



MEMORANDUM

TO: Byron O'Connor, Project Manager; Eric Domingue, Project Manager
DATE: November 9th, 2013
FROM: Tracey Parkin; Environmental Coordinator
SUBJECT: Rose Creek Additional Monitoring 1

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.

Details of the investigation and subsequent results have been summarized in a memorandum, "Elevated Zinc Levels in Rose Creek" (Parkin, T. 2013), and submitted to the Yukon Government (YG) on November 4th, 2013. On November 5th, 2013, YG requested increased monitoring to occur in Rose Creek until a further plan has been developed

Monitoring Program

Increased monitoring in Rose Creek was to include the following:

- Twice a week sampling to occur on Monday and Thursday at monitoring locations R8, R9, R10, NF1 - Oct, NF2, X2, X3A, X10 and X14;
- Maxxam Analytics analysis for the full surface water suite outlined in Appendix C of the Care and Maintenance contract with a one (1) day reporting turnaround time;
- In-house sampling to occur Monday – Thursday and Saturday at monitoring locations R8, R9, R10, NF1- Oct, NF2, X2, X3A, X10 and X14 with Zinc and Turbidity analysis to be performed at FMC Laboratory; and
- The field parameters Temperature, pH and Conductivity (EC) will also be recorded for each sample collected.

On November 8th, 2013, an amendment was made to the scope of work and sample collection for Maxxam Analytics was removed.



MEMORANDUM

Methodology

All samples were collected 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.

Results

All sampling locations are illustrated in Appendix A.

A summary of all field parameters are located in Appendix B.

A field parameters are illustrated in Appendix C.

Analytical results available to date are located in Appendix D.

Appendix A

Map



Map Sheet 1: Additional Monitoring Locations



Appendix B

Tables



Table 1: Rose Creek Historical Averages

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Site	pH	EC (μS/cm)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Turbidity (NTU)
R8	7.91	181	0.006	0.006	0.91
R9	7.94	201	0.006	0.006	0.91
R10	7.90	202	0.011	0.011	0.91
NF1	7.70	179	0.040	0.035	
NF2	7.85	200	0.021	0.020	1.00
X2	7.84	221	0.039	0.037	1.12
X3A	7.85	238	0.045	0.059	2.12
X10	7.98	238	0.040	0.036	1.29
X14	7.92	505	0.053	0.041	2.75



Table 2: November 5th, 2013 - Field Parameters

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Site	Time	Temperature (°C)	pH	EC (µS/cm)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Turbidity (NTU)	Comments
R8	11:14 AM	<0.0	7.73	178	0.002	-0.002	0.81	
R9	1:30 PM	0.3	7.62	213			0.86	No in-house sample collected as site was added to scope of work after sample collection was completed.
R10	10:56 AM	<0.0	7.51	207	0.006	0.005	0.91	
NF1 - Oct	10:45 AM	0.0	5.26	1080	2.485	2.804	16.57	Sample taken from location established in October. Strong sulphur like smell at sampling location, sediment in sample and once capped the bottle began to expand.
NF2	10:15 AM	0.7	7.04	276	0.904	0.824	1.94	
X2	9:58 AM	<0.0	7.33	250	0.359	0.329	1.68	
X3A	11:16 AM	0.8	7.00	306	0.505	0.444	13.77	
X10	10:51 AM	0.1	7.30	261	0.215	0.184	2.77	
X14	9:38 AM	0.2	7.47	829	0.186	0.153	8.44	



Table 3: November 6th, 2013 – Field Parameters

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Site	Time	Temperature (°C)	pH	EC (µS/cm)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Comments
R8	9:36 AM	0.1	7.21	178	0.000	-0.002	
R9	9:15 AM	<0.0	7.28	202	0.000	-0.002	
R10	9:05 AM	<0.0	7.19	201	0.011	0.005	
NF1 - Oct	8:54 AM	1.3	5.30	1064	2.437	2.463	Sample taken from location established in October. Strong sulphur like smell at sampling location, sediment in sample and once capped the bottle began to expand.
NF2	9:28 AM	<0.0	7.46	228	0.676	0.631	
X2	9:13 AM	<0.0	7.51	233	0.311	0.283	
X3A	9:00 AM	<0.0	7.47	335	0.513	0.439	
X10	8:48 AM	<0.0	8.25	249	0.190	0.172	
X14	8:38 AM	<0.0	7.74	744	0.163	0.137	



Table 4: November 7th, 2013 – Field Parameters

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Site	Time	Temperature (°C)	pH	EC (µS/cm)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Turbidity (NTU)	Comments
R8	12:56 PM	<0.0	7.47	188	<RDL	<RDL	0.76	
R9	12:33 PM	<0.0	7.48	206	<RDL	<RDL	0.93	
R10	12:22 PM	<0.0	7.54	219	0.007	0.004	0.93	
NF1 - Oct	2:58 PM	<0.0	6.83	0			22.10	Strong sulphur like smell at sampling location, sediment in sample and once capped the bottle began to expand. High range meter used for EC therefore value would not register.
NF2	10:08 AM	<0.0	7.42	245	0.769	0.665	2.53	
X2	12:53 PM	0.2	7.74	242	0.358	0.303	1.33	
X3A	12:39 PM	0.2	7.90	262	0.291	0.203	9.55	
X10	12:23 PM	0.1	8.11	271	0.192	0.157	1.97	
X14	11:43 AM	0.1	7.77	845	0.162	0.136	7.09	



Table 5: November 9th, 2013 – Field Parameters

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Site	Time	Temperature (°C)	pH	EC (µS/cm)	Total Zinc (mg/L)	Dissolved Zinc (mg/L)	Comments
R8	9:24 AM	<0.0	7.72	7	<RDL	<RDL	EC was rechecked. Value verified.
R9	9:26 AM	<0.0	7.42	224	<RDL	<RDL	
R10	9:17 AM	<0.0	6.74	271	0.003	0.002	
NF1 - Oct	9:37 AM	0.1	5.51	1092	2.081	2.269	Sample taken from location established in October.
NF2	10:04 AM	<0.0	7.02	294	0.563	0.502	
X2	8:46 AM	0.3	7.61	261	0.304	0.321	
X3A	8:36 AM	0.2	7.85	278	0.186	0.176	
X10	8:24 AM	0.1	7.85	273	0.209	0.178	
X14	8:13 AM	0.2	7.50	1010	0.172	0.135	

Appendix C

Figures



Figure 1: pH

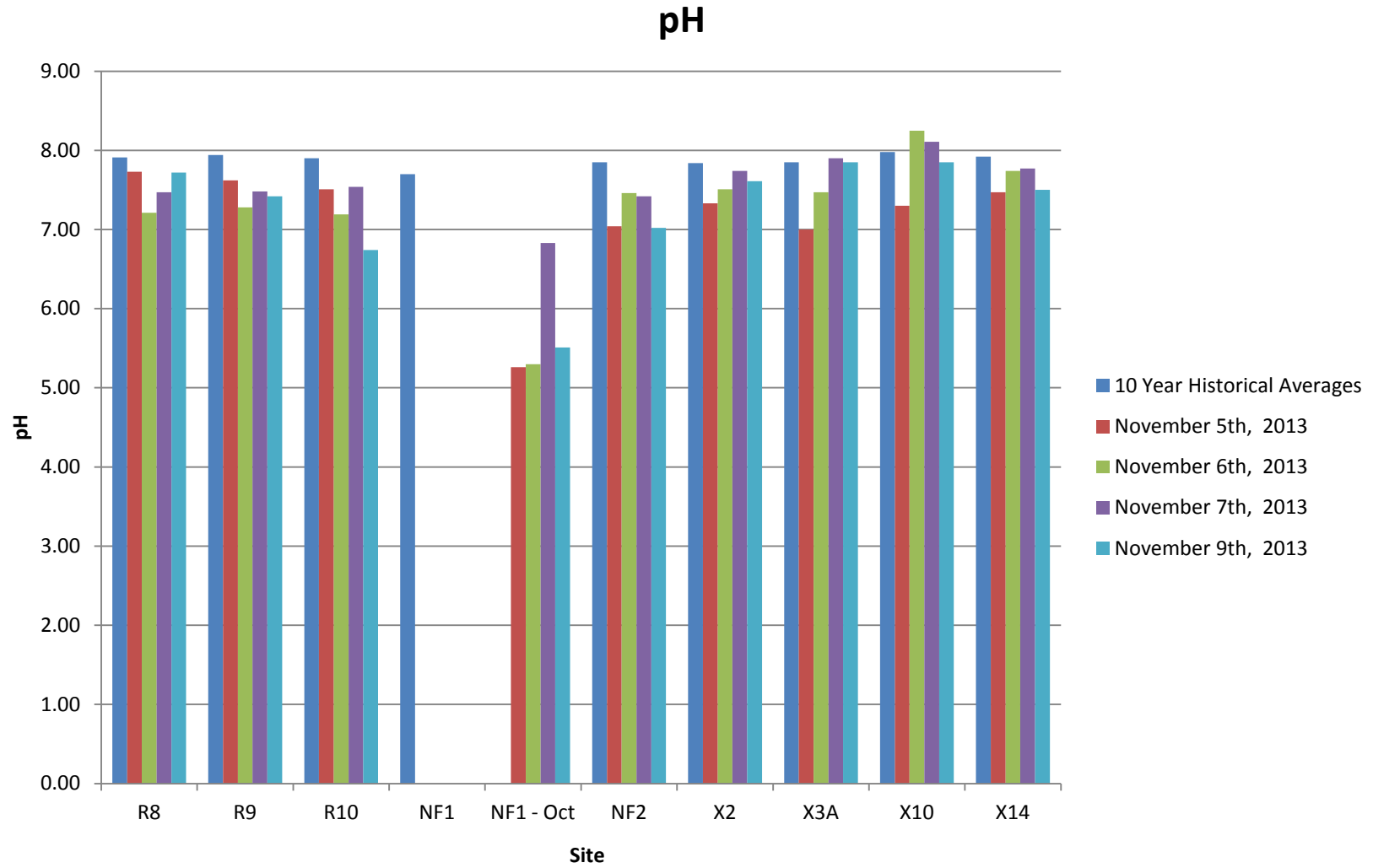




Figure 2: EC

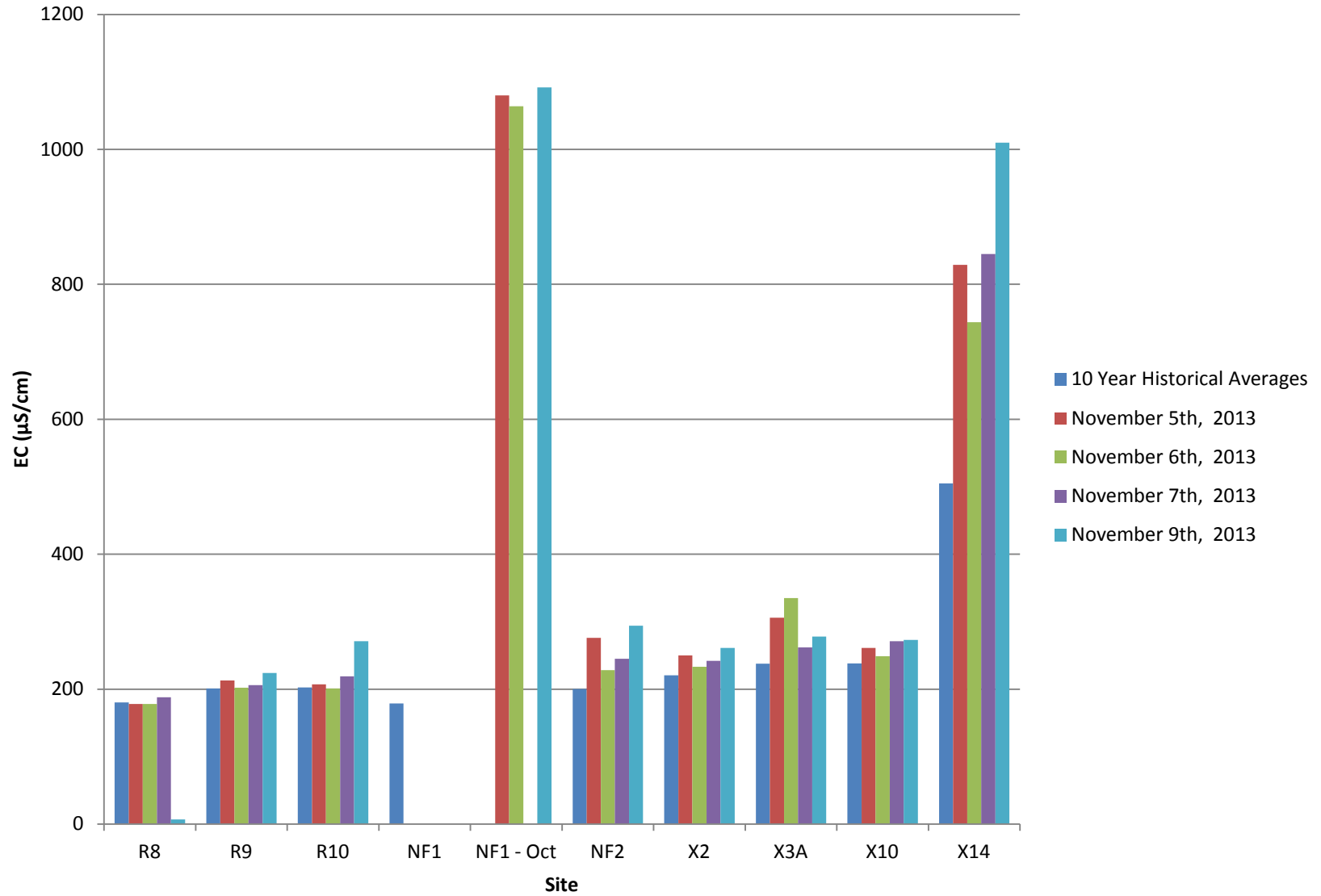




Figure 3: Total Zinc

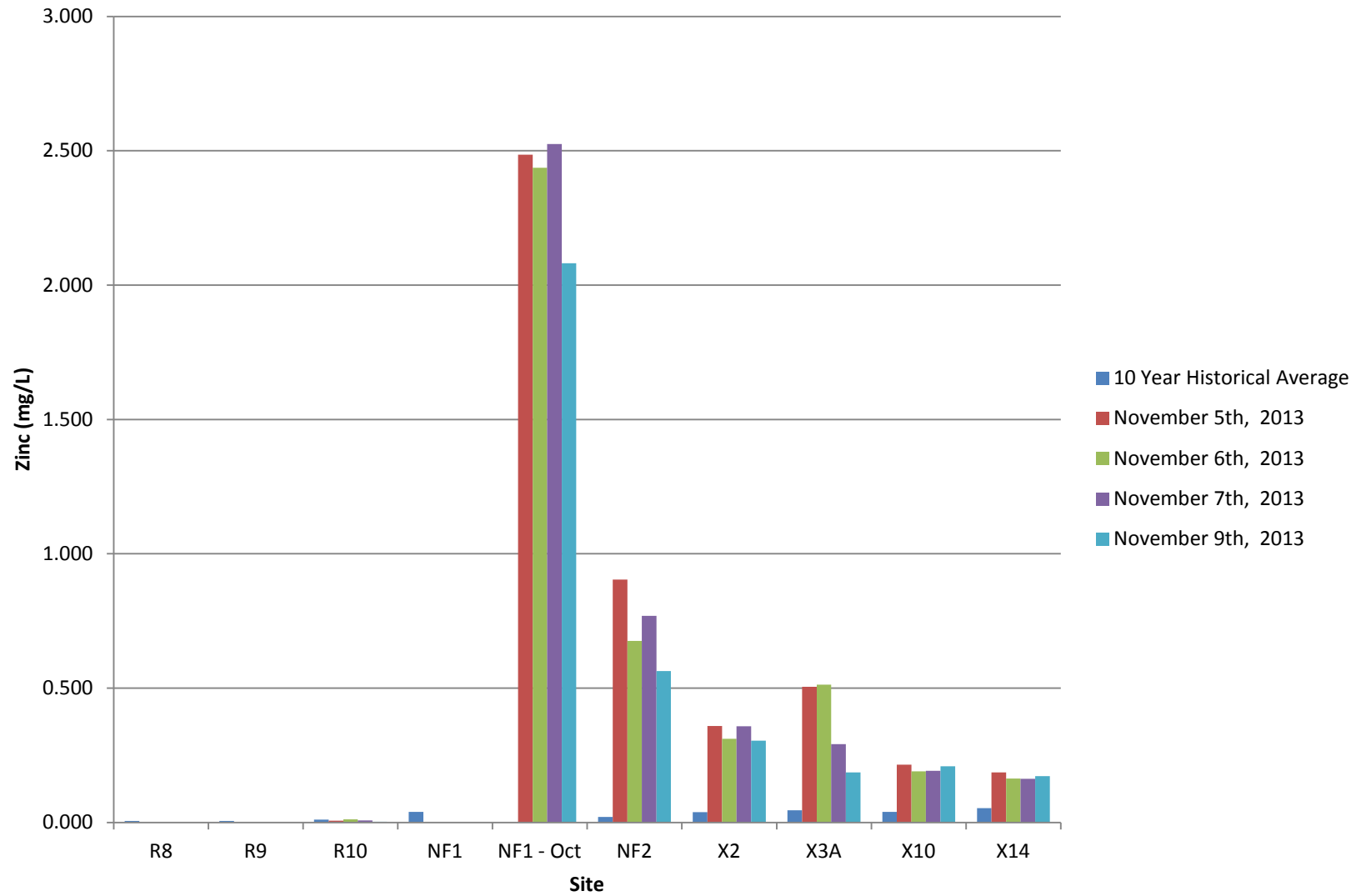




Figure 4: Dissolved Zinc

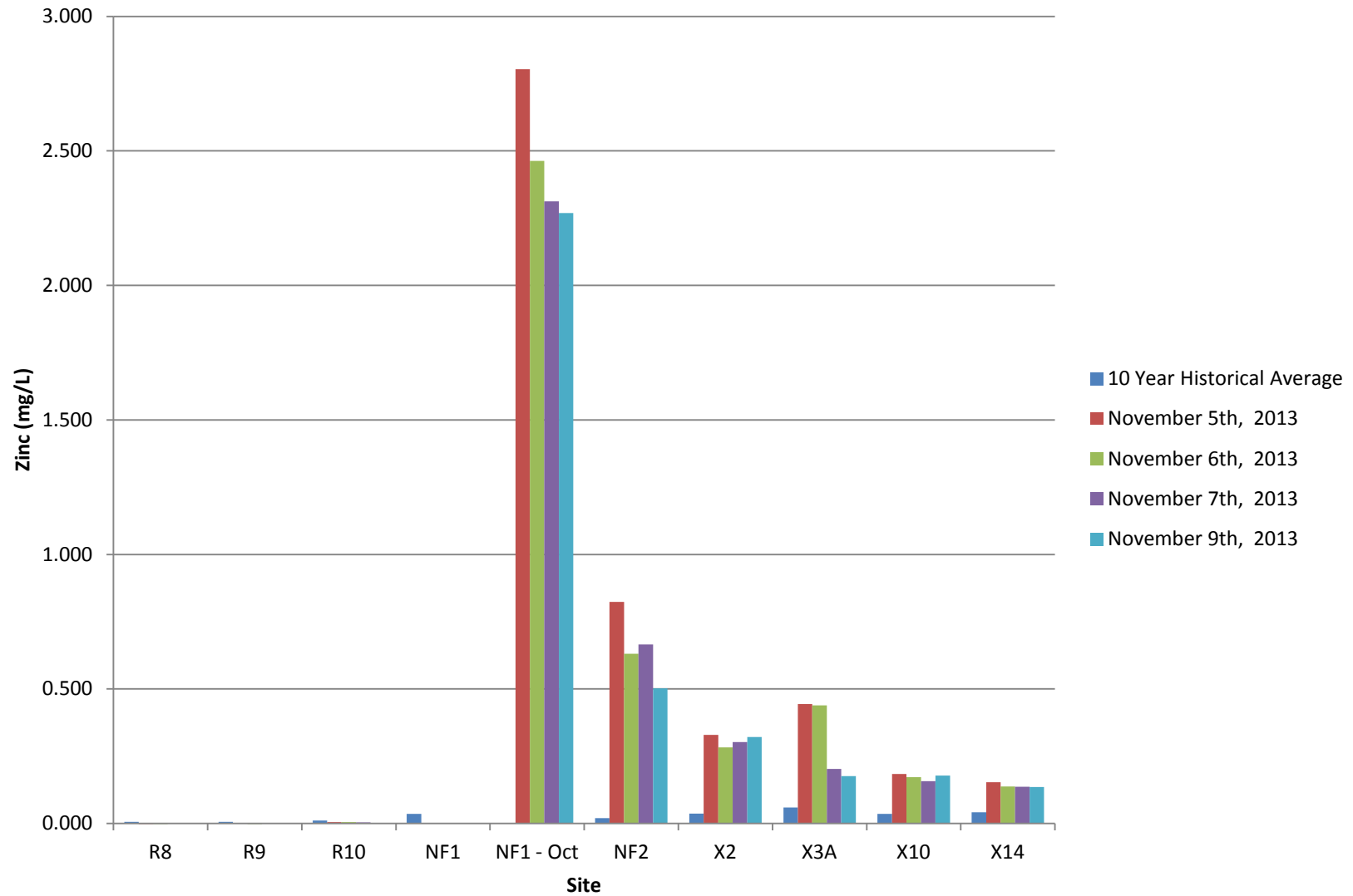
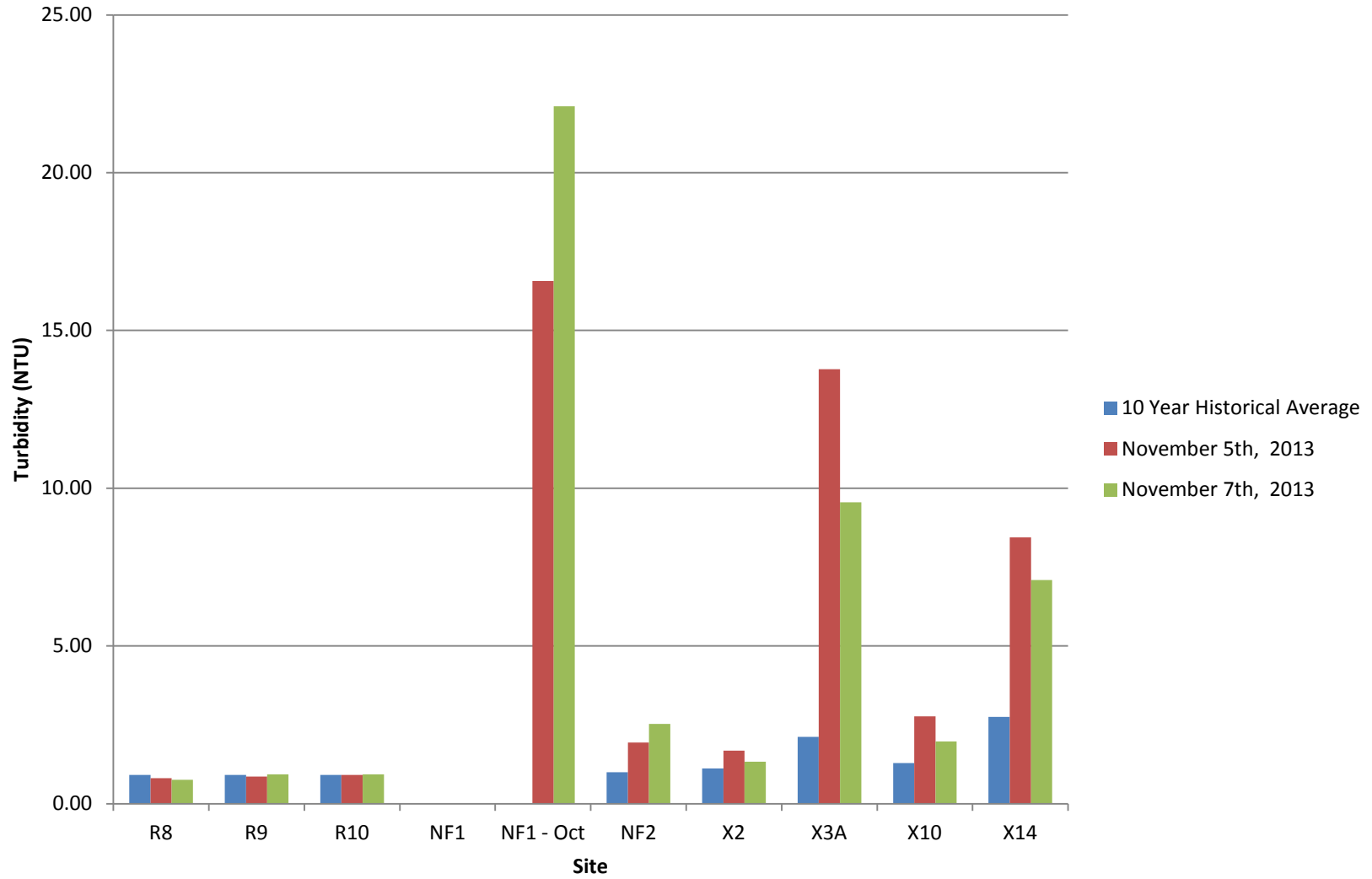




Figure 5: Turbidity



Appendix D

Analytical Results



**Rose Creek Additional Monitoring 1 - Maxxam Analytics Results
General Chemistry**

Rose Creek Drainage																									
Station	Date	Sample Type	ALK mg/L	ALKPP mg/L	CaCO3 mg/L	CaCO3-d mg/L	Chloride mg/L	CO3 mg/L	COND µmho/cm	CONDf µS/cm	DOC mg/L	HCO3 mg/L as CaCO3	Ion Balance	NH3 mg/L	NO2 mg/L	NO2/3 mg/L	NO3 mg/L	OH mg/L	pH	pHF	SO4-d mg/L	TDS mg/L	TEMP-F °C	TOC mg/L	TSS mg/L
NF1 - Oct	11/5/2013	Surface	347.00	<0.5	517	474	1.10	<0.5	1070.0		3.9	423.0	0.97	0.23	<0.5	<2.0	<2.0	<0.5	6.10		229.0	788.00		9.72	755
NF2	11/5/2013	Surface	97.70	<0.5	124	127	<0.5	<0.5	243.0	276.0	1.9	119.0	1.10	0.02	<0.5	<2.0	<2.0	<0.5	7.69	7.04	28.6	150.00	0.70	2.19	5
R10	11/5/2013	Surface	94.10	<0.5	110	115	<0.5	<0.5	213.0	207.0	2.1	115.0	1.10	0.01	<0.5	<2.0	<2.0	<0.5	7.87	7.51	15.2	150.00	0.00	2.15	2
R9	11/5/2013	Surface	92.90	<0.5	115	112	<0.5	<0.5	211.0	213.0	2.0	113.0	1.10	0.01	<0.5	<2.0	<2.0	<0.5	7.85	7.62	14.3	94.00	0.30	2.14	<1.0
X10	11/5/2013	Surface	113.00	<0.5	147	148	0.61	<0.5	272.0	261.0	1.8	138.0	1.10	0.02	<0.5	<2.0	<2.0	<0.5	7.97	7.30	28.3	184.00	0.10	2.11	<1.0
X14	11/5/2013	Surface			447	458	0.84		818.0	829.0	1.7		1.20	0.14	<0.5	<2.0	<2.0		7.88	7.47		586.00	0.20	2.16	4
X2	11/5/2013	Surface	97.80	<0.5	127	127	<0.5	<0.5	237.0	250.0	2.0	119.0	1.10	0.01	<0.5	<2.0	<2.0	<0.5	7.81	7.33	24.2	146.00	0.00	2.19	1
X3A	11/5/2013	Surface	102.00	<0.5	133	139	0.67	<0.5	262.0	306.0	1.7	125.0	1.10	0.02	<0.5	<2.0	<2.0	<0.5	7.76	7.00	28.1	146.00	0.80	2.21	5



Rose Creek Additional Monitoring 1 - Maxxam Analytics Results
Dissolved Metals

Rose Creek Drainage																																			
Station	Date	Sample Type	Ag-d µg/L	Al-d µg/L	As-d µg/L	Ba-d µg/L	B-d µg/L	Be-d µg/L	Bi-d µg/L	Ca-d mg/L	Cd-d µg/L	Co-d µg/L	Cr-d µg/L	Cu-d µg/L	Fe-d µg/L	K-d mg/L	Li-d mg/L	Mg-d mg/L	Mn-d µg/L	Mo-d µg/L	Na-d mg/L	Ni-d µg/L	Pb-d µg/L	Sb-d µg/L	S-d mg/L	Se-d µg/L	Si-d µg/L	Sn-d µg/L	Sr-d µg/L	Ti-d µg/L	Tl-d µg/L	U-d µg/L	V-d µg/L	Zn-d µg/L	Zr-d µg/L
NF1 - Oct	11/5/2013	Surface	<0.005	81.90	0.86	135.00	<50.0	0.07	<0.005	123.00	1.84	105.00	0.31	0.28	27700.00	3.46	0.04	40.50	6780.00	0.12	11.90	45.30	0.58	0.03	83.90	<0.04	13600.00	<0.2	693.00	<0.5	0.08	1.04	<0.2	2200.00	0.17
NF2	11/5/2013	Surface	<0.005	9.50	0.60	60.20	<50.0	<0.01	<0.005	35.50	0.43	4.15	<0.1	0.42	274.00	0.85	0.01	9.36	252.00	0.62	2.72	6.71	1.07	0.07	9.50	0.37	6240.00	<0.2	149.00	<0.5	0.00	1.63	<0.2	918.00	<0.1
R10	11/5/2013	Surface	<0.005	5.07	0.49	56.70	<50.0	<0.01	<0.005	35.30	0.01	0.05	<0.1	0.42	94.00	0.79	0.00	6.62	26.10	0.59	2.41	0.51	0.07	0.07	5.90	0.35	6410.00	<0.2	134.00	<0.5	<0.002	1.60	<0.2	8.02	<0.1
R9	11/5/2013	Surface	<0.005	4.46	0.52	53.80	<50.0	<0.01	<0.005	33.70	0.01	0.03	<0.1	0.41	92.70	0.80	0.00	6.71	23.50	0.64	2.47	0.39	0.07	0.06	4.80	0.33	6240.00	<0.2	134.00	<0.5	<0.002	1.60	<0.2	2.63	<0.1
X10	11/5/2013	Surface	<0.005	2.78	0.29	61.40	<50.0	<0.01	<0.005	43.80	0.08	0.82	<0.1	0.38	257.00	0.94	0.00	9.46	130.00	0.55	2.53	1.84	0.37	0.07	9.10	0.36	5840.00	<0.2	173.00	<0.5	<0.002	2.00	<0.2	199.00	<0.1
X14	11/5/2013	Surface	<0.005	1.74	0.21	56.90	<50.0	<0.01	<0.005	136.00	0.09	13.20	<0.1	0.33	366.00	1.93	0.01	28.60	7590.00	0.57	7.46	10.50	0.10	0.06	101.00	0.34	6310.00	<0.2	388.00	<0.5	0.01	2.74	<0.2	160.00	<0.1
X2	11/5/2013	Surface	<0.005	5.86	0.55	56.60	<50.0	<0.01	<0.005	37.00	0.17	1.73	<0.1	0.44	194.00	0.86	0.01	8.44	175.00	0.64	2.64	3.15	1.01	0.08	9.50	0.32	6410.00	<0.2	142.00	<0.5	<0.002	1.75	<0.2	365.00	<0.1
X3A	11/5/2013	Surface	<0.005	2.55	0.27	57.70	<50.0	<0.01	<0.005	40.60	0.09	1.02	<0.1	0.40	2140.00	1.02	0.00	9.08	181.00	0.49	2.63	2.10	0.47	0.06	12.50	0.34	5710.00	<0.2	172.00	<0.5	0.00	1.91	<0.2	420.00	<0.1



Rose Creek Additional Monitoring 1 - Maxxam Analytics Results
Total Metals

Rose Creek Drainage																																			
Station	Date	Sample Type	Ag µg/L	Al µg/L	As µg/L	B µg/L	Ba µg/L	Be µg/L	Bi µg/L	Ca mg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe µg/L	K mg/L	Li mg/L	Mg mg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	S mg/L	Sb µg/L	Se µg/L	Si µg/L	Sn µg/L	Sr µg/L	Ti µg/L	Tl µg/L	U µg/L	V µg/L	Zn µg/L	Zr µg/L
NF1 - Oct	11/5/2013	Surface	0	3450	7	<50.0	213.000	0.51	0.05	137.00	3.79	125.0000	2.8100	16.6000	35200.00	4.05	0.05	42.80	7470.000	0.155	12.40	74.8000	76.7	93.80	0.0790	0.1160	14700.00	<0.2	716.00	46.7000	0.2030	4.1300	8.5100	2730.0	0.75
NF2	11/5/2013	Surface	<0.005	42.50	1	<50.0	62.300	<0.01	<0.005	35.10	0.45	4.0900	0.1300	0.7810	506.00	0.85	0.01	8.81	262.000	0.604	2.59	6.6200	6.7600	10.20	0.0770	0.3540	6300.00	<0.2	146.00	1.4600	0.0080	1.6100	<0.2	907.000	<0.1
R10	11/5/2013	Surface	<0.005	14	1	<50.0	52.700	<0.01	<0.005	33.00	0.02	0.0610	0.1200	0.4360	151.00	0.81	0.00	6.65	25.800	0.588	2.43	0.4390	0.2	5.80	0.0650	0.3210	6010.00	<0.2	133.00	0.7400	<0.002	1.5700	<0.2	8.210	<0.1
R9	11/5/2013	Surface	<0.005	14.50	1	<50.0	54.600	<0.01	<0.005	34.90	0.01	0.0440	<0.1	0.4750	147.00	0.83	0.00	6.68	24.700	0.587	2.44	0.3940	0.1560	5.50	0.0660	0.3300	6410.00	<0.2	134.00	<0.5	<0.002	1.5200	<0.2	8.550	<0.1
X10	11/5/2013	Surface	<0.005	7.92	0	<50.0	60.300	<0.01	<0.005	43.00	0.08	0.8330	<0.1	0.4950	551.00	0.98	0.00	9.54	131.000	0.520	2.47	1.8700	1.1200	9.70	0.0760	0.3700	5870.00	<0.2	173.00	<0.5	<0.002	1.9700	<0.2	206.000	<0.1
X14	11/5/2013	Surface	<0.005	10.20	0	<50.0	57.100	<0.01	<0.005	132.00	0.11	13.9000	<0.1	0.3890	1220.00	2.05	0.01	28.80	7530.000	0.593	7.61	10.7000	0.9160	107.00	0.0700	0.3270	6220.00	<0.2	400.00	<0.5	0.0090	2.7200	<0.2	178.000	<0.1
X2	11/5/2013	Surface	<0.005	18.20	1	<50.0	60.900	<0.01	<0.005	36.90	0.18	1.7800	0.1300	0.6520	315.00	0.88	0.01	8.52	179.000	0.642	2.75	3.2700	3.4600	9.20	0.0810	0.3370	6510.00	<0.2	145.00	<0.5	0.0050	1.5800	<0.2	372.000	<0.1
X3A	11/5/2013	Surface	<0.005	14.00	0	<50.0	62.000	<0.01	<0.005	39.40	0.12	1.0100	0.1100	0.5640	3210.00	1.01	0.00	8.48	174.000	0.479	2.48	2.0700	1.8500	11.20	0.0680	0.3350	5830.00	<0.2	177.00	<0.5	0.0040	1.7800	<0.2	441.000	<0.1