Understanding "Reasonable Potential“ and Use of Pro UCL

What POTWs Can Do to Minimize the Chance of Having Metals Limits Added to Their Discharge Permit

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South Valley WRF
April 2016

Permit Renewal Process

1. POTW supplies available data
2. DEQ inputs the data into a spreadsheet
3. Performs Reasonable Potential (RP) screen
4. Full RP analysis for metals indicated in screen
5. Update permit if needed with increased monitoring or discharge limits

Reasonable Potential Screen

- Use acute and chronic levels taken from R317
- Adjust for effluent hardness if appropriate
- This number becomes the benchmark
- Take highest value reported & compare to benchmark
- If the highest reported value is greater than ½ the benchmark proceed with full RP analysis

Reasonable Potential Screen

Metals, ug/L		Effluent RP Screening													
Metal		Cyanide	Iron	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc	Aluminum	Molybdenum	Selenium	Mercury
ARP Val		1	1.34483	0.13457	0.00886	0.1349	0.05319	0.28400	1.61685	0.02903	0.41017	1.01562	1	0.02446	1
CRP Val		1	1	0.2181	0.00088	1	0.03522	0.01936	0.19776	1	0.44604	1	1	0.00613	1
2009	Sum	ND	0.003	0.0041	ND	ND	0.0111	0.001	0.0059	ND	0.06	ND	ND	0.0013	ND
	Fall	ND	0.18	0.0039	ND	ND	0.0133	0.0009	0.007	ND	0.06	0.02	ND	0.0015	ND
2010	Win	ND	ND	0.0025	ND	ND	0.0103	ND	0.0065	ND	0.06	ND	ND	0.0017	ND
	Spr	ND	0.03	0.0024	ND	ND	0.0104	ND	0.0089	ND	0.07	ND	ND	0.002	ND
	Sum	ND	0.04	0.0041	ND	ND	0.0151	ND	0.0051	ND	0.05	ND	ND	0.0018	ND
	Fall	ND	0.05	0.003	ND	ND	0.0099	ND	0.0069	ND	0.05	ND	ND	0.0011	ND
2011	Win	ND	0.03	0.0035	ND	ND	0.0135	ND	0.0051	ND	0.06	0.05	ND	0.0023	ND
	Spr	ND	0.04	ND	ND	ND	0.0982	ND	0.0054	ND	0.01	ND	ND	ND	ND
	Sum	ND	ND	0.0042	ND	0.024	0.0335	0.001	0.0077	0.0008	0.05	ND	ND	0.007	ND
	Fall	ND	0.03	0.0033	ND	ND	0.0131	ND	0.0077	ND	0.05	ND	ND	0.0023	ND
2012	Win	ND	ND	0.0037	ND	ND	0.0072	ND	0.007	ND	0.06	ND	ND	0.0042	ND
	Spr	ND	0.1	0.004	ND	ND	0.0093	0.0006	0.0056	ND	0.06	ND	ND	0.0027	ND
	Sum	ND	ND	0.0054	ND	ND	0.0081	ND	0.0112	ND	0.05	ND	ND	0.0044	ND
	Fall	0.017	0.03	0.0037	ND	ND	0.0096	ND	0.0099	ND	0.05	ND	ND	0.0034	ND
2013	Win	ND	0.03	0.0028	ND	ND	0.0078	ND	0.0052	ND	0.06	ND	ND	0.003	ND
	Spr	ND	ND	0.0027	ND	ND	0.006	ND	ND	ND	0.03	ND	ND	ND	ND
	Sum	0.002	0.05	0.0048	ND	ND	0.0099	0.0006	0.0046	ND	0.05	0.06	ND	0.0024	ND
	Fall	ND	0.03	0.0036	ND	ND	0.0072	ND	0.0064	ND	0.06	0.08	ND	0.0024	ND
14	Win	ND	ND	0.0025	ND	ND	0.0055	ND	0.0039	ND	0.05	ND	ND	0.0019	ND
ND Value		0.002	0.02	0.0005	0.0005	0.005	0.001	0.0005	0.0005	0.0005	0.01	0.01	0.01	0.0005	0.0002
Max		0.017	0.18	0.0054	0.0005	0.024	0.0982	0.001	0.0112	0.0008	0.07	0.08	0.01	0.007	0.0002
Run A RP?		No	No	No	No	No	YES	No	No	No	No	No	No	No	No
Run C RP?		No	No	No	YES	No	YES	No	No	No	No	No	No	YES	No

Step #1 RP Screen

Metals, ug/L		Effluent RP Screening												
Metal		Cyanide	Iron	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc	Aluminum	Molybdenum	Selenium	Mercury
ARP Val		1	1.34483	0.13457	0.00886	0.1349	0.05319	0.28400	1.6168	0.02903	0.41017	1.01562	1	0.02446	1
CRP Val		1	1	0.2181	0.00089	1	0.03522	0.01936	0.19776	1	0.44604	1	1	0.00613	1
2009	Sum	ND	0.003	0.0041	ND	ND	0.0111	0.001	0.0059	ND	0.06	ND	ND	0.0013	ND
	Fall	ND	0.18	0.0039	ND	ND	0.0133	0.0009	0.007	ND	0.06	0.02	ND	0.0015	ND
2010	Win	ND	ND	0.0025	ND	ND	0.0103	ND	0.0065	ND	0.06	ND	ND	0.0017	ND
	Spr	ND	0.03	0.0024	ND	ND	0.0104	ND	0.0089	ND	0.07	ND	ND	0.002	ND
	Sum	ND	0.04	0.0041	ND	ND	0.0151	ND	0.0051	ND	0.05	ND	ND	0.0018	ND
	Fall	ND	0.05	0.003	ND	ND	0.0099	ND	0.0069	ND	0.05	ND	ND	0.0011	ND
2011	Win	ND	0.03	0.0035	ND	ND	0.0135	ND	0.0051	ND	0.06	0.05	ND	0.0023	ND
	Spr	ND	0.04	ND	ND	ND	0.0982	ND	0.0054	ND	0.01	ND	ND	ND	ND
	Sum	ND	ND	0.0042	ND	0.024	0.0335	0.001	0.0077	0.0008	0.05	ND	ND	0.007	ND
	Fall	ND	0.03	0.0033	ND	ND	0.0131	ND	0.0077	ND	0.05	ND	ND	0.0023	ND
2012	Win	ND	ND	0.0037	ND	ND	0.0072	ND	0.007	ND	0.06	ND	ND	0.0042	ND
	Spr	ND	0.1	0.004	ND	ND	0.0093	0.0006	0.0056	ND	0.06	ND	ND	0.0027	ND
	Sum	ND	ND	0.0054	ND	ND	0.0081	ND	0.0112	ND	0.05	ND	ND	0.0044	ND
	Fall	0.017	0.03	0.0037	ND	ND	0.0096	ND	0.0099	ND	0.05	ND	ND	0.0034	ND
2013	Win	ND	0.03	0.0028	ND	ND	0.0078	ND	0.0052	ND	0.06	ND	ND	0.003	ND
	Spr	ND	ND	0.0027	ND	ND	0.006	ND	ND	ND	0.03	ND	ND	ND	ND
	Sum	0.002	0.05	0.0048	ND	ND	0.0099	0.0006	0.0046	ND	0.05	0.06	ND	0.0024	ND
	Fall	ND	0.03	0.0036	ND	ND	0.0072	ND	0.0064	ND	0.06	0.08	ND	0.0024	ND
14	Win	ND	ND	0.0025	ND	ND	0.0055	ND	0.0039	ND	0.05	ND	ND	0.0019	ND
ND Value		0.002	0.02	0.0005	0.0005	0.005	0.001	0.0005	0.0005	0.0005	0.01	0.01	0.01	0.0005	0.0002
Max		0.017	0.18	0.0054	0.0005	0.024	0.0982	0.001	0.0112	0.0008	0.07	0.08	0.01	0.007	0.0002
Run A RP?		No	No	No	No	No	YES	No	No	No	No	No	No	No	No
Run C RP?		No	No	No	YES	No	YES	No	No	No	No	No	No	YES	No

Reasonable Potential Analysis

1. Calculate Coefficient of Variance (CV) from data set
2. Using CV and number of samples, calculate acute and chronic multiplier
3. Multiply highest reported value by multiplier to get Maximum Estimated Pollutant Concentration (MEC) for acute and chronic
4. Compare $MAC_{a\&c}$ to $MEC_{a\&c}$
5. 1 of 4 Possible Outcomes for Reasonable Potential

Reasonable Potential Multiplication Factor for Acute

Reasonable Potential Multiplying Factors: 95% Confidence Limit and 95% Probability Basis

Number of Samples	Coefficient of Variation																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
1	1.4	1.9	2.6	3.6	4.7	6.2	8	10.1	12.6	15.5	18.7	22.3	26.4	30.8	35.6	40.7	46.2	52.1	58.4	64.9
2	1.3	1.6	2	2.5	3.1	3.8	4.6	5.4	6.4	7.4	8.5	9.7	10.9	12.2	13.6	15	16.4	17.9	19.5	21.1
3	1.2	1.5	1.8	2.1	2.5	3	3.5	4	4.6	5.2	5.8	6.5	7.2	7.9	8.6	9.3	10	10.8	11.5	12.3
4	1.2	1.4	1.7	1.9	2.2	2.6	2.9	3.3	3.7	4.2	4.6	5	5.5	6	6.4	6.9	7.4	7.8	8.3	8.8
5	1.2	1.4	1.6	1.8	2.1	2.3	2.6	2.9	3.2	3.6	3.9	4.2	4.5	4.9	5.2	5.6	5.9	6.2	6.6	6.9
6	1.1	1.3	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.4	3.7	3.9	4.2	4.5	4.7	5	5.2	5.5	5.7
7	1.1	1.3	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9
8	1.1	1.3	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	2.8	3	3.2	3.3	3.5	3.7	3.9	4	4.2	4.3
9	1.1	1.2	1.4	1.5	1.7	1.8	2	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.2	3.4	3.5	3.6	3.8	3.9
10	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2	2.2	2.3	2.4	2.6	2.7	2.8	3	3.1	3.2	3.3	3.4	3.6
11	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3	3.1	3.2	3.3
12	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3
13	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.4	2.5	2.5	2.6	2.7	2.8	2.9
14	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.6	2.7
15	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5
16	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2	2.1	2.1	2.2	2.3	2.3	2.4	2.4
17	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2	2	2.1	2.2	2.2	2.3	2.3
18	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2	2	2.1	2.1	2.2	2.2
19	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9	2	2	2	2.1	2.1
20	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	2	2	2
40	1	1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Reasonable Potential Multiplication Factor for Chronic

Table 3-1 Reasonable Potential Multiplying Factors: 99% Confidence Limit and 99% Probability Basis

Number of Samples	Coefficient of Variation																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
1	1.6	2.5	3.9	6	9	13.2	18.9	26.5	36.2	48.3	63.3	81.4	102.8	128	157.1	190.3	227.8	269.9	316.7	368.3
2	1.4	2	2.9	4	5.5	7.4	9.8	12.7	16.1	20.2	24.9	30.3	36.3	43	50.4	58.4	67.2	76.6	86.7	97.5
3	1.4	1.9	2.5	3.3	4.4	5.6	7.2	8.9	11	13.4	16	19	22.2	25.7	29.4	33.5	37.7	42.3	47	52
4	1.3	1.7	2.3	2.9	3.8	4.7	5.9	7.2	8.7	10.3	12.2	14.2	16.3	18.6	21	23.6	26.3	29.1	32.1	35.1
5	1.3	1.7	2.1	2.7	3.4	4.2	5.1	6.2	7.3	8.6	10	11.5	13.1	14.8	16.6	18.4	20.4	22.4	24.5	26.6
6	1.3	1.6	2	2.5	3.1	3.8	4.6	5.5	6.4	7.5	8.6	9.8	11.1	12.4	13.8	15.3	16.8	18.3	19.9	21.5
7	1.3	1.6	2	2.4	2.9	3.6	4.2	5	5.8	6.7	7.7	8.7	9.7	10.8	12	13.1	14.4	15.6	16.9	18.2
8	1.2	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.3	6.1	6.9	7.8	8.7	9.6	10.6	11.6	12.6	13.6	14.7	15.8
9	1.2	1.5	1.8	2.2	2.7	3.2	3.7	4.3	5	5.7	6.4	7.1	7.9	8.7	9.6	10.4	11.3	12.2	13.1	14
10	1.2	1.5	1.8	2.2	2.6	3	3.5	4.1	4.7	5.3	5.9	6.6	7.3	8	8.8	9.5	10.3	11	11.8	12.6
11	1.2	1.5	1.8	2.1	2.5	2.9	3.4	3.9	4.4	5	5.6	6.2	6.8	7.4	8.1	8.8	9.4	10.1	10.8	11.5
12	1.2	1.4	1.7	2	2.4	2.8	3.2	3.7	4.2	4.7	5.2	5.8	6.4	7	7.5	8.1	8.8	9.4	10	10.6
13	1.2	1.4	1.7	2	2.3	2.7	3.1	3.6	4	4.5	5	5.5	6	6.5	7.1	7.6	8.2	8.7	9.3	9.9
14	1.2	1.4	1.7	2	2.3	2.6	3	3.4	3.9	4.3	4.8	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2
15	1.2	1.4	1.6	1.9	2.2	2.6	2.9	3.3	3.7	4.1	4.6	5	5.4	5.9	6.4	6.8	7.3	7.7	8.2	8.7
16	1.2	1.4	1.6	1.9	2.2	2.5	2.9	3.2	3.6	4	4.4	4.8	5.2	5.6	6.1	6.5	6.9	7.3	7.8	8.2
17	1.2	1.4	1.6	1.9	2.1	2.5	2.8	3.1	3.5	3.8	4.2	4.6	5	5.4	5.8	6.2	6.6	7	7.4	7.8
18	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3	3.4	3.7	4.1	4.4	4.8	5.2	5.6	5.9	6.3	6.7	7	7.4
19	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3	3.3	3.6	4	4.3	4.6	5	5.3	5.7	6	6.4	6.7	7.1
20	1.2	1.3	1.6	1.8	2	2.3	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.8	5.2	5.5	5.8	6.1	6.5	6.8
30	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9
40																				
60	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3	3

4 Possible Outcomes From RP Analysis

Outcome A- If the MEC is greater than the MAC at a 95% CL (acute), an effluent limitation will be placed in the permit.

Outcome B- If the MEC is greater than the MAC at 99% CL (chronic), then no limitation should be placed in the permit unless a need is indicated by the criteria in the qualitative analysis portion of this document. Routine monitoring requirements will be placed in the permit as outlined in DWQ's monitoring frequency guidelines.

Outcome C- If the MEC is greater than 50% of the MAC at the 99% CL, then no limitation should be placed in the permit unless routine monitoring requirements will be placed in the permit as outlined in DWQ's monitoring frequency guidelines.

Outcome D- If the MEC is less than 50% of the MAC, then no limitation or routine monitoring requirements should be placed in the permit unless a need is indicated by the criteria in the qualitative analysis portion of this document.

(MAC- maximum allowable pollutant concentration)

(MEC- maximum estimated pollution concentration)

Qualitative Evaluation

1- There are intermittent changes in pollutant concentrations in amounts that could effect the outcome of the RP determination but that, due to timing of sampling, are not reflected in the RP data.

2- Before the next permit renewal, planned growth, planned additions of industrial users, or other foreseeable conditions are expected to increase pollutant concentrations.

3- The effluent may plausibly contain pollutants whose maximum allowable pollutant concentration is below the PQL (practical quantitation limit- also known as method detection limit MDL).

Copper Results

RP Procedure Output		Effluent Data	
Facility Name:	South Valley	#	
Permit Number:	UT0024384	1	0.0011
Outfall Number:	1	2	0.0009
Parameter	Copper	3	0.013
Distribution	Lognormal	4	0.014
Data Units	mg/L	5	0.006
Reporting Limit	0.0001	6	0.037
Significant Figures	3	7	0.011
Confidence Interval	95	8	0.02
		9	0.012
Maximum Reported Effluent Conc	0.037	10	0.009
Coeffficient of Variance (CV)	0.772	11	0.011
RP Multiplier	1.15	12	0.01
Projected Maximum Effluent Conc (MEC)	0.0424	13	0.017
		14	0.012
Acute Criterion? (MAC_{95})	0.055 *	15	0.0111
Chronic Criterion?	0.0436 *	16	0.0133
Human Health Criterion?	0	17	0.0103
		18	0.0104
RP for Acute?	NO	19	0.0151
RP for Chronic?	NO	20	0.0099
RP for Humna Health?	N/A	21	0.0135
		22	0.0335
Confidence Interval	99	23	0.0131
		24	0.0072
Maximum Reported Effluent Conc	0.037	25	0.0093
Coeffficient of Variance (CV)	0.772	26	0.0081
RP Multiplier	2.13	27	0.0096
Projected Maximum Effluent Conc (MEC)	0.0789	28	0.0078
		29	0.006
Acute Criterion?	0.055 *	30	0.0099
Chronic Criterion? (MAC_{99})	0.0436 *	31	0.0072
Human Health Criterion?	0	32	0.0055
		33	0.0055
RP for Acute?	YES	34	0.0084
RP for Chronic?	YES	35	0.0067
RP for Humna Health?	N/A	36	0.0052
		37	0.0048
Pro UCL ran on data to find outlier	Outcome B	38	0.0064
Outlier removed		39	0.0076
Spring 2011, 0.0982 mg/L		40	0

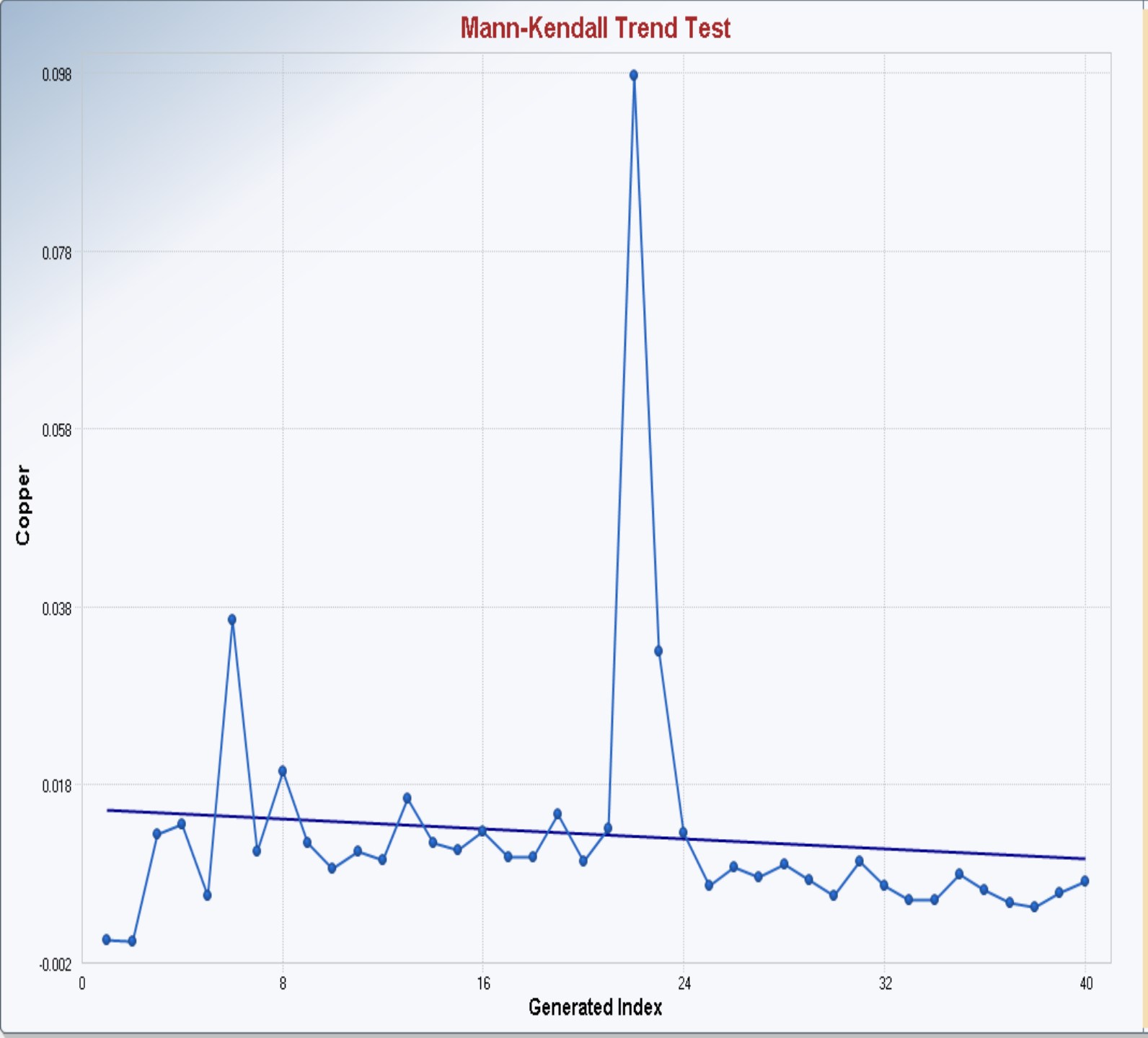
* Copper value adjusted for hardness.

Selenium Results

RP Procedure Output		Effluent Data	
Facility Name:	South Valley	#	
Permit Number:	UT0024384	1	0.0024
Outfall Number:	1	2	0.0019
Parameter	Selenium	3	0.002
Distribution	Lognormal	4	0.0011
Data Units	mg/L	5	0.0021
Reporting Limit	0.0005	6	0.0038
Significant Figures	3	7	0.0027
Confidence Interval	95	8	0.0022
		9	0.0034
Maximum Reported Effluent Conc	0.0044	10	0.0019
Coeffficient of Variance (CV)	0.482	11	0.0027
RP Multiplier	1.1	12	0.0015
Projected Maximum Effluent Conc (MEC)	0.00482	13	0.0017
		14	0.0021
Acute Criterion? (MAC_{95})	0.0253	15	0.0013
Chronic Criterion?	0.0076	16	0.0015
Human Health Criterion?	0	17	0.0017
		18	0.002
RP for Acute?	NO	19	0.0018
RP for Chronic?	NO	20	0.0011
RP for Humna Health?	N/A	21	0.0023
		22	0.0005
Confidence Interval	99	23	0.0023
		24	0.0042
Maximum Reported Effluent Conc	0.0044	25	0.0027
Coeffficient of Variance (CV)	0.482	26	0.0044
RP Multiplier	1.66	27	0.0034
Projected Maximum Effluent Conc (MEC)	0.0073	28	0.003
		29	0.0005
Acute Criterion?	0.0253	30	0.0024
Chronic Criterion? (MAC_{99})	0.0076	31	0.0024
Human Health Criterion?	0	32	0.0019
		33	0.0018
RP for Acute?	NO	34	0.002
RP for Chronic?	Yes	35	0.002
RP for Humna Health?	N/A	36	0.0018
		37	0.0021
Pro UCL ran on data to find outlier	Outcome C	38	0.0026
Outlier removed		39	0.0029
Summer 2011, 0.007 mg/L		40	0

Identify Outliers Using Pro UCL

- Pro UCL Version 5.0.00
- Created for EPA by Lockheed Martin
- Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations
- Free
- Easily downloaded from EPA Website
  - www.epa.gov/land-research/proucl-software
- User Guide EPA/600/R-07-041
- Some functionality of Excel
- Handles Excel spreadsheets



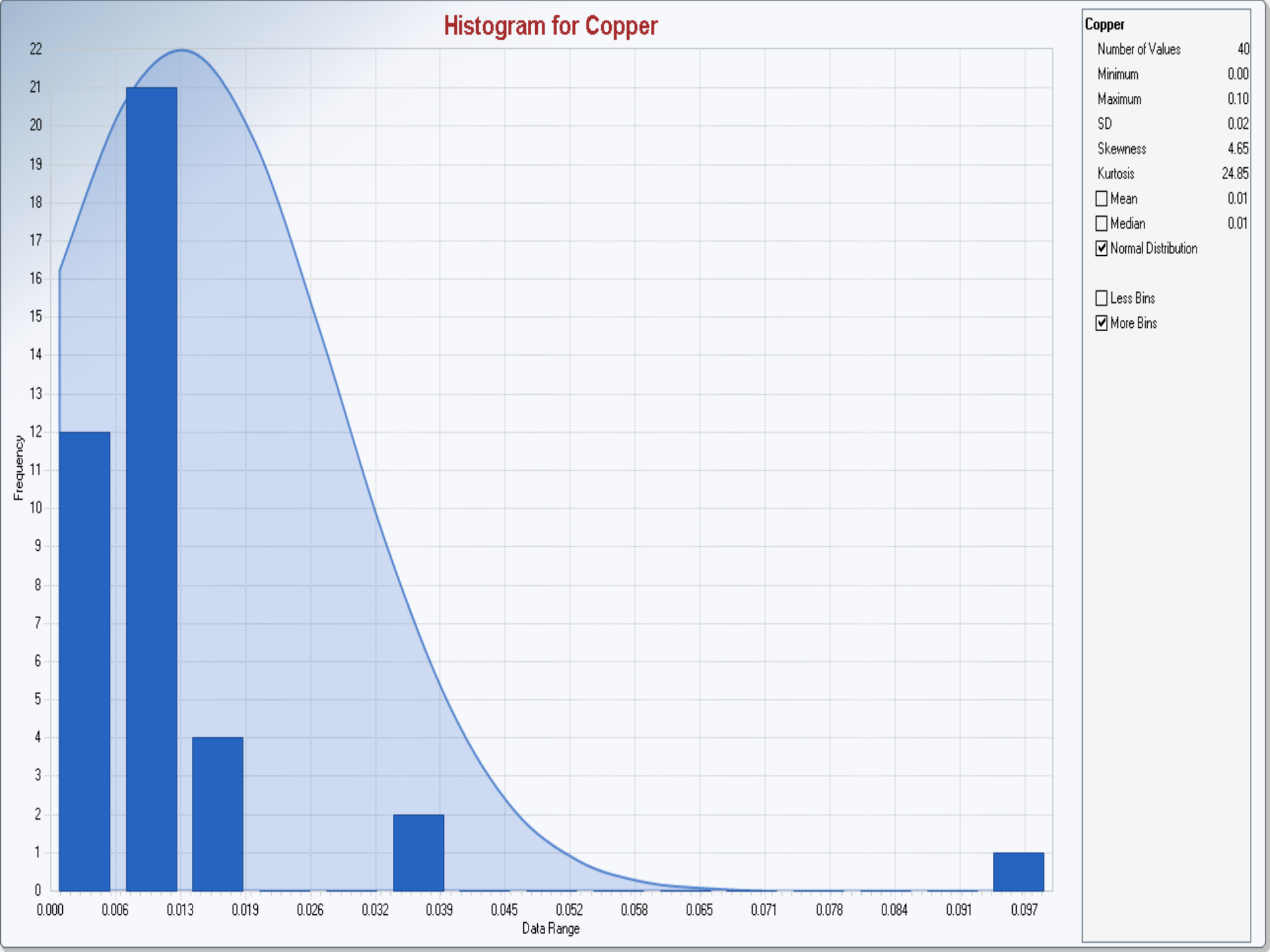
Mann-Kendall Trend Analysis

n	40
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	85.7943
Standardized Value of S	-3.0888
Test Value (S)	-266
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0010

OLS Regression Line (Blue)

OLS Regression Slope	-0.0001
OLS Regression Intercept	0.0158

Statistically significant evidence of a decreasing trend at the specified level of significance.


Histogram for Copper
Frequency
Data Range
0.000
0.006
0.013
0.019
0.026
0.032
0.039
0.045
0.052
0.058
0.065
0.071
0.078
0.084
0.091
0.097
Copper
Number of Values 40
Minimum 0.00
Maximum 0.10
SD 0.02
Skewness 4.65
Kurtosis 24.85
Mean 0.01
Median 0.01
Normal Distribution
Less Bins
More Bins

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation 4/19/2016 10:01:53 AM

From File Copper & Selenium & Cyanide 2006 - 2015.xls

Full Precision OFF

Rosner's Outlier Test for Copper

Mean	**0.0129**
Standard Deviation	**0.0154**
Number of data	**40**
Number of suspected outliers	**3**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.0129	0.0152	0.0982	22	5.591	3.04	3.38
2	0.0108	0.00697	0.037	6	3.766	3.03	3.37
3	0.0101	0.00555	0.0335	23	4.224	3.01	3.36

For 5% significance level, there are 3 Potential Outliers

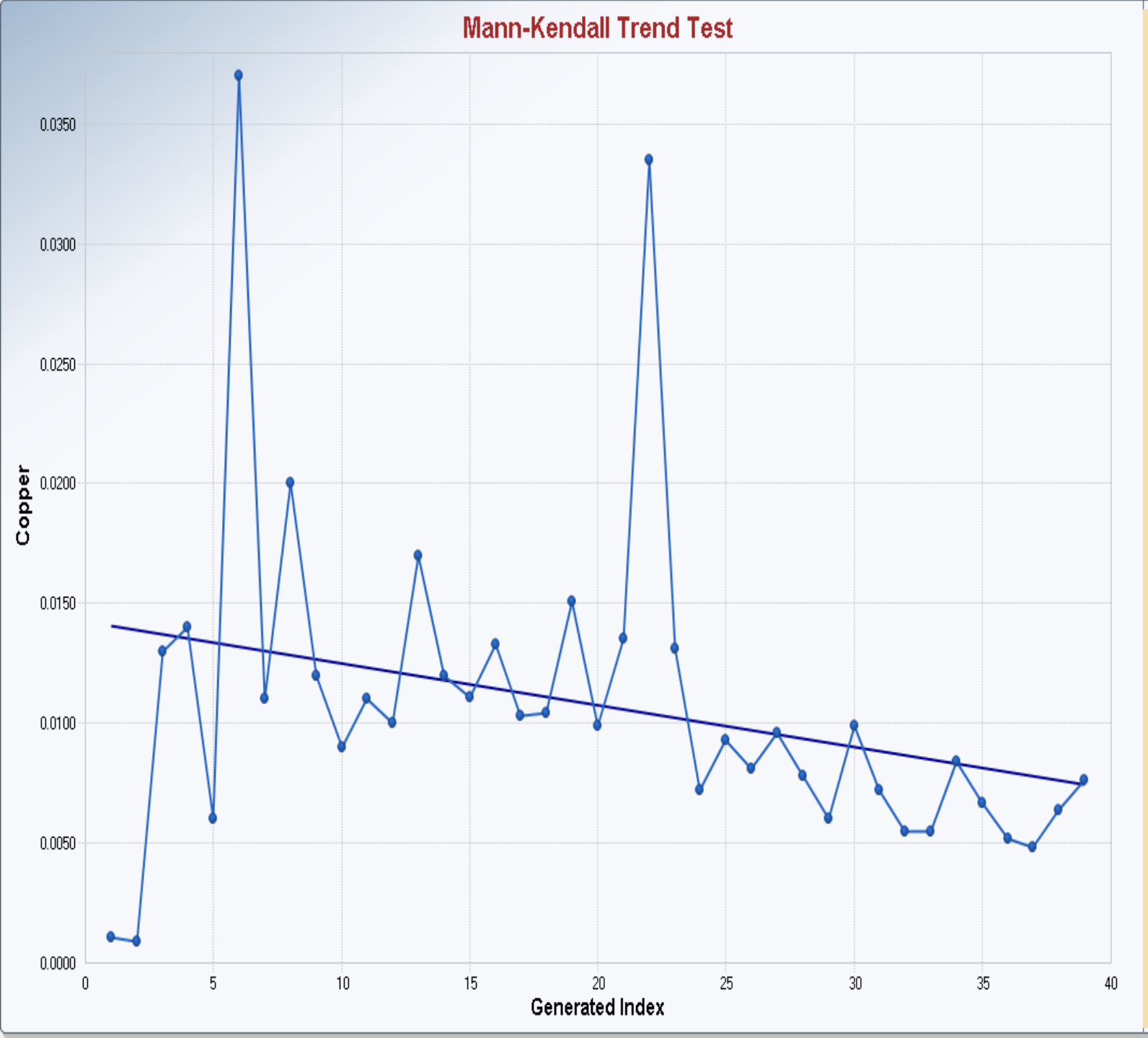
Potential outliers are:

0.0982, 0.037, 0.0335

For 1% Significance Level, there are 3 Potential Outliers

Potential outliers are:

0.0982, 0.037, 0.0335



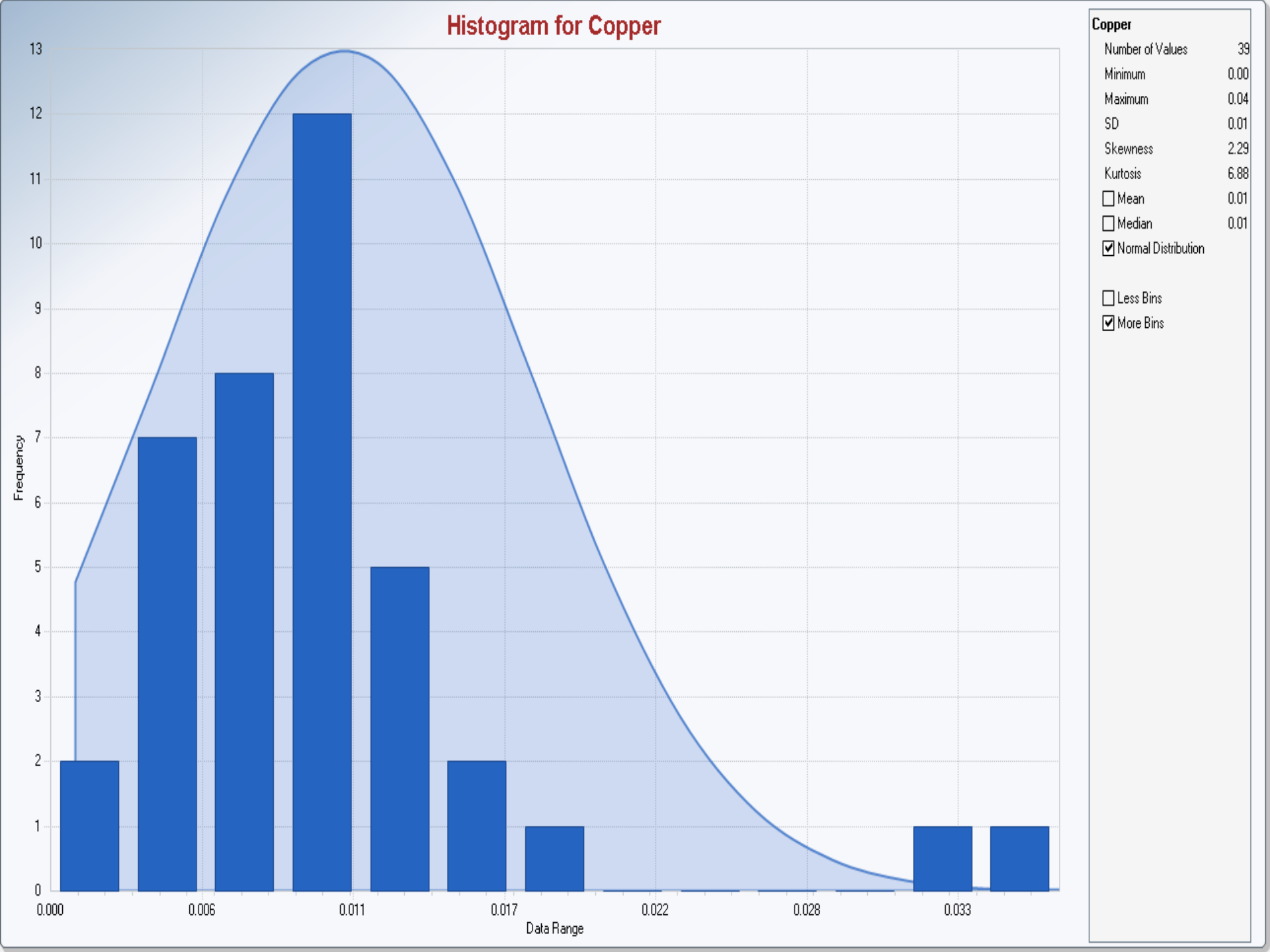
Mann-Kendall Trend Analysis

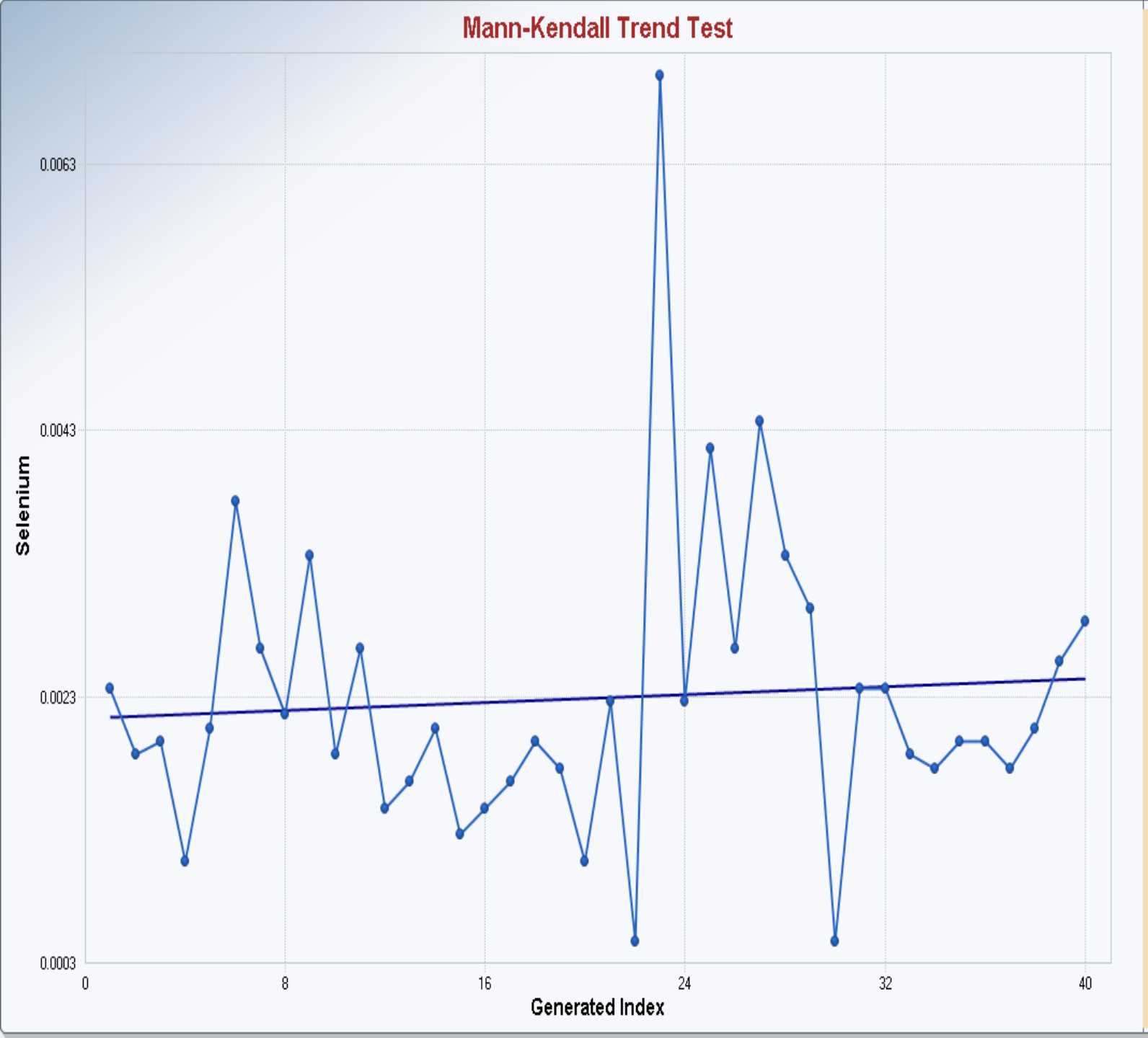
n	39
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	82.6297
Standardized Value of S	-3.2434
Test Value (S)	-269
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0006

OLS Regression Line (Blue)

OLS Regression Slope	-0.0002
OLS Regression Intercept	0.0142

Statistically significant evidence of a decreasing trend at the specified level of significance.


Histogram for Copper
Frequency
Data Range
0.000
0.006
0.011
0.017
0.022
0.028
0.033
Copper
Number of Values 39
Minimum 0.00
Maximum 0.04
SD 0.01
Skewness 2.29
Kurtosis 6.88
Mean 0.01
Median 0.01
Normal Distribution
Less Bins
More Bins



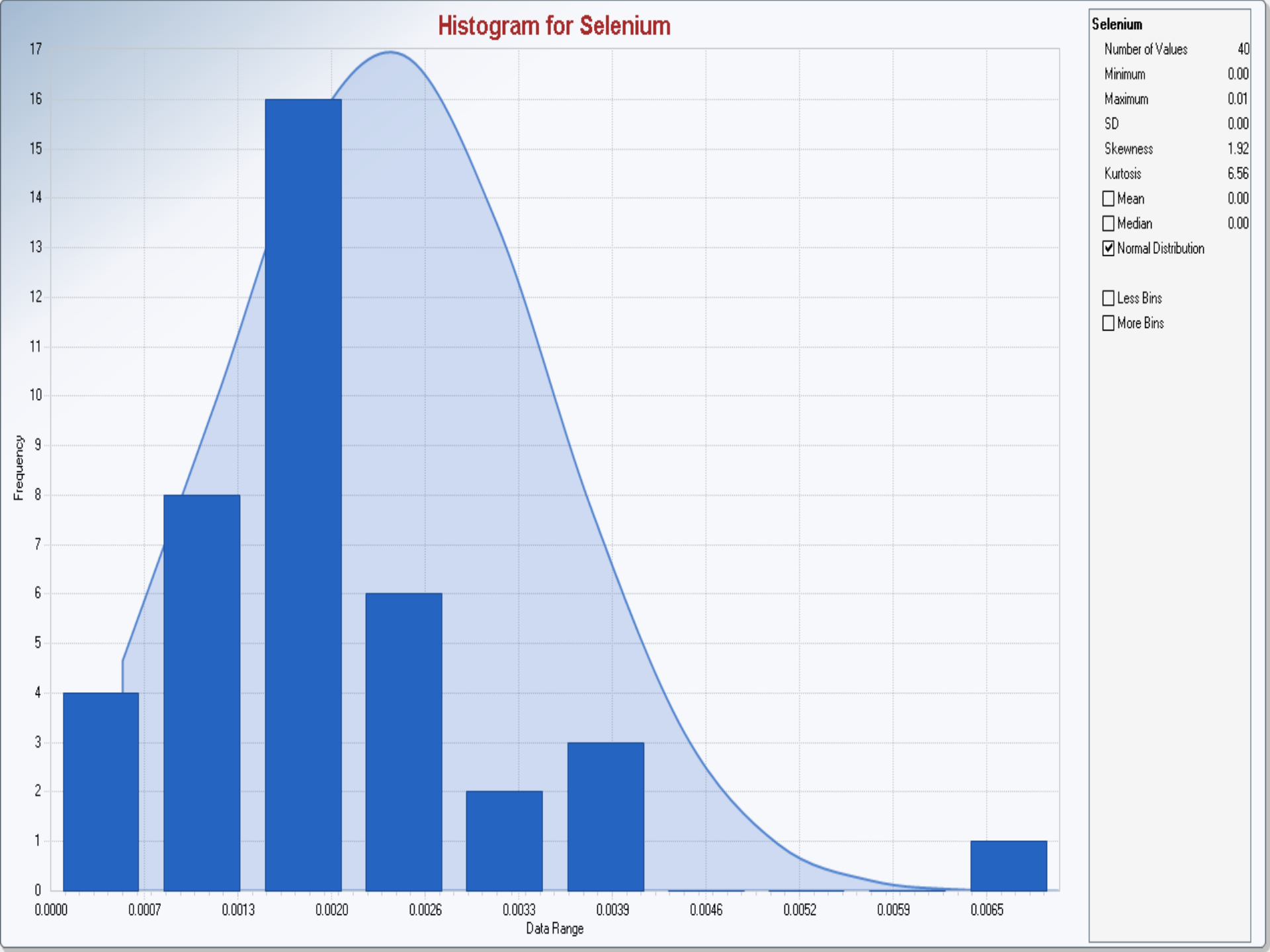
Mann-Kendall Trend Analysis

n	40
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	85.6368
Standardized Value of S	0.5372
Test Value (S)	47
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.2956

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0022

Insufficient statistical evidence of a significant trend at the specified level of significance.


Histogram for Selenium
Frequency
Data Range
0.0000
0.0007
0.0013
0.0020
0.0026
0.0033
0.0039
0.0046
0.0052
0.0059
0.0065
Selenium
Number of Values 40
Minimum 0.00
Maximum 0.01
SD 0.00
Skewness 1.92
Kurtosis 6.56
Mean 0.00
Median 0.00
Normal Distribution
Less Bins
More Bins

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation 4/19/2016 10:04:18 AM

From File Copper & Selenium & Cyanide 2006 - 2015.xls

Full Precision OFF

Rosner's Outlier Test for Selenium

Mean	**0.00233**
Standard Deviation	**0.00114**
Number of data	**40**
Number of suspected outliers	**3**

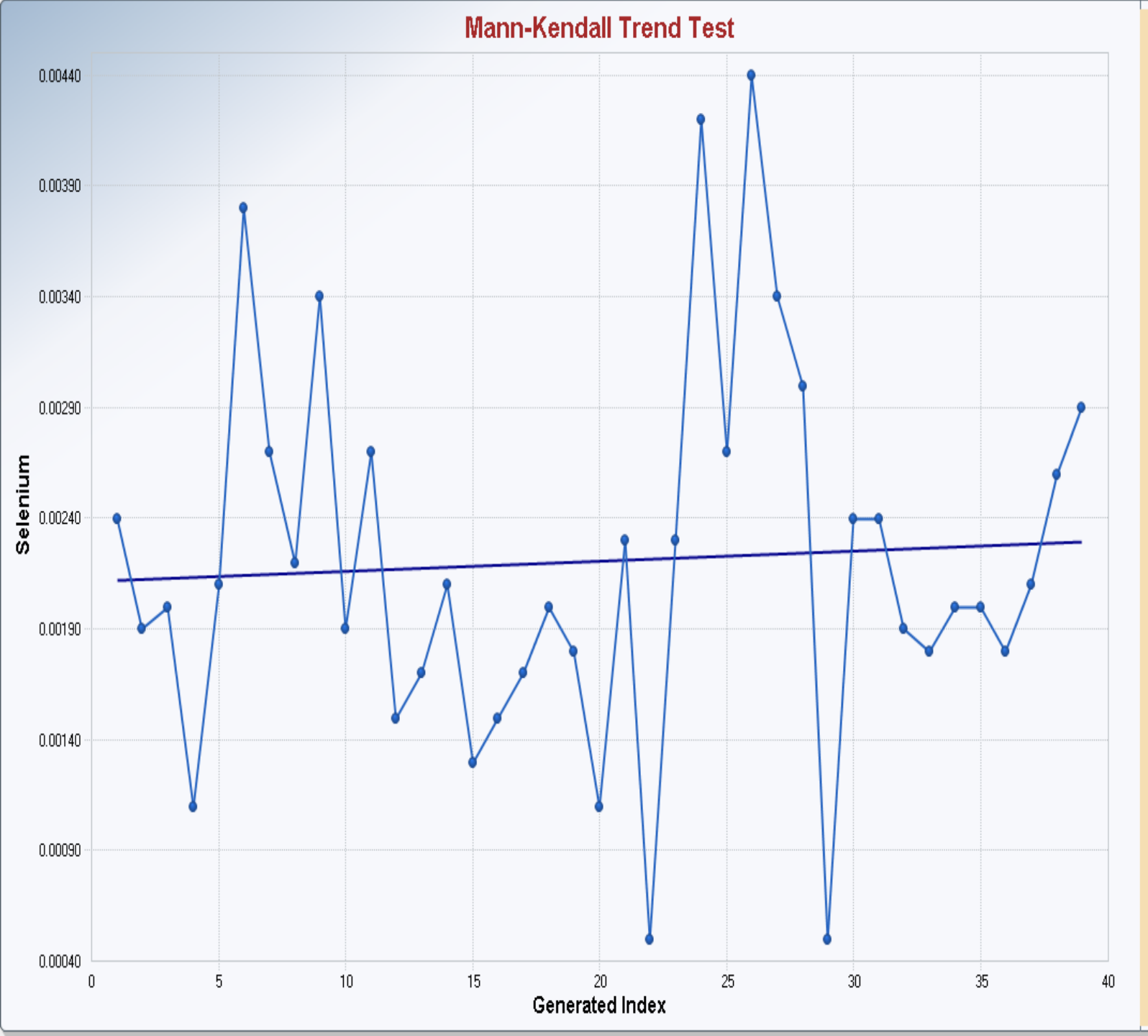
#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.00233	0.00112	0.007	23	4.168	3.04	3.38
2	0.00221	8.5667E-4	0.0044	27	2.559	3.03	3.37
3	0.00215	7.8766E-4	0.0042	25	2.603	3.01	3.36

For 5% Significance Level, there is 1 Potential Outlier

Potential outliers is: 0.007

For 1% Significance Level, there is 1 Potential Outlier

Potential outliers is: 0.007



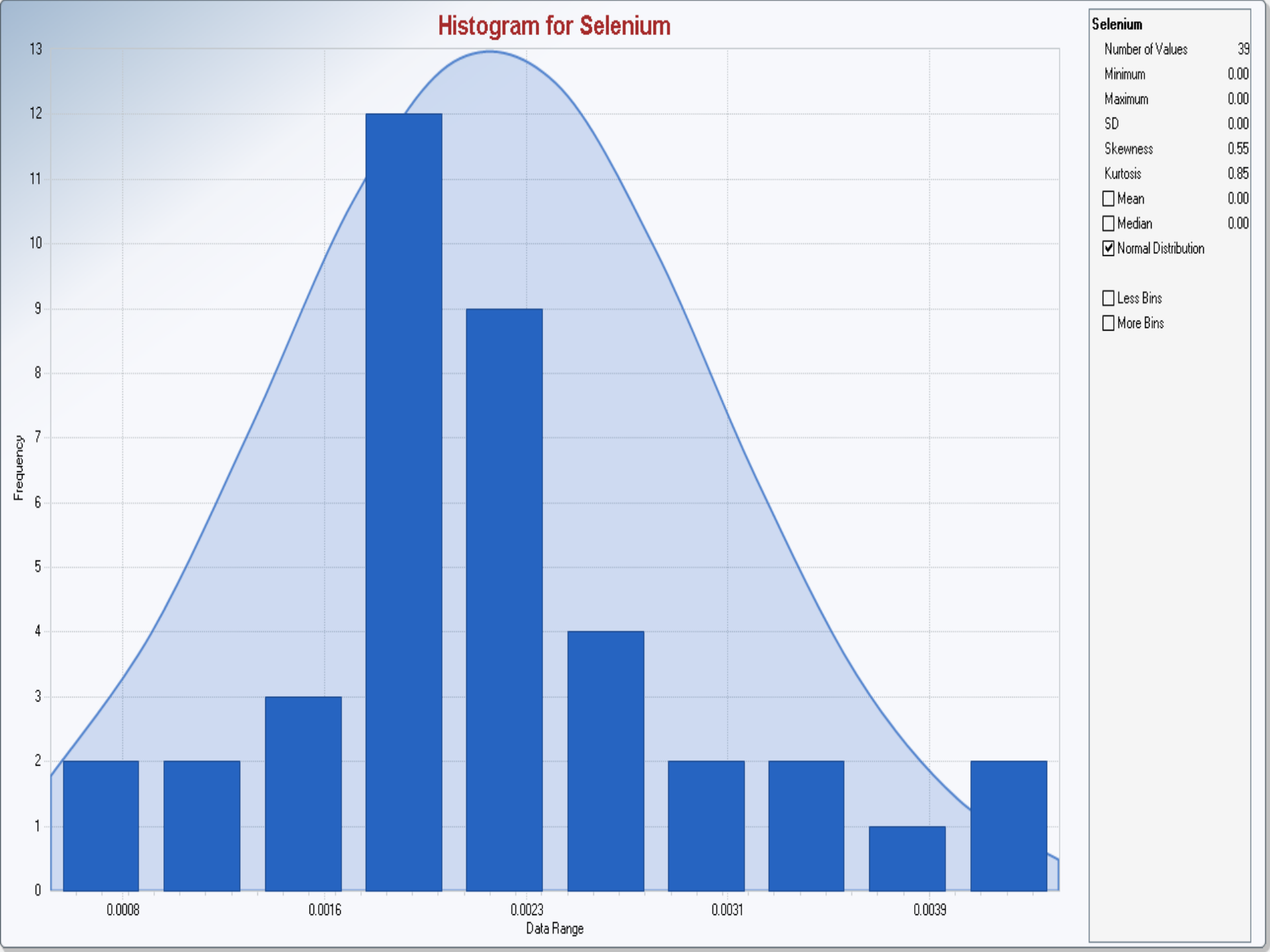
Mann-Kendall Trend Analysis

n	39
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	82.4662
Standardized Value of S	0.4972
Test Value (S)	42
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.3095

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0021

Insufficient statistical evidence of a significant trend at the specified level of significance.


Histogram for Selenium
Frequency
Data Range
0.0008
0.0016
0.0023
0.0031
0.0039
Selenium
Number of Values 39
Minimum 0.00
Maximum 0.00
SD 0.00
Skewness 0.55
Kurtosis 0.85
Mean 0.00
Median 0.00
Normal Distribution
Less Bins
More Bins

General Statistics on Uncensored Full Data

Date/Time of Computation 4/19/2016 10:13:13 AM

User Selected Options

From File Copper & Selenium & Cyanide 2006 - 2015.xls

Full Precision OFF

From File: Copper & Selenium & Cyanide 2006 - 2015.xls

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	SD	SEM	MAD/0.675	Skewness	Kurtosis	CV
Copper	40	0	9.0000E-4	0.0982	0.0129	0.0154	0.00244	0.00467	4.655	24.85	1.193
Selenium	40	0	5.0000E-4	0.007	0.00233	0.00114	1.7953E-4	5.9303E-4	1.924	6.556	0.488
Cyanide	40	0	0.002	0.017	0.00295	0.00287	4.5425E-4	0	3.836	15.88	0.974

General Statistics on Uncensored Full Data

Date/Time of Computation 4/19/2016 10:11:52 AM

User Selected Options

From File Copper & Selenium & Cyanide 2006 - 2015.xls

Full Precision OFF

From File: Copper & Selenium & Cyanide 2006 - 2015.xls

General Statistics for Uncensored Data Sets

Variable	NumObs	# Missing	Minimum	Maximum	Mean	SD	SEM	MAD/0.675	Skewness	Kurtosis	CV
Copper	39	1	9.0000E-4	0.037	0.0108	0.00697	0.00112	0.0046	2.293	6.881	0.648
Selenium	39	1	5.0000E-4	0.0044	0.00221	8.5667E-4	1.3718E-4	5.9303E-4	0.548	0.845	0.388
Cyanide	39	1	0.002	0.011	0.00259	0.00177	2.8389E-4	0	3.622	14.08	0.685

Effective Changes of Removing 1 Outlier

Metal	Highest Value	CV Before	Multiplier Before	MEC Before	Next Highest Value	CV After	Multiplier After	MEC After
Acute MEC								
Copper	0.0982	1.193	1.2	0.118	0.037	0.648	1.1	0.0407
Selenium	0.007	0.488	1.1	0.0077	0.0044	0.388	1.1	0.0048
Cyanide	0.017	0.974	1.2	0.024	0.005	0.685	1.1	0.0055
Chronic MEC								
Copper	0.0982	1.193	2.13	0.2092	0.037	0.648	2.13	0.0788
Selenium	0.007	0.488	1.66	0.0116	0.0044	0.388	1.66	0.0073
Cyanide	0.017	0.974	1.25	0.0213	0.005	0.685	1.25	0.0063

Changes to Permit

Metal	MEC Before	MAC	Results Before	MEC After	Results After
Acute					
Copper	0.118	0.055	Outcome A Permit Limit	0.0407	No Limit
Selenium	0.0077	0.0253	No Limit	0.0048	No Limit
Cyanide	0.024	0.035	No Limit	0.0055	No Limit
Chronic					
Copper	0.2092	0.0436	Outcome B + Monitoring	0.0788	Outcome B + Monitoring
Selenium	0.0116	0.0076	Outcome B + Monitoring	0.0073	Outcome C + Monitoring
Cyanide	0.0213	0.0114	Outcome B + Monitoring	0.0063	Outcome C + Monitoring

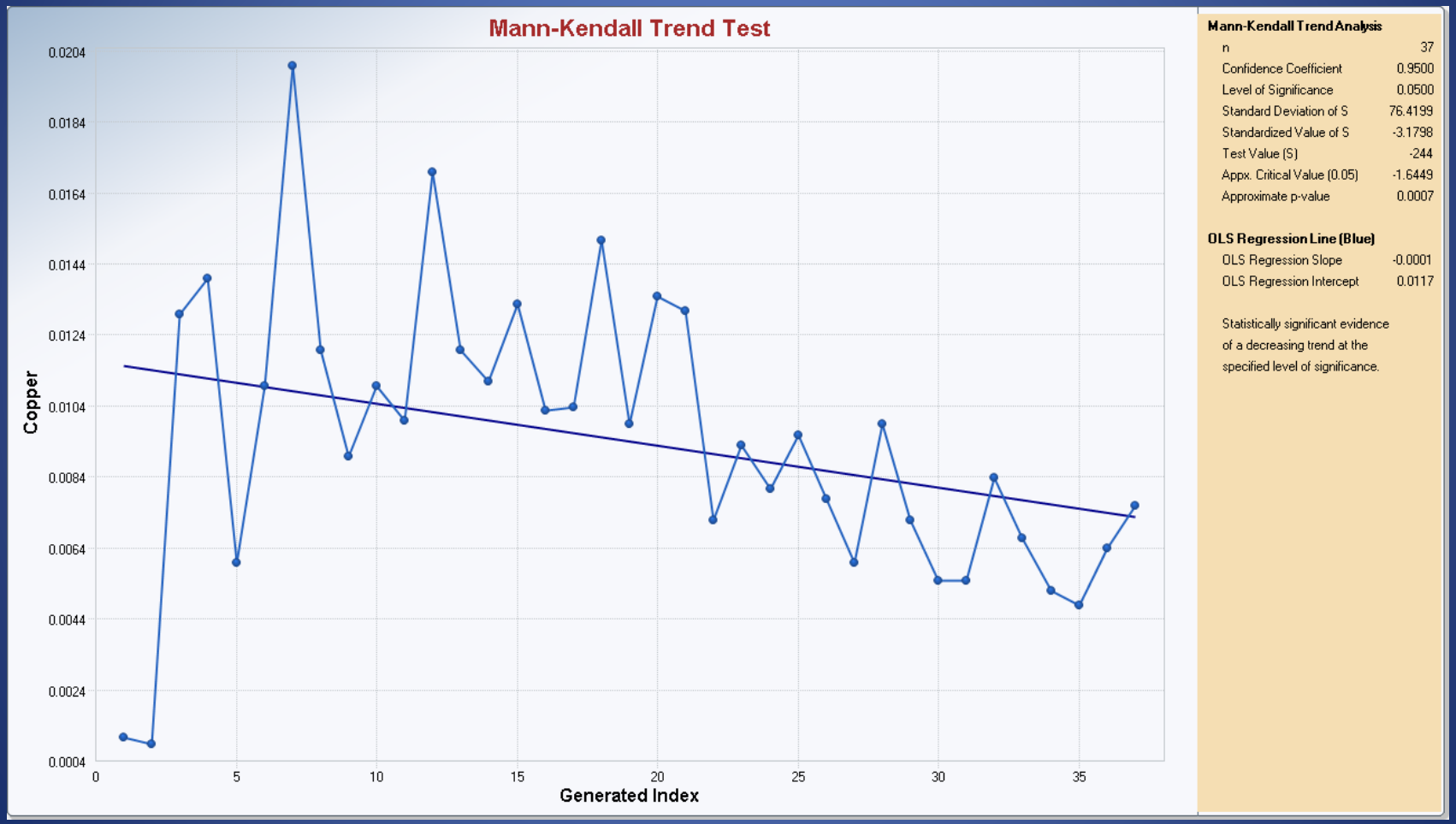
Why a Permit Change for Mercury But Not Cadmium

Effluent RP Screening														
Metal		Cyanide	Iron	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc	Aluminum	Molybdenum	Selenium	Mercury
ARP Val		1	1.34483	0.13457	0.00886	0.13493	0.05319	0.2840	1.6168	0.02903	0.41017	1.01562	1	0.02446	1
CRP Val		1	1	0.2181	0.00089	1	0.03522	0.0193	0.1977	1	0.44604	1	1	0.00613	1
2009	Sum	ND	0.003	0.0041	ND	ND	0.0111	0.001	0.0059	ND	0.06	ND	ND	0.0013	ND
	Fall	ND	0.18	0.0039	ND	ND	0.0133	0.0009	0.007	ND	0.06	0.02	ND	0.0015	ND
2010	Win	ND	ND	0.0025	ND	ND	0.0103	ND	0.0065	ND	0.06	ND	ND	0.0017	ND
	Spr	ND	0.03	0.0024	ND	ND	0.0104	ND	0.0089	ND	0.07	ND	ND	0.002	ND
	Sum	ND	0.04	0.0041	ND	ND	0.0151	ND	0.0051	ND	0.05	ND	ND	0.0018	ND
	Fall	ND	0.05	0.003	ND	ND	0.0099	ND	0.0069	ND	0.05	ND	ND	0.0011	ND
2011	Win	ND	0.03	0.0035	ND	ND	0.0135	ND	0.0051	ND	0.06	0.05	ND	0.0023	ND
	Spr	ND	0.04	ND	ND	ND		ND	0.0054	ND	0.01	ND	ND	ND	ND
	Sum	ND	ND	0.0042	ND	0.024	0.0335	0.001	0.0077	0.0008	0.05	ND	ND		ND
	Fall	ND	0.03	0.0033	ND	ND	0.0131	ND	0.0077	ND	0.05	ND	ND	0.0023	ND
2012	Win	ND	ND	0.0037	ND	ND	0.0072	ND	0.007	ND	0.06	ND	ND	0.0042	ND
	Spr	ND	0.1	0.004	ND	ND	0.0093	0.0006	0.0056	ND	0.06	ND	ND	0.0027	ND
	Sum	ND	ND	0.0054	ND	ND	0.0081	ND	0.0112	ND	0.05	ND	ND	0.0044	ND
	Fall	0.017	0.03	0.0037	ND	ND	0.0096	ND	0.0099	ND	0.05	ND	ND	0.0034	ND
2013	Win	ND	0.03	0.0028	ND	ND	0.0078	ND	0.0052	ND	0.06	ND	ND	0.003	ND
	Spr	ND	ND	0.0027	ND	ND	0.006	ND	ND	ND	0.03	ND	ND	ND	ND
	Sum	0.002	0.05	0.0048	ND	ND	0.0099	0.0006	0.0046	ND	0.05	0.06	ND	0.0024	ND
	Fall	ND	0.03	0.0036	ND	ND	0.0072	ND	0.0064	ND	0.06	0.08	ND	0.0024	ND
14	Win	ND	ND	0.0025	ND	ND	0.0055	ND	0.0039	ND	0.05	ND	ND	0.0019	ND
ND Value		0.002	0.02	0.0005	0.0005	0.005	0.001	0.0005	0.0005	0.0005	0.01	0.01	0.01	0.0005	0.0002
Max		0.017	0.18	0.0054	0.0005	0.024	0.0335	0.001	0.0112	0.0008	0.07	0.08	0.01	0.0044	0.0002
Run A RP?		No	No	No	No	No	No	No	No	No	No	No	No	No	No
Run C RP?		No	No	No	YES	No	YES	No	No	No	No	No	No	No	No

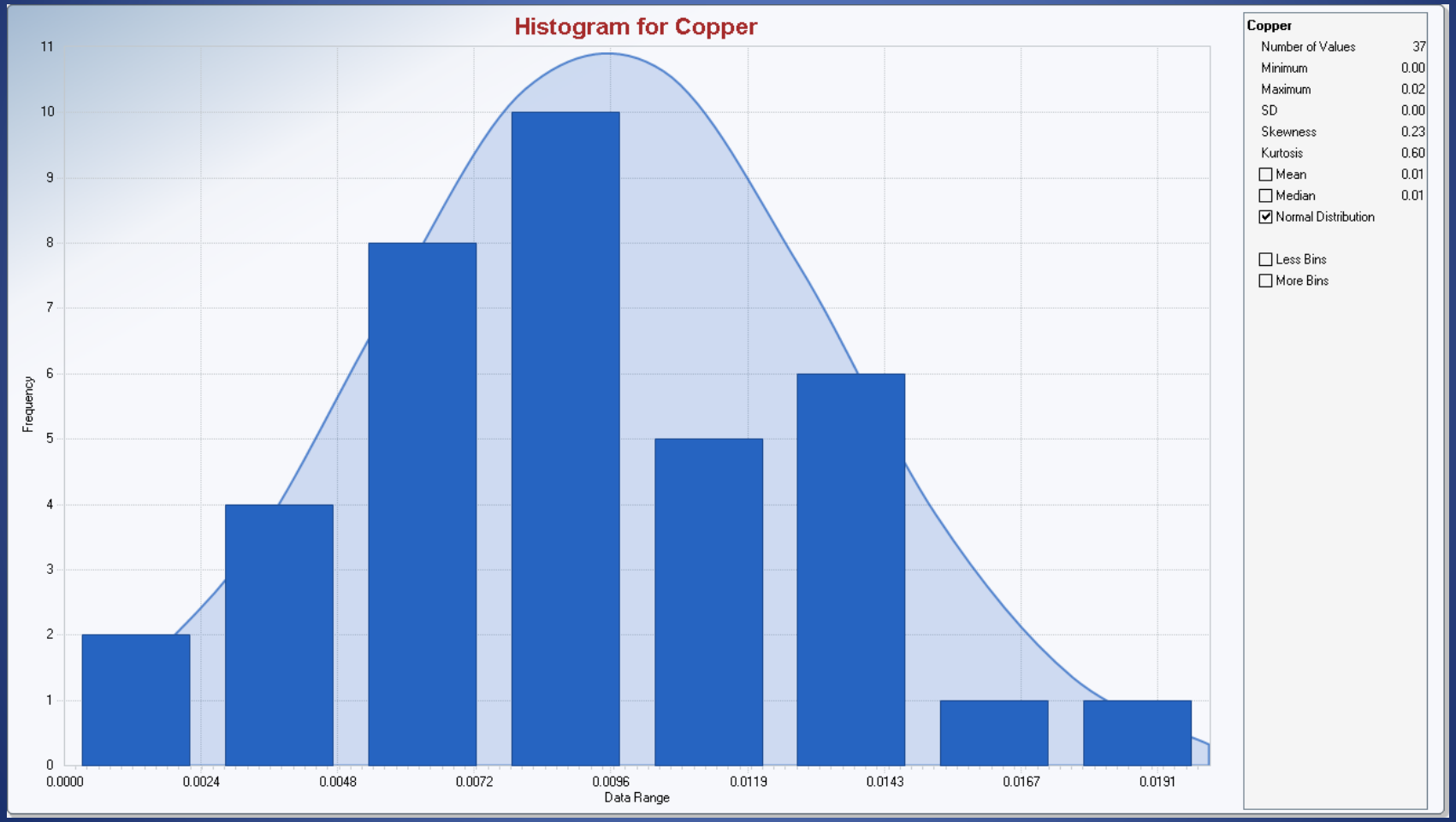
Recommendations

- Go through your data and investigate suspect data try to correct existing errors now
- Use analysis methods with lowest detection
- Immediately upon receipt carefully review all data reports from lab
- Must have more than 10 data points
  - ideal minimum is 20
  - shooting for 100
- Identify outlier(s) before sending data into State
- Be prepared to discuss reasons why

Copper With 3 Outliers Removed



Copper With 3 Outliers Removed



Effective Changes of Removing 3 Outliers

Metal	Highest Value	CV Before	Multiplier Before	MEC Before	Next Highest Value	CV After	Multiplier After	MEC After
Acute MEC (95%)								
Copper	0.0982	1.193	1.2	0.118	0.0151	0.424	1.1	0.0166
Chronic MEC (99%)								
Copper	0.0982	1.193	2.13	0.2092	0.0151	0.424	1.5	0.0227

Changes to Permit

Metal	MEC Before	MAC	Results Before	MEC After	Results After
Acute					
Copper	0.118	0.055	Outcome A Permit Limit	0.0166	No Limit (<1/2)
Chronic					
Copper	0.2092	0.0436	Outcome B + Monitoring	0.0227	Outcome C + Monitoring (barely >1/2)
Good case to continue current monitoring frequency.					

	Copper	Copper_D	Selenium	Selenium _D	Cyanide	Cyanide_D
Win 2006	0.0011	1	0.0024	1	0.007	1
Spr 2006	0.0009	1	0.0019	1	0.003	1
Sum 2006	0.013	1	0.002	1	0.002	0
Fall 2006	0.014	1	0.0011	1	0.005	1
Win 2007	0.006	1	0.0021	1	0.011	1
Spr 2007	0.037	1	0.0038	1	0.002	0
Sum 2007	0.011	1	0.0027	1	0.002	0
Fall 2007	0.02	1	0.0022	1	0.002	0
Win 2008	0.012	1	0.0034	1	0.006	1
Spr 2008	0.009	1	0.0019	1	0.002	0
Sum 2008	0.011	1	0.0027	1	0.002	0
Fall 2008	0.01	1	0.0015	1	0.002	0
Win 2009	0.017	1	0.0017	1	0.002	0
Spr 2009	0.012	1	0.0021	1	0.002	0
Sum 2009	0.0111	1	0.0013	1	0.002	0
Fall2009	0.0133	1	0.0015	1	0.002	0
Win 2010	0.0103	1	0.0017	1	0.002	0
Spr 2010	0.0104	1	0.002	1	0.002	0
Sum 2010	0.0151	1	0.0018	1	0.002	0
Fall 2010	0.0099	1	0.0011	1	0.002	0
Win 2011	0.0135	1	0.0023	1	0.002	0
Spr 2011	0.0982	1	0.0005	0	0.002	0
Sum 2011	0.0335	1	0.007	1	0.002	0
Fall2011	0.0131	1	0.0023	1	0.002	0
Win 2012	0.0072	1	0.0042	1	0.002	0
Spr 2012	0.0093	1	0.0027	1	0.002	0
Sun 2012	0.0081	1	0.0044	1	0.002	0
Fall 2012	0.0096	1	0.0034	1	0.017	1
Win 2013	0.0078	1	0.003	1	0.002	0
Spr 2013	0.006	1	0.0005	0	0.002	0
Sum 013	0.0099	1	0.0024	1	0.002	1
Fall 2013	0.0072	1	0.0024	1	0.002	0
Win 2014	0.0055	1	0.0019	1	0.002	1
Spr 2014	0.0055	1	0.0018	1	0.002	0
Sum 2014	0.0084	1	0.002	1	0.002	0
Fall 2014	0.0067	1	0.002	1	0.002	0
Win 2015	0.0052	1	0.0018	1	0.002	1
Spr 2015	0.0048	1	0.0021	1	0.002	1