Pike Lake Study

A summary of water quality results for "Site D"

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RIDEAU VALLEY
CONSERVATION AUTHORITY

Background

This study was initiated due to concerns of a possible link between elevated nutrient concentrations at site D on Pike Lake (RVL-01D) and the upstream waste management centre (recycling depot) located on Stanleyville Rd. Concerns regarding metal contamination were also raised at this time, though it was noted that metal inputs may be attributed to an old mine that drains into Pike Lake and/or the waste management site. Multiple grab samples were collected at various sites from 2011 to 2013 as shown in Table 1 and analyzed for water chemistry; locations of sites are shown on the accompanying map (figure 1). Spring and fall samples were taken to account for periods when high flow may be more likely to occur, though sampling dates did not necessarily coincide with actual high flow events. All samples were collected by RVCA staff and analyzed by the City of Ottawa Laboratory Services.

Table 1. Water quality sites monitored throughout Pike Lake study (2011-2013)

Site	Description	Dates sampled
Old mine	Creek draining from abandoned mine-potential source of metals	Jul 2011 Sep 2011 April 2012 Nov 2012 Apr 2013
Near old mine	Creek draining into Pike Lake, sampled as Old Mine site could not be accessed	Apr 2013
RVL-01D	Watershed Watch monitoring site located at mouth of creek draining wetland downstream of waste management site	Jul 2011 Sep 2011 Apr 2012 Nov 2012 April 2013
U/S Ref Wet	Creek upstream of reference wetland, sampled since reference wetland (Ref Wet) could not be accessed	April 2013
Ref Wet	Reference wetland sampled to compare to site RVL-01 as a control for a site not under influence of WM	Jul 2011 Sep 2011 Apr 2012 Nov 2012
2nd Ref Wet	Additional reference wetland point, sampled due to field error	Apr 2013
D01-D04	Sites upstream of RVL-01D to assess water quality throughout creek in wetland area	Apr 2012
STA-01	RVCA baseline water quality sites on Stanleyville Rd downstream of WM	April 2011 May 2011 Jun 2011 Jul 2011 Aug 2011 Sep 2011 Apr 2012 Nov 2012 Apr 2013
WM Site	Site monitored upstream of Waste Management site to assess contribution of creek that runs into the WM site	Jul 2011 Apr 2012 Apr 2013

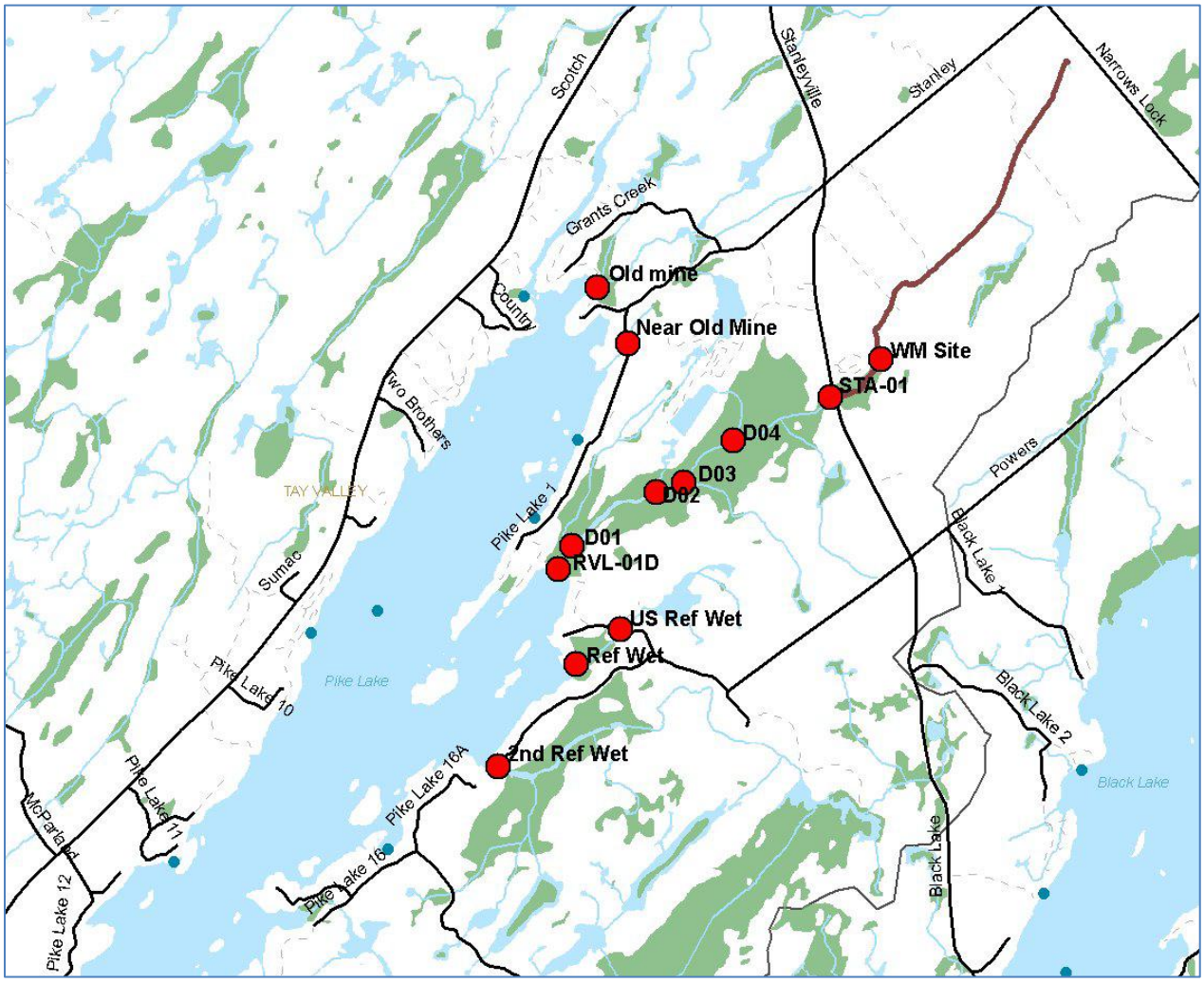

Figure 1. Location of water quality monitoring sites used in Pike Lake study

Results

Table 2 shows the results for nutrients, metals, E. coli and total suspended solids. Only those metals for which there was at least one observed concentration above their respective guideline are shown; for a complete list of the results please refer to Appendix 1. Samples were evaluated against guidelines established by the Provincial Water Quality Objectives (PWQO) and are shown in in table 3. There is no established PWQO for total Kjeldahl nitrogen (TKN) therefore the RVCA guideline of 0.500 mg/l was used for this parameter. The concentrations of analyzed parameters was considered with respect to local precipitation data to observe if rainfall events coincided with elevated concentrations however due to limited data this assumption cannot be supported, this data can be viewed in Appendix 2 (figures 1-5).

Table 2. Selected water quality results, please note shading indicates that the result exceeded the established guideline for the respective parameter.

Date	Site	Aluminum Extractable	Copper Extractable	Iron Extractable	Total Kjeldahl Nitrogen	Total Phosphorus	Total Suspended Solids	E Coli - Total	Zinc Extractable
27-Jul-11	WM SITE	12.4000	0.0240	15.3000	8.900	1.240	165		0.1390
12-Apr-12	WM SITE	0.0085	0.0005	0.0258	0.430	0.020	4	E10	0.0017
11-Apr-13	WM SITE	0.0209	0.0005	0.0500	0.530	0.021	<2	<10	0.0007
20-Apr-11	STA-01	0.0100	0.0046	0.0400	0.420	0.013	2	10	0.0020
31-May-11	STA-01				0.910	0.090	43	50	
20-Jun-11	STA-01				3.500	0.380	132	100	
27-Jul-11	STA-01	0.9900	0.0173	7.2000	7.700	1.122	250	110	0.1110
23-Aug-11	STA-01	3.4000	0.0470	19.1000	9.300	1.100	300	91	0.4000
22-Sep-11	STA-01	0.9800	0.0124	7.8000	4.000	0.440	147	40	0.1430
12-Apr-12	STA-01	0.0077	0.0003	0.0636	0.530	0.038	2	10	0.0024
7-Nov-12	STA-01	0.0098	0.0007	0.3139	0.960	0.117	26	10	0.0010
11-Apr-13	STA-01	0.0126	0.0010	0.0678	0.650	0.033	<2	<10	0.0009
23-Apr-13	STA-01	0.0251	0.0006	0.0858	0.550	0.021	4	2	0.0022
12-Apr-12	D04	0.0165	0.0115	0.0416	0.680	0.026	13	10	0.0039
12-Apr-12	D03	0.0065	0.0002	0.0307	0.580	0.020	2	10	0.0016
12-Apr-12	D02	0.0104	0.0003	0.0317	0.610	0.034	3	10	0.0022
12-Apr-12	D01	0.0087	0.0010	0.0182	0.650	0.024	4	10	0.0019
27-Jul-11	OLD MINE	0.0170	0.0039	0.1710	0.680	0.040	18		0.0030

22-Sep-11	OLD MINE	0.1920	0.0042	0.5600	0.560	0.018	36		0.0050
12-Apr-12	OLD MINE	0.0051	0.0005	0.0198	0.490	0.022*	9	10	0.0012
7-Nov-12	OLD MINE	0.0176	0.0007	0.1356	0.790	0.047	8	10	0.0007
23-Apr-13	OLD MINE	0.0138	0.0005	0.0285	0.430	0.011	<2	22	0.0023
11-Apr-13	Near Old Mine	0.0353	0.0010	0.2458	0.550	0.035	<2	<10	0.0018
27-Jul-11	REFERENCE WETLAND	0.0070	0.0038	0.0120	0.550	0.016	5		0.0020
22-Sep-11	REFERENCE WETLAND	0.0050	0.0018	0.0280	0.470	0.011	2		<0.0010
12-Apr-12	REFERENCE WETLAND	0.0040	0.0002	0.0196	0.410	0.017	5	10	0.0011
7-Nov-12	REFERENCE WETLAND	0.0179	0.0004	0.2810	0.780	0.03*	2	10	0.0010
23-Apr-13	2nd Ref Wet	0.0238	0.0005	0.1107	0.600	0.023*	<2	24	0.0018
11-Apr-13	U/S Ref Wet	0.1008	0.0005	0.7476	0.480	0.027	3	10	0.0008
27-Jul-11	RVL-01 D	0.0070	0.0037	0.0060	0.420	0.011	9		0.0020
22-Sep-11	RVL-01 D	0.0070	0.0021	0.0150	0.420	0.006	2		<0.001
12-Apr-12	RVL-01 D	0.0052	0.0003	0.0258	0.400	0.016	2	10	0.0016
7-Nov-12	RVL-01 D	0.0354	0.0009	0.0645	0.990	0.042	16	10	0.0017
23-Apr-13	RVL-01 D	0.0043	0.0005	0.0191	0.620	0.017	<2	2	0.0016

*Please note that the PWQO for total phosphorus (TP) is 0.030 mg/l in streams and 0.020 mg/l in lakes.

Table 2. Guidelines for selected water quality parameters

Parameter	Guideline (mg/l)	Source
Aluminum (Al)	0.075	Ontario Provincial Water Quality Objectives (PWQO)
Copper (Cu)	0.0005	Ontario Provincial Water Quality Objectives (PWQO)
Iron (Fe)	0.300	Ontario Provincial Water Quality Objectives (PWQO)
Total phosphorus (TP)	0.030	Ontario Provincial Water Quality Objectives (PWQO)
Total Kjeldahl nitrogen (TKN)	0.500	RVCA Guideline

Nutrient concentrations; total phosphorus (TP) and total Kjeldahl nitrogen (TKN) were frequently elevated above their respective guidelines and exceedances were noted at all monitored sites (table 2). A comparison of nutrient concentrations across all monitored sites with respect to guidelines is shown in figure 2.

TKN concentrations at the site of interest, RVL-01D, exceeded guidelines twice (40% of samples) and one TP exceedance (20% of samples) was observed at this site throughout this study. Concentrations at the reference wetland were comparable to RVL-01D (figure 2). Sites D01-D04 do not provide evidence of a pulse of nutrients from STA-01 downstream to RVL-01D, as there is not distinct gradient of concentration but rather variability throughout the creek. However it should be noted that this statement is drawn from a single sampling day and additional data would be needed to make a definitive conclusion. The elevated nutrient concentrations of STA-01 compared to downstream sites (RVL-01D) indicate that the majority of nutrients may be attenuated by the large wetland complex.

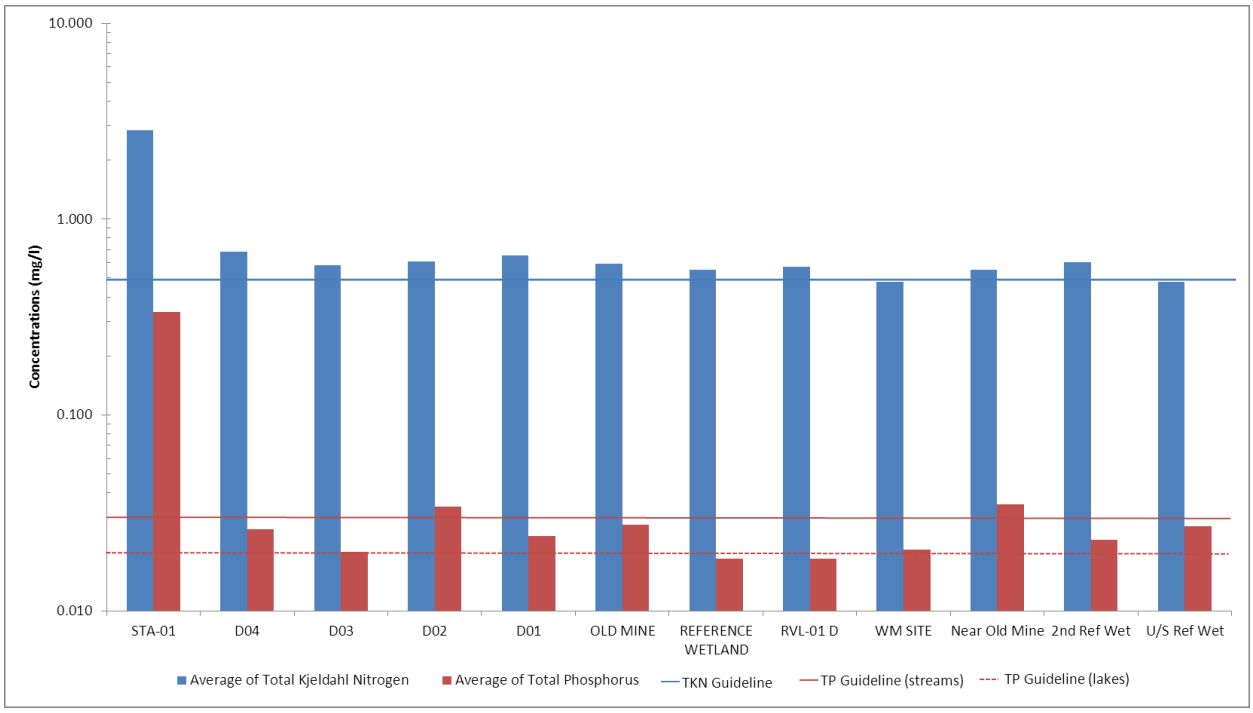

Figure 2. Nutrient concentrations across monitored sites, mean values are shown for STA-01, OLD Mine, Reference Wetland, RVL-01D and WM site all other sites are based on single results value.

In terms of metal concentrations; aluminum, copper and iron most frequently exceeded established guidelines though these exceedances were not observed at all sites (table 2). Metals are often associated with sediment, thus total suspended solids (TSS) concentration have also been included and shows that higher metals concentrations are typically concurrent with high TSS concentrations, and elevated results are more likely to occur during periods of high runoff or erosion events. Given this point it should be noted that the 27 Jul 2011 sample at the WM site (table 2) was taken in very low flow condition and sediment contamination of the sample did occur which likely resulted in higher than normal concentrations of all metals at this site.

No metals were elevated above the guidelines at RVL-01D. There were also few elevated results upstream of RVL-01D; sites D01-D04 had one elevated copper sample and the majority of results for STA-01 were also below guidelines (table 2). Mean concentrations of metals results by site are also shown in figure 3, similarly to the nutrient results comparable trends can be noted between the reference wetland and RVL-01D

As previously noted metal contamination due the influence of an old mine was also of concern in the preliminary stages of this investigation. Elevated concentrations of aluminum and iron were found in the 22 Sep 2011 sample (table 2) however subsequent samples were below guidelines and average concentrations were comparable to other areas of the lake (figure 3).

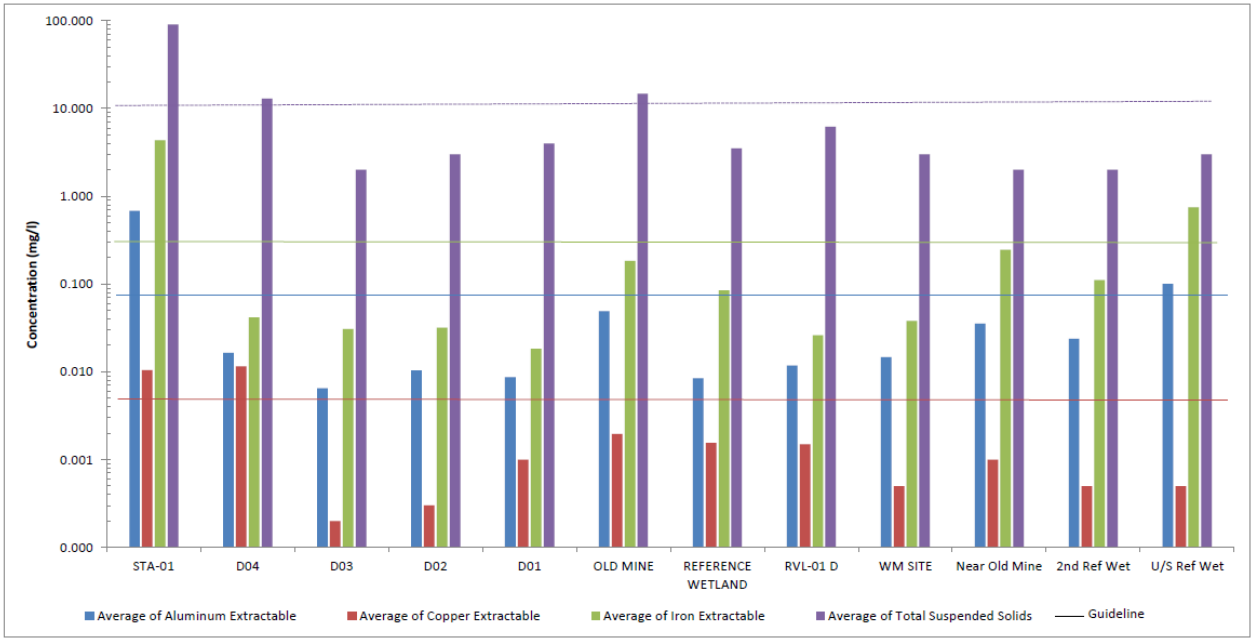

Figure 3. Metal and TSS cocentrations across monitored sites, mean values are shown for STA-01, OLD Mine, Reference Wetland, RVL-01D and WM site all other sites are based on single results value.

Summary

Grab sample water chemistry results showed that there are no elevated metal concentrations at site RVL-01D that may pose a threat to aquatic life. While exceedances have occurred at other sites they are not persistently high. TP and TKN are often elevated at the monitored sites on the lake were not consistent and rarely exceed guidelines at RVL-01D. The recently published Tay River Subwatershed Report and accompanying Pike Lake-Crosby Lake Catchment report reiterate these results indicating that "Good" water quality conditions occur on Pike Lake (http://www.rvca.ca/watershed/subwatershed_reporting/tay/tay.html) as criteria for aquatic health and recreational water quality is generally met with few exceptions.

In order to prevent future deterioration of water quality at RVL-01D and throughout Pike Lake property owners and lake users should continue to employ best management practices to ensure the health of the lake can continued to be enjoyed by all.

Although efforts have been made to ensure the accuracy of the sampling techniques, samples and laboratory analysis; the limited study's objective was to investigate any trends in water quality conditions related to RVL-01D. Any abnormal trends would require further investigation using more rigorous sampling schedules and techniques. We would like to thank the Pike Lake Property Owners Association and Tay Valley Township for their assistance with this study.

Appendix 1

Water quality results from Pike Lake study-highlighted values indicate results exceed established guidelines

Date	Site	Aluminum Extractable	Barium Extractable	Boron Extractable	Copper Extractable	Iron Extractable	Manganese Extractable	Nickel Extractable	Strontium Extractable	Titanium Extractable	Total Kjeldahl Nitrogen	Total Phosphorus	Total Suspended Solids	Uranium Extractable	Vanadium Extractable	Zinc Extractable	Antimony Extractable	Arsenic Extractable	Beryllium Extractable	Bismuth Extractable	Cadmium Extractable	Chromium Extractable	Cobalt Extractable	E.Coli - Total	Lead Extractable	Molybdenum Extractable	Selenium Extractable	Silver Extractable	Thallium Extractable	Tin Extractable	Tungsten Extractable	Zirconium Extractable
27-Jul-11	WM SITE	12.4	0.35		0.024	15.3	1.36	0.011	0.49	1.08	8.9	1.24	165	0.061	0.032	0.139	0.001		0.0064	<0.0005	0.0016	0.023	0.011		0.017	0.0105						
12-Apr-12	WM SITE	0.0085	0.1377	0.0474	0.0005	0.0258	0.0073	0.0013		0.0001	0.43	0.02	4	0.0006	0.0002	0.0017	0.0002	0.0005	0.0001	0.0001	0.0001	0.0002	0.0001	E10	0.0001	0.0007	0.0004	0.0001		0.0001	0.0003	0.0001
11-Apr-13	WM SITE	0.0209	0.0901	0.0242	0.0005	0.05	0.0088	0.0011	0.2741	0.0011	0.53	0.021	2	0.0004	0.0003	0.0007	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.0002	<0.0005	<10	<0.0001	<0.0005	0.0002	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005
20-Apr-11	STA-01	0.01	0.082		0.0046	0.04	0.0038	<0.001		0.0011	0.42	0.013	2	<0.005	0.0007	0.002	0.001		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	10	<0.001	0.002				0.0017		
31-May-11	STA-01										0.91	0.090	43											50								
20-Jun-11	STA-01										3.5	0.380	132											100								
27-Jul-11	STA-01	0.99	0.26		0.0173	7.2	0.47	0.004	0.46	0.052	7.7	1.122	250	0.024	0.0077	0.111			0.0031	<0.0005	0.0011	0.0023	0.0018	110	0.005	0.0071				0.0008		
23-Aug-11	STA-01	3.4	0.47		0.047	19.1	0.72	0.011	0.66	0.171	9.3	1.1	300	0.056	0.0191	0.4	0.001		0.0071	<0.0005	0.003	0.0089	0.0046	91	0.012	0.0104				0.0013		
22-Sep-11	STA-01	0.98	0.23		0.0124	7.8	0.46	0.003	0.52	0.046	4	0.44	147	0.026	0.0057	0.143			0.0026	<0.0005	0.0011	0.002	0.001	40	0.003	0.0059				0.0032		
12-Apr-12	STA-01	0.0077	0.1258	0.0408	0.0003	0.0636	0.0274	0.0013		0.0001	0.53	0.038	2	0.0006	0.0002	0.0024	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	10	0.0001	0.0004	0.0003	0.0001		0.0001	0.0002	0.0001
7-Nov-12	STA-01	0.0098	0.1222	0.0431	0.0007	0.3139	0.1894	0.0023	0.275	0.0007	0.96	0.117	26	0.0003	0.0002	0.001	<0.0002	0.0003	<0.0001	<0.0001	<0.0001	0.0002	0.0002	10	<0.0001	0.0006	<0.0002	<0.0001	<0.0001	<0.0001	0.0007	0.0001
11-Apr-13	STA-01	0.0126	0.078	0.0254	0.001	0.0678	0.0189	0.001	0.2558	0.0006	0.65	0.033	2	0.0005	0.0003	0.0009	<0.0002	0.0004	<0.0001	<0.0001	<0.0001	0.0002	<0.0005	<10	<0.0001	<0.0005	0.0003	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005
23-Apr-13	STA-01	0.0251	0.0921	0.0287	0.0006	0.0858	0.0107	0.0017	0.3162	0.003	0.55	0.021	4	0.0004	0.0004	0.0022	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.0002	<0.0005	2	<0.0001	0.0005	<0.0002	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005
12-Apr-12	D04	0.0165	0.0789	0.0247	0.0115	0.0416	0.0097	0.0009		0.0001	0.68	0.026	13	0.0001	0.0001	0.0039	0.0002	0.0005	0.0001	0.0001	0.0001	0.0002	0.0001	10	0.0001	0.0002	0.0002	0.0001		0.0001	0.0002	0.0001
12-Apr-12	D03	0.0065	0.0971	0.0262	0.0002	0.0307	0.0069	0.001		0.0001	0.58	0.02	2	0.0003	0.0001	0.0016	0.0002	0.0004	0.0001	0.0001	0.0001	0.0002	0.0001	10	0.0001	0.0003	0.0003	0.0001		0.0001	0.0002	0.0001
12-Apr-12	D02	0.0104	0.0981	0.0282	0.0003	0.0317	0.0108	0.0012		0.0001	0.61	0.034	3	0.0003	0.0001	0.0022	0.0002	0.0004	0.0001	0.0001	0.0001	0.0002	0.0001	10	0.0001	0.0003	0.0003	0.0001		0.0001	0.0002	0.0001
12-Apr-12	D01	0.0087	0.0577	0.024	0.001	0.0182	0.0078	0.0007	0.2235	0.0001	0.63	0.024	4	0.0001	0.0001	0.0019	0.0002	0.0004	0.0001	0.0001	0.0001	0.0001	0.0001	10	0.0001	0.0002	0.0002	0.0001		0.0001	0.0002	0.0001
27-Jul-11	OLD MINE	0.017	0.042		0.0039	0.171	0.21	<0.001	0.1	0.0012	0.68	0.04	18	<0.005	0.0005	0.003	0.001		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.001	0.0022				<0.0005		
22-Sep-11	OLD MINE	0.192	0.053		0.0042	0.56	0.41	<0.001	0.102	0.0091	0.56	0.018	36	<0.005	0.001	0.005	0.001		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.001	0.0024				<0.0005		
12-Apr-12	OLD MINE	0.0051	0.0587	0.0169	0.0005	0.0198	0.014	0.0007	0.1286	0.0001	0.49	0.022*	9	0.0001	0.0001	0.0012	0.0002	0.0004	0.0001	0.0001	0.0001	0.0001	0.0001	10	0.0001	0.0002	0.0002	0.0001		0.0001	0.0003	0.0001
7-Nov-12	OLD MINE	0.0176	0.0918	0.0234	0.0007	0.1356	0.1717	0.0012	0.1508	0.0012	0.79	0.047	8	0.0002	0.0004	0.0007	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	10	<0.0001	0.0004	<0.0002	0.0001	<0.0001	0.0002	<0.0002	<0.0001
23-Apr-13	OLD MINE	0.0138	0.0684	0.0144	0.0005	0.0285	0.0075	<0.0001	0.1131	0.0002	0.43	0.011	2	0.0001	0.0002	0.0023	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	22	<0.0001	<0.0005	<0.0002	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005
11-Apr-13	Near Old Mine	0.0353	0.0268	0.0081	0.001	0.2458	0.0338	0.0005	0.0342	0.001	0.55	0.035	2	<0.0001	0.0002	0.0018	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.0002	<0.0005	<10	<0.0001	<0.0005	<0.0002	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005
27-Jul-11	REFERENCE WETLAND	0.007	0.029		0.0038	0.012	0.0196	<0.001	0.093	<0.0005	0.55	0.016	5	<0.005	0.0005	0.002	0.001		<0.0005	0.0007	<0.0005	<0.0005	<0.0005		<0.001	0.0017				<0.0005		
22-Sep-11	REFERENCE WETLAND	0.005	0.029		0.0018	0.028	0.037	<0.001	0.097	<0.0005	0.47	0.011	2	<0.005	<0.0005	<0.001	0.001		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.001	0.0014				<0.0005		
12-Apr-12	REFERENCE WETLAND	0.004	0.0394	0.0149	0.0002	0.0196	0.0145	0.0004	0.1215	0.0001	0.41	0.017	5	0.0001	0.0001	0.0011	0.0002	0.0003	0.0001	0.0001	0.0001	0.0002	0.0001	10	0.0001	0.0002	0.0003	0.0001		0.0001	0.0002	0.0001
7-Nov-12	REFERENCE WETLAND	0.0179	0.0553	0.0126	0.0004	0.281	0.1138	0.0005	0.1743	0.0008	0.78	0.03*	2	<0.0001	0.0001	0.001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	10	<0.0001	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0002	<0.0001
23-Apr-13	2nd Ref Wet	0.0238	0.0319	0.0084	0.0005	0.1107	0.0144	<0.0001	0.089	0.0003	0.6	0.023*	2	<0.0001	0.0002	0.0018	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	24	<0.0001	<0.0005	<0.0002	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005
11-Apr-13	U/S Ref Wet	0.1008	0.0573	0.0092	0.0005	0.7476	0.1285	0.0004	0.0648	0.0065	0.48	0.027	3	<0.0001	0.0004	0.0008	<0.0002	0.0003	<0.0001	<0.0001	<0.0001	0.0003	<0.0005	10	0.0001	<0.0005	<0.0002	<0.0001	<0.0001	<0.0001	<0.0005	<0.0005
27-Jul-11	RVL-01 D	0.007	0.031		0.0037	0.006	0.0123	<0.001	0.098	0.0005	0.42	0.011	9	<0.005	<0.0005	0.002	0.001		<0.0005	0.0006	<0.0005	<0.0005	<0.0005		<0.001	0.0019				<0.0005		
22-Sep-11	RVL-01 D	0.007	0.028		0.0021	0.015	0.0096	<0.001	0.096	<0.0005	0.42	0.006	2	<0.005	<0.0005	<0.001	0.001		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.001	0.0015				<0.0005		
12-Apr-12	RVL-01 D	0.0052	0.0396	0.0149	0.0003	0.0258	0.0202	0.0006	0.1224	0.0001	0.4	0.016	2	0.0001	0.0001	0.0016	0.0002	0.0004	0.0001	0.0001	0.0001	0.0001	0.0001	10	0.0001	0.0002	0.0002	0.0001		0.0001	0.0002	0.0001
7-Nov-12	RVL-01 D	0.0354	0.0463	0.0185	0.0009	0.0645	0.0561	0.0008	0.1496	0.0019	0.99	0.042	16	<0.0001	0.0003	0.0017	<0.0002	0.0003	<0.0001	<0.0001	<0.0001	0.0001	0.0001	10	0.0003	0.0006	<0.0002	<0.0001	<0.0001	0.0002	0.0009	<0.0001
23-Apr-13	RVL-01 D	0.0043	0.0586	0.0225	0.0005	0.0191	0.0059	<0.0001	0.2448	<0.0002	0.62	0.017	2	<0.0001	0.0002	0.0016	<0.0002	<0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	2	<0.0001	<0.0005	<0.0002	<0.0001	<0.0001	<0.0005	<0.0005	<0.0005

*Please note that the guideline from total phosphorus (TP) is 0.030 mg/l in stream and 0.020 mg/l in lakes

Appendix 2

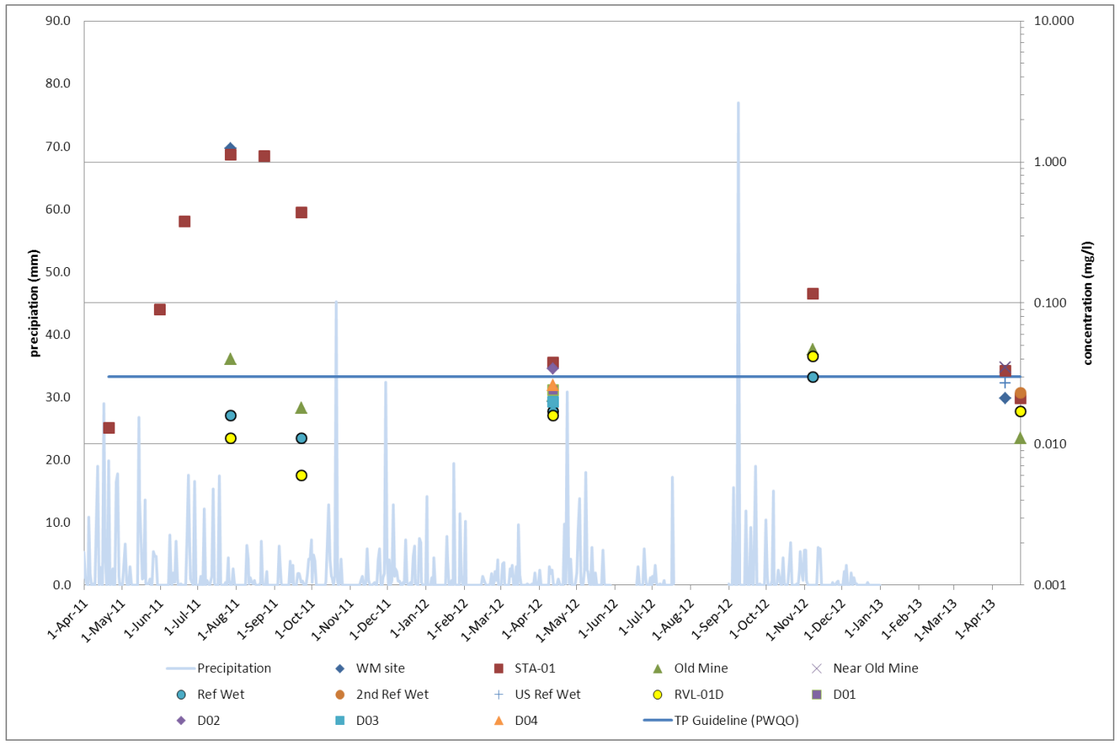

Figure 1. Precipitation and total phosphorus (TP) results for monitored sites.

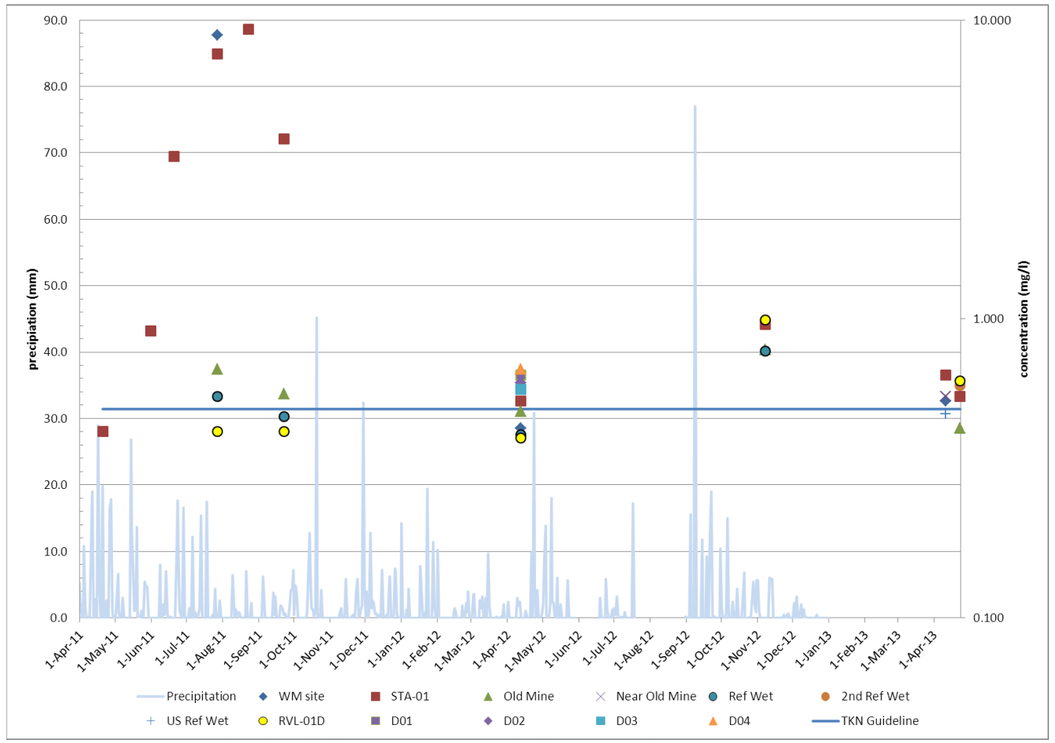

Figure 2. Precipitation and total Kjeldahl nitrogen (TKN) reuslts for monitored sites.

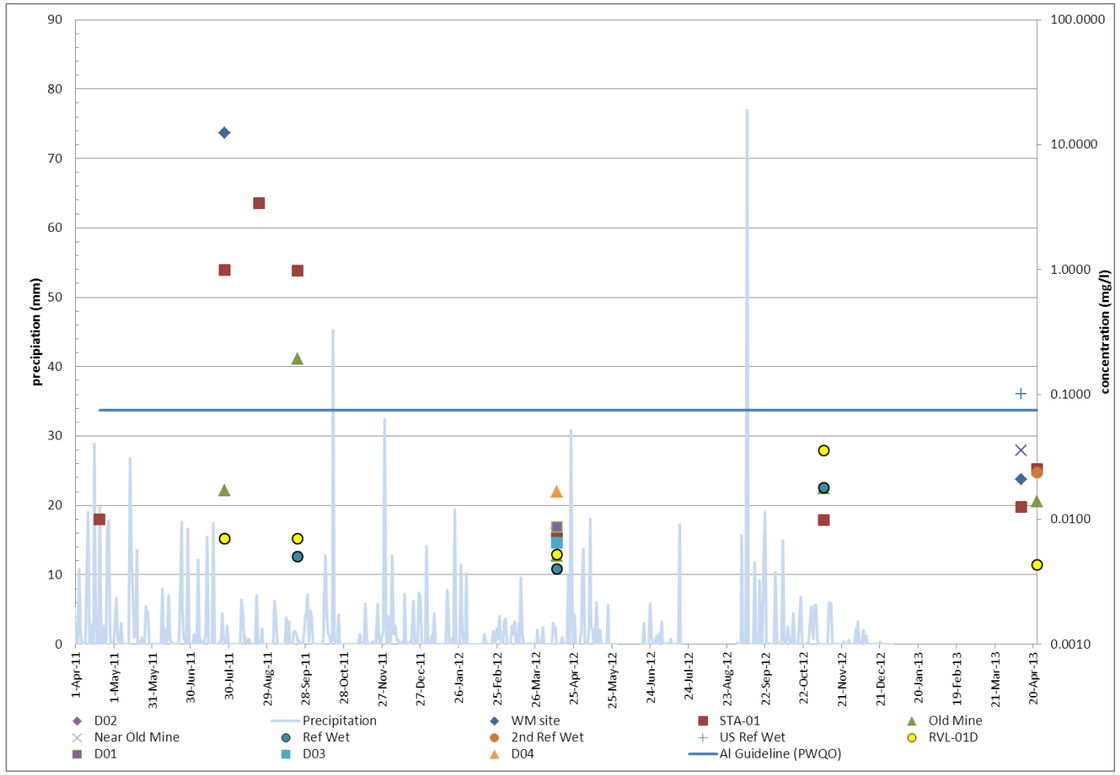

Figure 3. Precipitation and aluminum (Al) results for monitored sites.

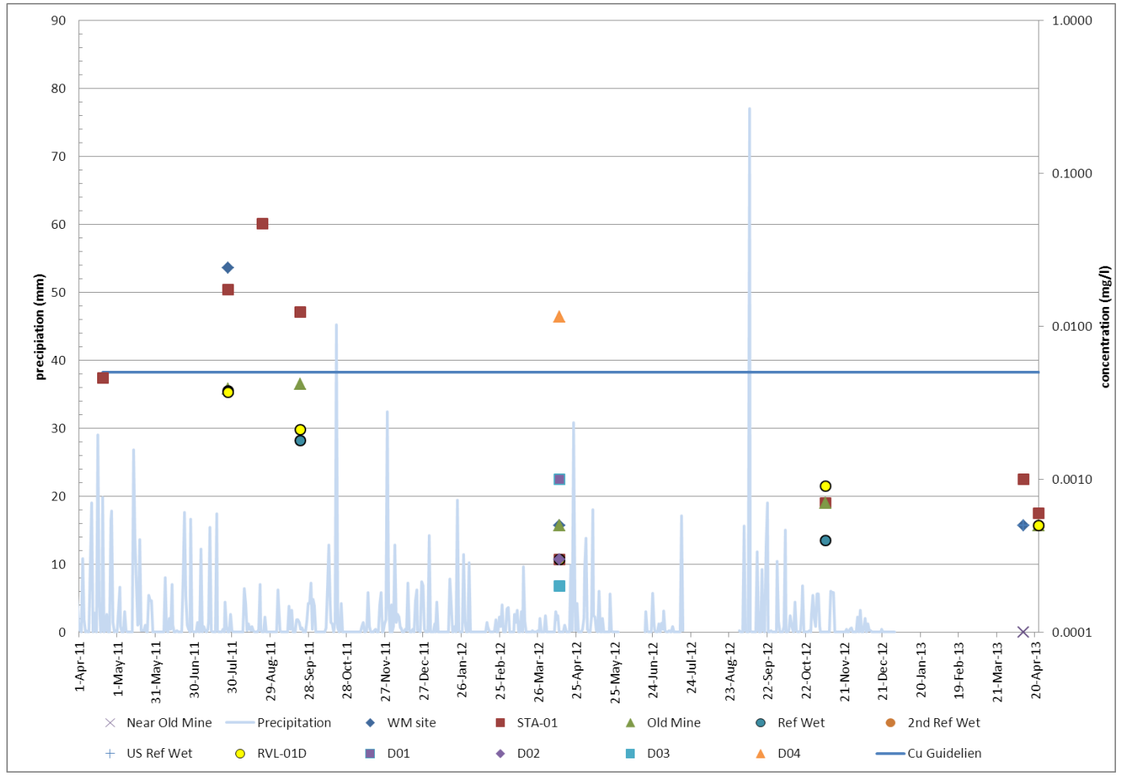

Figure 4. Precipitation and copper (Cu) results for monitored sites.

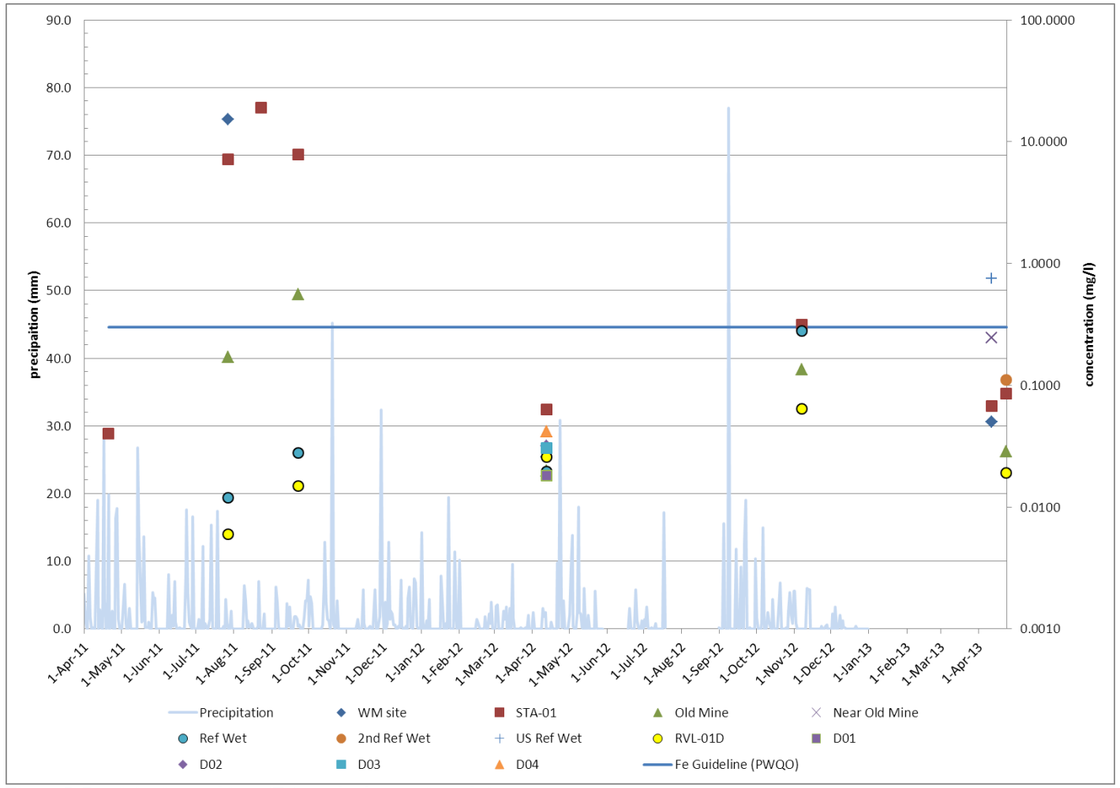

Figure 5. Precipitation and iron (Fe) results for monitored sites.