

2007 FWMP Presentation

Hecla
GREENS CREEK



Tailings Area Fresh Water Monitoring Program



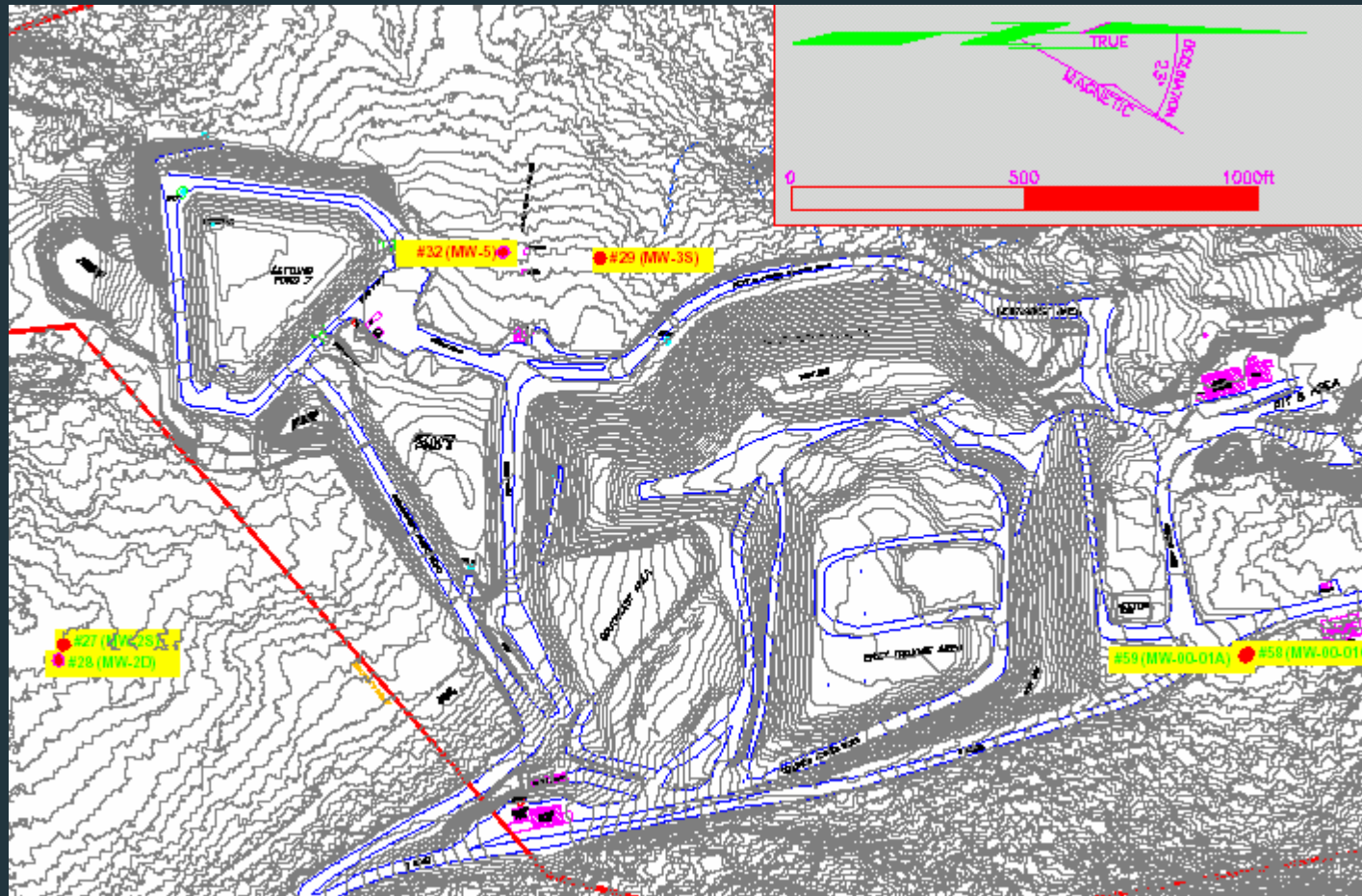
- Comparison against AWQS
- Upgradient / Downgradient comparative graphs for SC, SO₄, Pb, & Zn
- Review of statistical tests for trends
- Collection of additional data at Tributary Creek (Site 9) and Upper Althea (Site 60)

Tailings Area Shallow Wells (PEAT)

Tailings Area: Shallow Wells (Peat)

- Site 58 “MW-T-00-01C”
 - Up-gradient reference site, located to the northeast of Tailings Area
- Site 27 “ MW-2S”
 - Down-gradient groundwater site, located south of Tailings Area
- Site 29 “MW-3S”
 - Down-gradient groundwater site, located east of Tailings Area
- Site 32 “MW-5”
 - Down-gradient groundwater site, located east of Tailings Area

Tailings Area Sampling Sites



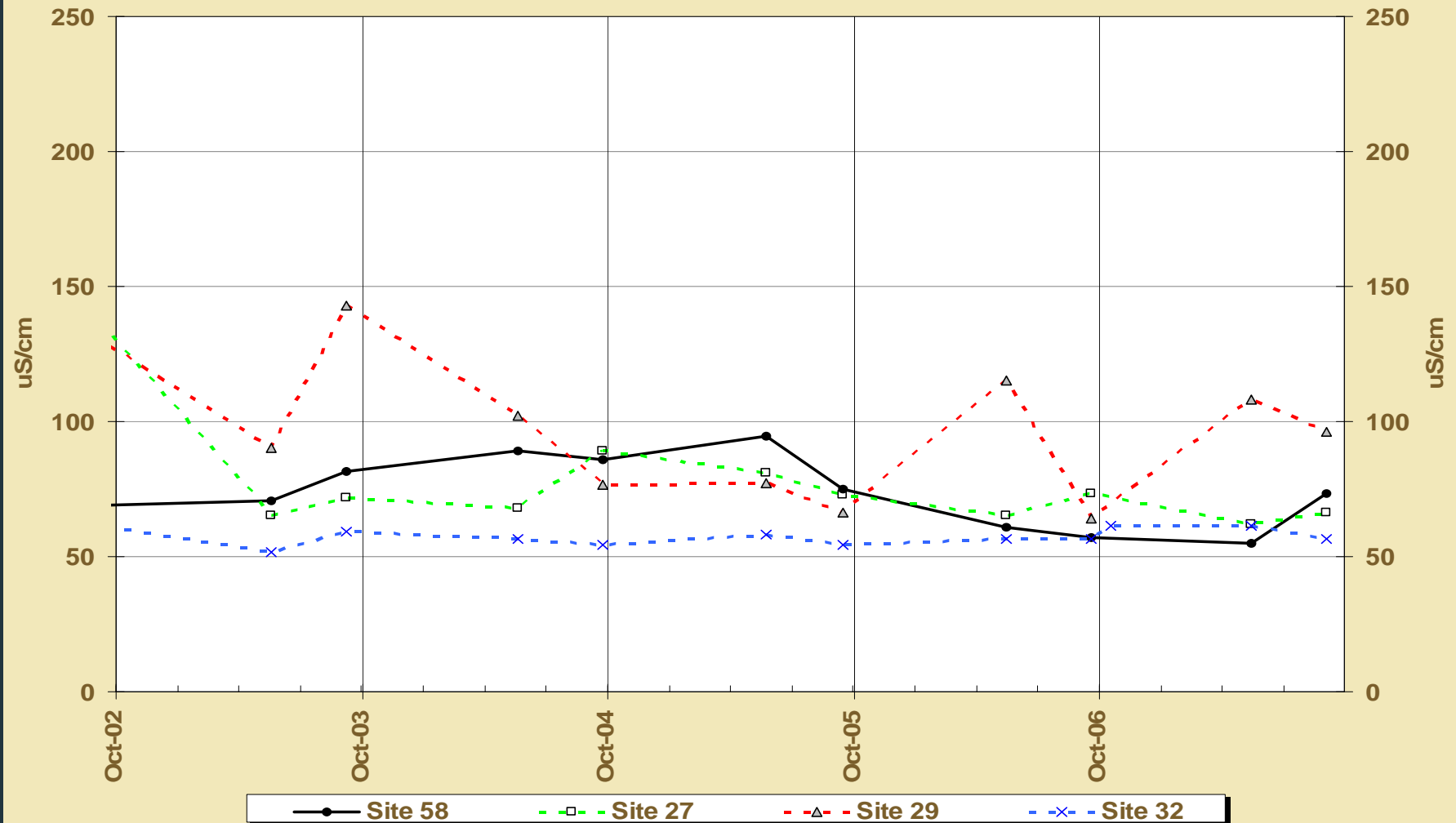
- Shallow wells continue historic trends in low pH, low alkalinity, and elevated lead
- New, lower drinking water standard for arsenic (changed from 50 ug/l to 10 ug/l) continues to result in exceedances for arsenic at shallow well Site 29.

AWQS Exceedances (continued)



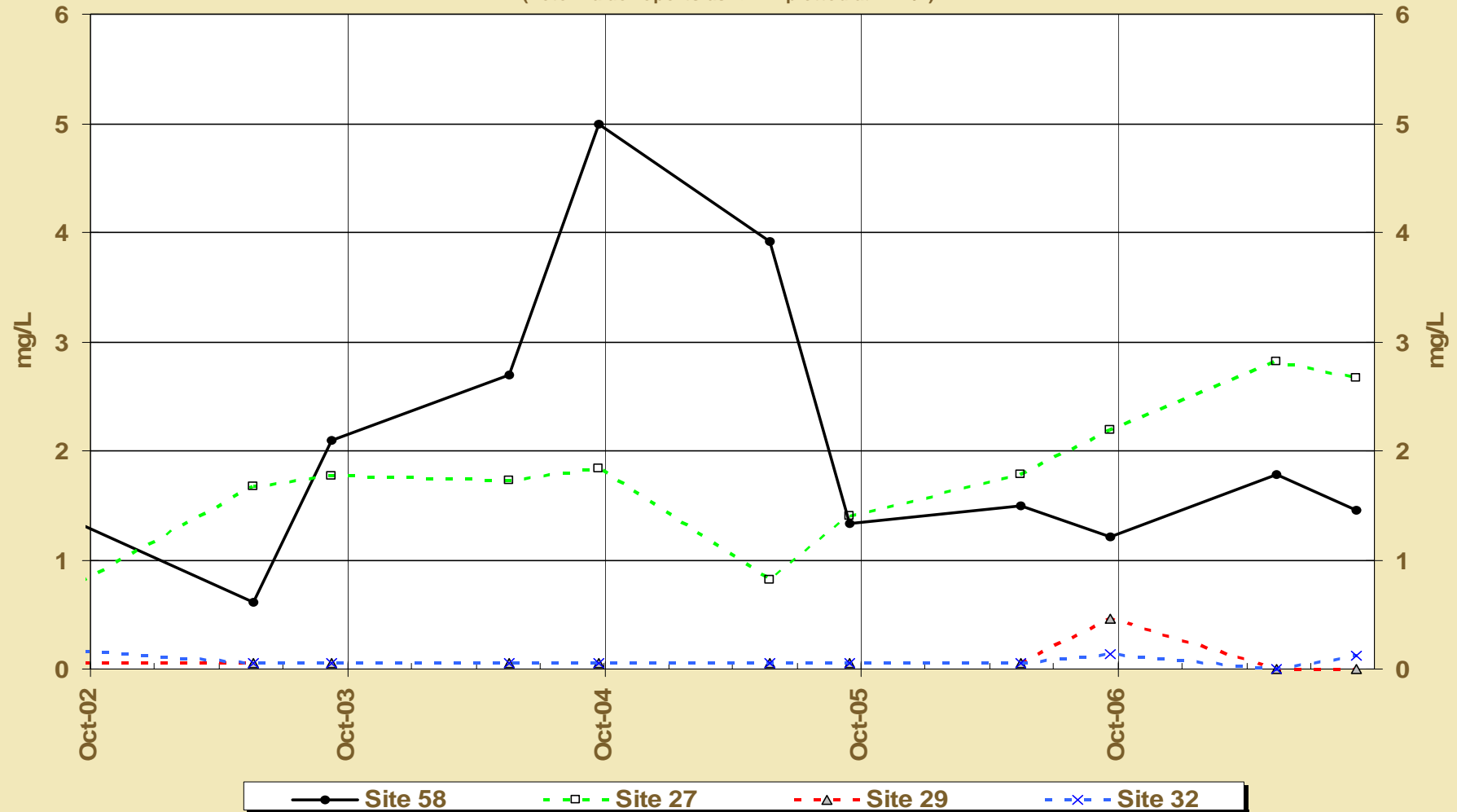
Site	Date	Parameter	Value	Standard	Hardness (mg/L)	Standard Type
58	15-May-07	pH Filed, su	6.42	6.5 - 8.5		Aquatic Life
58	15-May-07	pH Laboratory, su	6.09	6.5 - 8.5		Aquatic Life
58	05-Sep-07	pH Filed, su	6.03	6.5 - 8.5		Aquatic Life
58	05-Sep-07	pH Laboratory, su	6.00	6.5 - 8.5		Aquatic Life
58	15-May-07	Total Alkalinity, mg/L	13.8	>20		Aquatic Life, Chronic
27	15-May-07	pH Filed, su	5.91	6.5 - 8.5		Aquatic Life
27	15-May-07	pH Laboratory, su	5.63	6.5 - 8.5		Aquatic Life
27	05-Sep-07	pH Filed, su	5.86	6.5 - 8.5		Aquatic Life
27	05-Sep-07	pH Laboratory, su	5.73	6.5 - 8.5		Aquatic Life
27	15-May-07	Total Alkalinity, mg/L	18.7	>20		Aquatic Life, Chronic
27	15-May-07	Lead, Dissolved, µg/L	2.11	0.54	20.5	Aquatic Life, Chronic
27	05-Sep-07	Lead, Dissolved, µg/L	0.94	0.54	23.7	Aquatic Life, Chronic
27	15-May-07	Zinc, Dissolved, µg/L	64.7	36.5	20.5	Aquatic Life, Chronic
29	14-May-07	pH Filed, su	5.70	6.5 - 8.5		Aquatic Life
29	14-May-07	pH Laboratory, su	5.49	6.5 - 8.5		Aquatic Life
29	05-Sep-07	pH Filed, su	5.63	6.5 - 8.5		Aquatic Life
29	05-Sep-07	pH Laboratory, su	5.56	6.5 - 8.5		Aquatic Life
29	14-May-07	Arsenic, Dissolved, µg/l	16.2	10	49.3	Drinking Water
29	05-Sep-07	Arsenic, Dissolved, µg/l	16.3	10	48.3	Drinking Water
32	14-May-07	pH Filed, su	5.45	6.5 - 8.5		Aquatic Life
32	14-May-07	pH Laboratory, su	5.07	6.5 - 8.5		Aquatic Life
32	05-Sep-07	pH Filed, su	5.17	6.5 - 8.5		Aquatic Life
32	05-Sep-07	pH Laboratory, su	5.10	6.5 - 8.5		Aquatic Life
32	14-May-07	Total Alkalinity, mg/L	16.2	>20		Aquatic Life, Chronic
32	05-Sep-07	Total Alkalinity, mg/L	15.9	>20		Aquatic Life, Chronic
32	14-May-07	Lead, Dissolved, µg/L	4.95	0.54	10	Aquatic Life, Chronic
32	05-Sep-07	Lead, Dissolved, µg/L	6.42	0.54	10.2	Aquatic Life, Chronic

Tailings (Shallow Wells) - Specific Conductance



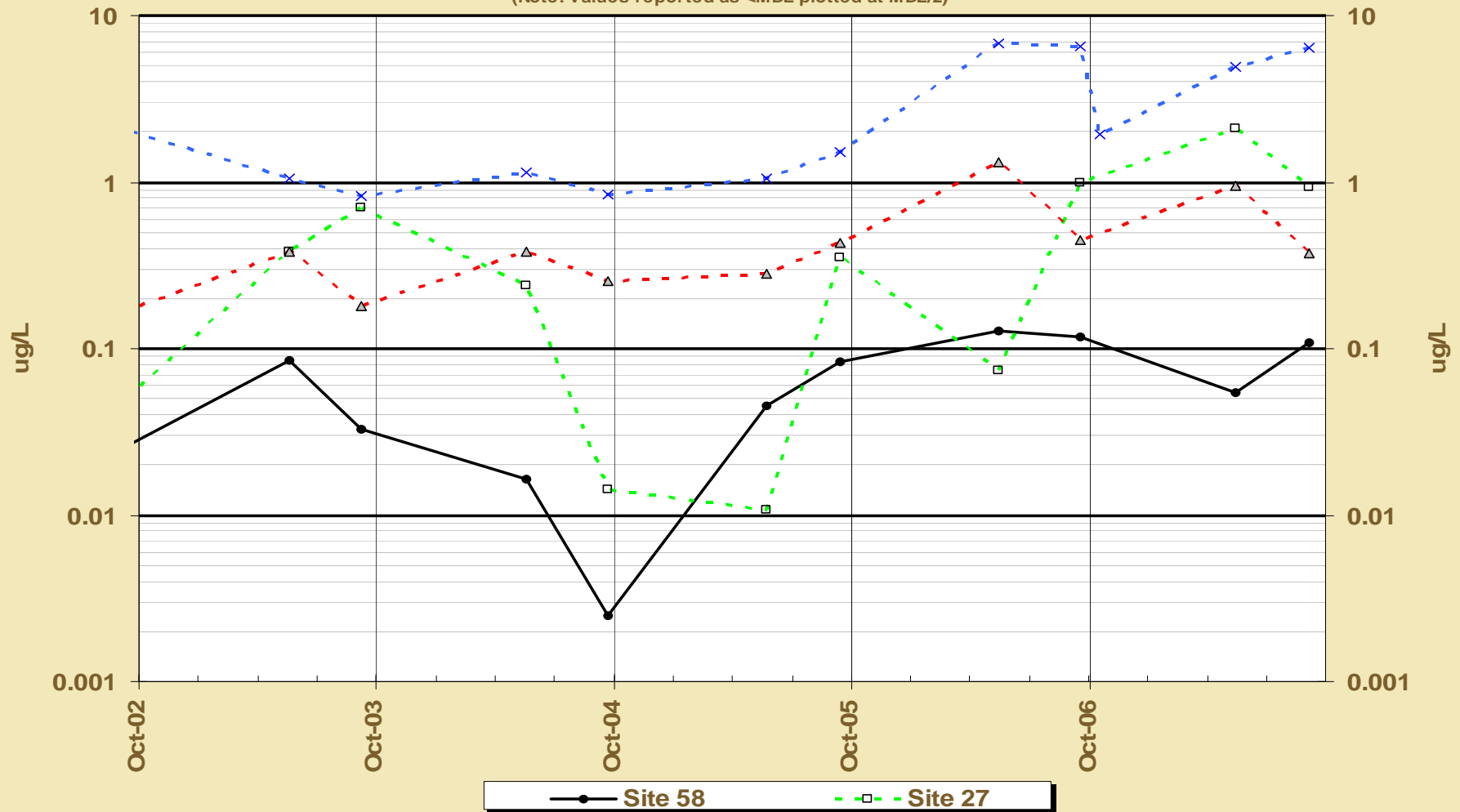
Tailings (Shallow Wells) - Total Sulfate

(Note: Value reports as <MDL plotted at MDL/2)



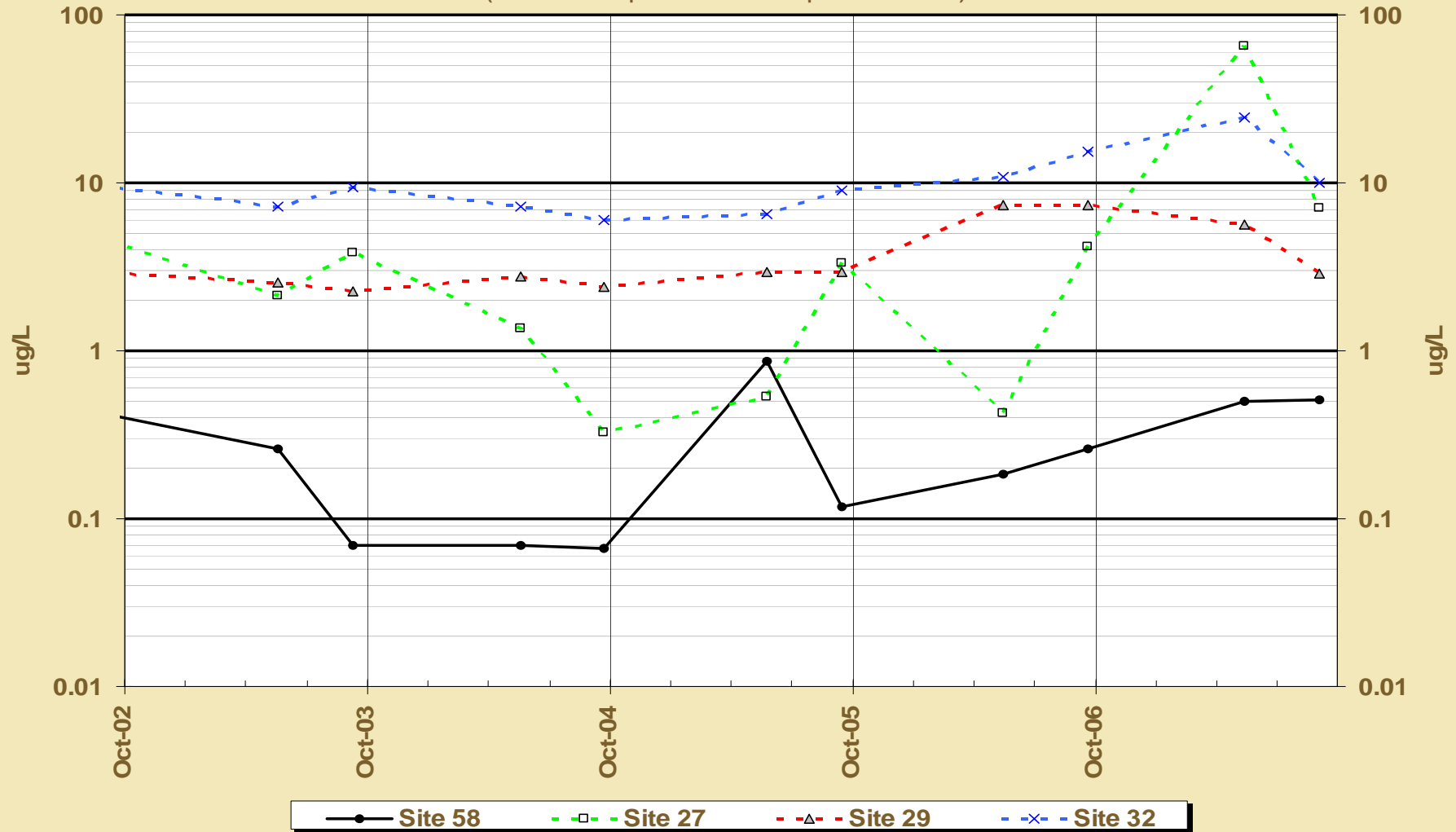
Tailings (Shallow Wells) - Dissolved Lead

(Note: Values reported as <MDL plotted at MDL/2)



Tailings (Shallow Wells) - Dissolved Zinc

(Note: Values reported as <MDL are plotted at 1/2MDL)



Tailings Shallow Wells-Statistical Trends

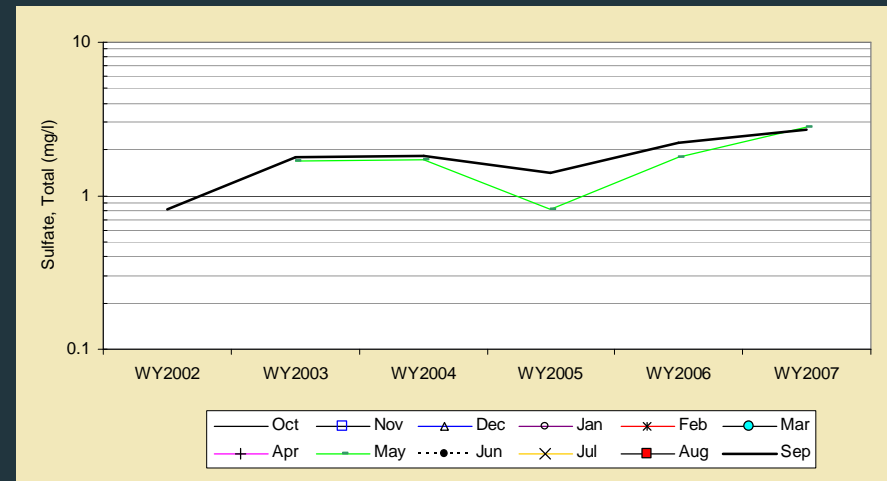
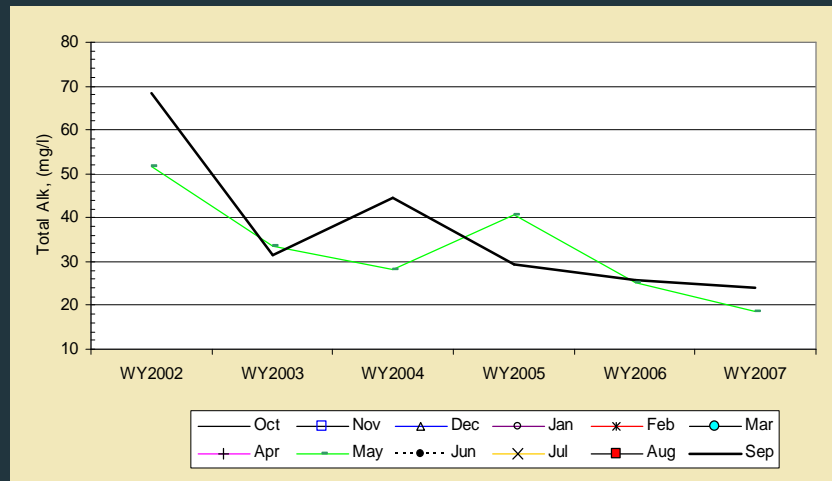


Mann-Kendall Seasonal Trend Test Probabilities

2007 Water Year

Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
58	0.25	0.12	0.45	0.50	0.66
27	0.04	0.06	<0.01	0.99	0.55
29	0.50	0.18	0.06	0.63	0.93
32	0.61	0.06	0.14	N/A	0.75

Site 27: Q(Alk)=-5.9 mg/L/yr ; Q(SO4)=+0.3 mg/L/yr



Tailings Area Deep Wells (Glacial / Marine Till)

Tailings Area: Deep Wells (Glacial / Marine Till)

- Site 59 “MW-T-00-01A”
 - Up-gradient reference site, located to the northeast of Tailings Area, completed in glacial till
- Site 28 “ MW-2D”
 - Down-gradient groundwater site, located south of Tailings Area, completed in marine silts/clays

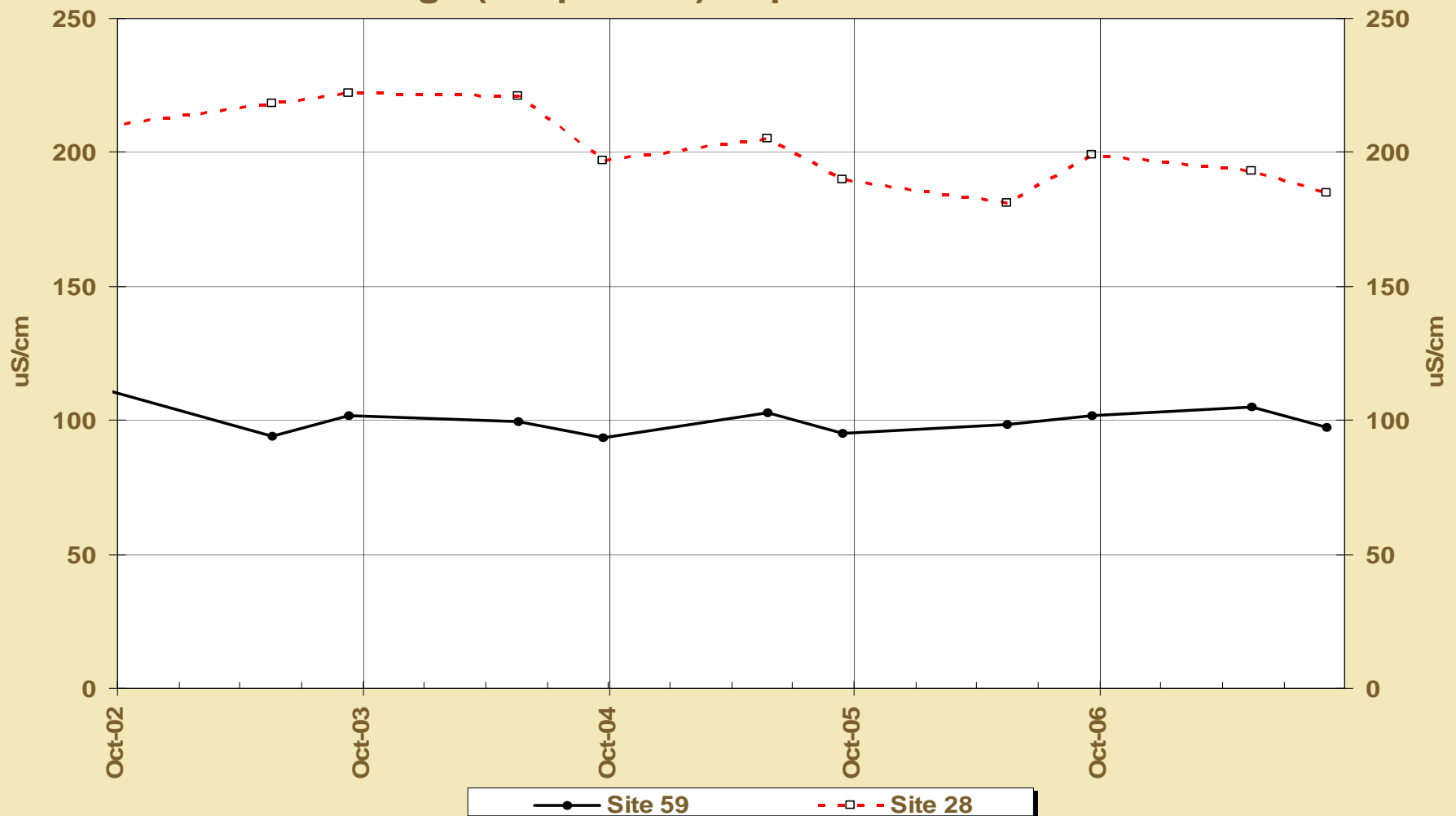
AWQS Exceedances Site 28



Downgradient deep well continues historic trends with elevated pH and arsenic.

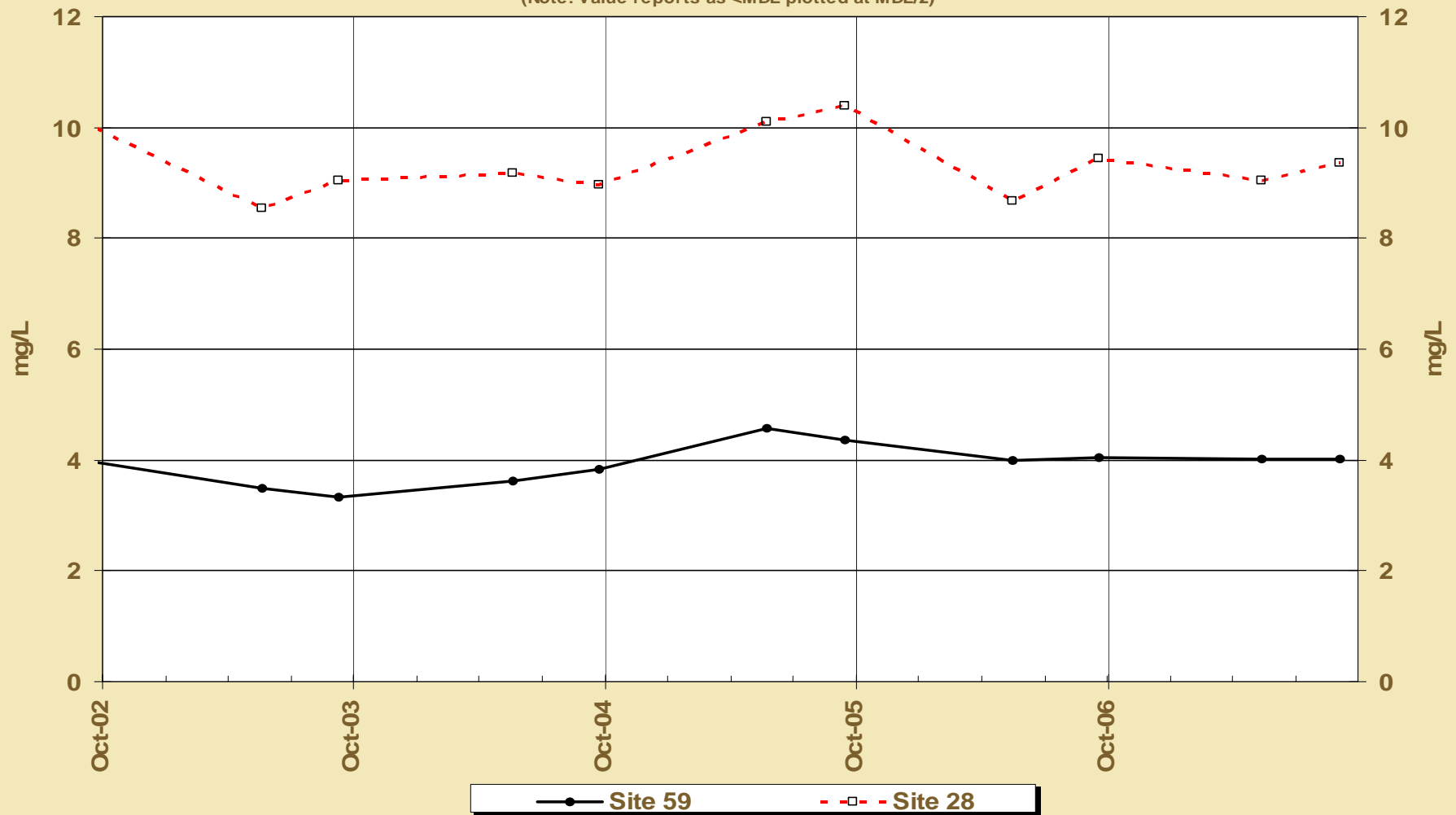
Site	Date	Parameter	Value	Standard	Hardness (mg/L)	Standard Type
28	15-May-07	pH Laboratory, su	8.65	6.5 - 8.5		Aquatic Life
28	15-May-07	Arsenic, Dissolved, µg/l	61.8	10	77.4	Drinking Water
28	05-Sep-07	Arsenic, Dissolved, µg/l	79.5	10	77.5	Drinking Water

Tailings (Deep Wells) - Specific Conductance



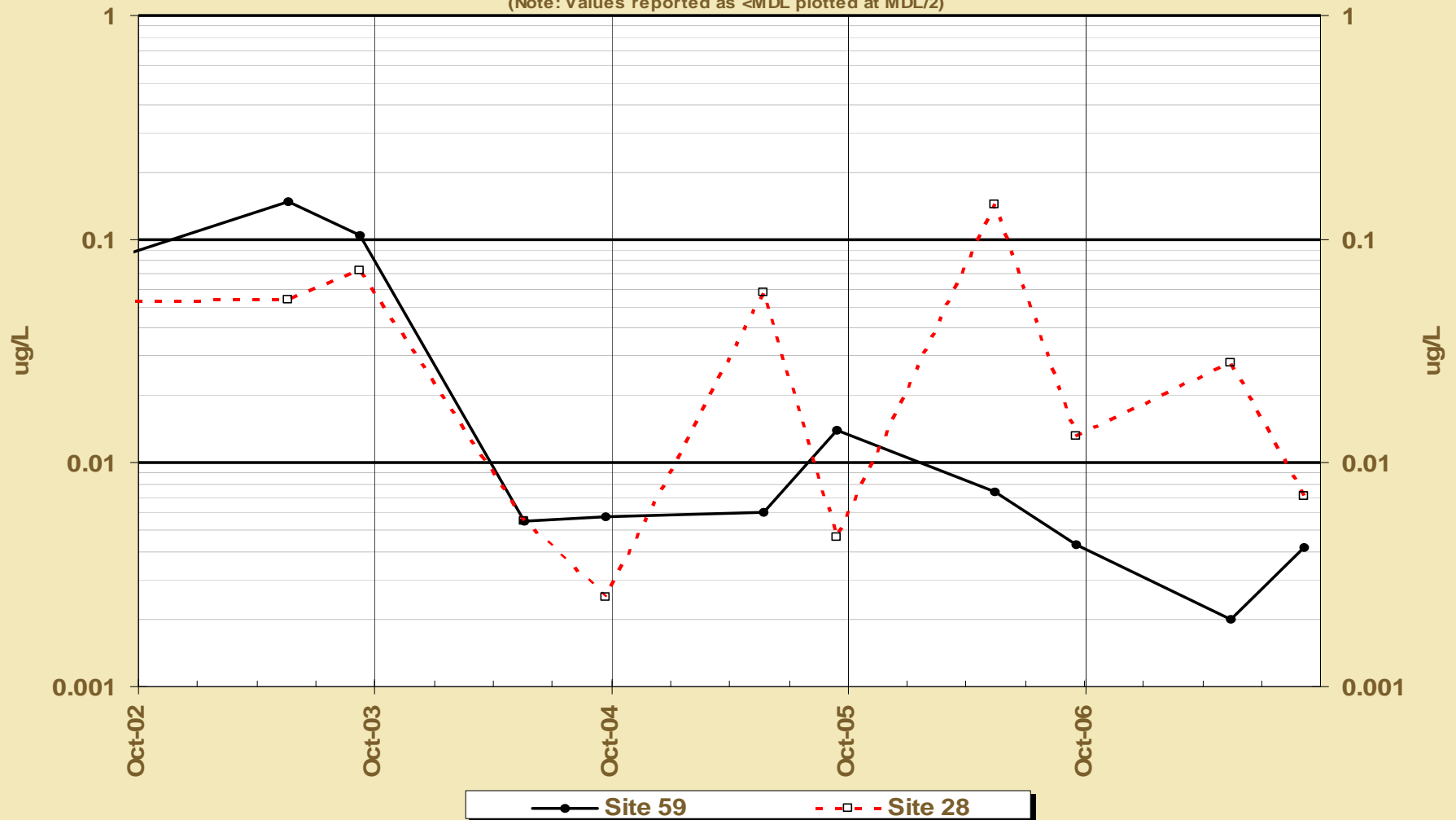
Tailings (Deep Wells) - Total Sulfate

(Note: Value reports as <MDL plotted at MDL/2)



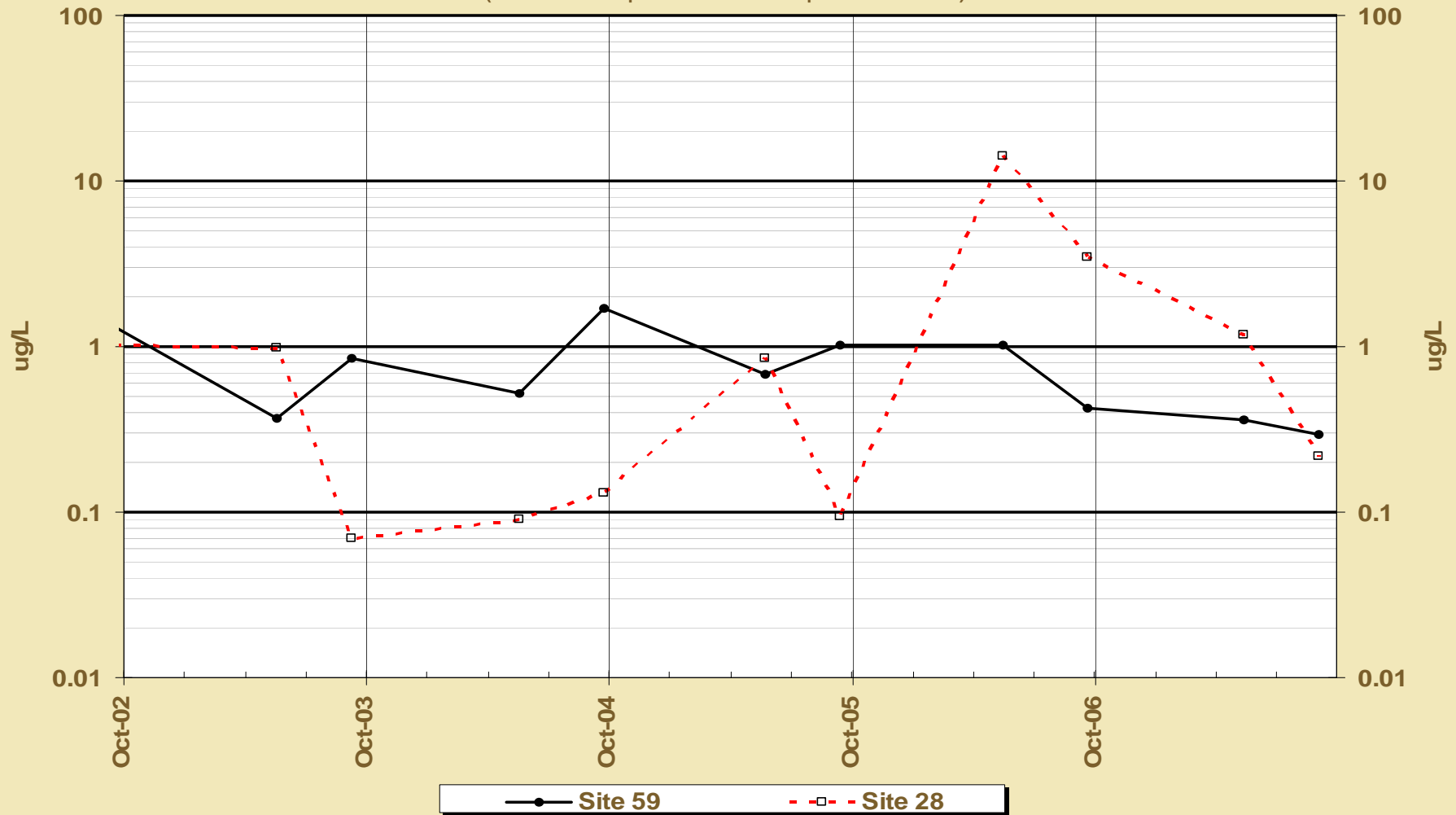
Tailings (Deep Wells) - Dissolved Lead

(Note: Values reported as <MDL plotted at MDL/2)



Tailings (Deep Wells) - Dissolved Zinc

(Note: Values reported as <MDL are plotted at 1/2MDL)



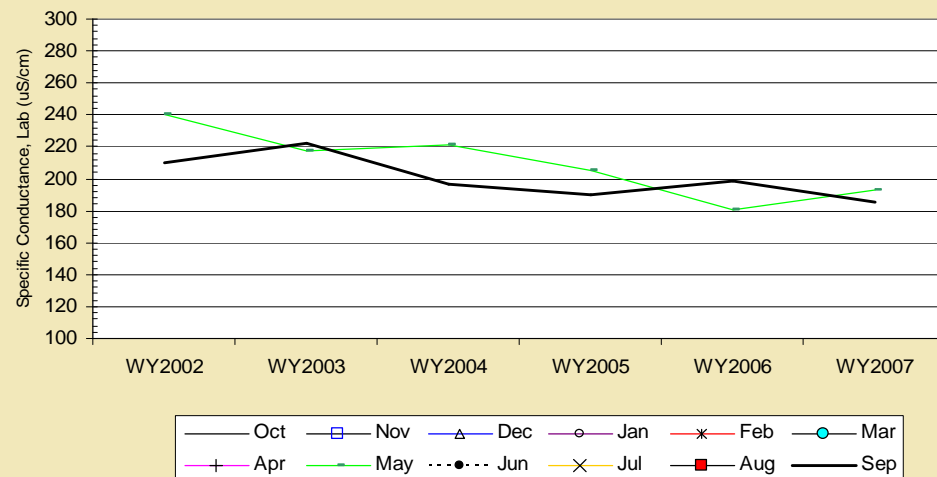
Tailings Deep Wells-Statistical Trends

Mann-Kendall Seasonal Trend Test Probabilities

2007 Water Year

Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
59	0.40	0.50	0.25	0.93	0.07
28	<0.01	0.12	0.03	0.50	0.66

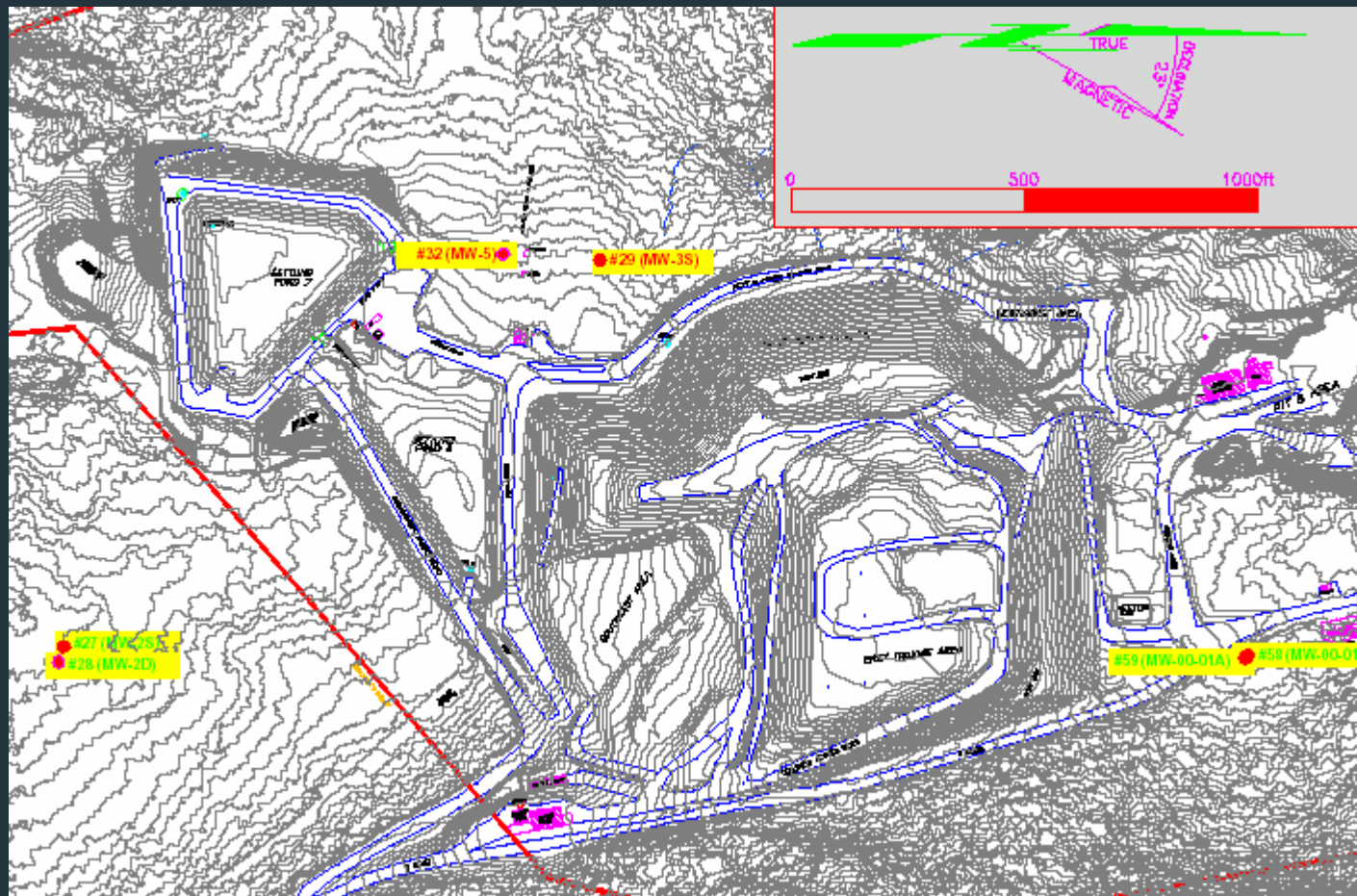
Site 28: Q=-7.3 uS/cm/yr



Tailings Area: Additional Sites

- Site 9 “Tributary Creek”
 - Down-gradient surface site, located approximately 1 mile from the tailings pile
- Site 60 “Lower Althea Creek”
 - Down-gradient surface site, approximately ¼ mile west of Pond 7

Tailings Area Sampling Sites



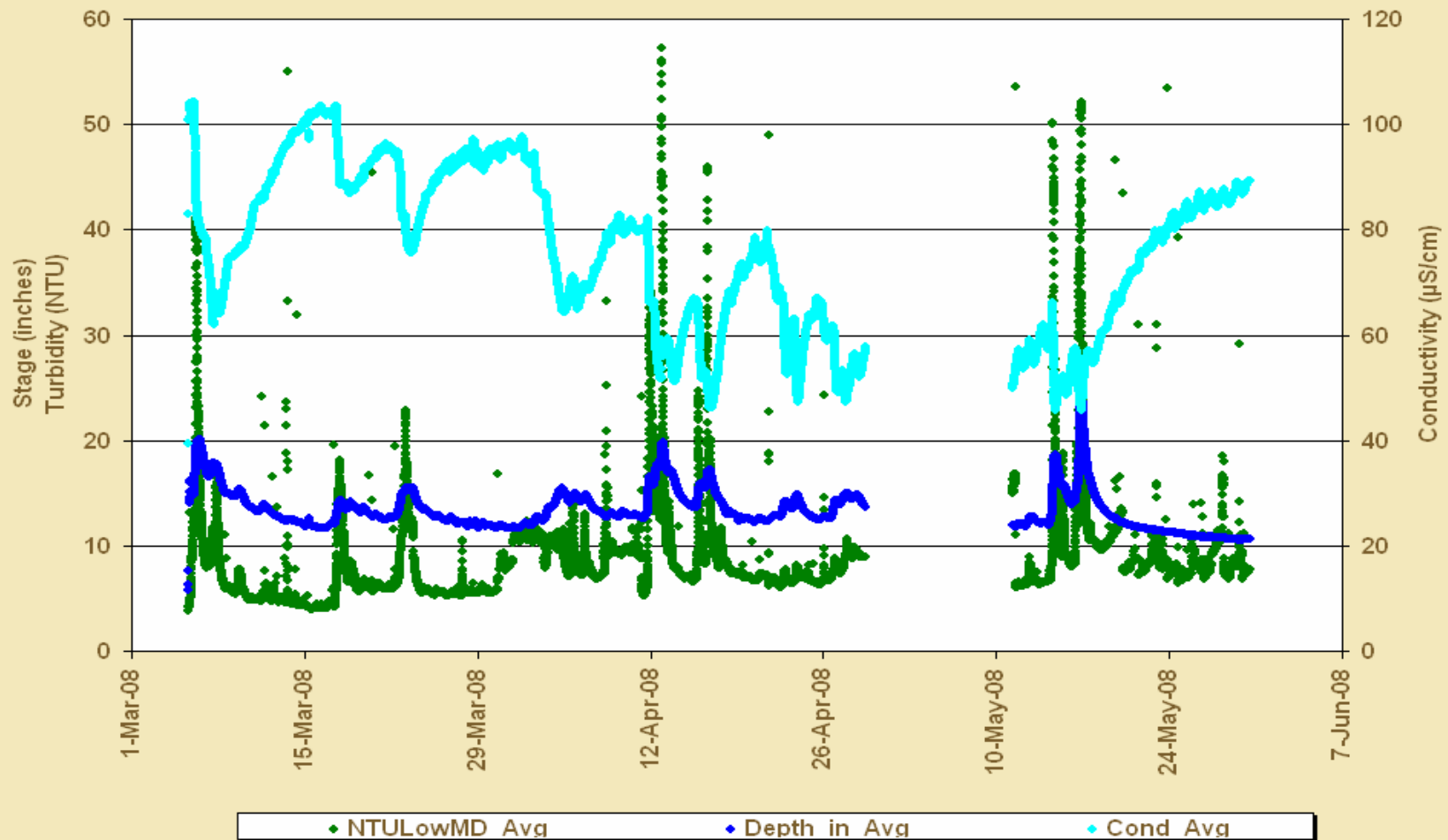
- Site 9 was originally monitored between 1981 through 1993.
- Was added back into the monitoring plan in 2001 as a biomonitoring site.
- Additional sampling for Suite Q analytes during the months of May, July, and September.
- Site 60 was added to the FWMP in WY 2006.
- Was added to monitor the impact of Pond 7 on the local watershed.

AWQS Exceedances Sites 9 & 60



Site	Date	Parameter	Value	Standard	Hardness (mg/L)	Standard Type
9	15-May-07	Total Alkalinity, mg/L	9.7	>20		Aquatic Life, Chronic
9	10-Jul-07	Total Alkalinity, mg/L	17.4	>20		Aquatic Life, Chronic
9	15-May-07	Lead, Dissolved, µg/L	0.63	0.54	21.6	Aquatic Life, Chronic
9	10-Jul-07	Lead, Dissolved, µg/L	0.78	0.77	34.1	Aquatic Life, Chronic
60	05-Sep-07	pH Filed, su	5.17	6.5 - 8.5		Aquatic Life

Preliminary data from datalogger system install at Tributary Creek.



Greens Creek & 1350 FWMP Sites

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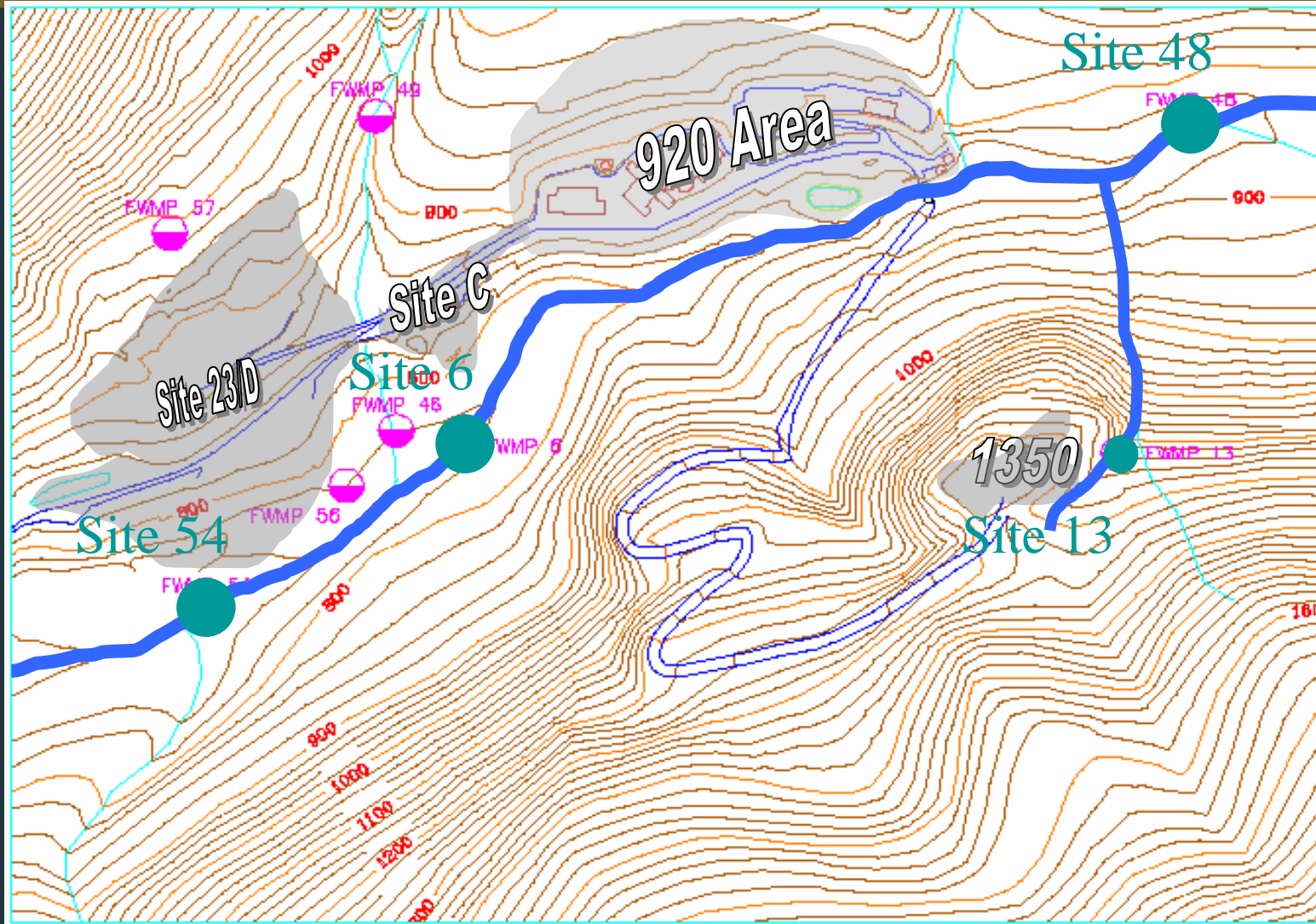


920 Area Fresh Water Monitoring Program

- Comparison against AWQS
- Upgradient / Downgradient comparative graphs for SC, SO₄, Pb, & Zn
- Review of statistical tests for trends and comparison of median values for selected analytes.

- Site 48 “Upper Greens Creek”
 - Up-gradient reference site
- Site 6 “Middle Greens Creek”
 - Below the influence from the 1350, 960, 920 Mine/Mill Complex, & Site C
- Site 54 “Lower Greens Creek”
 - Referenced to Site 6, below influence of Site 23/D
- Site 13 “1350 Mine Audit Discharge East”
 - Monitors the effect of contact water from the eastern portion of the 1350 Waste Rock site.

Greens Creek / 920 Area Map



AWQS Exceedances in Greens Creek



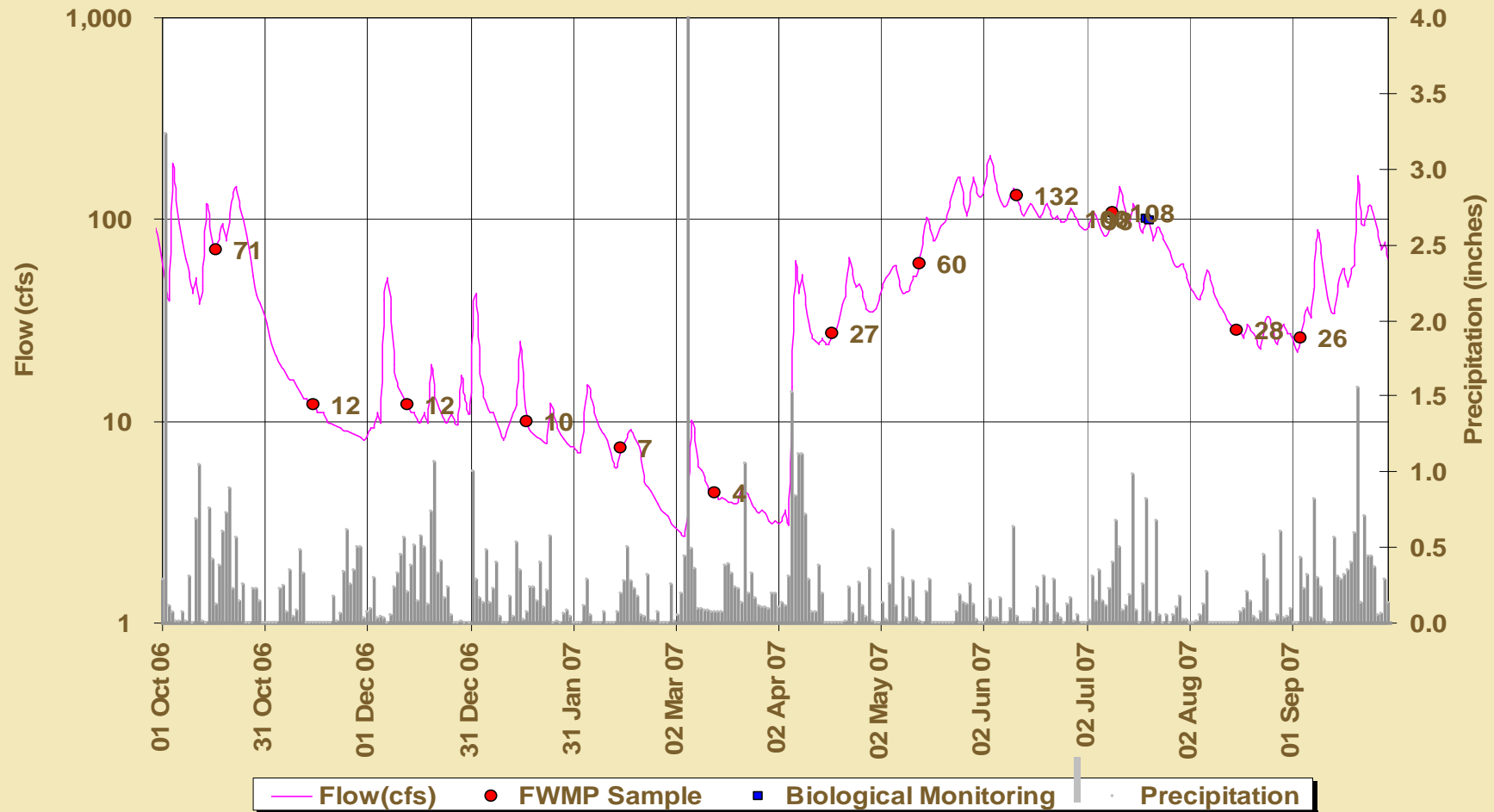
- No measured parameters exceeded AWQS for sites 48 and 6.
- Two exceedances were noted for pH at site 54

Site	Date	Parameter	Value	Standard	Hardness (mg/L)	Standard Type
54	15-Nov-06	pH Laboratory, su	6.39	6.5 - 8.5		Aquatic Life
54	17-Jan-07	pH Laboratory, su	6.40	6.5 - 8.5		Aquatic Life
13	10-Jul-07	pH Filed, su	6.43	6.5 - 8.5		Aquatic Life

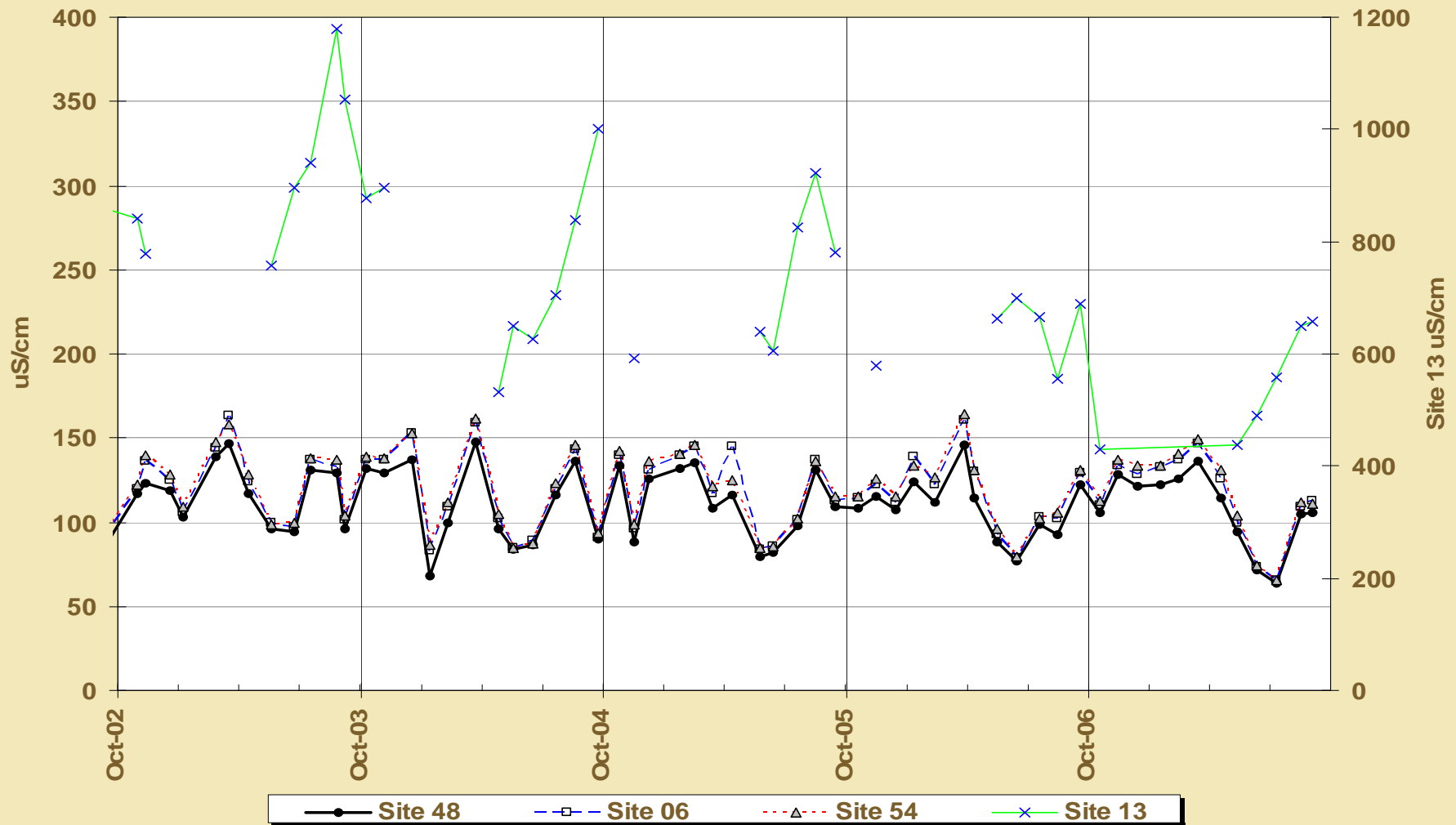
- Site 13 had a single exceedance for pH

WY2007 Greens Creek Flow

WY2007- Greens Creek Hydrograph/Precipitation

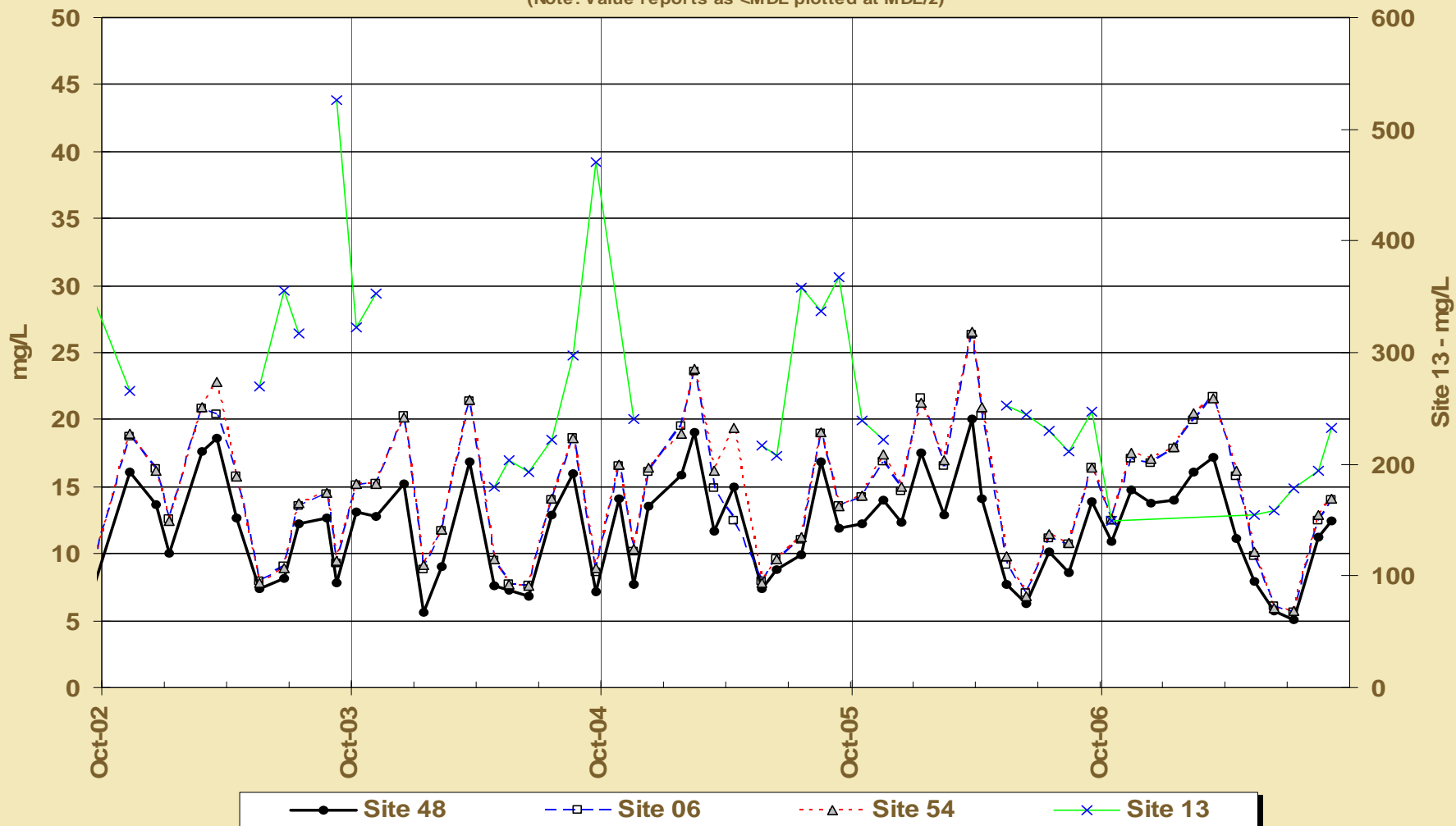


Greens Creek - Specific Conductance



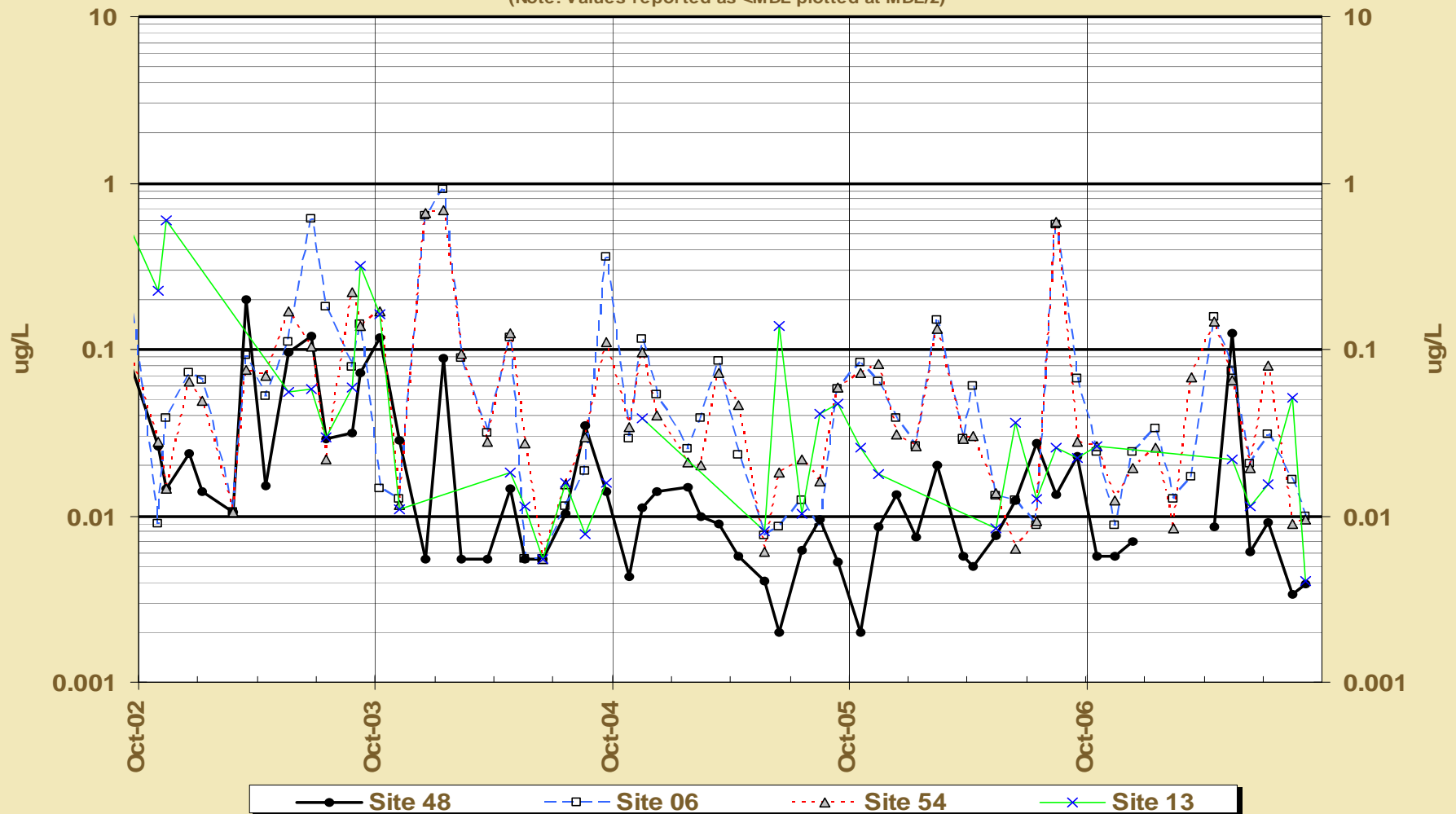
Greens Creek - Total Sulfate

(Note: Value reports as <MDL plotted at MDL/2)



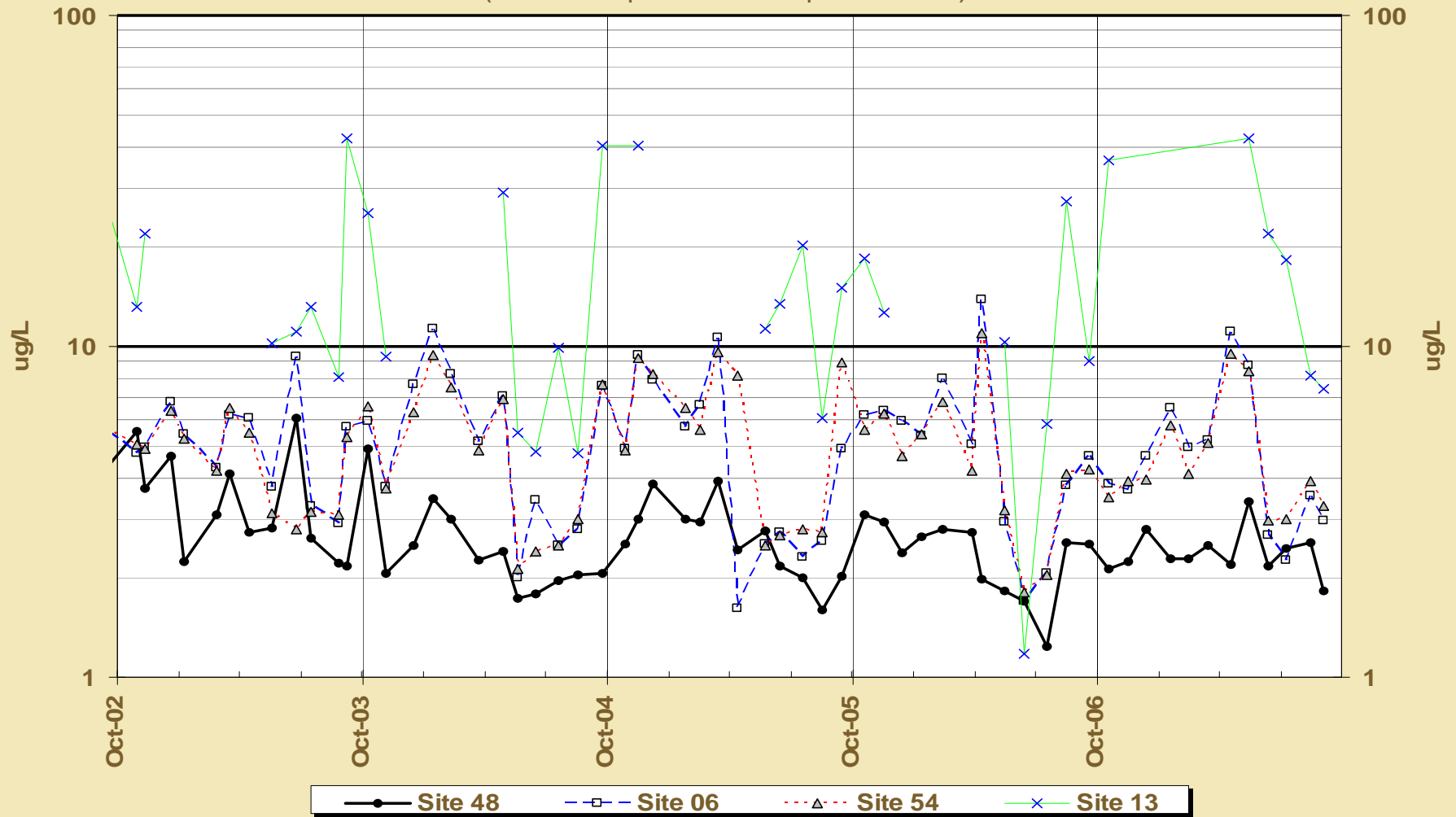
Greens Creek - Dissolved Lead

(Note: Values reported as <MDL plotted at MDL/2)



Greens Creek - Dissolved Zinc

(Note: Values reported as <MDL are plotted at 1/2MDL)



Greens Creek / 920 Area-Statistical Testing (Conductivity Graphs)



Mann-Kendall Seasonal Trend Test Probabilities

2007 Water Year

Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
48	0.02	0.31	0.19	0.50	<0.01
6	0.05	0.01	0.31	0.66	0.04
54	0.06	<0.01	0.41	0.66	0.19
13	<0.01	0.73	0.14	<0.01	0.50

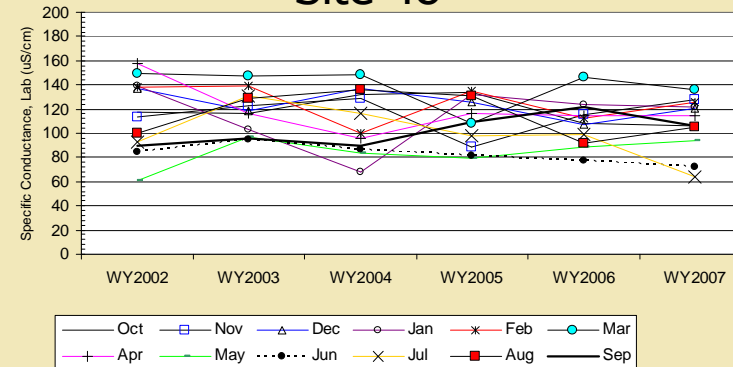
Site 48: Q=-2.0 uS/cm/yr ; Q(Zn)=-0.13 ug/L/yr

Site 6: Q= -0.1 su/yr

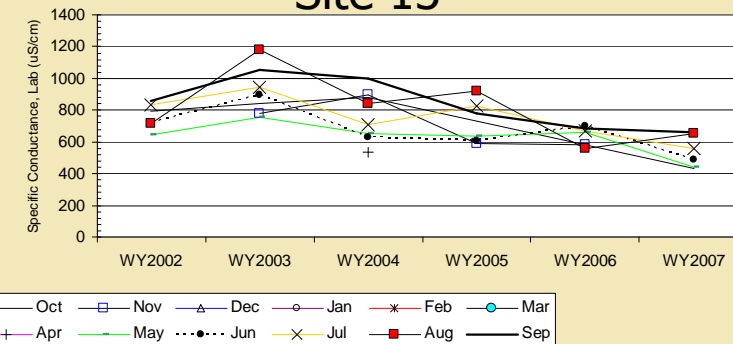
Site 54: Q= -0.1 su/yr

Site 13: Q=-58 uS/cm/yr ; Q(SO4)=-33 mg/L/yr

Site 48



Site 13



Greens Creek / 920 Area-Statistical Testing (pH graphs)



Mann-Kendall Seasonal Trend Test Probabilities

2007 Water Year

Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
48	0.02	0.31	0.19	0.50	<0.01
6	0.05	0.01	0.31	0.66	0.04
54	0.06	<0.01	0.41	0.66	0.19
13	<0.01	0.73	0.14	<0.01	0.50

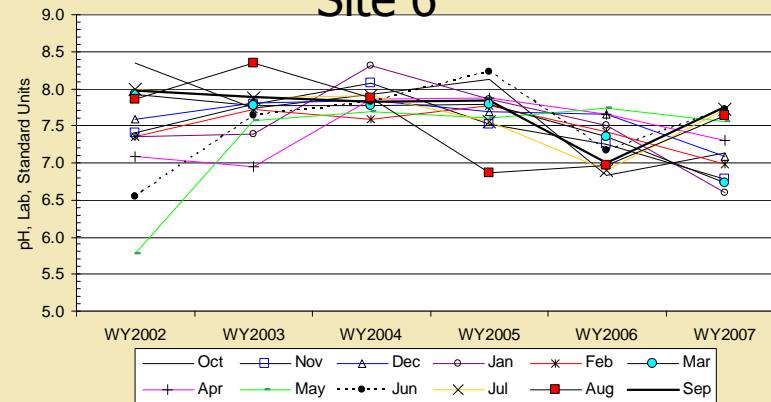
Site 48: Q=-2.0 uS/cm/yr ; Q(Zn)=-0.13 ug/L/yr

Site 6: Q= -0.1 su/yr

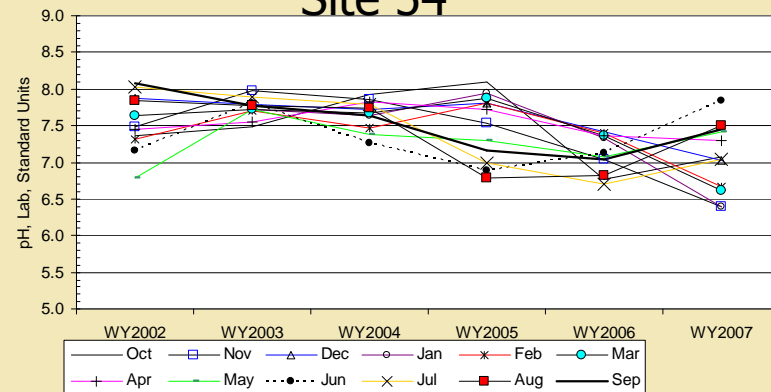
Site 54: Q= -0.1 su/yr

Site 13: Q=-58 uS/cm/yr ; Q(SO4)=-33 mg/L/yr

Site 6



Site 54



Greens Creek / 920 Area-Statistical Testing (graphs cont)



Mann-Kendall Seasonal Trend Test Probabilities

2007 Water Year

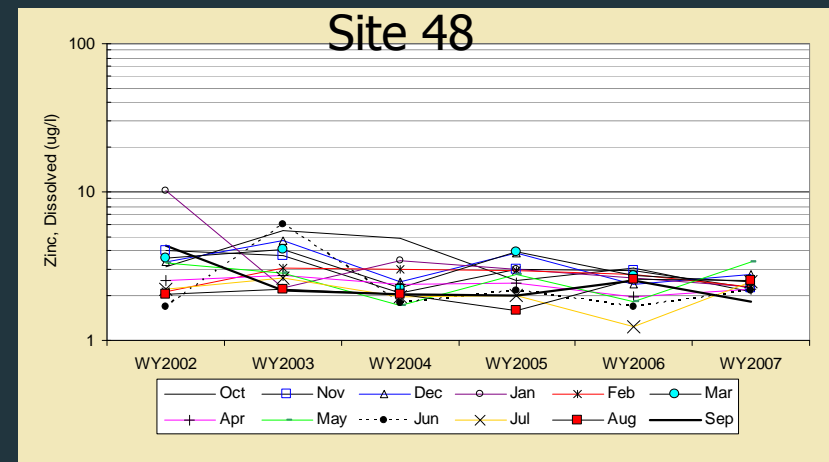
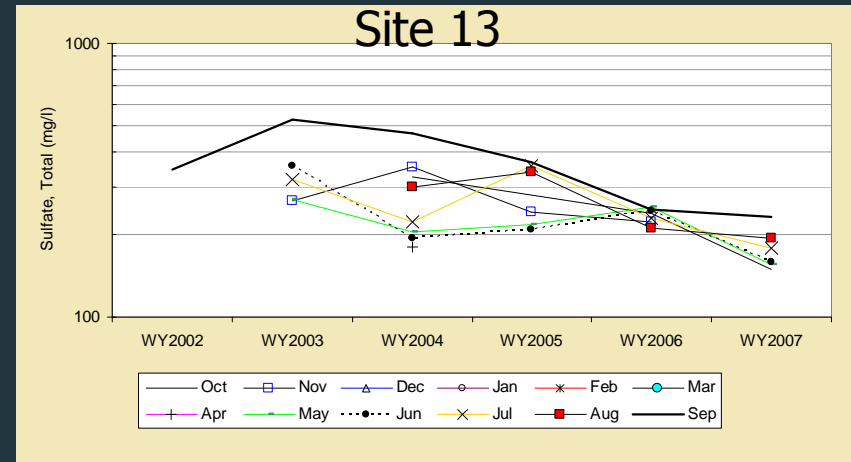
Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
48	0.02	0.31	0.19	0.50	<0.01
6	0.05	0.01	0.31	0.66	0.04
54	0.06	<0.01	0.41	0.66	0.19
13	<0.01	0.73	0.14	<0.01	0.50

Site 48: Q=-2.0 uS/cm/yr ; Q(Zn)=-0.13 ug/L/yr

Site 6: Q= -0.1 su/yr

Site 54: Q= -0.1 su/yr

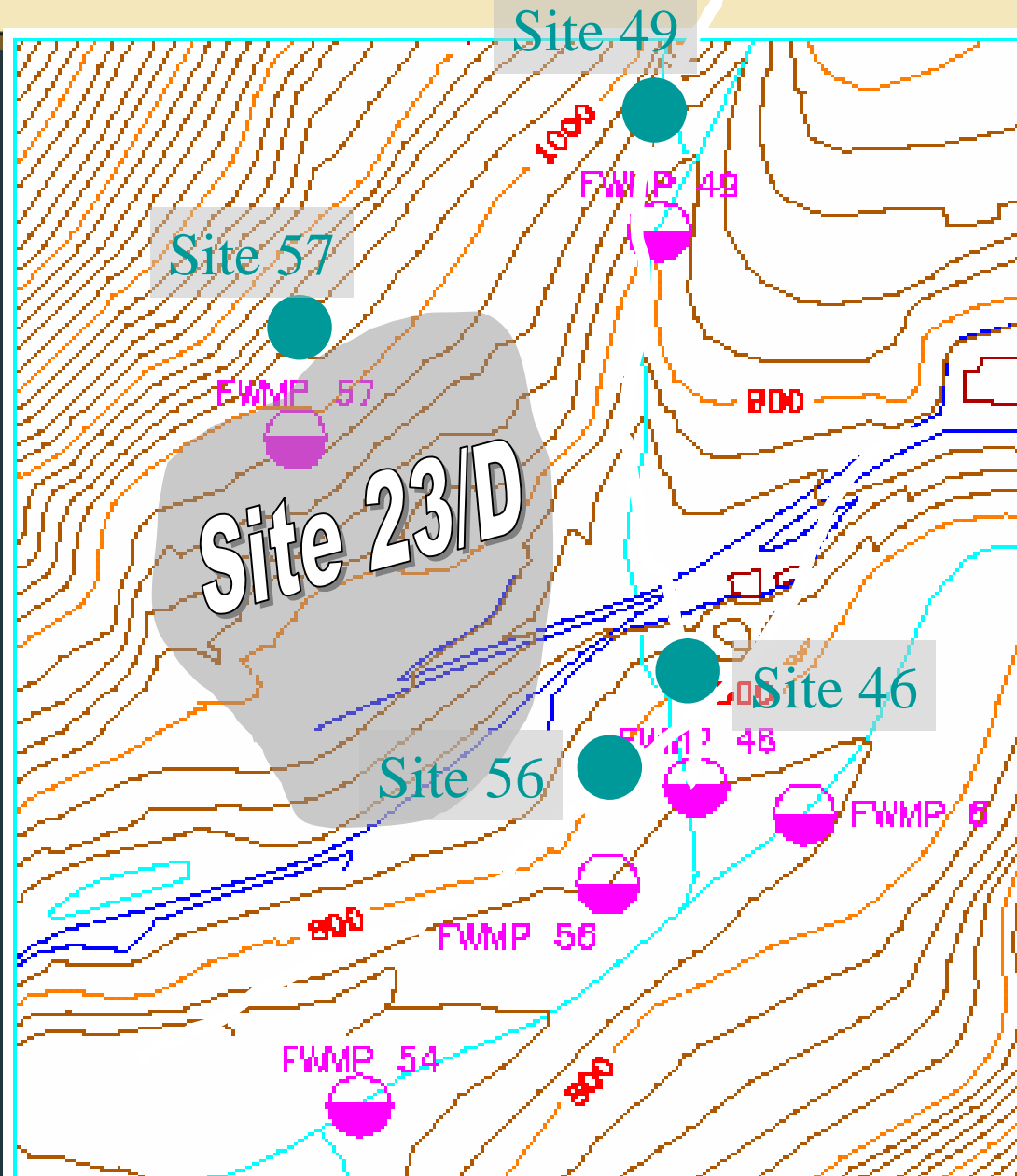
Site 13: Q=-58 uS/cm/yr ; Q(SO4)=-33 mg/L/yr



Bruin Creek & Site 23 FWMP Monitoring Wells

Bruin Creek / 920 Area Map

- Site 49 "Upper Bruin Creek"
 - Up-gradient reference site
- Site 46 "Lower Bruin Creek"
 - Below influence from Site 23/D
- Site 57 "MW-23-00-03"
 - Up-gradient groundwater reference site, located above Site 23
- Site 56 "MW-D-00-01"
 - Down-gradient groundwater site, located below Site D

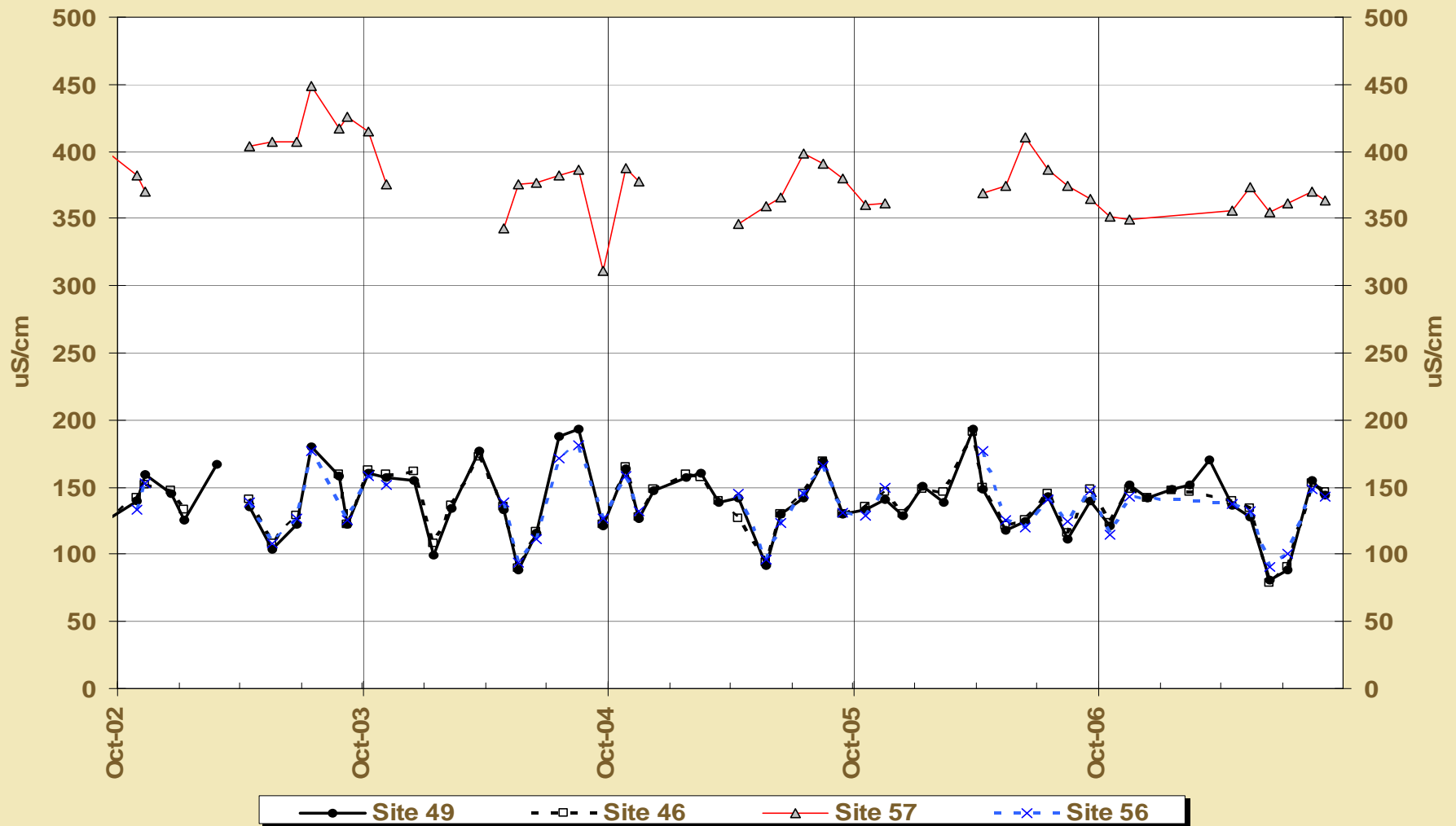


AWQS Exceedances in Bruin Creek & Site 23/D Wells



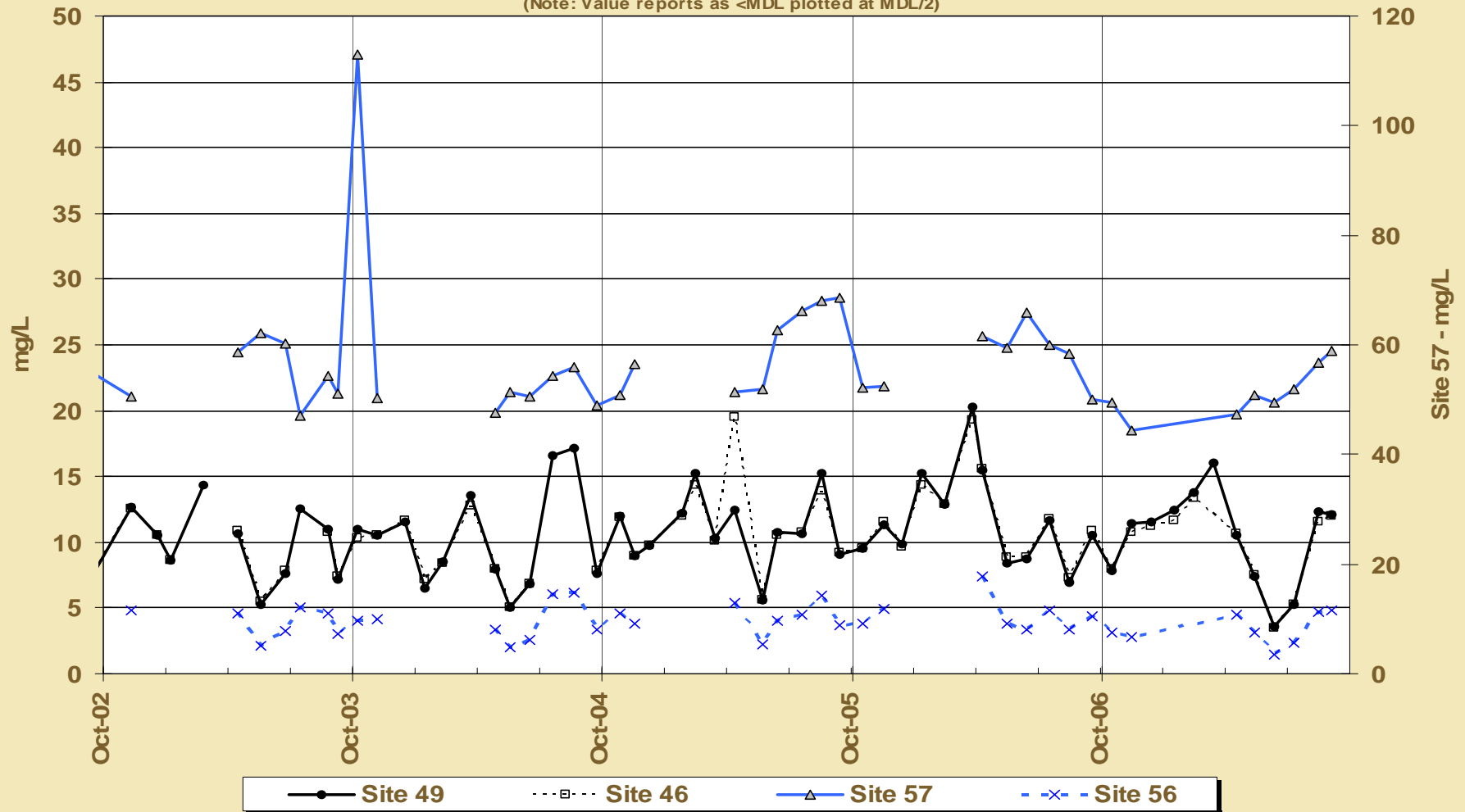
- No measured parameters exceeded AWQS for the Bruin Creek sites (49 & 46) or for the Site 23/D wells (57 & 56).

Site 23 Area - Specific Conductance



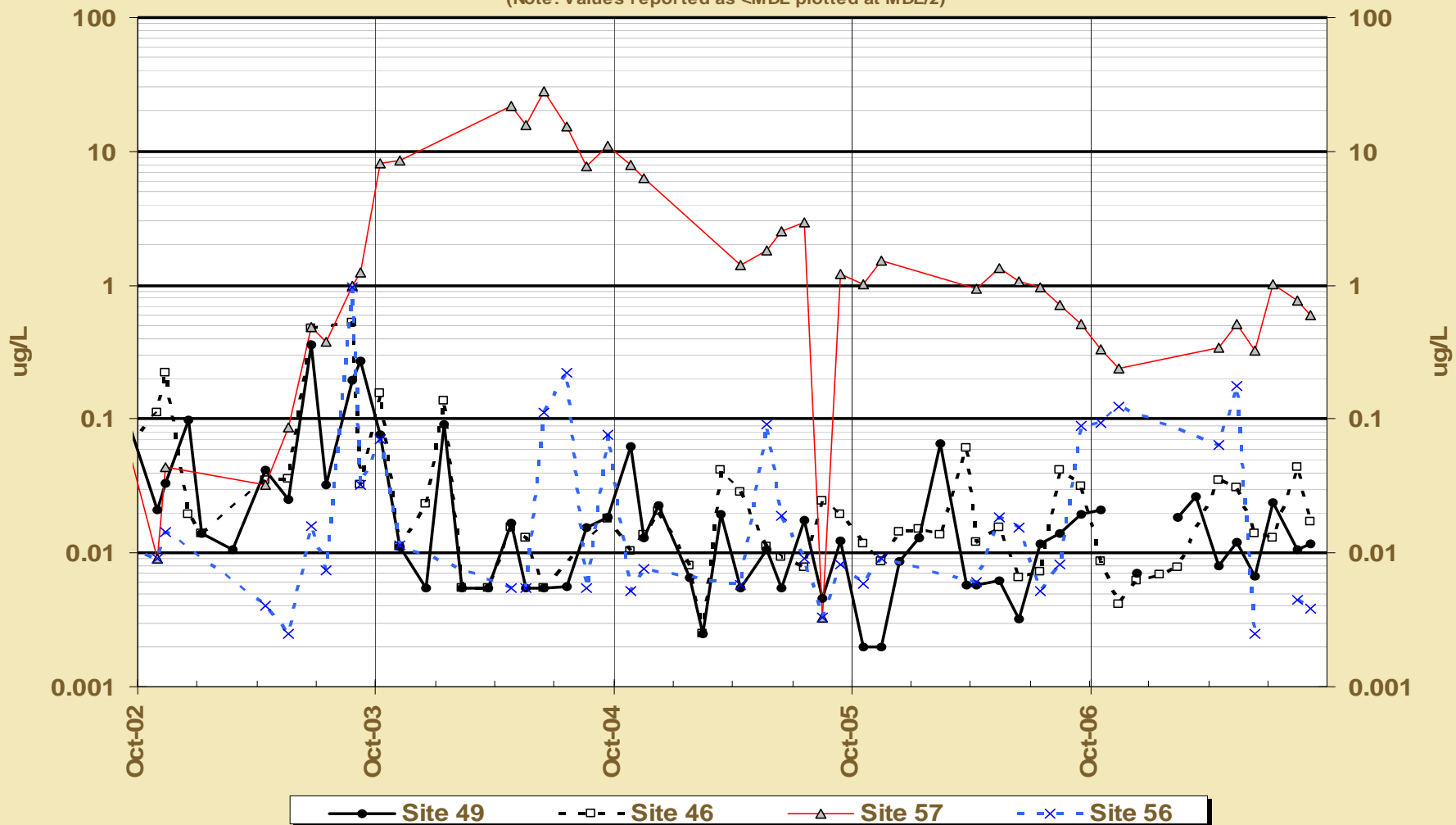
Site 23 Area - Total Sulfate

(Note: Value reports as <MDL plotted at MDL/2)



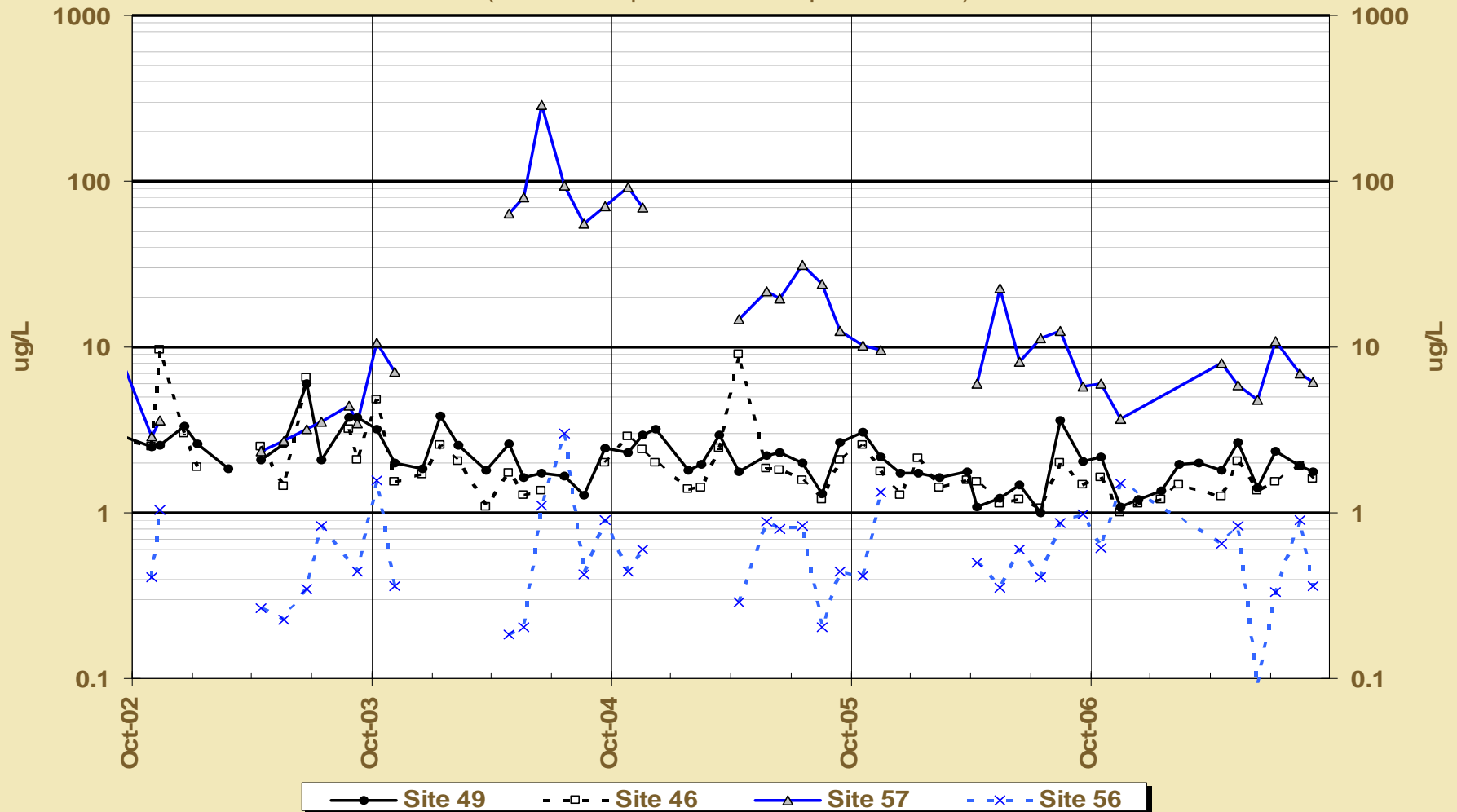
Site 23 Area - Dissolved Lead

(Note: Values reported as <MDL plotted at MDL/2)



Site 23 Area - Dissolved Zinc

(Note: Values reported as <MDL are plotted at 1/2MDL)



Bruin Creek - Site 23 - D Wells Statistical Testing (pH graphs)

Mann-Kendall Seasonal Trend Test Probabilities

2007 Water Year

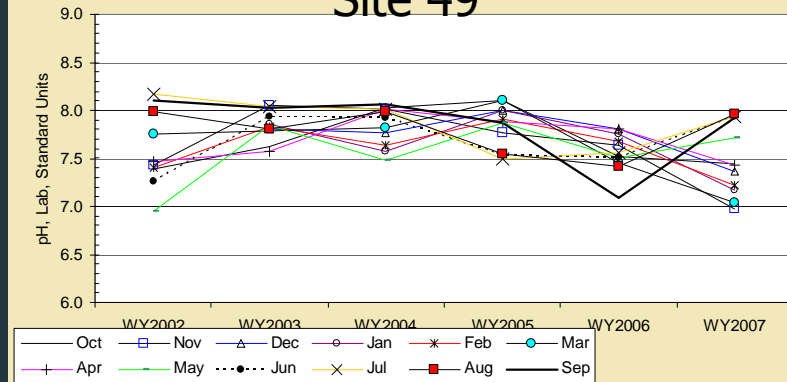
Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
49	0.37	0.02	0.32	0.84	<0.01
46	0.65	<0.01	0.84	0.83	<0.01
57	<0.01	0.16	0.01	0.37	0.77
56	0.14	0.09	0.56	0.50	0.55

Site 49: Q= -0.04 su/yr ; Q(Zn)= -0.16 ug/L/yr

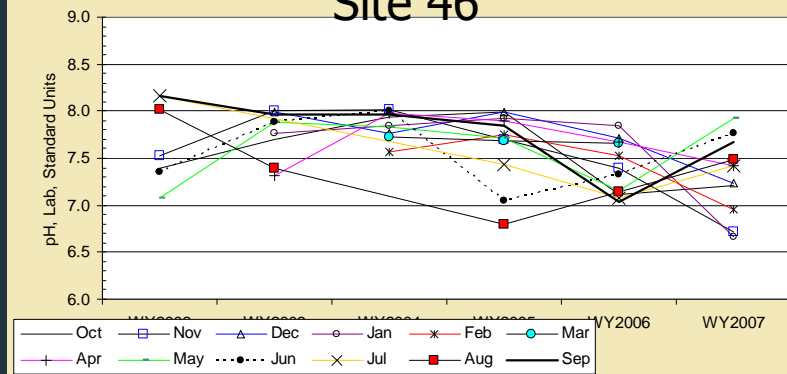
Site 46: Q= -0.09 su/yr, Q(Zn)= -0.21 ug/L/yr

Site57: Q=-10 uS/cm/yr ; Q(Alk)= -2 mg/L/yr

Site 49



Site 46



Bruin Creek - Site 23 - D Wells Statistical Testing (Dissolved Zinc)



Mann-Kendall Seasonal Trend Test Probabilities

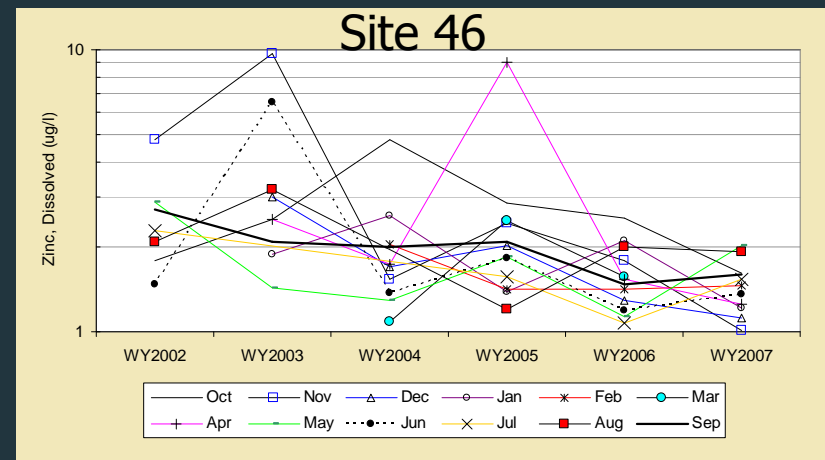
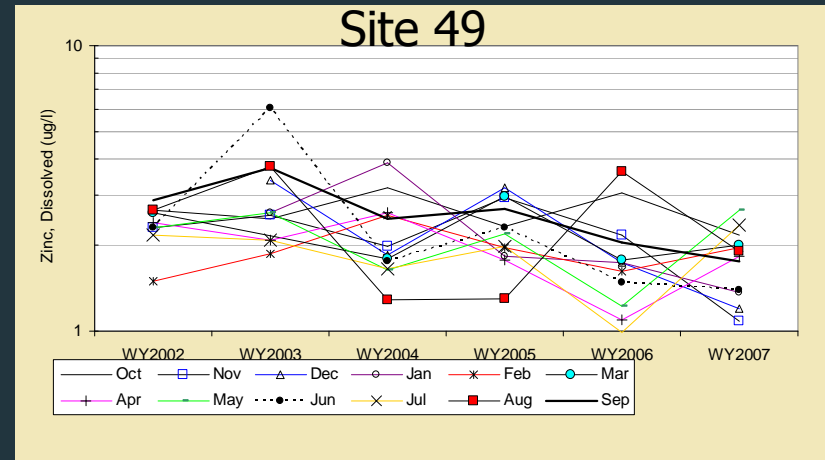
2007 Water Year

Site	Cond.	pH	Alkalinity	Sulfate	Diss.-Zinc
49	0.37	0.02	0.32	0.84	<0.01
46	0.65	<0.01	0.84	0.83	<0.01
57	<0.01	0.16	0.01	0.37	0.77
56	0.14	0.09	0.56	0.50	0.55

Site 49: Q= -0.04 su/yr ; Q(Zn)= -0.16 ug/L/yr

Site 46: Q= -0.09 su/yr, Q(Zn)= -0.21 ug/L/yr

Site57: Q=-10 uS/cm/yr ; Q(Alk)= -2 mg/L/yr



Greens Creek, 920 Area, Bruin Creek, Site 23/D Wells Statistical Testing (Comparison of Means)



2007 Water Year					
Comparison of Medians, Signed-Rank Test Probabilities					
Sites	Cond.	pH	Alkalinity	SO ₄	Diss-Zinc
6 - 48	<0.01	1.00	<0.01	<0.01	<0.01
54 - 6	<0.01	1.00	0.10	<.01	0.85
Calculated Medians					
Site	Cond. (uS/cm)	pH (su)	Alkalinity (mg/l)	SO ₄ (mg/l)	Diss-Zinc (ug/l)
48	110	7.50	42.6	11.8	2.29
6	120	7.22	44.3	14.9	4.24
54	122	7.07	45	15.2	3.95

2007 Water Year					
Comparison of Medians, Signed-Rank Test Probabilities					
Sites	Cond.	pH	Alkalinity	SO ₄	Diss-Zinc
46 - 49	0.46	1.00	0.55	0.94	1.00
56 - 57	1.00	0.99	1.00	1.00	1.00
Calculated Medians					
Site	Cond. (uS/cm)	pH (su)	Alkalinity (mg/l)	SO ₄ (mg/l)	Diss-Zinc (ug/l)
46	143	7.44	61.7	11.5	1.87
49	142	7.42	59	10.8	1.46
56	359	7.55	141	50.2	6.04
57	135	7.42	52.8	7.5	0.63



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GREENS CREEK