



MEMORANDUM

TO: Byron O'Connor, Project Manager; Eric Domingue, Project Manager
DATE: November 3rd, 2013
FROM: Tracey Parkin; Environmental Coordinator
SUBJECT: Elevated Zinc Levels in Rose Creek

Background

During periods of Cross Valley Pond (CVP) discharge, samples are collected from the compliance point X5 and from Rose Creek at sampling location X14 on a daily basis. For each sample, the field parameters of Temperature, pH and Conductivity (EC) are recorded. The samples are also analysed for total and dissolved Zinc at the Faro Mine Complex (FMC) Laboratory to ensure that X5 is not exceeding the effluent water quality standard limit of 0.500 mg/L as outlined in Appendix C of the Care and Maintenance contract. An unofficial Zinc limit of 0.150 mg/L has been applied to X14 to prevent loading.

During 2013, X5 experienced Turbidity fluctuations resulting in sporadic discharge events. On October 22nd, 2013, the X5 siphon was opened and since the Turbidity results were compliant discharge took place. Daily analysis, however, revealed that Zinc levels at X14 were above the internal trigger level of 0.100 mg/L and the X5 discharge values resulting in the X5 siphon being turned off. On October 23rd, 2013, the X5 siphon was again turned on and allowed to discharge. Daily analysis once again returned high Zinc levels at X14 which were again above the internal trigger and X5 discharge values. The siphon was turned off and an investigation into potential sources of increased zinc began.

Investigation

On October 23rd, 2013, monitoring took place in Rose Creek upstream of X14 at four (4) locations, R10, X2, X3A and X10, to determine potential sources for increased Zinc. Influences into Rose Creek were also monitored at five (5) locations: X11, X12, Weir 3, X13 and NWID. Field parameters of Temperature, pH and EC were recorded and total and dissolved Zinc analysis took place at the FMC Laboratory. Samples were analysed on October 24th, 2013, and the subsequent results displayed elevated Zinc values first occurring at X2 and continuing downstream to X14.

As the S-Wells lie downstream of R10 and upstream of X2, it was initially thought that water was escaping the S-Well seepage interceptor system (SIS) and entering Rose Creek. On October 24th, 2013, it was decided to increase flow from SRK08-SPW2 to reduce the water level and hopefully the Zinc in Rose Creek. The X5 siphon was not turned on but samples were collected from X2 and X14 which remained consistent with samples collected on October 23rd, 2013.

On October 28th, 2013, the X5 siphon was turned on and samples were collected from X5, X2 and X14. As sample results stayed consistent and X5 Turbidity was compliant, the siphon remained open and continued to discharge. Also, in the afternoon, SRK08-SPW1 was turned on in an effort to draw down the water level in the SIS.

On October 29th, 2013, SRK08-SPW1 and the X5 siphon continued to run. Samples were



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collected at X2, X5 and X14 and again results remained consistent, thus additional monitoring was planned.

On October 30th, 2013, samples were collected at X2, X5 and X14 with results remaining consistent. Additional monitoring took place between the North Fork Rock Drain and the mine access road at seven (7) locations, NF2, NFRC-SC1, NFRC-SC2, NFRC-SC3, NFRC-SC4, X2b and X2. The banks of the creek were inspected for any surface or seepage locations that could possibly influence Rose Creek. No influences were located and Zinc analysis took place on October 31st, 2013. In addition to monitoring, SRK08-SPW1 was turned off and the pump from SRK08-SPW3 was removed for cleaning and replaced with a spare pump in an effort to increase flow and reduce the water level in the SIS sump.

On October 31st, 2013, samples were collect at X2, X5 and X14 with results remaining consistent. Analysis of the October 30th, 2013, additional monitoring revealed that Zinc levels at NF2 were higher than downstream Rose Creek results and approximately 35 times historic results, therefore the source of the elevated Zinc levels is higher upstream than the S-Wells and possibly the North Fork Rock Drain.

Additional monitoring than took place in Rose Creek before it is influenced by FMC to below the North Fork Rock Drain at seven (7) location, R7, FAROCR, R8, R9, R10, NF1 - Oct and NF2. Again, the banks of the creek were inspected for any surface and seepage locations that could possibly be influencing Rose Creek. Field samplers noted that seeps NE1, NE2 and NE3 were flowing which is not the norm for this time of year. Also, it was noted that sampling location NF1 – Oct smelled of sulphur and “air bubbles” with silt were forming.

Zinc analysis took place on November 1st, 2013 and revealed that R7 – R10 zinc values remained within historic range, NF1 – Oct was approximately 62 times higher than NF1 historic values and NF2 confirmed the original result.

Methodology

All samples were collected in accordance with “Standard Methods for the Examination of Water and Waste Water.”

The field parameters, temperature, pH and Conductivity, were measured with a Hanna combo meter. Conductivity was not recorded at four (4) sampling locations as a high range Hanna Combo pen was used and Conductivity values were too low to register.

Total and dissolved Zinc analysis occurred at the Faro Mine Complex (FMC) Laboratory.

Results

A summary of all field parameters and FMC Laboratory analytical results are located in Appendix A.

Field parameters and FMC Laboratory results are illustrated in Appendix B.

All sampling locations are illustrated in Appendix C.

Appendix A

Tables



Table 1: Rose Creek Historical Averages

Table 1: Rose Creek 10 Year Historical Averages

Site	pH	EC ($\mu\text{S/cm}$)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)
R7	7.95	191.3	0.012	0.009
FAROCR	7.47	69.6	0.020	0.017
R8	7.91	180.5	0.006	0.006
R9	7.94	201	0.006	0.006
R10	7.9	202.4	0.011	0.011
NF1	7.7	178.9	0.040	0.035
NF1 - Oct				
NF2	7.85	200.1	0.021	0.020
NFRC-SC1	7.85	212	0.012	0.012
NFRC-SC2	7.83	214.2	0.014	0.015
NFRC-SC3	7.86	215.2	0.054	0.053
NFRC-SC4	7.86	213.6	0.031	0.030
X2b				
X2	7.84	220.6	0.039	0.037
X3A	7.85	237.8	0.045	0.059
X10	7.98	238.3	0.040	0.036
X11	7.67	2366.7	0.010	0.012
X12	7.91	1235.6	0.007	0.006
Weir 3	7.76	1713.7	0.008	0.010
X13	7.74	1965.6	0.008	0.019
NWID	8.06	296.2	0.022	0.022
X5	7.77	1618.6	0.217	0.179
X14	7.92	505	0.053	0.041



Table 2: Rose Creek Monitoring Results – October 23rd, 2013

Table 2: October 23rd, 2013 - Monitoring Results

Site	Time	Temp °C	pH	EC μS/cm	Total Zinc mg/L	Dissolved Zinc mg/L
R10	2:07 PM	1.2	7.63	253	0.006	0.054
X2	2:59 PM	0.6	7.11	229	0.346	0.398
X3A	1:30 PM	0.4	7.97	246	0.202	0.223
X10	1:50 PM	0.3	8.25	244	0.174	0.187
X11	2:58 PM	3.4	6.70	3063	-0.001	-0.001
X12	2:36 PM	3.3	7.15	163	0.011	0.018
Weir 3	2:45 PM	2.2	6.80	2193	0.009	0.010
X13	3:04 PM	2.3	6.81	2568	0.013	0.014
NWID	3:25 PM	0.2	8.54	398	0.002	0.006
X5	9:25 AM	1.5	7.38	2635	0.136	0.108
X14	3:35 PM	0.7	8.02	383	0.162	0.179



Table 3: Rose Creek Monitoring Results – October 30th, 2013

Table 3: October 30th, 2013 - Monitoring Results

Site	Time	Temp °C	pH	EC μS/cm	Total Zinc mg/L	Dissolved Zinc mg/L
NF2	12:12 PM	0.1	7.54	200	0.753	0.729
NFRC-SC1	12:06 PM	0.2	7.57	200	0.349	0.347
NFRC-SC2	11:50 AM	0.1	7.59	200	0.345	0.331
NFRC-SC3	11:31 AM	<0.0	7.45	220	0.394	0.330
NFRC-SC4	11:04 AM	0.0	7.49	220	0.382	0.332
X2b	10:40 AM	0.4	7.41	250	0.381	0.320
X2	10:30 AM	0.6	8.19	250	0.385	0.331
X5	7:41 AM	1.7	7.50	2394	0.128	0.115
X14	8:24 AM	2.1	7.90	575	0.170	0.143



Table 4: Rose Creek Monitoring Results – October 31st, 2013

Table 3: October 31st, 2013 - Monitoring Results

Site	Time	Temp °C	pH	EC µS/cm	Total Zinc mg/L	Dissolved Zinc mg/L
R7	2:44 PM	0.9	7.11		0.003	0.006
FAROCR	2:40 PM	1.1	7.32		0.001	0.003
R8	2:34 PM	1.8	7.09	130	-0.002	0.000
R9	2:41 PM	1.3	6.96		0.006	0.008
R10	2:10 PM	1.9	6.86		0.006	0.008
NF1 - Oct	1:49 PM	2.0	4.98	1150	2.464	2.363
NF2	12:53 PM	2.5	6.61	300	0.700	0.750

Appendix B

Figures



Figure 1: Rose Creek - pH

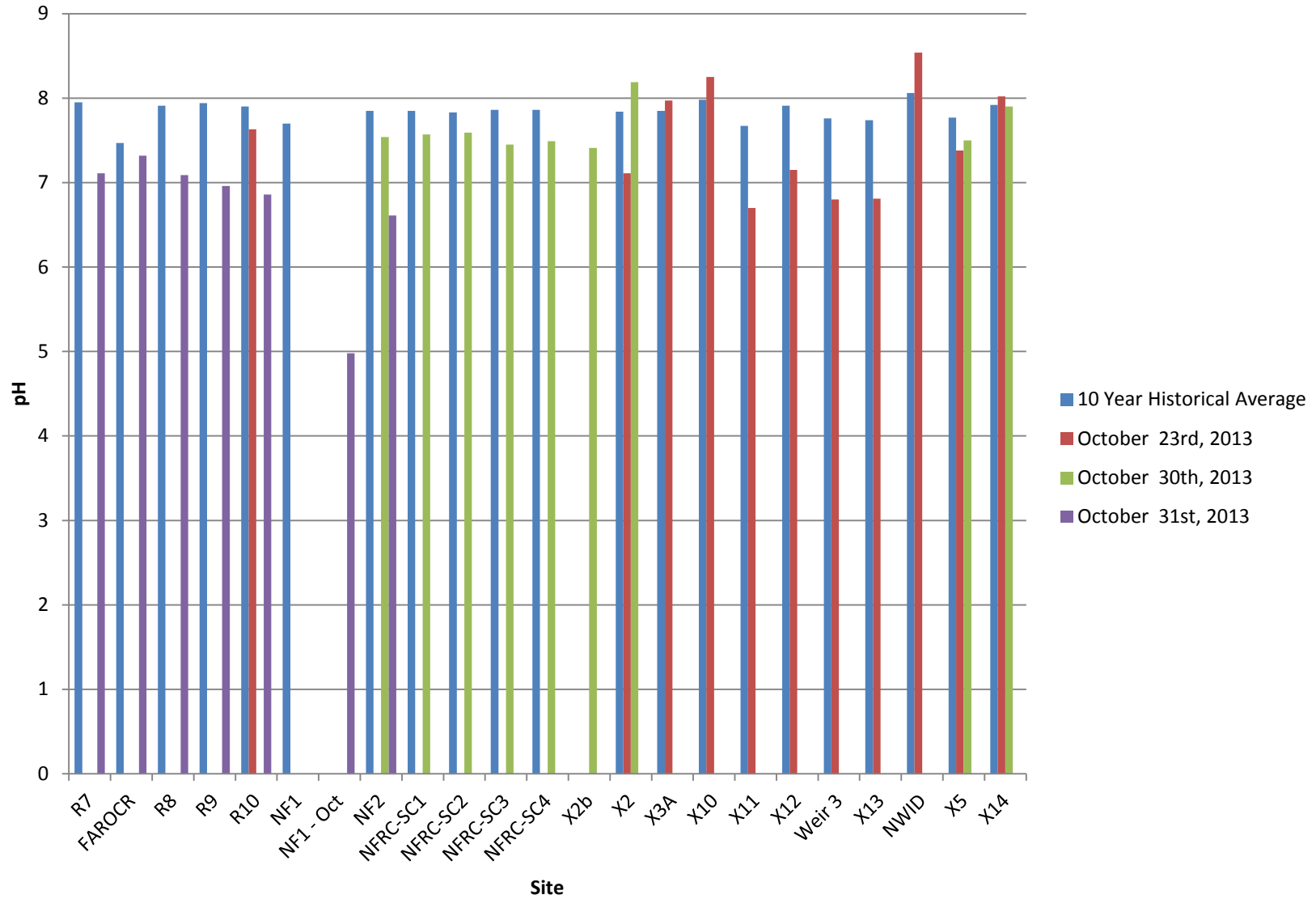




Figure 2: Rose Creek - EC

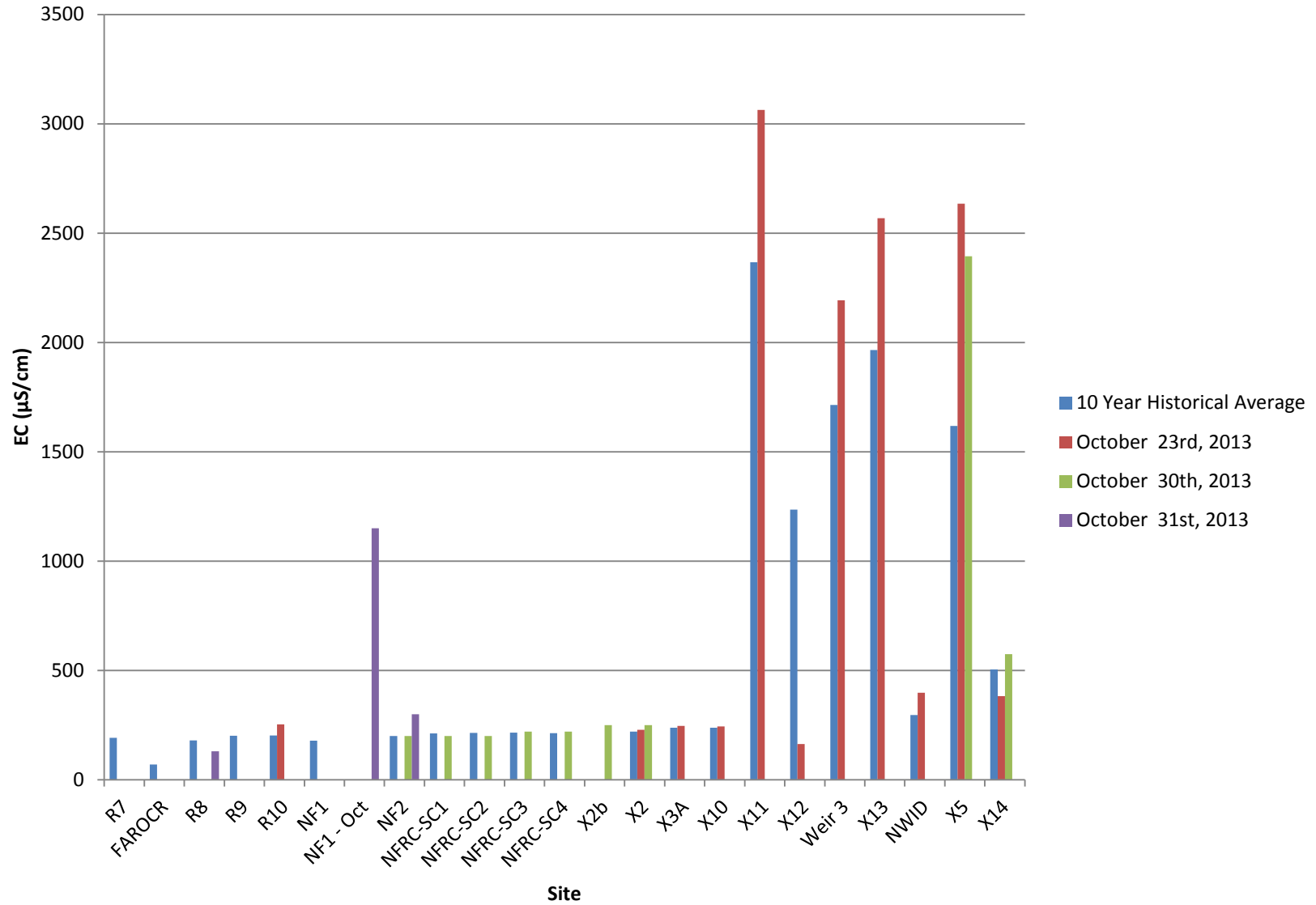




Figure 3: Rose Creek - Total Zinc

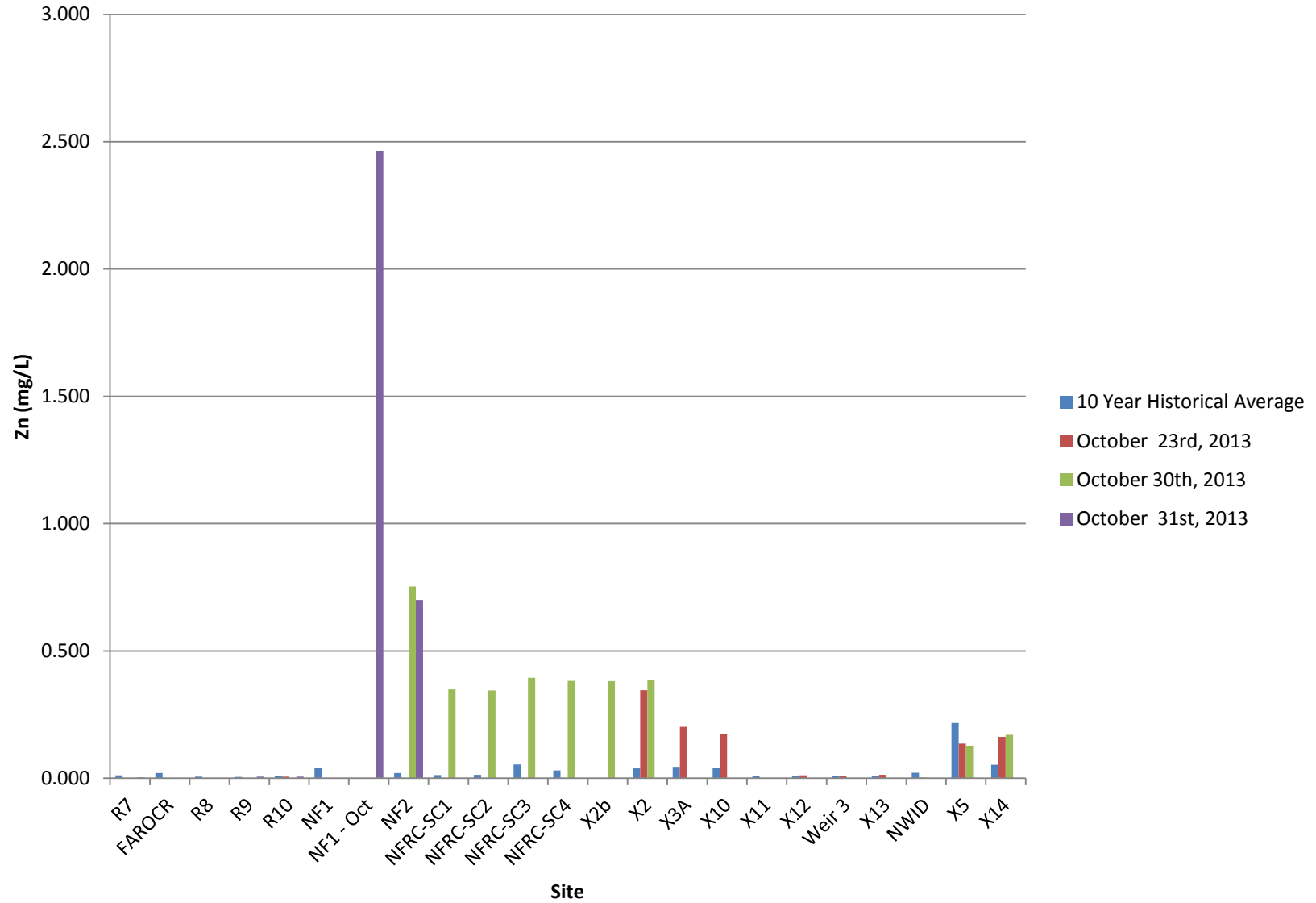
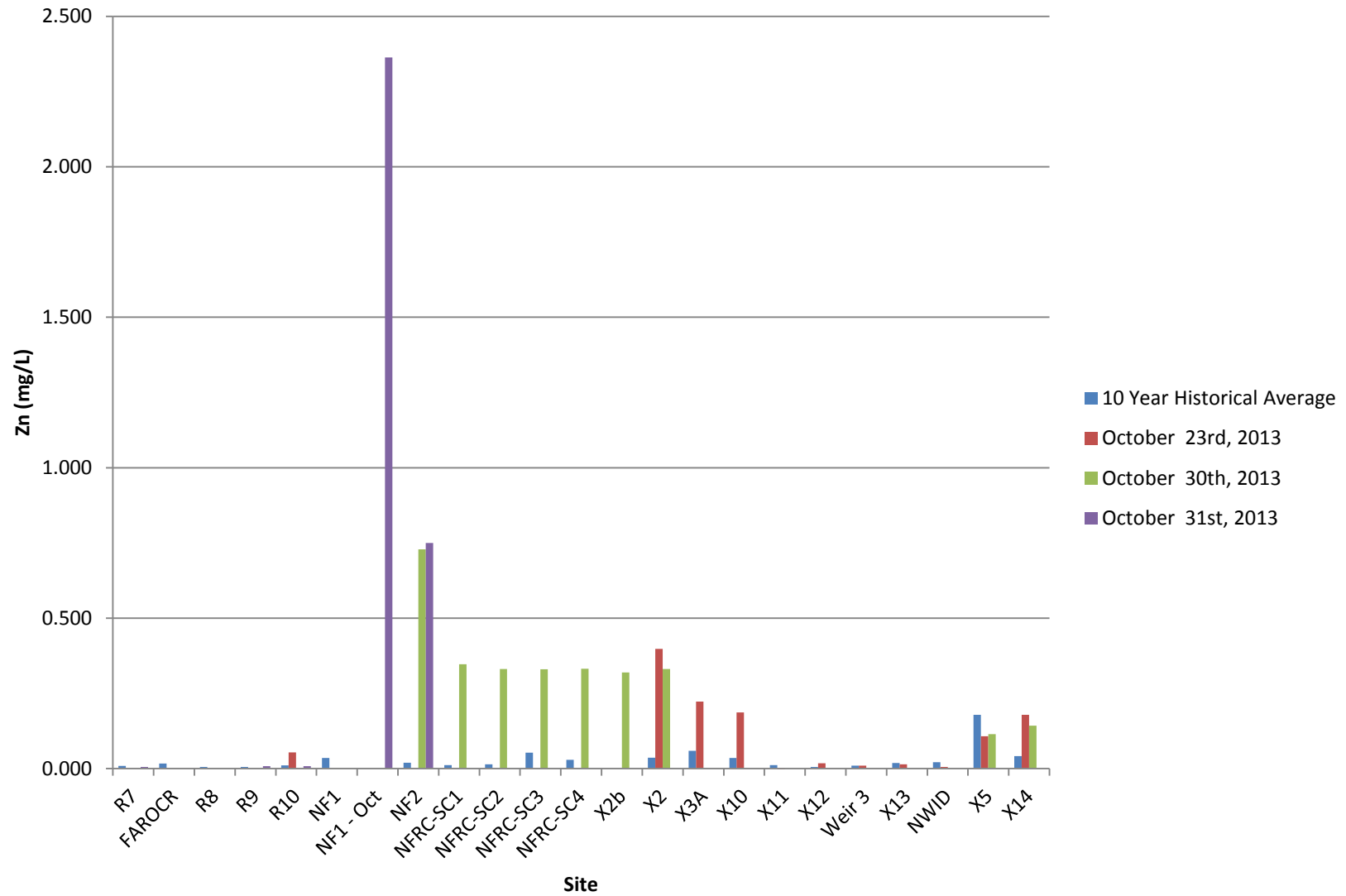




Figure 4: Rose Creek - Dissolved Zinc



Appendix C

Maps



Map Sheet 1: Rose Creek Monitoring Locations

