootstrap UCL	9.599	95% Percentile Bootstrap UCL	5.67
95% BCA Bootstrap UCL	5.78		
90% Chebyshev(Mean, Sd) UCL	6.186	95% Chebyshev(Mean, Sd) UCL	6.658
97.5% Chebyshev(Mean, Sd) UCL	7.314	99% Chebyshev(Mean, Sd) UCL	8.603

Suggested UCL to Use

95% Student's-t UCL	5.884

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:53
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operation	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	1
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.04	Minimum Non-Detect	1.02
Maximum Detect	2.03	Maximum Non-Detect	1.02
Variance Detects	0.268	Percent Non-Detects	20%
Mean Detects	1.488	SD Detects	0.517
Median Detects	1.44	CV Detects	0.348
Skewness Detects	0.127	Kurtosis Detects	-5.265
Mean of Logged Detects	0.35	SD of Logged Detects	0.356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.819	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.394	Standard Error of Mean	0.228
SD	0.442	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.881	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.77	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.079	95% KM Chebyshev UCL	2.39
97.5% KM Chebyshev UCL	2.82	99% KM Chebyshev UCL	3.667

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.56	Anderson-Darling GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.336	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	10.8	k star (bias corrected MLE)	2.867
Theta hat (MLE)	0.138	Theta star (bias corrected MLE)	0.519
nu hat (MLE)	86.41	nu star (bias corrected)	22.94
MLE Mean (bias corrected)	1.488	MLE Sd (bias corrected)	0.879

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	9.934	nu hat (KM)	99.34
Approximate Chi Square Value (99.34, α)	77.34	Adjusted Chi Square Value (99.34, β)	68.89
95% Gamma Approximate KM-UCL (use when n>=5C	1.79	95% Gamma Adjusted KM-UCL (use when n<50)	2.01

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.364	Mean	1.263
Maximum	2.03	Median	1.05
SD	0.673	CV	0.533
k hat (MLE)	3.378	k star (bias corrected MLE)	1.485
Theta hat (MLE)	0.374	Theta star (bias corrected MLE)	0.851
nu hat (MLE)	33.78	nu star (bias corrected)	14.85
MLE Mean (bias corrected)	1.263	MLE Sd (bias corrected)	1.036
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (14.85, α)	7.154	Adjusted Chi Square Value (14.85, β)	4.997
95% Gamma Approximate UCL (use when n>=50)	2.621	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.804	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.301	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.306	Mean in Log Scale	0.172
SD in Original Scale	0.604	SD in Log Scale	0.504
95% t UCL (assumes normality of ROS data)	1.882	95% Percentile Bootstrap UCL	1.714
95% BCA Bootstrap UCL	1.66	95% Bootstrap t UCL	2.339
95% H-UCL (Log ROS)	2.842		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.284	95% H-UCL (KM -Log)	2.014
KM SD (logged)	0.306	95% Critical H Value (KM-Log)	2.415
KM Standard Error of Mean (logged)	0.158		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.292	Mean in Log Scale	0.145
SD in Original Scale	0.626	SD in Log Scale	0.552
95% t UCL (Assumes normality)	1.889	95% H-Stat UCL	3.183

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.881	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 11:55		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	1.3	Mean	1.912
Maximum	2.76	Median	1.83
SD	0.539	Std. Error of Mean	0.241
Coefficient of Variation	0.282	Skewness	0.982

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.425	95% Adjusted-CLT UCL (Chen-1995)	2.421
		95% Modified-t UCL (Johnson-1978)	2.443
Gamma GOF Test			
A-D Test Statistic	0.238	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.203	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.62	k star (bias corrected MLE)	6.782
Theta hat (MLE)	0.115	Theta star (bias corrected MLE)	0.282
nu hat (MLE)	166.2	nu star (bias corrected)	67.82
MLE Mean (bias corrected)	1.912	MLE Sd (bias corrected)	0.734
		Approximate Chi Square Value (0.05)	49.87
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	43.21
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	2.6	95% Adjusted Gamma UCL (use when n<50)	3.001
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.979	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.262	Mean of logged Data	0.618
Maximum of Logged Data	1.015	SD of logged Data	0.274
Assuming Lognormal Distribution			
95% H-UCL	2.653	90% Chebyshev (MVUE) UCL	2.61
95% Chebyshev (MVUE) UCL	2.927	97.5% Chebyshev (MVUE) UCL	3.367
99% Chebyshev (MVUE) UCL	4.23		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.308	95% Jackknife UCL	2.425
95% Standard Bootstrap UCL	2.267	95% Bootstrap-t UCL	2.572
95% Hall's Bootstrap UCL	4.682	95% Percentile Bootstrap UCL	2.298
95% BCA Bootstrap UCL	2.39		
90% Chebyshev(Mean, Sd) UCL	2.635	95% Chebyshev(Mean, Sd) UCL	2.962
97.5% Chebyshev(Mean, Sd) UCL	3.416	99% Chebyshev(Mean, Sd) UCL	4.309

Suggested UCL to Use

95% Student's-t UCL	2.425

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A72 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 11:56
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	386	Mean	650.8
Maximum	858	Median	646
SD	175.9	Std. Error of Mean	78.66
Coefficient of Variation	0.27	Skewness	-0.674

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	818.5	95% Adjusted-CLT UCL (Chen-1995)	754.9
		95% Modified-t UCL (Johnson-1978)	814.5
Gamma GOF Test			
A-D Test Statistic	0.309	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.251	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.95	k star (bias corrected MLE)	6.112
Theta hat (MLE)	43.54	Theta star (bias corrected MLE)	106.5
nu hat (MLE)	149.5	nu star (bias corrected)	61.12
MLE Mean (bias corrected)	650.8	MLE Sd (bias corrected)	263.2
		Approximate Chi Square Value (0.05)	44.14
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	37.92
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	901.1	95% Adjusted Gamma UCL (use when n<50)	1049
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.272	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.956	Mean of logged Data	6.444
Maximum of Logged Data	6.755	SD of logged Data	0.302
Assuming Lognormal Distribution			
95% H-UCL	947.9	90% Chebyshev (MVUE) UCL	916.4
95% Chebyshev (MVUE) UCL	1036	97.5% Chebyshev (MVUE) UCL	1202
99% Chebyshev (MVUE) UCL	1528		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	780.2	95% Jackknife UCL	818.5
95% Standard Bootstrap UCL	763.8	95% Bootstrap-t UCL	797.7
95% Hall's Bootstrap UCL	794	95% Percentile Bootstrap UCL	765.6
95% BCA Bootstrap UCL	745.2		
90% Chebyshev(Mean, Sd) UCL	886.8	95% Chebyshev(Mean, Sd) UCL	993.7
97.5% Chebyshev(Mean, Sd) UCL	1142	99% Chebyshev(Mean, Sd) UCL	1433

Suggested UCL to Use

95% Student's-t UCL	818.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Al in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:25
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	6770	Mean	17123
Maximum	40700	Median	10510
SD	15852	Std. Error of Mean	7926
Coefficient of Variation	0.926	Skewness	1.9

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.748	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.381	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35775	95% Adjusted-CLT UCL (Chen-1995)	38205
		95% Modified-t UCL (Johnson-1978)	37030
Gamma GOF Test			
A-D Test Statistic	0.515	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.353	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.05	k star (bias corrected MLE)	0.679
Theta hat (MLE)	8354	Theta star (bias corrected MLE)	25214
nu hat (MLE)	16.4	nu star (bias corrected)	5.433
MLE Mean (bias corrected)	17123	MLE Sd (bias corrected)	20778
		Approximate Chi Square Value (0.05)	1.357
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	68540	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.305	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.82	Mean of logged Data	9.485
Maximum of Logged Data	10.61	SD of logged Data	0.786
Assuming Lognormal Distribution			
95% H-UCL	201468	90% Chebyshev (MVUE) UCL	34933
95% Chebyshev (MVUE) UCL	43315	97.5% Chebyshev (MVUE) UCL	54949
99% Chebyshev (MVUE) UCL	77801		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	30160	95% Jackknife UCL	35775
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	40900	95% Chebyshev(Mean, Sd) UCL	51671
97.5% Chebyshev(Mean, Sd) UCL	66620	99% Chebyshev(Mean, Sd) UCL	95985

Suggested UCL to Use

95% Student's-t UCL	35775

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:26
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	20.5	Mean	27.93
Maximum	33.8	Median	28.7
SD	6.092	Std. Error of Mean	3.046
Coefficient of Variation	0.218	Skewness	-0.466

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.243	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	35.09	95% Adjusted-CLT UCL (Chen-1995)	32.18
		95% Modified-t UCL (Johnson-1978)	34.97

Gamma GOF Test

A-D Test Statistic	0.31	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.278	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	26.51	k star (bias corrected MLE)	6.794
Theta hat (MLE)	1.053	Theta star (bias corrected MLE)	4.11
nu hat (MLE)	212.1	nu star (bias corrected)	54.35
MLE Mean (bias corrected)	27.93	MLE Sd (bias corrected)	10.71
		Approximate Chi Square Value (0.05)	38.41
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	39.51	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.928	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.247	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.02	Mean of logged Data	3.311
Maximum of Logged Data	3.52	SD of logged Data	0.228

Assuming Lognormal Distribution

95% H-UCL	39.34	90% Chebyshev (MVUE) UCL	37.47
95% Chebyshev (MVUE) UCL	41.79	97.5% Chebyshev (MVUE) UCL	47.79
99% Chebyshev (MVUE) UCL	59.56		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	32.94	95% Jackknife UCL	35.09
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	37.06	95% Chebyshev(Mean, Sd) UCL	41.2
97.5% Chebyshev(Mean, Sd) UCL	46.95	99% Chebyshev(Mean, Sd) UCL	58.23

Suggested UCL to Use

95% Student's-t UCL	35.09

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:30
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2.7	Mean	4.01
Maximum	5.6	Median	3.87
SD	1.21	Std. Error of Mean	0.605
Coefficient of Variation	0.302	Skewness	0.649

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.976	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.22	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.433	95% Adjusted-CLT UCL (Chen-1995)	5.214
		95% Modified-t UCL (Johnson-1978)	5.466
Gamma GOF Test			
A-D Test Statistic	0.213	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.182	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.85	k star (bias corrected MLE)	3.88
Theta hat (MLE)	0.27	Theta star (bias corrected MLE)	1.034
nu hat (MLE)	118.8	nu star (bias corrected)	31.04
MLE Mean (bias corrected)	4.01	MLE Sd (bias corrected)	2.036
		Approximate Chi Square Value (0.05)	19.31
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.445	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.995	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.176	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.993	Mean of logged Data	1.355
Maximum of Logged Data	1.723	SD of logged Data	0.302
Assuming Lognormal Distribution			
95% H-UCL	6.588	90% Chebyshev (MVUE) UCL	5.812
95% Chebyshev (MVUE) UCL	6.629	97.5% Chebyshev (MVUE) UCL	7.762
99% Chebyshev (MVUE) UCL	9.988		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.005	95% Jackknife UCL	5.433
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.824	95% Chebyshev(Mean, Sd) UCL	6.646
97.5% Chebyshev(Mean, Sd) UCL	7.787	99% Chebyshev(Mean, Sd) UCL	10.03

Suggested UCL to Use

95% Student's-t UCL	5.433

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:36
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	113	Mean	199
Maximum	284	Median	199.5
SD	72.4	Std. Error of Mean	36.2
Coefficient of Variation	0.364	Skewness	-0.0356

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	1	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.133	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	284.2	95% Adjusted-CLT UCL (Chen-1995)	257.9
		95% Modified-t UCL (Johnson-1978)	284.1

Gamma GOF Test

A-D Test Statistic	0.208	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.178	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.288	k star (bias corrected MLE)	2.489
Theta hat (MLE)	21.43	Theta star (bias corrected MLE)	79.97
nu hat (MLE)	74.3	nu star (bias corrected)	19.91
MLE Mean (bias corrected)	199	MLE Sd (bias corrected)	126.1
		Approximate Chi Square Value (0.05)	10.78
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	367.4	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.181	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.727	Mean of logged Data	5.239
Maximum of Logged Data	5.649	SD of logged Data	0.393

Assuming Lognormal Distribution

95% H-UCL	415.1	90% Chebyshev (MVUE) UCL	315.6
95% Chebyshev (MVUE) UCL	368.3	97.5% Chebyshev (MVUE) UCL	441.3
99% Chebyshev (MVUE) UCL	584.8		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	258.5	95% Jackknife UCL	284.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	307.6	95% Chebyshev(Mean, Sd) UCL	356.8
97.5% Chebyshev(Mean, Sd) UCL	425.1	99% Chebyshev(Mean, Sd) UCL	559.2

Suggested UCL to Use

95% Student's-t UCL	284.2

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2.83	Mean	3.988
Maximum	5.6	Median	3.76
SD	1.18	Std. Error of Mean	0.59
Coefficient of Variation	0.296	Skewness	1.024

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.239	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.376	95% Adjusted-CLT UCL (Chen-1995)	5.281
		95% Modified-t UCL (Johnson-1978)	5.427
Gamma GOF Test			
A-D Test Statistic	0.238	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.09	k star (bias corrected MLE)	4.19
Theta hat (MLE)	0.248	Theta star (bias corrected MLE)	0.952
nu hat (MLE)	128.7	nu star (bias corrected)	33.52
MLE Mean (bias corrected)	3.988	MLE Sd (bias corrected)	1.948
		Approximate Chi Square Value (0.05)	21.28
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.281	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.985	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.195	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.04	Mean of logged Data	1.352
Maximum of Logged Data	1.723	SD of logged Data	0.286
Assuming Lognormal Distribution			
95% H-UCL	6.323	90% Chebyshev (MVUE) UCL	5.685
95% Chebyshev (MVUE) UCL	6.456	97.5% Chebyshev (MVUE) UCL	7.525
99% Chebyshev (MVUE) UCL	9.626		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.958	95% Jackknife UCL	5.376
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.758	95% Chebyshev(Mean, Sd) UCL	6.56
97.5% Chebyshev(Mean, Sd) UCL	7.673	99% Chebyshev(Mean, Sd) UCL	9.859

Suggested UCL to Use

95% Student's-t UCL	5.376

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:15
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.02	Mean	0.0353
Maximum	0.05	Median	0.036
SD	0.015	Std. Error of Mean	0.00867
Coefficient of Variation	0.425	Skewness	-0.199

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0606	95% Adjusted-CLT UCL (Chen-1995)	0.0485
		95% Modified-t UCL (Johnson-1978)	0.0605

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	7.544	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00468	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	45.27	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.241	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.912	Mean of logged Data	-3.411
Maximum of Logged Data	-2.996	SD of logged Data	0.464

Assuming Lognormal Distribution

95% H-UCL	0.265	90% Chebyshev (MVUE) UCL	0.0632
95% Chebyshev (MVUE) UCL	0.0758	97.5% Chebyshev (MVUE) UCL	0.0932
99% Chebyshev (MVUE) UCL	0.127		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0496	95% Jackknife UCL	0.0606
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0613	95% Chebyshev(Mean, Sd) UCL	0.0731
97.5% Chebyshev(Mean, Sd) UCL	0.0895	99% Chebyshev(Mean, Sd) UCL	0.122

Suggested UCL to Use

95% Student's-t UCL	0.0606

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:39
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	297	Mean	513
Maximum	729	Median	513
SD	187.5	Std. Error of Mean	93.75
Coefficient of Variation	0.366	Skewness	0

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.989	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.161	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	733.6	95% Adjusted-CLT UCL (Chen-1995)	667.2
		95% Modified-t UCL (Johnson-1978)	733.6

Gamma GOF Test

A-D Test Statistic	0.217	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.209	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.315	k star (bias corrected MLE)	2.496
Theta hat (MLE)	55.07	Theta star (bias corrected MLE)	205.6
nu hat (MLE)	74.52	nu star (bias corrected)	19.96
MLE Mean (bias corrected)	513	MLE Sd (bias corrected)	324.7
		Approximate Chi Square Value (0.05)	10.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	946.1	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.192	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.694	Mean of logged Data	6.186
Maximum of Logged Data	6.592	SD of logged Data	0.391

Assuming Lognormal Distribution

95% H-UCL	1063	90% Chebyshev (MVUE) UCL	811.6
95% Chebyshev (MVUE) UCL	946.5	97.5% Chebyshev (MVUE) UCL	1134
99% Chebyshev (MVUE) UCL	1501		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	667.2	95% Jackknife UCL	733.6
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	794.3	95% Chebyshev(Mean, Sd) UCL	921.7
97.5% Chebyshev(Mean, Sd) UCL	1098	99% Chebyshev(Mean, Sd) UCL	1446

Suggested UCL to Use

95% Student's-t UCL	733.6

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:40
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2780	Mean	4340
Maximum	7120	Median	3730
SD	1936	Std. Error of Mean	967.9
Coefficient of Variation	0.446	Skewness	1.527

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.291	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6618	95% Adjusted-CLT UCL (Chen-1995)	6722
		95% Modified-t UCL (Johnson-1978)	6741
Gamma GOF Test			
A-D Test Statistic	0.345	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.254	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.696	k star (bias corrected MLE)	2.091
Theta hat (MLE)	563.9	Theta star (bias corrected MLE)	2076
nu hat (MLE)	61.57	nu star (bias corrected)	16.73
MLE Mean (bias corrected)	4340	MLE Sd (bias corrected)	3001
		Approximate Chi Square Value (0.05)	8.477
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	8563	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.231	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.93	Mean of logged Data	8.309
Maximum of Logged Data	8.871	SD of logged Data	0.408
Assuming Lognormal Distribution			
95% H-UCL	9408	90% Chebyshev (MVUE) UCL	6932
95% Chebyshev (MVUE) UCL	8115	97.5% Chebyshev (MVUE) UCL	9757
99% Chebyshev (MVUE) UCL	12983		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5932	95% Jackknife UCL	6618
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7244	95% Chebyshev(Mean, Sd) UCL	8559
97.5% Chebyshev(Mean, Sd) UCL	10385	99% Chebyshev(Mean, Sd) UCL	13971

Suggested UCL to Use

95% Student's-t UCL	6618

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:42
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	5.5	Mean	6.4
Maximum	7.19	Median	6.455
SD	0.761	Std. Error of Mean	0.38
Coefficient of Variation	0.119	Skewness	-0.283

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.295	95% Adjusted-CLT UCL (Chen-1995)	6.968
		95% Modified-t UCL (Johnson-1978)	7.286
Gamma GOF Test			
A-D Test Statistic	0.268	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.252	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	92.73	k star (bias corrected MLE)	23.35
Theta hat (MLE)	0.069	Theta star (bias corrected MLE)	0.274
nu hat (MLE)	741.9	nu star (bias corrected)	186.8
MLE Mean (bias corrected)	6.4	MLE Sd (bias corrected)	1.324
		Approximate Chi Square Value (0.05)	156.2
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.655	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.224	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.705	Mean of logged Data	1.851
Maximum of Logged Data	1.973	SD of logged Data	0.121
Assuming Lognormal Distribution			
95% H-UCL	7.507	90% Chebyshev (MVUE) UCL	7.557
95% Chebyshev (MVUE) UCL	8.08	97.5% Chebyshev (MVUE) UCL	8.808
99% Chebyshev (MVUE) UCL	10.24		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.026	95% Jackknife UCL	7.295
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.541	95% Chebyshev(Mean, Sd) UCL	8.058
97.5% Chebyshev(Mean, Sd) UCL	8.776	99% Chebyshev(Mean, Sd) UCL	10.19

Suggested UCL to Use

95% Student's-t UCL	7.295

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Se in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:43
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.717	Minimum Non-Detect	1
Maximum Detect	1.43	Maximum Non-Detect	1.02
Variance Detects	0.254	Percent Non-Detects	50%
Mean Detects	1.074	SD Detects	0.504
Median Detects	1.074	CV Detects	0.47
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.0125	SD of Logged Detects	0.488

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.895	Standard Error of Mean	0.218
SD	0.309	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.409	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.254	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.55	95% KM Chebyshev UCL	1.847
97.5% KM Chebyshev UCL	2.259	99% KM Chebyshev UCL	3.067

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	8.721	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.123	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	34.88	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	8.408	nu hat (KM)	67.27
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (67.27, α)	49.39	Adjusted Chi Square Value (67.27, β)	41.13
95% Gamma Approximate KM-UCL (use when n>=50	1.219	95% Gamma Adjusted KM-UCL (use when n<50)	1.464

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.895	Mean in Log Scale	-0.16
SD in Original Scale	0.357	SD in Log Scale	0.345
95% t UCL (assumes normality of ROS data)	1.315	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.627		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.789	Mean in Log Scale	-0.335
SD in Original Scale	0.439	SD in Log Scale	0.491
95% t UCL (Assumes normality)	1.305	95% H-Stat UCL	2.243

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.409	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:45
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.24	Mean	1.923
Maximum	2.78	Median	1.835
SD	0.75	Std. Error of Mean	0.375
Coefficient of Variation	0.39	Skewness	0.297

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.884	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.277	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.805	95% Adjusted-CLT UCL (Chen-1995)	2.599
		95% Modified-t UCL (Johnson-1978)	2.814

Gamma GOF Test

A-D Test Statistic	0.418	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.307	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.664	k star (bias corrected MLE)	2.333
Theta hat (MLE)	0.222	Theta star (bias corrected MLE)	0.824
nu hat (MLE)	69.31	nu star (bias corrected)	18.66
MLE Mean (bias corrected)	1.923	MLE Sd (bias corrected)	1.259
		Approximate Chi Square Value (0.05)	9.871
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	3.635	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.271	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.215	Mean of logged Data	0.595
Maximum of Logged Data	1.022	SD of logged Data	0.398

Assuming Lognormal Distribution

95% H-UCL	4.059	90% Chebyshev (MVUE) UCL	3.056
95% Chebyshev (MVUE) UCL	3.569	97.5% Chebyshev (MVUE) UCL	4.282
99% Chebyshev (MVUE) UCL	5.682		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.539	95% Jackknife UCL	2.805
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.047	95% Chebyshev(Mean, Sd) UCL	3.557
97.5% Chebyshev(Mean, Sd) UCL	4.264	99% Chebyshev(Mean, Sd) UCL	5.653

Suggested UCL to Use

95% Student's-t UCL	2.805

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A73 below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 12:46
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	749	Mean	1049
Maximum	1450	Median	999
SD	292	Std. Error of Mean	146
Coefficient of Variation	0.278	Skewness	0.992

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.317	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1393	95% Adjusted-CLT UCL (Chen-1995)	1367
		95% Modified-t UCL (Johnson-1978)	1405

Gamma GOF Test		
A-D Test Statistic	0.354	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.299	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	18.06	k star (bias corrected MLE)	4.682
Theta hat (MLE)	58.09	Theta star (bias corrected MLE)	224.1
nu hat (MLE)	144.5	nu star (bias corrected)	37.46
MLE Mean (bias corrected)	1049	MLE Sd (bias corrected)	484.9
		Approximate Chi Square Value (0.05)	24.44
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1608	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.28	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	6.619	Mean of logged Data	6.928
Maximum of Logged Data	7.279	SD of logged Data	0.271

Assuming Lognormal Distribution			
95% H-UCL	1609	90% Chebyshev (MVUE) UCL	1472
95% Chebyshev (MVUE) UCL	1664	97.5% Chebyshev (MVUE) UCL	1930
99% Chebyshev (MVUE) UCL	2454		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	1289	95% Jackknife UCL	1393
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1487	95% Chebyshev(Mean, Sd) UCL	1686
97.5% Chebyshev(Mean, Sd) UCL	1961	99% Chebyshev(Mean, Sd) UCL	2502

Suggested UCL to Use

95% Student's-t UCL	1393

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 13:09		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	6620	Mean	16373
Maximum	31900	Median	10600
SD	13593	Std. Error of Mean	7848
Coefficient of Variation	0.83	Skewness	1.566

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.331	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	39289	95% Adjusted-CLT UCL (Chen-1995)	36866
		95% Modified-t UCL (Johnson-1978)	40472

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	2.381	k star (bias corrected MLE)	N/A
Theta hat (MLE)	6877	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	14.29	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.269	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.798	Mean of logged Data	9.479
Maximum of Logged Data	10.37	SD of logged Data	0.807

Assuming Lognormal Distribution

95% H-UCL	7347437	90% Chebyshev (MVUE) UCL	36910
95% Chebyshev (MVUE) UCL	46345	97.5% Chebyshev (MVUE) UCL	59441
99% Chebyshev (MVUE) UCL	85165		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	29282	95% Jackknife UCL	39289
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	39917	95% Chebyshev(Mean, Sd) UCL	50581
97.5% Chebyshev(Mean, Sd) UCL	65383	99% Chebyshev(Mean, Sd) UCL	94459

Suggested UCL to Use

95% Student's-t UCL	39289

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:10
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	19.9	Mean	29.9
Maximum	39.4	Median	30.4
SD	9.76	Std. Error of Mean	5.635
Coefficient of Variation	0.326	Skewness	-0.23

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	46.35	95% Adjusted-CLT UCL (Chen-1995)	38.37
		95% Modified-t UCL (Johnson-1978)	46.23

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	13.25	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.257	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	79.49	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.991	Mean of logged Data	3.36
Maximum of Logged Data	3.674	SD of logged Data	0.345

Assuming Lognormal Distribution

95% H-UCL	93.07	90% Chebyshev (MVUE) UCL	47.55
95% Chebyshev (MVUE) UCL	55.52	97.5% Chebyshev (MVUE) UCL	66.6
99% Chebyshev (MVUE) UCL	88.35		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	39.17	95% Jackknife UCL	46.35
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	46.8	95% Chebyshev(Mean, Sd) UCL	54.46
97.5% Chebyshev(Mean, Sd) UCL	65.09	99% Chebyshev(Mean, Sd) UCL	85.96

Suggested UCL to Use

95% Student's-t UCL	46.35

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:10
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2.72	Mean	3.507
Maximum	4.24	Median	3.56
SD	0.761	Std. Error of Mean	0.44
Coefficient of Variation	0.217	Skewness	-0.314

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.996	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.195	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.79	95% Adjusted-CLT UCL (Chen-1995)	4.145
		95% Modified-t UCL (Johnson-1978)	4.777
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	30.75	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.114	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	184.5	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.985	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.001	Mean of logged Data	1.238
Maximum of Logged Data	1.445	SD of logged Data	0.224
Assuming Lognormal Distribution			
95% H-UCL	6.116	90% Chebyshev (MVUE) UCL	4.858
95% Chebyshev (MVUE) UCL	5.469	97.5% Chebyshev (MVUE) UCL	6.318
99% Chebyshev (MVUE) UCL	7.986		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.23	95% Jackknife UCL	4.79
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4.825	95% Chebyshev(Mean, Sd) UCL	5.423
97.5% Chebyshev(Mean, Sd) UCL	6.252	99% Chebyshev(Mean, Sd) UCL	7.881

Suggested UCL to Use

95% Student's-t UCL	4.79

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:44
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	3.68	Mean	4.473
Maximum	5.02	Median	4.72
SD	0.703	Std. Error of Mean	0.406
Coefficient of Variation	0.157	Skewness	-1.384

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.304	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.659	95% Adjusted-CLT UCL (Chen-1995)	4.794
		95% Modified-t UCL (Johnson-1978)	5.605

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	57.31	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0781	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	343.9	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.315	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.303	Mean of logged Data	1.489
Maximum of Logged Data	1.613	SD of logged Data	0.164

Assuming Lognormal Distribution

95% H-UCL	6.422	90% Chebyshev (MVUE) UCL	5.744
95% Chebyshev (MVUE) UCL	6.319	97.5% Chebyshev (MVUE) UCL	7.118
99% Chebyshev (MVUE) UCL	8.686		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5.141	95% Jackknife UCL	5.659
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.691	95% Chebyshev(Mean, Sd) UCL	6.243
97.5% Chebyshev(Mean, Sd) UCL	7.009	99% Chebyshev(Mean, Sd) UCL	8.513

Suggested UCL to Use

95% Student's-t UCL	5.659

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:10
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	98.8	Mean	176.9
Maximum	292	Median	140
SD	101.8	Std. Error of Mean	58.75
Coefficient of Variation	0.575	Skewness	1.418

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.308	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	348.5	95% Adjusted-CLT UCL (Chen-1995)	325
		95% Modified-t UCL (Johnson-1978)	356.5

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	4.91	k star (bias corrected MLE)	N/A
Theta hat (MLE)	36.04	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	29.46	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.593	Mean of logged Data	5.07
Maximum of Logged Data	5.677	SD of logged Data	0.553

Assuming Lognormal Distribution

95% H-UCL	3088	90% Chebyshev (MVUE) UCL	338.4
95% Chebyshev (MVUE) UCL	411.9	97.5% Chebyshev (MVUE) UCL	514
99% Chebyshev (MVUE) UCL	714.6		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	273.6	95% Jackknife UCL	348.5
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	353.2	95% Chebyshev(Mean, Sd) UCL	433
97.5% Chebyshev(Mean, Sd) UCL	543.8	99% Chebyshev(Mean, Sd) UCL	761.5

Suggested UCL to Use

95% Student's-t UCL	348.5

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:11
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	468	Mean	533.7
Maximum	593	Median	540
SD	62.74	Std. Error of Mean	36.22
Coefficient of Variation	0.118	Skewness	-0.45

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.992	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.207	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	639.4	95% Adjusted-CLT UCL (Chen-1995)	583.2
		95% Modified-t UCL (Johnson-1978)	637.9

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	106.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	5.002	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	640.1	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.986	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	6.148	Mean of logged Data	6.275
Maximum of Logged Data	6.385	SD of logged Data	0.119

Assuming Lognormal Distribution

95% H-UCL	679.3	90% Chebyshev (MVUE) UCL	643.7
95% Chebyshev (MVUE) UCL	693.5	97.5% Chebyshev (MVUE) UCL	762.7
99% Chebyshev (MVUE) UCL	898.5		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	593.2	95% Jackknife UCL	639.4
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	642.3	95% Chebyshev(Mean, Sd) UCL	691.6
97.5% Chebyshev(Mean, Sd) UCL	759.9	99% Chebyshev(Mean, Sd) UCL	894.1

Suggested UCL to Use

95% Student's-t UCL	639.4

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:11
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2480	Mean	3143
Maximum	4340	Median	2610
SD	1038	Std. Error of Mean	599.5
Coefficient of Variation	0.33	Skewness	1.702

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.802	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4894	95% Adjusted-CLT UCL (Chen-1995)	4759
		95% Modified-t UCL (Johnson-1978)	4992

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	15.11	k star (bias corrected MLE)	N/A
Theta hat (MLE)	208	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	90.66	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.818	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.356	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.816	Mean of logged Data	8.02
Maximum of Logged Data	8.376	SD of logged Data	0.309

Assuming Lognormal Distribution

95% H-UCL	7994	90% Chebyshev (MVUE) UCL	4799
95% Chebyshev (MVUE) UCL	5552	97.5% Chebyshev (MVUE) UCL	6597
99% Chebyshev (MVUE) UCL	8649		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	4129	95% Jackknife UCL	4894
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4942	95% Chebyshev(Mean, Sd) UCL	5757
97.5% Chebyshev(Mean, Sd) UCL	6887	99% Chebyshev(Mean, Sd) UCL	9108

Suggested UCL to Use

95% Student's-t UCL	4894

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:11
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	8.16	Mean	10.01
Maximum	12.1	Median	9.78
SD	1.98	Std. Error of Mean	1.143
Coefficient of Variation	0.198	Skewness	0.523

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.99	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.214	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13.35	95% Adjusted-CLT UCL (Chen-1995)	12.26
		95% Modified-t UCL (Johnson-1978)	13.41

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	38.66	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.259	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	232	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.998	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.188	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.099	Mean of logged Data	2.291
Maximum of Logged Data	2.493	SD of logged Data	0.197

Assuming Lognormal Distribution

95% H-UCL	15.91	90% Chebyshev (MVUE) UCL	13.42
95% Chebyshev (MVUE) UCL	14.96	97.5% Chebyshev (MVUE) UCL	17.1
99% Chebyshev (MVUE) UCL	21.3		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	11.89	95% Jackknife UCL	13.35
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.44	95% Chebyshev(Mean, Sd) UCL	15
97.5% Chebyshev(Mean, Sd) UCL	17.15	99% Chebyshev(Mean, Sd) UCL	21.39

Suggested UCL to Use

95% Student's-t UCL	13.35

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:12
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	1.25	Mean	1.997
Maximum	3.09	Median	1.65
SD	0.968	Std. Error of Mean	0.559
Coefficient of Variation	0.485	Skewness	1.405

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.904	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.307	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.628	95% Adjusted-CLT UCL (Chen-1995)	3.4
		95% Modified-t UCL (Johnson-1978)	3.704

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	6.909	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.289	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	41.45	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.266	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.223	Mean of logged Data	0.617
Maximum of Logged Data	1.128	SD of logged Data	0.464

Assuming Lognormal Distribution

95% H-UCL	14.82	90% Chebyshev (MVUE) UCL	3.545
95% Chebyshev (MVUE) UCL	4.25	97.5% Chebyshev (MVUE) UCL	5.229
99% Chebyshev (MVUE) UCL	7.15		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.916	95% Jackknife UCL	3.628
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3.673	95% Chebyshev(Mean, Sd) UCL	4.432
97.5% Chebyshev(Mean, Sd) UCL	5.486	99% Chebyshev(Mean, Sd) UCL	7.556

Suggested UCL to Use

95% Student's-t UCL	3.628

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A73B below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 13:12		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	659	Mean	1114
Maximum	1720	Median	964
SD	546.2	Std. Error of Mean	315.4
Coefficient of Variation	0.49	Skewness	1.145

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.275	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2035	95% Adjusted-CLT UCL (Chen-1995)	1856
		95% Modified-t UCL (Johnson-1978)	2070
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	6.514	k star (bias corrected MLE)	N/A
Theta hat (MLE)	171.1	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	39.09	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.986	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.491	Mean of logged Data	6.937
Maximum of Logged Data	7.45	SD of logged Data	0.483
Assuming Lognormal Distribution			
95% H-UCL	9849	90% Chebyshev (MVUE) UCL	2016
95% Chebyshev (MVUE) UCL	2425	97.5% Chebyshev (MVUE) UCL	2994
99% Chebyshev (MVUE) UCL	4110		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1633	95% Jackknife UCL	2035
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2060	95% Chebyshev(Mean, Sd) UCL	2489
97.5% Chebyshev(Mean, Sd) UCL	3084	99% Chebyshev(Mean, Sd) UCL	4252
Suggested UCL to Use			
95% Student's-t UCL	2035		

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options		
Date/Time of Computation		2/18/2015 13:57
From File	WorkSheet.xls	
Full Precision	OFF	
Confidence Coefficient	95%	
Number of Bootstrap Operations	2000	

General Statistics			
Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	6640	Mean	20820
Maximum	48600	Median	7220
SD	24060	Std. Error of Mean	13891
Coefficient of Variation	1.156	Skewness	1.731

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.76	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.381	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	61382	95% Adjusted-CLT UCL (Chen-1995)	58502
		95% Modified-t UCL (Johnson-1978)	63695
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	1.248	k star (bias corrected MLE)	N/A
Theta hat (MLE)	16682	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7.488	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.781	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.372	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.801	Mean of logged Data	9.492
Maximum of Logged Data	10.79	SD of logged Data	1.126
Assuming Lognormal Distribution			
95% H-UCL	3.02E+09	90% Chebyshev (MVUE) UCL	52502
95% Chebyshev (MVUE) UCL	67461	97.5% Chebyshev (MVUE) UCL	88224
99% Chebyshev (MVUE) UCL	129007		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	43669	95% Jackknife UCL	61382
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	62493	95% Chebyshev(Mean, Sd) UCL	81370
97.5% Chebyshev(Mean, Sd) UCL	107569	99% Chebyshev(Mean, Sd) UCL	159034

Suggested UCL to Use	
95% Student's-t UCL	61382

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 13:57		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	9.22	Mean	19.91
Maximum	37.2	Median	13.3
SD	15.11	Std. Error of Mean	8.727
Coefficient of Variation	0.759	Skewness	1.591

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.857	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	45.39	95% Adjusted-CLT UCL (Chen-1995)	42.83
		95% Modified-t UCL (Johnson-1978)	46.72

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	2.895	k star (bias corrected MLE)	N/A
Theta hat (MLE)	6.877	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.37	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.221	Mean of logged Data	2.808
Maximum of Logged Data	3.616	SD of logged Data	0.723

Assuming Lognormal Distribution

95% H-UCL	2668	90% Chebyshev (MVUE) UCL	42.69
95% Chebyshev (MVUE) UCL	53.14	97.5% Chebyshev (MVUE) UCL	67.65
99% Chebyshev (MVUE) UCL	96.16		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	34.26	95% Jackknife UCL	45.39
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	46.09	95% Chebyshev(Mean, Sd) UCL	57.94
97.5% Chebyshev(Mean, Sd) UCL	74.4	99% Chebyshev(Mean, Sd) UCL	106.7

Suggested UCL to Use

95% Student's-t UCL	45.39

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:57
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	1.99	Mean	5.047
Maximum	10.5	Median	2.65
SD	4.734	Std. Error of Mean	2.733
Coefficient of Variation	0.938	Skewness	1.694

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.36	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13.03	95% Adjusted-CLT UCL (Chen-1995)	12.4
		95% Modified-t UCL (Johnson-1978)	13.47

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	1.931	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.613	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.59	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.325	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.688	Mean of logged Data	1.338
Maximum of Logged Data	2.351	SD of logged Data	0.889

Assuming Lognormal Distribution

95% H-UCL	8316	90% Chebyshev (MVUE) UCL	11.75
95% Chebyshev (MVUE) UCL	14.86	97.5% Chebyshev (MVUE) UCL	19.18
99% Chebyshev (MVUE) UCL	27.66		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	9.543	95% Jackknife UCL	13.03
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.25	95% Chebyshev(Mean, Sd) UCL	16.96
97.5% Chebyshev(Mean, Sd) UCL	22.12	99% Chebyshev(Mean, Sd) UCL	32.24

Suggested UCL to Use

95% Student's-t UCL	13.03

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 13:57		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	67	Mean	187.6
Maximum	413	Median	82.7
SD	195.4	Std. Error of Mean	112.8
Coefficient of Variation	1.042	Skewness	1.719

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.784	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	517	95% Adjusted-CLT UCL (Chen-1995)	492.8
		95% Modified-t UCL (Johnson-1978)	535.6
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	1.562	k star (bias corrected MLE)	N/A
Theta hat (MLE)	120.1	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	9.373	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.836	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.347	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.205	Mean of logged Data	4.881
Maximum of Logged Data	6.023	SD of logged Data	0.995
Assuming Lognormal Distribution			
95% H-UCL	2000919	90% Chebyshev (MVUE) UCL	454.7
95% Chebyshev (MVUE) UCL	579.6	97.5% Chebyshev (MVUE) UCL	752.9
99% Chebyshev (MVUE) UCL	1093		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	373.1	95% Jackknife UCL	517
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	526	95% Chebyshev(Mean, Sd) UCL	679.3
97.5% Chebyshev(Mean, Sd) UCL	892.1	99% Chebyshev(Mean, Sd) UCL	1310

Suggested UCL to Use

95% Student's-t UCL	517

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	3/2/2015 12:44		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5.01	Mean	5.207
Maximum	5.45	Median	5.16
SD	0.224	Std. Error of Mean	0.129
Coefficient of Variation	0.043	Skewness	0.898

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.967	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.249	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.584	95% Adjusted-CLT UCL (Chen-1995)	5.491
		95% Modified-t UCL (Johnson-1978)	5.595

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	819.2	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00636	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4915	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.611	Mean of logged Data	1.649
Maximum of Logged Data	1.696	SD of logged Data	0.0427

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	5.592
95% Chebyshev (MVUE) UCL	5.766	97.5% Chebyshev (MVUE) UCL	6.008
99% Chebyshev (MVUE) UCL	6.484		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5.419	95% Jackknife UCL	5.584
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.594	95% Chebyshev(Mean, Sd) UCL	5.77
97.5% Chebyshev(Mean, Sd) UCL	6.013	99% Chebyshev(Mean, Sd) UCL	6.492

Suggested UCL to Use

95% Student's-t UCL	5.584

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	98	Mean	295.7
Maximum	435	Median	354
SD	175.9	Std. Error of Mean	101.6
Coefficient of Variation	0.595	Skewness	-1.328

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.297	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	592.2	95% Adjusted-CLT UCL (Chen-1995)	379.5
		95% Modified-t UCL (Johnson-1978)	579.2

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	2.944	k star (bias corrected MLE)	N/A
Theta hat (MLE)	100.4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.66	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.339	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.585	Mean of logged Data	5.51
Maximum of Logged Data	6.075	SD of logged Data	0.808

Assuming Lognormal Distribution

95% H-UCL	139915	90% Chebyshev (MVUE) UCL	697.6
95% Chebyshev (MVUE) UCL	876	97.5% Chebyshev (MVUE) UCL	1124
99% Chebyshev (MVUE) UCL	1610		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	462.7	95% Jackknife UCL	592.2
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	600.4	95% Chebyshev(Mean, Sd) UCL	738.4
97.5% Chebyshev(Mean, Sd) UCL	929.9	99% Chebyshev(Mean, Sd) UCL	1306

Suggested UCL to Use

95% Student's-t UCL	592.2

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	2070	Mean	2743
Maximum	3820	Median	2340
SD	942.1	Std. Error of Mean	543.9
Coefficient of Variation	0.343	Skewness	1.573

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.863	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.332	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4332	95% Adjusted-CLT UCL (Chen-1995)	4166
		95% Modified-t UCL (Johnson-1978)	4414

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	13.85	k star (bias corrected MLE)	N/A
Theta hat (MLE)	198	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	83.13	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.893	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.314	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.635	Mean of logged Data	7.88
Maximum of Logged Data	8.248	SD of logged Data	0.324

Assuming Lognormal Distribution

95% H-UCL	7558	90% Chebyshev (MVUE) UCL	4256
95% Chebyshev (MVUE) UCL	4944	97.5% Chebyshev (MVUE) UCL	5898
99% Chebyshev (MVUE) UCL	7773		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3638	95% Jackknife UCL	4332
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	4375	95% Chebyshev(Mean, Sd) UCL	5114
97.5% Chebyshev(Mean, Sd) UCL	6140	99% Chebyshev(Mean, Sd) UCL	8156

Suggested UCL to Use

95% Student's-t UCL	4332

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	5.93	Mean	9.713
Maximum	16.5	Median	6.71
SD	5.89	Std. Error of Mean	3.401
Coefficient of Variation	0.606	Skewness	1.698

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.362	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.64	95% Adjusted-CLT UCL (Chen-1995)	18.87
		95% Modified-t UCL (Johnson-1978)	20.2
Gamma GOF Test			
Not Enough Data to Perform GOF Test			
Gamma Statistics			
k hat (MLE)	4.658	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.085	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	27.95	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.839	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.345	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.78	Mean of logged Data	2.162
Maximum of Logged Data	2.803	SD of logged Data	0.559
Assuming Lognormal Distribution			
95% H-UCL	178.7	90% Chebyshev (MVUE) UCL	18.58
95% Chebyshev (MVUE) UCL	22.64	97.5% Chebyshev (MVUE) UCL	28.27
99% Chebyshev (MVUE) UCL	39.34		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.31	95% Jackknife UCL	19.64
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	19.92	95% Chebyshev(Mean, Sd) UCL	24.54
97.5% Chebyshev(Mean, Sd) UCL	30.95	99% Chebyshev(Mean, Sd) UCL	43.55

Suggested UCL to Use

95% Student's-t UCL	19.64

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.588	Minimum Non-Detect	0.994
Maximum Detect	3.26	Maximum Non-Detect	0.994
Variance Detects	3.57	Percent Non-Detects	33.33%
Mean Detects	1.924	SD Detects	1.889
Median Detects	1.924	CV Detects	0.982
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.325	SD of Logged Detects	1.211

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.479	Standard Error of Mean	1.028
SD	1.26	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.482	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	3.17	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.564	95% KM Chebyshev UCL	5.962
97.5% KM Chebyshev UCL	7.901	99% KM Chebyshev UCL	11.71

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.667	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.154	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.667	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.378	nu hat (KM)	8.269
		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (8.27, α)	2.892	Adjusted Chi Square Value (8.27, β)	1.019
95% Gamma Approximate KM-UCL (use when n>=50	4.228	95% Gamma Adjusted KM-UCL (use when n<50)	11.99

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.479	Mean in Log Scale	0.0399
SD in Original Scale	1.543	SD in Log Scale	0.989
95% t UCL (assumes normality of ROS data)	4.079	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	14069		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.448	Mean in Log Scale	-0.0162
SD in Original Scale	1.57	SD in Log Scale	1.041
95% t UCL (Assumes normality)	4.094	95% H-Stat UCL	37170

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	7.901

Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.512	Mean	1.401
Maximum	2.18	Median	1.51
SD	0.839	Std. Error of Mean	0.485
Coefficient of Variation	0.599	Skewness	-0.576

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.987	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.816	95% Adjusted-CLT UCL (Chen-1995)	2.026
		95% Modified-t UCL (Johnson-1978)	2.789

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	3.226	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.434	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	19.35	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.291	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.669	Mean of logged Data	0.174
Maximum of Logged Data	0.779	SD of logged Data	0.753

Assuming Lognormal Distribution

95% H-UCL	294.6	90% Chebyshev (MVUE) UCL	3.166
95% Chebyshev (MVUE) UCL	3.954	97.5% Chebyshev (MVUE) UCL	5.048
99% Chebyshev (MVUE) UCL	7.196		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.198	95% Jackknife UCL	2.816
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	2.854	95% Chebyshev(Mean, Sd) UCL	3.513
97.5% Chebyshev(Mean, Sd) UCL	4.427	99% Chebyshev(Mean, Sd) UCL	6.222

Suggested UCL to Use

95% Student's-t UCL	2.816

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A75B below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 13:58
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	578	Mean	2190
Maximum	5320	Median	672
SD	2711	Std. Error of Mean	1565
Coefficient of Variation	1.238	Skewness	1.73

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.765	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.379	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level	
Data appear Approximate Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6760	95% Adjusted-CLT UCL (Chen-1995)	6435
		95% Modified-t UCL (Johnson-1978)	7021

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics			
k hat (MLE)	1.058	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2070	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.349	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.801	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.364	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	6.36	Mean of logged Data	7.15
Maximum of Logged Data	8.579	SD of logged Data	1.24

Assuming Lognormal Distribution			
95% H-UCL	4.08E+09	90% Chebyshev (MVUE) UCL	5684
95% Chebyshev (MVUE) UCL	7345	97.5% Chebyshev (MVUE) UCL	9652
99% Chebyshev (MVUE) UCL	14182		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	4765	95% Jackknife UCL	6760
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6886	95% Chebyshev(Mean, Sd) UCL	9013
97.5% Chebyshev(Mean, Sd) UCL	11965	99% Chebyshev(Mean, Sd) UCL	17764

Suggested UCL to Use

95% Student's-t UCL	6760

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7660	Mean	15428
Maximum	29900	Median	12075
SD	10281	Std. Error of Mean	5141
Coefficient of Variation	0.666	Skewness	1.372

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.855	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	27525	95% Adjusted-CLT UCL (Chen-1995)	27653
		95% Modified-t UCL (Johnson-1978)	28113

Gamma GOF Test

A-D Test Statistic	0.369	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.396	k star (bias corrected MLE)	1.016
Theta hat (MLE)	4542	Theta star (bias corrected MLE)	15188
nu hat (MLE)	27.17	nu star (bias corrected)	8.126
MLE Mean (bias corrected)	15428	MLE Sd (bias corrected)	15307
		Approximate Chi Square Value (0.05)	2.808
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	44642	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.256	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.944	Mean of logged Data	9.49
Maximum of Logged Data	10.31	SD of logged Data	0.627

Assuming Lognormal Distribution

95% H-UCL	78329	90% Chebyshev (MVUE) UCL	29207
95% Chebyshev (MVUE) UCL	35525	97.5% Chebyshev (MVUE) UCL	44293
99% Chebyshev (MVUE) UCL	61516		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	23883	95% Jackknife UCL	27525
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	30849	95% Chebyshev(Mean, Sd) UCL	37835
97.5% Chebyshev(Mean, Sd) UCL	47531	99% Chebyshev(Mean, Sd) UCL	66576

Suggested UCL to Use

95% Student's-t UCL	27525

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	13.2	Mean	19.35
Maximum	28.5	Median	17.85
SD	6.488	Std. Error of Mean	3.244
Coefficient of Variation	0.335	Skewness	1.283

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.895	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.32	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	26.98	95% Adjusted-CLT UCL (Chen-1995)	26.91
		95% Modified-t UCL (Johnson-1978)	27.33
Gamma GOF Test			
A-D Test Statistic	0.343	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.3	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	12.9	k star (bias corrected MLE)	3.392
Theta hat (MLE)	1.5	Theta star (bias corrected MLE)	5.705
nu hat (MLE)	103.2	nu star (bias corrected)	27.14
MLE Mean (bias corrected)	19.35	MLE Sd (bias corrected)	10.51
		Approximate Chi Square Value (0.05)	16.26
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	32.3	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.278	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.58	Mean of logged Data	2.923
Maximum of Logged Data	3.35	SD of logged Data	0.318
Assuming Lognormal Distribution			
95% H-UCL	33	90% Chebyshev (MVUE) UCL	28.47
95% Chebyshev (MVUE) UCL	32.62	97.5% Chebyshev (MVUE) UCL	38.38
99% Chebyshev (MVUE) UCL	49.68		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	24.69	95% Jackknife UCL	26.98
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	29.08	95% Chebyshev(Mean, Sd) UCL	33.49
97.5% Chebyshev(Mean, Sd) UCL	39.61	99% Chebyshev(Mean, Sd) UCL	51.63

Suggested UCL to Use	
95% Student's-t UCL	26.98

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.73	Mean	4.808
Maximum	6.75	Median	4.375
SD	1.39	Std. Error of Mean	0.695
Coefficient of Variation	0.289	Skewness	1.31

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.443	95% Adjusted-CLT UCL (Chen-1995)	6.437
		95% Modified-t UCL (Johnson-1978)	6.519
Gamma GOF Test			
A-D Test Statistic	0.387	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.283	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	17.43	k star (bias corrected MLE)	4.525
Theta hat (MLE)	0.276	Theta star (bias corrected MLE)	1.063
nu hat (MLE)	139.5	nu star (bias corrected)	36.2
MLE Mean (bias corrected)	4.808	MLE Sd (bias corrected)	2.26
		Approximate Chi Square Value (0.05)	23.43
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7.428	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.894	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.252	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.316	Mean of logged Data	1.541
Maximum of Logged Data	1.91	SD of logged Data	0.272
Assuming Lognormal Distribution			
95% H-UCL	7.388	90% Chebyshev (MVUE) UCL	6.751
95% Chebyshev (MVUE) UCL	7.634	97.5% Chebyshev (MVUE) UCL	8.86
99% Chebyshev (MVUE) UCL	11.27		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.951	95% Jackknife UCL	6.443
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6.893	95% Chebyshev(Mean, Sd) UCL	7.838
97.5% Chebyshev(Mean, Sd) UCL	9.149	99% Chebyshev(Mean, Sd) UCL	11.72

Suggested UCL to Use

95% Student's-t UCL	6.443

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:45
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3.72	Mean	4.208
Maximum	4.99	Median	4.06
SD	0.609	Std. Error of Mean	0.304
Coefficient of Variation	0.145	Skewness	0.77

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.87	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.284	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.924	95% Adjusted-CLT UCL (Chen-1995)	4.833
		95% Modified-t UCL (Johnson-1978)	4.943
Gamma GOF Test			
A-D Test Statistic	0.421	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.32	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	65.57	k star (bias corrected MLE)	16.56
Theta hat (MLE)	0.0642	Theta star (bias corrected MLE)	0.254
nu hat (MLE)	524.6	nu star (bias corrected)	132.5
MLE Mean (bias corrected)	4.208	MLE Sd (bias corrected)	1.034
		Approximate Chi Square Value (0.05)	106.9
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	5.215	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.87	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.314	Mean of logged Data	1.429
Maximum of Logged Data	1.607	SD of logged Data	0.142
Assuming Lognormal Distribution			
95% H-UCL	5.097	90% Chebyshev (MVUE) UCL	5.101
95% Chebyshev (MVUE) UCL	5.505	97.5% Chebyshev (MVUE) UCL	6.067
99% Chebyshev (MVUE) UCL	7.171		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.708	95% Jackknife UCL	4.924
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	5.12	95% Chebyshev(Mean, Sd) UCL	5.534
97.5% Chebyshev(Mean, Sd) UCL	6.108	99% Chebyshev(Mean, Sd) UCL	7.235

Suggested UCL to Use

95% Student's-t UCL	4.924

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	103	Mean	146.5
Maximum	223	Median	130
SD	55.55	Std. Error of Mean	27.77
Coefficient of Variation	0.379	Skewness	1.2

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.872	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	211.9	95% Adjusted-CLT UCL (Chen-1995)	210
		95% Modified-t UCL (Johnson-1978)	214.6
Gamma GOF Test			
A-D Test Statistic	0.377	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.293	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.15	k star (bias corrected MLE)	2.705
Theta hat (MLE)	14.43	Theta star (bias corrected MLE)	54.15
nu hat (MLE)	81.23	nu star (bias corrected)	21.64
MLE Mean (bias corrected)	146.5	MLE Sd (bias corrected)	89.07
		Approximate Chi Square Value (0.05)	12.07
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	262.7	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.262	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.635	Mean of logged Data	4.937
Maximum of Logged Data	5.407	SD of logged Data	0.358
Assuming Lognormal Distribution			
95% H-UCL	276.2	90% Chebyshev (MVUE) UCL	223.9
95% Chebyshev (MVUE) UCL	259.2	97.5% Chebyshev (MVUE) UCL	308.1
99% Chebyshev (MVUE) UCL	404.1		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	192.2	95% Jackknife UCL	211.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	229.8	95% Chebyshev(Mean, Sd) UCL	267.6
97.5% Chebyshev(Mean, Sd) UCL	320	99% Chebyshev(Mean, Sd) UCL	422.9

Suggested UCL to Use

95% Student's-t UCL	211.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:17
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.038	Minimum Non-Detect	0.02
Maximum Detect	0.04	Maximum Non-Detect	0.02
Variance Detects	2.00E-06	Percent Non-Detects	33.33%
Mean Detects	0.039	SD Detects	0.00141
Median Detects	0.039	CV Detects	0.0363
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.245	SD of Logged Detects	0.0363

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0327	Standard Error of Mean	0.00734
SD	0.00899	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0541	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0447	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0547	95% KM Chebyshev UCL	0.0647
97.5% KM Chebyshev UCL	0.0785	99% KM Chebyshev UCL	0.106

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1521	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.56E-05	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6083	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	13.19	nu hat (KM)	79.15
		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (79.15, α)	59.66	Adjusted Chi Square Value (79.15, β)	46.69
95% Gamma Approximate KM-UCL (use when n>=50)	0.0433	95% Gamma Adjusted KM-UCL (use when n<50)	0.0554

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0376	Mean in Log Scale	-3.283
SD in Original Scale	0.00268	SD in Log Scale	0.072
95% t UCL (assumes normality of ROS data)	0.0421	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0293	Mean in Log Scale	-3.698
SD in Original Scale	0.0168	SD in Log Scale	0.786
95% t UCL (Assumes normality)	0.0576	95% H-Stat UCL	10.03

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Pb in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:19
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	231	Mean	299.5
Maximum	367	Median	300
SD	64.01	Std. Error of Mean	32
Coefficient of Variation	0.214	Skewness	-0.0237

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.231	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	374.8	95% Adjusted-CLT UCL (Chen-1995)	351.7
		95% Modified-t UCL (Johnson-1978)	374.8
Gamma GOF Test			
A-D Test Statistic	0.334	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.27	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	28.67	k star (bias corrected MLE)	7.335
Theta hat (MLE)	10.45	Theta star (bias corrected MLE)	40.83
nu hat (MLE)	229.4	nu star (bias corrected)	58.68
MLE Mean (bias corrected)	299.5	MLE Sd (bias corrected)	110.6
		Approximate Chi Square Value (0.05)	42.07
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	417.8	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.242	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.442	Mean of logged Data	5.685
Maximum of Logged Data	5.905	SD of logged Data	0.217
Assuming Lognormal Distribution			
95% H-UCL	413.1	90% Chebyshev (MVUE) UCL	396.9
95% Chebyshev (MVUE) UCL	441	97.5% Chebyshev (MVUE) UCL	502.2
99% Chebyshev (MVUE) UCL	622.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	352.1	95% Jackknife UCL	374.8
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	395.5	95% Chebyshev(Mean, Sd) UCL	439
97.5% Chebyshev(Mean, Sd) UCL	499.4	99% Chebyshev(Mean, Sd) UCL	617.9

Suggested UCL to Use

95% Student's-t UCL	374.8

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Mn in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	3010	Mean	4348
Maximum	6900	Median	3740
SD	1736	Std. Error of Mean	868.1
Coefficient of Variation	0.399	Skewness	1.757

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.792	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.385	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6390	95% Adjusted-CLT UCL (Chen-1995)	6590
		95% Modified-t UCL (Johnson-1978)	6517

Gamma GOF Test

A-D Test Statistic	0.537	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.385	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.836	k star (bias corrected MLE)	2.626
Theta hat (MLE)	442	Theta star (bias corrected MLE)	1656
nu hat (MLE)	78.69	nu star (bias corrected)	21.01
MLE Mean (bias corrected)	4348	MLE Sd (bias corrected)	2683
		Approximate Chi Square Value (0.05)	11.6
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7876	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.851	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.356	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.01	Mean of logged Data	8.326
Maximum of Logged Data	8.839	SD of logged Data	0.357

Assuming Lognormal Distribution

95% H-UCL	8164	90% Chebyshev (MVUE) UCL	6628
95% Chebyshev (MVUE) UCL	7669	97.5% Chebyshev (MVUE) UCL	9114
99% Chebyshev (MVUE) UCL	11953		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5775	95% Jackknife UCL	6390
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6952	95% Chebyshev(Mean, Sd) UCL	8131
97.5% Chebyshev(Mean, Sd) UCL	9769	99% Chebyshev(Mean, Sd) UCL	12985

Suggested UCL to Use

95% Student's-t UCL	6390

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7.27	Mean	9.415
Maximum	13.1	Median	8.645
SD	2.567	Std. Error of Mean	1.283
Coefficient of Variation	0.273	Skewness	1.512

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test		
Shapiro Wilk Test Statistic	0.874	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.3	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.44	95% Adjusted-CLT UCL (Chen-1995)	12.56
		95% Modified-t UCL (Johnson-1978)	12.6

Gamma GOF Test		
A-D Test Statistic	0.365	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	19.86	k star (bias corrected MLE)	5.132
Theta hat (MLE)	0.474	Theta star (bias corrected MLE)	1.834
nu hat (MLE)	158.9	nu star (bias corrected)	41.06
MLE Mean (bias corrected)	9.415	MLE Sd (bias corrected)	4.156
		Approximate Chi Square Value (0.05)	27.37
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	14.12	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.919	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.265	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	1.984	Mean of logged Data	2.217
Maximum of Logged Data	2.573	SD of logged Data	0.254

Assuming Lognormal Distribution			
95% H-UCL	13.93	90% Chebyshev (MVUE) UCL	12.97
95% Chebyshev (MVUE) UCL	14.58	97.5% Chebyshev (MVUE) UCL	16.83
99% Chebyshev (MVUE) UCL	21.23		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	11.53	95% Jackknife UCL	12.44
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	13.26	95% Chebyshev(Mean, Sd) UCL	15.01
97.5% Chebyshev(Mean, Sd) UCL	17.43	99% Chebyshev(Mean, Sd) UCL	22.18

Suggested UCL to Use

95% Student's-t UCL	12.44

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	1.06	Minimum Non-Detect	0.498
Maximum Detect	1.4	Maximum Non-Detect	1.02
Variance Detects	0.0578	Percent Non-Detects	50%
Mean Detects	1.23	SD Detects	0.24
Median Detects	1.23	CV Detects	0.195
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.197	SD of Logged Detects	0.197

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.864	Standard Error of Mean	0.272
SD	0.385	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.505	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.312	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.681	95% KM Chebyshev UCL	2.051
97.5% KM Chebyshev UCL	2.565	99% KM Chebyshev UCL	3.574

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	52.01	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0236	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	208.1	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	5.03	nu hat (KM)	40.24
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (40.24, α)	26.71	Adjusted Chi Square Value (40.24, β)	20.87
95% Gamma Approximate KM-UCL (use when n>=50)	1.302	95% Gamma Adjusted KM-UCL (use when n<50)	1.666

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.914	Mean in Log Scale	-0.159
SD in Original Scale	0.391	SD in Log Scale	0.426
95% t UCL (assumes normality of ROS data)	1.373	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	2.103		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.805	Mean in Log Scale	-0.417
SD in Original Scale	0.521	SD in Log Scale	0.776
95% t UCL (Assumes normality)	1.418	95% H-Stat UCL	9.42

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	1.505	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.724	Mean	1.078
Maximum	1.37	Median	1.109
SD	0.297	Std. Error of Mean	0.148
Coefficient of Variation	0.275	Skewness	-0.372

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.241	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.427	95% Adjusted-CLT UCL (Chen-1995)	1.293
		95% Modified-t UCL (Johnson-1978)	1.423
Gamma GOF Test			
A-D Test Statistic	0.309	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.278	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	16.43	k star (bias corrected MLE)	4.274
Theta hat (MLE)	0.0656	Theta star (bias corrected MLE)	0.252
nu hat (MLE)	131.4	nu star (bias corrected)	34.19
MLE Mean (bias corrected)	1.078	MLE Sd (bias corrected)	0.521
		Approximate Chi Square Value (0.05)	21.82
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.689	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.929	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.323	Mean of logged Data	0.0444
Maximum of Logged Data	0.315	SD of logged Data	0.292
Assuming Lognormal Distribution			
95% H-UCL	1.733	90% Chebyshev (MVUE) UCL	1.548
95% Chebyshev (MVUE) UCL	1.761	97.5% Chebyshev (MVUE) UCL	2.056
99% Chebyshev (MVUE) UCL	2.636		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.322	95% Jackknife UCL	1.427
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.523	95% Chebyshev(Mean, Sd) UCL	1.725
97.5% Chebyshev(Mean, Sd) UCL	2.005	99% Chebyshev(Mean, Sd) UCL	2.555

Suggested UCL to Use

95% Student's-t UCL	1.427

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Zn in sediment of the Animas River at sampling location A75D below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1030	Mean	1738
Maximum	2910	Median	1505
SD	884.1	Std. Error of Mean	442
Coefficient of Variation	0.509	Skewness	0.946

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.878	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.271	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2778	95% Adjusted-CLT UCL (Chen-1995)	2688
		95% Modified-t UCL (Johnson-1978)	2813
Gamma GOF Test			
A-D Test Statistic	0.39	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.458	k star (bias corrected MLE)	1.531
Theta hat (MLE)	318.3	Theta star (bias corrected MLE)	1135
nu hat (MLE)	43.66	nu star (bias corrected)	12.25
MLE Mean (bias corrected)	1738	MLE Sd (bias corrected)	1404
		Approximate Chi Square Value (0.05)	5.392
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	3947	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.888	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.278	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.937	Mean of logged Data	7.366
Maximum of Logged Data	7.976	SD of logged Data	0.497
Assuming Lognormal Distribution			
95% H-UCL	5086	90% Chebyshev (MVUE) UCL	2999
95% Chebyshev (MVUE) UCL	3572	97.5% Chebyshev (MVUE) UCL	4369
99% Chebyshev (MVUE) UCL	5934		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2465	95% Jackknife UCL	2778
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	3064	95% Chebyshev(Mean, Sd) UCL	3664
97.5% Chebyshev(Mean, Sd) UCL	4498	99% Chebyshev(Mean, Sd) UCL	6136

Suggested UCL to Use

95% Student's-t UCL	2778

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Al in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7360	Mean	20025
Maximum	37400	Median	17670
SD	14820	Std. Error of Mean	7410
Coefficient of Variation	0.74	Skewness	0.385

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.291	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	37463	95% Adjusted-CLT UCL (Chen-1995)	33735
		95% Modified-t UCL (Johnson-1978)	37700

Gamma GOF Test

A-D Test Statistic	0.477	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.325	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.195	k star (bias corrected MLE)	0.715
Theta hat (MLE)	9122	Theta star (bias corrected MLE)	27988
nu hat (MLE)	17.56	nu star (bias corrected)	5.724
MLE Mean (bias corrected)	20025	MLE Sd (bias corrected)	23674
		Approximate Chi Square Value (0.05)	1.5
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	76391	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.84	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.289	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.904	Mean of logged Data	9.66
Maximum of Logged Data	10.53	SD of logged Data	0.833

Assuming Lognormal Distribution

95% H-UCL	330609	90% Chebyshev (MVUE) UCL	43920
95% Chebyshev (MVUE) UCL	54715	97.5% Chebyshev (MVUE) UCL	69699
99% Chebyshev (MVUE) UCL	99131		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	32213	95% Jackknife UCL	37463
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	42254	95% Chebyshev(Mean, Sd) UCL	52323
97.5% Chebyshev(Mean, Sd) UCL	66299	99% Chebyshev(Mean, Sd) UCL	93751

Suggested UCL to Use

95% Student's-t UCL	37463

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for As in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:37
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	15.9	Mean	21.93
Maximum	29.7	Median	21.05
SD	6.96	Std. Error of Mean	3.48
Coefficient of Variation	0.317	Skewness	0.25

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.295	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	30.11	95% Adjusted-CLT UCL (Chen-1995)	28.11
		95% Modified-t UCL (Johnson-1978)	30.19
Gamma GOF Test			
A-D Test Statistic	0.494	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.329	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.17	k star (bias corrected MLE)	3.459
Theta hat (MLE)	1.665	Theta star (bias corrected MLE)	6.339
nu hat (MLE)	105.4	nu star (bias corrected)	27.67
MLE Mean (bias corrected)	21.93	MLE Sd (bias corrected)	11.79
		Approximate Chi Square Value (0.05)	16.67
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	36.39	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.836	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.295	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.766	Mean of logged Data	3.049
Maximum of Logged Data	3.391	SD of logged Data	0.321
Assuming Lognormal Distribution			
95% H-UCL	37.68	90% Chebyshev (MVUE) UCL	32.39
95% Chebyshev (MVUE) UCL	37.13	97.5% Chebyshev (MVUE) UCL	43.71
99% Chebyshev (MVUE) UCL	56.64		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	27.65	95% Jackknife UCL	30.11
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	32.37	95% Chebyshev(Mean, Sd) UCL	37.09
97.5% Chebyshev(Mean, Sd) UCL	43.66	99% Chebyshev(Mean, Sd) UCL	56.55

Suggested UCL to Use

95% Student's-t UCL	30.11

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Be in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options			
Date/Time of Computation	2/18/2015 14:37		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	3.51	Minimum Non-Detect	1.98
Maximum Detect	4.85	Maximum Non-Detect	1.99
Variance Detects	0.898	Percent Non-Detects	50%
Mean Detects	4.18	SD Detects	0.948
Median Detects	4.18	CV Detects	0.227
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	1.417	SD of Logged Detects	0.229

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.08	Standard Error of Mean	0.847
SD	1.198	95% KM (BCA) UCL	N/A
95% KM (t) UCL	5.073	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.473	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	5.621	95% KM Chebyshev UCL	6.772
97.5% KM Chebyshev UCL	8.369	99% KM Chebyshev UCL	11.51

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	38.59	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	154.3	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	6.613	nu hat (KM)	52.91
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (52.91, α)	37.2	Adjusted Chi Square Value (52.91, β)	30.15
95% Gamma Approximate KM-UCL (use when n>=50)	4.381	95% Gamma Adjusted KM-UCL (use when n<50)	5.405

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.992	Mean in Log Scale	1.004
SD in Original Scale	1.477	SD in Log Scale	0.496
95% t UCL (assumes normality of ROS data)	4.73	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	8.731		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.586	Mean in Log Scale	0.705
SD in Original Scale	1.92	SD in Log Scale	0.833
95% t UCL (Assumes normality)	4.845	95% H-Stat UCL	42.74

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	5.073	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Cd in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2.46	Mean	10.07
Maximum	18.6	Median	9.615
SD	7.763	Std. Error of Mean	3.881
Coefficient of Variation	0.771	Skewness	0.158

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	19.21	95% Adjusted-CLT UCL (Chen-1995)	16.78
		95% Modified-t UCL (Johnson-1978)	19.26
Gamma GOF Test			
A-D Test Statistic	0.355	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.281	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.812	k star (bias corrected MLE)	0.62
Theta hat (MLE)	5.558	Theta star (bias corrected MLE)	16.25
nu hat (MLE)	14.5	nu star (bias corrected)	4.958
MLE Mean (bias corrected)	10.07	MLE Sd (bias corrected)	12.79
		Approximate Chi Square Value (0.05)	1.133
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	44.08	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.9	Mean of logged Data	2.009
Maximum of Logged Data	2.923	SD of logged Data	0.956
Assuming Lognormal Distribution			
95% H-UCL	401.9	90% Chebyshev (MVUE) UCL	24.09
95% Chebyshev (MVUE) UCL	30.34	97.5% Chebyshev (MVUE) UCL	39.01
99% Chebyshev (MVUE) UCL	56.05		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	16.46	95% Jackknife UCL	19.21
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	21.72	95% Chebyshev(Mean, Sd) UCL	26.99
97.5% Chebyshev(Mean, Sd) UCL	34.31	99% Chebyshev(Mean, Sd) UCL	48.69

Suggested UCL to Use

95% Student's-t UCL	19.21

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cu in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	92	Mean	191
Maximum	357	Median	157.5
SD	119.8	Std. Error of Mean	59.89
Coefficient of Variation	0.627	Skewness	1.234

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	331.9	95% Adjusted-CLT UCL (Chen-1995)	329
		95% Modified-t UCL (Johnson-1978)	338.1
Gamma GOF Test			
A-D Test Statistic	0.295	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.713	k star (bias corrected MLE)	1.095
Theta hat (MLE)	51.44	Theta star (bias corrected MLE)	174.4
nu hat (MLE)	29.7	nu star (bias corrected)	8.759
MLE Mean (bias corrected)	191	MLE Sd (bias corrected)	182.5
		Approximate Chi Square Value (0.05)	3.182
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	525.7	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.522	Mean of logged Data	5.112
Maximum of Logged Data	5.878	SD of logged Data	0.604
Assuming Lognormal Distribution			
95% H-UCL	873	90% Chebyshev (MVUE) UCL	356.9
95% Chebyshev (MVUE) UCL	432.7	97.5% Chebyshev (MVUE) UCL	537.8
99% Chebyshev (MVUE) UCL	744.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	289.5	95% Jackknife UCL	331.9
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	370.7	95% Chebyshev(Mean, Sd) UCL	452.1
97.5% Chebyshev(Mean, Sd) UCL	565	99% Chebyshev(Mean, Sd) UCL	786.9

Suggested UCL to Use

95% Student's-t UCL	331.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Cr in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	3/2/2015 12:45
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	4.28	Mean	5.403
Maximum	7.38	Median	4.975
SD	1.372	Std. Error of Mean	0.686
Coefficient of Variation	0.254	Skewness	1.554

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.864	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.306	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.017	95% Adjusted-CLT UCL (Chen-1995)	7.1
		95% Modified-t UCL (Johnson-1978)	7.106

Gamma GOF Test

A-D Test Statistic	0.387	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.291	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	22.87	k star (bias corrected MLE)	5.883
Theta hat (MLE)	0.236	Theta star (bias corrected MLE)	0.918
nu hat (MLE)	182.9	nu star (bias corrected)	47.07
MLE Mean (bias corrected)	5.403	MLE Sd (bias corrected)	2.227
		Approximate Chi Square Value (0.05)	32.32
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7.867	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.906	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.274	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.454	Mean of logged Data	1.665
Maximum of Logged Data	1.999	SD of logged Data	0.237

Assuming Lognormal Distribution

95% H-UCL	7.721	90% Chebyshev (MVUE) UCL	7.304
95% Chebyshev (MVUE) UCL	8.168	97.5% Chebyshev (MVUE) UCL	9.368
99% Chebyshev (MVUE) UCL	11.72		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	6.531	95% Jackknife UCL	7.017
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	7.46	95% Chebyshev(Mean, Sd) UCL	8.393
97.5% Chebyshev(Mean, Sd) UCL	9.686	99% Chebyshev(Mean, Sd) UCL	12.23

Suggested UCL to Use

95% Student's-t UCL	7.017

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hg in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/23/2015 9:20
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.02	Mean	0.041
Maximum	0.06	Median	0.043
SD	0.0201	Std. Error of Mean	0.0116
Coefficient of Variation	0.49	Skewness	-0.444

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.993	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0748	95% Adjusted-CLT UCL (Chen-1995)	0.0569
		95% Modified-t UCL (Johnson-1978)	0.0743

Gamma GOF Test
Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	5.344	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00767	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	32.06	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.951	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.268	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.512	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.912	Mean of logged Data	-3.291
Maximum of Logged Data	-2.813	SD of logged Data	0.563

Assuming Lognormal Distribution

95% H-UCL	0.806	90% Chebyshev (MVUE) UCL	0.08
95% Chebyshev (MVUE) UCL	0.0976	97.5% Chebyshev (MVUE) UCL	0.122
99% Chebyshev (MVUE) UCL	0.17		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0601	95% Jackknife UCL	0.0748
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	0.0758	95% Chebyshev(Mean, Sd) UCL	0.0915
97.5% Chebyshev(Mean, Sd) UCL	0.113	99% Chebyshev(Mean, Sd) UCL	0.156

Suggested UCL to Use

95% Student's-t UCL	0.0748

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

ProUCL calculations for Pb in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	244	Mean	299.5
Maximum	378	Median	288
SD	65.08	Std. Error of Mean	32.54
Coefficient of Variation	0.217	Skewness	0.482

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.876	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	376.1	95% Adjusted-CLT UCL (Chen-1995)	361.4
		95% Modified-t UCL (Johnson-1978)	377.4
Gamma GOF Test			
A-D Test Statistic	0.426	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.321	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	28.76	k star (bias corrected MLE)	7.356
Theta hat (MLE)	10.42	Theta star (bias corrected MLE)	40.72
nu hat (MLE)	230.1	nu star (bias corrected)	58.85
MLE Mean (bias corrected)	299.5	MLE Sd (bias corrected)	110.4
		Approximate Chi Square Value (0.05)	42.21
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	417.6	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.871	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.287	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.497	Mean of logged Data	5.685
Maximum of Logged Data	5.935	SD of logged Data	0.215
Assuming Lognormal Distribution			
95% H-UCL	411.2	90% Chebyshev (MVUE) UCL	395.7
95% Chebyshev (MVUE) UCL	439.3	97.5% Chebyshev (MVUE) UCL	499.9
99% Chebyshev (MVUE) UCL	618.8		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	353	95% Jackknife UCL	376.1
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	397.1	95% Chebyshev(Mean, Sd) UCL	441.3
97.5% Chebyshev(Mean, Sd) UCL	502.7	99% Chebyshev(Mean, Sd) UCL	623.3

Suggested UCL to Use

95% Student's-t UCL	376.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Mn in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	2130	Mean	7425
Maximum	13100	Median	7235
SD	5216	Std. Error of Mean	2608
Coefficient of Variation	0.703	Skewness	0.104

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.246	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13563	95% Adjusted-CLT UCL (Chen-1995)	11860
		95% Modified-t UCL (Johnson-1978)	13586
Gamma GOF Test			
A-D Test Statistic	0.336	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.279	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.235	k star (bias corrected MLE)	0.725
Theta hat (MLE)	3323	Theta star (bias corrected MLE)	10237
nu hat (MLE)	17.88	nu star (bias corrected)	5.803
MLE Mean (bias corrected)	7425	MLE Sd (bias corrected)	8718
		Approximate Chi Square Value (0.05)	1.54
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	27980	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.921	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.255	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.664	Mean of logged Data	8.672
Maximum of Logged Data	9.48	SD of logged Data	0.849
Assuming Lognormal Distribution			
95% H-UCL	138250	90% Chebyshev (MVUE) UCL	16668
95% Chebyshev (MVUE) UCL	20798	97.5% Chebyshev (MVUE) UCL	26529
99% Chebyshev (MVUE) UCL	37787		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	11715	95% Jackknife UCL	13563
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	15250	95% Chebyshev(Mean, Sd) UCL	18794
97.5% Chebyshev(Mean, Sd) UCL	23713	99% Chebyshev(Mean, Sd) UCL	33377

Suggested UCL to Use

95% Student's-t UCL	13563

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ni in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	7.36	Mean	18.27
Maximum	31.6	Median	17.05
SD	10.78	Std. Error of Mean	5.391
Coefficient of Variation	0.59	Skewness	0.475

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.216	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	30.95	95% Adjusted-CLT UCL (Chen-1995)	28.5
		95% Modified-t UCL (Johnson-1978)	31.16
Gamma GOF Test			
A-D Test Statistic	0.232	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.659	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.207	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.568	k star (bias corrected MLE)	1.059
Theta hat (MLE)	5.119	Theta star (bias corrected MLE)	17.25
nu hat (MLE)	28.55	nu star (bias corrected)	8.47
MLE Mean (bias corrected)	18.27	MLE Sd (bias corrected)	17.75
		Approximate Chi Square Value (0.05)	3.01
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	51.4	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.197	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.996	Mean of logged Data	2.758
Maximum of Logged Data	3.453	SD of logged Data	0.644
Assuming Lognormal Distribution			
95% H-UCL	102.2	90% Chebyshev (MVUE) UCL	35.53
95% Chebyshev (MVUE) UCL	43.31	97.5% Chebyshev (MVUE) UCL	54.12
99% Chebyshev (MVUE) UCL	75.34		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	27.13	95% Jackknife UCL	30.95
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	34.44	95% Chebyshev(Mean, Sd) UCL	41.76
97.5% Chebyshev(Mean, Sd) UCL	51.93	99% Chebyshev(Mean, Sd) UCL	71.9

Suggested UCL to Use

95% Student's-t UCL	30.95

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1.02	Mean	1.285
Maximum	1.71	Median	1.205
SD	0.314	Std. Error of Mean	0.157
Coefficient of Variation	0.244	Skewness	1.074

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.654	95% Adjusted-CLT UCL (Chen-1995)	1.633
		95% Modified-t UCL (Johnson-1978)	1.668
Gamma GOF Test			
A-D Test Statistic	0.33	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.275	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	23.81	k star (bias corrected MLE)	6.118
Theta hat (MLE)	0.054	Theta star (bias corrected MLE)	0.21
nu hat (MLE)	190.5	nu star (bias corrected)	48.95
MLE Mean (bias corrected)	1.285	MLE Sd (bias corrected)	0.52
		Approximate Chi Square Value (0.05)	33.89
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.856	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.0198	Mean of logged Data	0.23
Maximum of Logged Data	0.536	SD of logged Data	0.234
Assuming Lognormal Distribution			
95% H-UCL	1.829	90% Chebyshev (MVUE) UCL	1.733
95% Chebyshev (MVUE) UCL	1.937	97.5% Chebyshev (MVUE) UCL	2.219
99% Chebyshev (MVUE) UCL	2.774		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.543	95% Jackknife UCL	1.654
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	1.755	95% Chebyshev(Mean, Sd) UCL	1.968
97.5% Chebyshev(Mean, Sd) UCL	2.264	99% Chebyshev(Mean, Sd) UCL	2.845

Suggested UCL to Use

95% Student's-t UCL	1.654

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Se in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/18/2015 14:38
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	1.16	Minimum Non-Detect	0.496
Maximum Detect	3.1	Maximum Non-Detect	0.997
Variance Detects	1.882	Percent Non-Detects	50%
Mean Detects	2.13	SD Detects	1.372
Median Detects	2.13	CV Detects	0.644
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.64	SD of Logged Detects	0.695

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.313	Standard Error of Mean	0.754
SD	1.067	95% KM (BCA) UCL	N/A
95% KM (t) UCL	3.088	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	2.554	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	3.576	95% KM Chebyshev UCL	4.601
97.5% KM Chebyshev UCL	6.024	99% KM Chebyshev UCL	8.818

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	4.462	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.477	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	17.85	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.515	nu hat (KM)	12.12
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (12.12, α)	5.306	Adjusted Chi Square Value (12.12, β)	3.132
95% Gamma Approximate KM-UCL (use when n>=50)	2.999	95% Gamma Adjusted KM-UCL (use when n<50)	5.08

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.142	Mean in Log Scale	-0.618
SD in Original Scale	1.389	SD in Log Scale	1.507
95% t UCL (assumes normality of ROS data)	2.776	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	9381		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.252	Mean in Log Scale	-0.203
SD in Original Scale	1.291	SD in Log Scale	1.09
95% t UCL (Assumes normality)	2.771	95% H-Stat UCL	141.3

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	3.088	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for Ag in sediment of the Animas River at Bakers Bridge below mainstem Mineral Creek

User Selected Options	
Date/Time of Computation	2/19/2015 11:31
From File	WorkSheet_e.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	1700	Mean	4620
Maximum	8670	Median	4055
SD	3335	Std. Error of Mean	1668
Coefficient of Variation	0.722	Skewness	0.502

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.891	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.277	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8544	95% Adjusted-CLT UCL (Chen-1995)	7810
		95% Modified-t UCL (Johnson-1978)	8614
Gamma GOF Test			
A-D Test Statistic	0.397	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.304	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.397	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.371	k star (bias corrected MLE)	0.759
Theta hat (MLE)	1949	Theta star (bias corrected MLE)	6084
nu hat (MLE)	18.97	nu star (bias corrected)	6.075
MLE Mean (bias corrected)	4620	MLE Sd (bias corrected)	5302
		Approximate Chi Square Value (0.05)	1.678
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	16724	95% Adjusted Gamma UCL (use when n<50)	N/A
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.887	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.264	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.438	Mean of logged Data	8.213
Maximum of Logged Data	9.068	SD of logged Data	0.796
Assuming Lognormal Distribution			
95% H-UCL	60185	90% Chebyshev (MVUE) UCL	9897
95% Chebyshev (MVUE) UCL	12284	97.5% Chebyshev (MVUE) UCL	15597
99% Chebyshev (MVUE) UCL	22105		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7363	95% Jackknife UCL	8544
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	9623	95% Chebyshev(Mean, Sd) UCL	11889
97.5% Chebyshev(Mean, Sd) UCL	15034	99% Chebyshev(Mean, Sd) UCL	21212

Suggested UCL to Use

95% Student's-t UCL	8544

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Appendix 15

ProUCL calculations for dissolved Al in pore water from the Animas River above the confluence with mainstem Cement Creek

User Selected Options	
Date/Time of Computation	3/5/2015 14:28
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	11	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	20.9	Minimum Non-Detect	20
Maximum Detect	6170	Maximum Non-Detect	20
Variance Detects	4686062	Percent Non-Detects	27.27%
Mean Detects	1259	SD Detects	2165
Median Detects	260	CV Detects	1.72
Skewness Detects	2.123	Kurtosis Detects	4.375
Mean of Logged Detects	5.552	SD of Logged Detects	2.069

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.661	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.357	Lilliefors GOF Test
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	921	Standard Error of Mean	584.3
SD	1813	95% KM (BCA) UCL	2035
95% KM (t) UCL	1980	95% KM (Percentile Bootstrap) UCL	1989
95% KM (z) UCL	1882	95% KM Bootstrap t UCL	7837
90% KM Chebyshev UCL	2674	95% KM Chebyshev UCL	3468
97.5% KM Chebyshev UCL	4570	99% KM Chebyshev UCL	6735

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.458	Anderson-Darling GOF Test
5% A-D Critical Value	0.778	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.413	k star (bias corrected MLE)	0.341
Theta hat (MLE)	3050	Theta star (bias corrected MLE)	3689
nu hat (MLE)	6.604	nu star (bias corrected)	5.461
MLE Mean (bias corrected)	1259	MLE Sd (bias corrected)	2155

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.258	nu hat (KM)	5.679
Approximate Chi Square Value (5.68, α)	1.478	Adjusted Chi Square Value (5.68, β)	1.159
95% Gamma Approximate KM-UCL (use when n>=50)	3539	95% Gamma Adjusted KM-UCL (use when n<50)	4514

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	915.6
Maximum	6170	Median	42.8
SD	1904	CV	2.08
k hat (MLE)	0.185	k star (bias corrected MLE)	0.195
Theta hat (MLE)	4962	Theta star (bias corrected MLE)	4700
nu hat (MLE)	4.06	nu star (bias corrected)	4.286
MLE Mean (bias corrected)	915.6	MLE Sd (bias corrected)	2074
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (4.29, α)	0.838	Adjusted Chi Square Value (4.29, β)	0.623
95% Gamma Approximate UCL (use when n>=50)	4684	95% Gamma Adjusted UCL (use when n<50)	6297

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.936	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.182	Lilliefors GOF Test
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	916.1	Mean in Log Scale	4.109
SD in Original Scale	1904	SD in Log Scale	3.059
95% t UCL (assumes normality of ROS data)	1957	95% Percentile Bootstrap UCL	1966
95% BCA Bootstrap UCL	2394	95% Bootstrap t UCL	7860
95% H-UCL (Log ROS)	10504481		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.855	95% H-UCL (KM -Log)	25280
KM SD (logged)	2.005	95% Critical H Value (KM-Log)	5.165
KM Standard Error of Mean (logged)	0.646		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	918.3	Mean in Log Scale	4.666
SD in Original Scale	1903	SD in Log Scale	2.302
95% t UCL (Assumes normality)	1958	95% H-Stat UCL	106111

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	3468	95% GROS Adjusted Gamma UCL	6297
95% Adjusted Gamma KM-UCL	4514		

Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cd in pore water from the Animas River above the confluence with mainstem Cement Creek

User Selected Options
Date/Time of Computation 3/5/2015 14:28
From File WorkSheet.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	0.279	Mean	23.58
Maximum	106.5	Median	1.67
SD	40.29	Std. Error of Mean	12.15
Coefficient of Variation	1.708	Skewness	1.752

Normal GOF Test

Shapiro Wilk Test Statistic	0.625	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.33	Lilliefors GOF Test
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	45.6	95% Adjusted-CLT UCL (Chen-1995)	50.42
		95% Modified-t UCL (Johnson-1978)	46.67

Gamma GOF Test

A-D Test Statistic	0.806	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.809	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.245	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.274	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.357	k star (bias corrected MLE)	0.32
Theta hat (MLE)	66.14	Theta star (bias corrected MLE)	73.72
nu hat (MLE)	7.844	nu star (bias corrected)	7.038
MLE Mean (bias corrected)	23.58	MLE Sd (bias corrected)	41.7
		Approximate Chi Square Value (0.05)	2.192
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	1.778

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	75.74	95% Adjusted Gamma UCL (use when n<50)	93.35

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.891	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.277	Mean of logged Data	1.28
Maximum of Logged Data	4.668	SD of logged Data	2.232

Assuming Lognormal Distribution

95% H-UCL	2400	90% Chebyshev (MVUE) UCL	78.75
95% Chebyshev (MVUE) UCL	102.9	97.5% Chebyshev (MVUE) UCL	136.4
99% Chebyshev (MVUE) UCL	202.2		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	43.56	95% Jackknife UCL	45.6
95% Standard Bootstrap UCL	42.7	95% Bootstrap-t UCL	110.9
95% Hall's Bootstrap UCL	147.4	95% Percentile Bootstrap UCL	42.46
95% BCA Bootstrap UCL	50.92		
90% Chebyshev(Mean, Sd) UCL	60.02	95% Chebyshev(Mean, Sd) UCL	76.53
97.5% Chebyshev(Mean, Sd) UCL	99.44	99% Chebyshev(Mean, Sd) UCL	144.4

Suggested UCL to Use

95% Adjusted Gamma UCL	93.35

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Cu in pore water from the Animas River above the confluence with mainstem Cement Creek

User Selected Options	
Date/Time of Computation	3/5/2015 14:28
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	1.27	Mean	223.9
Maximum	2250	Median	3.46
SD	672.7	Std. Error of Mean	202.8
Coefficient of Variation	3.004	Skewness	3.304

Normal GOF Test			
Shapiro Wilk Test Statistic	0.379	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.485	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	591.5	95% Adjusted-CLT UCL (Chen-1995)	773.4
		95% Modified-t UCL (Johnson-1978)	625.2
Gamma GOF Test			
A-D Test Statistic	1.64	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.848	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.325	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.28	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.231	k star (bias corrected MLE)	0.229
Theta hat (MLE)	968.9	Theta star (bias corrected MLE)	979.2
nu hat (MLE)	5.084	nu star (bias corrected)	5.031
MLE Mean (bias corrected)	223.9	MLE Sd (bias corrected)	468.2
		Approximate Chi Square Value (0.05)	1.167
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	0.895
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	965.7	95% Adjusted Gamma UCL (use when n<50)	1259
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.82	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.279	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.239	Mean of logged Data	2.299
Maximum of Logged Data	7.719	SD of logged Data	2.412
Assuming Lognormal Distribution			
95% H-UCL	19254	90% Chebyshev (MVUE) UCL	302.3
95% Chebyshev (MVUE) UCL	396.6	97.5% Chebyshev (MVUE) UCL	527.6
99% Chebyshev (MVUE) UCL	784.8		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	557.5	95% Jackknife UCL	591.5
95% Standard Bootstrap UCL	551.4	95% Bootstrap-t UCL	7505
95% Hall's Bootstrap UCL	5240	95% Percentile Bootstrap UCL	628.4
95% BCA Bootstrap UCL	833.1		
90% Chebyshev(Mean, Sd) UCL	832.4	95% Chebyshev(Mean, Sd) UCL	1108
97.5% Chebyshev(Mean, Sd) UCL	1491	99% Chebyshev(Mean, Sd) UCL	2242

Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL	2242

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Pb in pore water from the Animas River above the confluence with mainstem Cement Creek

User Selected Options	
Date/Time of Computation	3/5/2015 14:29
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	11	Number of Distinct Observations	8
Number of Detects	6	Number of Non-Detects	5
Number of Distinct Detects	6	Number of Distinct Non-Detects	2
Minimum Detect	0.123	Minimum Non-Detect	0.1
Maximum Detect	65.6	Maximum Non-Detect	0.5
Variance Detects	673.6	Percent Non-Detects	45.45%
Mean Detects	13.66	SD Detects	25.95
Median Detects	1.29	CV Detects	1.9
Skewness Detects	2.255	Kurtosis Detects	5.155
Mean of Logged Detects	0.579	SD of Logged Detects	2.418

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.626	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.34	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	7.499	Standard Error of Mean	6.194
SD	18.75	95% KM (BCA) UCL	18.37
95% KM (t) UCL	18.73	95% KM (Percentile Bootstrap) UCL	19.22
95% KM (z) UCL	17.69	95% KM Bootstrap t UCL	194.9
90% KM Chebyshev UCL	26.08	95% KM Chebyshev UCL	34.5
97.5% KM Chebyshev UCL	46.18	99% KM Chebyshev UCL	69.13

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.446	Anderson-Darling GOF Test
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.262	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.355	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.333	k star (bias corrected MLE)	0.278
Theta hat (MLE)	41.01	Theta star (bias corrected MLE)	49.2
nu hat (MLE)	3.997	nu star (bias corrected)	3.332
MLE Mean (bias corrected)	13.66	MLE Sd (bias corrected)	25.92

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.16	nu hat (KM)	3.518
Approximate Chi Square Value (3.52, α)	0.541	Adjusted Chi Square Value (3.52, β)	0.388
95% Gamma Approximate KM-UCL (use when n>=50)	48.76	95% Gamma Adjusted KM-UCL (use when n<50)	68.03

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.455
Maximum	65.6	Median	0.123
SD	19.69	CV	2.641
k hat (MLE)	0.195	k star (bias corrected MLE)	0.203
Theta hat (MLE)	38.21	Theta star (bias corrected MLE)	36.82
nu hat (MLE)	4.293	nu star (bias corrected)	4.455
MLE Mean (bias corrected)	7.455	MLE Sd (bias corrected)	16.57
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (4.46, α)	0.909	Adjusted Chi Square Value (4.46, β)	0.682
95% Gamma Approximate UCL (use when n>=50)	36.53	95% Gamma Adjusted UCL (use when n<50)	48.74

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.454	Mean in Log Scale	-2.26
SD in Original Scale	19.69	SD in Log Scale	3.839
95% t UCL (assumes normality of ROS data)	18.21	95% Percentile Bootstrap UCL	18.36
95% BCA Bootstrap UCL	25.51	95% Bootstrap t UCL	247
95% H-UCL (Log ROS)	16469143		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.713	95% H-UCL (KM -Log)	222.1
KM SD (logged)	2.162	95% Critical H Value (KM-Log)	5.526
KM Standard Error of Mean (logged)	0.715		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	7.492	Mean in Log Scale	-0.899
SD in Original Scale	19.67	SD in Log Scale	2.453
95% t UCL (Assumes normality)	18.24	95% H-Stat UCL	1011

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	18.73	95% KM (Percentile Bootstrap) UCL	19.22

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Mn in pore water from the Animas River above the confluence mainstem Cement Creek

User Selected Options	
Date/Time of Computation	3/5/2015 14:29
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	1
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	2.57	Minimum Non-Detect	2
Maximum Detect	78300	Maximum Non-Detect	2
Variance Detects	8.44E+08	Percent Non-Detects	9.09%
Mean Detects	17912	SD Detects	29057
Median Detects	1065	CV Detects	1.622
Skewness Detects	1.611	Kurtosis Detects	1.264
Mean of Logged Detects	6.525	SD of Logged Detects	4.007

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.68	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.313	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	16284	Standard Error of Mean	8512
SD	26782	95% KM (BCA) UCL	30726
95% KM (t) UCL	31711	95% KM (Percentile Bootstrap) UCL	30586
95% KM (z) UCL	30285	95% KM Bootstrap t UCL	68468
90% KM Chebyshev UCL	41820	95% KM Chebyshev UCL	53387
97.5% KM Chebyshev UCL	69441	99% KM Chebyshev UCL	100977

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.393	Anderson-Darling GOF Test
5% A-D Critical Value	0.846	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.165	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.293	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.222	k star (bias corrected MLE)	0.222
Theta hat (MLE)	80843	Theta star (bias corrected MLE)	80771
nu hat (MLE)	4.431	nu star (bias corrected)	4.435
MLE Mean (bias corrected)	17912	MLE Sd (bias corrected)	38036

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.37	nu hat (KM)	8.133
Approximate Chi Square Value (8.13, α)	2.812	Adjusted Chi Square Value (8.13, β)	2.328
95% Gamma Approximate KM-UCL (use when n>=50)	47093	95% Gamma Adjusted KM-UCL (use when n<50)	56893

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	16284
Maximum	78300	Median	590
SD	28090	CV	1.725
k hat (MLE)	0.179	k star (bias corrected MLE)	0.191
Theta hat (MLE)	91020	Theta star (bias corrected MLE)	85381
nu hat (MLE)	3.936	nu star (bias corrected)	4.196
MLE Mean (bias corrected)	16284	MLE Sd (bias corrected)	37287
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (4.20, α)	0.801	Adjusted Chi Square Value (4.20, β)	0.593
95% Gamma Approximate UCL (use when n>=50)	85346	95% Gamma Adjusted UCL (use when n<50)	115211

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.185	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	16284	Mean in Log Scale	5.649
SD in Original Scale	28090	SD in Log Scale	4.785
95% t UCL (assumes normality of ROS data)	31634	95% Percentile Bootstrap UCL	30309
95% BCA Bootstrap UCL	35146	95% Bootstrap t UCL	68483
95% H-UCL (Log ROS)	1.41E+15		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	5.995	95% H-UCL (KM -Log)	2.97E+11
KM SD (logged)	3.993	95% Critical H Value (KM-Log)	9.856
KM Standard Error of Mean (logged)	1.269		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	16284	Mean in Log Scale	5.932
SD in Original Scale	28090	SD in Log Scale	4.28
95% t UCL (Assumes normality)	31634	95% H-Stat UCL	5.66E+12

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	53387	95% GROS Adjusted Gamma UCL	115211
95% Adjusted Gamma KM-UCL	56893		

Warning: Recommended UCL exceeds the maximum observation

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.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL calculations for dissolved Zn in pore water from the Animas River above the confluence with mainstem Cement Creek

User Selected Options			
Date/Time of Computation	3/5/2015 14:29		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	179	Mean	5735
Maximum	29900	Median	675
SD	9691	Std. Error of Mean	2922
Coefficient of Variation	1.69	Skewness	2.038
Normal GOF Test			
Shapiro Wilk Test Statistic	0.653	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.3	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11031	95% Adjusted-CLT UCL (Chen-1995)	12459
		95% Modified-t UCL (Johnson-1978)	11330
Gamma GOF Test			
A-D Test Statistic	0.829	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.791	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.248	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.271	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.447	k star (bias corrected MLE)	0.386
Theta hat (MLE)	12831	Theta star (bias corrected MLE)	14870
nu hat (MLE)	9.833	nu star (bias corrected)	8.485
MLE Mean (bias corrected)	5735	MLE Sd (bias corrected)	9234
		Approximate Chi Square Value (0.05)	3.019
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	2.512
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	16118	95% Adjusted Gamma UCL (use when n<50)	19367
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.221	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.187	Mean of logged Data	7.208
Maximum of Logged Data	10.31	SD of logged Data	1.843
Assuming Lognormal Distribution			
95% H-UCL	120509	90% Chebyshev (MVUE) UCL	15021
95% Chebyshev (MVUE) UCL	19376	97.5% Chebyshev (MVUE) UCL	25421
99% Chebyshev (MVUE) UCL	37294		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	10541	95% Jackknife UCL	11031
95% Standard Bootstrap UCL	10420	95% Bootstrap-t UCL	23243
95% Hall's Bootstrap UCL	33946	95% Percentile Bootstrap UCL	10845
95% BCA Bootstrap UCL	12604		
90% Chebyshev(Mean, Sd) UCL	14500	95% Chebyshev(Mean, Sd) UCL	18471
97.5% Chebyshev(Mean, Sd) UCL	23982	99% Chebyshev(Mean, Sd) UCL	34807
Suggested UCL to Use			
95% Adjusted Gamma UCL	19367		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL calculations for Hardness in pore water from the Animas River above the confluence with mainstem Cement Creek

User Selected Options	
Date/Time of Computation	3/9/2015 10:14
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

General Statistics

Total Number of Observations	11	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	118	Mean	296
Maximum	853	Median	158
SD	226.9	Std. Error of Mean	68.42
Coefficient of Variation	0.767	Skewness	1.649
Normal GOF Test			
Shapiro Wilk Test Statistic	0.784	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.274	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	420	95% Adjusted-CLT UCL (Chen-1995)	444.9
		95% Modified-t UCL (Johnson-1978)	425.7
Gamma GOF Test			
A-D Test Statistic	0.755	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.737	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.258	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.391	k star (bias corrected MLE)	1.8
Theta hat (MLE)	123.8	Theta star (bias corrected MLE)	164.5
nu hat (MLE)	52.6	nu star (bias corrected)	39.59
MLE Mean (bias corrected)	296	MLE Sd (bias corrected)	220.7
		Approximate Chi Square Value (0.05)	26.17
Adjusted Level of Significance	0.0278	Adjusted Chi Square Value	24.41
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	447.7	95% Adjusted Gamma UCL (use when n<50)	480.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.85	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.271	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.267	Data Not Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.771	Mean of logged Data	5.467
Maximum of Logged Data	6.749	SD of logged Data	0.676
Assuming Lognormal Distribution			
95% H-UCL	500	90% Chebyshev (MVUE) UCL	474.2
95% Chebyshev (MVUE) UCL	557.4	97.5% Chebyshev (MVUE) UCL	673
99% Chebyshev (MVUE) UCL	899.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	408.5	95% Jackknife UCL	420
95% Standard Bootstrap UCL	403.1	95% Bootstrap-t UCL	505.1
95% Hall's Bootstrap UCL	557.7	95% Percentile Bootstrap UCL	410.2
95% BCA Bootstrap UCL	439.5		
90% Chebyshev(Mean, Sd) UCL	501.3	95% Chebyshev(Mean, Sd) UCL	594.2
97.5% Chebyshev(Mean, Sd) UCL	723.3	99% Chebyshev(Mean, Sd) UCL	976.7

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	594.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Appendix 16

2010 Benthic Macroinvertebrate Data Analysis, for the Animas River Stakeholders's Group, 12/7/10

Chester Anderson, B.U.G.S. Consulting

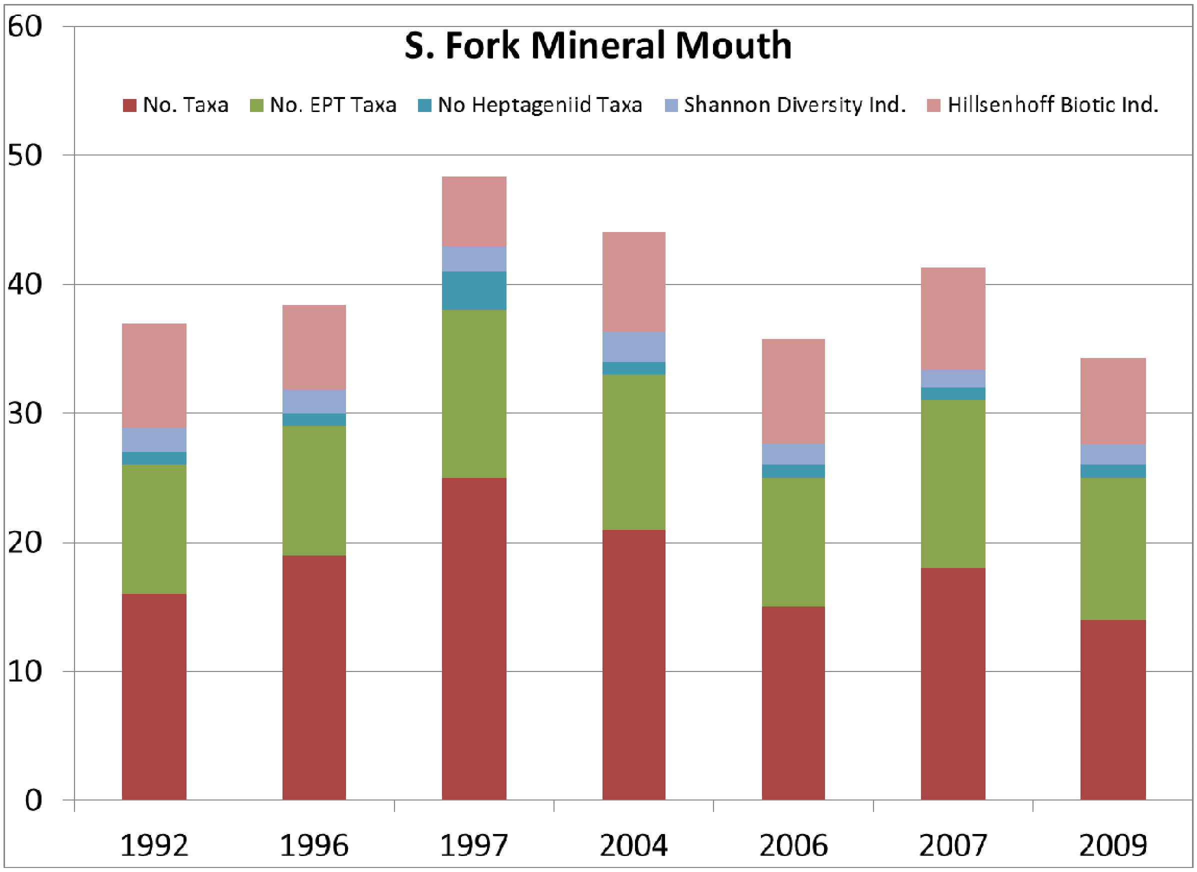
Methods:

I looked at several indices that are relatively independent of each other:

1. Total number of taxa along with the Shannon-Wiener diversity index. The Shannon Wiener index incorporates the relative number of each taxa (evenness) along with the total number of taxa into 1 metric. Typically the value of the Shannon-Wiener diversity index ranges from 1.5 (low species richness and evenness) to 3.5 (high species evenness and richness).
2. Total number of EPT (Ephemerotpera (mayflies) Plectoptera (stoneflies) and Trichoptera (caddisflies)) taxa along with the proportion of EPT taxa to the total number of taxa. These taxa tend to be more sensitive to pollution than other taxa.
3. Total number of Heptaganiid (flat-headed mayflies) taxa along with the proportion of Heptaganiid taxa to the total number of taxa. Heptaganiid are known to be very sensitive to metal pollution.
4. Hilsenhoff biotic index. The HBI ranges from 0 to 10, higher values indicating taxa with greater tolerances to pollution and thus poorer conditions in the river. The HBI formula takes accounts for the relative number of each taxa with particular tolerance values into the final metric. For graphical consistency with the other metrics, I subtracted the HBI from 10. Therefore, with my modified HBI, an increasing value indicates improving conditions on the graphs shown below. Although originally created for sensitivity to organic pollution, tolerance values work okay as indications of overall sensitivity to pollution.

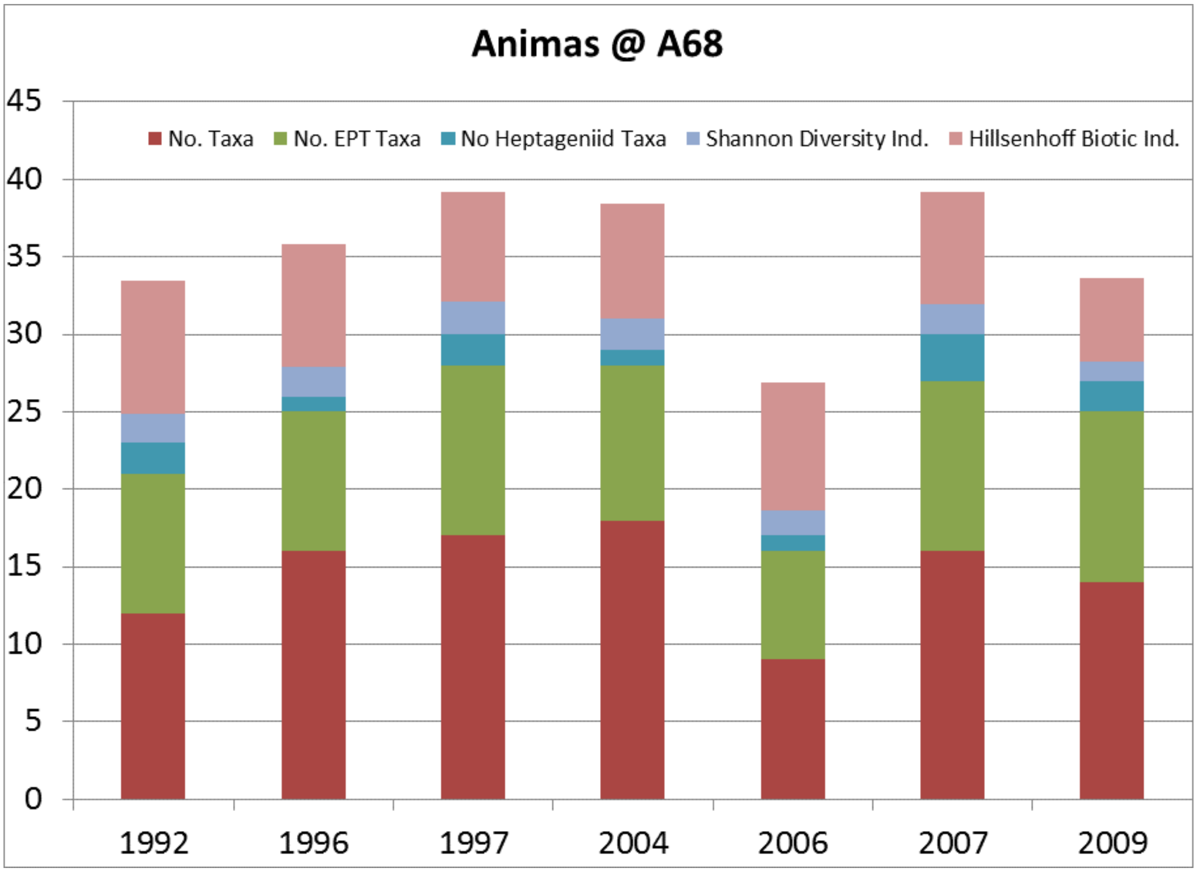
Below I discuss each sample site, comparing data collected after 2004 to the 2004 data itself and to the 96, 97 baseline data and to the CDPH&E's 1992 data. Although not reflected in the overall metric, in my analysis and discussions I give more weight to metrics in the following order: total number of Heptageniid taxa, total number of EPT taxa, Shannon-Wiener Diversity Index, total number of taxa, the HBI, and the proportions of total number.

The data collected at the Animas River at KOA campground includes the 96, 97 ARSG baseline data and post baseline data collected by the Animas Nutrient Workgroup and the Animas Watershed Partnership.

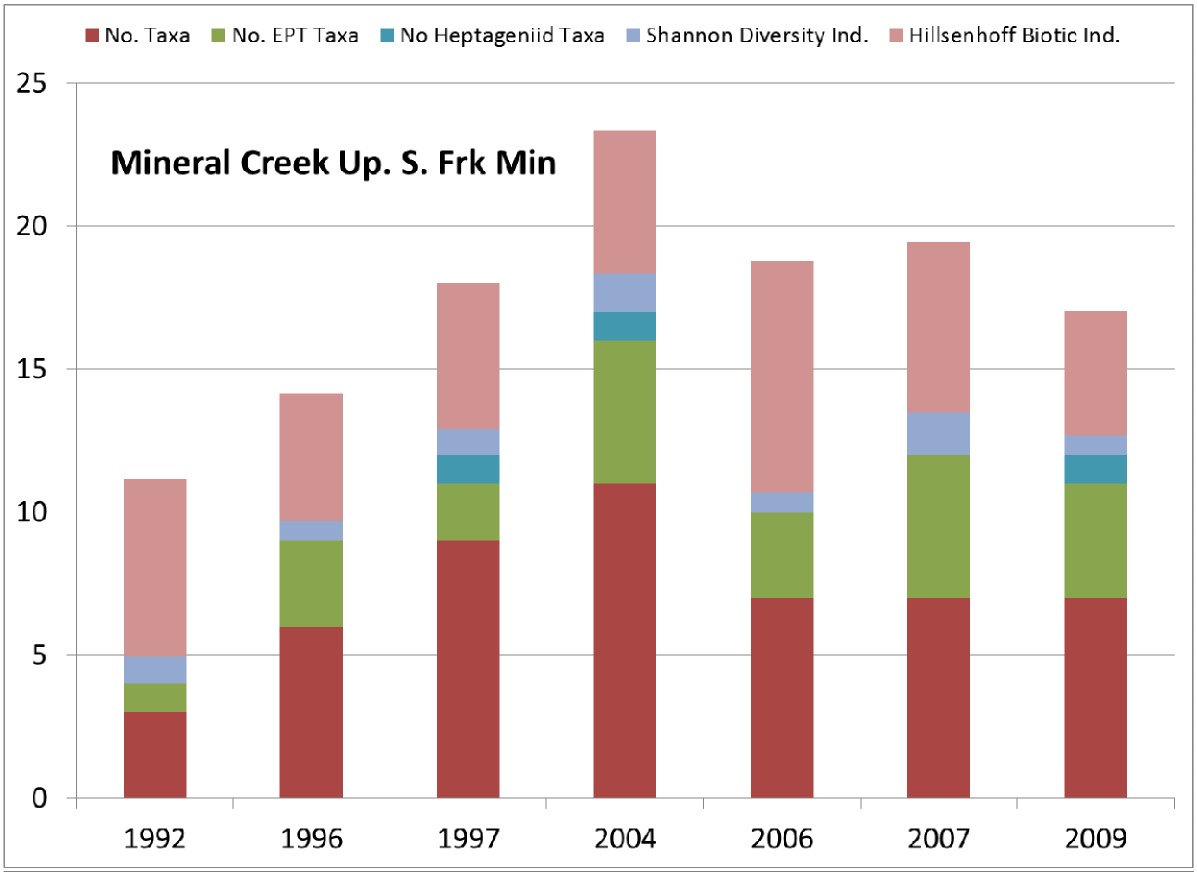


<u>South Fork Mineral just upstream of confluence with Mineral (M28)</u>

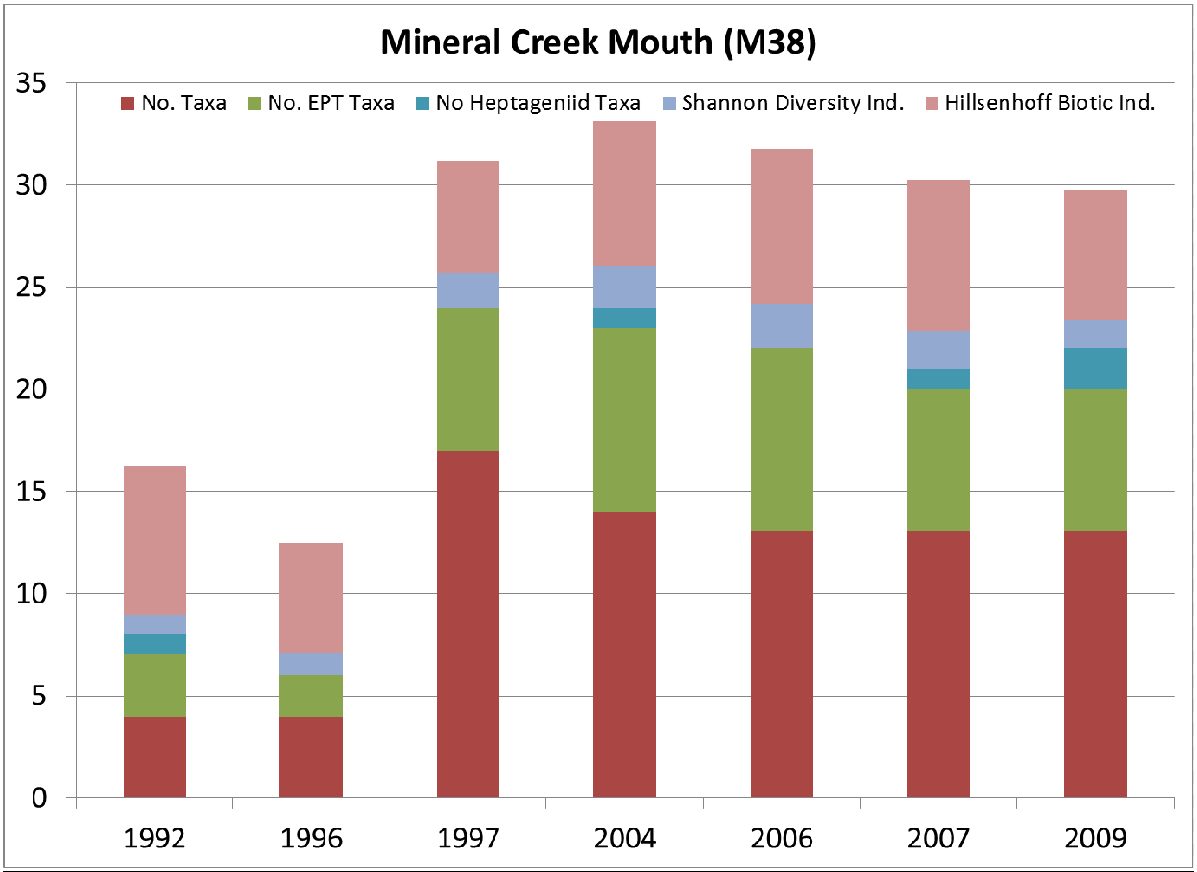
At this site there was a large decrease in the total number of taxa from 2004 (21) to 2009 (14) although the number of EPT taxa remained relatively constant, ranging from 12 in 2004 to 11 in 2009 and an average of 11.5 in the 96, 97 baseline data. The diversity index decreased significantly compared to the 2004 samples and decreased slightly when compared to the baseline data. The taxa in the 2009 samples had somewhat higher tolerance values resulting in the HBI increasing from 2.29 in 2004 to 3.30 in 2009 both showing improving conditiosn when compared to an average HBI of 3.97 for the 96, 97 baseline data. *Overall, the indices show slightly decreasing conditions at this site compared to the baseline and the 2004 data but relatively consistent compared to other sample sites.*



<u>Animas River upstream of Cement Creek (A68).</u>
At this sample site there was a decrease in the total number of taxa in the 2009 (=14) samples when compared to the 2004 (=18) although the number of EPT taxa remained the same (11 in 2009 and 10 in 2004 with an average of 10 total taxa found in the 96, 97 baseline data). Of significance indicating improving conditions at this sample site, were the 3 Heptageniid taxa found in 2007 and the 2 Heptageniid taxa found in 2009 as well as increasing numbers of EPT taxa. Both the diversity index and the HBI showed declining conditions compared to both 2004 data and baseline data. *Overall, the indices show slightly improving conditions at this site compared to the baseline data and similar conditions when compared to the 2004 data.*

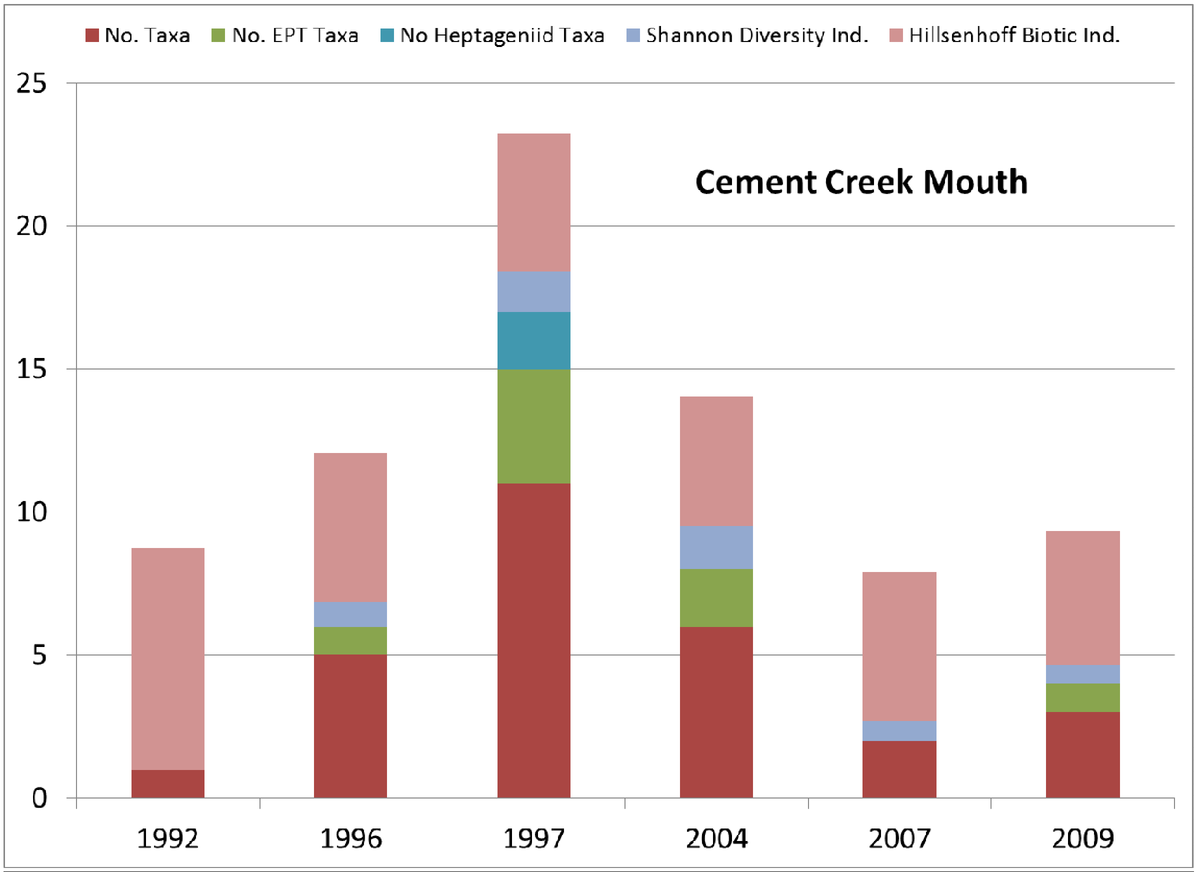


<u>Mineral Creek upstream of confluence with S. Fork of Mineral Creek (M27)</u>
The number of taxa found in 2009 (=7) was less than the number of taxa found in 2004 (=11), although similar to the number of taxa found in 96, 97 baseline data (average = 7.5). The number of EPT taxa in 2009 was the same as found in 2004 and greater than the number of EPT taxa found in the baseline data. The diversity index and the HBI showed similar trends to trends in the number of EPT taxa at this sample site. *Overall, the indices show slight improvement at this site compared to the baseline data and similar conditions compared to the 2004 data.*



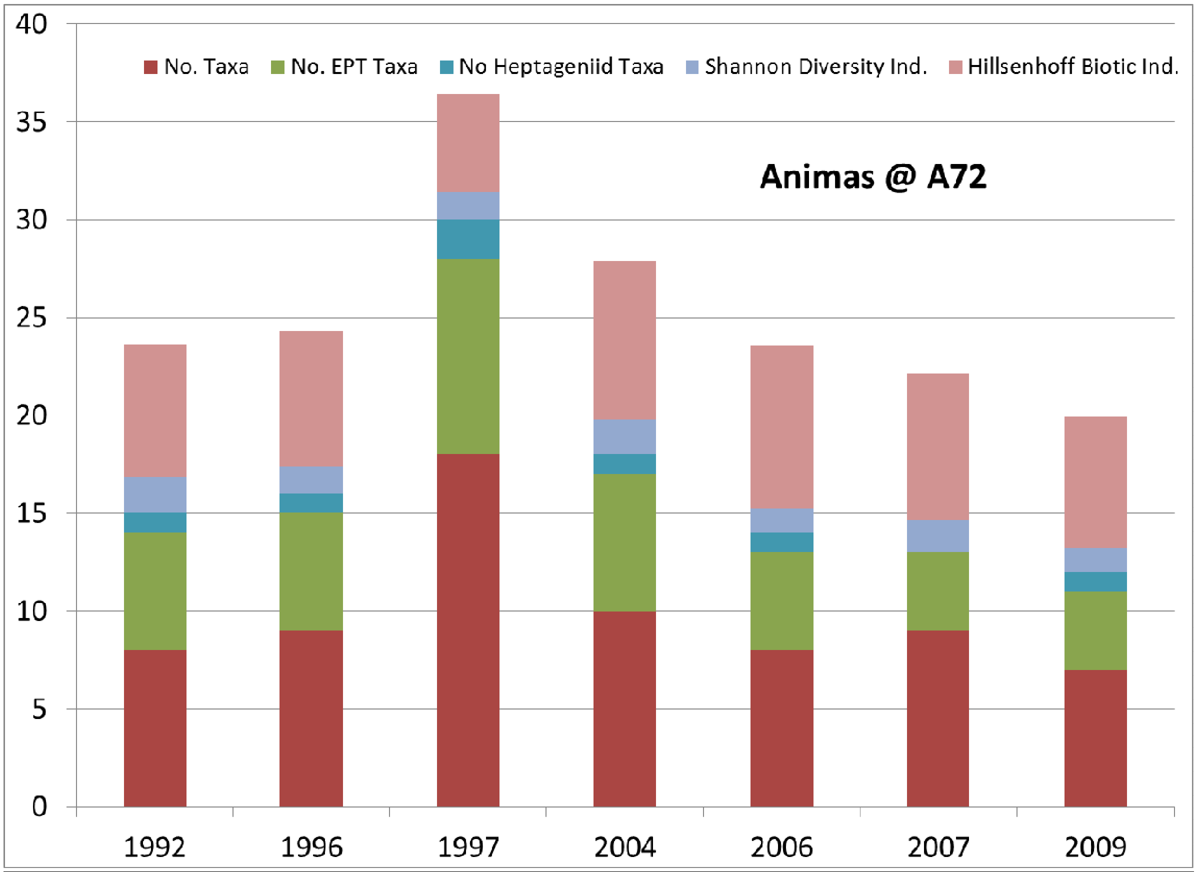
Mineral Creek Mouth (M38)

The total number of taxa in 2009 (=13) was as high as the total number of taxa found in 2004 (=14) and slightly greater than average, total number of taxa found in the 96, 97 baseline data (=10.5). Since 2004 this site has more or less sustained the number of EPT taxa. (7 in 2009, 9 in 2004) with an increase in the number of taxa when compared to the 96, 97 baseline data (= 4.5 total number of taxa) although the Shannon-Wiener diversity index has declined since 2004 and the HBI has increased. Both the diversity index and the HBI show similar or improved conditions when compared to the 96, 97 baseline data. Of significance to this sample site were the 2 Heptageniid taxa found in 2009 and the 1 Heptageniid taxa found in 2007. *Overall, the indices show improving conditions at this site compared to the baseline data and similar conditions compared to the 2004 data.*



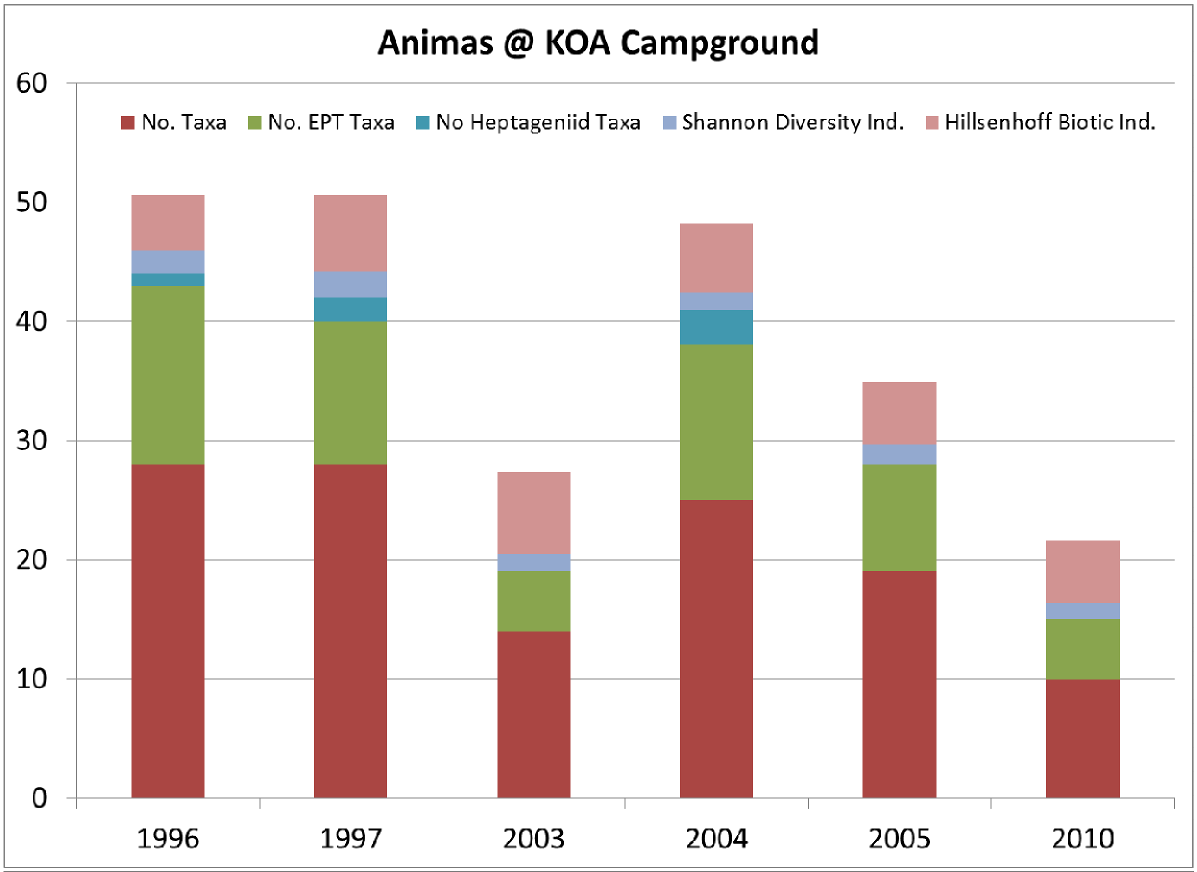
Cement Creek Mouth (CC01)

The total number of taxa (=3) and the number of EPT taxa (=1) in the 2009 samples were less than what was found in 2004 when there were 6 total number of taxa and 2 EPT taxa. The 2009 data was also less than the total number of taxa (average = 8) and the number of EPT taxa (average = 2.5) that were found in the 96, 97 baseline samples. Similar downward trends at this site were found in the diversity index and the HBI. *All indices at this site show declining conditions compared to the baseline data and compared to the 2004 data.*



Animas River @ A72

Only 7 total number of taxa were found in the 2009 samples at A72, 3 less than what were found in the 2004 samples when the total number of taxa was 10 and 6 less than the average, total number of taxa found in the 96, 97 baseline samples where the average was 13. The number of EPT taxa declined as well, from 10 in 2004 to 7 in 2009 which was slightly less than the number of EPT taxa found in the baseline data with an average of 8. The diversity index in 2009 at A72 was 1.23 compared to 1.8 in 2004. There was also an increase in the HBI from 1.89 in 2004 to 3.31 in 2009 which was less than the average HBI found in the 96, 97 baseline data of 4.04 which also indicates decreasing conditions at A72. The loss of individual EPT taxa at this site since 2004 included the complete loss of all Perlodid stoneflies and Taeniopterygidae caddisflies along with the predatory Ryacophila caddisfly. *All indices at this site show declining conditions compared to the baseline data and to the the 2004 data.*



Animas River @ KOA Campground
In 2010 the number of taxa was 10 whereas 27 were found in 2004 and 20 in 2005 along with a large decrease in the number of EPT taxa - from 13 in 2004 to 9 in 2005 and 5 in 2010. There were 3 Heptageniid taxa in the samples in 2004 but all Heptageniids were absent in the 2005 and the 2010 samples and all stoneflies were absent in the 2010 samples, The HBI increased to a high of 4.97 in 2010 compared to 2004 when it was 4.23 and increased when compared to the average of the 96, 97 baseline HBI which was 4.44. *All indices at this site show declining conditions compared to the baseline data and to the 2004 data.*

Overall Observations:
Given the declining conditions found at the mouth of Cement Creek, the Animas at A72 and the Animas at KOA Campground along compared to the relatively stable conditions of the Animas upstream of Cement Creek (A68) and improving conditions at the mouth of Mineral Creek (MC38) it is clear that water quality in Cement Creek has declined and had a deleterious effect on the Animas at A27 and possibly as far down as the Animas at KOA Campground.

Appendix 17.a: Selected HQs associated with pore water and bulk sediment from the Dec. 2012 sediment toxicity test
Baseline Ecological Risk Assessment
Upper Animas River Mining District

December 2012 *Hyalella azteca* sediment toxicity test

Sampling location	Survival[a] (mean ±SE)	Signif.?[b]	Biomass[a] (mean±SE)	Signif.?[b]	Aluminum HQs			Arsenic HQs			Cadmium HQs			Copper HQs			Lead HQs			Manganese HQs			Zinc HQs		
					$PW_{initial}$	PW_{final}	SED[c]	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED
A56 ("upstream")	62.5±8.2%	Y	20.3±1.9 µg/org	Y	<1	--	<1	<1	--	**2.4**	<1	--	**1.9**	**1.5**	--	**2.1**	**2.7**	--	**16.2**	**2.8**	--	**5.0**	<1	--	**7.7**
A68	56.3±3.2%	Y	22.6±1.6 µg/org	Y	**1.7**	--	<1	<1	--	**2.5**	<1	--	**3.4**	**2.9**	--	**4.1**	**5.4**	--	**20.3**	**3.8**	--	**10.1**	<1	--	**16.6**
A72	36.3±4.2%	Y	16.1±1.7 µg/org	Y	<1	--	<1	<1	--	**1.4**	**1.4**	--	<1	<1	--	**1.3**	<1	--	**5.5**	**4.6**	--	**3.6**	<1	--	**2.1**
A73B	5.0±1.9%	Y	4.0±1.7 µg/org	Y	<1	--	<1	<1	--	<1	<1	--	**1.0**	<1	--	**1.6**	<1	--	**4.4**	**8.3**	--	**3.7**	<1	--	**2.7**
A75B	48.8±5.2%	Y	17.8±1.9 µg/org	Y	<1	--	<1	<1	--	**1.1**	<1	--	**2.1**	<1	--	**2.8**	<1	--	**3.4**	**5.2**	--	**3.7**	<1	--	**10.8**
Bakers Bridge	76.3±3.8%	Y	26.2±1.0 µg/org	Y	<1	--	<1	<1	--	**1.2**	<1	--	**3.4**	<1	--	**2.5**	<1	--	**3.7**	**4.0**	--	**7.3**	<1	--	**19.7**
CC49	0%	Y	no survival	Y	**12.9**	--	<1	<1	--	**2.0**	**3.1**	--	<1	**2.0**	--	<1	**3.4**	--	**1.6**	**3.2**	--	<1	**2.8**	--	<1
M34	8.8±3.5%	Y	5.1±2.0 µg/org	Y	<1	--	<1	<1	--	<1	<1	--	<1	<1	--	<1	<1	--	**1.2**	**4.6**	--	**1.0**	<1	--	<1

HQ = hazard quotient; PW = pore water; SED = sediment
note 1: the "initial" pore water samples were collected before the organisms were added to the test beakers
note 2: no "final" pore water samples were collected at the end of the test
note 3: the PW HQs were derived using dissolved metals data and the standard chronic surface water benchmarks or hardness-depedent benchmark equations presented in Table 3.1 of the BERA
[a] see Table 3.23 in the BERA
[b] is the result significantly different from the negative lab control?
[c] All the sediment HQs presented in this table were derived using the "effect" benchmarks presented in Table 3.1 of the BERA

Appendix 17.b: Selected HQs associated with pore water and bulk sediment from the November 2014 sediment toxicity test
Baseline Ecological Risk Assessment
Upper Animas River Mining District

November 2014 *Hyalella azteca* sediment toxicity test

Sampling location	Survival[a] (mean ±SE)	Signif.?[b]	Biomass[a] (mean±SE)	Signif.?[b]	Aluminum HQs			Arsenic HQs			Cadmium HQs			Copper HQs			Lead HQs			Manganese HQs			Zinc HQs		
					$PW_{initial}$	PW_{final}	SED[c]	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED	$PW_{initial}$	PW_{final}	SED
A56 ("upstream")	43.8±9.2%	Y	14.3±3.2 µg/g	Y	**1.6**	<1	<1	<1	<1	<1	**2.7**	**2.3**	**2.3**	**5.2**	**4.5**	**1.6**	**2.2**	**3.0**	**9.2**	**6.3**	**4.8**	**7.7**	**1.1**	<1	**7.0**
A60	77.5±6.5%	N	23.1±1.9 µg/g	Y	<1	<1	<1	<1	<1	<1	**10.4**	**14.1**	**1.9**	**1.0**	<1	**1.8**	<1	<1	**12.6**	**1.8**	**5.1**	**6.2**	**2.9**	**3.8**	**4.6**
A68	70.0±10.0%	N	23.2±3.3 µg/g	Y	<1	<1	<1	<1	<1	<1	**2.1**	**2.3**	**2.2**	<1	<1	**1.4**	<1	<1	**9.7**	<1	<1	**7.9**	**1.2**	**1.2**	**5.4**
A72	70.0±4.6%	N	27.9±2.4 µg/g	Y	<1	<1	<1	<1	<1	<1	**4.4**	**3.4**	<1	<1	<1	<1	<1	<1	**3.9**	**1.8**	**6.1**	**2.8**	**1.1**	<1	**1.9**
A73	73.8±7.8%	N	21.2±2.4 µg/g	Y	<1	<1	<1	<1	<1	<1	**1.3**	**1.9**	<1	**1.2**	<1	<1	<1	<1	**3.4**	<1	<1	**2.3**	**1.5**	**1.9**	**1.6**
A75D	76.3±7.5%	N	24.9±3.2 µg/g	Y	<1	<1	<1	<1	<1	<1	**3.2**	**3.3**	<1	<1	<1	<1	<1	<1	**2.6**	**1.3**	**1.7**	**3.1**	**1.0**	**1.1**	**2.4**
Bakers Bridge	86.3±3.8%	N	30.7±2.2 µg/g	Y	**1.6**	<1	<1	<1	<1	<1	**2.4**	<1	<1	<1	<1	<1	<1	<1	**1.9**	**2.3**	**2.5**	**3.3**	<1	<1	**3.7**

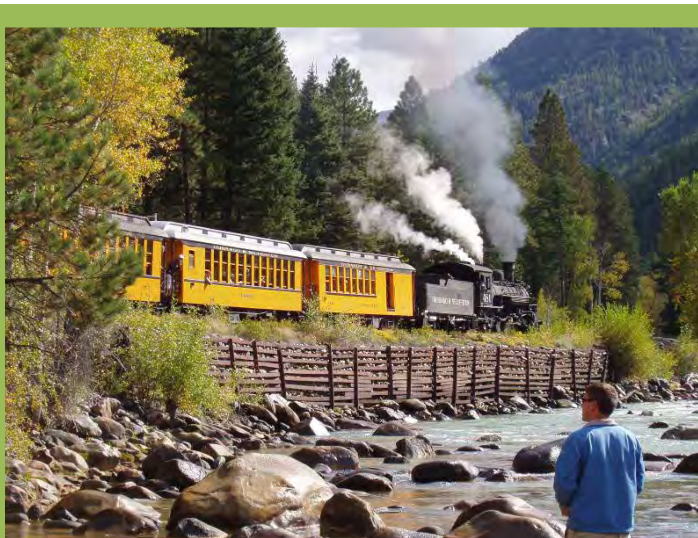
HQ = hazard quotient; PW = pore water; SED = sediment
note 1: the "initial" pore water samples were collected before the organisms were added to the test beakers
note 2: the "final" pore water samples were collected at the end of the test
note 3: the PW HQs were derived using dissolved metals data and the standard chronic surface water benchmarks or hardness-depedent benchmark equations presented in Table 3.1 of the BERA
[a] see Table 3.23 in the BERA
[b] is the result significantly different from the negative lab control?
[c] All the sediment HQs presented in this table were derived using the "effect" benchmarks presented in Table 3.1 of the BERA

Appendix 18

2010 Animas River Report

San Juan Basin

Jim White, Aquatic Biologist
Colorado Division of Wildlife
151 E. 16th Street
Durango, CO 81301



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Animas River

Animas #1&2 (Durango) Mark and Recapture Population Estimate

Date(s)	September 7-10, 2010
Gear	14 ft Raft Electrofishing boat with Smith-Root 2.5 GPP and throwable anode arrangement. VVP settings were High Range 20-25% and 60PPS.
Drainage	San Juan
Water Code(s)	Animas #1 (37982) and Animas #2 (37994)

INTRODUCTION

The Animas River is split into two management sections through the City of Durango. Animas #1 is defined as the Gold Medal Reach from the confluence of Lightner Creek just below the Highway 160 Bridge to Riviera Bridge behind Home Depot. This 4.4 mile reach of river is managed with a two-fish 16 inches or greater bag limit and artificial fly and lure only. Gold medal criteria is defined as a reach of river that consistently produces 60 pounds of trout per surface acre or more and 12 fish greater than or equal to 14 inches per surface acre of river. Rainbow trout consist of 30% of fish captured by anglers and brown trout 66%[1]; catch rates average about 0.3 fish per hour. An estimated 1,955 anglers fished the Animas River Gold Medal reach from July-September, 1997. Those anglers released all of the rainbow trout and 96% of the brown trout captured. With the increase population of Durango over the last 10+ years, the number of anglers has undoubtedly grown. Stocking on the Animas River #1 consists generally of 10k brown trout and 10k rainbow trout fingerlings each year. These fish are distributed by raft in June and July. Since 2005 approximately 10k Colorado cutthroat trout fingerlings have been stocked annually.

The Animas River #2 is managed with Standard Regulations that allow the use of bait and a 4 trout daily bag limit (no size restrictions). This 2.7 mile reach of the Animas River unofficially begins at 32nd Street and continues downstream to the Lightner Creek confluence. Anglers, estimated at 1,635, during the 1997 fishing season reported catching 45% rainbows, 54% brown trout, and 1% Snake River cutthroats. Approximately 72% of trout captured were released. This is a high percentage for a Standard Regulation

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[1] 1997 Animas River Creel Census Data. Note. There were no trout stocked into the Animas River #1 and #2 in 1997 because of hatchery shortages caused by whirling disease.

water. Angler catch rates were reported at 0.44 fish per hour. Stocking over the past 10 years varies a little but generally 10k rainbow and brown trout fingerlings are stocked by raft each year in the Animas #2. Since 2005 we have been stocking approximately 10k Colorado cutthroat trout fingerlings in addition to the browns and rainbows. Because of the higher use associated with Standard Bag limits in an Urban Area, an average of 2000 catchable rainbow trout have been stocked annually.

The Animas River will be impacted by the Animas La-Plata Project. The Animas La-Plata's featured project component, Ridges Basin Dam was completed in November 2007. Limited pumping began in the fall of 2008 with full pumping of 280 cfs from the Animas River started in June 2009. Pumping was shut down in August 2009 and resumed in the spring of 2010. The reservoir, Lake Nighthorse, is now approximately 70% full.

The Bureau of Reclamation (BOR) is mitigating the impacts from pumping by stocking a total of 100,000 sub-catchable rainbow trout into the Animas River from Durango to Bondad. A Memorandum of Understanding (MOU) was signed by the Bureau of Reclamation, Southern Ute Indian Tribe (SUIT), and Colorado Division of Wildlife (CDOW) in the Fall of 2009. The purpose of this MOU is to coordinate fish management efforts on the Animas River between the signatory parties so that a quality trout fishery is maintained (defined by Gold Medal standards on waters managed by CDOW). Specific action items in this agreement include the CDOW supplying whirling disease resistant strains of rainbow trout eggs to the Fish and Wildlife Service for rearing. The BOR will pay for raising and transporting the fish to the Animas River. SUIT and CDOW agreed to stock out the fish annually and coordinate fish inventories on a biennial basis. The CDOW and SUIT will provide the BOR with a report at the end of the 2016 field season evaluating the effectiveness of the stocking program relative to existing fish populations before pumping operations began. The results and discussion presented in this report can be considered part of the coordination effort and adaptive management clauses of the MOU agreement.

METHODS

A 2-pass mark and recapture population estimate was conducted by electrofishing raft on the Animas #1 and #2 during the week of Sept. 7-10. Animas River flows ranged between 300-350 cfs during this time period. All fish were marked with by punching a small hole in the caudal fin and releasing them back to the river. The Animas #1 was Marked on 9/8 and fish were recaptured on 9/10. The Animas #2 was Marked on 9/7 and the Recapture run done on 9/9. All data were entered into the CDOW's "Jake-O-Matic" or JOM database. JOM uses the Peterson index for mark and recapture population estimates.

RESULTS AND DISCUSSION

The density (fish per mile) and biomass (lbs/acre) of trout in the Gold Medal reach of the Animas River has declined since 2002 and 2006, respectively (Table 1). The Animas River still qualifies as a Gold Medal fishery by exceeding 60 lbs/acre of trout biomass and trout density of 12 trout $\geq$ 14 inches per surface acre. This declining trend in biomass is primarily marked by a downward trend in the abundance of large (>400 mm; ~16 in) rainbows and browns since 2002 (Figure 1). The density of rainbow trout and brown trout greater than 14 inches is down about 62% from the historic average (Table 1). The abundance of trout (fish/mile) during the 2010 survey was about twice as high as the average abundance reported since 1991; however, approximately 80% of those fish were from earlier stocking of 5 inch rainbow trout (Hofer/Colorado River rainbow hybrids or HXCs). The HXC rainbows were stocked to mitigate impacts to the fishery in the Animas River.

Table 1 Trout population statistics for the Gold Medal reach of the Animas River

Animas #1 Gold Medal												
Month/Year	Oct-91	Nov-93	Sep-94	Sep-96	Sep-98	Sep-00	Nov-02	Nov-04	Sep-06	Sep-08	Sep-10	Average
All trout combined (fish/acre)	61	53	56	146	54	141	51	90	141	73	148	87
All trout combined (fish/mile)	738	641	678	1752	653	1706	617	1089	873	887	1792	972
Total trout biomass (lbs/acre)	64	51	43	128	65	144	120	96	93	75	71	89
All trout > 14 inches (fish/acre)	21	22	17	61	35	69	49	44	31	21	13	35
Rainbows> 14 inches (fish/acre)	10	9	9	38	9	28	19	33	10	10	5	16

The most striking result of this year's fish inventory on the Animas River is the noticeable decline in the density and biomass of larger rainbow trout. Length frequency analysis suggest about 43% of the biomass in the 2004 and 2006 fish surveys was attributable to the higher abundance of larger rainbow trout (Figure 1). The length frequency chart for rainbows clearly shows captures of rainbows over about 12 inches (300 mm) has been in the 8% or greater range since 2002. This year less than 2% of the rainbows captured were in that same size range and there appears to be little recruitment of Age-1+ fish (250-300 mm; Figure x) into the larger size classes of rainbows. A similar observation was made for the Animas River #2, Standard Regulation reach, just upstream (Table 2).

Brown trout (Figure 1) density and age class structure in the Gold Medal Reach appears relatively stable over the past 10 years. A relatively large cohort of Age-1+ browns are poised to recruit into the quality size (14 inch) group of fish next year (2011). Brown trout are becoming more abundant relative to rainbow trout in the Gold Medal reach. In 2006, at the peak of large rainbow abundance, there were almost 3 rainbows over 14 inches for every brown trout per mile of river. That ratio has flipped and now there is less than 0.6 rainbows for every brown trout in the Gold Medal reach of the Animas River.

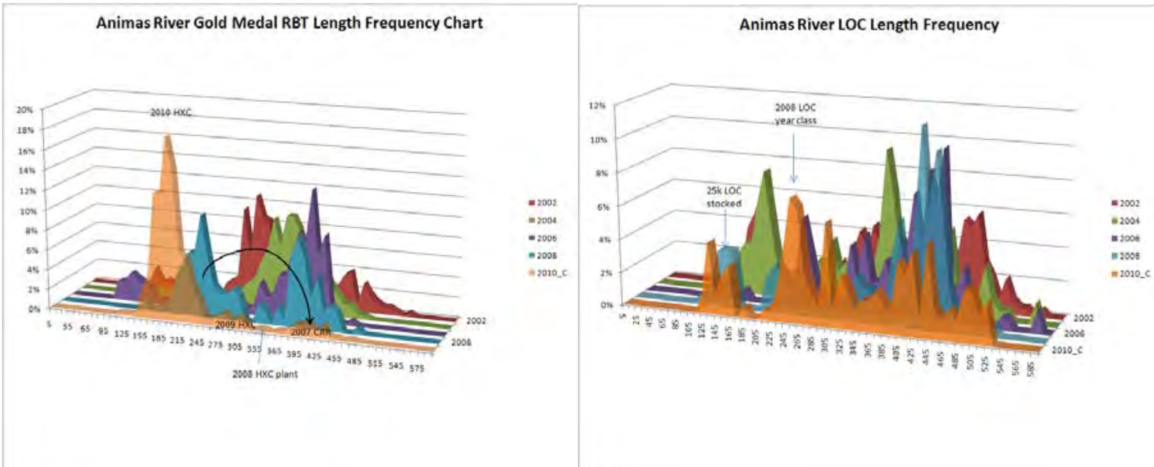

Figure 1 Length frequency charts of rainbow trout (left) and brown trout (right) captured in the Animas River Gold Medal reach during 2010 (orange area) fish inventory.

The Animas River #2, or Standard Regulation Reach, from 32nd Street Bridge to the Lightner Creek confluence has also experienced a decline in trout abundance and biomass since 2006. We recorded the second lowest biomass of trout in 11 fish inventories (Table 2). Biomass of trout has declined about 45% since 2008 is now 52% of the historic average. Larger browns (>14 inches) typically dominate the fish species composition in the Standard Regulation reach; however, both larger browns and rainbows were depressed in total numbers and quality sized fish (Figure 2).

Table 2 Trout population statistics for the Standard Regulation reach of the Animas River.

Animas #2 Standard											
Month/Year	Oct-91	Nov-93	Sep-94	Sep-96	Sep-98	Sep-00	Nov-02	Nov-04	Sep-06	Sep-08	Sep-10	Average
All trout combined (fish/acre)	147	43	122	66	38	57	130	115	84	97	56	87
All trout combined (fish/mile)	1779	520	1476	799	460	690	1573	1392	1406	1171	720	1090
Total trout biomass (lbs/acre)	115	32	56	41	28	42	99	104	115	58	32	66
All trout > 14 inches (fish/acre)	37	12	10	11	12	16	38	17	34	13	4	19
Rainbows> 14 inches (fish/acre)	3	2	2	2	6	5	10	7	11	4	0.2	5

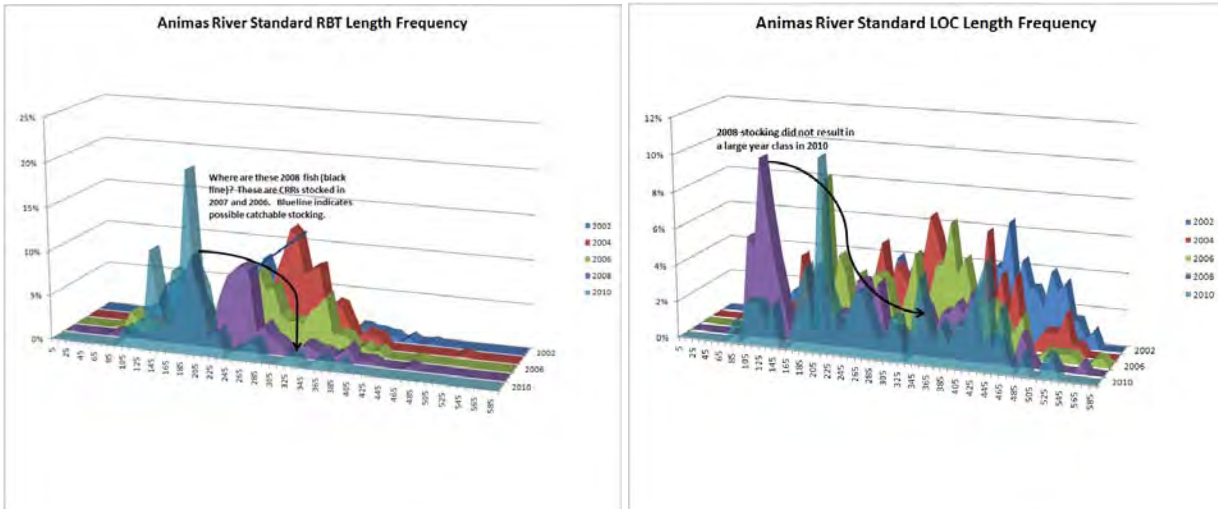

Figure 2 Length frequency charts of rainbow trout (left) and brown trout (right) captured in the Animas River Standard Regulation reach during 2010 (orange area) fish inventory.

The decline of larger rainbows, and apparent lack of recruitment into the Age 1+ or larger size groups, is probably related to the interactions between flow, temperature, water quality, and stocking. The quality of habitat for both rainbow and brown trout is typically best if river flows exceed 50% of the average annual daily flow. Average annual daily flow (1900-2005) for the Animas River in Durango is 819 cfs. “Excellent” habitat conditions are present at 410 cfs or better, “Fair” at 410-205 cfs, and “Poor” at anything below 205 cfs[2].

Baseflows in the Animas River mostly explain the fluctuation in fish biomass and abundance. When baseflows are relatively high such as during the 2004-2007 timeframe (Table 3) biomass is relatively high (Table 2 and 3). When baseflows are relatively low, such as in 2009 and 2010, biomass and abundance tends to move downwards.

High baseflows may also be more beneficial to larger rainbows relative to larger brown trout. The ratio of rainbow to brown trout greater than 14 inches is much greater during high baseflow years than in low baseflow years (Figure 3). This relationship may explain why larger rainbows in the Standard and Gold Medal reaches of the Animas are in decline. Although habitat suitability models predict these relationships, it is helpful to see our fish inventory results validate those relationships for the Animas River through Durango.

[2] Habitat Suitability Information for rainbow and brown trout from Raleigh et al. 1984 & 1986, respectively.

Table 3 Average daily flow (cfs) for the Animas River from 2000-2010.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Base (cfs)	Rank (best-worst)
2000	190	175	236	958	2169	1155	350	271	318	327	289	230	278	9
2001	204	198	311	955	3155	2101	737	580	245	192	179	190	288	8
2002	178	154	138	322	544	358	154	134	317	302	213	180	202	12
2003	166	149	200	494	1830	1338	335	340	583	245	207	169	310	7
2004	161	171	582	1002	2450	1919	622	277	600	518	439	317	443	4
2005	318	374	521	1620	3929	3434	1447	571	344	642	323	240	470	3
2006	223	207	230	918	2136	1295	582	574	489	1595	457	316	564	1
2007	274	263	525	829	2304	2312	831	890	657	563	299	315	502	2
2008	247	235	483	1150	2592	3453	1305	477	343	257	216	186	391	5
2009	183	208	344	831	3409	1735	744	236	213	203	170	145	248	10
2009*	194	224	369	867	3420	1390	557	242	225	213	188	158	264	11
2010	159	164	200	859	2130	1920	442	572	302	277	237	220	315	6

Baseflow = July-March

Winterflow = November, December, January and February

2009 = discharge below the Pumpstation for Lake Nighthorse*

Note: 1999 baseflows averaged 600 cfs!

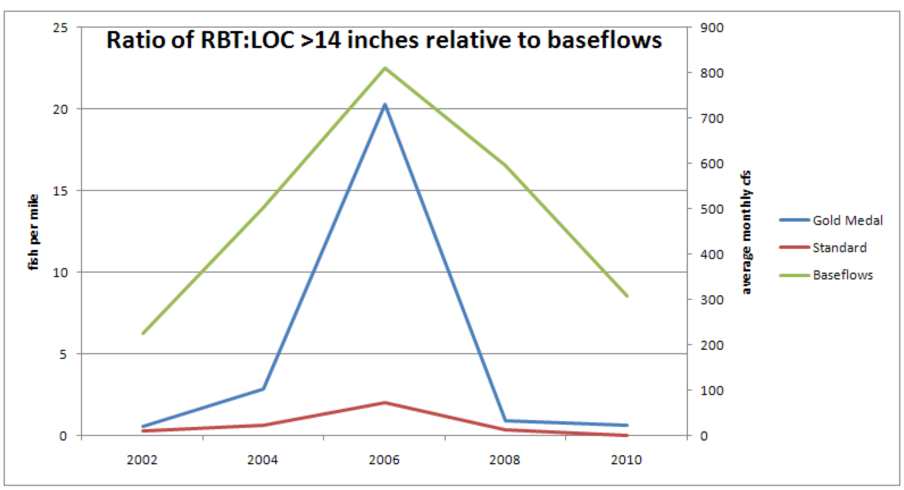

Figure 3 Relationship between baseflows and the ratio of quality rainbow and brown trout in the Animas River through Durango.

Other factors possibly limiting the biomass, density, and quality of trout observed in the Animas River in 2010 are water temperatures, stocking, and possibly increased heavy metal contamination from the Upper Animas River Basin. Low baseflows and warm water temperatures were observed through much of 2009 and 2010. Unfortunately, water temperature monitoring was not started on in the Gold Medal reach of the Animas River until August 2009 – a moot effort considering our temperature data logger was stolen! However, data collected in 2010 suggest low baseflows coupled with high ambient air temperatures created warm water conditions very stressful to salmonids (Figure 4). In mid-July 2010, trout were subjected to three days of water temperatures exceeding Colorado's coldwater temperature threshold. Fish were exposed to temperatures above 70ºF for up to 9 hours at time coming dangerously close to the upper lethal temperature of 77ºF. Similar conditions were observed in 2009 when baseflows were even further depressed naturally and by A-LP pumping operations.

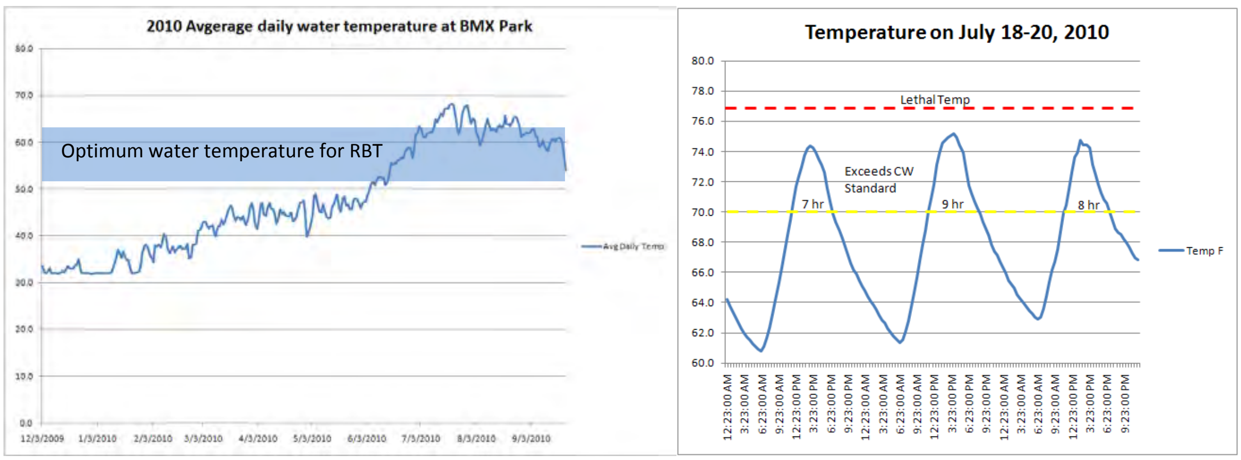

Figure 4 Average daily water temperature for the Animas River below the Animas-LaPlata pumping plant between December 2009 and September 2010 (left) and three of the warmest days in July 2010 (right). Baseflows during the July 18-20 period were 282 cfs (288 cfs above the pumping plant).

At higher water temperatures, trout do not like to move. The Animas River #2 experiences extremely heavy recreational use during the warmest days of summer from rafters, swimmers, and "tubers". If trout are disturbed and displaced by these activities, it could be very stressful and possibly lethal to some trout. We are witnessing increased use, and encouragement of this use, by building whitewater park features in the Animas and San Juan rivers. The impacts of increased recreation such as tubing during the most stressful periods for trout are not known but more study on movement and habitat use is needed.

Dissolved heavy metal concentrations since 2006 are, with increasing frequency, exceeding chronic and acute water quality standards (Table 4). Rainbow trout and mottled sculpin are very sensitive to high concentrations of zinc. Rainbow trout recruitment, density, and biomass are down since 2006 which do correspond to a rise in both chronic and acute zinc levels as well as other dissolved metals. The drop in trout biomass is most dramatic in the Standard Regulation trout section (115 lbs/ac to 32 lbs/ac). Whether that drop is caused by, or associated, with zinc toxicity is not known but rainbow trout abundance does improve downstream where presumably zinc concentrations are reduced by increasing sediments from Lightner Creek.

This year we captured the fewest mottled sculpin in the Animas #2 (Standard) in the last 10 years of sampling this section. Mottled sculpin are captured incidentally during fish inventories and total numbers of sculpin captured are probably not very indicative of the overall population status of these fish. However, with the low abundance of trout (and suckers) in this section, netters were eager to net any fish immobilized by the electrofishing boat; therefore, one would assume we would capture more sculpins, not less during this year's survey. We also saw a corresponding decline in the abundance and distribution of fish in the Upper Animas River Basin (see next Section) where metals, not habitat (i.e., baseflows) are the limiting factor.

Table 4 Percent exceedence of State water quality standards (A) & (B). Paired Data collected at Bakers Bridge (A), Trimble Bridge (B), and 32nd Street Bridge (B) (note: over 15% of chronic standard is a violation of the State's Water Quality standards, except for iron where 50% is used). Data table assembled by Peter Butler, with the Animas River Stakeholders Group (ARSG) on 11/17/10. Butler provided the following notes: Comparing data by going back in five year increments. (Notes: Additional discharges above Gladstone started around 2000-2001. They appear to have stabilized to current levels in 2005. Discharges added proportionally more zinc than cadmium. The period of 2000-2005 included extreme drought and low flow conditions. Although some remediation began in 1991, most projects were done between 1995 and 2005. Samples were essentially collected monthly, but before 1999, more intensive sampling occurred April though July - three to four samples per month.)"

Year	Zn chronic	Zn acute	Cd chronic	Pb chronic	Iron chronic
1992-1995	56%	27%	32%	3%	34%
1996-1998	42%	9%	19%	0%	29%
2002-2005	39%	17%	71%	0%	27%
2006-mid 2009	73%	41%	59%	23%	56%

(B) Paired Data for Trimble Lane and 32nd St.

	Trimble lane			32nd St.	
Year	Zn chronic	Zn acute		Pb chronic	
1992-1995	34%	6%			
1996-1998	14%	5%			
2002-2005	7%	2%		2%	
2006-mid 2009	11%	3%		17%	

Dissolved heavy metals have always been present in the Animas River #1 and #2 at levels where little trout reproduction occurs but juvenile and adult trout survival in recent times has always been adequate to provide quality fishing opportunities. Young trout and mottled sculpin were noted in low abundance near Baker's Bridge in the late 1990s when acute levels of zinc were at their lowest (Table 4). Poor water quality in Durango is probably not limiting juvenile and adult trout populations. Sub-optimal baseflows creating poor habitat conditions may be more detrimental. However, given the increase in dissolved metal concentrations, particularly zinc, one cannot rule out some population level impacts associated with dissolved metal toxicity. If toxicity events occurred, they would be most apparent on rainbow trout and sculpin populations.

Stocking may be an additional factor in the observed decline of rainbow trout in the Animas River. Fingerling stocking, and method of stocking (raft), of both rainbow and brown trout has remained relatively stable over the past 10 years. The only significant change was a switch to fingerling Hofer/Colorado River rainbows (HXC) fish in 2008 and a change to 5 inch HXCs in 2009 and 2010. Research by the CDOW on the Gunnison River suggest recruitment rates (% of Age -1+ fish) of the Colorado River rainbow strain (CRR) and Hofer crossed with CRRs are about the same (HXCs may actually do a little better than CRRs). Higher densities of HXC stocking probably does not explain an overall dip in rainbow trout numbers or recruitment. An average of 2,100 catchable rainbow trout (10+ inches) were stocked from 2003-2007. These fish were eliminated in 2009 and 2010 because of hatchery shortages. There is some indication (Figure 2) that catchables made up a significant portion of the Animas River #2 biomass and probably contributed to the Animas #1 biomass as well with catch and release so widely practiced. The absence of these catchable trout in the past two years may have some impact to total biomass but probably not a significant one.

One task with the recent fish sampling effort is to evaluate recruitment of HXC stocking in the Animas River. HXCs have been stocked by the CDOW in 2008 and by the BOR/FWS in 2009 and 2010 as part of the Animas-La Plata (A-LP) mitigation. Stocking rates for HXCs were determined by past management efforts and available habitat. Stocking rates for HXC's in the Gold Medal Reach were doubled to compensate for anticipated losses from dewatering the Animas. Stocking numbers went from 10k rainbow trout fingerlings to 20k rainbow sub-catchables. All fish were raft stocked in 2009 and 2010. In 2010, we moved our stocking point upstream to 32nd Street bridge instead of across from the A-LP pumping plant at Santa Rita Park in Durango. We did this because the Southern Ute Tribe was planning their 2010 fish inventory in late July and did not want to spend a lot of time capturing and working up newly stocked fish. Fish were also stocked above the Gold Medal reach because HXC movement in the Gunnison River is generally about 3 miles downstream after stocking; therefore, we thought we could get better distribution into the mitigation area by stocking a portion of the fish upstream.

The 2008 year class of HXC were stocked at 3.1 inches in late August. It appears that predation by brown trout and poor baseflows limited their recruitment into the 300-350 mm range (10-14 inches; Figure x). Competition between Age-1 brown and HXC trout may also have played a role in the poor recruitment of the 2008 HXC age class. In an effort to bump up a declining brown trout population we stocked 24,000 fingerlings in late June 2008. Browns and rainbows use similar habitats at that early age. Age-2+ (2008 class) browns did relatively well relative to the HXCs suggesting competition between the two may have been a factor in low HXC recruitment.

Poor baseflow conditions and high temperatures most likely limited the recruitment of Age-1+ (2009 year class) HXC stocked as mitigation for A-LP to less than 2% in the Gold Medal reach of the Animas. Although large brown trout are capable of preying on 5-6 inch stocked HXC, the sheer density of HXCs stocked relative to the population of larger brown trout suggest predation was not a controlling factor in recruitment. Many of the 2009 HXCs were captured by anglers in the late fall of 2009. Anglers reported catching very few of these 2009 HXC plants in the spring of 2010 before runoff suggesting many of these fish did not survive the winter. Domestication, brought about by genetics and hatchery life prior to stocking, may limit the survival capability of these fish during stressful times. One school of thought is to limit the exposure of these fish to hatchery life for as little time a possible and stock them out young allowing greater natural selection to occur thereby increasing the remaining fish chances of recruiting into the adult population from one year to the next. Stocking more numerous and smaller HXCs may be a management option we want to pursue next year.

The relative contribution of catchable trout to the rainbow trout biomass in the Animas River is not known. We have assumed it was low more than 1 year out because highly domesticated catchable trout do not overwinter well or tolerate natural events like spring flooding without either being displaced or dying. We have not tested this assumption in the Animas using catchable HXCs. Stocking a limited number of catchable HXCs, in addition to fingerling HXCs, may help maintain a quality fishery in the CDOW and SUIT reaches. These stocking strategies need to be vetted through the MOU partnership and a management strategy and assessment protocol implemented in 2012.

Conclusion:

- Low baseflows likely explain most of the downward trend in trout biomass. Rainbows are more sensitive to habitat alteration (warm temperatures and poorer quality riffle habitat). One would expect rainbows to be disproportionately affected by the loss of quality riffle habitat and colder water due to low baseflows relative to brown trout.
- Zinc toxicity is not likely to significantly affect rainbow trout in the Durango Area and south to the SUIT waters. However, it is worth monitoring through the Animas River Stakeholers Group and the River Watch program. Additional fry shocking may be warranted at historic sites.
- The whirling disease resistant Hofer Colorado River rainbow hybrids, or HXCs, are probably the best strain of fish to stock in the Animas River. Five inch sub-catchables may not be the best stocking size. More work needs to be done on a stocking strategy (smaller but more abundant and/or larger but less abundant stocking).

Recommendations:

- Interim sampling (i.e., do Gold Medal run in early march to determine overwinter survival)
- Evaluate option of stocking larger fish at densities compatible with the Animas River's average density (e.g., 1000 fish/mile x 3 miles in Standard Reach = 3000 fish). Mark these fish and look for them in 2012.
- Deploy more temperature loggers to assess flow and temperature impacts
- Conduct a Creel Census – last one done in 1997 (harvest changes? Angler attitude? C&R practice?)
- Coordination and communication with the Animas River Stakeholders Group (ARSG) on water quality testing
- Repeat 1996 fry shocking; mottled sculpin and trout reproduction found as high as Bakers Bridge – an absence or skewed distribution of fishes could indicate zinc toxicity
- Explore the possibility of a movement study of rainbow trout in the Animas #2 to assess recreational impacts to fish during the peak summer tubing season (2012)
- Communication: Present results to Area 15; Post results on Web; E-mail to TU and angling community and present at ART

Animas #3&4 (Upper Animas) Walk Shocking

Date(s)	September 20-22, 2010
Gear	Bank shocking array with Smith-Root 2.5 GPP. VVP settings were High Range 40-60% and 60PPS.
Drainage	San Juan
Water Code(s)	Animas #3 (38009), Animas #4 (38011), and Mineral Creek (42076)

INTRODUCTION

In 1997, the Animas River Stakeholders Group (ARSG) initiated a number of smaller mining reclamation projects aimed at improving water quality in the Animas River. The CDOW agreed to assist the ARSG by monitoring the Upper Animas River fishery at 4 different locations every five years (Figure 5). The question everyone was interested in was would remediation efforts be enough to see a biological response in the fish populations in the Animas River? A biological response in the upper Animas would be an expansion in distribution and abundance of adult trout. In the lower Animas River (Durango) we might expect better water quality conditions to create better survival of mottled sculpin, rainbow, and brown trout fry.

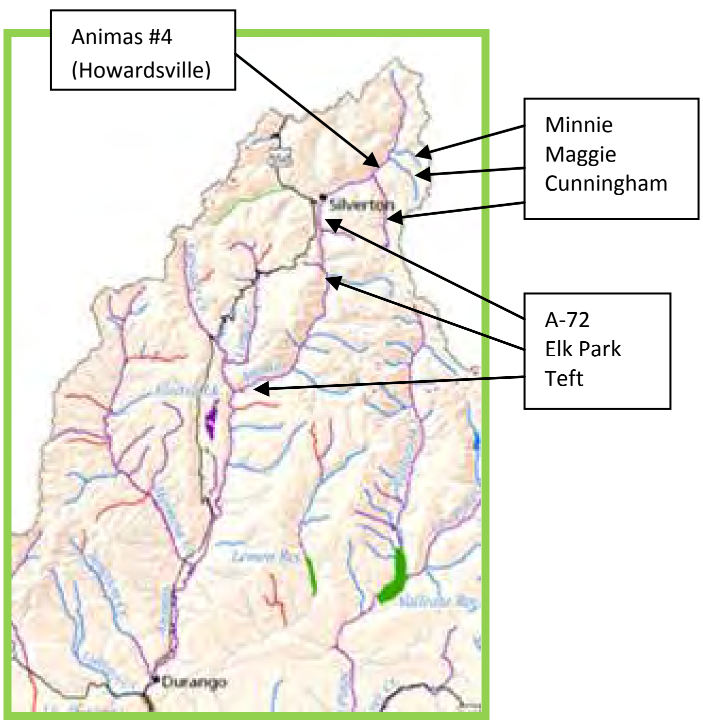

Figure 5 Upper Animas River fish sampling sites for 2009 and 2010.

METHODS

Fish were collected using a Smith-Root 2.5 GPP bank shock set up with an 5 anode array and 500 ft of cable. Two passes were done at each station unless no adult fish were captured on the first pass. All data were entered into the JOM database.

RESULTS AND DISCUSSION

A biological response (i.e., fish abundance and distribution) to mine cleanup efforts is mixed. In the Animas River #4 (above the Mineral Creek confluence with the Animas River in Silverton) we have documented increasing brook trout abundance and distribution in Howardsville, Cunningham, Maggie, and Minnie gulches (creeks; Table 5). Abundance of brook trout dramatically increased in Cunningham, Maggie, and Minnie Gulches from surveys done in the late 1980s. The Howardsville site on the mainstem of the Animas River produces a respectable 29 lbs/acre. Poor physical habitat condition appears to be the limiting factor at this site not water quality.

Table 5 Fish density estimates for seven sites in the Upper Animas River drainage.

Teft Spur (fish/mile)						Cunningham Gulch (fish/mi)		
Year	1992	1998	2005	2010		Avg. of 2 sites		
brook	349	349	338	98		Year	1987	2009
rainbow	48	24	8	0		brook	94	528
brown	0	8	23	0		cutthroat	10	84
RXN	0	16	0	0				
						Maggie Gulch (fish/mi)		
Elk Park (fish/mi)						Year	1987	2009
Year	1992	1998	2005	2010		brook	22	339
brook	88	69	81	0		cutthroat	45	21
rainbow	0	0	1	0				
A-72 USGS (fish/mi)						Minnie Gulch (fish/mi)		
Year	1992	1998	2005	2010		Year	1976	2009
brook	0	0	5	0		brook	0	442
						cutthroat	1	0
Howardsville (fish/mi)								
Year	1992	1998	2005	2010				
brook	78	559	1024	1082				
rainbow	4	0	0	0				
cutthroat	4	0	0	0				

Trout populations in the Animas River #3, below the Mineral Creek confluence, are declining in abundance and distribution (Figure 6). Brook trout are an important water quality indicator because they are much more tolerant of heavy metals than cutthroat, rainbow, or brown trout. A large water treatment project was apparently discontinued in the Gladstone area near Silverton (Cement Creek) in 2004. While there are a number of natural and anthropomorphic background sources of dissolved metals in and around the Silverton area, declines in fish abundance suggest water quality has declined significantly since 2005.

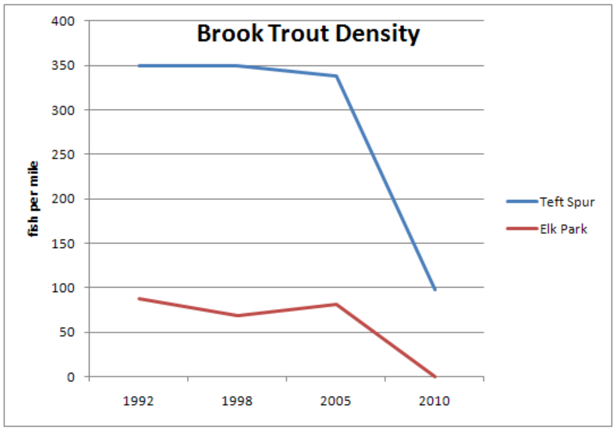

Figure 6 Brook trout density in two historic upper Animas River electrofishing sites.

CONCLUSION

- Poor physical habitat conditions are not suspected of limiting trout populations in the Upper Animas River basin. Low baseflows and warm temperatures are not significant factors in this steep gradient and colder upper reaches.

RECOMMENDATIONS

- Continue to assist ARSG with biological information
- Communicate report with ARSG and interested parties
- Approach BLM with physical habitat improvement project on the Animas River #4

Photo 1 Representative photos of the Upper Animas River fish shocking. From top right to bottom left. Loading the train at Rockwood (9am start). Top of braided section at Teft Spur. Bottom two photos are of the trip down the canyon from Silverton (7am start) to Elk Park.

Appendix 19

(not available to date)

Appendix 20

Historic Multi-Metric Index (MMI) scores for the Animas River

Animas Biotype 1

Metric Scores

Red = impairment for aquatic life use

Bbridge	9/26/2014
EP Taxa	45.6
Percent Chironomidae	95.8
Sens. Plains Families	36.3
Predator-Shredder Tax	35.7
Clinger Taxa	30.5
Non-Insect Percent	52.5
Shannon Diversity	2.28
HBI	3.91
MMI Score	**49.4**

	Surber	Kicknet		Kicknet	
A75D	10/28/1996	10/3/1997	10/1/2004	10/28/2010	10/16/2014
EP Taxa	58.1	47.4	47.4	36.7	36.7
Percent Chironomidae	28.7	82.3	88.1	85.2	77.1
Sens. Plains Families	18.0	17.3	53.9	49.0	55.3
Predator-Shredder Tax	71.4	64.3	28.6	28.6	64.3
Clinger Taxa	10.4	18.9	35.9	18.9	10.4
Non-Insect Percent	81.3	66.1	79.1	100.0	80.2
Shannon Diversity	3.04	3.18	3.28	2.96	3.00
HBI	4.08	2.76	1.92	1.66	2.37
MMI Score	**44.7**	**49.4**	**55.5**	**53.1**	**54.0**

	Surber	Kicknet	Kicknet			
James R	11/2/1996	9/19/1997	9/15/2003	10/1/2004	10/10/2005	9/26/2014
EP Taxa	78.3	78.3	14.2	78.3	56.9	67.6
Percent Chironomidae	42.7	82.4	90.0	95.6	76.6	86.3
Sens. Plains Families	66.0	34.1	12.7	14.0	5.2	22.2
Predator-Shredder Tax	71.4	71.4	28.6	50.0	50.0	42.9
Clinger Taxa	65.1	65.1	31.1	65.1	48.1	48.1
Non-Insect Percent	83.8	40.7	100.0	81.3	79.1	76.3
Shannon Diversity	2.83	3.34	2.11	2.27	2.29	2.43
HBI	4.52	3.30	2.79	3.63	4.02	4.31
MMI Score	**67.9**	**62.0**	**46.1**	**64.1**	**52.6**	**57.2**

	Surber	Kicknet		Kicknet	
A75CC	10/28/1996	10/3/1997	10/1/2004	10/28/2010	10/16/2014
EP Taxa	57.6	46.9	46.9	68.3	89.7
Percent Chironomidae	53.5	79.0	98.6	83.2	81.4
Sens. Plains Families	23.0	21.7	59.0	38.7	25.5
Predator-Shredder Tax	64.3	57.1	78.6	64.3	57.1
Clinger Taxa	69.5	44.0	69.5	35.4	44.0
Non-Insect Percent	47.3	34.1	60.4	83.8	51.5
Shannon Diversity	4.13	3.79	3.55	3.53	3.44
HBI	4.11	3.35	3.40	1.93	3.05
MMI Score	**52.5**	**47.1**	**68.8**	**62.3**	**58.2**

Animas Metric Scores Red = impairment for aquatic life use

Biotype 2

	Kicknet
A53	10/11/2014
Total Taxa	44.4
Predator-Shredder Taxa	42.9
Clinger Taxa	41.2
Percent Ephemeroptera	25.2
Beck's Biotic Index	48.5
Shannon Diversity	2.93
HBI	2.32
MMI Score	**40.4**

	Kicknet	Kicknet	Surber	Kicknet		Kicknet	Kicknet	
A72	10/11/1992	11/15/1996	11/15/1996	9/9/1997	10/1/2004	10/7/2006	10/24/2010	9/25/2014
Total Taxa	22.2	25.0	11.1	38.9	27.8	22.2	16.7	22.2
Predator-Shredder Taxa	28.6	35.7	14.3	28.6	35.7	21.4	14.3	14.3
Clinger Taxa	23.5	23.5	11.8	35.3	35.3	23.5	11.8	17.6
Percent Ephemeroptera	28.9	1.2	0.0	3.4	16.3	5.1	0.0	4.8
Beck's Biotic Index	30.3	33.3	9.1	36.4	33.3	21.2	12.1	15.2
Shannon Diversity	2.65	2.11	1.56	2.05	2.60	1.80	2.11	1.91
HBI	3.17	2.71	4.56	6.71	1.45	1.54	3.48	3.46
MMI Score	**26.7**	**23.8**	**9.3**	**28.5**	**29.7**	**18.7**	**11.0**	**14.8**

	Kicknet	Surber	Kicknet		
A73	10/8/1992	10/29/1996	10/3/1997	10/1/2004	10/16/2014
Total Taxa	27.8	41.7	36.1	41.7	30.6
Predator-Shredder Taxa	21.4	42.9	35.7	50.0	42.9
Clinger Taxa	29.4	41.2	35.3	52.9	41.2
Percent Ephemeroptera	3.9	3.6	17.5	3.3	5.4
Beck's Biotic Index	39.4	42.4	42.4	51.5	33.3
Shannon Diversity	1.51	2.68	2.76	2.99	1.61
HBI	1.24	2.66	2.00	2.49	1.28
MMI Score	**24.4**	**34.3**	**33.4**	**39.9**	**30.7**

	Kicknet	Kicknet	Surber	Kicknet		Kicknet	Kicknet	Kicknet	
A68	10/8/1992	10/23/1996	11/15/1996	9/9/1997	10/1/2004	10/7/2006	10/30/2007	10/24/2010	9/25/2014
Total Taxa	30.6	33.3	16.7	33.3	44.4	22.2	38.9	47.2	41.7
Predator-Shredder Taxa	35.7	35.7	21.4	35.7	42.9	28.6	42.9	57.1	28.6
Clinger Taxa	35.3	29.4	23.5	35.3	41.2	23.5	47.1	52.9	41.2
Percent Ephemeroptera	63.8	18.5	20.9	68.9	14.7	25.2	14.1	32.6	21.6
Beck's Biotic Index	42.4	33.3	18.2	42.4	45.5	27.3	45.5	57.6	48.5
Shannon Diversity	2.67	2.10	2.76	3.07	2.95	2.37	2.87	3.16	2.69
HBI	1.01	2.18	2.10	2.55	2.38	1.61	2.67	1.98	4.66
MMI Score	**41.6**	**30.1**	**20.1**	**43.1**	**37.7**	**25.4**	**37.7**	**49.5**	**36.3**

A60	9/25/2014
Total Taxa	52.8
Predator-Shredder Taxa	50.0
Clinger Taxa	47.1
Percent Ephemeroptera	17.0
Beck's Biotic Index	60.6
Shannon Diversity	3.15
HBI	4.05
MMI Score	**45.5**

A56	9/24/2014
Total Taxa	47.2
Predator-Shredder Taxa	50.0
Clinger Taxa	52.9
Percent Ephemeroptera	15.0
Beck's Biotic Index	63.6
Shannon Diversity	2.22
HBI	4.26
MMI Score	**45.8**

	Kicknet	
A55	10/8/1992	9/24/2014
Total Taxa	33.3	55.6
Predator-Shredder Taxa	35.7	50.0
Clinger Taxa	47.1	47.1
Percent Ephemeroptera	91.1	56.9
Beck's Biotic Index	39.4	63.6
Shannon Diversity	1.86	3.56
HBI	0.59	1.69
MMI Score	**49.3**	**54.6**

	Surber	Kicknet		
A75EC	10/29/1996	10/3/1997	10/1/2004	10/16/2014
Total Taxa	41.7	30.6	30.6	63.9
Predator-Shredder Taxa	35.7	28.6	42.9	78.6
Clinger Taxa	35.3	29.4	41.2	52.9
Percent Ephemeroptera	59.6	71.9	28.9	25.1
Beck's Biotic Index	42.4	39.4	48.5	100.0
Shannon Diversity	2.88	2.10	1.83	2.27
HBI	2.15	1.05	1.51	1.58
MMI Score	**42.9**	**40.0**	**38.4**	**64.1**

	Kicknet	Surber/Kick	Kicknet		Kicknet	Kicknet	Kicknet	
M34	10/8/1992	11/15/1996	9/9/1997	10/1/2004	10/7/2006	10/30/2007	10/24/2010	9/25/2014
Total Taxa	8.3	11.1	47.2	36.1	38.9	36.1	25.0	27.8
Predator-Shredder Taxa	7.1	14.3	42.9	35.7	50.0	35.7	35.7	21.4
Clinger Taxa	11.8	5.9	29.4	41.2	23.5	29.4	17.6	29.4
Percent Ephemeroptera	34.7	0.0	1.9	36.8	11.1	1.3	0.0	5.4
Beck's Biotic Index	15.2	6.1	39.4	39.4	39.4	33.3	18.2	30.3
Shannon Diversity	1.06	1.55	2.92	3.11	3.54	2.73	2.35	1.96
HBI	1.50	4.67	4.79	2.53	2.92	2.47	2.95	1.84
MMI Score	**15.4**	**7.5**	**32.2**	**37.8**	**32.6**	**27.2**	**19.3**	**22.9**

CC49	9/25/2014
Total Taxa	2.8
Predator-Shredder Taxa	0.0
Clinger Taxa	0.0
Percent Ephemeroptera	0.0
Beck's Biotic Index	0.0
Shannon Diversity	0.00
HBI	6.00
MMI Score	**0.6**