Mount Nansen Surface Water Quality Assessment - 2008/09 to 2011/12

Assessment of Current Surface Water Quality Conditions

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1 Introduction

Surface water monitoring is conducted at the former Mount Nansen mine site as part of ensuring the protection of the environment and human health and safety, as well as gathering data to assist in the choice of a final closure option. Assessment and Abandoned Mines (AAM), the current owner of the site, had previously ensured an overall analysis of the surface water quality be conducted as part of preparing the options analysis for the final closure and remediation of the site. To ensure a yearly analysis of the surface water quality is continued, post option evaluation and selection, this report has been prepared to summarize the assessment of the surface water quality data from the Mount Nansen mine site and to determine if there are any trends or changes from historical norms, and to identify any possible areas of concern.

1.1 Scope of Work

Specifically the Mount Nansen Surface Water Quality Assessment consists of the following components:

- Review the Mount Nansen 2011/12 surface water quality data in comparison to 2008/09, 2009/10 and 2010/11;
- Comment on how the current and historical water quality results compare to the previous water licence Effluent Quality Standards (EQS) and the CCME Guidelines for the Protection of Aquatic Life and discuss the possible effects;
- Comment on any trends or changes from historical norms;
- Provide an explanation as to implications of any trends or changes from historical norms; and
- Prepare a final report documenting the review, any trends or changes from historical norms, how the results compare to the EQS, CCME guidelines, and an explanation of the implications.

2 Assessment Approach and Methodology

2.1 Overview of Study Area

The study area is shown on Figure 1. The primary drainage for the Mount Nansen site is Dome Creek. Dome Creek runs from above the mill site, past the tailings facility into Victoria Creek. Pony Creek drains a small portion of the mine site north of the Brown-McDade Pit and eventually flows into Back Creek; a tributary to Victoria Creek influenced ongoing placer mining operations. Victoria Creek is the ultimate receiving environment for all drainage from the site and in contrast to Dome Creek, is known to support fish and fish habitat.

2.2 Description of Monitoring Stations

This study focuses on catchments of Dome Creek, Pony Creek, Back Creek and Victoria Creek, all potentially impacted by the mill, waste rock, tailings pond, Brown-McDade Pit and discharges from the seepage pond. The Mount Nansen site is shown in relation to the receiving environment and the surface water quality monitoring stations in Figure 1. These fourteen surface water quality monitoring stations have been separated into four categories: reference, mine source loading, near-field receiving environment (mine-impacted and non-fish habitat) and far-field receiving environment (mine-impacted and fish habitat/potential fish habitat).

A summary of the surface water quality monitoring stations included in this assessment is presented in Table 2-1.

Table 2-1 Surface Water Quality Monitoring Stations

Category	Station ID	Description
Reference	Vic Ref	Victoria Creek Reference Site
	Dry Creek	Dry Creek Reference Site
	Upper Vic	Victoria Creek, north of confluence with Back Creek
	DX	Dome Creek, upstream of Mill Site
	Pony U/S	Pony Creek, upstream of Pit and waste rock pile
Mine Source Loads	D1	Dome Creek, upstream of Tailings Pond
	Tailings	Tailings Pond Site
	Seep	Seepage Discharge Site
	Pit	Brown-McDade Pit Site
Near-Field Receiving Environment	D1	Dome Creek, upstream of Tailings Pond
	Upper Dome	Dome Creek, downstream of Tailings Pond
	Dome @ Rd	Dome Creek at Mine Access Road
	Pony D/S	Pony Creek, Downstream of Pit
Far-Field Receiving Environment	Back	Back Creek, near confluence with Victoria Creek
	Vic @ Rd	Victoria Creek, north of Mine Access Road

Upstream of the tailings facility on Dome Creek, there are two water quality monitoring locations, DX and D1. The mill complex is situated in between these two stations. The Upper Dome Creek monitoring site is situated downstream of the tailings facility, just downstream of where tailings seepage water enters Dome Creek. Flow at the Upper Dome Creek monitoring site is a combination of flow through the diversion channel and flow from the continuous discharge from the seepage pond. The receiving environment site for Victoria Creek is represented by the sampling location Vic @ Rd. This location is downstream of

inputs from both Dome Creek and Back Creek, and includes all potential mine site related inputs to the receiving environment.

2.3 Methodology

A large amount of surface water quality data has been collected over the past ten years at the Mount Nansen site. Surface water quality sampling began in 1999 by the Department of Indian and Northern Affairs (DIAND). The Government of Yukon took over the sampling program in 2003, and in 2005 contracted this work to Environmental Dynamics (EDI). In 2009, AECOM prepared a comprehensive compilation of the available site water quality data up to October 2009 (AECOM 2010). Review of the compiled water quality data indicated a marked improvement in parameter detection limits after December 2007. Since 2007, water quality samples have been consistently analyzed at one laboratory at suitable detection limits to allow comparison to CCME Guidelines for the Protection of Aquatic Life. The focus of this assessment is a comparison of the 2011/12 surface water quality data to that collected in 2008/09, 2009/10 and 2010/11. In consideration of this, water quality data used in this assessment was limited to data collected between April 2008 and March 2012. For each time period the data is compiled for the period of April to March of the following year as shown in Table 2-2.

Table 2-2 Time Periods for Water Quality Data Compilation

Sample Session	Time Period
2008/09	April 2008 – March 2009
2009/10	April 2009 – March 2010
2010/11	April 2010 – March 2011
2011/12	April 2011 – March 2012

2.3.1 CCME Guidelines and Water Licence Standards

The water quality data has been compared to either one of two sets of guidelines and standards. Mine source loads have been compared to the Canadian Council of Ministers for the Environment Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME 2008) and the Effluent Quality Standards (EQS) from Water licence QZ94-004 issued by Yukon Territory Water Board to B.Y.G. Natural Resources Inc. for the Mount Nansen mine site on February 13, 1996. Reference and receiving water bodies have been compared to the CCME Guidelines for the Protection of Freshwater Aquatic Life. For cadmium, the draft long-term exposure aquatic life guideline, recently released for review, was used. The draft updated cadmium guideline for long-term exposure is:

$$CWQG = 10^{\{0.83[\log(hardness)] - 2.46\}}$$

where the CWQG is in µg/L and hardness is measured as $CaCO_3$ equivalents in mg/L.

Table 2-3 CCME Water Quality Guidelines and Water Licence Standards

Parameter	Units	CCME	EQS
pH	pH units	6.5 – 9.0	6.0 – 8.5
TSS	mg/L	-	50
Ammonia-N	mg/L	0.832 at pH=8.0 and temperature=10°C	-
Nitrate-N	mg/L	2.9	-
Nitrite-N	mg/L	0.06	-
Cyanide-Total	mg/L	0.005 mg/L (as Free CN)	0.3
CN-WAD	mg/L	-	0.1
Total Aluminum	mg/L	0.005 at pH <6.5 0.1 at pH ≥6.5	-
Total Antimony	mg/L	-	0.15
Total Arsenic	mg/L	0.005	-
Dissolved Arsenic	mg/L	-	0.15
Total Barium	mg/L	-	1
Total Cadmium	mg/L	0.00004 at hardness <17 mg/ 0.00012 at hardness 60 mg/L 0.00021 at hardness 120 mg/L 0.00029 at hardness 180 mg/L 0.00042 at hardness >280 mg/L	0.02
Total Chromium	mg/L	0.0089	0.04
Total Copper	mg/L	0.002 at hardness 0-120 mg/L 0.003 at hardness 120-180 mg/L 0.004 at hardness >180 mg/L	0.2
Total Iron	mg/L	0.3	1.0
Total Lead	mg/L	0.001 at hardness 0-60 mg/L 0.002 at hardness 60-120 mg/L 0.004 at hardness 120-180 mg/L 0.007 at hardness >180 mg/L	0.1
Total Manganese	mg/L	-	0.5
Total Mercury	mg/L	0.000026	0.005
Total Molybdenum	mg/L	0.073	-
Total Nickel	mg/L	0.025 at hardness 0-60 mg/L 0.065 at hardness 60-120 mg/L 0.110 at hardness 120-180 mg/L 0.150 at hardness >180 mg/L	0.3
Total Selenium	mg/L	0.001	-
Total Silver	mg/L	0.0001	0.10
Total Thallium	mg/L	0.0008	-
Total Zinc	mg/L	0.03	0.30
Toxicity (LC50)	%	-	100

2.3.2 Statistical and Trend Analysis

The minimum, median, maximum, and upper and lower quartile concentrations, along with the number of samples have been calculated for a suite of selected parameters for each station for the full period from April 2008 to March 2012. As well for receiving environment stations, the same statistics are calculated for each annual time period to support preparation of annual box-whisker plots and assessment of changes in water quality over time. The parameters selected include those with an associated EQS, CCME guideline along with key indicator and modifying species including hardness, alkalinity and sulphate. For purposes of calculating the statistics non-detect values were set to their detection limit. The

selected parameters were compared to the EQS or the CCME guidelines, as appropriate, and the number of exceedences also identified. It should be noted that, although there is a CCME guideline and an EQS for total mercury, this parameters has not been analyzed for as part of the site routine monitoring program and therefore is not included in this analysis. However, dissolved mercury is analyzed as part of the routine monitoring program.

In addition trend analysis was also carried out over the full period (April 2008 to March 2012) to identify any key changes in water quality at mine source and receiving environment monitoring locations for key parameters of concern and indicator species, specifically sulphate, arsenic, cadmium, copper and zinc. This was accomplished through visual analysis of time series plots and comparison of annual box-and-whisker plots. Inter-station comparisons were also carried out within each catchment area for key parameters of concern to assess the influence of the mine site on downstream water quality.

3 Surface Water Quality Assessment

The full compilation of the surface water quality data from the fourteen surface water quality monitoring sites in the Mount Nansen study area from April 2008 to March 2012 is presented in Appendix A. Exceedences above either the EQS or CCME guidelines are also highlighted in Appendix A. The data presented in Appendix A was used to generate the statistics outlined in Section 2.3.2, which are provided in Appendix B. The following sections summarize the results of the water quality assessment. It is organized by source area for mine related source loadings and by watercourse or catchment for the reference and receiving monitoring stations.

3.1 Mine Related Source Loadings

3.1.1 Tailings Pond

The tailings impoundment area holds an estimated 300,000 m^3 of tailings along with residual mill process chemicals including copper sulphate, lime, cyanide and associated degradation compounds including cyanate, thiocyanate, ammonia, nitrite, and nitrate. Water flow in Dome Creek is diverted around the tailings impoundment and the tailings pond only receives inflow from local area runoff and precipitation. Maintaining a low volume of water in the pond is required for dam stability as well as to assist in reducing dam seepage. Prior to 2007/08 when required water was pumped and discharged ultimately to Dome Creek. Since 2007/08 there has not been a need to pump water from the tailings pond. The summary statistics for tailings pond water quality is presented in Appendix B-1.

The majority of metals in the tailings pond water exceeded the EQS, as illustrated in Appendix B-1, including antimony, dissolved arsenic, cadmium, copper, iron, lead, manganese, and zinc. Total iron and manganese exceeded the EQS in the majority of the samples, 100% and 88% respectively. Total zinc concentrations were above the EQS in approximately one-third of the samples while total lead and antimony exceeded in only approximately 10% of the samples. The remaining metals only exceeded the EQS in a few samples (~2% to 4%). In addition, the EQS for total suspended solids was exceeded in 6% of the samples.

The tailings pond water quality was also compared to the CCME guidelines and the concentrations of the majority of total metals and nitrogen species exceed guidelines. Only total nickel and molybdenum were present at concentrations below the CCME guidelines. Concentrations of total arsenic, cadmium, copper, lead, silver and zinc exceeded their respective guidelines in over 90% of the samples (92% to 100%). Nitrogen species including ammonia, nitrate and nitrite, exceeded the CCME guidelines in approximately one quarter of the samples (15% to 27%).

Box-whisker plots comparing water quality in the tailings pond between sample sessions are presented in Figures 2 and 3 for total arsenic, dissolved arsenic, total cadmium, total zinc and sulphate. For statistical purposes the sample collected on March 7, 2012 was not included in the calculation of statistics for metals. Review of the data from that sample indicates it was compromised due to an abnormally high total suspended solid level (656 mg/L). Inclusion of this sample erroneously skewed the results of the statistical analysis.

In general, concentrations of total arsenic in the tailings pond water have been relatively consistent since 2009/10, with median concentrations below 2008/09 levels (0.157 mg/L) ranging between 0.125 mg/L and 0.144 mg/L. Dissolved arsenic concentrations dropped between 2008/09 (median = 0.0962 mg/L) and 2009/10 (median = 0.0621 mg/L) and have been steadily increasing since that time to concentrations in 2011/12 (median = 0.092 mg/L) similar to 2008/09 levels. Concentrations of total cadmium and total zinc

exhibit an increasing trend between 2008/09 and 2010/11, then decreasing marginally in 2011/12. Sulphate concentrations exhibit the same trend, decreasing in 2011/12 to concentrations below those 2008/09 levels. It should be noted that it is difficult to fully assess trends in water quality in the tailings pond in isolation of information and data regarding how the water in the pond is managed including information on tailings pond water levels. The concentrations of some of the parameters, such as arsenic, cadmium and zinc, may have increased due to the pumping down of the tailings pond water level and subsequent exposure and oxidation of exposed sulphides (Lorax 2011).

3.1.2 Seepage Pond

There is continual shallow underground seepage from the tailings impoundment. This seepage is collected in the seepage pond and continuously pumped to Dome Creek. The summary statistics for seepage pond water quality is presented in Appendix B-2.

In contrast to the tailings pond water quality, the only total metals that exceeded the EQS in the seepage pond water quality are chromium, iron and manganese. Total iron and manganese exceeded the EQS in 100% of the samples. In addition total suspended solids and WAD cyanide also exceeded the EQS, in 4% and 3% of the samples respectively.

The seepage pond water quality was also compared to the CCME guidelines and the concentrations of the ammonia, nitrate, nitrite and ten total metals exceeded the guidelines: aluminum, arsenic, cadmium, chromium, copper, iron, lead, selenium, silver and zinc. Concentrations of total arsenic, cadmium, copper, and iron exceeded their respective guidelines in over 90% of the samples (99% to 100%). Nitrogen species including ammonia, nitrate and nitrite, exceeded the CCME guidelines over 50% of the samples with ammonia exceeding in 99% of the samples and 84% of the samples.

Box-whisker plots comparing water quality in the seepage pond between sample sessions are presented in Figures 4 and 5 for total arsenic, dissolved arsenic, total cadmium, total zinc and sulphate. In general, concentrations of total arsenic in the seepage pond water have decreased somewhat since 2008/09, with median concentrations dropping from 0.0359 mg/L in 2008/09 to 0.0275 mg/L in 2011/12. In contrast, dissolved arsenic concentrations remained relatively unchanged from 2008/09 to 2010/11, ranging between 0.0025 mg/L and 0.0038 mg/L, and then increased substantially to a median concentration of 0.0143 mg/L in 2011/12. In addition, as illustrated in Figure 4, the range of dissolved arsenic concentrations increase dramatically in 2011/12 compared to previous years, increasing from between 0.0017 mg/L to 0.0098 mg/L in 2010/11 to 0.0017 mg/L to 0.032 mg/L in 2011/12. Total cadmium concentrations remained relatively stable between 2008/09 and 2011/12, ranging from 0.00067 mg/L to 00082 mg/L. Seepage pond concentrations of total zinc have decreased steadily since 2008/09 from a median concentration of 0.019 mg/L to 0.012 in 2011/12. Sulphate concentrations exhibit the same trend as total zinc, decreasing from a median concentration of 708 mg/L in 2008/09 to 561 mg/L in 2011/12.

The water quality in the seepage pond is significantly different than that from in tailings pond, particularly with respect to nitrogen species, cyanide species and some key metals species including arsenic, cadmium, copper, iron, lead, manganese and zinc. A comparison of median concentrations of these species in the tailings pond water and the seepage pond water is provided in Table 3-1.

Table 3-1 Comparison of Tailings Pond and Seepage Pond Water Quality

Parameter	Tailings Pond	Seepage Pond
	Median Concentration (mg/L)	Median Concentration (mg/L)
Ammonia-N	0.32	5.65
Nitrate-N	1.01	3.05
Nitrite-N	0.01	0.17
WAD Cyanide	0.004	0.016
SAD Cyanide	0.022	1.2
Cyanate	0.3	1.1
Thiocyanate	0.3	8.1
Total Arsenic	0.142	0.032
Total Cadmium	0.00347	0.00077
Total Copper	0.056	0.008
Total Iron	0.587	10.15
Total Lead	0.028	0.0002
Total Manganese	1.63	7.29
Total Zinc	0.195	0.014

The seepage pond water quality has higher concentrations of nitrogen species, cyanide species, manganese and iron while it has lower concentrations of total arsenic, total cadmium, total copper, total lead and total zinc. There are various reasons for this difference in the water quality at these intrinsically linked monitoring stations including:

- Ongoing chemical reactions occurring along the flow path between the tailings pond and the seepage pond, including attenuation of arsenic (Lorax 2011);
- Reduction along the flow path that results in a more reduced water in the seepage pond compared to the tailings pond as indicated by the higher concentrations of iron, manganese and ammonia in the seepage pond water (Lorax 2011);
- The seepage water quality may be more representative of tailings pore water quality and therefore contain higher levels of various parameters including residual cyanide species and their degradation products (ammonia, nitrate and nitrite); and
- Dilution due to inflow of regional groundwater to the seepage pond, which includes leaking from the diversion ditch (AECOM 2009).

3.1.3 Brown-McDade Pit

The Brown-McDade Pit is sampled at the deepest part of the pit. Samples are typically collected at surface, middle and bottom of the pit lake. For purposes of generating summary statistics to characterize the general pit water quality, the water quality data for the three sample depths was compiled into one dataset. The summary statistics for the pit water quality is presented in Appendix B-3. Statistics were also generated for each sample depth to provide for an assessment of the variation in pit water quality with depth (Appendix B-4 to B-6).

Concentrations of total suspended solids and four total metals in pit exceeded the EQS, including cadmium, iron, manganese and zinc. Total zinc concentrations were above the EQS in 100% of the samples and total manganese exceeded EQS in 46% of the samples. Total cadmium and iron had lower rates of exceedences, above the EQS in 14% and 3% of the samples, respectively. In addition, the EQS for total suspended solids was exceeded in only 3% of the samples, all associated with samples from the bottom.

The pit water quality was also compared to the CCME guidelines and the concentrations of nitrate, nitrite and nine total metals exceeded the guidelines: aluminum, arsenic, cadmium, copper, irons, lead, selenium, silver and zinc. Concentrations of total arsenic, cadmium, copper and zinc exceeded the guidelines in over 93% of the samples (93% to 100%). Total chromium, iron, selenium and silver exceeded guidelines in less than 10% of the samples. Nitrite exceeded the CCME guidelines in approximately one quarter of the samples while nitrate concentrations were above the guidelines in 5% of the samples.

Box-whisker plots comparing water quality in the Brown-McDade Pit between sample sessions are presented in Figure 6 for total arsenic, dissolved arsenic, total cadmium, total zinc and sulphate. The concentrations of total arsenic in the pit remained relatively unchanged from 2008/09 (median = 0.0081 mg/L) to 2011/12 (median = 0.0071). A similar trend is exhibited by dissolved arsenic. In contrast total cadmium and zinc concentrations have decreased since 2008/09 from median concentrations of 0.0159 mg/L and 1.52 mg/L to 0.0095 mg/L and 1.18 mg/L, respectively. Sulphate concentrations remained relatively stable from 2008/09 to 2010/11 (848 mg/L to 869 mg/L), then increased in 2011/12 to a median concentration of 1010 mg/L.

The water quality in the pit is variable with depth. A comparison of median concentrations of key parameters at the various depths is provided in Table 3-2 and illustrated graphically in Figure 7 for total arsenic, total cadmium, total zinc and sulphate. In general concentrations metals including total arsenic, cadmium, iron, manganese and zinc increase with depth along with sulphate and ammonia while the more oxidizing conditions in the top of the water column favours species like nitrate.

Table 3-2 Comparison of Tailings Pond and Seepage Pond Water Quality

Parameter	Pit - Top	Pit - Middle	Pit - Bottom
	Median Concentration (mg/L)	Median Concentration (mg/L)	Median Concentration (mg/L)
Sulphate	792	861	1125
Ammonia-N	0.01	0.01	0.045
Nitrate-N	1.36	1.35	0.68
Nitrite-N	0.01	0.01	0.01
Total Arsenic	0.0091	0.0085	0.0098
Total Cadmium	0.0091	0.0092	0.011
Total Copper	0.009	0.008	0.009
Total Iron	0.06	0.071	0.086
Total Manganese	0.21	0.216	1.44
Total Zinc	1.12	1.19	1.39

3.2 Dome Creek

As shown on Figure 1, there are four water quality monitoring stations on Dome Creek. DX is the furthest upstream and upstream of any mine site infrastructure and as such is used to represent unimpacted or reference water quality in Dome Creek. Station D1 is located downstream of the mill site and water quality from this site can be used to assess potential influences on Dome Creek water quality due to inflows from the mill area. The Upper Dome Creek site is located downstream of the tailings facility, just below the confluence where tailings seepage water enters Dome Creek. Flow at the Upper Dome Creek monitoring site is a combination of flow through the diversion channel and flow from the continuous discharge from the seepage pond. The Dome @ Rd station is located where the mine access road crosses Dome Creek. The summary statistics for each of the Dome Creek stations is presented in

Appendix B-7 to B-10. A comparison of Dome Creek median concentrations and percent of exceedence above CCME guidelines is presented in Table 3-3.

3.2.1 Reference Site – DX

The water quality in Dome Creek above the mine site at DX exceeds the CCME guidelines for ammonia and nitrate and nine total metals: aluminum, arsenic, chromium, copper, iron, lead, selenium, silver and zinc. Total aluminum, total arsenic and total iron exceeded the guidelines in over 50% of the samples: 66%, 56% and 56% respectively. Total copper and nitrate exceeded the guidelines in approximately 20% of the samples, total silver in 15% of the samples and total zinc in 10% of the samples. Ammonia, total chromium, total lead, and total selenium exceeded their respective guideline value in 5% or less of the samples.

3.2.2 Near-Field Receiving Environment – D1

The influence of the mill site is evident at D1, located below the mill on Dome Creek. Nitrate, and ten total metals exceeded the CCME guidelines at D1: aluminum (16%), arsenic (100%), cadmium (96%), chromium (2%), copper (9%), iron (18%), lead (2%), selenium (7%), silver (4%) and zinc (96%). Although similar parameters that exceeded the guidelines at DX are exceeded at D1, the number of samples that exceeded and the magnitude of the exceedence for key parameters of concern and indicator parameters are higher at D1, specifically sulphate, total arsenic, cadmium, and zinc as illustrated in Table 3-3.

Box-whisker plots comparing water quality in Dome Creek at D1 between sample sessions are presented in Figure 8 for total arsenic, total cadmium, total zinc and sulphate. In general, there is slight decreasing trend in the concentrations of total arsenic since 2008, with median concentrations decreasing from 0.015 mg/L in 2008/09 to 0.0114 mg/L in 2011/12. Concentrations of total cadmium and total zinc are highly variable but overall have increased since 2008/09 from 0.00097 mg/L and 0.198 mg/L to 0.00494 mg/L and 1.03 mg/L, respectively. Sulphate concentrations exhibit a slight decreasing trend, median concentrations decreasing from 410 mg/L in 2008/09 to 368 mg/L in 2011/12.

Table 3-3 Comparison of Water Quality in Dome Creek

Parameter	Station DX		Station D1		Station Upper Dome		Station Dome @ Rd	
	Median Concentration (mg/L)	% Above CCME Guideline	Median Concentration (mg/L)	% Above CCME Guideline	Median Concentration (mg/L)	% Above CCME Guideline	Median Concentration (mg/L)	% Above CCME Guideline
Sulphate	156	-	398	-	403	-	317	-
Ammonia Nitrogen	0.02	2	0.01	0	0.89	53	0.515	23
Nitrate Nitrogen	0.02	0	0.08	0	0.53	3	0.42	0
Nitrite Nitrogen	0.01	20	0.01	36	0.012	34	0.011	19
WAD Cyanide	0.002	-	0.002	-	0.004	-	0.002	-
SAD Cyanide	0.002	-	0.002	-	0.094	-	0.027	-
Cyanate	0.2	-	0.2	-	0.4	-	0.4	-
Thiocyanate	0.2	-	0.1	-	0.6	-	0.4	-
Total Aluminum	0.133	66	0.023	16	0.208	58	0.23	83
Total Arsenic	0.0057	56	0.0124	100	0.0184	100	0.0277	100
Dissolved Arsenic	0.0022	-	0.0088	-	0.0058	-	0.0075	-
Total Cadmium	0.00004	0	0.00214	96	0.00023	25	0.00015	11
Total Chromium	0.0005	2	0.0004	2	0.001	9	0.0011	6
Total Copper	0.002	20	0.001	9	0.004	44	0.004	34
Total Iron	0.358	56	0.112	18	2.31	100	2.79	100
Total Lead	0.0007	5	0.0005	2	0.0005	9	0.0015	9
Total Molybdenum	0.0001	0	0.0002	0	0.0008	0	0.0006	0
Total Nickel	0.001	0	0.0024	0	0.003	0	0.003	0
Total Selenium	0.0006	2	0.0006	7	0.0006	12	0.0006	9
Total Silver	0.00001	15	0.00001	4	0.00001	9	0.00002	11
Total Thallium	0.00002	0	0.00005	0	0.00002	0	0.00002	0
Total Zinc	0.009	10	0.516	98	0.02	34	0.02	32

- No applicable guideline

3.2.3 Near-Field Receiving Environment – Upper Dome Creek

At the Upper Dome Creek monitoring site, ammonia and nitrate exceeded the CCME guidelines as well as the same suite of metals that exceeded at D1. Ammonia, total aluminum, total arsenic and total iron exceeded the guidelines if over 50% of the sample: 53%, 100% and 100% respectively, all with concentrations higher than those at D1 and the DX reference station. Median total cadmium and total zinc concentrations are lower than those found at site D1, but remain elevated in comparison to the Dome Creek reference station (DX). In addition, cyanide (SAD cyanide median = 0.027 mg/L) and nitrogen related (ammonia median = 0.515 mg/l and nitrite median = 0.42 mg/L) compound concentrations at the Upper Dome Creek site are also elevated in comparison to stations DX and D1 due to the influence of seepage from the upstream tailings area.

Box-whisker plots comparing water quality at Upper Dome between sample sessions are presented in Figures 9 and 10 for total arsenic, dissolved arsenic, total cadmium, total zinc, dissolved arsenic and sulphate. In general, there is slight increasing trend in the concentrations of total arsenic since 2008, with median concentrations increasing from 0.0147 mg/L in 2008/09 to 0.0299 mg/L in 2011/12. Dissolved arsenic concentrations remained relatively stable from 2008/09 to 2010/11 (median concentrations ranging from 0.0046 mg/L to 0.0059 mg/L) then increased in 2011/12 to levels approximately two times higher (median = 0.01 mg/L). Concentrations of total cadmium and total zinc exhibit the same trend, decreasing marginally from 2008/09 then increasing in 2011/12. In addition for total arsenic, dissolved arsenic and total zinc the range of measured concentrations increased in 2011/12 compared to previous years. Sulphate concentrations have remained relatively stable since 2008/09 with a slight decrease in 2010/11.

3.2.4 Near-Field Receiving Environment – Dome @ Rd

At the Dome @ Rd monitoring site, the suite of parameters that exceeded the CCME guidelines were the same as those at Upper Dome Creek. Similar to Upper Dome Creek, total arsenic and total iron exceeded their respective CCME guidelines in 100% of the samples. Generally, the majority of the water quality parameters at the Dome @ Rd station were elevated in comparison to the DX reference station but lower, primarily due to dilution effects, than those measured at the Upper Dome Creek station.

Box-whisker plots comparing water quality at Dome @ Rd between sample sessions are presented in Figures 11 and 12 for total arsenic, dissolved arsenic, cadmium, zinc, and sulphate. In general, there is slight increasing trend in the concentrations of total arsenic since 2008, with median concentrations increasing from 0.0185 mg/L in 2008/09 to 0.0341 mg/L in 2011/12. Similar to Upper Dome, dissolved arsenic concentrations at Dome @ Rd remained relatively stable from 2008/09 to 2010/11 (median concentrations ranging from 0.0059 mg/L to 0.0067 mg/L) then increased in 2011/12 to levels approximately two times higher (median =0.0113 mg/L). Concentrations of total cadmium and total zinc have remained relatively stable from 2008/09 to 2010/11 then increase marginally in 2011/12. In addition for total arsenic, dissolved arsenic, total cadmium and total zinc the range of measured concentrations increased in 2011/12 compared to previous years. Sulphate concentrations exhibit a decreasing trend, steadily decreasing increasing from 2008/09 (median = 342 mg/L) to 2011/12 (median = 292 mg/L).

3.2.5 Dome Creek – Inter-station Comparison

Inter-station comparison of Dome Creek water quality comparing was conducted comparing main trace elements of concern (total arsenic, dissolved arsenic, total zinc and total cadmium) and sulphate (Figures 13 and 14). In general, inspection of the water quality data for Dome Creek shows a clear mine-related influence. Concentrations of total arsenic increase in a downstream direction with the highest

concentrations typically being measured Dome @ Rd. Median total arsenic concentrations in Dome Creek at Upper Dome (median = 0.0184 mg/L) and Dome @ Rd (median = 0.0277 mg/L are significantly higher than those upstream of the site at DX (median = 0.0057). Dissolved arsenic concentrations exhibit a slightly different trend with dissolved arsenic levels at D1 exceeding concentrations downstream at some points in the historical record.

For total cadmium and zinc, peak concentrations occur at D1, immediately downstream of the mill area, then decrease due to downstream dilution effects and possible attenuation. Downstream of the inflow of the seepage from the tailings area, the concentrations of total cadmium and total zinc are higher at Upper Dome than at Dome @ Rd, as concentrations continue to be reduced by ongoing dilution and possible attenuation. Sulphate concentrations in Dome Creek are presented in Figure 14. Again inspection of the sulphate concentrations in Dome Creek downstream of any mine related infrastructure and inflows shows a definitive mine-related influence, generally increasing in a downstream direction peaking at Upper Dome, then decreasing at Dome @ Rd due to dilution effects. Sulphate concentrations in Dome Creek at Upper Dome (median = 403 mg/L) and Dome @ Rd (median = 317) exhibit a pronounced increase in comparison to levels upstream at DX (156 mg/L).

3.3 Pony Creek

Pony Creek is a small, ephemeral tributary of Back Creek that flows southeast past the northern end of the Brown McDade Pit. Waste rock was historically deposited in Pony Creek during mining of the Pony Creek Adit. There is two water quality sampling stations in Pony Creek: Pony U/S and Pony D/S. Pony U/S is upstream of the waste rock and is used to represent reference water quality of Pony Creek. Pony D/S is located downstream of where the waste rock was deposited. The summary statistics for each of the Pony Creek stations is presented in Appendices B-11 and B-12. A comparison of median concentrations and percent of exceedence above CCME guidelines is presented in Table 3-4.

3.3.1 Reference – Pony U/S

The water quality at the Pony Creek reference site marginally exceeded CCME guidelines for nitrate (11%) and five total metals: aluminum (16%), arsenic (16%), copper (9%), selenium (2%), and silver (7%). The concentration of total iron exceeded the CCME guideline in approximately 58% of the samples.

3.3.2 Near-Field Receiving Environment – Pony D/S

The water quality in Pony Creek at Pony D/S is influenced by the historic practice of depositing waste rock within the stream channel. The same suite of parameters that were present above guidelines in Pony U/S exceeded the CCME guidelines at Pony D/S although the frequency and magnitude of exceedence is higher. In addition concentrations of total cadmium and total lead also exceeded their respective CCME guidelines, in 98% and 39% of the samples respectively.

Box-whisker plots comparing water quality at Pony D/S between sample sessions are presented in Figure 15 for total arsenic, cadmium, zinc, and sulphate. In general the concentrations of total arsenic have remained relatively unchanged since 2008. Concentrations of total cadmium, zinc and sulphate exhibit the same trend, increasing from 2008/09 to 2009/10 then steadily decreasing in the following years to concentrations similar to those measured in 2008/09.

Table 3-4 Comparison of Water Quality Pony Creek

Parameter	Station Pony U/S		Station Pony D/S	
	Median Concentration (mg/L)	% Above CCME Guideline	Median Concentration (mg/L)	% Above CCME Guideline
Sulphate	88.5	-	97.6	-
Ammonia Nitrogen	0.02	0	0.01	0
Nitrate Nitrogen	0.02	0	0.08	0
Nitrite Nitrogen	0.01	11	0.01	22
Total Aluminum	0.034	16	0.136	59
Total Arsenic	0.0023	16	0.0066	65
Dissolved Arsenic	0.0018	-	0.0039	-
Total Cadmium	0.00003	0	0.00123	98
Total Chromium	0.0004	0	0.0005	0
Total Copper	0.001	9	0.011	100
Total Iron	0.32	53	0.2	41
Total Lead	0.0002	0	0.0028	39
Total Molybdenum	0.0001	0	0.0001	0
Total Nickel	0.001	0	0.001	0
Total Selenium	0.0006	2	0.0006	2
Total Silver	0.00001	7	0.00004	26
Total Thallium	0.00001	0	0.00001	0
Total Zinc	0.007	0	0.112	96

3.3.3 Pony Creek – Inter-station Comparison

Inter-station comparison of Pony Creek was conducted for the main trace elements of concern (total arsenic, total zinc and total cadmium) and sulphate (Figure 16). In general, inspection of the water quality data for Pony Creek at Pony D/S shows a clear mine-related influence, primarily due to historic practice of depositing waste rock in the stream channel. For example, total cadmium and zinc concentrations in Pony Creek at Pony D/S (total cadmium median = 0.00123 mg/L and total zinc median = 0.112) exhibit a pronounced increase in comparison to levels upstream at Pony U/S (total cadmium median = 0.00003 mg/L and total zinc median = 0.007 mg/L) (Table 3-4).

3.4 Back Creek

The water quality monitoring station is located on Back Creek, just above the confluence with Victoria Creek. There are historical and active placer mining activities upstream of the Back Creek monitoring station and the water quality in Back Creek reflects these mining activities with high levels of total suspended solids (up to 18,900 mg/L) and metals associated with the particulate matter. Pony Creek flows into Back Creek upstream of the confluence with Victoria Creek. The summary statistics for Back Creek are presented in Appendix B-13.The CCME guidelines were exceeded for nitrite (9%) and twelve total metals: aluminum (80%), arsenic (68%), cadmium (46%), chromium (23%), copper (50%), iron (100%), lead (43%), nickel (5%), selenium (21%), silver (32%), thallium (9%) and zinc (36%).

An inter-station comparison between Pony Creek and Back Creek was conducted to assess the impacts of mine-influenced drainage in Pony Creek on Back Creek. Time-series plots of total arsenic, dissolved arsenic, total cadmium and total zinc concentrations in Pony Creek and Back Creek are presented in Figure 17. It is evident from these figures that concentrations of these parameters in Back Creek do not correlate with those in Pony Creek. In many instances, peak concentrations in Back Creek occur in isolation of those in Pony Creek, most likely due to the influence of ongoing placer mining activities taking place in the Back Creek watershed. Furthermore, the inflow of Pony Creek to Back Creek is relatively

small and any mine related inputs that reach Back Creek are most likely diluted by the time they reach the Back Creek monitoring location.

3.5 Dry Creek

The Dry Creek reference monitoring station is located over a ridge to the west of Mount Nansen in a separate catchment basin that drains away from the mine site. It was added to the sampling program in 2007 to provide further information on the reference or background water quality in the area. The summary statistics for Dry Creek are presented in Appendix B-14. The water quality at Dry Creek exceeded the CCME guidelines for nitrite (only one sample) and ten total metals: aluminum (24%), arsenic (4%), cadmium (11%), chromium (1%), copper (21%), iron 19%, lead (7%), selenium (5%), silver (7%) and zinc (4%). In most cases the median concentrations of these metals were well below their respective guidelines and the exceedences were associated with metals associated with suspended solids and particulate matter.

3.6 Victoria Creek

There are two reference water quality monitoring stations on Victoria Creek, Upper Vic and Vic Ref, and one receiving monitoring station, Vic @ Rd. Upper Vic is located immediately upstream of the confluence with Back Creek and Victoria Creek and Vic Ref is located approximately 500 m further upstream. Vic Ref was added to the sampling program in 2007 due to the possibility of backwater effects at the Upper Vic site due to Back Creek. The receiving environment site, Vic @ Road, is located on Victoria Creek where it crosses the mine access road. This location is downstream of inputs from both Dome Creek and Back Creek, and includes all potential mine site related inputs to the receiving environment. In contrast to Dome Creek, Victoria Creek is known to support fish and fish habitat. The summary statistics for each of the Victoria Creek stations is presented in Appendices B-15 to B-17. A comparison of median concentrations and percent of exceedence above CCME guidelines for the Victoria Creek monitoring sites is presented in Table 3-5.

Table 3-5 Comparison of Water Quality in Victoria Creek

Parameter	Station Vic Ref		Station Upper Vic		Station Vic @ Rd	
	Median Concentration (mg/L)	% Above CCME Guideline	Median Concentration (mg/L)	% Above CCME Guideline	Median Concentration (mg/L)	% Above CCME Guideline
Sulphate	11	-	11	-	26.8	-
Ammonia Nitrogen	0.01	0	0.01	0	0.01	0
Nitrate Nitrogen	0.04	0	0.05	0	0.1	0
Nitrite Nitrogen	0.01	0	0.01	1	0.01	0
WAD Cyanide	0.002	-	0.002	-	0.002	-
SAD Cyanide	0.002	-	0.002	-	0.002	-
Cyanate	0.2	-	0.2	-	0.2	-
Thiocyanate	0.1	-	0.1	-	0.3	-
Total Aluminum	0.017	30	0.015	24	0.092	43
Total Arsenic	0.0003	5	0.0003	4	0.0016	17
Dissolved Arsenic	0.0002	-	0.0002	-	0.0012	-
Total Cadmium	0.00001	9	0.00001	11	0.00003	17
Total Chromium	0.0004	5	0.0004	1	0.0005	3
Total Copper	0.001	28	0.001	21	0.002	40
Total Iron	0.047	26	0.035	19	0.3	48
Total Lead	0.0001	12	0.0001	7	0.0005	18
Total Molybdenum	0.0003	0	0.0003	0	0.0004	0
Total Nickel	0.001	0	0.001	0	0.001	0
Total Selenium	0.0006	5	0.0004	5	0.0006	12
Total Silver	0.00001	7	0.00001	7	0.00001	13
Total Thallium	0.00001	0	0.00001	0	0.00001	3
Total Zinc	0.003	5	0.003	4	0.008	12

3.6.1 Reference – Upper Vic and Vic Ref

The water quality at the two reference sites, Upper Vic and Vic Ref, exhibited similar water quality with concentrations of ten total metals exceeding their respective guidelines: aluminum, arsenic, cadmium, chromium, copper, iron, lead, selenium, silver and zinc. Total aluminum, copper and iron had the highest percent exceedence at both reference stations, between approximately 20% and 30%. In most cases the elevated levels of these total metals are associated with particulate matter with their corresponding dissolved concentrations being well below the guideline values.

The water quality in Victoria Creek at Vic @ Rd is significantly influenced by elevated levels of suspended solids from both natural and anthropogenic sources (including placer mining in the Back Creek watershed) with total suspended solids concentrations as high as 1240 mg/L. Due to this influence of upstream sediment inputs caution should be taken in the interpretation and assessment of the water quality data at Vic @ Rd, specifically with total metals. The same suite of metals that exceed CCME guidelines at the Victoria Creek reference sites are exceeded at Vic @ Rd, although the magnitude and frequency of exceedence is higher. Concentrations of total aluminum, copper and iron exceeded guideline values in over 40% of the measurements.

Box-whisker plots comparing water quality at Vic @ Rd between sample sessions are presented in Figure 18 for dissolved arsenic, cadmium, iron, zinc, and sulphate. In general the concentrations of dissolved arsenic and zinc have remained relatively unchanged since 2008 while dissolved cadmium concentrations exhibit a slight increasing trend. Furthermore, concentrations of dissolved cadmium in 2011/12 are marginally higher than previous years, with a higher level of annual variability.

3.6.2 Victoria Creek – Inter-station Comparison

Inter-station comparisons on Victoria Creek were conducted for the main trace elements of concern (arsenic, zinc and cadmium) and sulphate (Figure 19). Dissolved metals, as opposed to total concentrations, were selected for the Victoria Creek inter-station comparison in order to isolate mine-related influences, and to specifically rule out the interfering effects of suspended solids contributed by both natural and anthropogenic sources upstream in the Victoria Creek catchment.

In general, the water quality data for Victoria Creek upstream of the Dome Creek confluence (Vic Upper and Vic Ref) show comparable water quality. In contrast, inspection of the water quality data for Victoria Creek downstream of the Dome Creek confluence (Vic @ Rd) shows a clear mine-related influence. For example, sulfate concentrations in Victoria Creek downstream of Dome Creek (median = 26.8 mg/L) exhibit a pronounced increase in comparison to levels upstream of Back Creek (Vic Ref median = 11 mg/L and Upper Vic median = 11 mg/L) (Table 3-5).

Downstream of the confluence of Dome Creek, the concentrations of dissolved arsenic show well-defined increases above reference water quality, reflecting the contribution of mine-related inputs. Dissolved arsenic concentrations in Victoria Creek increase by almost an order of magnitude from upstream median values of ~0.0002 mg/L to median levels downstream of Dome Creek at Vic @ Rd of 0.0012 mg/L (Table 3-5). At all sites, dissolved arsenic values remained below the CCME guideline for total arsenic of 0.005 mg/L.

The downstream trends for dissolved zinc and dissolved cadmium are less pronounced than those observed for sulfate and dissolved arsenic. Dissolved zinc concentrations below the Dome Creek

confluence show only a minor increase in concentration in comparison to levels observed upstream. Similarly, inputs from Dome Creek have only a minor influence on dissolved cadmium concentration in Victoria Creek. Dissolved cadmium concentrations upstream of Dome Creek are only marginally lower than those values reported downstream of the Dome Creek confluence. At all times, dissolved zinc concentrations in Victoria Creek at Vic @ Rd remained below the CCME guideline for total zinc of 0.03 mg/L and the majority of samples had dissolved cadmium concentrations below the total cadmium guideline value of 0.00012 mg/L.

Collectively, the water quality data for Victoria Creek at Vic @ Rd demonstrate that inputs from Dome Creek have a marked effect on water quality with respect to sulfate and arsenic. Minor mine-related signatures from Dome Creek with respect to zinc and cadmium are also observed; however, the effect on these parameters is far less pronounced.

4 Summary

A detailed assessment of the surface water quality data for the Mount Nansen mine site from April 2008 to March 2012 was carried out looking at how the current surface water quality conditions at the site compare to EQS and CCME guidelines as well as to identify any changes in water quality from historic norms. As a result of this assessment the following conclusions can be made with respect to the surface water quality conditions at the site:

- Tailings Pond
  - Dissolved arsenic concentrations vary annually and in 2011/12 are present at concentrations similar to 2008/09 levels.
  - Concentrations of total cadmium and zinc also vary annually, increasing between 2008/09 and 2010/11 then decreasing in 2011/12 to concentrations marginally higher than 2008/09 levels.
  - Assessment of trends in water quality in the tailings pond is difficult to fully assess in absence tailings pond water level data.
  - These annual variations in tailings pond water quality may, in part, be a result of fluctuating water levels in the pond and potential oxidation of exposed sulphides as the pond level is lowered.

- Seepage Pond
  - Total arsenic concentrations have been decreasing since 2008/09.
  - Dissolved arsenic concentrations remained relatively unchanged between 2008/09 and 2010/11 then increased by almost one order of magnitude in 2011/12.
  - Total cadmium concentrations remained relatively stable while total zinc and sulphate levels have steadily decreased since 2008/09.

- Brown-McDade Pit
  - Water quality in the pit varies with depths with concentrations of sulphate, ammonia and metals increasing with depth.
  - Total and dissolved arsenic levels remain relatively unchanged in 2011/12 from 2008/09 levels.
  - Total cadmium and arsenic concentrations have decreased since 2008/09.
  - Sulphate concentrations remained relatively stable until 2010/11 then increased in 2011/12.

- Dome Creek
  - The influence of the mill site on water quality is evident at D1 with increased levels of many parameters above reference water quality conditions.
  - Concentrations of total arsenic have decreased slightly at D1 while total cadmium and zinc concentrations have increased dramatically.
  - Total cadmium and zinc concentrations at Upper Dome are lower than those at D1 but elevated in comparison to reference conditions.
  - Concentrations of cyanide and nitrogen species are elevated in Upper Dome Creek in comparison to upstream conditions, indicative of the influence of seepage from the tailings area.
  - Dissolved arsenic concentrations at Upper Dome and Dome @ RD remained relatively unchanged between 2008/09 to 2010/11 then increased by almost two times in 2011/12,

most likely in response to a corresponding increase in dissolved arsenic concentrations in discharges from the seepage pond.
    - Concentrations of total cadmium and zinc at Upper Dome and Dome @ Rd increased in 2011/12 to concentrations above 2008/09 levels.
    - The water quality in Dome Creek shows a clear mine-related influence with peak arsenic concentrations occurring downstream below the tailings area while peak cadmium and zinc concentrations occur downstream of the mill area.

- Pony Creek
    - The water quality data in Pony Creek at Pony U/S is influenced by the historic placement of waste rock in the channel with elevated levels of metals including cadmium, lead and zinc.
    - Total arsenic concentrations at Pony U/S remain unchanged since 2008/09 while total cadmium, zinc and sulphate concentrations increased from 2008/09 to 2009/10 then decreased in 2011/12 to levels similar to 2008/09.

- Back Creek
    - The water quality in Back Creek is influenced by upstream historic and ongoing placer mining activities which significantly masks any inputs and potential impacts of the Mount Nansen mine site via the inflow of Pony Creek.

- Victoria Creek
    - Elevated levels of suspended solids, and associated metal loading, from both anthropogenic and natural sources upstream significantly influence the water quality in Victoria Creek at Vic @ Rd.
    - Dissolved arsenic and zinc concentrations in Victoria Creek downstream of all mine related inflows remain relatively unchanged since 2008/09.
    - Dissolved cadmium concentrations at Vic @ Rd have increased since 2008/09 and exhibited a higher degree of variability in 2011/12.
    - Collectively, site water quality data for Victoria Creek downstream of the site demonstrate that inputs from the mine site have a marked effect on water quality with respect to sulfate and arsenic. Minor mine-related signatures are evident with respect to zinc and cadmium are also observed; however, the effect on these parameters is far less.
    - Overall the current levels of dissolved arsenic, dissolved zinc and dissolved cadmium in Victoria Creek are not anticipated to have adverse effects on aquatic communities, with concentrations generally below the CCME guidelines for total metals.

5 References

AECOM (2009). Tailings Seepage Collection Pond Water Balance. Prepared for Assessment and Abandoned Mines Branch, Department of Energy, Mines and Resources, Government of Yukon, November 2009.

AECOM (2010). Mt. Nansen Surface Water Quality Baseline Characterization. Prepared for Assessment and Abandoned Mines Branch, Department of Energy, Mines and Resources, Government of Yukon, February 2010.

CCME (2008). Canadian Water Quality Guidelines for the Protection of Aquatic Life. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment.

Lorax (2011). Mount Nansen Mine Geochemical Assessment in Support of Evaluation of Closure Plan Options. Prepared for Assessment and Abandoned Mines Branch, Department of Energy, Mines and Resources, Government of Yukon, July 2011.

Figures

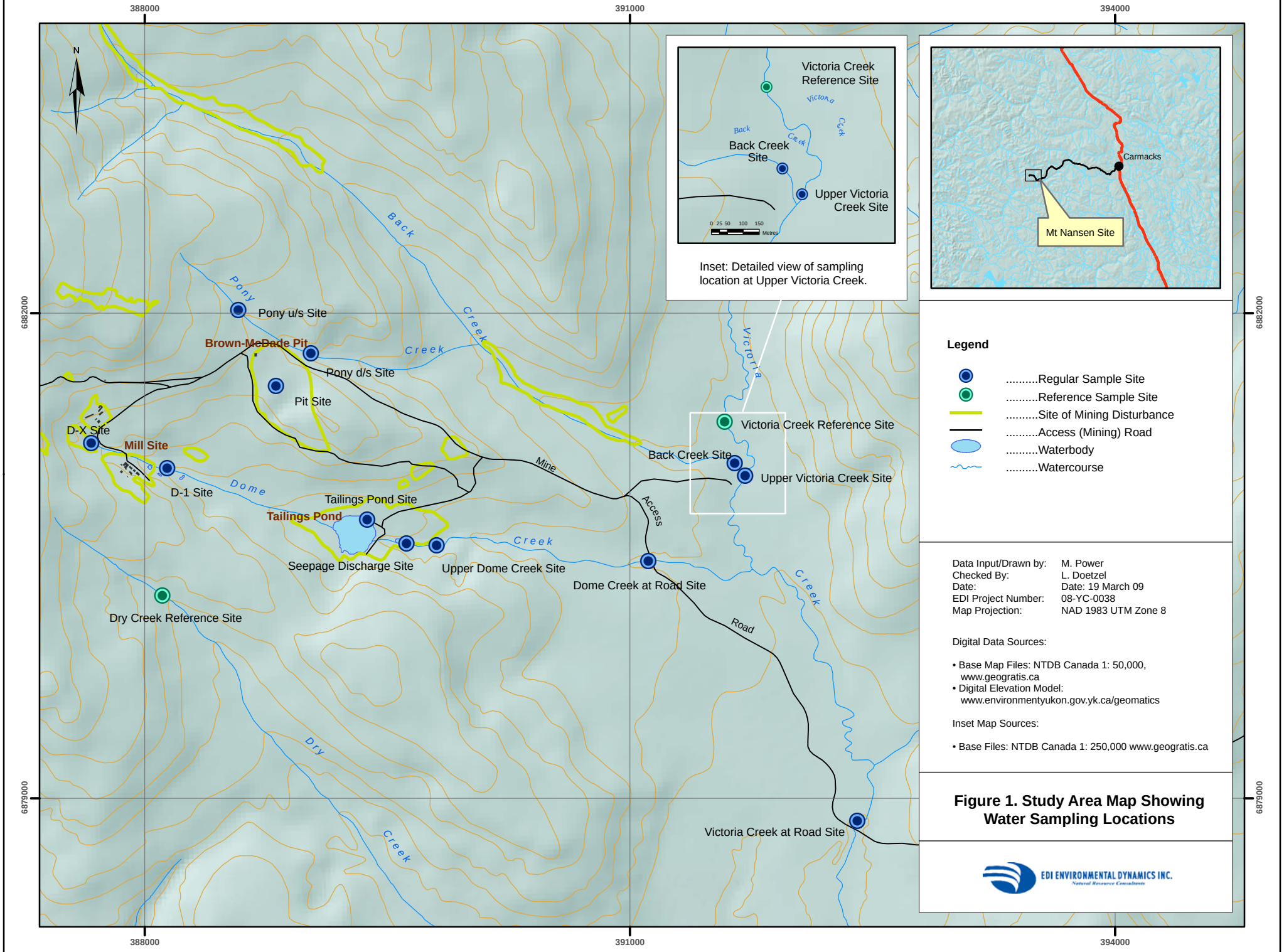

Figure 1. Study Area Map Showing Water Sampling Locations

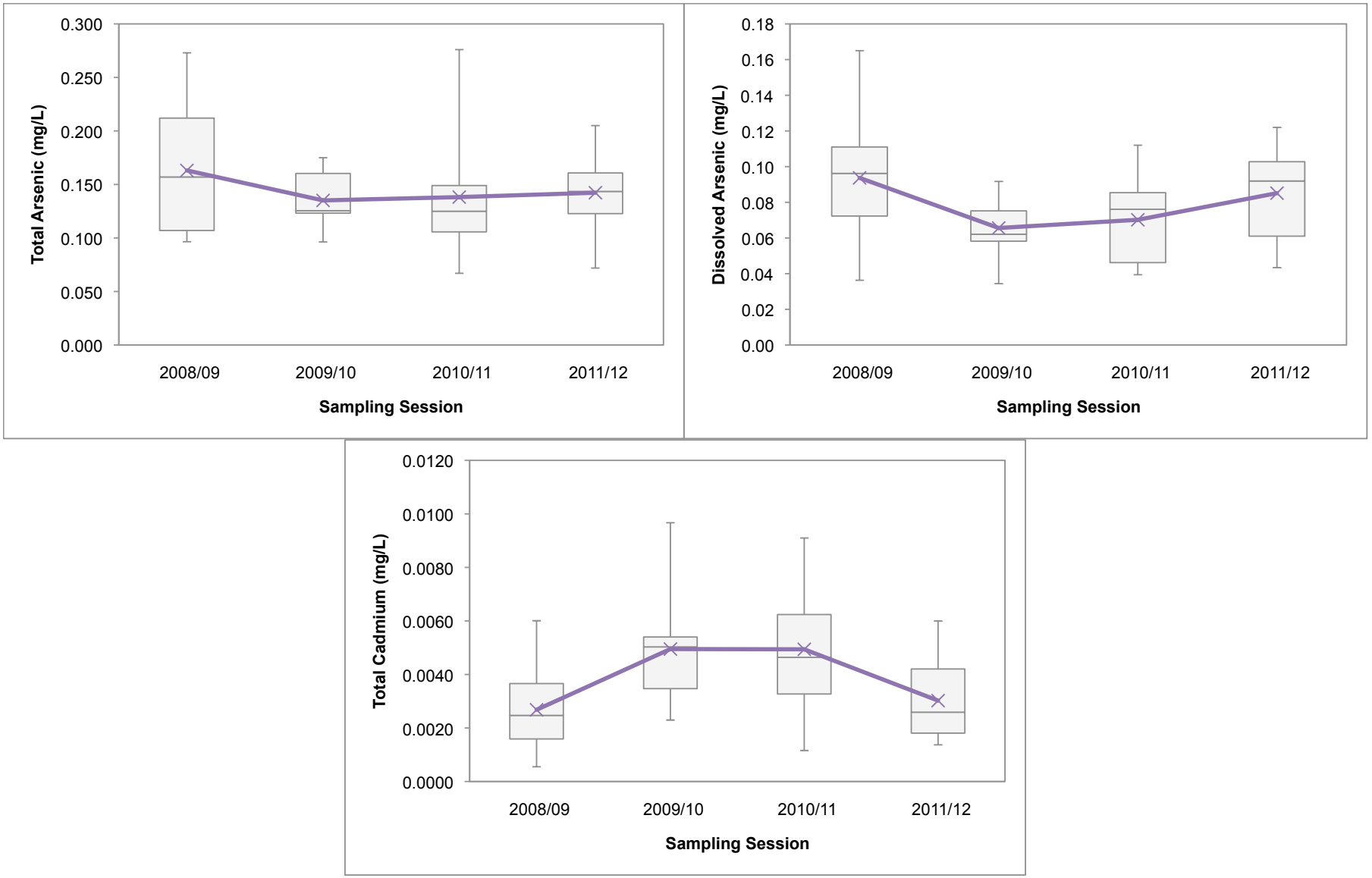

Figure 2 Tailings Pond Box-Whisker Plots for Total Arsenic, Dissolved Arsenic, and Total Cadmium

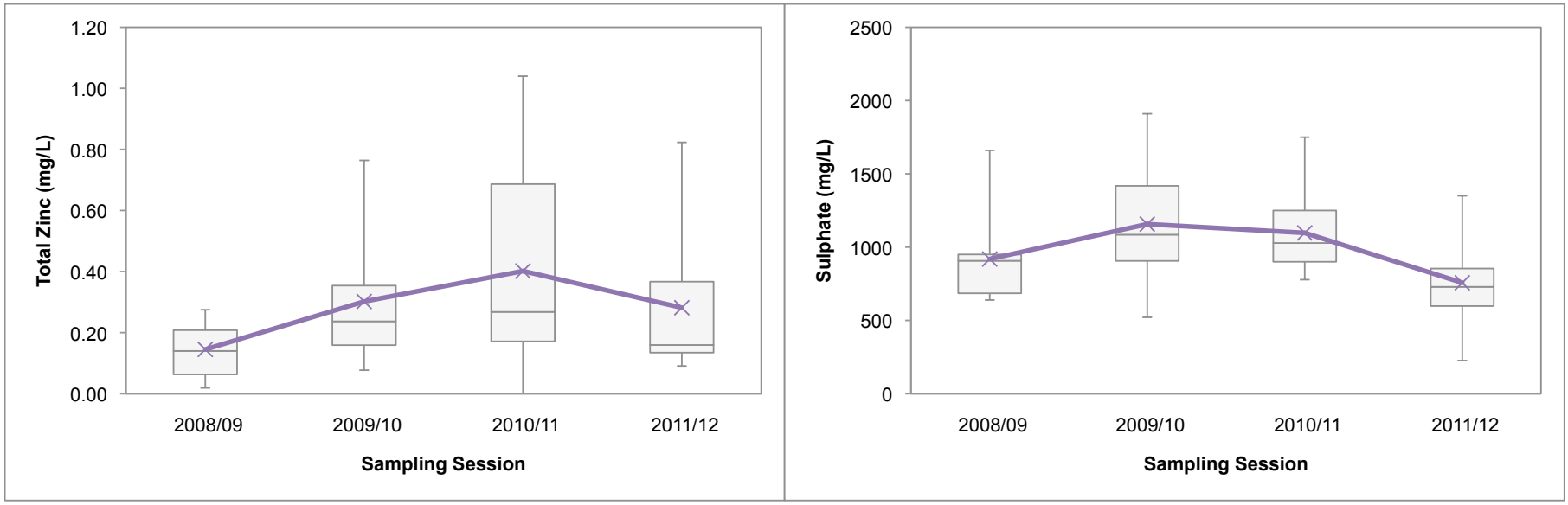

Figure 3 Tailings Pond Box-Whisker Plots for Total Zinc and Sulphate

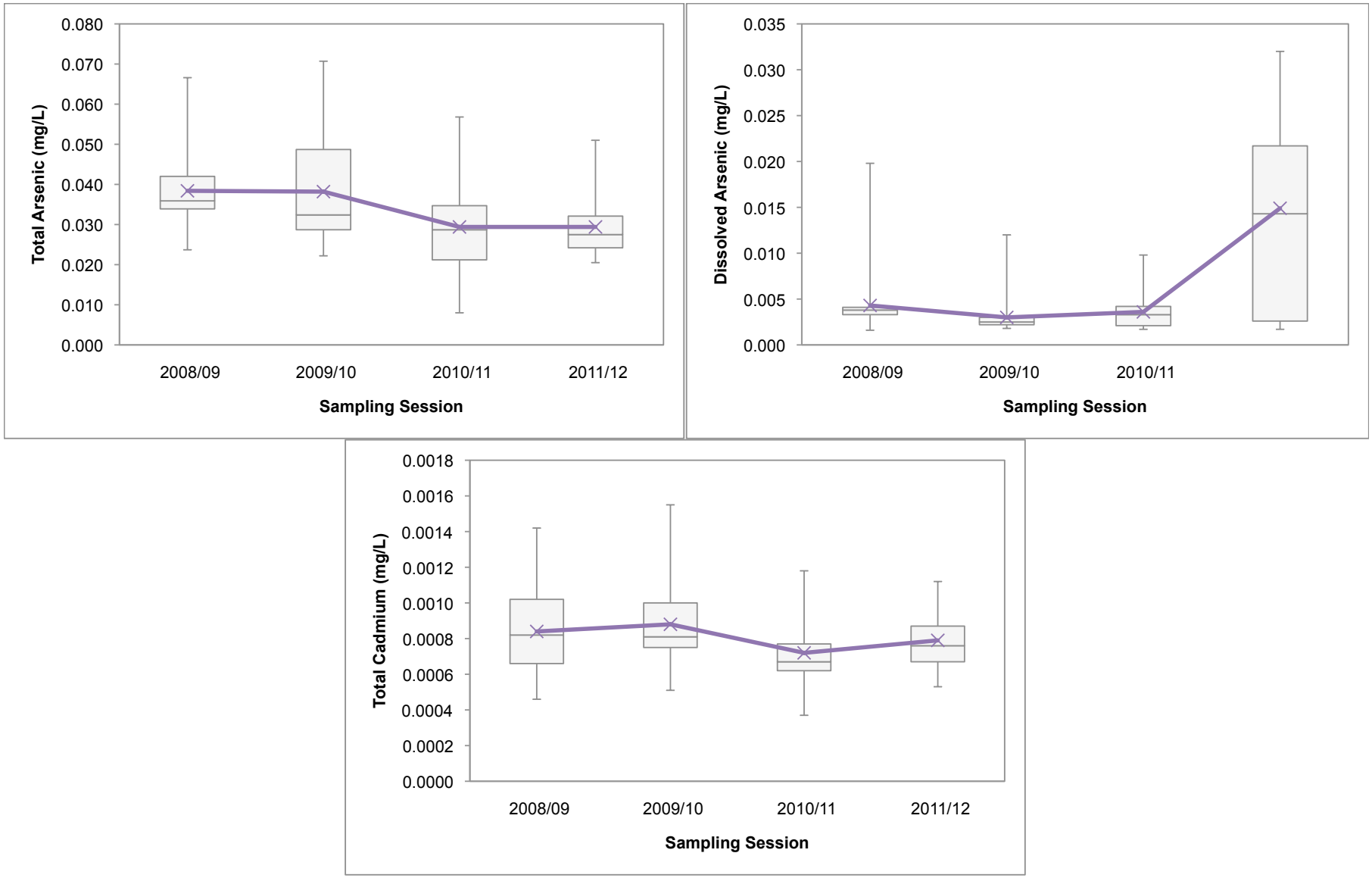

Figure 4 Seepage Pond Box-Whisker Plots for Total Arsenic, Dissolved Arsenic, and Total Cadmium

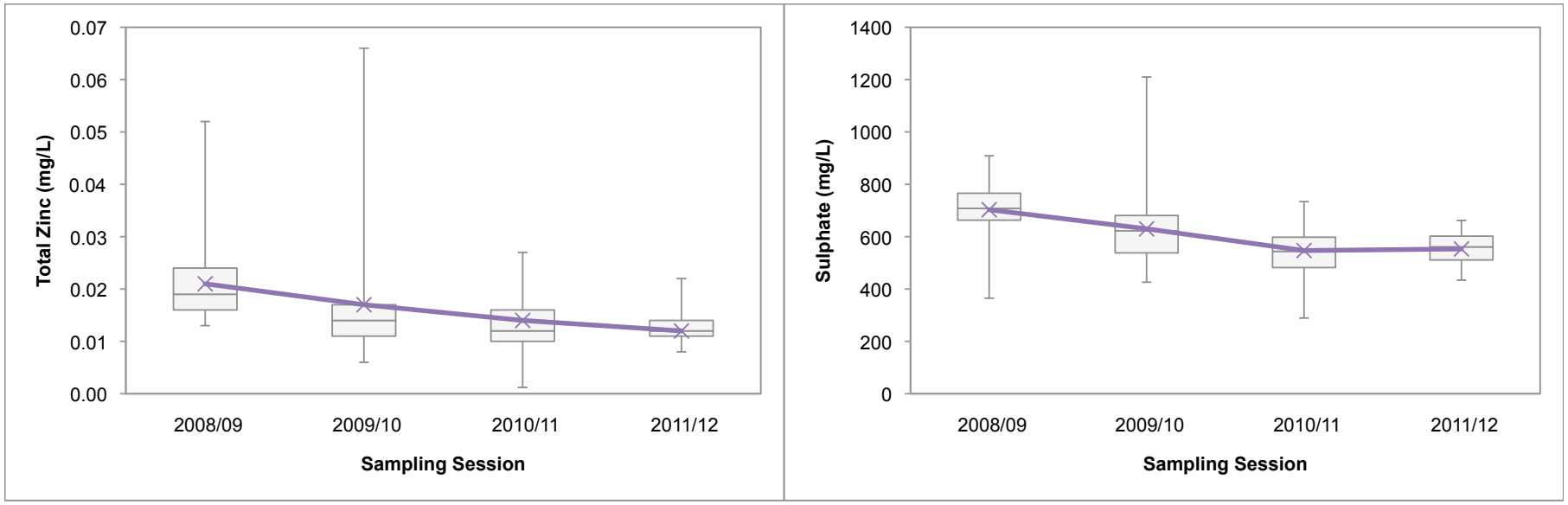

Figure 5 Seepage Pond Box-Whisker Plots for Total Zinc and Sulphate

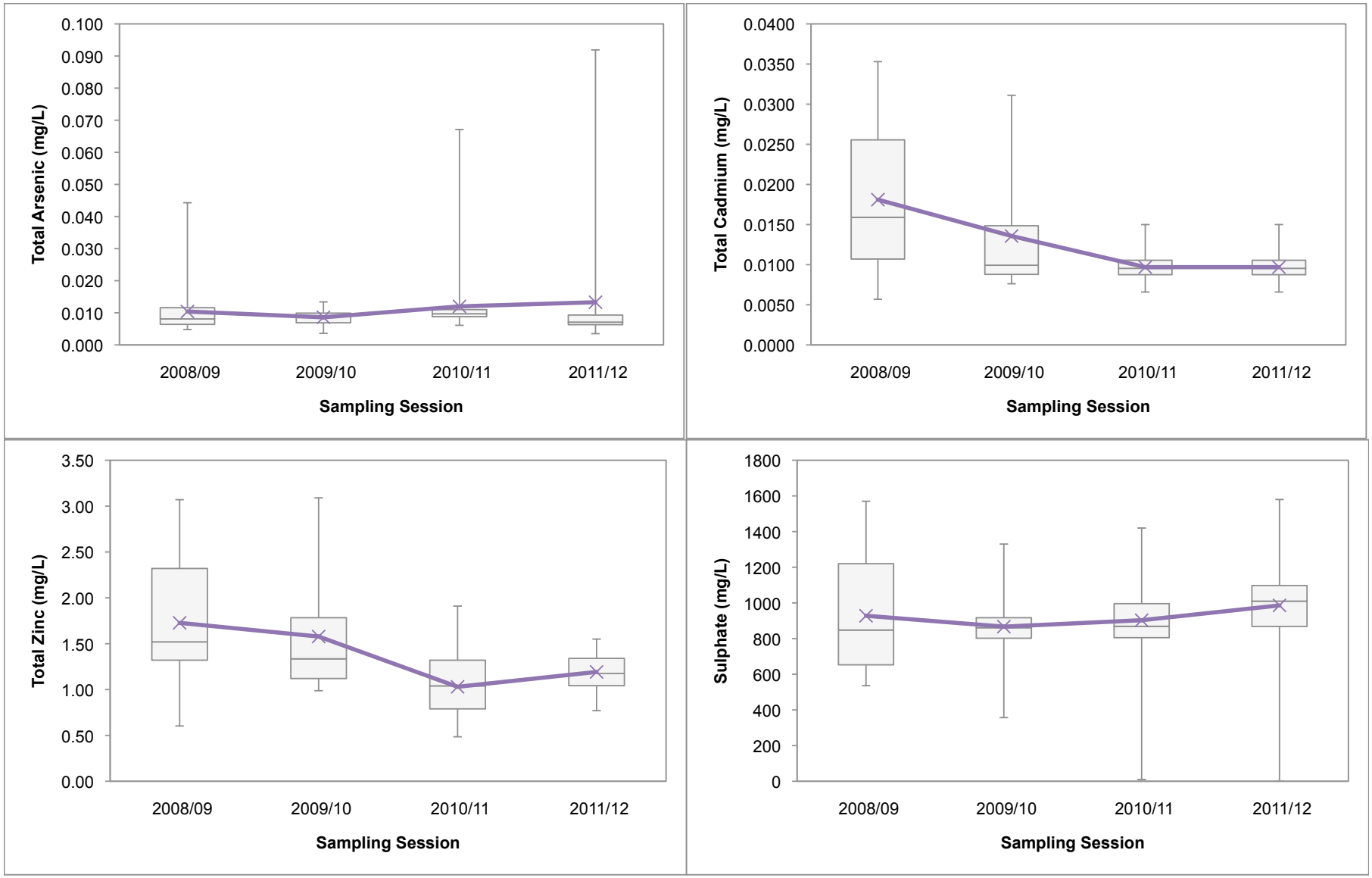

Figure 6 Brown-McDade Pit Box-Whisker Plots for Total Arsenic, Total Cadmium, Total Zinc and Sulphate

Figure 7 Brown-McDade Pit Total Arsenic, Total Cadmium, Total Zinc and Sulphate Concentrations at Different Depths

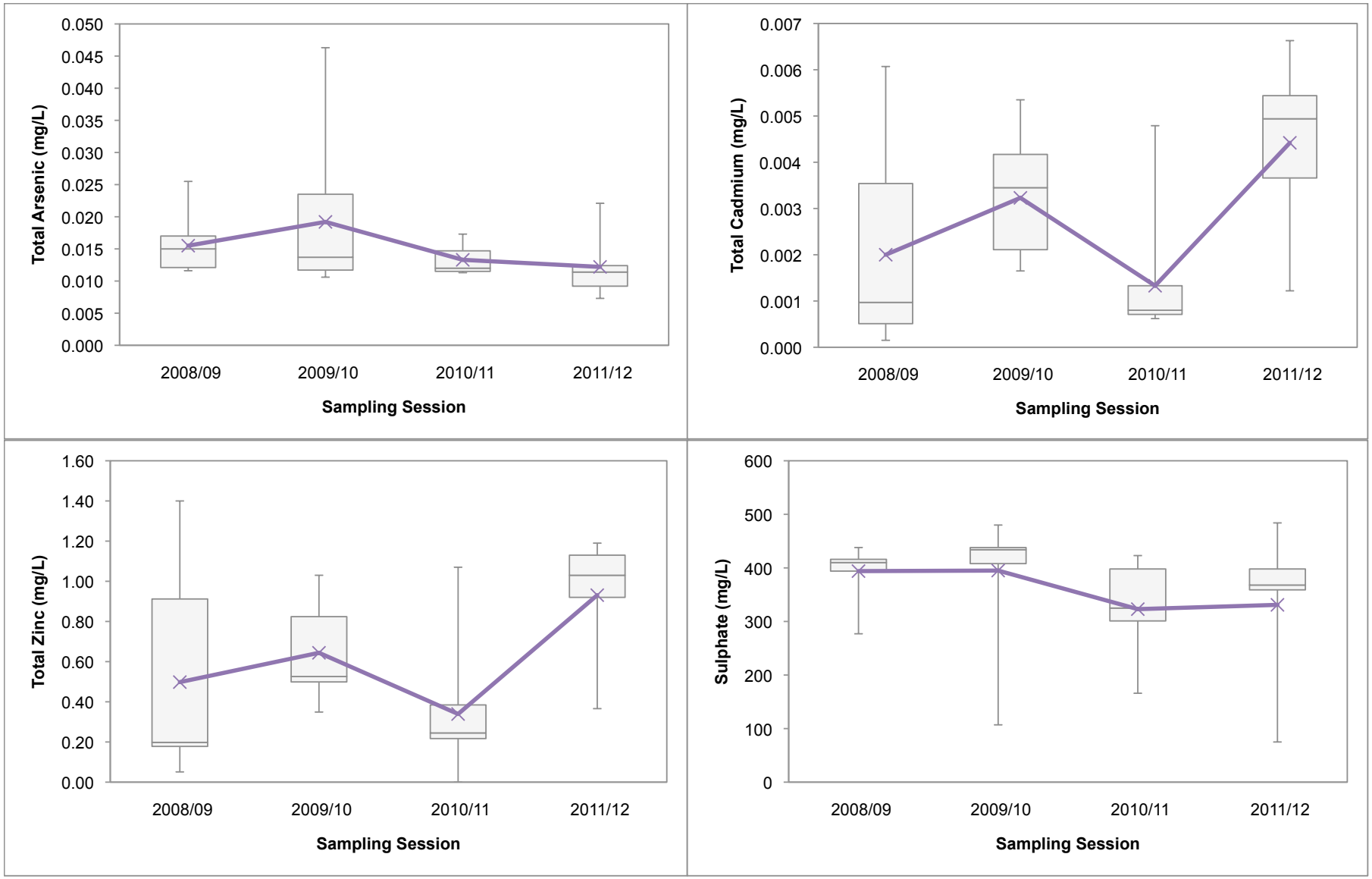

Figure 8 Dome Creek at D1 Box-Whisker Plots for Total Arsenic, Total Cadmium, Total Zinc and Sulphate

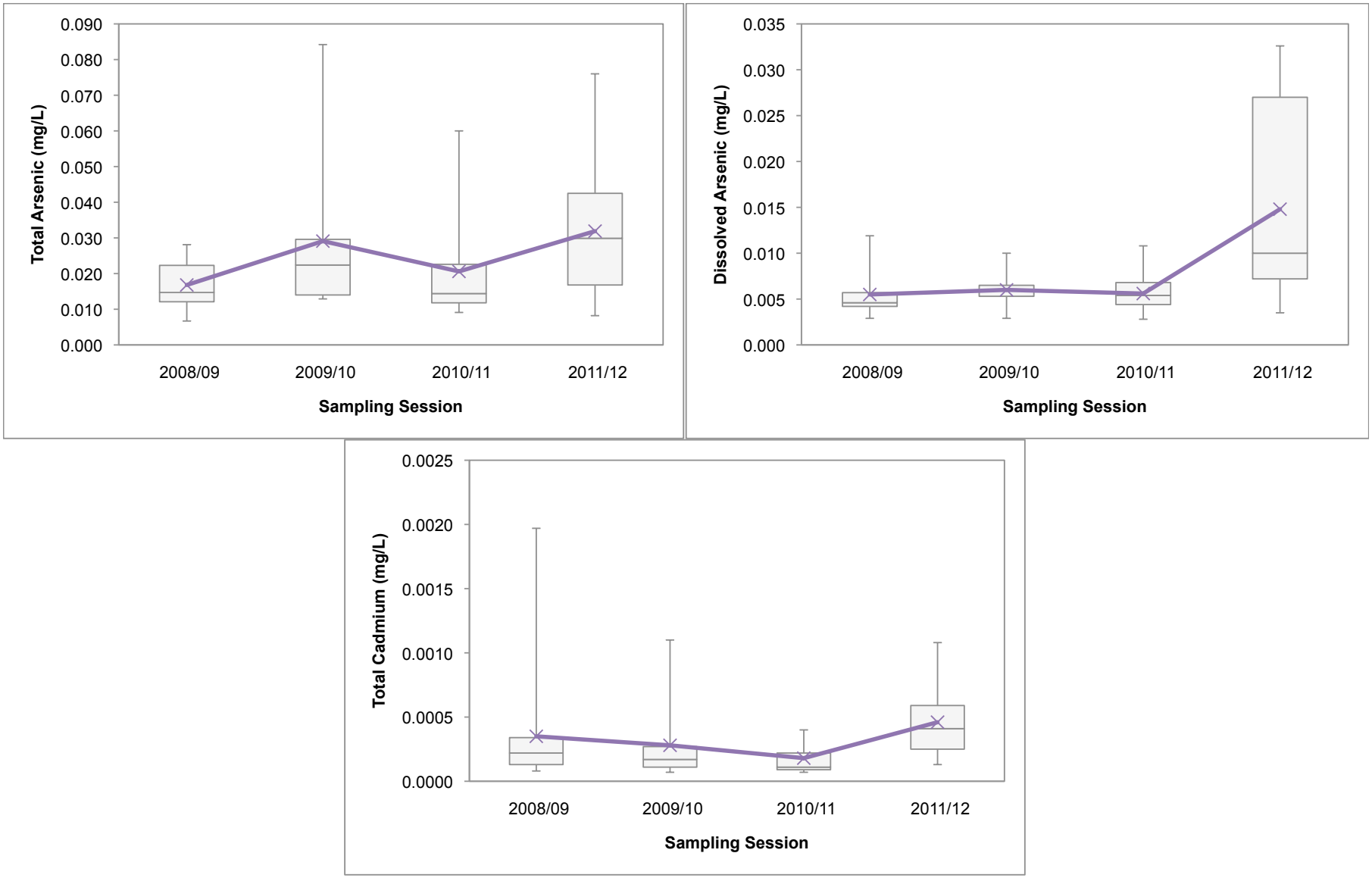

Figure 9 Dome Creek at Upper Dome Box-Whisker Plots for Total Arsenic, Dissolved Arsenic, and Total Cadmium

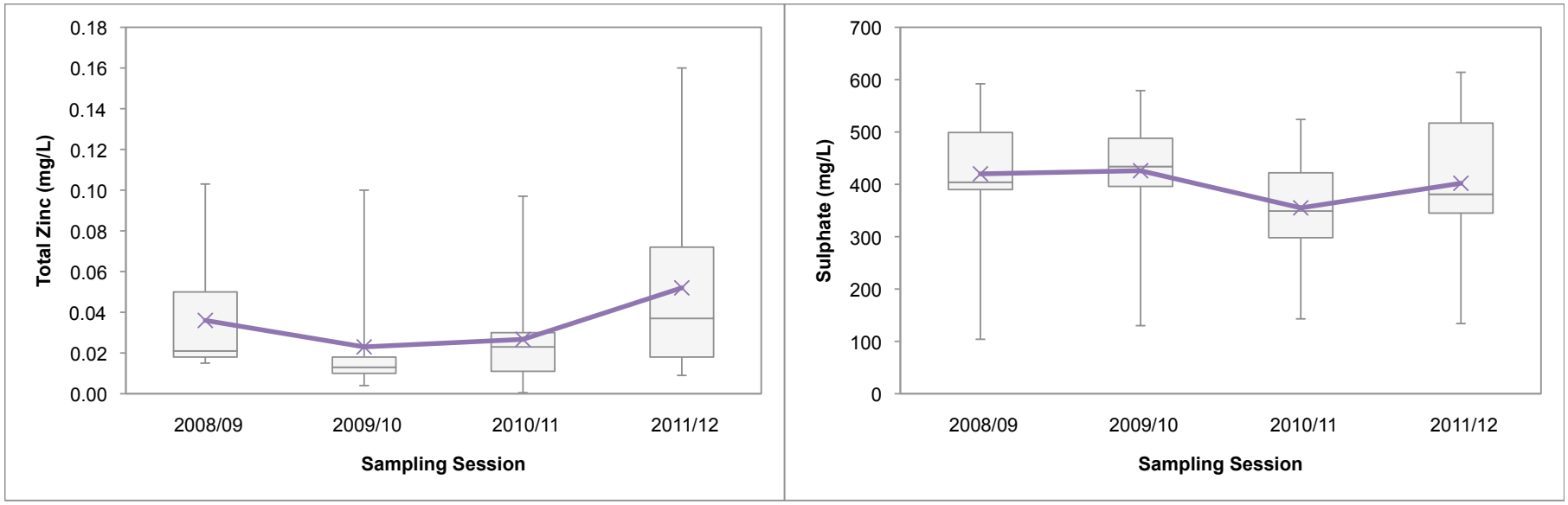

Figure 10 Dome Creek at Upper Dome Box-Whisker Plots for Total Zinc and Sulphate

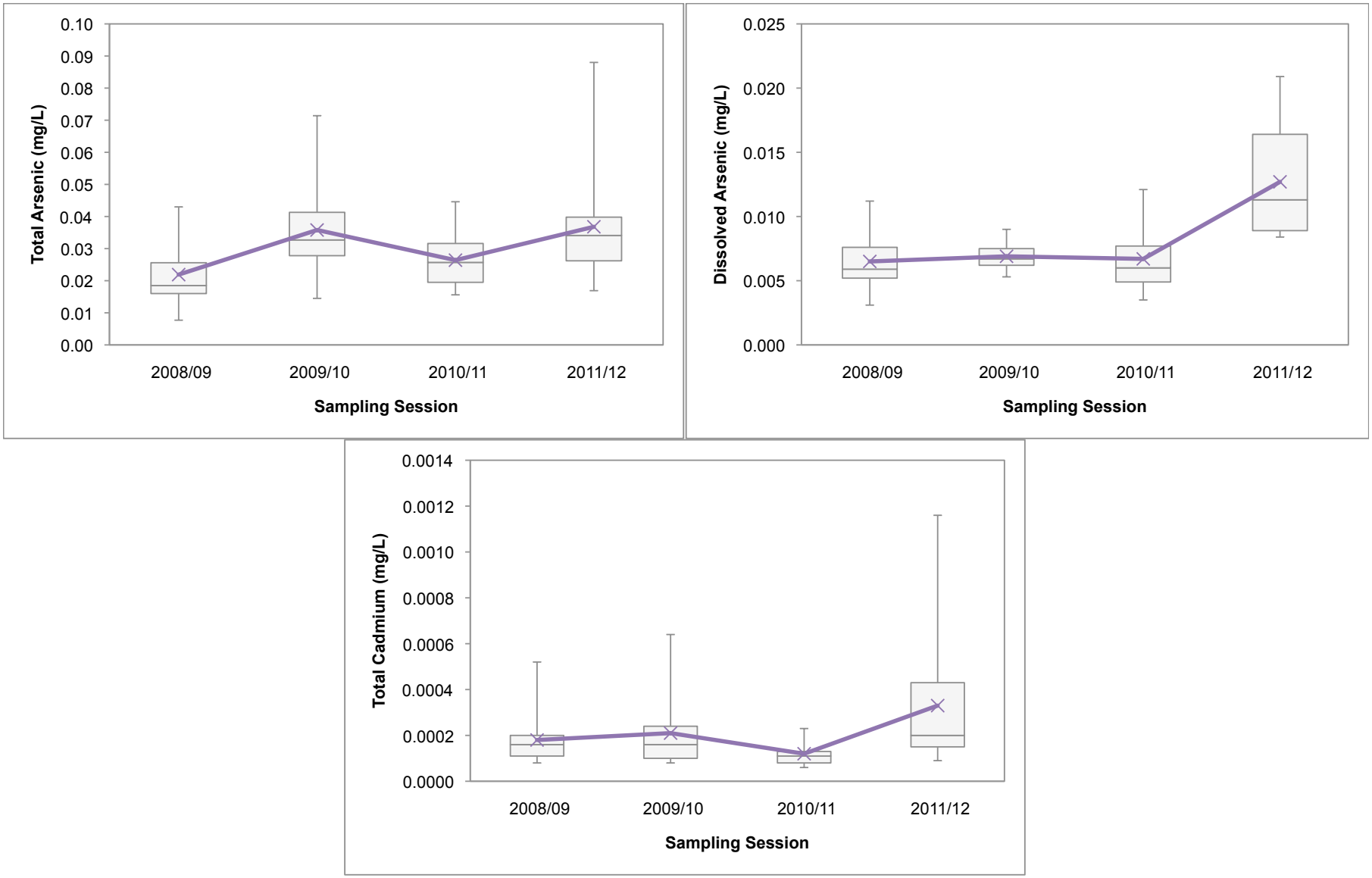

Figure 11 Dome Creek at Dome @ Rd Box-Whisker Plots for Total Arsenic, Dissolved Arsenic, and Total Cadmium

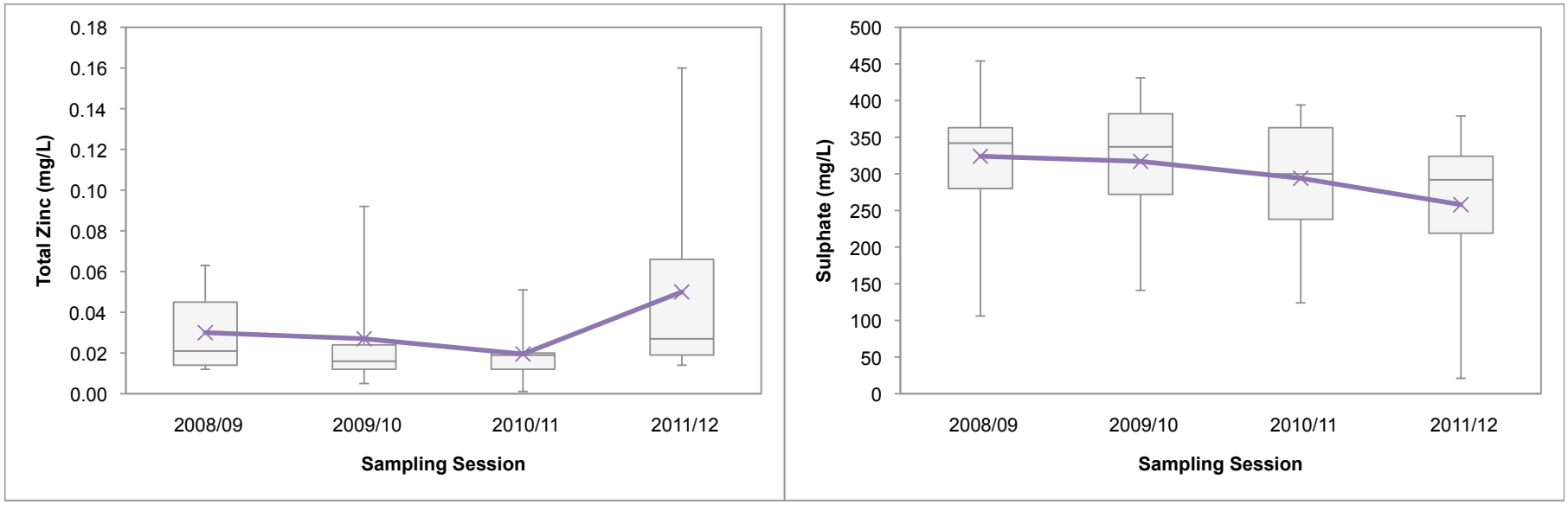

Figure 12 Dome Creek at Dome @ Rd Box-Whisker Plots for Total Zinc and Sulphate

Figure 13 Dome Creek Inter-stations Comparisons for Total Arsenic, Dissolved Arsenic, and Total Cadmium

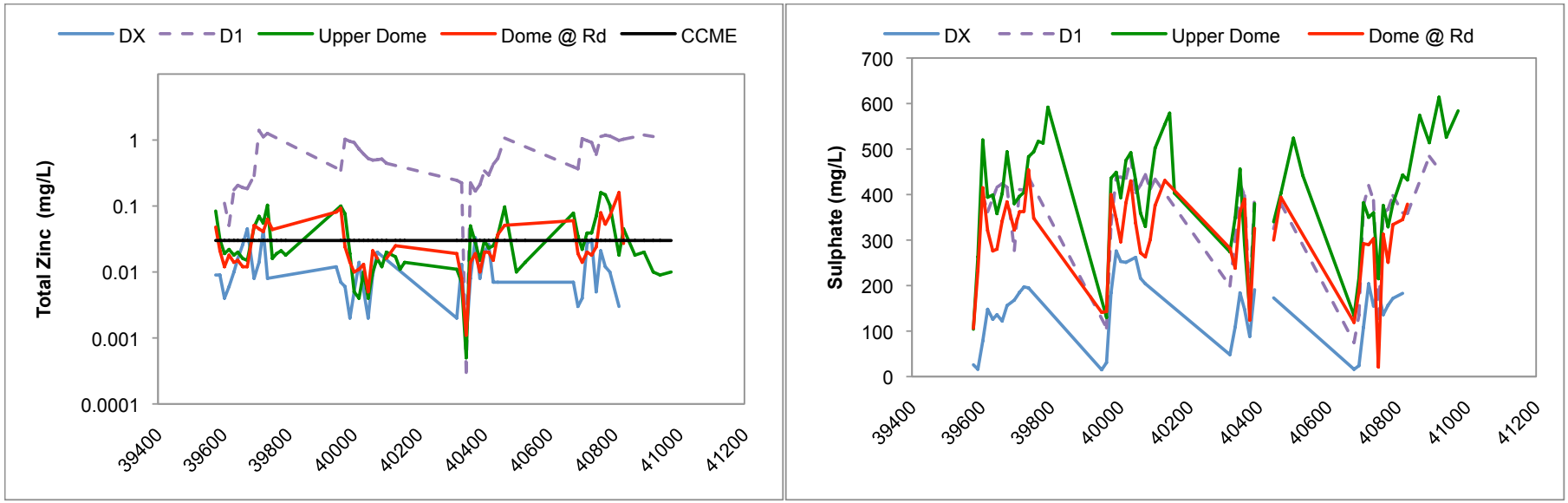

Figure 14 Dome Creek Inter-station Comparisons for Total Zinc and Sulphate

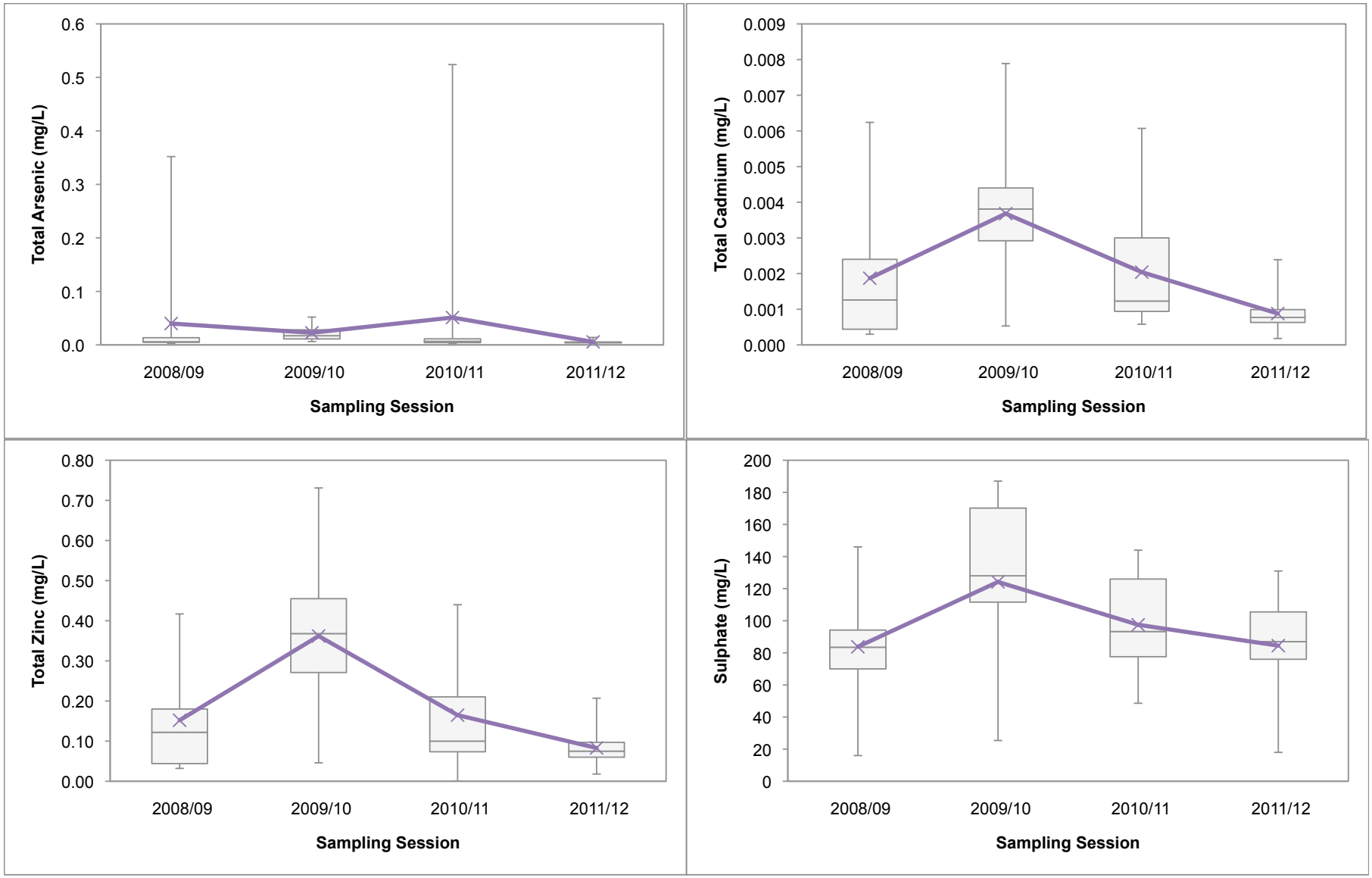

Figure 15 Pony Creek at Pony D/S Box-Whisker Plots for Total Arsenic, Total Cadmium, Total Zinc and Sulphate

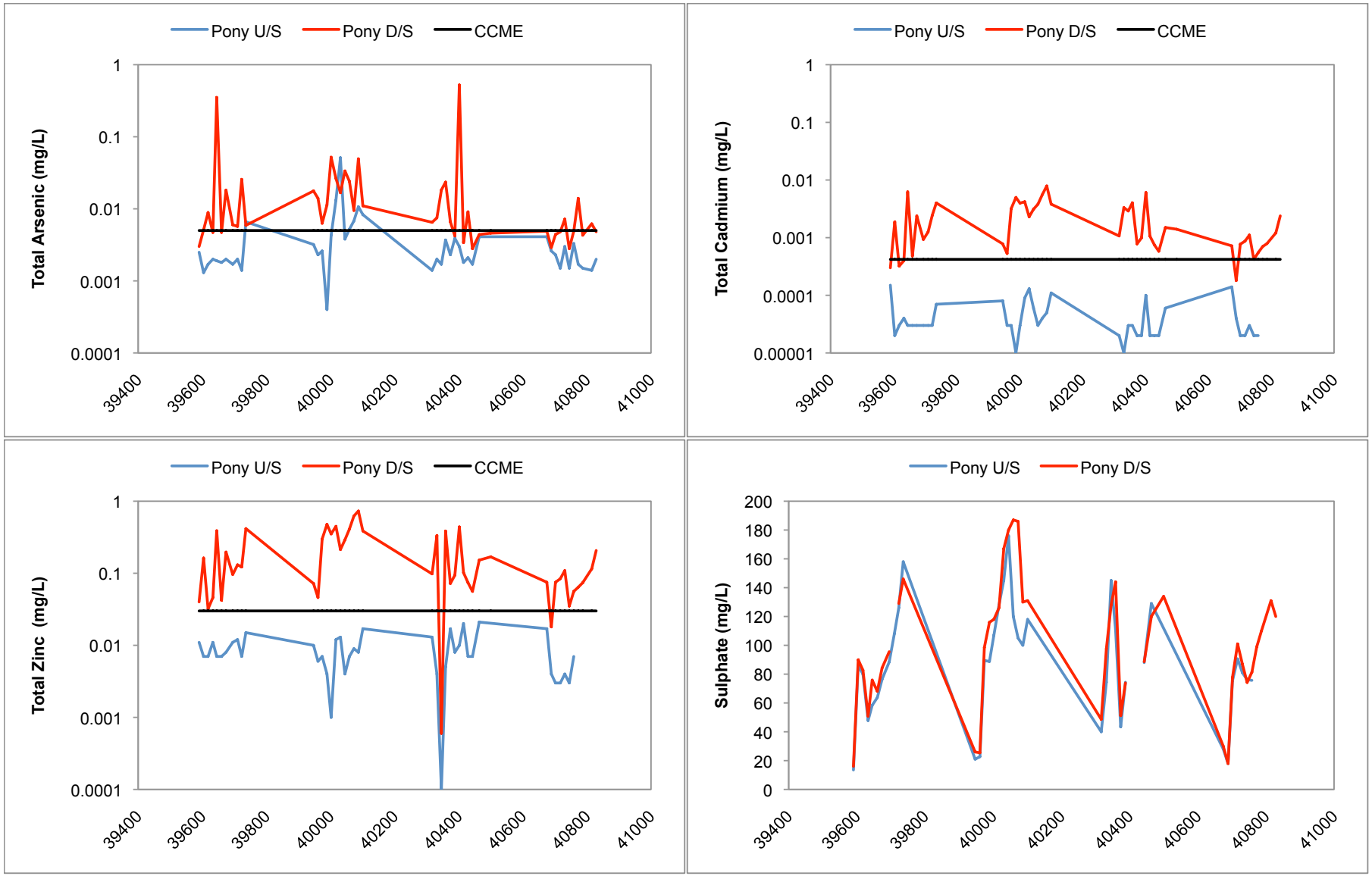

Figure 16 Pony Creek Inter-station Comparison Total Arsenic, Total Cadmium, Total Zinc and Sulphate

Figure 17 Pony Creek and Back Creek Inter-station Comparison Total Arsenic,Dissolved Arsenic, Total Cadmium and Total Zinc

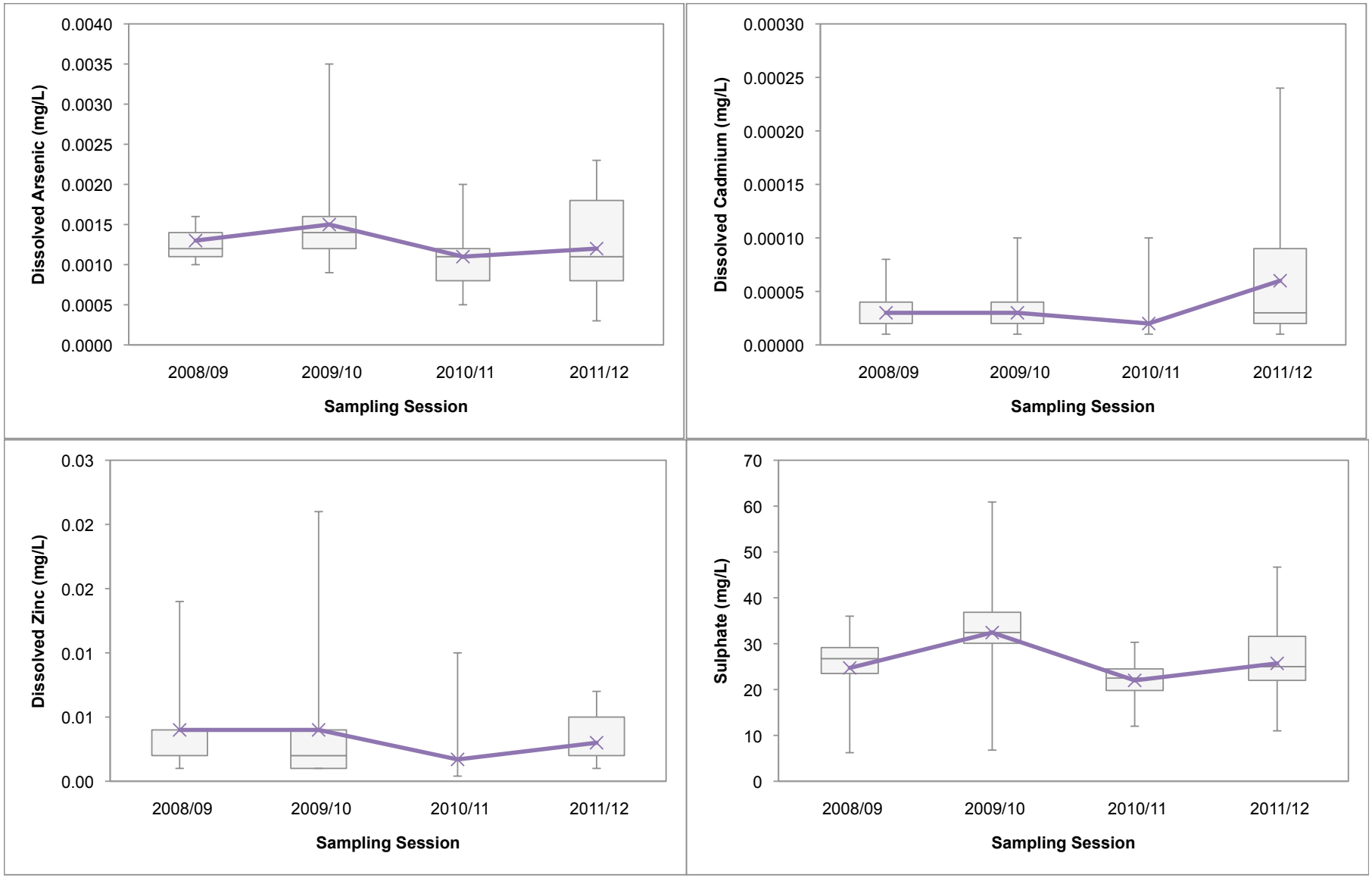

Figure 18 Victoria Creek at Vic @ Rd Box-Whisker Plots for Dissolved Arsenic, Dissolved Cadmium, Dissolved Zinc and Sulphate

Figure 19 Victoria Creek Inter-station Comparison Dissolved Arsenic, Dissolvedl Cadmium, Dissolved Zinc and Sulphate

Appendix A

Mount Nansen Surface Water Quality Data – April 2008 to March 2012 (provided electronically)

Appendix B

Mount Nansen Surface Water Quality Data – Station Summary Statistics

Table B-1. Summary of Tailings Pond Water Quality (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences (EQS/CCME)	Percent of Exceedences (EQS/CCME)
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	51	6.99	7.67	7.91	8.04	8.28	0	0
Hardness (as $CaCO_3$)	mg/L			48	328	818	908	1258	2120	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			52	34	72	86	162	384	-	-
Sulphate	mg/L			50	226	731	907	1128	1910	-	-
Total Suspended Solids	mg/L		50	52	1	5	9	17	656	3 EQS	6 EQS
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		52	0.01	0.08	0.32	0.78	8.6	12 CCME	23 CCME
Nitrate Nitrogen	mg/L	2.9		52	0.01	0.36	1.01	2	9.81	8 CCME	15 CCME
Nitrite Nitrogen	mg/L	0.06		52	0.005	0.01	0.01	0.071	0.33	14 CCME	27 CCME
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3							-	-
WAD Cyanide	mg/L		0.1	52	0.002	0.002	0.004	0.006	0.014	0	0
SAD Cyanide	mg/L			52	0.002	0.008	0.022	0.049	0.2	-	-
Cyanate	mg/L			52	0.2	0.2	0.3	0.4	1.8	-	-
Thiocyanate	mg/L			52	0.1	0.1	0.3	0.6	1.7	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		52	0.012	0.051	0.112	0.219	13.4	0	0
Total Antimony	mg/L		0.15	52	0.0404	0.0863	0.106	0.1275	0.49	6 EQS	12 EQS
Total Arsenic	mg/L	0.005		52	0.067	0.1158	0.142	0.1673	9.02	52 CCME	100 CCME
Dissolved Arsenic			0.15	52	0.0344	0.059	0.0796	0.0974	3.04	2 EQS	4 EQS
Total Barium	mg/L		1	52	0.01	0.016	0.018	0.025	0.4	0	0
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	52	0.00055	0.00219	0.00347	0.0052	0.0508	1 EQS/52 CCME	2 EQS/100 CCME
Total Chromium	mg/L	0.0089	0.04	52	0.0004	0.0004	0.0006	0.0009	0.03	0 EQS/1 CCME	0 EQS/2 CCME
Total Copper	mg/L	0.002-0.004[g]	0.2	52	0.028	0.044	0.056	0.075	1.5	1 EQS/52 CCME	2 EQS/100 CCME
Total Iron	mg/L	0.3	1	52	0.1	0.34	0.587	1.038	95.3	13 EQS/45 CCME	87 EQS/27 CCME
Total Lead	mg/L	0.001-0.007[h]	0.1	52	0.0047	0.0145	0.0277	0.0569	3.72	5 EQS/48 CCME	10 EQS/92 CCME
Total Manganese	mg/L		0.5	50	0.123	0.885	1.63	2.498	17.4	44 EQS	88 EQS
Total Molybdenum	mg/L	0.073		52	0.001	0.0023	0.00279	0.004	0.02	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	52	0.0011	0.004	0.005	0.0073	0.05	0	0
Total Selenium	mg/L	0.001		52	0.0002	0.0006	0.0006	0.0006	0.17	4 CCME	8 CCME
Total Silver	mg/L	0.0001	0.1	52	0.00002	0.00021	0.00036	0.00075	0.0636	0 EQS/48 CCME	0 EQS/92 CCME
Total Thallium	mg/L	0.008		52	0.00008	0.00028	0.00035	0.00045	0.0037	1 CCME	2 CCME
Total Zinc	mg/L	0.03	0.3	52	0.0003	0.1247	0.195	0.351	4	16 EQS/50 CCME	31 EQS/96 CCME

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{\{0.83[\log(\text{hardness})]-2.46\}}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-2. Summary of Seepage Water Quality (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences (EQS/CCME)	Percent of Exceedences (EQS/CCME)
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	75	6.53	7.01	7.13	7.27	7.83	0	0
Hardness (as $CaCO_3$)	mg/L			66	387	662	742	790	1300	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			76	119	228	238	251	346	-	-
Sulphate	mg/L			74	289	538	608	682	1210	-	-
Total Suspended Solids	mg/L		50	73	2	21	27	36	94	3 EQS	4 EQS
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		76	0.01	4.55	5.65	6.5	17	75 CCME	99 CCME
Nitrate Nitrogen	mg/L	2.9		76	0.22	1.95	3.05	3.86	5.51	39 CCME	51 CCME
Nitrite Nitrogen	mg/L	0.06		76	0.01	0.1	0.17	0.295	0.6	64 CCME	84 CCME
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	76	0.006	0.012	0.016	0.022	0.164	2 EQS	3 EQS
SAD Cyanide	mg/L			76	0.07	0.775	1.2	2	10	-	-
Cyanate	mg/L			76	0.2	0.6	1.1	1.6	6.5		
Thiocyanate	mg/L			76	1	5.6	8.1	13.4	131		
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		76	0.015	0.026	0.03	0.052	1.29	0	0
Total Antimony	mg/L		0.15	76	0.0005	0.0007	0.0008	0.001	0.0104	0	0
Total Arsenic	mg/L	0.005		76	0.008	0.0265	0.0323	0.0388	0.0707	76 CCME	100 CCME
Dissolved Arsenic			0.15	76	0.0016	0.0022	0.0033	0.0044	0.032	0	0
Total Barium	mg/L		1	76	0.047	0.057	0.063	0.067	0.105	0	0
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	76	0.00037	0.00066	0.00077	0.00098	0.00155	0 EQS/75 CCME	0 EQS/99 CCME
Total Chromium	mg/L	0.0089	0.04	76	0.0004	0.0008	0.001	0.0013	0.062	1 EQS/1 CCME	1 EQS/1 CCME
Total Copper	mg/L	0.002-0.004[g]	0.2	76	0.004	0.006	0.008	0.009	0.024	0 EQS/75 CCME	0 EQS/99 CCME
Total Iron	mg/L	0.3	1	76	3.17	8.14	10.15	14.27	31.6	76 EQS and CCME	100 EQS and CCME
Total Lead	mg/L	0.001-0.007[h]	0.1	76	0.0001	0.0002	0.0002	0.0005	0.0354	0 EQS/2 CCME	0 EQS/3 CCME
Total Manganese	mg/L		0.5	73	3.71	6.26	7.29	7.96	15.5	73 EQS	100 EQS
Total Molybdenum	mg/L	0.073		76	0.0008	0.00109	0.0012	0.00153	0.003	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	76	0.0005	0.004	0.005	0.006	0.0303	0	0
Total Selenium	mg/L	0.001		76	0.0002	0.0006	0.0006	0.0006	0.006	6 CCME	8 CCME
Total Silver	mg/L	0.0001	0.1	76	0.00001	0.00002	0.00004	0.00007	0.00061	0 EQS/8 CCME	0 EQS/11 CCME
Total Thallium	mg/L	0.008		76	0.00001	0.00001	0.00001	0.00005	0.0001	0	0
Total Zinc	mg/L	0.03	0.3	76	0.0012	0.011	0.014	0.0192	0.066	0 EQS/5 CCME	0 EQS/7 CCME

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{\{0.83[\log(\text{hardness})]-2.46\}}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-3. Summary of Pit Water Quality - All Sample Depths (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences (EQS/CCME)	Percent of Exceedences (EQS/CCME)
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	114	6.77	7.31	7.55	7.82	8.09	0	0
Hardness (as $CaCO_3$)	mg/L			99	5	986	1180	1345	2000	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			114	82	164	196	218	283	-	-
Sulphate	mg/L			114	0.8	774.8	876.5	1060	1580	-	-
Total Suspended Solids	mg/L		50	111	1	2	2	4	374	3 EQS	3 EQS
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		114	0.005	0.01	0.015	0.05	0.44	0	0
Nitrate Nitrogen	mg/L	2.9		114	0.02	0.69	1.04	1.47	11	6 CCME	5 CCME
Nitrite Nitrogen	mg/L	0.06		114	0.005	0.01	0.01	0.035	0.54	27 CCME	24 CCME
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3							-	-
WAD Cyanide	mg/L		0.1							-	-
SAD Cyanide	mg/L									-	-
Cyanate	mg/L			114	0.0002	0.0043	0.0062	0.0073	0.0096	-	-
Thiocyanate	mg/L			114	0.0035	0.0069	0.009	0.0103	0.0919	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		114	0.005	0.009	0.017	0.035	0.515	0	0
Total Antimony	mg/L		0.15	114	0.0002	0.0043	0.0062	0.0073	0.0096	0	0
Total Arsenic	mg/L	0.005		114	0.0035	0.0069	0.009	0.0103	0.0919	108 CCME	95 CCME
Dissolved Arsenic			0.15	114	0.0004	0.0046	0.0061	0.0079	0.0998	0	0
Total Barium	mg/L		1	114	0.01	0.013	0.014	0.017	0.03	0	0
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	114	0.00453	0.00755	0.00957	0.01455	0.0353	16 EQS/114 CCME	14 EQS/100 CCME
Total Chromium	mg/L	0.0089	0.04	114	0.0004	0.0004	0.0004	0.0005	0.004	0	0
Total Copper	mg/L	0.002-0.004[g]	0.2	114	0.002	0.007	0.009	0.027	0.103	0 EQS/106 CCME	0 EQS/93 CCME
Total Iron	mg/L	0.3	1	114	0.01	0.044	0.07	0.114	4.48	3 EQS/10 CCME	3 EQS/9 CCME
Total Lead	mg/L	0.001-0.007[h]	0.1	114	0.0001	0.0008	0.0016	0.0028	0.022	0 EQS/2 CCME	0 EQS/2 CCME
Total Manganese	mg/L		0.5	109	0.027	0.169	0.376	1.21	8.92	50 EQS	46 EQS
Total Molybdenum	mg/L	0.073		114	0.00004	0.0001	0.0002	0.00029	0.002	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	114	0.0016	0.0037	0.004	0.005	0.013	0	0
Total Selenium	mg/L	0.001		114	0.0002	0.0006	0.0006	0.0006	0.006	2 CCME	2 CCME
Total Silver	mg/L	0.0001	0.1	114	0.00001	0.00001	0.00001	0.00003	0.0003	0 EQS/7 CCME	0 EQS/6 CCME
Total Thallium	mg/L	0.008		114	0.00001	0.0001	0.00011	0.00012	0.00018	0	0
Total Zinc	mg/L	0.03	0.3	114	0.485	1.04	1.27	1.48	3.09	114 EQS and CCME	100 EQS and CCME

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{(0.83[\log(\text{hardness})]-2.46)}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-4. Summary of Pit Water Quality - Top (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences (EQS/CCME)	Percent of Exceedences (EQS/CCME)		
General Parameters													
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	38	7.21	7.54	7.7	7.96	8.09	0	0	0	0
Hardness (as $CaCO_3$)	mg/L			33	340	774	1080	1210	1390	-	-	0	0
Total Alkalinity (as $CaCO_3$)	mg/L			38	82	150	178	200	227	-	-	0	0
Sulphate	mg/L			38	10	639	792	890	1060	-	-	0	0
Total Suspended Solids	mg/L		50	37	1	2	2	3	15	0	0	0	0
Nutrients													
Ammonia Nitrogen	mg/L	0.832[c]		38	0.01	0.01	0.01	0.04	0.17	0	0	0	0
Nitrate Nitrogen	mg/L	2.9		38	0.3	0.78	1.36	1.62	4.01	5 CCME	13 CCME	0	0
Nitrite Nitrogen	mg/L	0.06		38	0.005	0.01	0.01	0.01	0.22	7 CCME	18 CCME	0	0
Cyanide													
Total Cyanide	mg/L	0.005[d]	0.3							-	-		
WAD Cyanide	mg/L		0.1							-	-		
SAD Cyanide	mg/L									-	-		
Cyanate	mg/L									-	-	0	0
Thiocyanate	mg/L									-	-	0	0
Metals													
Total Aluminum	mg/L	0.005-0.1[e]		38	0.006	0.009	0.017	0.031	0.108	0	0	0	0
Total Antimony	mg/L		0.15	38	0.0037	0.0054	0.0068	0.0086	0.0096	0	0	0	0
Total Arsenic	mg/L	0.005		38	0.0035	0.0075	0.0091	0.0098	0.013	35 CCME	92 CCME	0	0
Dissolved Arsenic			0.15	38	0.0022	0.0052	0.0063	0.0078	0.0092	0	0	0	0
Total Barium	mg/L		1	38	0.012	0.013	0.015	0.017	0.022	0	0	0	0
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	38	0.00453	0.00669	0.00909	0.01095	0.0183	0 EQS/38 CCME	0 EQS/100 CCME	0	0
Total Chromium	mg/L	0.0089	0.04	38	0.0004	0.0004	0.0004	0.0005	0.0022	0	0	0	0
Total Copper	mg/L	0.002-0.004[g]	0.2	38	0.002	0.007	0.009	0.02	0.05	0 EQS/35 CCME	0 EQS/92 CCME	0	0
Total Iron	mg/L	0.3	1	38	0.02	0.042	0.06	0.095	0.2	0	0	0	0
Total Lead	mg/L	0.001-0.007[h]	0.1	38	0.0005	0.0009	0.0016	0.0025	0.0052	0	0	0	0
Total Manganese	mg/L		0.5	36	0.0777	0.153	0.21	0.5105	1	9 EQS	25 EQS	9	25
Total Molybdenum	mg/L	0.073		38	0.0001	0.0001	0.0002	0.00029	0.001	0	0	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	38	0.0016	0.003	0.004	0.004	0.012	0	0	0	0
Total Selenium	mg/L	0.001		38	0.0002	0.0006	0.0006	0.0006	0.0007	0	0	0	0
Total Silver	mg/L	0.0001	0.1	38	0.00001	0.00001	0.00001	0.00003	0.00018	0 EQS/2 CCME	0 EQS/5 CCME	0	0
Total Thallium	mg/L	0.008		38	0.00001	0.00009	0.0001	0.00011	0.00013	0	0	0	0
Total Zinc	mg/L	0.03	0.3	38	0.485	0.879	1.12	1.373	1.9	38 EQS and CCME	100 EQS and CCME	38	100

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{\{0.83[\log(\text{hardness})]-2.46\}}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-5. Summary of Pit Water Quality - Middle (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences (EQS/CCME)	Percent of Exceedences (EQS/CCME)
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	38	7.02	7.41	7.63	7.96	8.09	0	0
Hardness (as $CaCO_3$)	mg/L			33	644	986	1120	1220	1740	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			38	105	162	184	202	234	-	-
Sulphate	mg/L			38	550	780	861	946	1420	-	-
Total Suspended Solids	mg/L		50	37	1	2	2	3	9	0	0
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		38	0.005	0.01	0.01	0.045	0.18	0	0
Nitrate Nitrogen	mg/L	2.9		38	0.31	0.83	1.35	1.58	11	1 CCME	3 CCME
Nitrite Nitrogen	mg/L	0.06		38	0.005	0.01	0.01	0.033	0.54	9 CCME	24 CCME
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3							-	-
WAD Cyanide	mg/L		0.1							-	-
SAD Cyanide	mg/L									-	-
Cyanate	mg/L									-	-
Thiocyanate	mg/L									-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		38	0.005	0.007	0.016	0.034	0.105	0	0
Total Antimony	mg/L		0.15	38	0.0015	0.0048	0.0065	0.0071	0.0086	0	0
Total Arsenic	mg/L	0.005		38	0.0048	0.0066	0.0085	0.0096	0.0164	35 CCME	92 CCME
Dissolved Arsenic	mg/l		0.15	38	0.0023	0.0044	0.006	0.0077	0.009	0	0
Total Barium	mg/L		1	38	0.011	0.013	0.014	0.016	0.03	0	0
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	38	0.00505	0.00739	0.00919	0.0138	0.0353	8 EQS/38 CCME	21 EQS/100 CCME
Total Chromium	mg/L	0.0089	0.04	38	0.0004	0.0004	0.0004	0.0005	0.0012	0	0
Total Copper	mg/L	0.002-0.004[g]	0.2	38	0.002	0.007	0.008	0.024	0.085	0 EQS/36 CCME	0 EQS/95 CCME
Total Iron	mg/L	0.3	1	38	0.01	0.041	0.071	0.109	0.365	0 EQS/1 CCME	0 EQS/3 CCME
Total Lead	mg/L	0.001-0.007[h]	0.1	38	0.0003	0.0007	0.0014	0.0028	0.0059	0	0
Total Manganese	mg/L		0.5	36	0.027	0.154	0.216	0.903	5.08	12 EQS	33 EQS
Total Molybdenum	mg/L	0.073		38	0.00004	0.0001	0.0002	0.0002	0.001	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	38	0.0016	0.0031	0.004	0.005	0.011	0	0
Total Selenium	mg/L	0.001		38	0.0002	0.0006	0.0006	0.0006	0.0007	0	0
Total Silver	mg/L	0.0001	0.1	38	0.00001	0.00001	0.00001	0.00002	0.0003	0 EQS/2 CCME	0 EQS/5 CCME
Total Thallium	mg/L	0.008		38	0.00001	0.00009	0.00011	0.00012	0.00018	0	0
Total Zinc	mg/L	0.03	0.3	38	0.572	1.02	1.185	1.4	3.09	38 EQS and CCME	100 EQS and CCME

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{(0.83[\log(\text{hardness})]-2.46)}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-6. Summary of Pit Water Quality - Bottom (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences (EQS/CCME)	Percent of Exceedences (EQS/CCME)
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	38	6.77	7.15	7.3	7.49	8.04	0	0
Hardness (as $CaCO_3$)	mg/L			33	5	1240	1390	1570	2000	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			38	152	203	226	236	283	-	-
Sulphate	mg/L			38	0.8	926	1125	1365	1580	-	-
Total Suspended Solids	mg/L		50	37	2	2	4	6	374	3 EQS	8 EQS
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		38	0.006	0.01	0.045	0.158	0.44	0	0
Nitrate Nitrogen	mg/L	2.9		38	0.02	0.39	0.68	1	1.68	0	0
Nitrite Nitrogen	mg/L	0.06		38	0.005	0.01	0.01	0.098	0.46	11 CCME	29 CCME
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3							-	-
WAD Cyanide	mg/L		0.1							-	-
SAD Cyanide	mg/L									-	-
Cyanate	mg/L			38	0.0002	0.0025	0.0037	0.0058	0.008	-	-
Thiocyanate	mg/L			38	0.0051	0.0073	0.0098	0.0146	0.0919	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		38	0.005	0.009	0.018	0.041	0.515	0	0
Total Antimony	mg/L		0.15	38	0.0002	0.0025	0.0037	0.0058	0.008	0	0
Total Arsenic	mg/L	0.005		38	0.0051	0.0073	0.0098	0.0146	0.0919	38 CCME	100 CCME
Dissolved Arsenic			0.15	38	0.0004	0.0039	0.0063	0.0085	0.0998	0	0
Total Barium	mg/L		1	38	0.01	0.012	0.014	0.017	0.026	0	0
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	38	0.00468	0.00861	0.01115	0.01613	0.0339	8 EQS/38 CCME	21 EQS/100 CCME
Total Chromium	mg/L	0.0089	0.04	38	0.0004	0.0004	0.0004	0.0006	0.004	0	0
Total Copper	mg/L	0.002-0.004[g]	0.2	38	0.003	0.008	0.009	0.029	0.103	0 EQS/35 CCME	0 EQS/92 CCME
Total Iron	mg/L	0.3	1	38	0.01	0.05	0.086	0.247	4.48	3 EQS/9 CCME	8 EQS/24 CCME
Total Lead	mg/L	0.001-0.007[h]	0.1	38	0.0001	0.0008	0.0018	0.0036	0.022	0 EQS/2 CCME	0 EQS/5 CCME
Total Manganese	mg/L		0.5	37	0.0868	0.526	1.44	3.13	8.92	29 EQS	78 EQS
Total Molybdenum	mg/L	0.073		38	0.00004	0.0001	0.00016	0.00027	0.002	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	38	0.003	0.0043	0.0055	0.006	0.013	0	0
Total Selenium	mg/L	0.001		38	0.0002	0.0006	0.0006	0.0006	0.006	2 CCME	5.3 CCME
Total Silver	mg/L	0.0001	0.1	38	0.00001	0.00001	0.00002	0.00005	0.00017	0 EQS/3 CCME	0 EQS/8 CCME
Total Thallium	mg/L	0.008		38	0.00001	0.0001	0.00011	0.00013	0.00018	0	0
Total Zinc	mg/L	0.03	0.3	38	0.51	1.182	1.385	1.695	2.96	38 EQS and CCME	100 EQS and CCME

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{\{0.83[\log(\text{hardness})]-2.46\}}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-7. Summary of Dome Creek Water Quality - DX (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	40	7.21	7.34	7.44	7.55	8.01	0	0
Hardness (as $CaCO_3$)	mg/L			39	0.029	180.5	243	281.5	475	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			41	19	56	78	96	176	-	-
Sulphate	mg/L			39	15	108.5	156	189.5	276	-	-
Total Suspended Solids	mg/L		50	40	1	3	14	39	190	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		41	0.007	0.01	0.02	0.05	4.8	1	2
Nitrate Nitrogen	mg/L	2.9		41	0.01	0.01	0.02	0.05	0.14	0	0
Nitrite Nitrogen	mg/L	0.06		41	0.005	0.01	0.01	0.05	0.18	8	20
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3							-	-
WAD Cyanide	mg/L		0.1	41	0.002	0.002	0.002	0.002	0.004	-	-
SAD Cyanide	mg/L			41	0.002	0.002	0.002	0.004	0.042	-	-
Cyanate	mg/L			41	0.2	0.2	0.2	0.2	0.2	-	-
Thiocyanate	mg/L			41	0.1	0.1	0.2	0.5	2.2	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		41	0.005	0.063	0.133	0.613	4.38	27	66
Total Antimony	mg/L		0.15	41	0.0006	0.0008	0.0009	0.0013	0.0026	-	-
Total Arsenic	mg/L	0.005		41	0.0018	0.0031	0.0057	0.016	0.053	23	56
Dissolved Arsenic			0.15	41	0.0012	0.0017	0.0022	0.0028	0.0095	-	-
Total Barium	mg/L		1	41	0.011	0.038	0.045	0.052	0.13	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	41	0.00001	0.00002	0.00004	0.0001	0.00041	0	0
Total Chromium	mg/L	0.0089	0.04	41	0.0004	0.0004	0.0005	0.0011	0.022	1	2
Total Copper	mg/L	0.002-0.004[g]	0.2	41	0.001	0.001	0.002	0.003	0.013	8	20
Total Iron	mg/L	0.3	1	41	0.03	0.2	0.358	1.6	7.32	23	56
Total Lead	mg/L	0.001-0.007[h]	0.1	41	0.0001	0.0003	0.0007	0.0016	0.0076	2	5
Total Manganese	mg/L		0.5	41	0.004	0.0281	0.079	0.114	0.744	-	-
Total Molybdenum	mg/L	0.073		41	0.00002	0.0001	0.0001	0.001	0.001	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	41	0.0005	0.001	0.001	0.002	0.01	0	0
Total Selenium	mg/L	0.001		41	0.0002	0.0002	0.0006	0.0006	0.006	1	2
Total Silver	mg/L	0.0001	0.1	41	0.00001	0.00001	0.00001	0.00005	0.00036	6	15
Total Thallium	mg/L	0.008		41	0.00001	0.00001	0.00002	0.00005	0.00015	0	0
Total Zinc	mg/L	0.03	0.3	41	0.001	0.006	0.009	0.016	0.045	4	10

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-8. Summary of Dome Creek Water Quality - D1 (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	45	7.37	7.91	7.98	8.05	8.23	0	0
Hardness (as $CaCO_3$)	mg/L			44	0.72	568	620.5	697	799	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			45	55	205	234	255	266	-	-
Sulphate	mg/L			43	75	346	398	422	484	-	-
Total Suspended Solids	mg/L		50	45	1	2	2	4	76	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		45	0.006	0.01	0.01	0.01	0.05	0	0
Nitrate Nitrogen	mg/L	2.9		45	0.01	0.03	0.08	0.12	0.34	0	0
Nitrite Nitrogen	mg/L	0.06		45	0.005	0.01	0.01	0.1	0.3	16	36
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	45	0.002	0.002	0.002	0.002	0.2	-	-
SAD Cyanide	mg/L			45	0.002	0.002	0.002	0.004	0.1	-	-
Cyanate	mg/L			45	0.2	0.2	0.2	0.2	0.2	-	-
Thiocyanate	mg/L			45	0.1	0.1	0.1	0.3	1.3	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		45	0.005	0.012	0.023	0.05	2.42	7	16
Total Antimony	mg/L		0.15	45	0.003	0.007	0.0086	0.0096	0.0113	-	-
Total Arsenic	mg/L	0.005		45	0.0073	0.0114	0.0124	0.0168	0.0463	45	100
Dissolved Arsenic			0.15	45	0.006	0.0077	0.0088	0.0104	0.0144	-	-
Total Barium	mg/L		1	45	0.012	0.019	0.02	0.022	0.058	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	45	0.00015	0.00093	0.00214	0.00468	0.00663	43	96
Total Chromium	mg/L	0.0089	0.04	45	0.0004	0.0004	0.0004	0.0005	0.0317	1	2
Total Copper	mg/L	0.002-0.004[g]	0.2	45	0.001	0.001	0.001	0.002	0.01	4	9
Total Iron	mg/L	0.3	1	45	0.031	0.087	0.112	0.24	4.37	8	18
Total Lead	mg/L	0.001-0.007[h]	0.1	45	0.0001	0.0002	0.0005	0.0011	0.0088	1	2
Total Manganese	mg/L		0.5	45	0.005	0.094	0.256	0.443	0.688	-	-
Total Molybdenum	mg/L	0.073		45	0.0001	0.0002	0.0002	0.001	0.0012	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	45	0.0005	0.002	0.0024	0.004	0.0123	0	0
Total Selenium	mg/L	0.001		45	0.0002	0.0006	0.0006	0.0006	0.006	3	7
Total Silver	mg/L	0.0001	0.1	45	0.00001	0.00001	0.00001	0.00002	0.00026	2	4
Total Thallium	mg/L	0.008		45	0.00001	0.00004	0.00005	0.00006	0.00012	0	0
Total Zinc	mg/L	0.03	0.3	45	0.0003	0.245	0.516	1.03	1.4	44	98

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-9. Summary of Dome Creek Water Quality - Upper Dome (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	58	6.93	7.56	7.91	8	8.25	0	0
Hardness (as $CaCO_3$)	mg/L			54	1.85	474	555.5	655.5	816	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			59	41	140	172	212	261	-	-
Sulphate	mg/L			57	104	350	403	494	614	-	-
Total Suspended Solids	mg/L		50	58	2	9	18	40	570	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		59	0.01	0.44	0.89	2.1	5.6	31	53
Nitrate Nitrogen	mg/L	2.9		59	0.04	0.25	0.53	1.21	4.98	2	3
Nitrite Nitrogen	mg/L	0.06		59	0.005	0.01	0.012	0.1	0.4	20	34
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	58	0.002	0.002	0.004	0.008	0.3	-	-
SAD Cyanide	mg/L			58	0.006	0.035	0.094	0.25	2	-	-
Cyanate	mg/L			58	0.2	0.3	0.4	0.8	3	-	-
Thiocyanate	mg/L			58	0.1	0.4	0.6	1.6	5.9	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		59	0.011	0.044	0.208	0.634	14.3	35	58
Total Antimony	mg/L		0.15	59	0.0004	0.0011	0.002	0.0029	0.0257	-	-
Total Arsenic	mg/L	0.005		59	0.0067	0.0134	0.0184	0.0297	0.0842	59	100
Dissolved Arsenic			0.15	59	0.0028	0.0045	0.0058	0.0085	0.0326	-	-
Total Barium	mg/L		1	59	0.028	0.046	0.053	0.062	0.31	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	59	0.00007	0.00012	0.00023	0.00042	0.00197	15	25
Total Chromium	mg/L	0.0089	0.04	59	0.0004	0.0006	0.001	0.0019	0.025	5	9
Total Copper	mg/L	0.002-0.004[g]	0.2	59	0.001	0.003	0.004	0.007	0.04	26	44
Total Iron	mg/L	0.3	1	59	0.7	1.72	2.31	5.13	18.7	59	100
Total Lead	mg/L	0.001-0.007[h]	0.1	59	0.0001	0.0003	0.0005	0.0019	0.015	5	9
Total Manganese	mg/L		0.5	59	0.328	0.903	1.42	3.1	7.58	-	-
Total Molybdenum	mg/L	0.073		59	0.0002	0.0005	0.0008	0.001	0.0014	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	59	0.0005	0.002	0.003	0.0048	0.02	0	0
Total Selenium	mg/L	0.001		59	0.0002	0.0005	0.0006	0.0006	0.006	7	12
Total Silver	mg/L	0.0001	0.1	59	0.00001	0.00001	0.00001	0.00005	0.00037	5	9
Total Thallium	mg/L	0.008		59	0.00001	0.00001	0.00002	0.00005	0.00022	0	0
Total Zinc	mg/L	0.03	0.3	59	0.0005	0.014	0.02	0.042	0.16	20	34

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-10. Summary of Dome Creek Water Quality - Dome @ Road (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	47	7.28	7.7	7.84	7.92	8.15	0	0
Hardness (as $CaCO_3$)	mg/L			46	1.63	372.5	458	512.75	654	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			48	46	116	142	168	208	-	-
Sulphate	mg/L			46	21	265	317	363	454	-	-
Total Suspended Solids	mg/L		50	47	2	8	14	38	458	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		48	0.01	0.287	0.515	0.792	26	11	23
Nitrate Nitrogen	mg/L	2.9		48	0.05	0.28	0.42	0.59	1.14	0	0
Nitrite Nitrogen	mg/L	0.06		48	0.005	0.01	0.011	0.04	0.17	9	19
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	48	0.002	0.002	0.002	0.004	0.01	-	-
SAD Cyanide	mg/L			48	0.002	0.01	0.027	0.052	0.42	-	-
Cyanate	mg/L			48	0.2	0.2	0.4	0.6	1.4	-	-
Thiocyanate	mg/L			48	0.1	0.2	0.4	0.9	2.3	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		47	0.04	0.155	0.23	0.793	11.6	39	83
Total Antimony	mg/L		0.15	47	0.0008	0.0016	0.0021	0.0029	0.0191	-	-
Total Arsenic	mg/L	0.005		47	0.0077	0.0192	0.0277	0.0349	0.088	47	100
Dissolved Arsenic			0.15	48	0.0031	0.0057	0.0075	0.009	0.0209	-	-
Total Barium	mg/L		1	47	0.026	0.048	0.055	0.066	0.23	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	47	0.00006	0.0001	0.00015	0.00022	0.00116	5	11
Total Chromium	mg/L	0.0089	0.04	47	0.0004	0.0007	0.0011	0.0024	0.148	3	6
Total Copper	mg/L	0.002-0.004[g]	0.2	47	0.001	0.002	0.004	0.005	0.02	16	34
Total Iron	mg/L	0.3	1	47	0.5	1.98	2.79	4.03	22	47	100
Total Lead	mg/L	0.001-0.007[h]	0.1	47	0.0002	0.0008	0.0015	0.0031	0.026	4	9
Total Manganese	mg/L		0.5	47	0.229	0.748	0.974	1.4	3.69	-	-
Total Molybdenum	mg/L	0.073		47	0.0002	0.0004	0.0006	0.001	0.0022	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	47	0.0005	0.002	0.003	0.004	0.0624	0	0
Total Selenium	mg/L	0.001		47	0.0002	0.0006	0.0006	0.0006	0.006	4	9
Total Silver	mg/L	0.0001	0.1	47	0.00001	0.00001	0.00002	0.00006	0.00072	5	11
Total Thallium	mg/L	0.008		47	0.00001	0.00001	0.00002	0.00005	0.00024	0	0
Total Zinc	mg/L	0.03	0.3	47	0.0011	0.014	0.02	0.0445	0.16	15	32

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-11. Summary of Pony Creek Water Quality - Pony US (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	44	6.75	7.11	7.29	7.52	7.84	0	0
Hardness (as $CaCO_3$)	mg/L			43	31	110	144	176	274	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			45	12	43	53	63	105	-	-
Sulphate	mg/L			43	13.5	74.4	88.5	117.5	176	-	-
Total Suspended Solids	mg/L		50	44	1	2	2	5	36	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		45	0.009	0.01	0.02	0.05	0.13	0	0
Nitrate Nitrogen	mg/L	2.9		45	0.01	0.01	0.02	0.1	1.82	0	0
Nitrite Nitrogen	mg/L	0.06		45	0.005	0.01	0.01	0.01	0.1	5	11
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	45	0.002	0.002	0.002	0.002	0.004	-	-
SAD Cyanide	mg/L			45	0.002	0.002	0.002	0.002	0.066	-	-
Cyanate	mg/L			45	0.2	0.2	0.2	0.2	0.4	-	-
Thiocyanate	mg/L			45	0.1	0.1	0.2	0.6	1.6	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		45	0.013	0.027	0.034	0.056	0.623	7	16
Total Antimony	mg/L		0.15	45	0.0002	0.0004	0.0004	0.0005	0.002	-	-
Total Arsenic	mg/L	0.005		45	0.0004	0.0017	0.0023	0.0038	0.0512	7	16
Dissolved Arsenic			0.15	45	0.0007	0.0016	0.0018	0.0022	0.0044	-	-
Total Barium	mg/L		1	45	0.024	0.04	0.05	0.061	0.163	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	45	0.00001	0.00002	0.00003	0.00005	0.00015	0	0
Total Chromium	mg/L	0.0089	0.04	45	0.0004	0.0004	0.0004	0.0005	0.004	0	0
Total Copper	mg/L	0.002-0.004[g]	0.2	45	0.001	0.001	0.001	0.002	0.01	4	9
Total Iron	mg/L	0.3	1	45	0.047	0.16	0.32	0.613	10.2	24	53
Total Lead	mg/L	0.001-0.007[h]	0.1	45	0.0001	0.0001	0.0002	0.0004	0.0015	0	0
Total Manganese	mg/L		0.5	45	0.005	0.035	0.08	0.15	3.91	-	-
Total Molybdenum	mg/L	0.073		45	0.00003	0.0001	0.0001	0.001	0.001	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	45	0.0005	0.001	0.001	0.001	0.01	0	0
Total Selenium	mg/L	0.001		45	0.0002	0.0006	0.0006	0.0006	0.006	1	2
Total Silver	mg/L	0.0001	0.1	45	0.00001	0.00001	0.00001	0.00001	0.00079	3	7
Total Thallium	mg/L	0.008		45	0.00001	0.00001	0.00001	0.00005	0.0001	0	0
Total Zinc	mg/L	0.03	0.3	45	0.0001	0.004	0.007	0.011	0.021	0	0

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-12. Summary of Pony Creek Water Quality - Pony DS (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	44	7.86	7.06	7.22	6.88	7.47	0	0
Hardness (as $CaCO_3$)	mg/L			43	380	120	151	34	229	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			45	200	43	57	13	98	-	-
Sulphate	mg/L			43	187	75.1	97.6	16	128.5	-	-
Total Suspended Solids	mg/L		50	45	88	2	8	1	28	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		45	0.1	0.01	0.01	0.007	0.03	0	0
Nitrate Nitrogen	mg/L	2.9		45	0.34	0.02	0.08	0.01	0.13	0	0
Nitrite Nitrogen	mg/L	0.06		45	0.17	0.01	0.01	0.005	0.02	10	22
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	45	0.004	0.002	0.002	0.002	0.002	-	-
SAD Cyanide	mg/L			45	0.054	0.002	0.002	0.002	0.004	-	-
Cyanate	mg/L			45	0.4	0.2	0.2	0.2	0.2	-	-
Thiocyanate	mg/L			45	1.7	0.1	0.1	0.1	0.6	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		46	1.59	0.062	0.136	0.015	0.259	27	59
Total Antimony	mg/L		0.15	46	0.0242	0.0014	0.0021	0.0005	0.005	-	-
Total Arsenic	mg/L	0.005		46	0.524	0.0047	0.0066	0.0028	0.0175	30	65
Dissolved Arsenic			0.15	45	0.0061	0.0031	0.0039	0.0014	0.0044	-	-
Total Barium	mg/L		1	46	0.065	0.031	0.037	0.02	0.041	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	46	0.00789	0.00076	0.00123	0.00018	0.00329	45	98
Total Chromium	mg/L	0.0089	0.04	46	0.0065	0.0004	0.0005	0.0004	0.0008	0	0
Total Copper	mg/L	0.002-0.004[g]	0.2	46	0.135	0.008	0.011	0.005	0.022	46	100
Total Iron	mg/L	0.3	1	46	8.48	0.1	0.2	0.033	0.567	19	41
Total Lead	mg/L	0.001-0.007[h]	0.1	46	0.178	0.0015	0.0028	0.0005	0.01	18	39
Total Manganese	mg/L		0.5	46	1.08	0.0321	0.0715	0.01	0.2675	-	-
Total Molybdenum	mg/L	0.073		46	0.001	0.0001	0.0001	0.00003	0.0008	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	46	0.01	0.001	0.001	0.0005	0.002	0	0
Total Selenium	mg/L	0.001		46	0.006	0.0006	0.0006	0.0002	0.0006	1	2
Total Silver	mg/L	0.0001	0.1	46	0.00287	0.00002	0.00004	0.00001	0.00011	12	26
Total Thallium	mg/L	0.008		46	0.00011	0.00001	0.00001	0.00001	0.00005	0	0
Total Zinc	mg/L	0.03	0.3	46	0.731	0.072	0.112	0.0006	0.3253	44	96

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-13. Summary of Back Creek Water Quality (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	43	7.13	7.8	7.95	8.24	8.06	0	0
Hardness (as $CaCO_3$)	mg/L			42	30	120	148	199	174	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			44	21	74	91	135	112	-	-
Sulphate	mg/L			42	9.41	46.48	56.85	79.6	60.95	-	-
Total Suspended Solids	mg/L		50	44	1	5	33	18900	318	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		44	0.008	0.01	0.02	0.16	0.05	0	0
Nitrate Nitrogen	mg/L	2.9		44	0.01	0.01	0.03	0.17	0.08	0	0
Nitrite Nitrogen	mg/L	0.06		44	0.005	0.01	0.01	0.1	0.01	4	9
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	44	0.002	0.002	0.002	0.004	0.002	-	-
SAD Cyanide	mg/L			44	0.002	0.002	0.002	0.15	0.004	-	-
Cyanate	mg/L			44	0.2	0.2	0.2	1.4	0.2	-	-
Thiocyanate	mg/L			44	0.1	0.2	0.5	2.1	1	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		44	0.025	0.17	0.828	588	6.333	35	80
Total Antimony	mg/L		0.15	44	0.0002	0.0004	0.0005	0.01	0.0011	-	-
Total Arsenic	mg/L	0.005		44	0.0024	0.0047	0.0077	3.53	0.0358	30	68
Dissolved Arsenic			0.15	44	0.0018	0.0026	0.0029	0.054	0.0035	-	-
Total Barium	mg/L		1	44	0.051	0.06	0.072	11.2	0.213	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	44	0.00006	0.00011	0.00018	0.109	0.00126	20	46
Total Chromium	mg/L	0.0089	0.04	44	0.0004	0.0005	0.0015	0.762	0.0078	10	23
Total Copper	mg/L	0.002-0.004[g]	0.2	44	0.001	0.002	0.004	1.49	0.017	22	50
Total Iron	mg/L	0.3	1	44	0.34	0.6	1.72	1110	13.025	44	100
Total Lead	mg/L	0.001-0.007[h]	0.1	44	0.0002	0.0009	0.0033	6.18	0.0342	19	43
Total Manganese	mg/L		0.5	44	0.156	0.395	0.895	48.4	1.31	-	-
Total Molybdenum	mg/L	0.073		44	0.0004	0.0007	0.001	0.013	0.00109	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	44	0.0005	0.001	0.002	0.5	0.0073	2	5
Total Selenium	mg/L	0.001		44	0.0002	0.0006	0.0006	0.03	0.0006	9	21
Total Silver	mg/L	0.0001	0.1	44	0.00001	0.00001	0.00004	0.0322	0.00028	14	32
Total Thallium	mg/L	0.008		44	0.00001	0.00001	0.00005	0.0068	0.00012	4	9
Total Zinc	mg/L	0.03	0.3	44	0.0005	0.0092	0.0175	10.3	0.0707	16	36

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-14. Summary of Dry Creek Water Quality (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	75	6.8	8.53	7.37	7.59	7.72	0	0
Hardness (as $CaCO_3$)	mg/L			66	22	238.347417	72.25	88.5	100	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			76	15	178	67	85	93	-	-
Sulphate	mg/L			74	2.09	82.8	11	15	17.1	-	-
Total Suspended Solids	mg/L		50	72	1	1100	2	2	4	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		76	0.005	0.16	0.01	0.01	0.02	0	0
Nitrate Nitrogen	mg/L	2.9		76	0.01	0.19	0.05	0.09	0.12	0	0
Nitrite Nitrogen	mg/L	0.06		76	0.005	0.99	0.01	0.01	0.02	1	1
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	75	0.002	0.004	0.002	0.002	0.002	-	-
SAD Cyanide	mg/L			75	0.002	0.1	0.002	0.002	0.002	-	-
Cyanate	mg/L			76	0.2	0.9	0.2	0.2	0.2	-	-
Thiocyanate	mg/L			76	0.1	1.9	0.1	0.2	0.4	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		75	0.005	15.9	0.015	0.04	0.1	18	24
Total Antimony	mg/L		0.15	75	0.0002	0.002	0.0002	0.0002	0.0002	-	-
Total Arsenic	mg/L	0.005		75	0.0002	0.0257	0.0003	0.0004	0.0005	3	4
Dissolved Arsenic			0.15	75	0.0002	0.002	0.0002	0.0003	0.0004	-	-
Total Barium	mg/L		1	75	0.034	0.41	0.058	0.069	0.08	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	75	0.00001	0.00336	0.00001	0.00002	0.00005	8	11
Total Chromium	mg/L	0.0089	0.04	75	0.0004	0.02	0.0004	0.0005	0.0006	1	1
Total Copper	mg/L	0.002-0.004[g]	0.2	75	0.001	0.04	0.001	0.002	0.002	16	21
Total Iron	mg/L	0.3	1	75	0.01	26.1	0.035	0.098	0.203	14	19
Total Lead	mg/L	0.001-0.007[h]	0.1	75	0.0001	0.0222	0.0001	0.0002	0.0003	5	7
Total Manganese	mg/L		0.5	74	0.005	0.549	0.0176	0.0246	0.0497	-	-
Total Molybdenum	mg/L	0.073		75	0.0002	0.001	0.0003	0.0004	0.001	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	75	0.0005	0.01	0.001	0.001	0.001	0	0
Total Selenium	mg/L	0.001		75	0.0002	0.006	0.0004	0.0006	0.0006	4	5
Total Silver	mg/L	0.0001	0.1	75	0.00001	0.00076	0.00001	0.00001	0.00001	5	7
Total Thallium	mg/L	0.008		75	0.00001	0.00011	0.00001	0.00001	0.00005	0	0
Total Zinc	mg/L	0.03	0.3	75	0.001	0.085	0.003	0.007	0.01	3	4

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

TableB-15. Summary of Victoria Creek Water Quality - Vic Ref (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	42	6.86	8.17	7.58	7.74	7.8	0	0
Hardness (as $CaCO_3$)	mg/L			42	23	124	72	84	99	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			43	15	103	62	72	90	-	-
Sulphate	mg/L			41	2.02	40	11	13	15	-	-
Total Suspended Solids	mg/L		50	43	1	984	2	2	8	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		43	0.01	0.28	0.01	0.01	0.025	0	0
Nitrate Nitrogen	mg/L	2.9		43	0.01	0.2	0.04	0.09	0.14	0	0
Nitrite Nitrogen	mg/L	0.06		43	0.005	0.1	0.01	0.01	0.025	0	0
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	43	0.002	0.004	0.002	0.002	0.002	-	-
SAD Cyanide	mg/L			43	0.002	0.11	0.002	0.002	0.004	-	-
Cyanate	mg/L			43	0.2	0.9	0.2	0.2	0.2	-	-
Thiocyanate	mg/L			43	0.1	1.7	0.1	0.1	0.3	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		43	0.009	13.7	0.017	0.058	0.157	13	30
Total Antimony	mg/L		0.15	43	0.0002	0.002	0.0002	0.0002	0.0002	-	-
Total Arsenic	mg/L	0.005		43	0.0002	0.014	0.0003	0.0004	0.0007	2	5
Dissolved Arsenic			0.15	43	0.0002	0.002	0.0002	0.0003	0.0004	-	-
Total Barium	mg/L		1	43	0.033	0.38	0.054	0.061	0.071	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	43	0.00001	0.00068	0.00001	0.00002	0.00004	4	9
Total Chromium	mg/L	0.0089	0.04	43	0.0004	0.018	0.0004	0.0004	0.0006	2	5
Total Copper	mg/L	0.002-0.004[g]	0.2	43	0.001	0.03	0.001	0.002	0.003	12	28
Total Iron	mg/L	0.3	1	43	0.013	24.3	0.047	0.122	0.336	11	26
Total Lead	mg/L	0.001-0.007[h]	0.1	43	0.0001	0.014	0.0001	0.0001	0.0003	5	12
Total Manganese	mg/L		0.5	43	0.0092	0.585	0.015	0.0185	0.029	-	-
Total Molybdenum	mg/L	0.073		43	0.00006	0.001	0.0003	0.0004	0.0004	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	43	0.0005	0.01	0.001	0.001	0.001	0	0
Total Selenium	mg/L	0.001		43	0.0002	0.006	0.0006	0.0006	0.0006	2	5
Total Silver	mg/L	0.0001	0.1	43	0.00001	0.00026	0.00001	0.00001	0.00001	3	7
Total Thallium	mg/L	0.008		43	0.00001	0.0001	0.00001	0.00001	0.00001	0	0
Total Zinc	mg/L	0.03	0.3	43	0.0004	0.077	0.003	0.005	0.011	2	5

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-16. Summary of Victoria Creek Water Quality - Vic Upper (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	75	6.8	8.53	7.37	7.59	7.72	0	0
Hardness (as $CaCO_3$)	mg/L			66	22	238.347417	72.25	88.5	100	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			76	15	178	67	85	93	-	-
Sulphate	mg/L			74	2.09	82.8	11	15	17.1	-	-
Total Suspended Solids	mg/L		50	72	1	1100	2	2	4	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		76	0.005	0.16	0.01	0.01	0.02	0	0
Nitrate Nitrogen	mg/L	2.9		76	0.01	0.19	0.05	0.09	0.12	0	0
Nitrite Nitrogen	mg/L	0.06		76	0.005	0.99	0.01	0.01	0.02	1	1
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	75	0.002	0.004	0.002	0.002	0.002	-	-
SAD Cyanide	mg/L			75	0.002	0.1	0.002	0.002	0.002	-	-
Cyanate	mg/L			76	0.2	0.9	0.2	0.2	0.2	-	-
Thiocyanate	mg/L			76	0.1	1.9	0.1	0.2	0.4	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		75	0.005	15.9	0.015	0.04	0.1	18	24
Total Antimony	mg/L		0.15	75	0.0002	0.002	0.0002	0.0002	0.0002	-	-
Total Arsenic	mg/L	0.005		75	0.0002	0.0257	0.0003	0.0004	0.0005	3	4
Dissolved Arsenic			0.15	75	0.0002	0.002	0.0002	0.0003	0.0004	-	-
Total Barium	mg/L		1	75	0.034	0.41	0.058	0.069	0.08	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	75	0.00001	0.00336	0.00001	0.00002	0.00005	8	11
Total Chromium	mg/L	0.0089	0.04	75	0.0004	0.02	0.0004	0.0005	0.0006	1	1
Total Copper	mg/L	0.002-0.004[g]	0.2	75	0.001	0.04	0.001	0.002	0.002	16	21
Total Iron	mg/L	0.3	1	75	0.01	26.1	0.035	0.098	0.203	14	19
Total Lead	mg/L	0.001-0.007[h]	0.1	75	0.0001	0.0222	0.0001	0.0002	0.0003	5	7
Total Manganese	mg/L		0.5	74	0.005	0.549	0.0176	0.0246	0.0497	-	-
Total Molybdenum	mg/L	0.073		75	0.0002	0.001	0.0003	0.0004	0.001	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	75	0.0005	0.01	0.001	0.001	0.001	0	0
Total Selenium	mg/L	0.001		75	0.0002	0.006	0.0004	0.0006	0.0006	4	5
Total Silver	mg/L	0.0001	0.1	75	0.00001	0.00076	0.00001	0.00001	0.00001	5	7
Total Thallium	mg/L	0.008		75	0.00001	0.00011	0.00001	0.00001	0.00005	0	0
Total Zinc	mg/L	0.03	0.3	75	0.001	0.085	0.003	0.007	0.01	3	4

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

d) 0.005 mg/L as Free Cyanide

e) 0.005mg/L at pH < 6.5, [Ca2+] < 4 mg/L, DOC < 2 mg/L: 0.1 mg/L at pH ≥ 6.5, [Ca2+] ≥ 4 mg/L, DOC ≥ 2 mg/L

f) Draft CCME Hardness based guideline = $10^{[0.83[\log(\text{hardness})]-2.46}$

g) 0.002 mg/L at [CaCO3] = 0 - 120 mg/L; 0.003 mg/L at [CaCO3] =120 - 180 mg/L; 0.004 mg/L at [CaCO3] >180mg/L

h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

i) 0.025 mg/L at [CaCO3] = 0 - 60 mg/L; 0.065 mg/L at [CaCO3] =60 - 120 mg/L; 0.110 mg/L at [CaCO3] =120 -180mg/L; 0.150 mg/L at [CaCO3] > 180mg/L

Table B-17. Summary of Victoria Creek Water Quality - Vic @ Rd (April 2008 - March 2012)

Parameter	Units	CWQG For Protection of Aquatic Life (FAL)[a]	Effluent Quality Standard[b]	Number of Samples	Minimum	25th Percentile	Median	75th Percentile	Maximum	Number of Exceedences	Percent of Exceedences
General Parameters											
pH (lab)	pH unit	6.5-9.0	6.0 - 8.5	59	6.88	7.44	7.78	7.88	8.18	0	0
Hardness (as $CaCO_3$)	mg/L			53	27	82	100	110	182	-	-
Total Alkalinity (as $CaCO_3$)	mg/L			60	17	63	76	88	134	-	-
Sulphate	mg/L			59	6.23	22	26.8	31.35	60.9	-	-
Total Suspended Solids	mg/L		50	59	1	2	4	11	1240	-	-
Nutrients											
Ammonia Nitrogen	mg/L	0.832[c]		60	0.005	0.01	0.01	0.02	0.06	0	0
Nitrate Nitrogen	mg/L	2.9		60	0.01	0.06	0.1	0.13	0.24	0	0
Nitrite Nitrogen	mg/L	0.06		60	0.005	0.01	0.01	0.02	0.1	0	0
Cyanide											
Total Cyanide	mg/L	0.005[d]	0.3								
WAD Cyanide	mg/L		0.1	60	0.002	0.002	0.002	0.002	0.004	-	-
SAD Cyanide	mg/L			60	0.002	0.002	0.002	0.004	0.14	-	-
Cyanate	mg/L			60	0.2	0.2	0.2	0.2	0.3	-	-
Thiocyanate	mg/L			60	0.1	0.1	0.3	0.6	3.9	-	-
Metals											
Total Aluminum	mg/L	0.005-0.1[e]		60	0.005	0.045	0.092	0.32	50.7	26	43
Total Antimony	mg/L		0.15	60	0.0002	0.0002	0.0003	0.0005	0.01	-	-
Total Arsenic	mg/L	0.005		60	0.0006	0.0013	0.0016	0.0027	0.419	10	17
Dissolved Arsenic			0.15	60	0.0003	0.001	0.0012	0.0015	0.0035	-	-
Total Barium	mg/L		1	60	0.043	0.057	0.065	0.074	0.906	-	-
Total Cadmium	mg/L	0.00004 - 0.00042[f]	0.02	60	0.00001	0.00002	0.00003	0.0001	0.00868	10	17
Total Chromium	mg/L	0.0089	0.04	60	0.0004	0.00047	0.0005	0.0011	0.04	2	3
Total Copper	mg/L	0.002-0.004[g]	0.2	60	0.001	0.002	0.002	0.003	0.06	24	40
Total Iron	mg/L	0.3	1	60	0.026	0.138	0.3	0.592	96.4	29	48
Total Lead	mg/L	0.001-0.007[h]	0.1	60	0.0001	0.0002	0.0005	0.0015	0.494	11	18
Total Manganese	mg/L		0.5	60	0.005	0.0362	0.0529	0.0809	3.43	-	-
Total Molybdenum	mg/L	0.073		60	0.0002	0.00038	0.0004	0.001	0.005	0	0
Total Nickel	mg/L	0.025-0.15[h]	0.3	60	0.0005	0.001	0.001	0.001	0.05	0	0
Total Selenium	mg/L	0.001		60	0.0002	0.0003	0.0006	0.0006	0.03	7	12
Total Silver	mg/L	0.0001	0.1	60	0.00001	0.00001	0.00001	0.00004	0.00352	8	13
Total Thallium	mg/L	0.008		60	0.00001	0.00001	0.00001	0.00005	0.001	2	3
Total Zinc	mg/L	0.03	0.3	60	0.0005	0.004	0.008	0.014	0.89	7	12

All units mg/l unless otherwise noted

a) Canadian water quality guidelines for the protection of aquatic life, Council of Ministers of the Environment, 2003

b) Effluent Quality Standards from Water Licence QZ94-004

c) Varies with temperature and pH: 0.832 at pH=8 and Temp =10°C

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h) 0.001 mg/L at [CaCO3] = 0 - 60 mg/L; 0.002 mg/L at [CaCO3] =60 - 120 mg/L; 0.004 mg/L at [CaCO3] =120 -180mg/L; 0.007 mg/L at [CaCO3] > 180mg/L

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