Mount Polley Mine
Selenium Monitoring
2012

Report Prepared for:

Mount Polley Mining Corp.
Box 12
Likely, British Columbia
V0L 1N0

Report Prepared by:

Minnow Environmental Inc.
101-1025 Hillside Ave.
Victoria, British Columbia
V8T 2A2

March, 2013

Mount Polley Mine
Selenium Monitoring
2012

Report Prepared for:

Mount Polley Mining Corp.

Report Prepared by:

Minnow Environmental Inc.

Dominic Hauck, M.Sc.
Principal Investigator

Pierre Stecko, M.Sc., EP, RPBio
Project Principal

TABLE OF CONTENTS

LIST OF FIGURES

After Page …

LIST OF TABLES

After Page …

1.0 INTRODUCTION

1.1 Background

The Mount Polley Mining Corporation, a division of the Imperial Metals Corporation, owns and operates the Mount Polley copper-gold mine located 56 kilometres north-east of Williams Lake, British Columbia (Figure 1.1). The mine operated from August 1997 to September 2001, was placed on care and maintenance from September 2001 to March 2005, and was re-opened in March 2005 in response to improved metal prices and the discovery of significant new ore reserves. Currently, mine life is expected to extend to 2023. Since March 2005, mining has been active at six open pits (Cariboo, Springer, Southeast, Wight, Pond Zone and Boundary Zone; Figure 1.1), with several additional areas identified as targets for future development (North Springer Zone, WX Zone and C2 Zone) and a number of additional areas under exploration. The Mount Polley Mine site also includes a crusher and mill (concentrator), a Tailings Storage Facility (TSF), seepage collection ponds, a surface water collection system, a settling pond, and access roads (Figure 1.1).

Mount Polley mill tailings and site water are discharged into the environmentally-secure TSF, with supernatant from the TSF recycled for re-use in the milling process. Due to accumulation of water within the TSF, the Mount Polley Mine recently applied and received approval (under the British Columbia *Environmental Management Act*) for the discharge of dam-filtered TSF supernatant to Hazeltine Creek (Figure 1.1). Dam-filtered TSF supernatant has not yet been discharged to Hazeltine Creek, but discharge will likely begin in 2013. Under the amended permit (PE-11678), target levels for a number of analytes in Hazeltine Creek, including selenium, were specified. In the case of selenium, British Columbia Water Quality Guidelines (BCWQGs) for water, sediment and rainbow trout muscle tissue (BCMOE 2001a,b) were identified as target levels. Site investigations by Mount Polley have shown that the principal source of selenium is runoff from waste rock dumps (not mill or tailings water). Furthermore, routine water quality monitoring conducted by Mount Polley also showed that, starting in late 2006, the North Waste Rock Dump was contributing selenium to North Dump Creek (maximum 0.040 mg/L), which flows into Polley Lake (Figure 1.1). This source to a receiving environment was eliminated in late 2009 by the construction of a collection system.

In light of the anticipated discharge of dam-filtered TSF supernatant to Hazeltine Creek, some elevations observed upstream, and current scientific understanding of mechanisms by which selenium can cause adverse effects, Mount Polley has initiated collection of selenium concentration data in local creeks and lakes (i.e., concentrations in water, sediment, periphyton, benthic macroinvertebrates and fish). In aquatic environments, selenium is taken

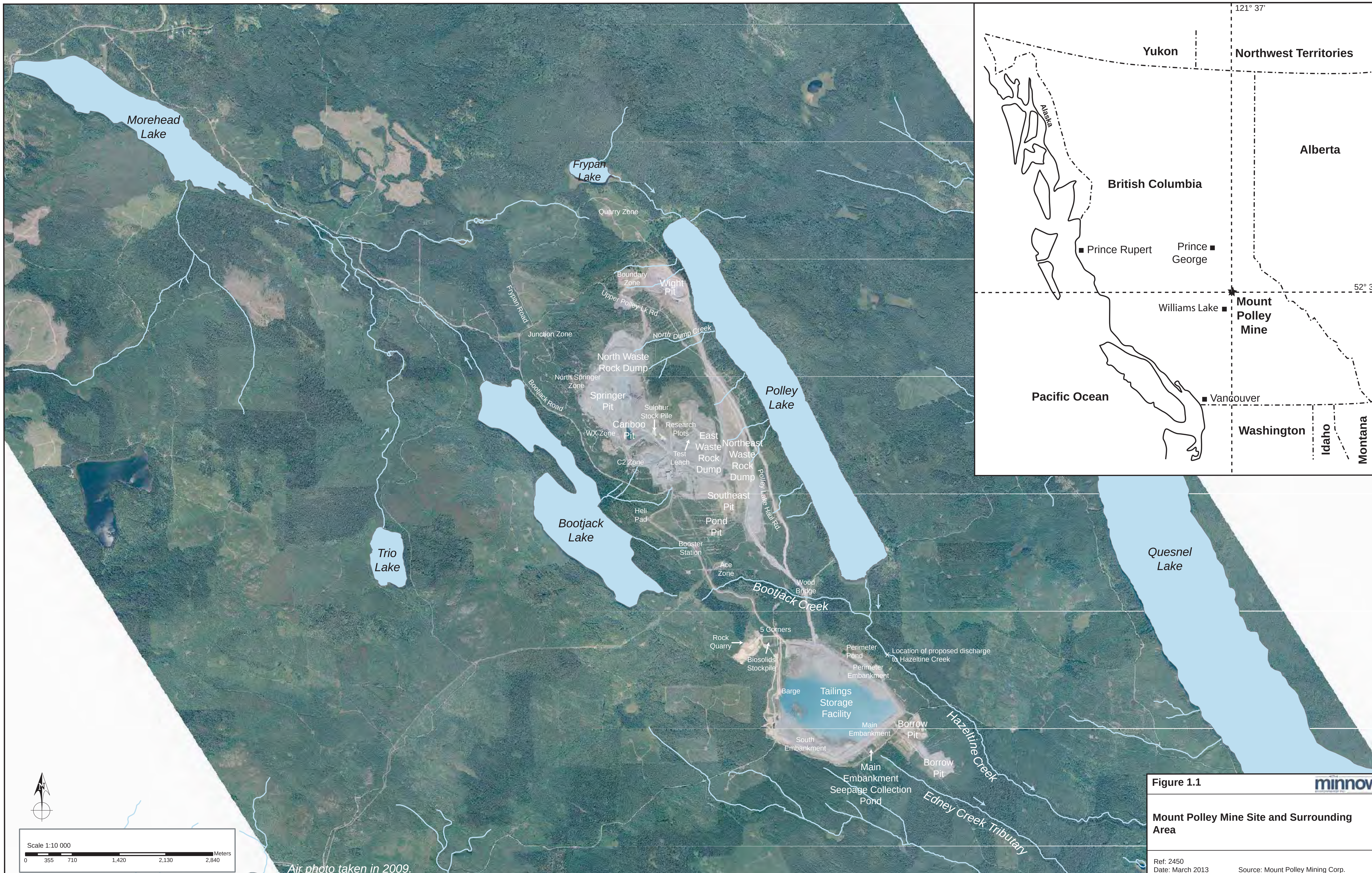


Figure 1.1

Mount Polley Mine Site and Surrounding Area

Ref: 2450
Date: March 2013
Source: Mount Polley Mining Corp.

up from water by primary producers (e.g., algae and bacteria) and transferred up food webs to aquatic invertebrates and vertebrates (Stewart et al. 2010). This uptake and transfer is highly site-specific, dependent on such factors as hydrology, productivity, and food web structure. At sufficiently high dietary concentrations, selenium causes reproductive effects among egg-laying vertebrates via maternal deposition in eggs and subsequent mortality or deformities among progeny (Janz et al. 2010; Young et al. 2010). Due to the high site-specificity of selenium incorporation into the aquatic food web and transfer through the aquatic food web, water-based guidelines for selenium are poor predictors of potential adverse effects to aquatic life (e.g., Luoma and Presser 2009; Janz et al. 2010; Stewart et al. 2010; Hodson et al. 2010; Ohlendorf et al. 2011; DeForest et al. 2012). Rather, scientific consensus is that the best available predictor of potential adverse effects are selenium concentrations in ripe ovaries or eggs (Luoma and Presser 2009; Janz et al. 2010; Stewart et al. 2010; Ohlendorf et al. 2011; Orr et al. 20102; DeForest et al. 2012).

In accordance with recommendations provided in the 2009/2010 selenium monitoring report (Minnow 2011), the Mount Polley Mine retained Minnow Environmental Inc. (Minnow) to repeat selenium monitoring in order to characterize current conditions (2012), assure the availability of an adequate quantity of pre-discharge selenium data for future receiving environments, and document temporal changes or improvements in North Dump Creek and downstream in response to the construction of the collection system. This brief report of the results was also prepared.

1.2 Project Objectives

The objectives of this study were: 1) to characterize selenium concentrations in relevant compartments of the aquatic environment in the vicinity of the Mount Polley Mine; 2) to compare concentrations spatially and temporally to determine if concentrations in water bodies near the mine have been influenced by mine activity; 3) to compare observed concentrations to published effect thresholds for aquatic biota and thereby characterize the risk of adverse effect; and 4) to utilize the collected information to inform the development of future monitoring plans.

1.3 Report Organization

Methods associated with the collection, compilation and analysis of selenium data are provided in Section 2.0 of this report. Section 3.0 provides the results of the selenium monitoring program, including spatial and temporal comparison of concentrations in water, sediment, periphyton, benthic invertebrates and fish, and comparisons to guidelines and effect thresholds. Conclusions of the monitoring are provided in Section 4.0 and form the basis for recommendations for future monitoring (also in Section 4.0). All references cited throughout this report are listed in Section 5.0.

2.0 METHODS

Selenium monitoring at the Mount Polley Mine in 2012 included water, sediment, periphyton, benthic invertebrates and fish (fish muscle and ovary tissue; Table 2.1; Figure 2.1). Water quality has been routinely monitored by the Mount Polley Mine since before the initiation of mine operations in 1997 (i.e., since 1995). Samples for the characterization of selenium concentrations in other compartments were collected on two different occasions in 2012. Samples of water, sediment, benthic invertebrates and fish (fish muscle and ovary tissue) from lakes, as well as fish muscle and ovary tissue from Hazeltine Creek were collected between May 2nd and 16th, 2012 by Minnow with the assistance of BioFor Consulting and the Mount Polley Mine Environmental Department. Samples of water, sediment, periphyton, and benthic invertebrates from creeks were collected between October 1st and 4th, 2012 by Minnow with the assistance of the Mount Polley Mine Environmental Department.

Selenium monitoring in 2012 was principally focussed on Polley Lake and Hazeltine Creek (Table 2.1; Figure 2.1). However, to support the interpretation of selenium concentrations within these two areas, samples were collected from a number of additional (reference) lakes and creeks located adjacent to the mine site (Table 2.1; Figure 2.1). Samples of sediment and benthic invertebrates were also collected from the Main Embankment Seepage Collection Pond (MESCP; in May 2012) to characterize a source pond. Detailed maps of the sample collection locations, as well as GPS coordinates and sample collection dates, are provided in Appendix A.

2.1 Water

Water is routinely monitored by the Mount Polley Mine Environment Department at a number of stations, including stations within Polley and Bootjack lakes, in Upper Hazeltine Creek and Lower Hazeltine Creek, at North Dump Creek and at the MESCP (Table 2.1; Figure 2.1). Data were provided by Mount Polley in MSExcel format and were used to plot aqueous selenium concentrations (Appendix B). Additional water samples were collected by Minnow at the time of the sediment and biological tissue collections in May or October 2012 and included two travel blanks, one equipment blank and one field duplicate for quality control. The additional water samples collected by Minnow were placed in a cooler immediately after collection and later placed in a refrigerator at approximately 4°C. Samples were shipped to the ALS Laboratory Group in Burnaby, BC within 24-hours of collection for analysis of selenium by Collision Cell ICP-MS.

Table 2.1: Summary of selenium monitoring at the Mount Polley Mine, 2012

Samples	Polley Lake	Upper Hazeltine Creek Pond	Upper Hazeltine Creek	Lower Hazeltine Creek	Hazeltine Creek Delta at Quesnel Lake	Upper Edney Creek	North Dump Creek	North Dump Creek Delta at Polley Lake	Main Embankment Seepage Collection Pond	Bootjack Lake	Trio Lake	Frypan Lake	Quesnel Lake
	PL	W7 Pond	W7	W11	DSW11	W8	W4	DSW4	E4	BL	TL	FL	QL
Water - routine *	✓	✖	✓	✓	✖	✓	✓	✖	✓	✓	✖	✖	✖
Water - extra spot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sediment	n=5	n=8	✖	✖	n=5	n=5	✖	n=5	n=5	n=5	n=5	n=5	n=5
Periphyton	✖	✖	n=8	n=5	✖	n=5	n=5	✖	✖	✖	✖	✖	✖
Benthos - erosional	✖	✖	n=8	n=5	✖	n=5	n=5	✖	✖	✖	✖	✖	✖
Benthos - depositional	n=5	n=8	✖	✖	n=5	n=5	✖	n=5	n=5	n=5	n=5	n=5	n=5
Rainbow Trout - muscle	n=5	✖	n=8	✖	n=5	✖	✖	✖	✖	n=5	n=5	n=5	n=5
Rainbow Trout - ovary	n=5	✖	n=8	✖	n=5	✖	✖	✖	✖	n=5	n=5	n=5	n=5
Longnose Sucker - muscle	n=5	✖	✖	✖	n=5	✖	✖	✖	✖	n=5	n=5	n=5	n=5
Longnose Sucker - ovary	n=5	✖	✖	✖	n=5	✖	✖	✖	✖	n=5	n=5	n=5	n=5

* Routine water is mine's responsibility

Spring (May) 2012

Fall (October) 2012

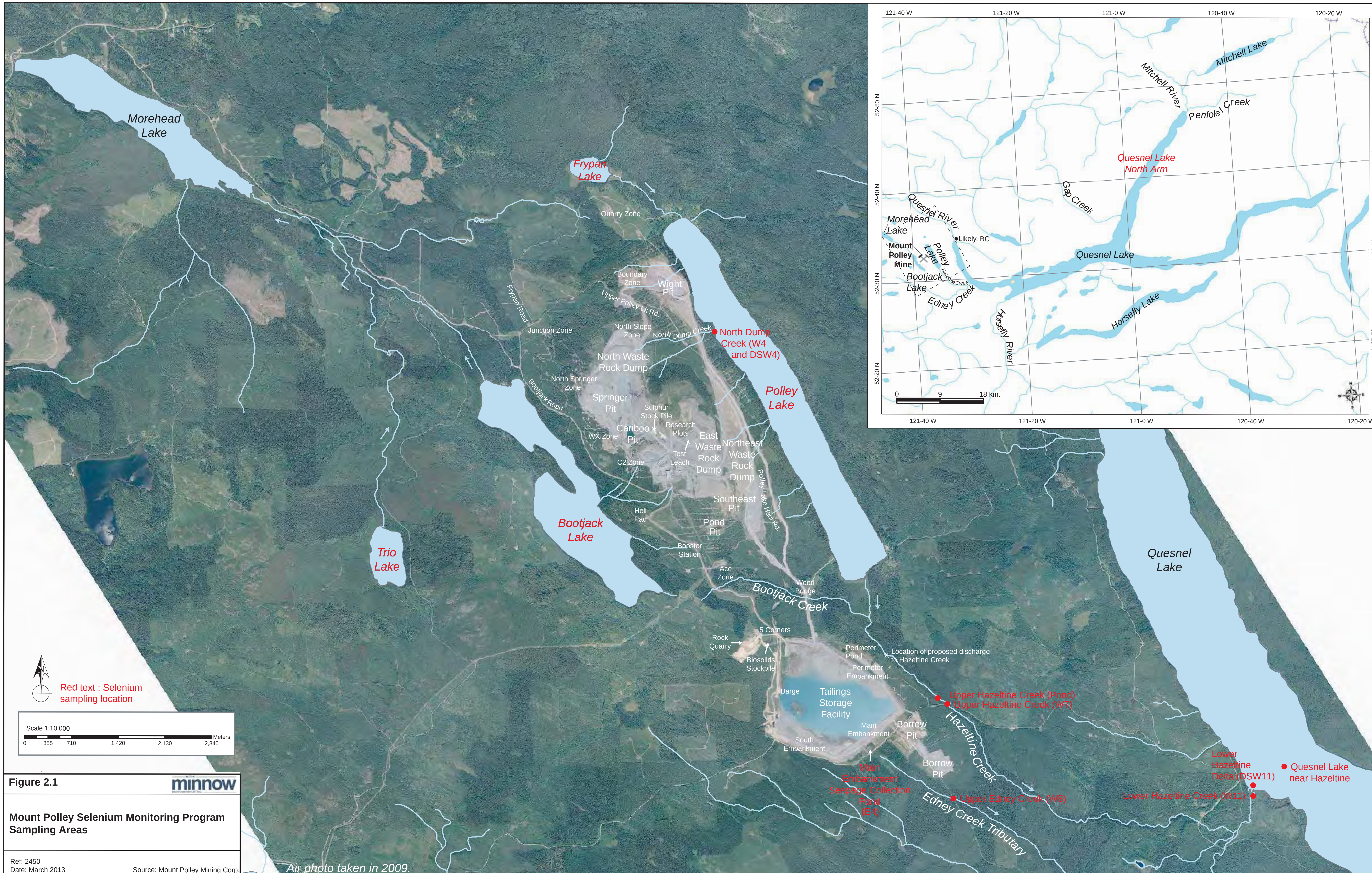


Figure 2.1

minnow

Mount Polley Selenium Monitoring Program Sampling Areas

Ref: 2450
Date: March 2013
Source: Mount Polley Mining Corp.

2.2 Sediment

Sediment samples were collected in May or October 2012 at five replicate stations within each lake, pond, and depositional creek area (Table 2.1; Figure 2.1; Appendix A). One exception was that eight replicate samples were collected at the pond in upper Hazeltine Creek in recognition of the importance of this location in future monitoring of the effluent discharge to be located a short distance upstream. Sediment samples for selenium and total organic carbon analysis were collected by coring, with the exception of the samples from lower Hazeltine Creek which were collected using a stainless steel spoon (due to limited depth of accumulation) and samples collected from the MESCP which were collected using a stainless steel petite ponar grab sampler (0.023 m^2 sampling area; due to substrate characteristics that precluded coring). In lakes, sediment samples were collected by gravity coring using a Kajak-Brinkhurst (KB) corer equipped with a 2-inch (5.1-cm) diameter lexan core tube. The corer was deployed from a boat with care taken to control the rate of descent, to maintain the corer in a vertical position during descent and to gently penetrate the sediment with minimal sediment disturbance. The corer was then carefully retrieved to surface and an extruder inserted into the bottom of the core tube to prevent any sediment slippage. Core samples were rejected if there was evidence of slippage, that the core did not penetrate the substrate vertically, or that the sediment-water interface was substantially disturbed. The core tube was then removed from the corer and the extruder was then used to push the sediment upwards towards the top of the core tube in a controlled fashion with care taken to minimize suspension of fines. In the event of suspension, momentum was stopped, allowing the solids to re-settle. Once the sediment was extruded to near the top of the tube, an extrusion collar marked at 1-cm intervals was carefully aligned on the top of the tube and the sediment extruded upwards into the collar. A core slicer was then carefully inserted between the tube and the collar at the 3-cm interval, to collect the top 3-cm of sediment. A minimum of three acceptable cores were composited and mixed to ensure homogeneity and provide sufficient sample volume for chemical analysis. Samples were then transferred to labelled polyethylene sample bags. Sediment samples from depositional areas in Hazeltine Creek (the pond upstream of Station W7) and Edney Creek (immediately downstream of the culvert at Station W8) were collected using a hand corer equipped with a 2-inch (5.1-cm) diameter lexan core tube and otherwise processed as described above. All sediment samples were placed into pre-labeled 250 mL glass jars, which were then placed in a cooler, and later placed in a refrigerator at approximately 4°C. A total of four duplicate sediment samples were collected for quality control. At the completion of each sampling program (i.e., spring and fall), sediment samples were submitted to the ALS Laboratory Group in Burnaby, BC, for analysis of selenium by Collision Cell ICP-MS and total organic carbon. Selenium in only the <63 um fraction (silt and clay) was requested, but the laboratory reported insufficient material in some samples to support sieving and analysis. Despite field observation that the samples did not contain sand or larger material, the only option to assure comparability among all samples was to revert to bulk analysis. Accordingly, the selenium concentrations for sediment are as bulk sediment.

2.3 Periphyton

Periphyton samples were collected in October 2012 as five replicates within each erosional creek station, with the exception of upper Hazeltine Creek, where eight replicate samples were collected in recognition of the importance of this location in future monitoring of the effluent discharge (Table 2.1; Figure 2.1; Appendix A). Samples were collected by scraping submerged cobble-size rocks using a stainless steel razor blade. Scraped material (periphyton) was placed in pre-labelled Whirl-Pak™ bags. Immediately after collection, periphyton samples were placed in a cooler, and later placed in a freezer until they were submitted to the ALS Laboratory Group in Burnaby, BC, for analysis of wet weight, dry weight and selenium by High-Resolution ICP-MS.

2.4 Benthic Invertebrates

Benthic invertebrate samples were collected in May or October 2012 at five replicate stations within each lake, pond, and creek area, with the exception of upper Hazeltine Creek (erosional samples at Station W7 and depositional samples at the pond upstream of Station W7), where eight replicate samples were collected in recognition of the importance of these locations in future monitoring of the effluent discharge (Table 2.1; Figure 2.1; Appendix A). Benthic invertebrate samples from depositional areas (lakes, the MESCP, and depositional locations in creeks) were collected using a 15.24 cm x 15.24 cm stainless steel ponar grab sampler (0.023 m^2 sampling area). Grab samples were placed into a 500 µm mesh sieve bag and sieved free of material less than 500 µm in diameter. Retained benthic organisms were removed by hand and with tweezers and placed into pre-labelled Whirl-Pak™ bags until the minimum desired sample size (the minimum sample weight required by the analytical laboratory; approximately 2 grams wet weight) was achieved. In creeks, benthic invertebrate samples were collected in areas with cobble substrate using a kick-net and by overturning rocks and collecting organisms by hand. Benthic organisms were placed into pre-labelled Whirl-Pak™ bags until the desired sample size was achieved. Immediately after collection, benthic invertebrate samples were placed in a cooler, and later placed in a freezer until they were submitted to the ALS Laboratory Group in Burnaby, BC, for analysis of wet weight, dry weight and selenium by High-Resolution ICP-MS.

2.5 Fish

Fish were collected in May 2012 from lakes by gill netting and angling (five replicate rainbow trout and five replicate sucker [as available]), and in Hazeltine Creek by backpack electrofishing (eight replicate rainbow trout; Table 2.1; Figure 2.1; Appendix A). In lakes, gill nets with mesh sizes varying from 2" to 4" (5.1 - 10.2 cm) were used. Nets were set as both short-sets (2-4 hours) and overnight sets and the length of net, mesh size, depth, set and lift time and location were recorded for each set. In Hazeltine Creek, backpack electrofishing was conducted by a certified and experienced field crew using a gas-powered Smith-Root 15-C electrofisher equipped with a net on the anode ring to allow the operator to capture fish. The operator was supported by a dip netter dedicated to capturing fish shocked by the electrofisher. Upon capture, fish were placed in buckets containing aerated water. At the completion of each electrofishing run, total shocking time was recorded.

All retained fish were dispatched and processed as soon as possible following retrieval (always within four hours). Processing included the measurement of length and weight, the collection of aging structures, the collection of fish tissues, and a record of any abnormalities. Lengths (both fork and total) were measured to the nearest millimetre using a measuring board. Weights were taken using a series of Pesola™ spring scales (i.e., 200g, 500g, 1000g and 2500g). These scales are typically demarcated at 1% of their total range and have a precision of ± 0.3%. Every fish was measured near the top of the scale's range to ensure that measurements achieve resolution near 1%. Ageing structures were removed from each fish, wrapped separately in wax paper and stored inside labeled envelopes for age analysis; otoliths and scales were collected from rainbow trout, and otoliths and pectoral fins rays were collected from each sucker. Each fish was cut open using a fillet knife and gender was recorded. Gonads and livers were removed and weighed to the nearest milligram (0.001 g) using a Scout Pro SPE-123 analytical balance surrounded by a draft shield. Skinless, boneless muscle samples (approximately 50 g) were collected from each fish using a fillet knife. Female gonad (ovary) samples and muscle samples were then placed in pre-labelled Whirl-Pak™ bags. Any external or internal abnormalities were recorded on data sheets prior to disposal of the carcass. Muscle and ovary samples were placed into a freezer until they were submitted to the ALS Laboratory Group in Burnaby, BC, for analysis of wet weight, dry weight and selenium by High-Resolution ICP-MS. Ageing structures were shipped to North Shore Environmental Services (NSES), Thunder Bay, ON for age analyses.

2.6 Data Management and Interpretation

Selenium data collected as described above (water, sediment, periphyton, benthic invertebrate tissue and fish tissue; Appendix B) were subjected to a data quality assessment to verify data quality prior to use in data analysis and interpretation. Data quality was judged to be good (Appendix C). Tissue selenium concentrations were reported on a dry weight basis, as dry weight concentrations are much more reliable and therefore recommended for all tissue chemistry studies (Ohlendorf et al. 2011). However, wet weight results are also available (Appendix Table B.6). Selenium concentration data were then compiled and summary statistics (mean and standard deviation) were calculated for reporting. Mean selenium concentrations were compared among areas using analysis of variance (ANOVA) and the student's t-test. Baseline selenium concentration data were available for sediment and fish muscle tissue (HKP 1996, HKP 1997, Beak 2000). Accordingly, mean selenium concentrations in sediment and fish muscle tissue were compared to baseline concentrations. Selenium concentration data for all environmental compartments from 2009/2010 were also available, with the exception of the depositional area (pond) sampled in upper Hazeltine Creek in 2012, which had no 2009/2010 equivalent. Thus, selenium concentrations in 2012 were compared to concentrations in 2009/2010 using analysis of variance (ANOVA) and the student's t-test.

To evaluate potential risk to aquatic life, selenium concentrations in water, sediment, and fish muscle tissue were also compared to British Columbia water, sediment and fish muscle tissue quality guidelines for aquatic life (0.002 mg/L, 2.0 mg/kg dry weight, and 1.0 mg/kg wet weight, respectively; BCMOE 2001a,b). However, as previously indicated, there is substantial recent evidence demonstrating that water-based guidelines for selenium are poor predictors of potential adverse effects to aquatic life (e.g., Stewart et al. 2010; Hodson et al. 2010; Ohlendorf et al. 2011; DeForest et al. 2012) and that better tools for the assessment of effects to sensitive organisms are available, the best of which are effect thresholds for ripe egg and/or ovary tissue in fish (e.g., Janz et al. 2010; DeForest et al. 2012). Therefore, selenium concentrations in fish ovaries were compared to the threshold (5^{th} percentile of EC10 values) for reproductive effects in eggs and ovaries (20 mg/kg dw; DeForest et al. 2010).

3.0 SELENIUM MONITORING RESULTS

3.1 Water

Routine water quality monitoring conducted by the Mount Polley Mine, supplemented by data from field programs, indicated that concentrations of selenium were near or below the method detection limit (0.0005 mg/L) in most receiving environments (Figures 3.1 and 3.2; Appendix Figures B.1 to B.6). Concentrations of total selenium and dissolved selenium were almost identical (Appendix Table B.1; Appendix Figures B.1 to B.6). The only receiving environment with elevated selenium concentrations was North Dump Creek (Station W4), which received seepage from the North Rock Dump prior to containment in late 2009 (and flows into Polley Lake). Since containment, selenium concentrations in North Dump Creek have decreased substantially, yet remain moderately elevated relative to concentrations in lakes and other creeks in the vicinity of the Mount Polley Mine. The average selenium concentrations in North Dump Creek in 2011 and 2012 were 0.0024 and 0.0023 mg/L, respectively, compared to 0.015 mg/L in 2009 prior to containment and 0.005 mg/L in late 2009 and 2010 after containment (Figure 3.1; Appendix Table B.1 and Figure B.2). In contrast, selenium concentrations in the Main Embankment Seepage Collection Pond (MESCP; Station E4) were higher in 2011 and 2012 than in 2009 and 2010 (Figure 3.1; Appendix Figure B.1). The concurrent increase in aqueous selenium concentrations in the MESCP and decrease in North Dump Creek indicates that the major source of selenium to the receiving environment has been contained and diverted to the collection pond.

3.2 Sediment

Mean sediment selenium concentrations were highest in the MESCP (8.1 ± 6.0 mg/kg dw; Figure 3.3; Appendix Table B.1), which is not surprising, as the MESCP collects seepage and water diverted from the North Rock Dump. It is worth noting, however, that there was substantial variability in the MESCP sediment selenium concentrations, which ranged from 2.5 to 17.1 mg/kg dw (Figure 3.3; Appendix Table B.2). Mean selenium concentration in Polley Lake sediment (5.0 ± 1.5 mg/kg dw) was also higher than in the other lakes (mean concentrations from 0.4 to 2.4 mg/kg dw; Figure 3.3; Appendix Table B.1). Concentrations of selenium in creek sediments were generally near or higher than levels observed in lakes, with the exception of Polley Lake, with mean concentrations of 2.7 ± 0.6 and 2.9 ± 0.4 mg/kg dw at Upper Hazeltine Creek (the pond upstream of Station W7) and Upper Edney Creek (Station W8), respectively (Figure 3.3; Appendix Table B.1). Overall, there is evidence of elevated sediment selenium concentrations in Polley Lake and creeks near the mine relative to other local lakes and creeks.

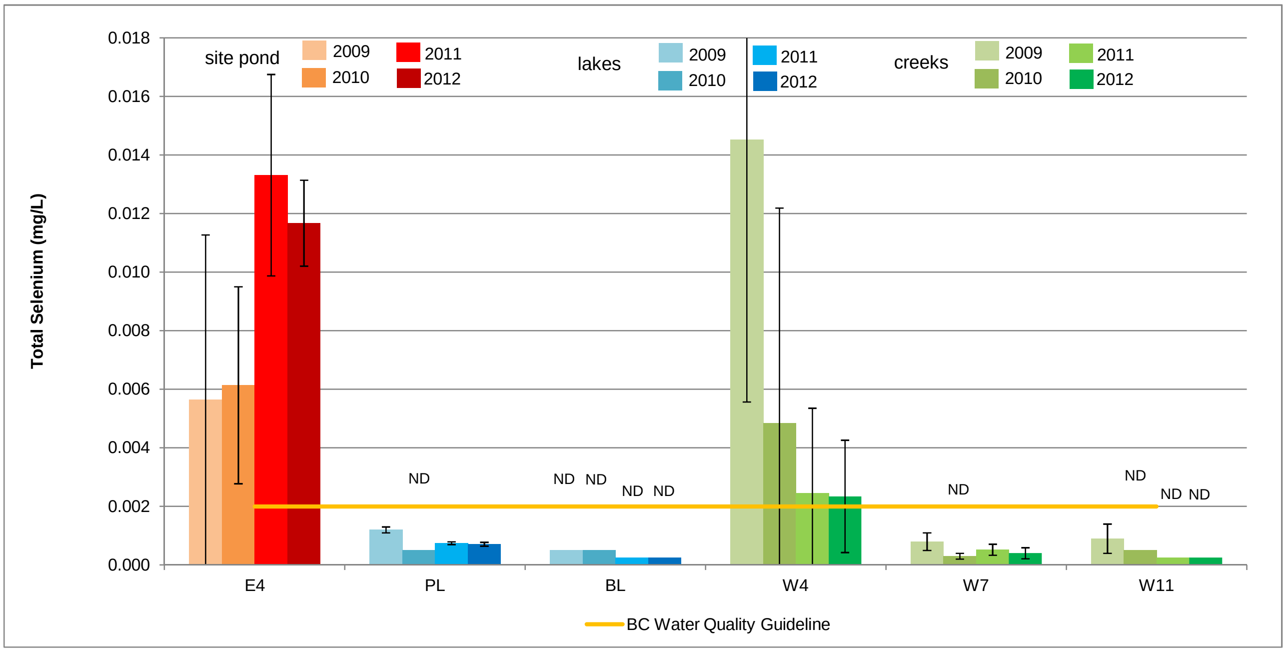


Figure 3.1: Selenium concentrations in water (mean ± standard deviation; maximum; in mg/L), Mount Polley Mine routine water quality monitoring, 2009-2012

ND = non-detect

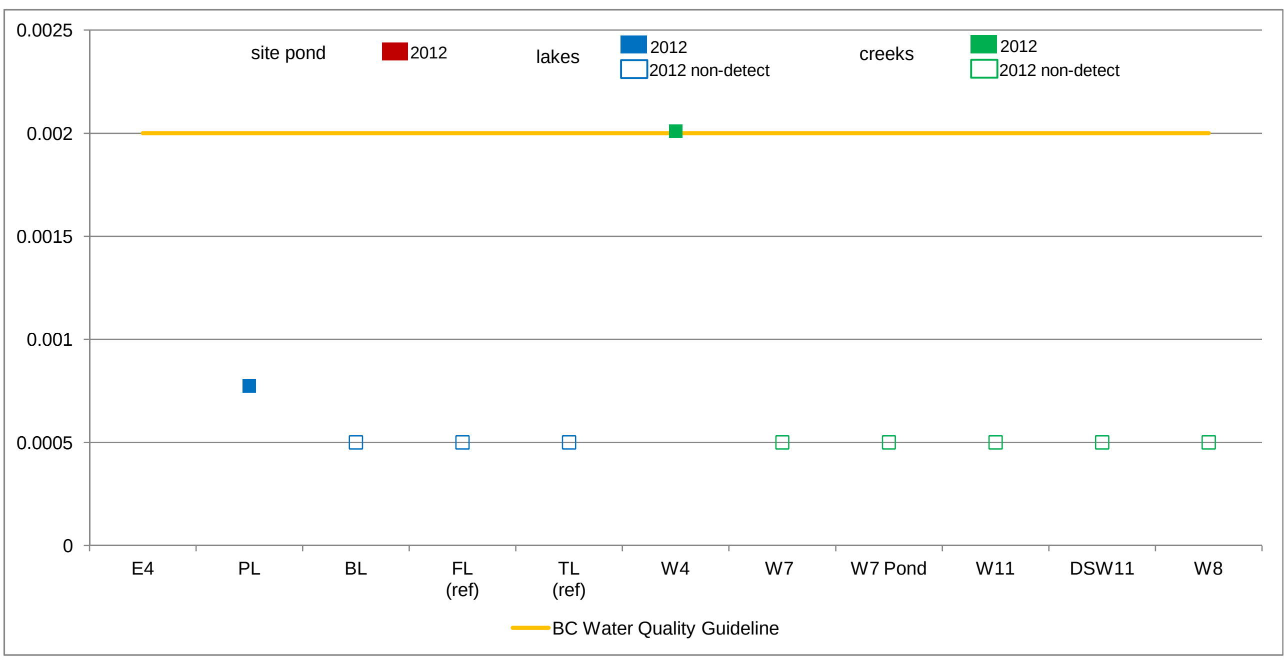


Figure 3.2: Selenium concentrations in water (mean ± standard deviation in mg/L), supporting spot samples, Mount Polley, May and October 2012.

ref = reference

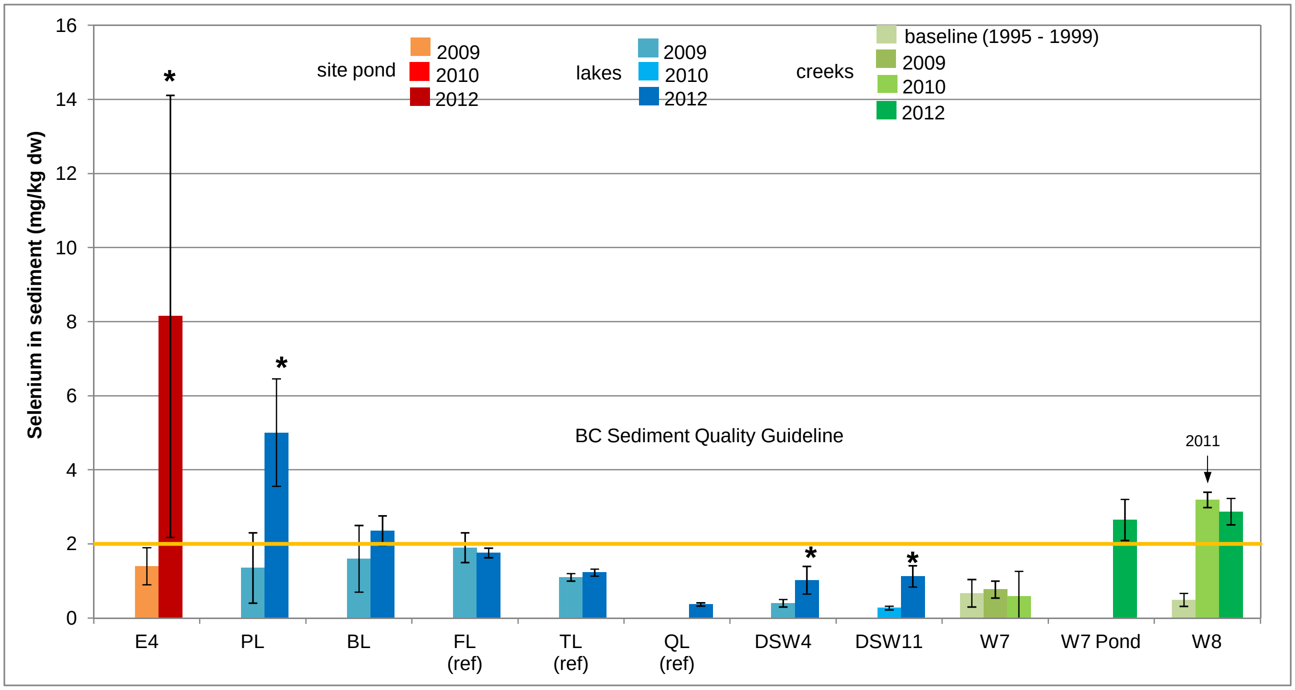


Table 3.3: Selenium concentrations in sediment, Mount Polley, 1995-1999, 2009/2010 and 2012. Statistically significant differences between 2009/2010 and 2012 are indicated by * .

Error bars indicate standard deviation.

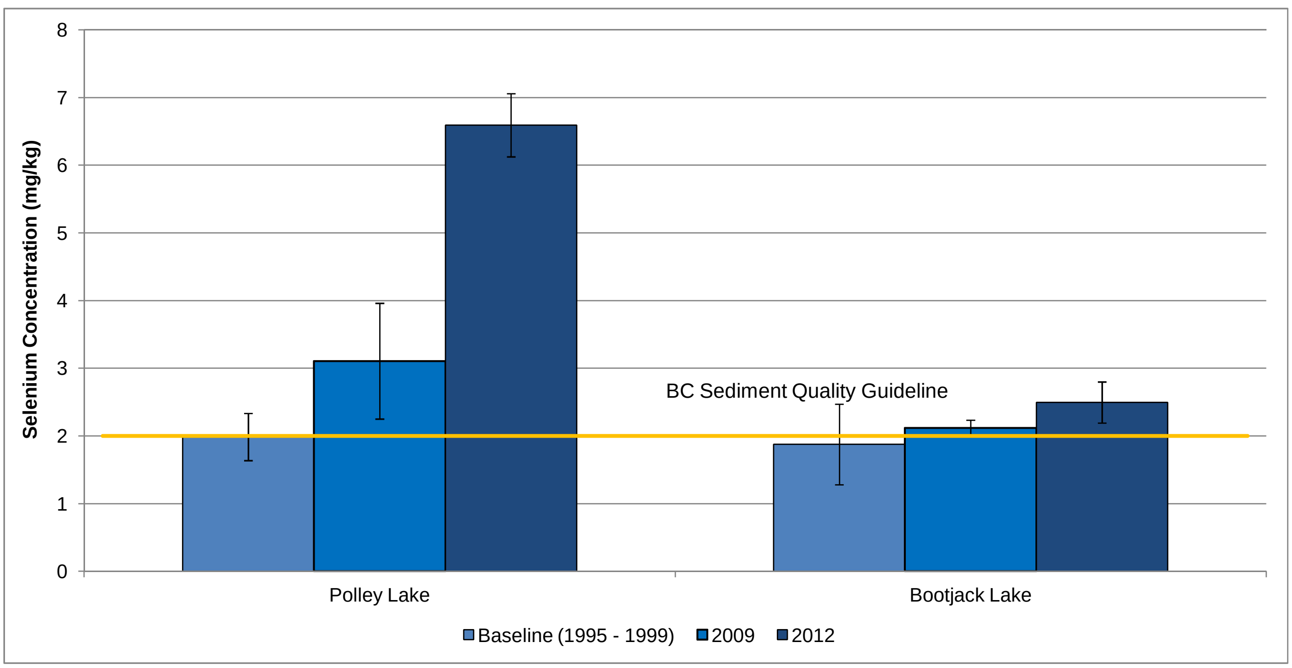


Figure 3.4: Temporal plot of concentrations of selenium in sediment from Polley Lake stations P1 and P2 and Bootjack Lake stations B1and B2, Mount Polley 1995-1999, 2009, and 2012.

Error bars indicate standard deviation; sediment collected by core in 2012, grab in 2009 and combination in baseline studies

In general, there was an increase in mean sediment selenium concentrations from 2009/2010 to 2012 in areas in proximity to the mine, while no such change was evident at the reference areas (Figure 3.3; Appendix Table B.1). Sediment selenium concentrations in 2012 were significantly higher than in 2009/2010 at the MESCP, Polley Lake, DSW4 (Polley Lake just offshore from North Dump Creek), and Lower Hazeltine Creek (at the delta at Quesnel Lake; Figure 3.3). The increase in sediment selenium concentration at the MESCP was consistent with a temporal increase in water concentration due to the conveyance of North Rock Dump seepage. Conversely, the apparent increase in sediment selenium concentration in Polley Lake from 2009/2011 to 2012 was likely due to differences in sample location (deeper sampling stations in 2012; Appendix A) and collection method (coring in 2012 compared to grabs in 2009/2010). The differences are also consistent with greater organic carbon content of the sediment collected by coring from deeper locations relative to those collected by grab from shallower locations (Appendix Figures B.7 and B.8). Sediment from the pond in Upper Hazeltine Creek (W7 Pond) also had higher selenium concentrations than erosional areas in the creek, while Upper Edney Creek 2012 sediment selenium concentrations were elevated relative to baseline concentrations (i.e., 1995 to 1999; Figure 3.3). Mean sediment selenium concentration at Polley Lake stations P1 and P2 was elevated in 2012 compared to baseline conditions, while no differences were observed between baseline and 2012 concentrations in Bootjack Lake (Stations B1 and B2; Figure 3.4). Overall, sediment selenium concentrations seem to have increased in areas near the mine.

3.3 Periphyton

Periphyton selenium concentrations ranged from 3.1 ± 0.3 mg/kg dw at Lower Hazeltine Creek to 5.8 ± 1.1 mg/kg dw at Upper Edney Creek (Figure 3.5; Appendix Tables B.1 and B.5). Periphyton selenium concentrations in Upper Hazeltine Creek were, on average, greater than in Lower Hazeltine Creek, with the decrease with distance from the mine suggesting a potential mine-related influence. However, temporal comparisons showed significantly greater periphyton selenium concentrations at Lower Hazeltine Creek from 2009/2010 to 2012, while there was no similar difference at Upper Hazeltine Creek (Figure 3.5; Appendix Table B.1). This suggests that periphyton selenium concentrations in Lower Hazeltine Creek do not definitively correspond to increases or decreases upstream and that differences observed between the two sites and years may be the result of natural variability. Concentrations of selenium in periphyton collected from Upper Edney Creek and North Dump Creek were similar to those in periphyton of Upper Hazeltine Creek (Figure 3.5).

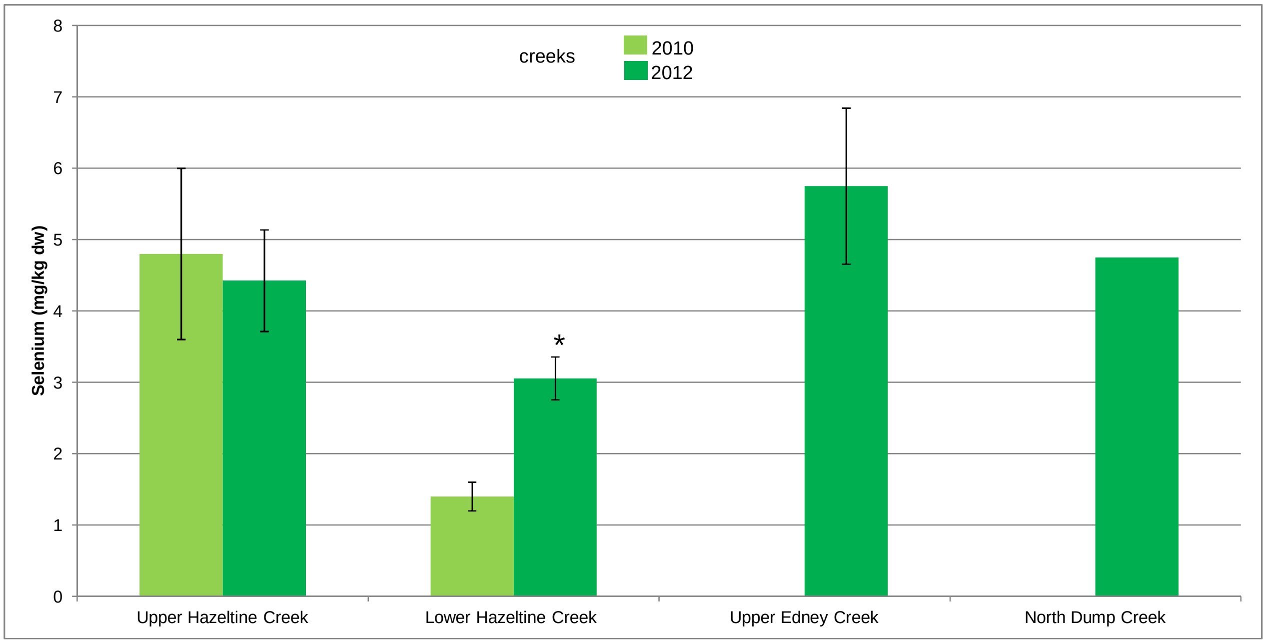


Figure 3.5: Selenium concentrations in periphyton (mean ± standard deviation in mg/kg dw), Mount Polley, 2010 and 2012. Statistically significant differences between 2009/2010 and 2012 are indicated by *.

Error bars indicate standard deviation.

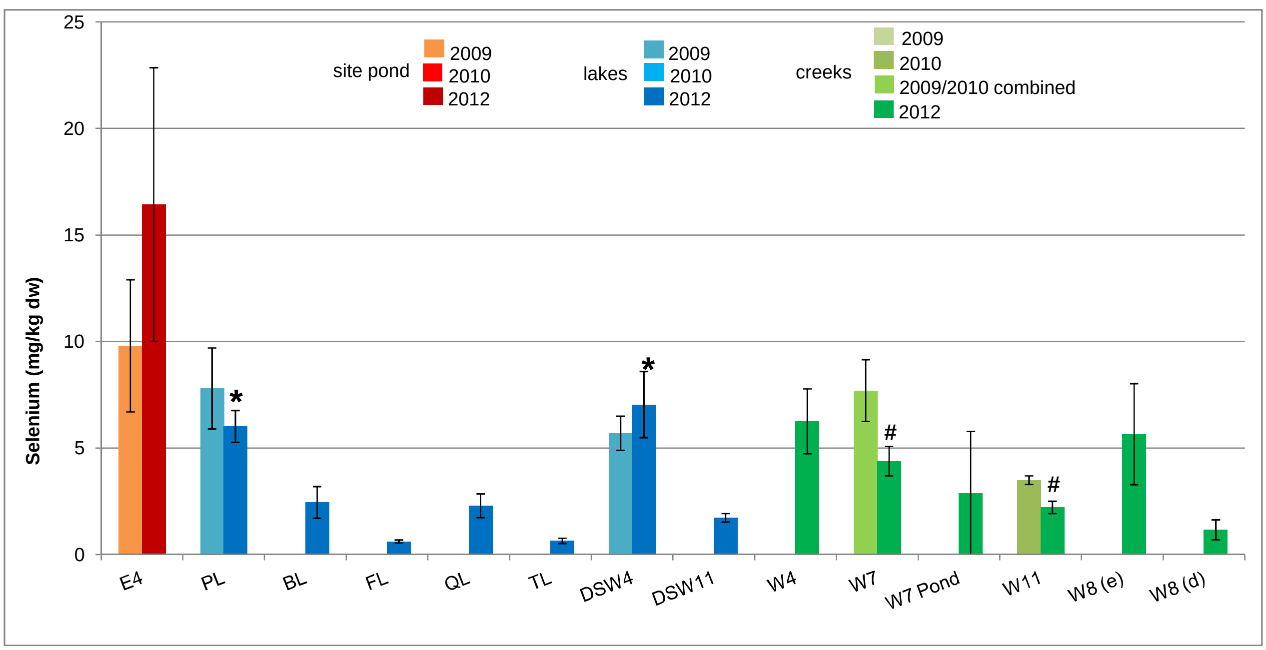


Figure 3.6: Selenium concentrations in benthos (mean ± standard deviation in mg/kg dw), Mount Polley, 2009, 2010 and 2012. Significant differences between reference and exposure lakes are indicated by *. Significant differences between 2009/2010 and 2012 are indicated by #.

e = erosional

d = depositional

Error bars indicate standard deviation.

3.4 Benthic Invertebrates

Mean benthic invertebrate selenium concentrations in depositional habitat ranged from 0.62 ± 0.07 mg/kg dw in Frypan Lake (reference) to 16.4 ± 6.4 mg/kg dw in the MESCP (Figure 3.6; Appendix Table B.2). However, in Polley Lake (i.e., the depositional habitat with the next highest benthic invertebrate selenium concentration after MESCP) the mean value was 6.0 ± 0.7 mg/kg dw (Figure 3.6; Appendix Table B.2). Despite being lower than in the MESCP, benthic invertebrate selenium concentrations from Polley Lake (both the representative lake samples and those collected near the inflow from North Dump Creek [DSW4]) were significantly elevated relative to reference lakes (Figure 3.6). In contrast, mean benthic invertebrate selenium concentration in Lower Hazeltine Creek (downstream of Station W11 at Quesnel Lake) was within the range observed in reference lakes (Figure 3.6; Appendix Table B.2). Selenium concentrations in benthic invertebrates collected from depositional habitat in Upper Hazeltine were slightly higher than at Lower Hazeltine Creek, the apparent gradient suggesting a potential mine influence. Conversely, selenium concentrations in benthic invertebrates collected from depositional habitat in Upper Edney Creek were lower than at Lower Hazeltine Creek and similar to the reference lakes.

Benthic invertebrate samples from erosional habitats had selenium concentrations that ranged from 2.2 ± 0.3 mg/kg dw in Lower Hazeltine Creek to 6.3 ± 1.5 mg/kg dw in North Dump Creek (Figure 3.6; Appendix B.2). Just as in periphyton and depositional benthos, mean selenium concentration in erosional benthos from Upper Hazeltine Creek was higher than in Lower Hazeltine Creek and reflected a general gradient that corresponds to distance from the mine (i.e., Upper Edney Creek and North Dump Creek were also generally higher than in Lower Hazeltine Creek). Interestingly, selenium concentrations in benthic invertebrates from mine-exposed erosional habitats were generally higher than those from analogous depositional areas (i.e., in Upper Hazeltine and Upper Edney Creeks; Figure 3.6; Appendix Table B.2). This is contrary to previous studies, which have found that depositional benthic invertebrates generally have higher selenium than their erosional counterparts and exhibit greater enrichment factors when found at similar environmental (i.e., water, periphyton) selenium concentrations (Orr et al. 2012). Relative to 2009/2010, mean benthic invertebrate selenium concentrations were significantly lower in 2012 in both Upper and Lower Hazeltine Creek, which corresponds to lower aqueous selenium but not to the temporal changes observed in sediment and periphyton selenium.

3.5 Fish Muscle

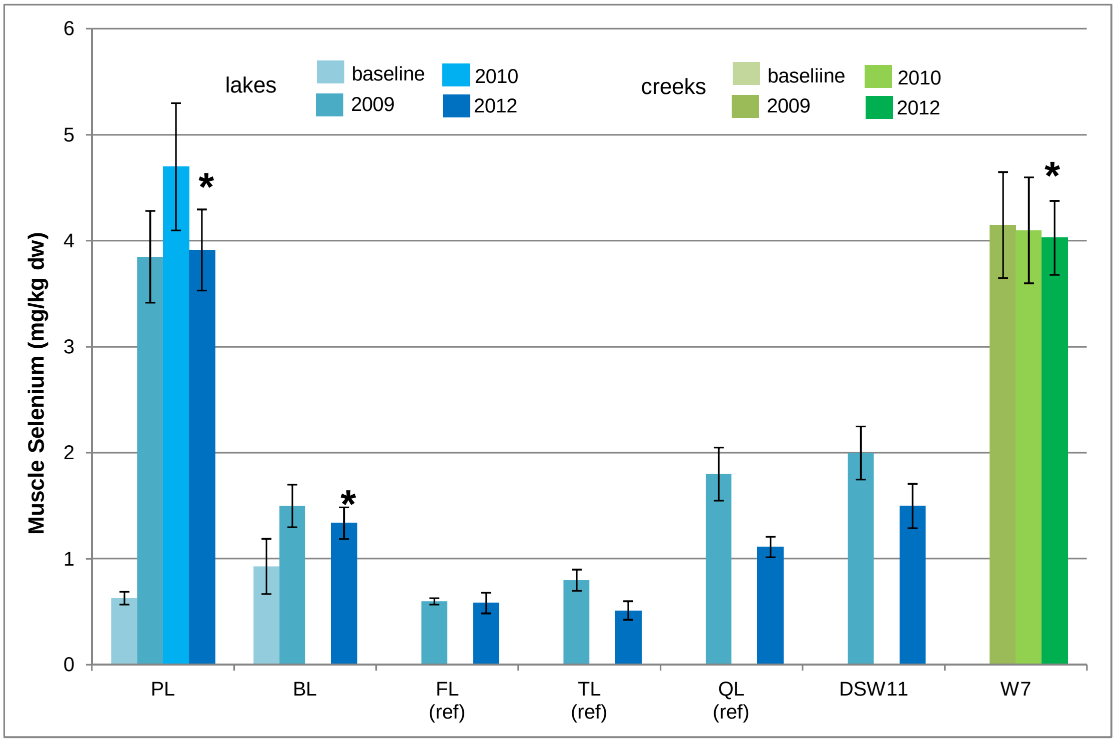
Mean selenium concentrations in muscle tissue of rainbow trout and longnose sucker from Polley Lake were significantly higher (3.9 ± 0.4 and 8.2 ± 1.4 mg/kg dw, respectively) than in all reference lakes (Figure 3.7; Appendix Table B.2). A similar spatial pattern was observed in sediment and benthic invertebrate tissue, which suggests a mine-related influence on selenium concentrations in Polley Lake. Rainbow trout from Upper Hazeltine Creek also had elevated muscle tissue selenium relative to reference lakes (4.0 ± 0.4 mg/kg dw; Figure 3.7; Appendix Table B.2) with concentrations comparable to those from Polley Lake. This is not surprising, as rainbow trout captured in Hazeltine Creek likely overwinter in Polley Lake. Selenium muscle tissue concentrations were higher in Polley Lake longnose sucker than in rainbow trout, which is likely due to dietary differences (i.e., longnose sucker are strict benthivores whereas rainbow trout generally also consume planktivorous and terrestrial invertebrates) as selenium bioaccumulation is primarily from the diet (Stewart et al. 2010; Janz et al. 2010). Overall, selenium concentrations in muscle tissue from fish captured near the mine were clearly elevated relative to reference areas, suggesting a mine-related influence.

In general, there was little temporal change over the 2009-2012 period in fish muscle selenium concentrations, with the possible exception of a decrease in Polley Lake longnose sucker (Figure 3.7). However, rainbow trout and longnose sucker captured from Polley Lake in 2009-2012 had higher muscle selenium concentrations than baseline (1995-1999; Figure 3.7). In contrast, Bootjack Lake showed little to no change from baseline concentrations (Figure 3.7), further suggesting that fish muscle tissue selenium concentrations in Polley Lake, but not in Bootjack Lake, have been influenced by mine activity.

3.6 Fish Ovaries

Selenium concentrations in the ovaries of rainbow trout and longnose sucker captured from Polley Lake (7.6 ± 0.8 and 8.8 ± 0.4 mg/kg dw) were significantly higher than in reference lakes (Figure 3.8; Appendix Table B.2). Rainbow trout from Hazeltine Creek also had significantly higher ovary selenium concentrations relative to reference locations (i.e., 7.5 ± 0.9 mg/kg dw in Hazeltine Creek compared to 2.4 to 3.7 mg/kg dw in reference areas; Figure 3.8; Appendix Tables A.1). As with fish muscle, there was little temporal change in fish ovary selenium concentrations over the 2009-2012 period, with the possible exception of a decrease in Polley Lake longnose sucker (Figure 3.8).

a) Rainbow Trout



b) Longnose Sucker

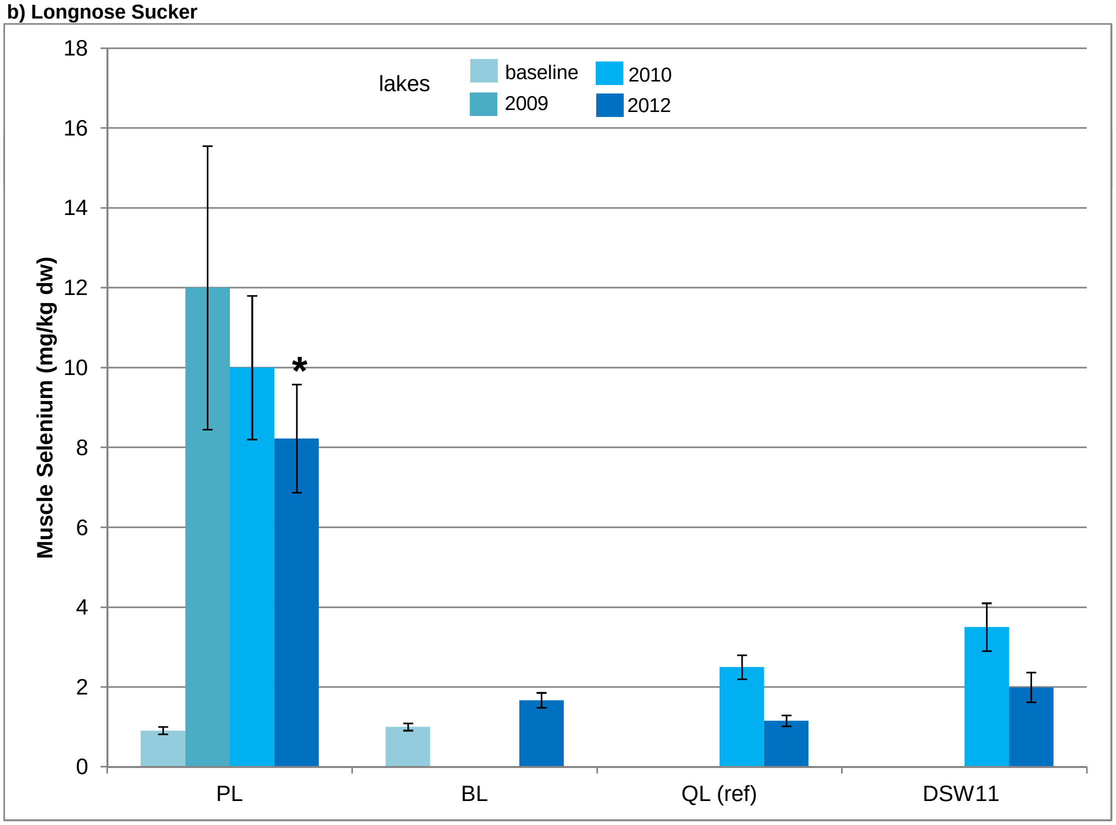
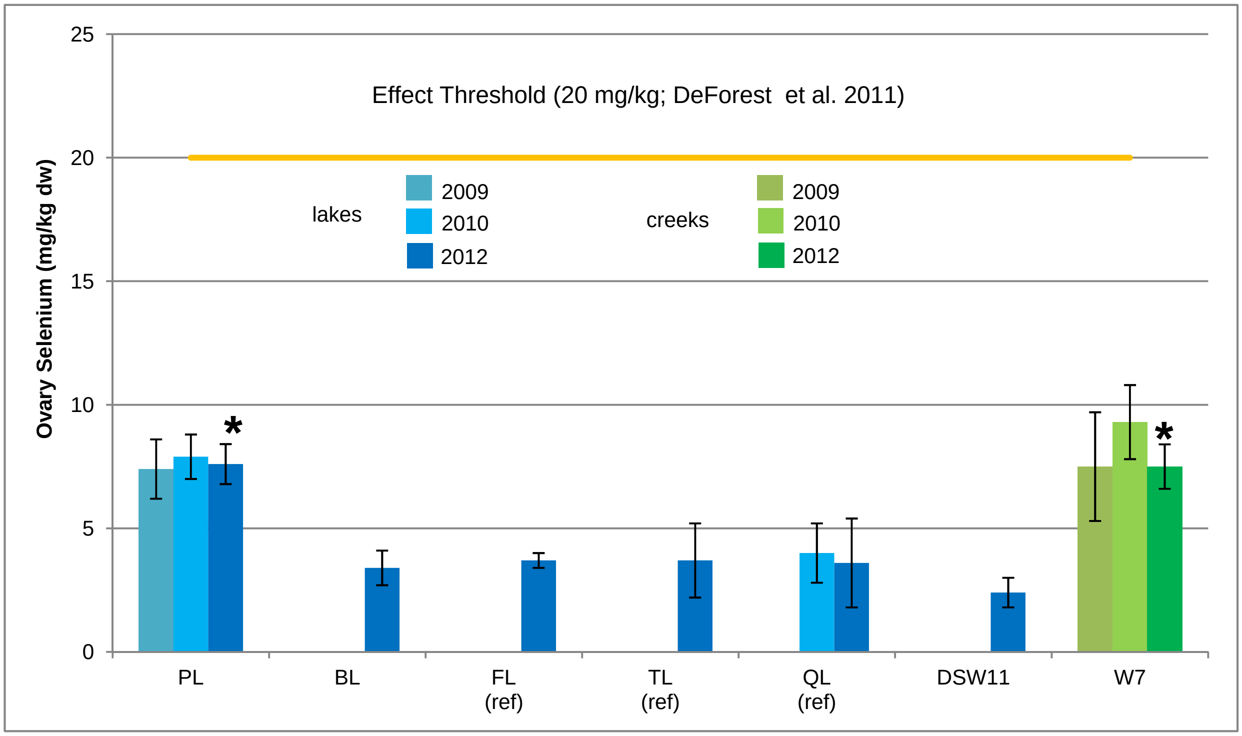


Figure 3.7: Selenium concentrations in fish muscle (mean ± standard deviation in mg/kg dw), baseline (1995-1999), 2009, 2010 and 2012. Significant differences between 2012 reference and exposure areas are indicated by *.

ref = reference

a) Rainbow Trout



b) Longnose Sucker

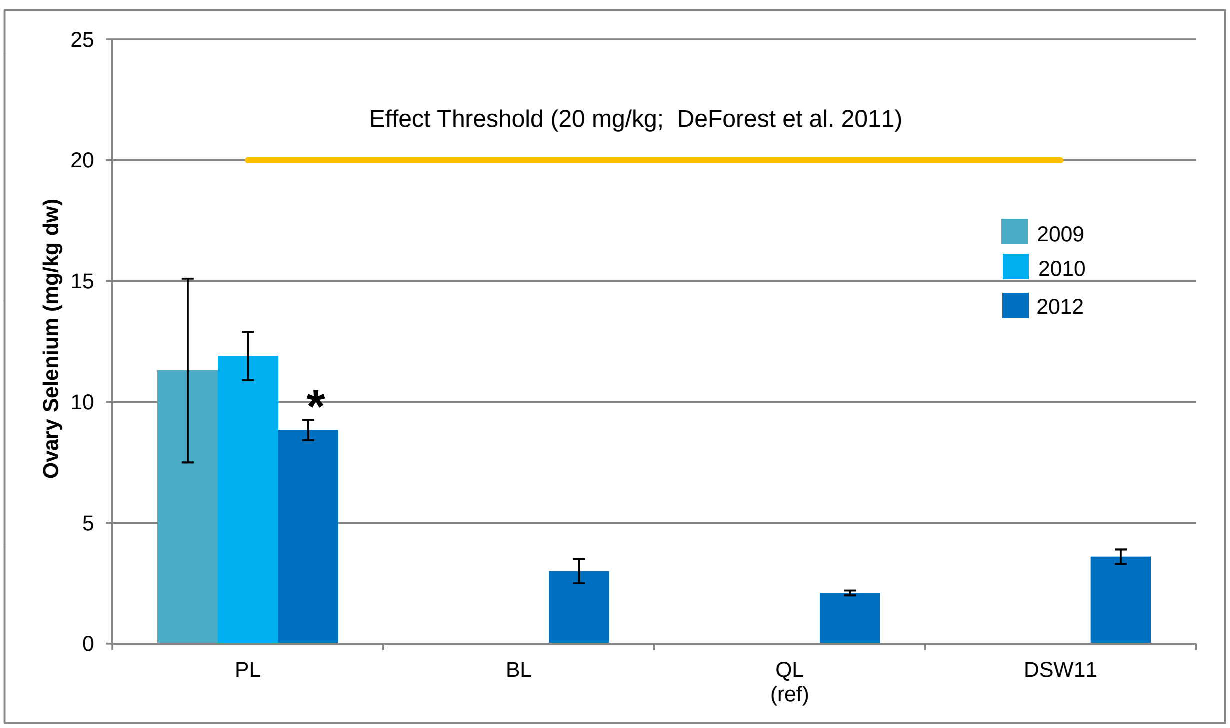


Figure 3.8: Selenium concentrations in fish ovaries (mean ± standard deviation in mg/kg dw), 2009-2012. Significant differences between refrence and exposure areas in 2012 are indicated by *.

ref = reference

3.7 Summary and Evaluation of Risk to Aquatic Life

Selenium concentrations in receiving environment water at North Dump Creek have decreased since interception of North Rock Dump seepage in late 2009. Mean aqueous selenium levels at North Dump Creek are now near the BC water quality guideline of 0.002 mg/L (compared to mean concentrations of 0.015 and 0.005 mg/L in 2009/2010 pre- and post-interception, respectively). Concentrations of selenium in water from all other stations monitored in 2009-2012 were below the BC water quality guideline. Despite the clear improvement in water quality at North Dump Creek, sediment selenium concentrations in Polley Lake were greater than the BC interim sediment quality guideline of 2.0 mg/kg dw in 2012. Sediment selenium concentrations in 2012 were generally higher than in 2009 due to collection from deeper locations by coring rather than by grab sampling. Regardless, selenium concentrations in sediment, benthos and fish tissue from Polley Lake were all elevated relative to reference lakes indicating a mine-related influence. This is supported by the observation of selenium concentrations in periphyton and benthic invertebrate tissue from Upper Hazeltine Creek that were higher than in Lower Hazeltine Creek. Concentrations of selenium in the muscle tissue of rainbow trout from Polley Lake and Upper Hazeltine Creek were below the interim BC fish tissue guideline of 1.0 mg/kg ww in 2012, but concentrations in Polley Lake longnose sucker were greater than the guideline (Appendix Table B.6).

Despite some comparison to guidelines for water, sediment and fish tissue (above), it is recognized that the most sensitive endpoint and that with the least uncertainty in predicting potential selenium toxicity in aquatic environments is selenium in the eggs or ovaries of egg-laying vertebrates (e.g., fish or birds; Janz et al. 2010). Recent literature suggests an effects threshold for the most sensitive species of 20 mg/kg dw selenium in eggs/ovaries of fish (DeForest et al. 2011). While ovary selenium concentrations in fish from areas near the mine have remained higher than in reference areas, at 7.6 ± 0.8 mg/kg dw (2012), rainbow trout from Polley Lake and Hazeltine Creek had ovary selenium concentrations well below the effects threshold. Longnose sucker ovary selenium concentrations from Polley Lake (i.e., 8.8 ± 0.4 mg/kg dw in 2012) have also remained well below the 20 mg/kg dw threshold. Furthermore, longnose sucker may be even more tolerant than rainbow trout, as the effects threshold for white sucker (*Catostomus commersonii*), a closely related species, is 26 mg/kg dw (DeForest et al. 2011). As such, current levels of fish ovary selenium near the Mount Polley Mine indicate concentrations lower than those expected to cause adverse effects.

Discharge of effluent from the Mount Polley Mine to Upper Hazeltine Creek has the potential to result in increased aqueous selenium concentration. In accordance with the BC water quality guidelines, Mount Polley will discharge in a manner to achieve concentrations at or below 0.002 mg/L limit (MPMC 2009). The substantial dilution of Hazeltine Creek in Quesnel

Lake (to <0.03% effluent; MPMC 2009) would not be expected to increase selenium concentrations in Quesnel Lake above background (<0.001 mg/L; Appendix Table B.1). Furthermore, as adult fish typically utilize Hazeltine Creek only for spawning, exposure would be limited. Although there is some uncertainty as to how discharge could increase selenium concentrations in sediment, periphyton, benthos and fish in Hazeltine Creek, studies in British Columbia have documented that much greater aqueous selenium concentrations (up to approximately 0.040 mg/L) can occur in creek environments without causing selenium in fish tissues to increase above effect threshold concentrations (Orr et al. 2011). Therefore, based on available information, it appears that risks of adverse effects of selenium to fish in Polley Lake, Hazeltine Creek and Quesnel Lake would be low. Nonetheless, effective monitoring and interpretation of selenium in the environment near the Mount Polley Mine is recommended.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Interception of seepage from the North Rock Dump to North Dump Creek in 2009 has reduced aqueous selenium concentrations in North Dump Creek. Nonetheless, monitoring of selenium concentrations in sediment, periphyton, benthos and fish tissue from Polley Lake and Hazeltine Creek and comparison to baseline and reference concentrations indicated a mine-related increase. Despite the fact that a mine-related influence is evident, and in consideration of the control of the main source of selenium to Polley Lake, there appears to be no current risk of adverse effects, as fish ovary selenium concentrations are well below the 20 mg/kg dw threshold for effects. Although there is some uncertainty as to how future discharge could influence selenium concentrations in Hazeltine Creek, based on available information, the risk of adverse effects of selenium to fish in Polley Lake, Hazeltine Creek and Quesnel Lake is considered to be low. Nonetheless, it is recommended that selenium is carefully monitored and that data are interpreted with care.

4.2 Recommendations

Based on the results of the Mount Polley 2012 selenium monitoring program, the following recommendations for future monitoring are provided:

- Continue to monitor water quality in accordance with the existing water quality monitoring program and evaluate potential changes over time on at least an annual basis.
- Continue annual monitoring of periphyton in Upper and Lower Hazeltine Creek in late September or early October as well as in sediment at the pond in Hazeltine Creek upstream of monitoring station W7. Both sediment and periphyton are relatively easy to collect and have been recommended as key selenium exposure assessment endpoints (e.g., Young et al. 2010; Hodson et al. 2010) because they reflect concentrations being incorporated into the food web. Compare concentrations of selenium in sediment and periphyton to those of previous years on an annual basis and ensure that sampling techniques and locations are consistent over time.
- Repeat the collection of rainbow trout ovaries (in the spring at Upper Hazeltine Creek at an initial frequency of annually) to determine selenium concentrations relative to previous observations and effect thresholds. Power analysis using rainbow trout ovary selenium concentrations in Hazeltine Creek from 2009-2012 indicated that a sample size of eight is sufficient to detect a significant change of ≤30% under all

comparisons except to the 2009 data as well as to detect a significantly different future mean that is well below the effect threshold of 20 mg/kg dw (Appendix Table B.8). As such, a sample size of eight is recommended for the repeat collection. Compare concentrations of selenium in rainbow trout ovaries to those of previous years on an annual basis and ensure that sampling techniques and locations are consistent over time.

- Review the selenium monitoring program annually, compare post-discharge to pre-discharge selenium concentrations, and adjust the monitoring program in response to findings.

5.0 REFERENCES

BCMOE (British Columbia Ministry of Environment). 2001a. Ambient Water Quality Guidelines for Selenium: Overview Report. Prepared by N.K. Nagpal. August 2001.

BCMOE (British Columbia Ministry of Environment). 2001b. Ambient Water Quality Guidelines for Selenium: Technical Appendix. Prepared by N.K. Nagpal and K. Howell. September 2001.

Beak (Beak International Incorporated). 2000. Mount Polley Biological Monitoring Program - 1999. Report Prepared for the Mount Polley Mining Corporation. April 2000.

DeForest, D.K., G. Gilron, S.A. Armstrong and E.L. Robertson. 2012. Species sensitivity distribution evaluation for selenium in fish eggs: Considerations for development of a Canadian tissue-based guideline. Integr. Environ. Assess. Manage. 8:6-12.

GEI Consultants, Golder Associates, Parametrix, University of Saskatchewan Toxicology Centre. 2008. Selenium Tissue Thresholds: Tissue Selection Criteria, Threshold Development Endpoints, and Potential to Predict Population or Community Effects in the Field. Submitted to North America Metals Council – Selenium Working Group, Washington DC. December 2008.

HKP (Hallam Knight Piésold Ltd.). 1996a. Mount Polley Project - Environmental Baseline and Monitoring Report: 1995. March 1996.

HKP (Hallam Knight Piésold Ltd.). 1997a. Mount Polley Mining Corporation - Mount Polley Project - Environmental Baseline and Monitoring Report: 1996. June 1997.

Hodson, P.V., R.J. Reash, S.P. Canton, P.V. Campbell, C.G. Delos, A. Fairbrother, N.P. Hitt, L.L. Miller, and H.M. Ohlendorf. 2010. Selenium Risk Characterization. In: p. 233-256, P. Chapman et al. (Eds.), Ecological Assessment of Selenium in the Aquatic Environment. CRC Press, Boca Raton, London, New York.

Holm, J., V.P. Palace, P. Siwik, G. Sterling, R. Evans, C. Baron, J. Werner and K. Wautier. 2005. Developmental Effects of Bioaccumulated Selenium in Eggs and Larvae of Two Salmonid species. Environ. Toxicol. Chem. 24: 2373-2381.

Janz, D.M., D.K. Deforest, J.L. Brooks, P.M. Chapman, G. Gilron, D. Hoff, A. Hopkins, D.O. McIntyre, C.A. Mebane, V.P. Palace, J.P. Skorupa, and M. Wayland. 2010. Selenium toxicity to aquatic organisms. pp. 141-231. In: P. Chapman et al. (Eds.), Ecological Assessment of Selenium in the Aquatic Environment. CRC Press, Boca Raton, London, New York.

Luoma, S.N. and T.S. Presser. 2009. Emerging Opportunities in Management of Selenium Contamination. Environ. Sci. Technol. 43: 8483-8487.

Minnow Environmental Inc. (Minnow). 2011. Mount Polley Mining Corp. - Mount Polley Selenium Monitoring 2009/2010. March 2011.

MPMC (Mount Polley Mining Corporation). 2009. Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent. Report Prepared by the Mount Polley Mining Corporation. July 2009.

Ohlendorf, H.M., S.M. Covington, E.R. Byron, and C.A. Arenal. 2011. Conducting site-specific assessments of selenium bioaccumulation in aquatic systems. Integr. Environ. Assess. Manage. 7:314-324.

Orr, P.L., C.I.E. Wiramanaden, M.D. Paine, W. Franklin and C. Fraser. 2011. Food chain model based on field data to predict westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) ovary selenium concentrations from water selenium concentrations in the Elk Valley, BC. Environ. Toxicol. Chem. 31(3): 672-680.

Orr. P.L., Guiger, K.R., Russel, C.K. 2006. Food chain transfer of selenium in lentic and lotic habitats of a western Canadian watershed. Ecotox. Env. Saf. 63: 175-188.

Presser, T.S. and S.N. Luoma. 2010. A methodology for ecosystem-scale modeling of selenium. Int. Env. Assess. Manage. 6(4): 685-710.

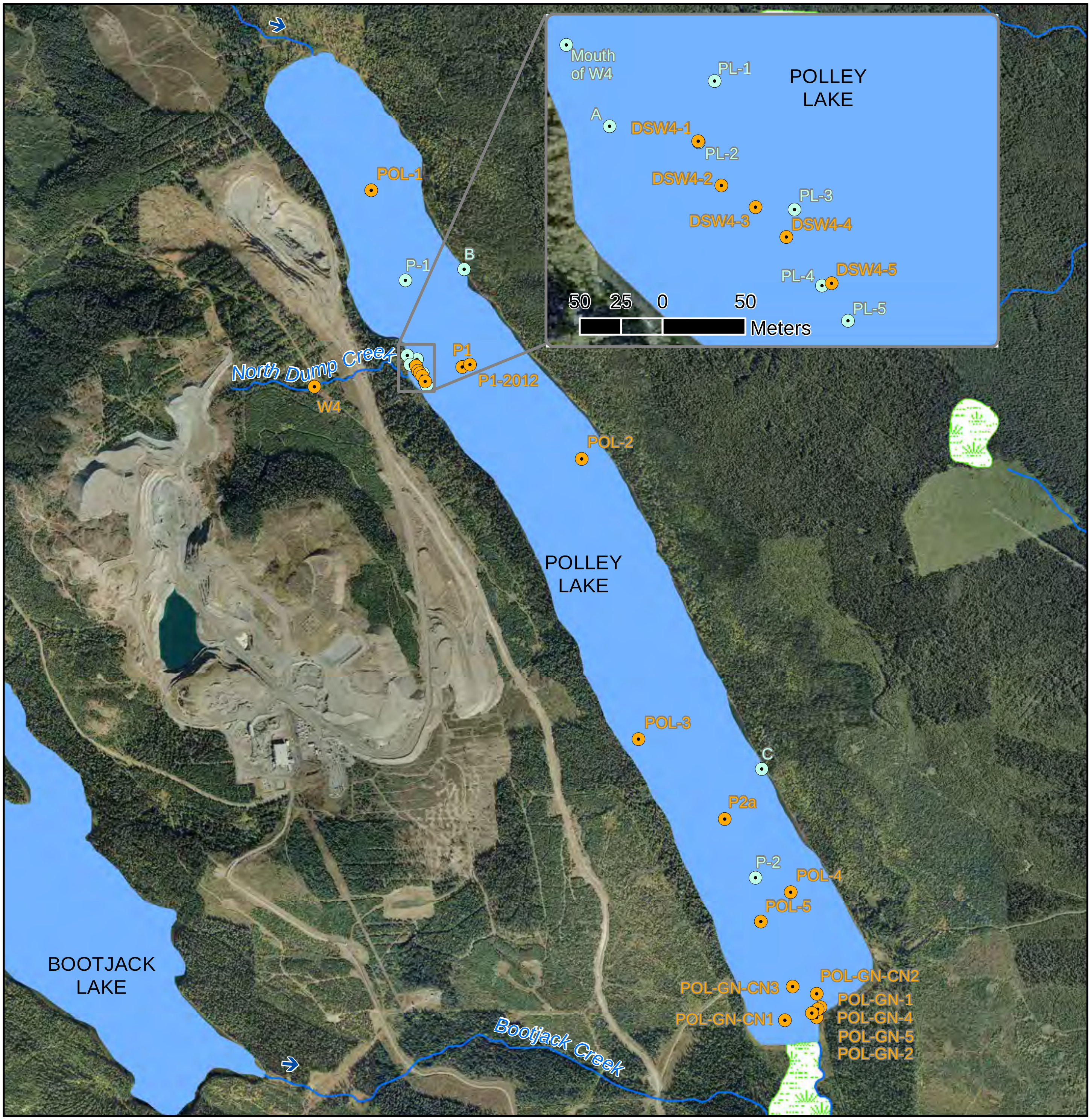
Stewart, R., M. Grosell, D. Buchwalter, N. Fisher, S. Luoma, T. Mathews, P. Orr, and W.-X. Wang. 2010. Bioaccumulation and trophic transfer of selenium. pp. 93-139. In: P. Chapman et al. (Eds.), Ecological Assessment of Selenium in the Aquatic Environment. CRC Press, Boca Raton, London, New York.

Wiramanaden, C. Forster, E.L, and Liber, K. 2010. Selenium distribution in a lake system receiving effluent from a metal mining and milling operation in Northern Saskatchewan, Canada. Environ. Toxicol. Chem. 29(3): 606-616.

Young, T.F., K. Finley, W.J Adams. J. Besser, W.D. Hopkins, D. Jolley, E. McNaughton, T.S. Presser, D.P. Shaw and J. Unrine. 2010. What You Need to Know about Selenium. pp. 7-45. In: P. Chapman et al. (Eds.), Ecological Assessment of Selenium in the Aquatic Environment. CRC Press, Boca Raton, London, New York.

APPENDIX A

SAMPLING LOCATIONS



N
W E
S

500 250 0 500
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

Features

- 2012 Sample Site
- 2009/2010 Sample Site
- Water Flow Direction
- Lake
- Wetland
- Creek

Figure A.1: Polley Lake and North Dump Creek Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.

N
W E
S

500 250 0 500
Meters

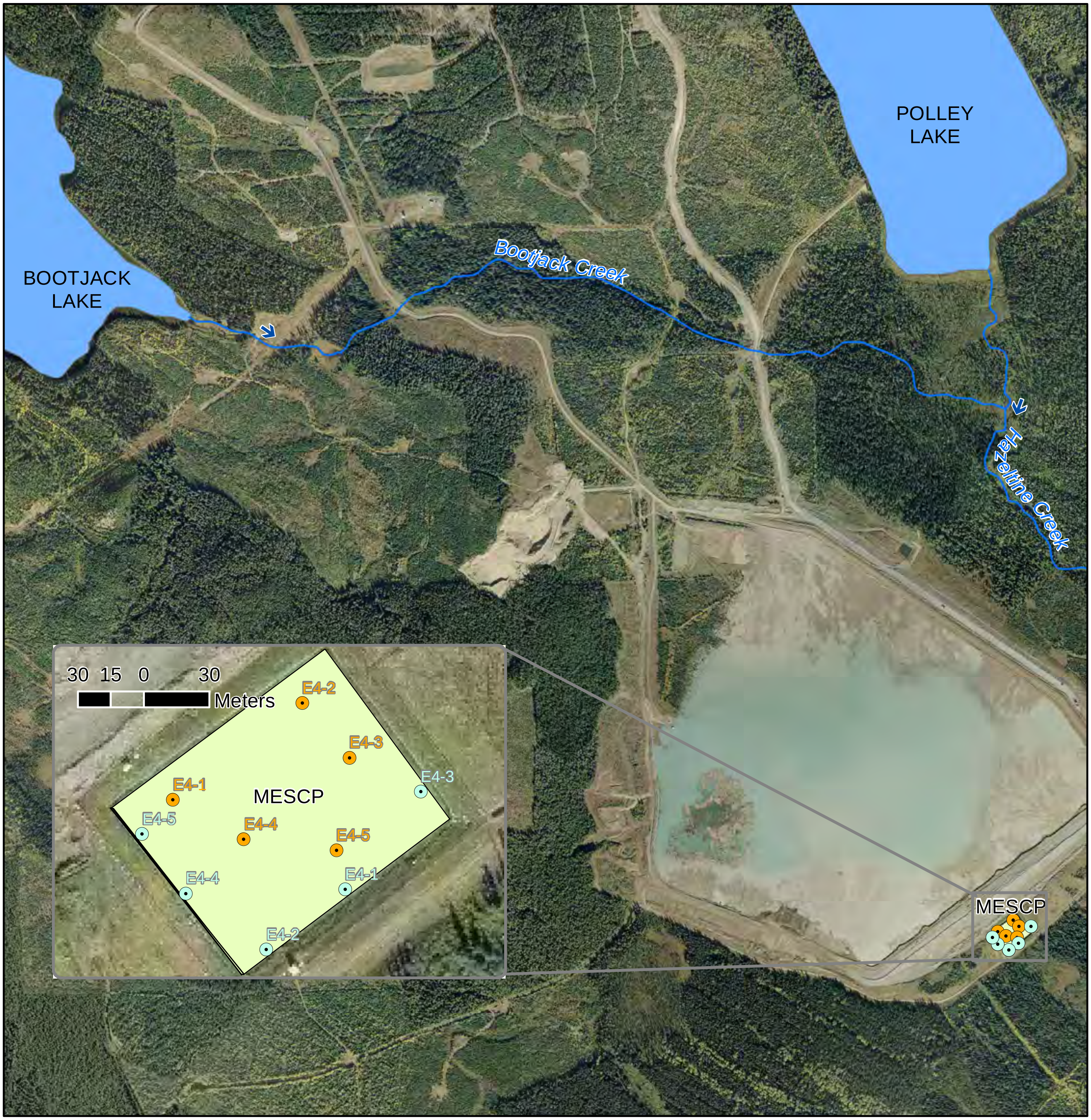
MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

Features

- 2012 Sample Site
- 2009-2012 Sample Site
- Water Flow Direction
- Contour (15m interval)
- Collection Pond
- Lake
- Wetland
- Creek
- Road

Figure A.2: Hazeltine Creek and Edney Creek Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:
minnow environmental inc.



N
W E
S

500 250 0 500
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

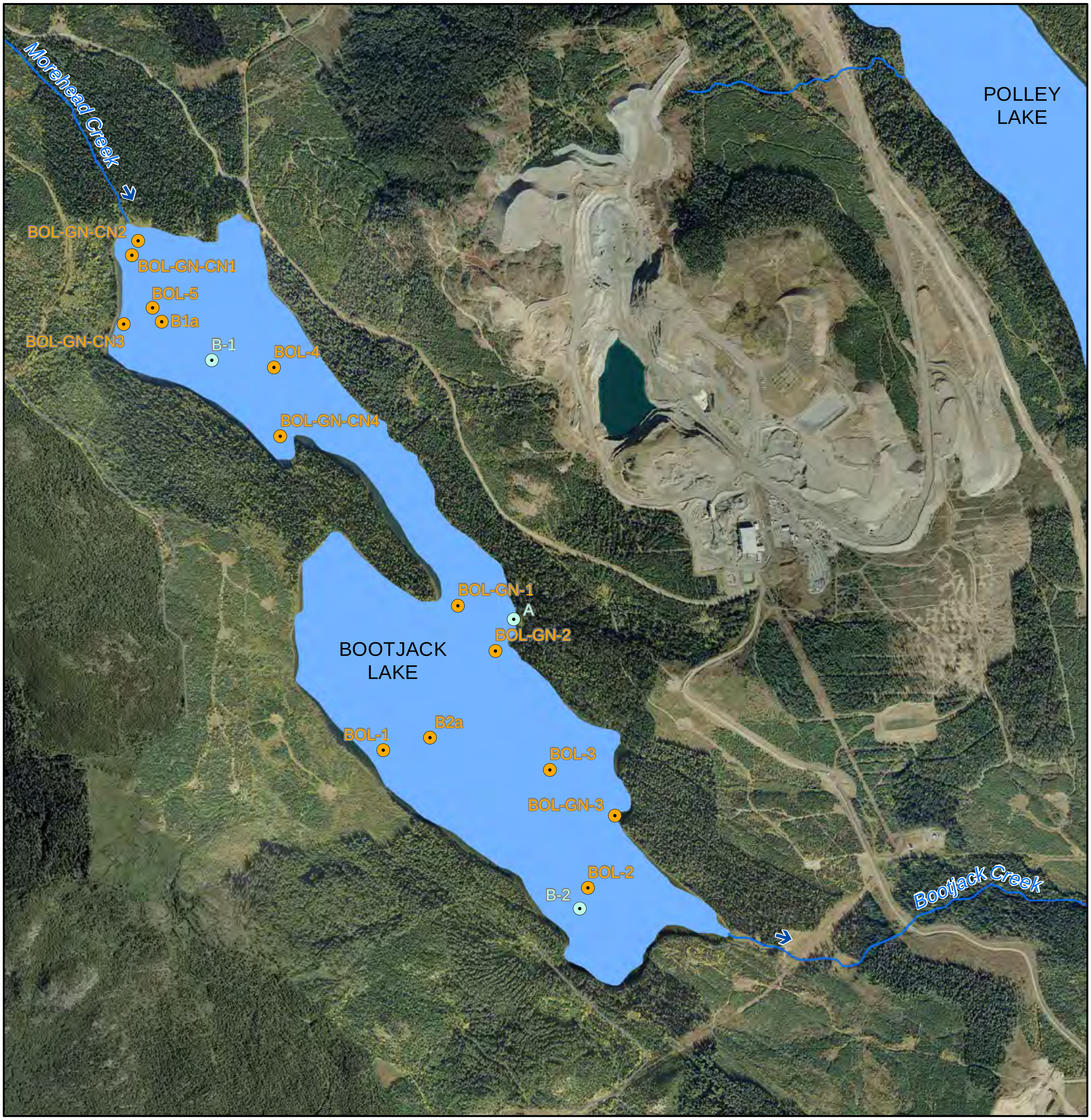
Features

- 2012 Sample Site
- 2009/2010 Sample Site
- Water Flow Direction
- Collection Pond
- Lake
- Creek

Figure A.3: Main Embankment Seepage Collection Pond (MESCP) Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.



N
W E
S

500 250 0 500
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

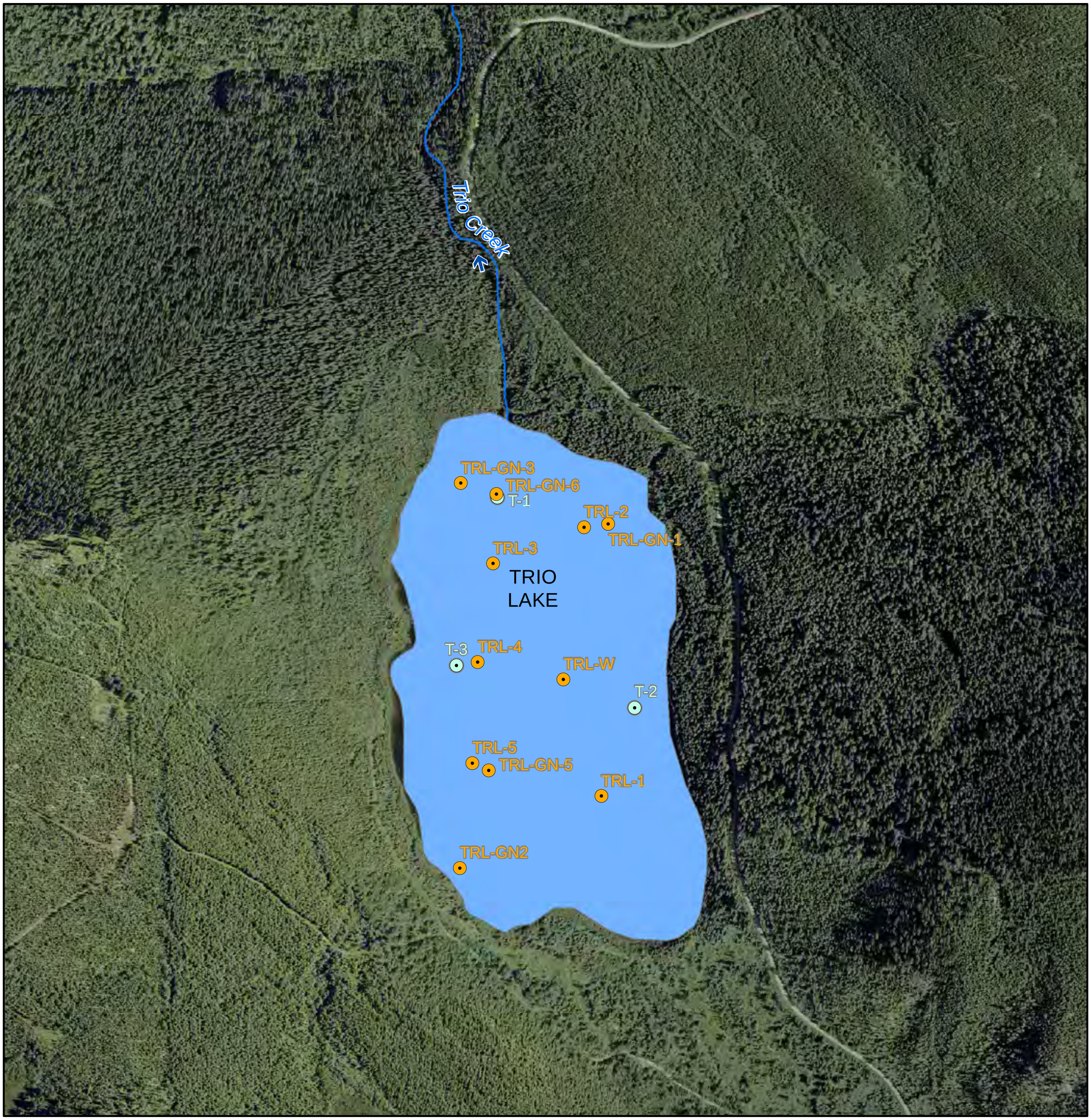
Features

- 2012 Sample Site
- 2009/2010 Sample Site
- Water Flow Direction
- Lake
- Wetland
- Creek

Figure A.4: Bootjack Lake Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.



N
W E
S

200 100 0 200
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

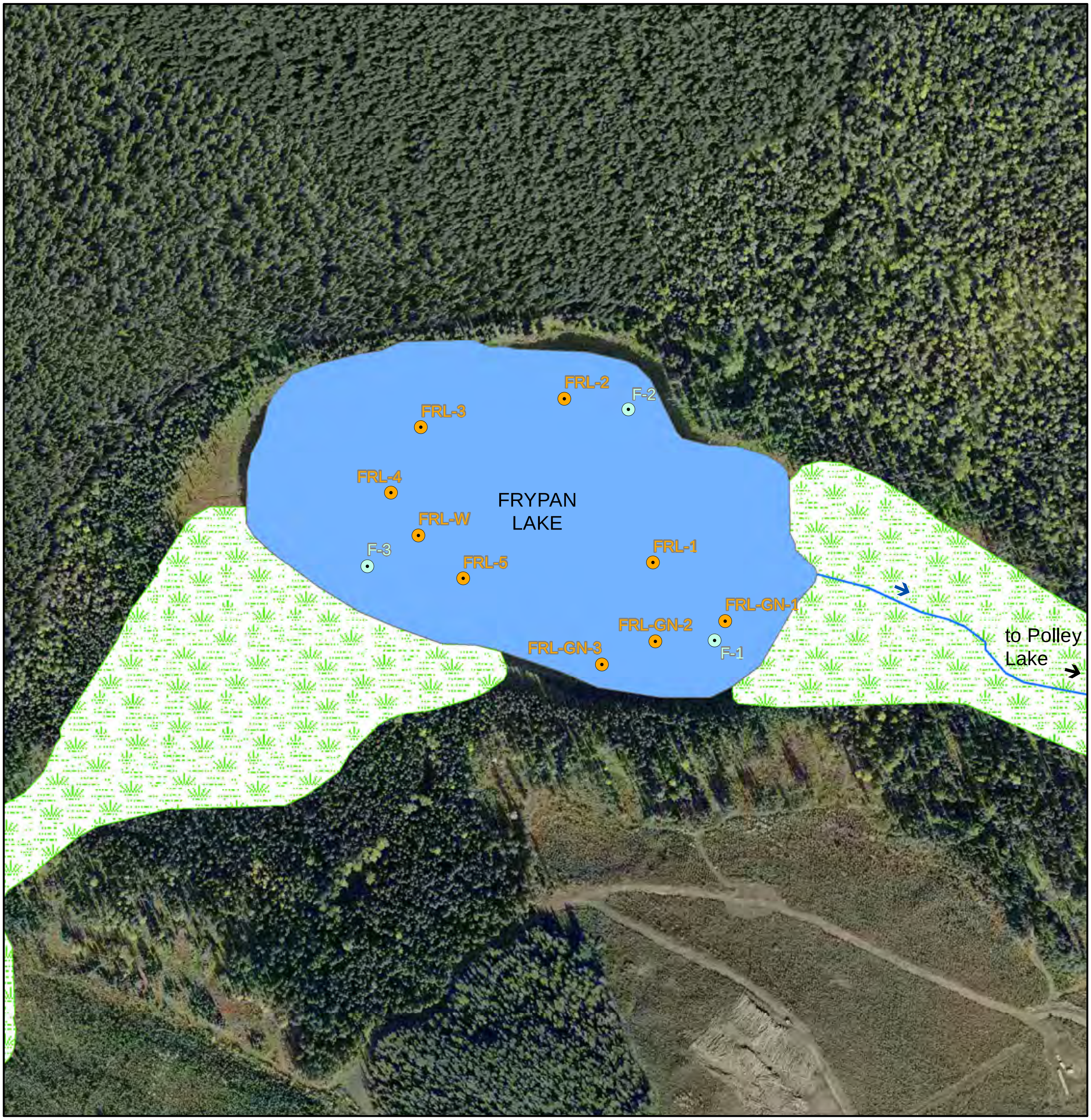
Features

- 2012 Sample Site
- 2009/2010 Sample Site
- Water Flow Direction
- Lake
- Wetland
- Creek

Figure A.5: Trio Lake Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.



N
W E
S

100 50 0 100
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

Features

- 2012 Sample Site
- 2009/2010 Sample Site
- Water Flow Direction
- Lake
- Wetland
- Creek

Figure A.6: Frypan Lake Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.

N
W E
S

500 250 0 500
Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

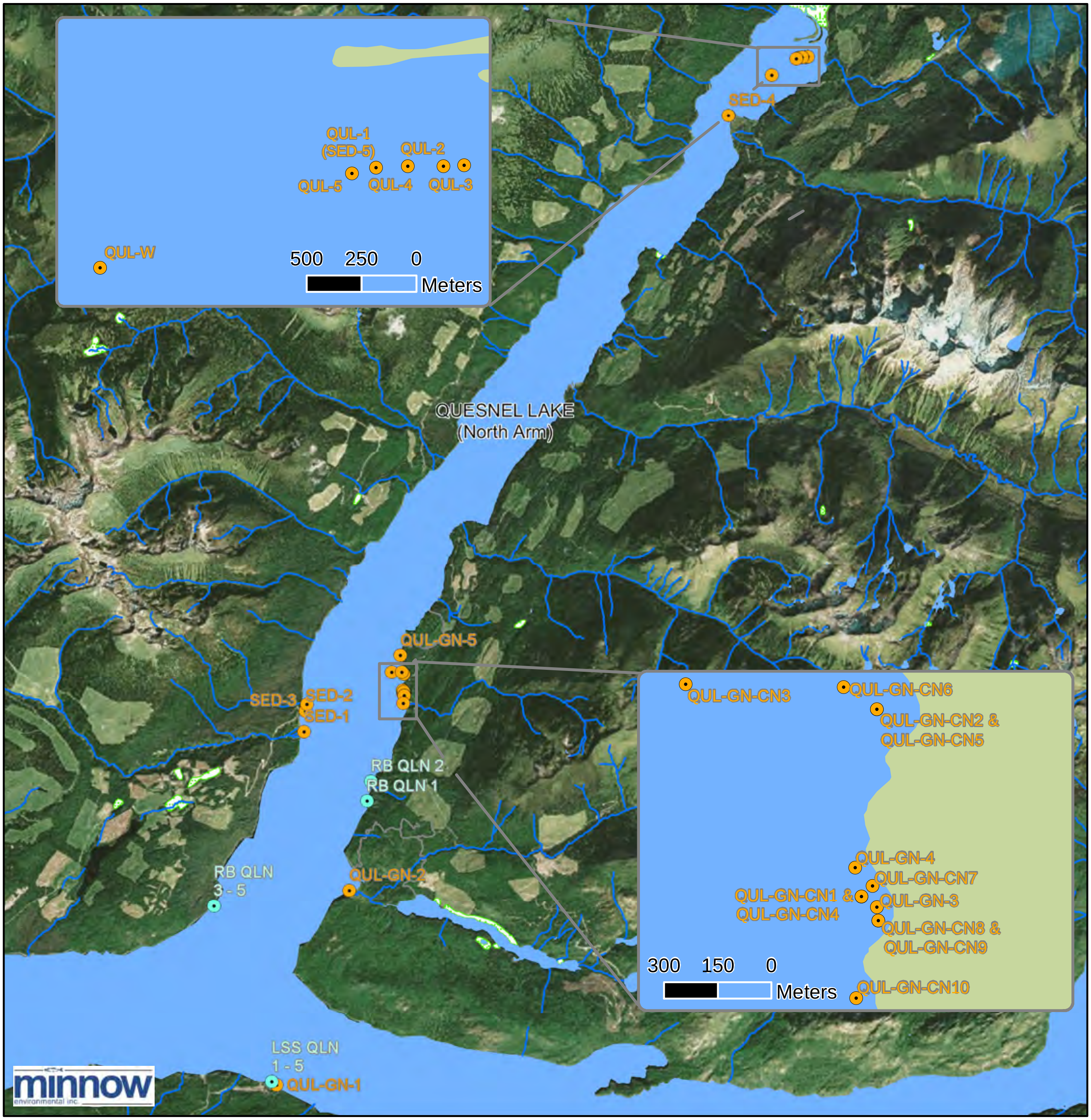
Features

- 2012 Sample Site
- 2009/2010 Sample SIte
- Water Flow Direction
- Lake
- Wetland
- Creek

Figure A.7: Quesnel Lake (at mouth of Hazeltine Creek) Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.



N
W E
S

5,000 2,500 0 Meters

MAP INFORMATION
Map Projection: NAD 1983
Data Source: Department of Natural Resources Canada. All rights reserved.
Created By: J.Wilson
Creation Date: March 2013
Project No.: 2450

Features

- 2012 Sample Sites
- 2009/2010 Sample Site
- Water Flow Direction
- Lake
- Wetland
- River/Creek

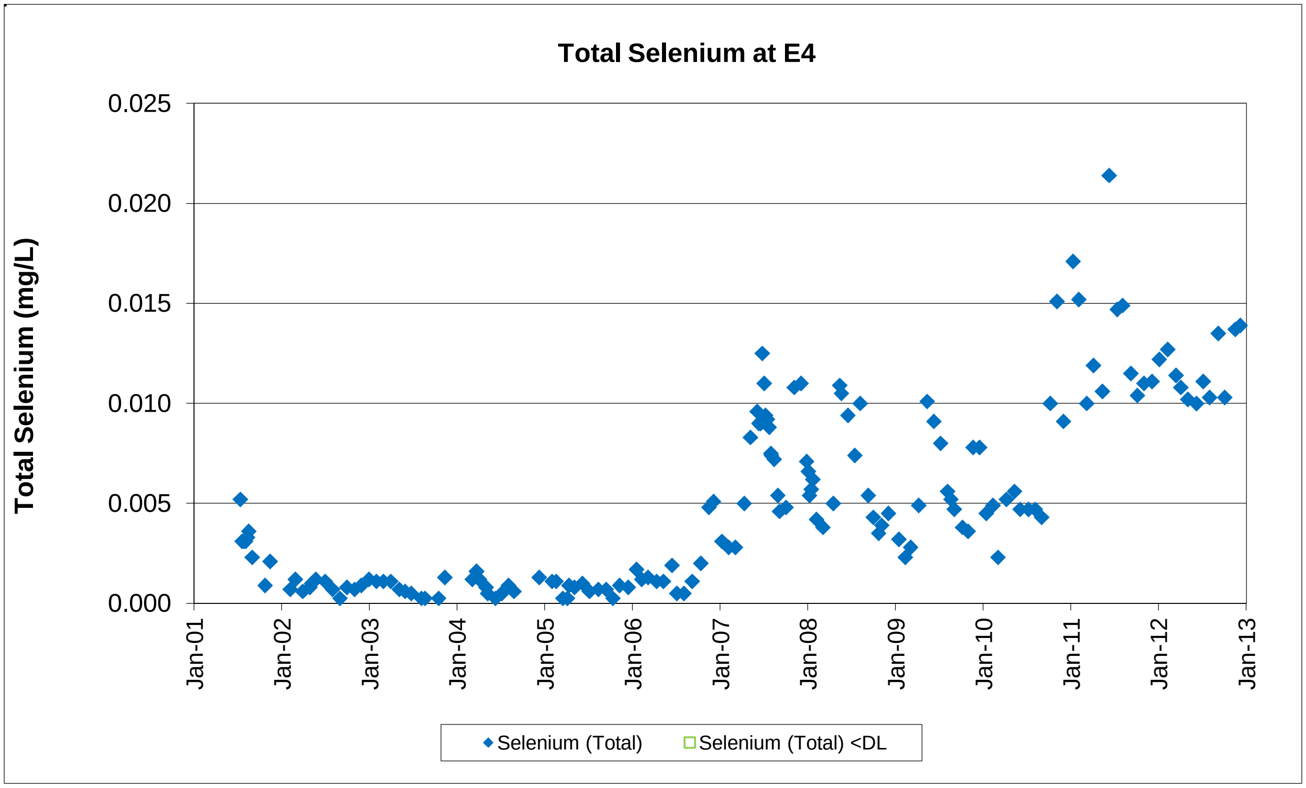
Figure A.8: Quesnel Lake (North Arm) Sampling Sites for the Mount Polley Selenium Monitoring Program

Created by:

minnow environmental inc.

APPENDIX B

SELENIUM DATA



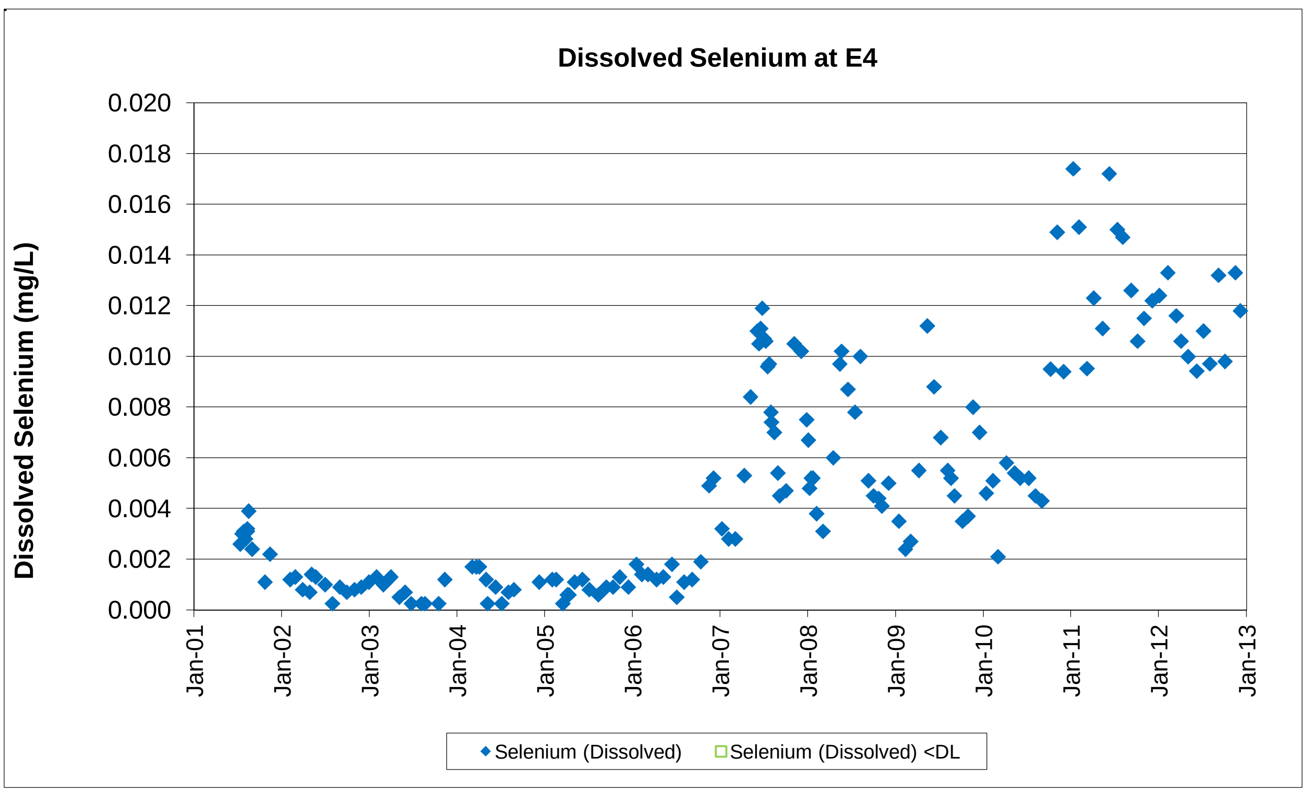
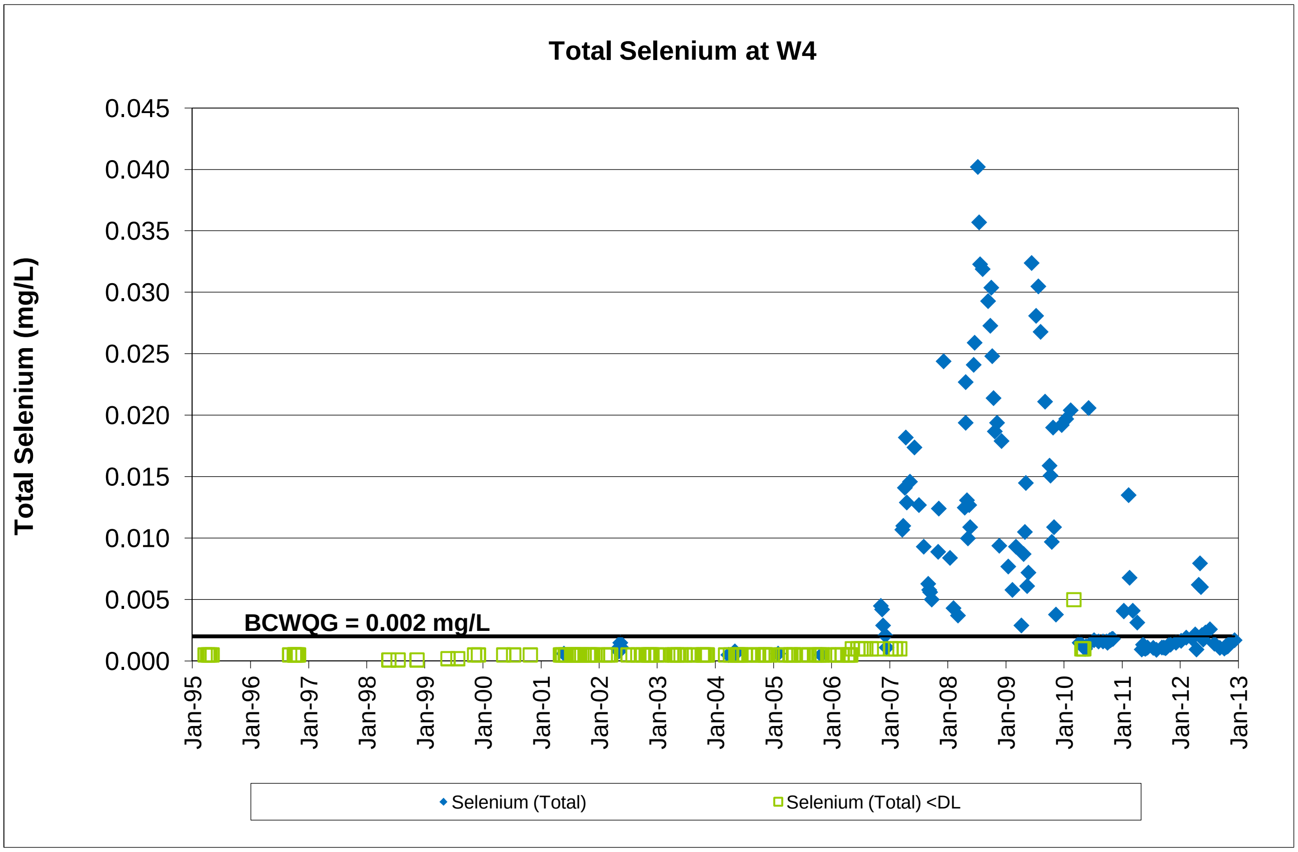


Figure B.1: Aqueous selenium concentrations in the Main Embankment Seepage Collection Pond, 2001-2012.



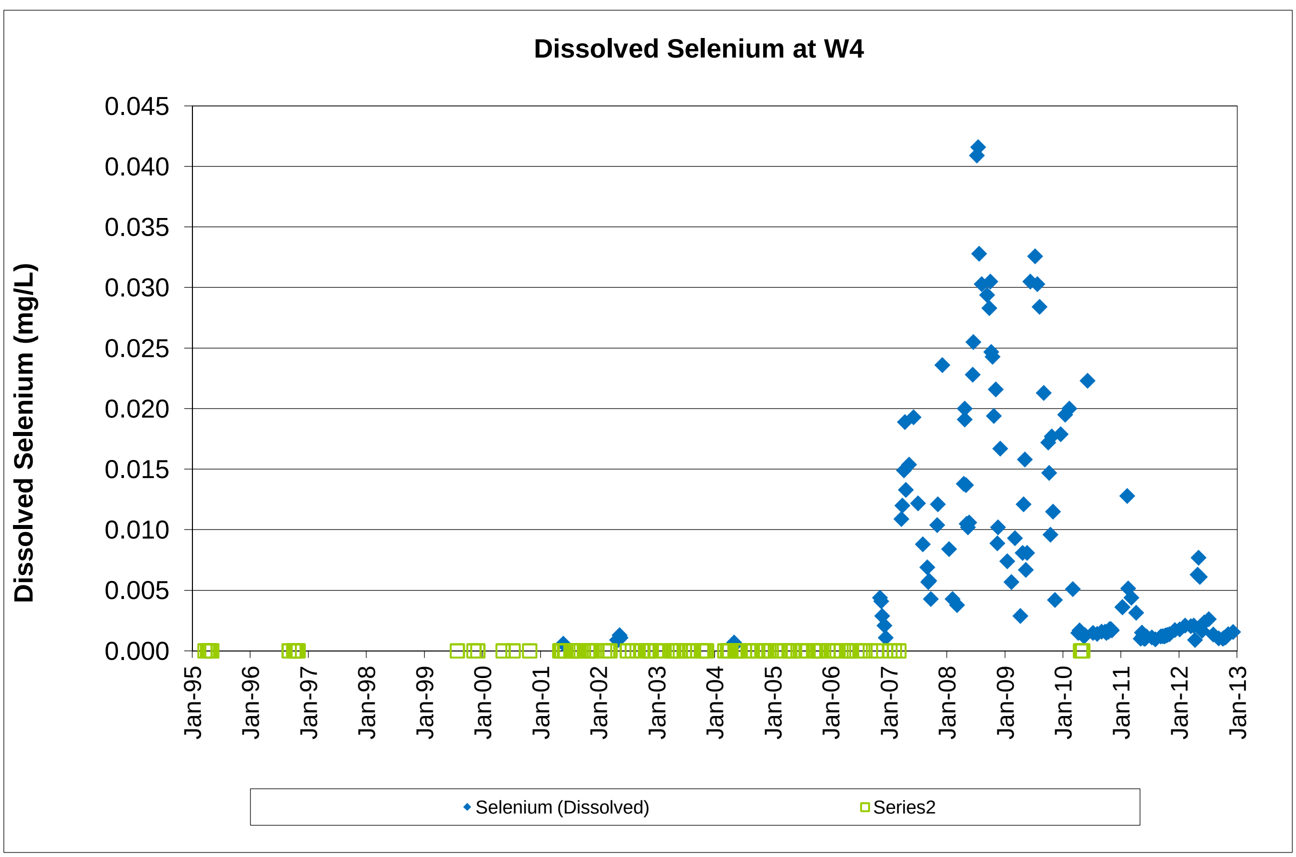
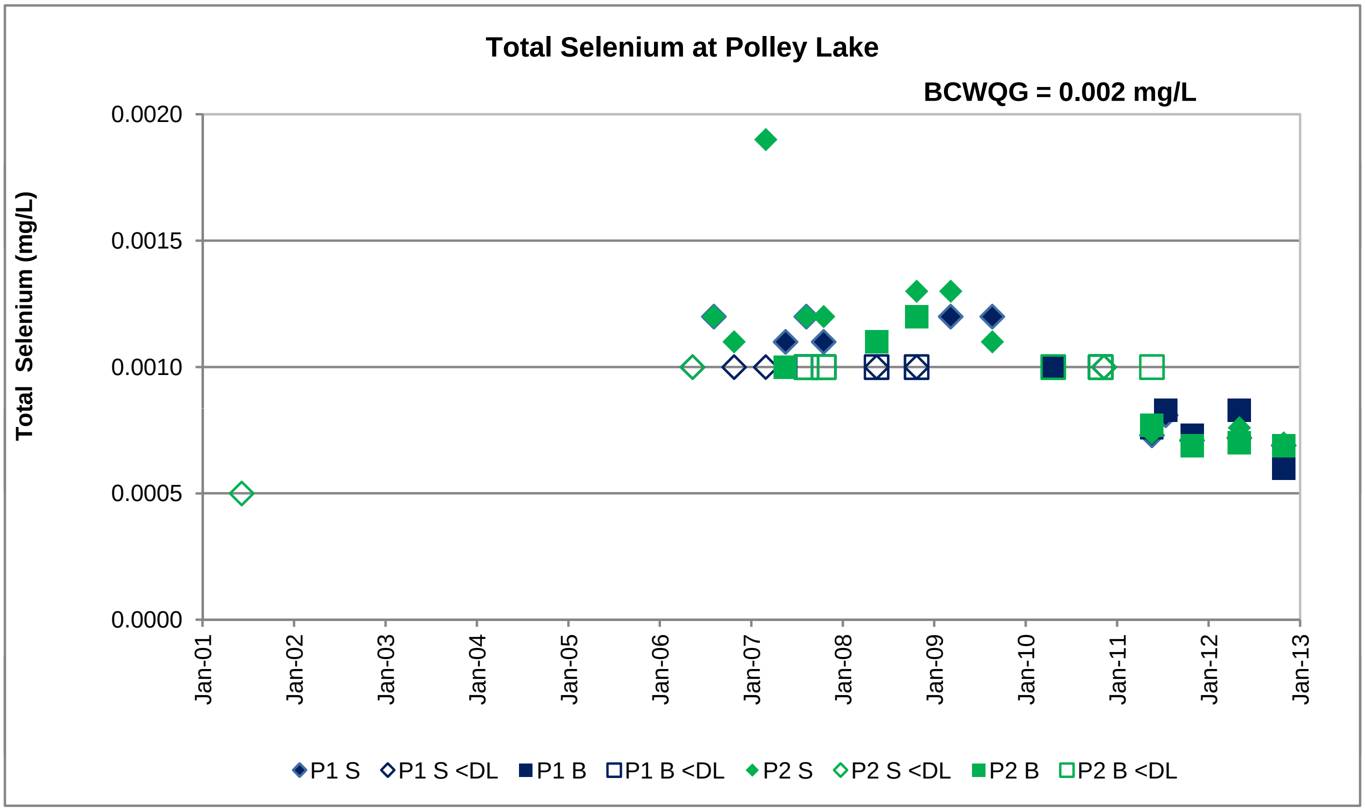


Figure B.2: Aqueous selenium concentrations in North Dump Creek, 1995-2012.



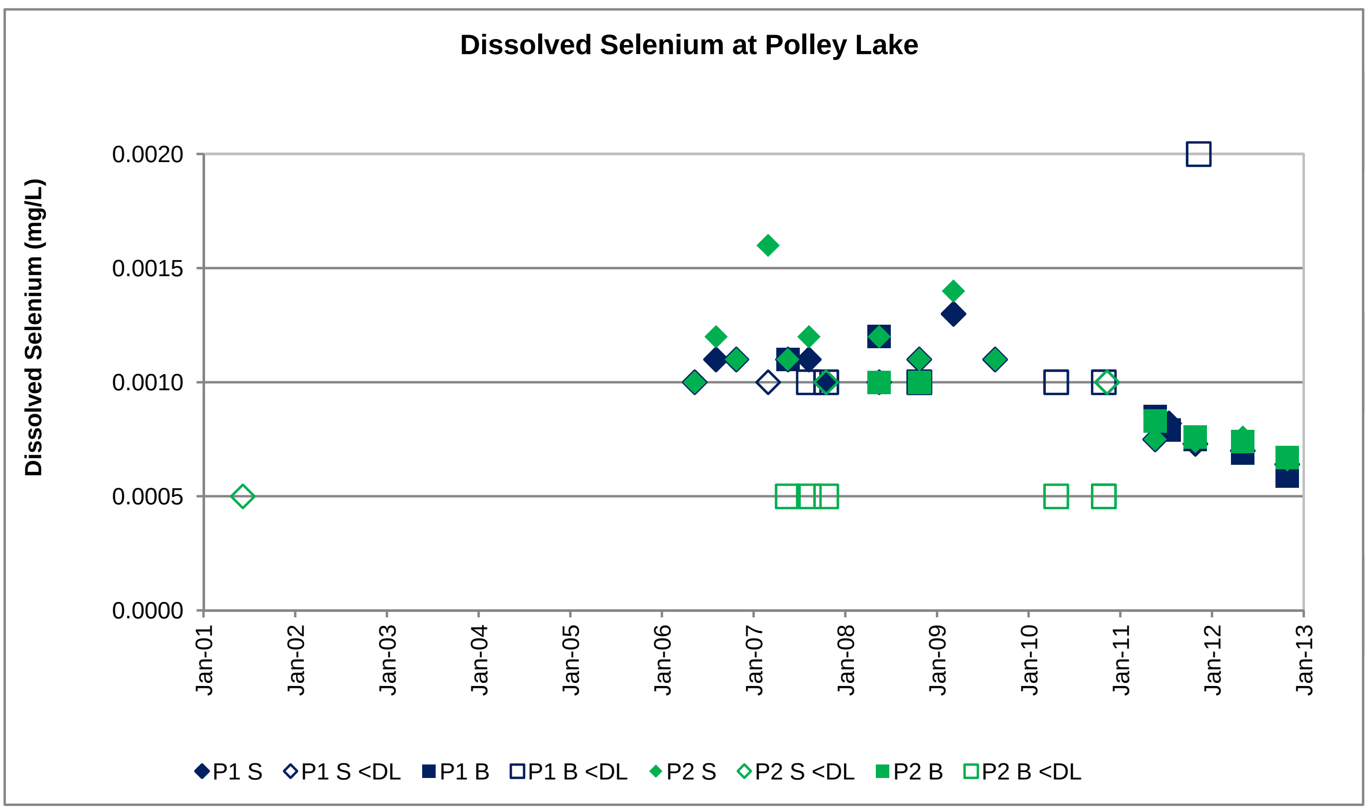
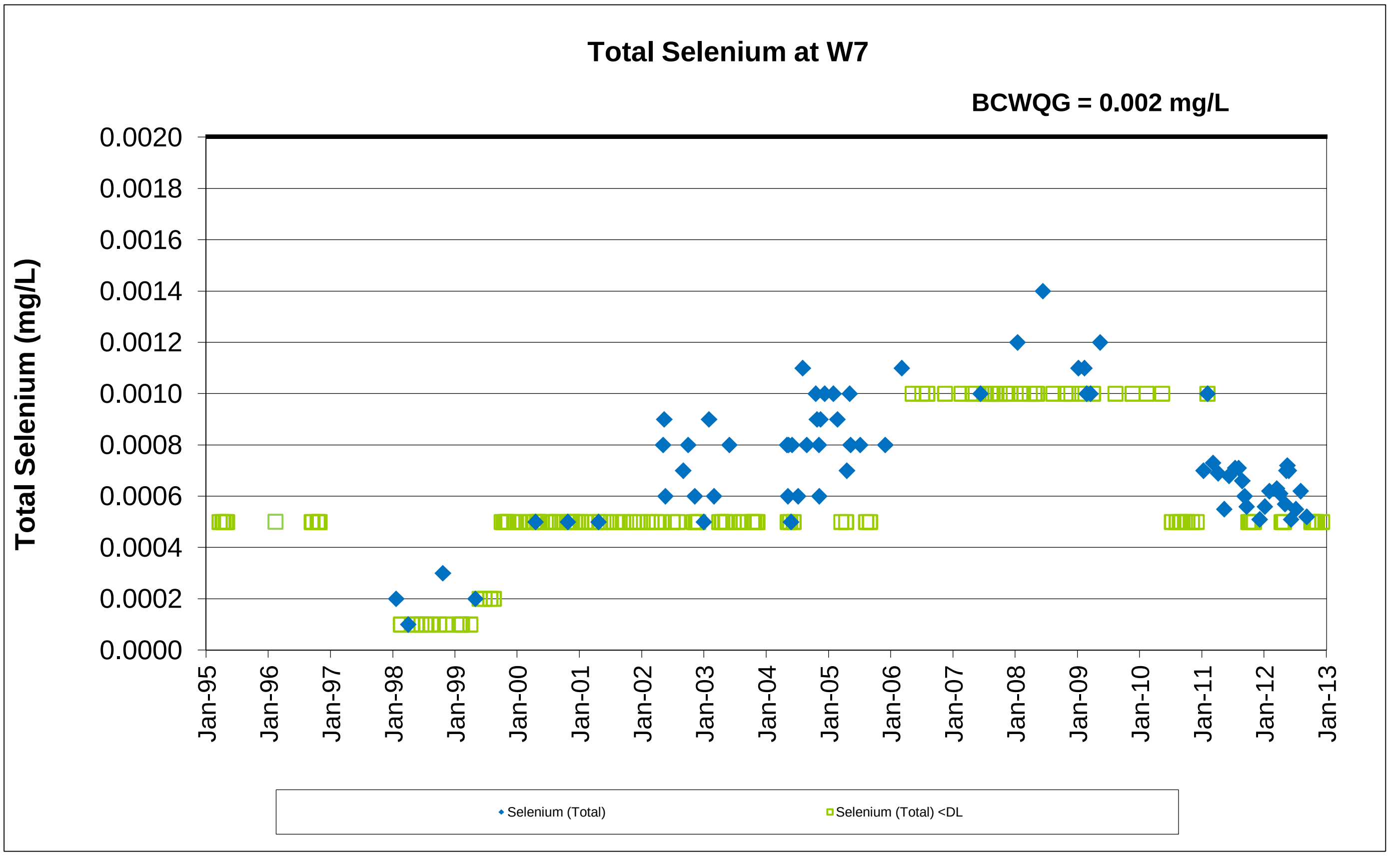


Figure B.3: Aqueous selenium concentrations in Polley Lake, 2001-2012.



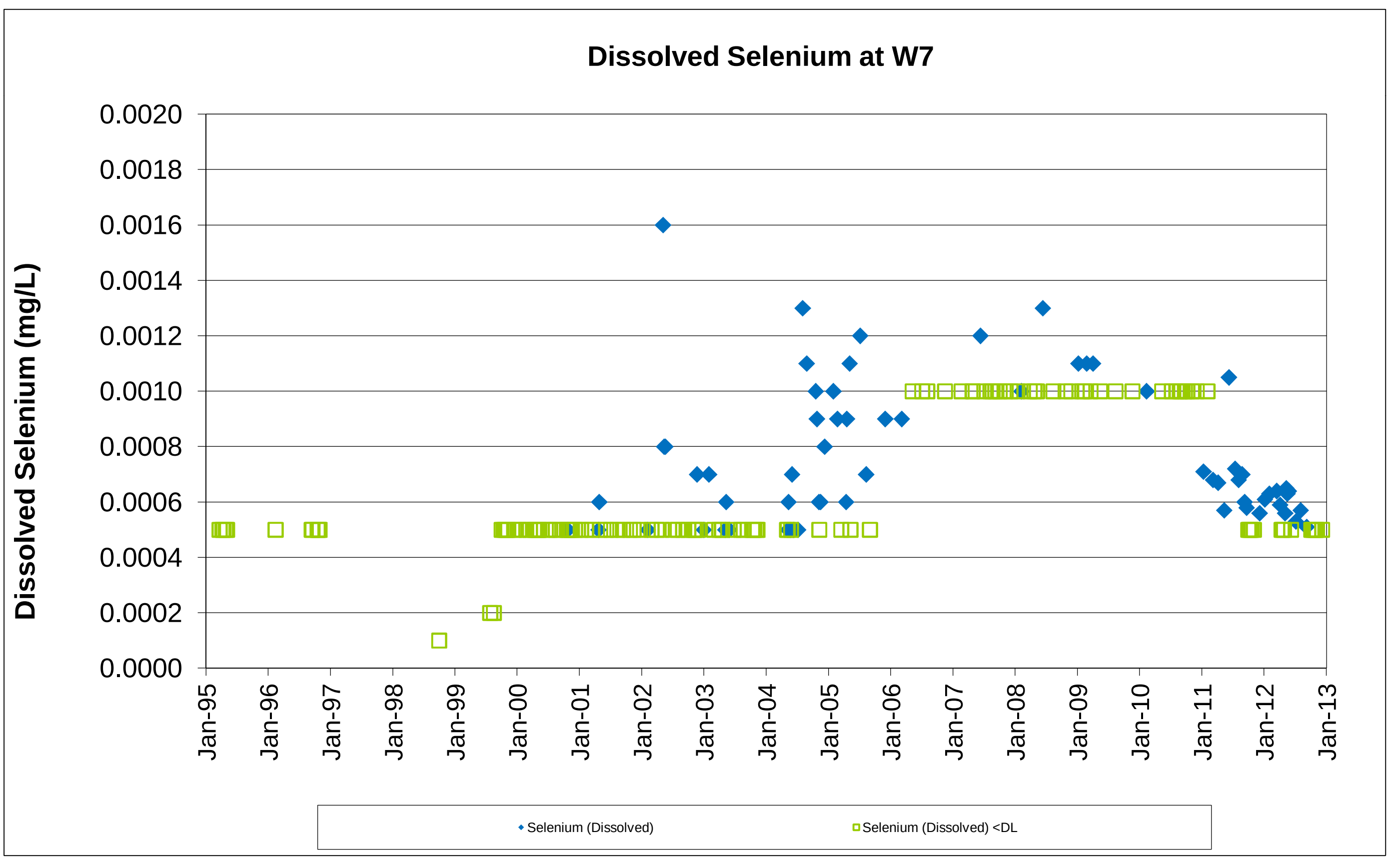
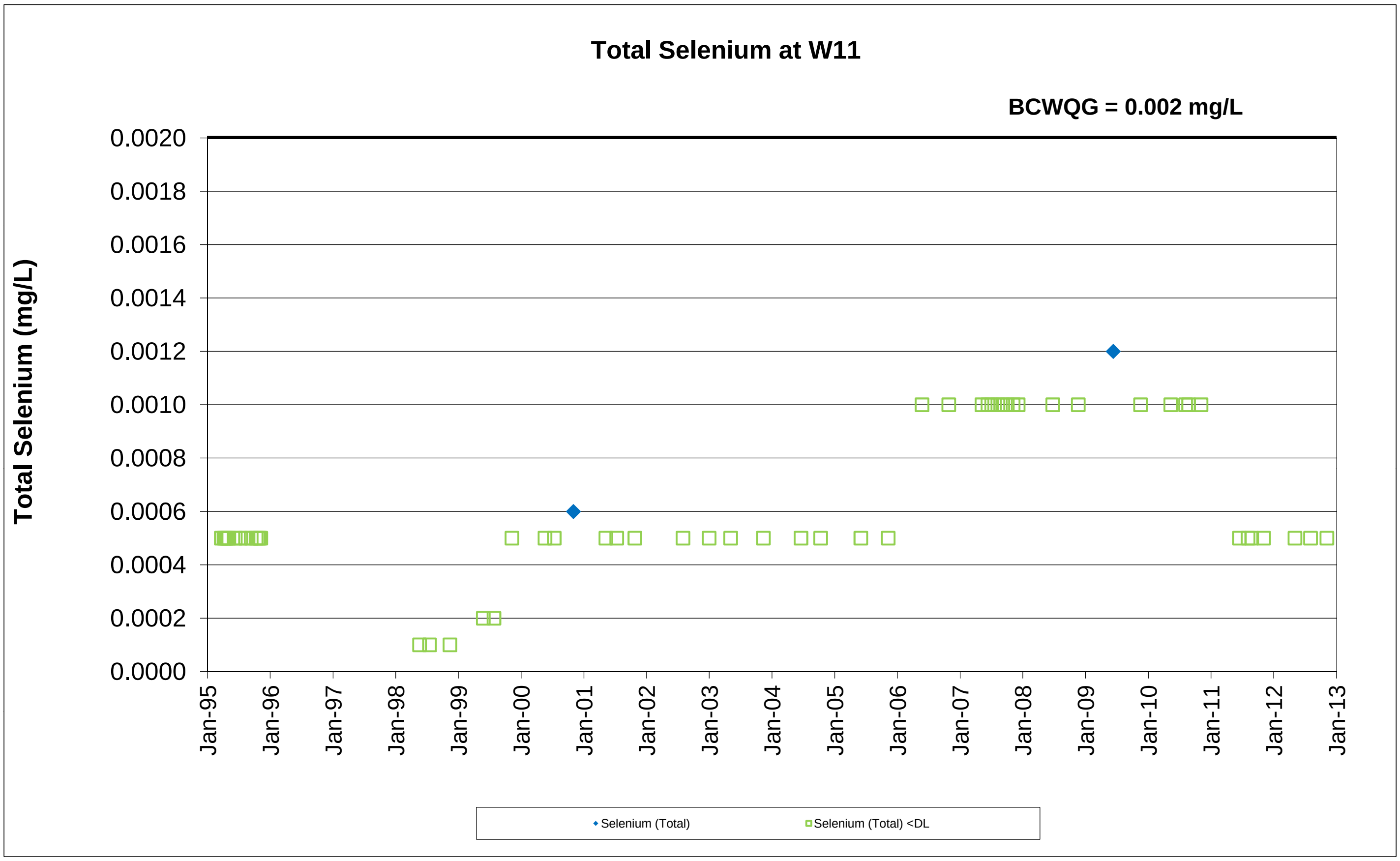


Figure B.4: Aqueous selenium concentrations in Upper Hazeltine Creek, 1995-2012.



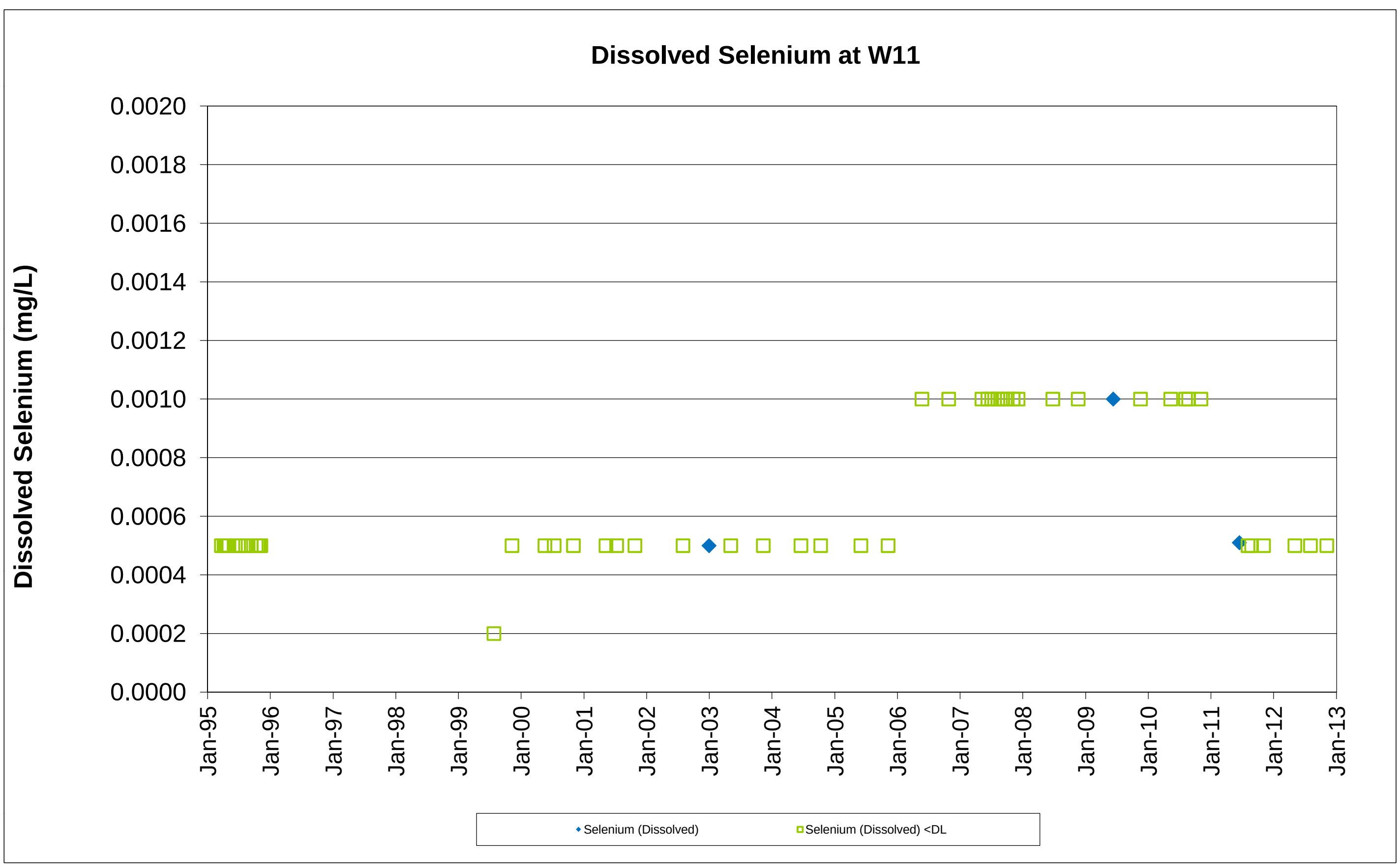
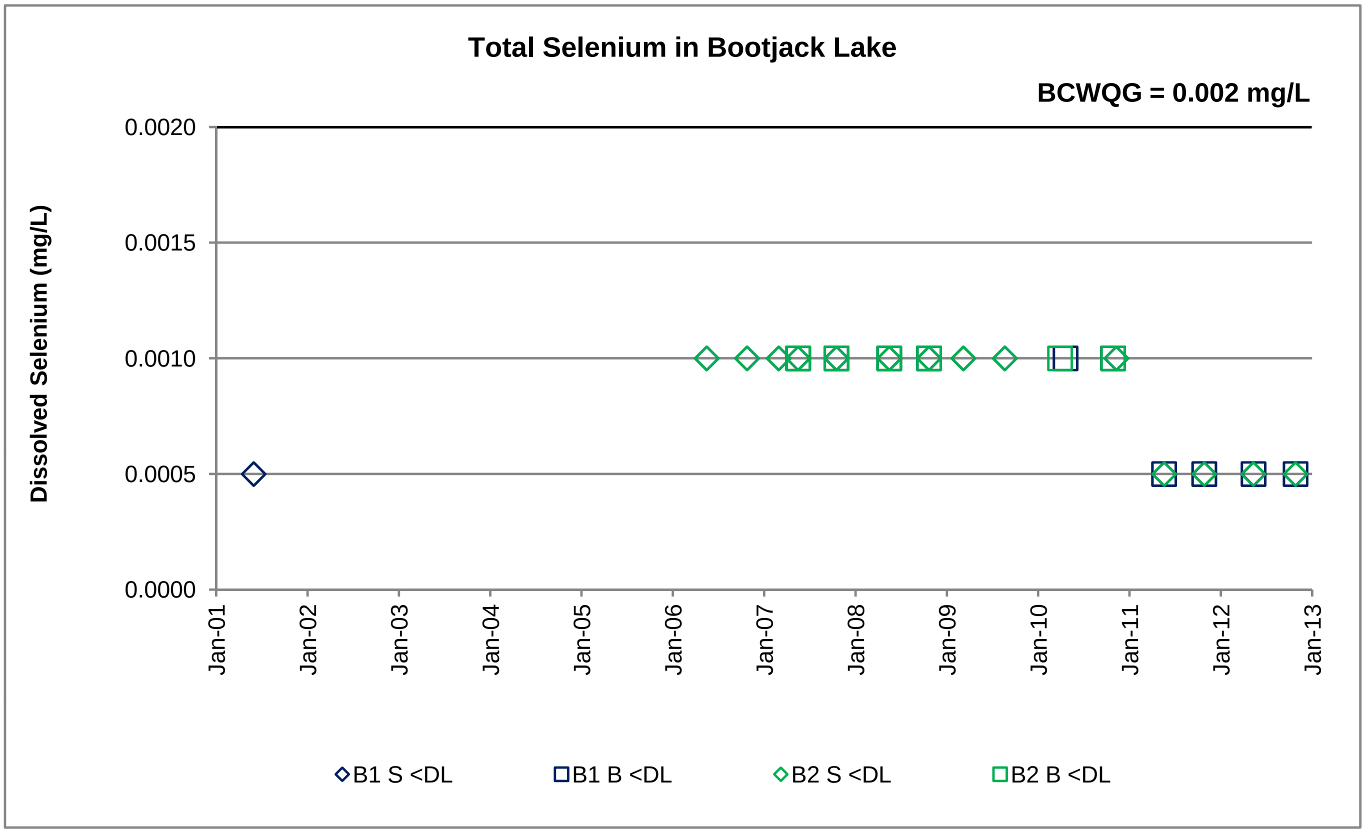


Figure B.5: Aqueous selenium concentrations in Lower Hazeltine Creek, 1995-2012.



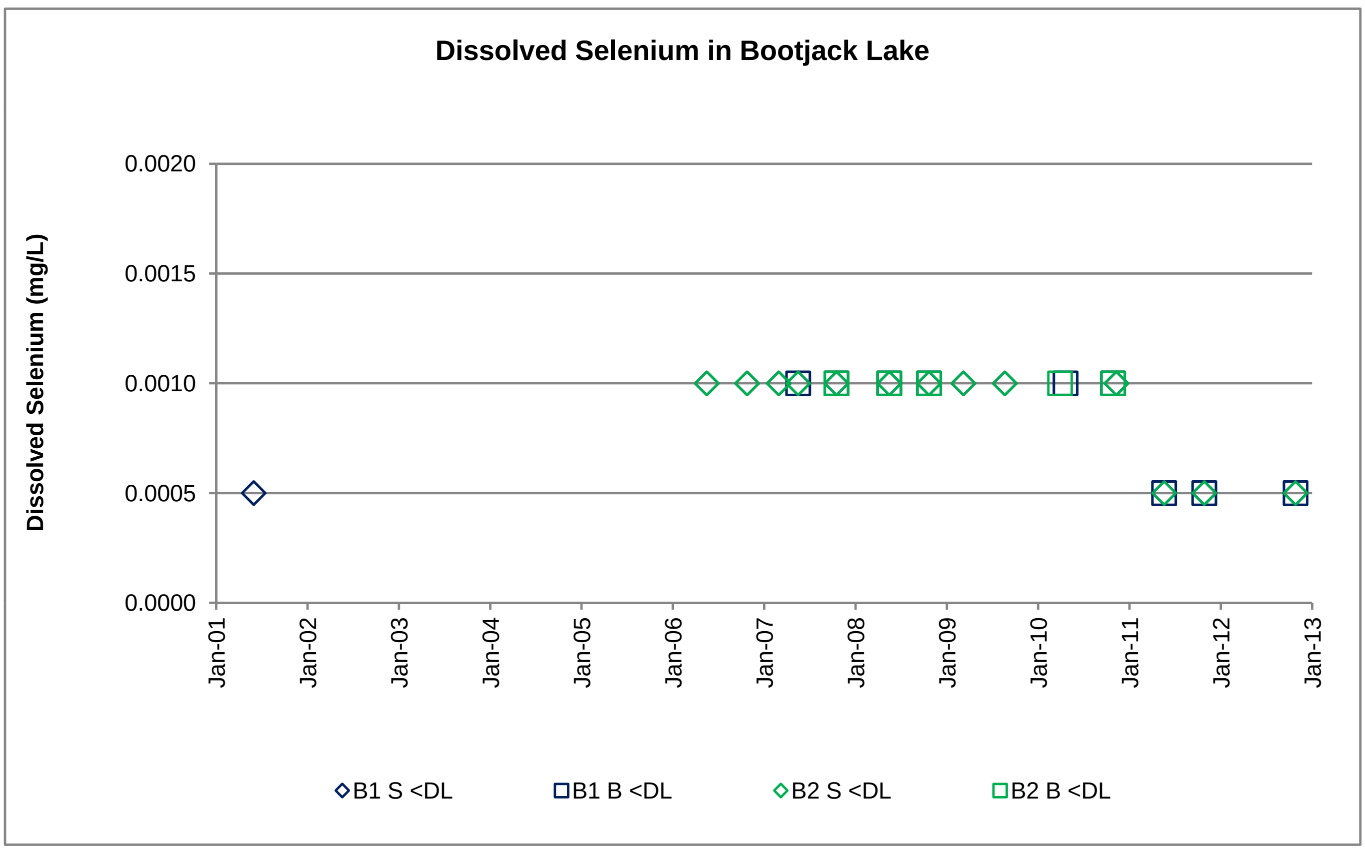
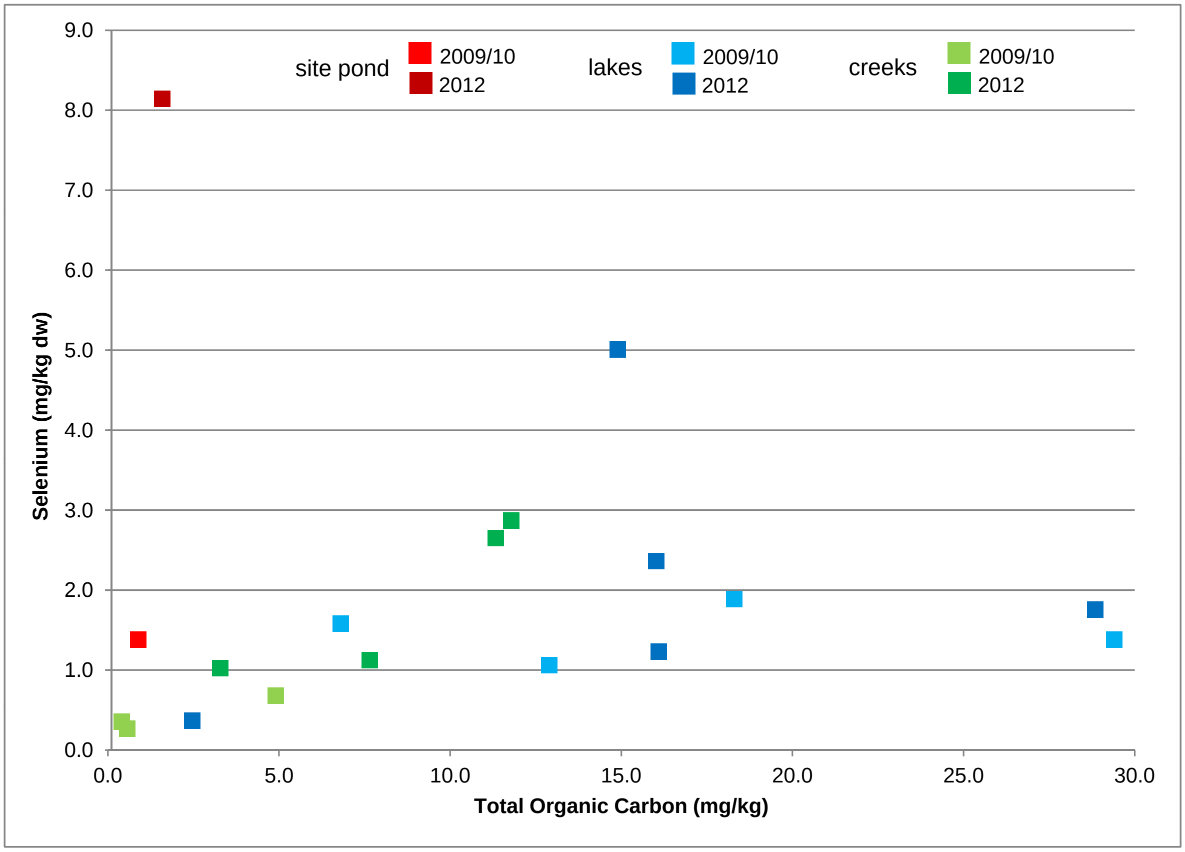


Figure B.6: Aqueous selenium concentrations in Bootjack Lake, 2001-2012.

a) Area mean values



b) Station values

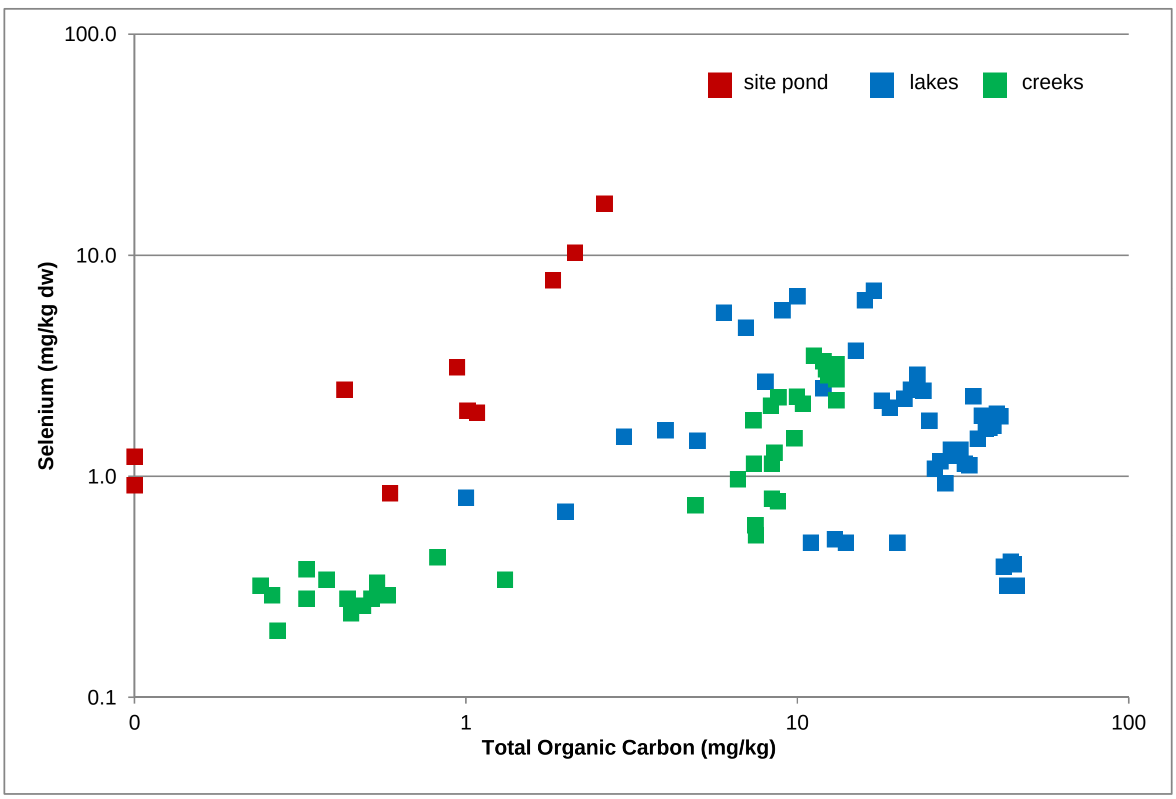


Figure B.7: Relationship between sediment selenium and sediment total organic carbon, Mount Polley Selenium Monitoring, 2009/2010 and 2012.

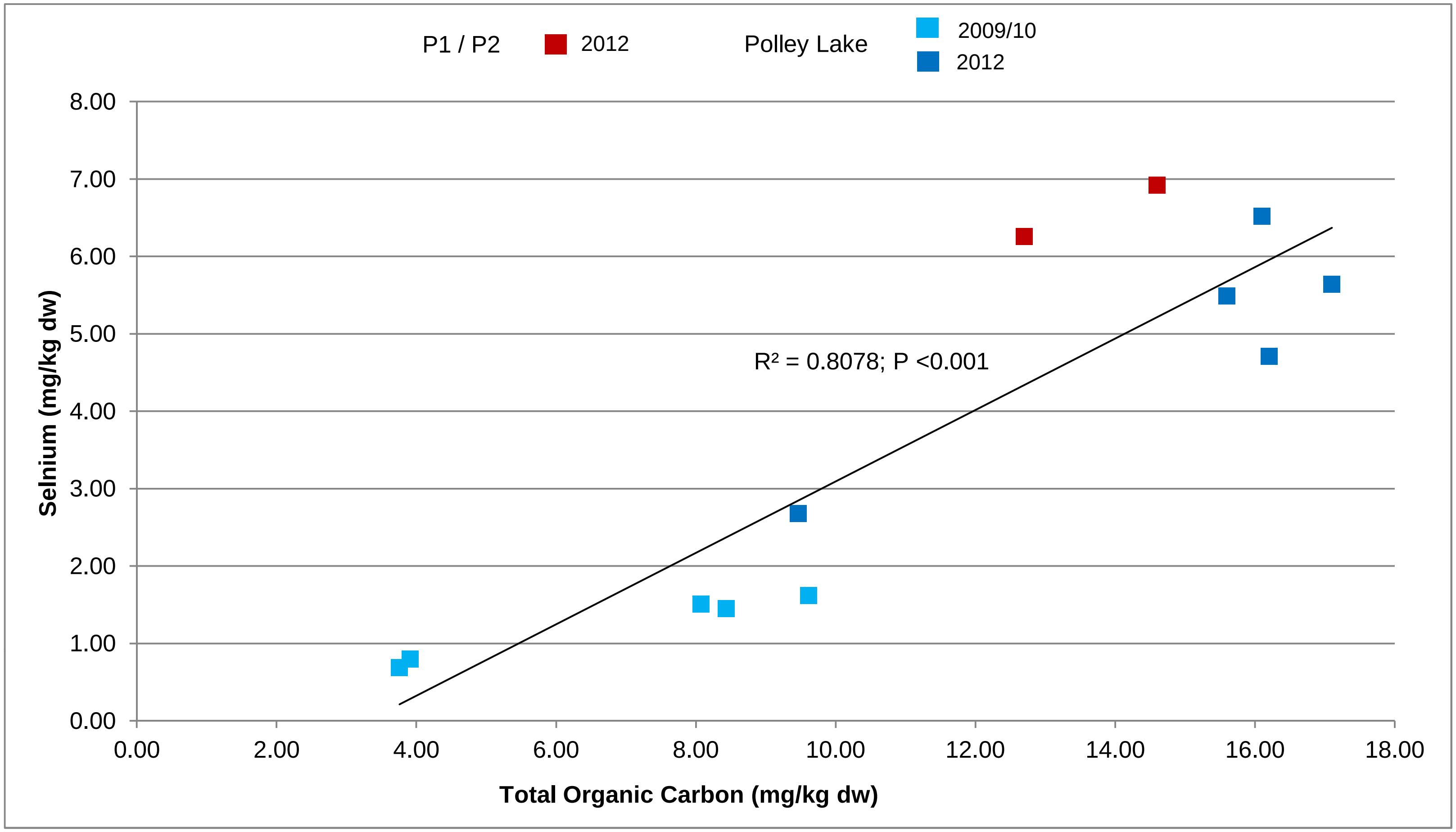


Figure B.8: Relationship between sediment selenium concentration and sediment total organic carbon from Polley Lake, Mount Polley 2009/2010 and 2012.

Table B.1: Mean selenium concentrations by location - Mount Polley selenium monitoring 2009/2010 and 2012 [1].

Compartment	Units	Period	Polley Lake	Upper Hazeltine Creek	Upper Hazeltine Creek Pond	Lower Hazeltine Creek	Hazeltine Creek Delta at Quesnel Lake	Upper Edney Creek	Main Embankment Seepage Collection Pond	North Dump Creek	North Dump Creek Delta at Polley Lake	Bootjack Lake	Trio Lake	Frypan Lake	Quesnel Lake - North Arm
			PL	W7	W7 (pond)	W11	DSW11	W8	E4	W4	DSW4	BL	TL	FL	QL
Water - dissolved	mg/L	Mean	0.0007 (0.00006) [22]	0.00064 (0.0001) [39]	-	<0.0005 [7]	-	-	0.0123 (0.0023) [24]	0.0023 (0.0023) [42]	-	<0.0005 [16]	×	×	×
	mg/L	Maximum	0.00085 [22]	0.0011 [39]	-	<0.0005 [7]	-	-	0.018 [24]	0.013 [42]	-	<0.0005 [16]	×	×	×
Water - total	mg/L	Mean	0.0007 (0.00005) [22]	0.0006 (0.00004) [39]	-	<0.0005 [7]	-	0.0005 [1]	0.0125 (0.0027) [24]	0.0024 (0.0024) [42]	-	<0.0005 [16]	×	0.0005 [1]	×
	mg/L	Maximum	0.00083 [22]	0.0007 [39]	-	<0.0005 [7]	-	-	0.021 [27]	0.014 [42]	-	<0.0005 [16]	×	×	×
Sediment	mg/kg dw	Spring 2009 [2]	1.2 (0.4) [5]	0.8 (0.2) [5]	-	-	-	-	1.4 (0.5) [5]	-	0.4 (0.1) [5]	-	-	-	-
	mg/kg dw	Fall 2009 [2]	1.5 (1.5) [5]	-	-	-	-	-	-	-	-	1.6 (0.9) [2]	1.1 (0.1) [2]	1.9 (0.4) [2]	-
	mg/kg dw	Fall 2010 [2]	-	0.6 (0.7) [5]	-	-	0.27 (0.05) [5]	-	-	-	-	-	-	-	-
	mg/kg dw	Spring 2012 [3]	5.0 (1.5) [5]	-	-	-	-	-	8.1 (6.0) [5]	-	1.0 (0.4) [5]	2.4 (0.4) [5]	1.2 (0.1) [5]	1.8 (0.1) [5]	0.4 (0.04) [5]
	mg/kg dw	Fall 2012 [3]	-	-	2.7 (0.6) [8]	-	1.1 (0.3) [5]	2.9 (0.4) [5]	-	-	-	-	-	-	-
Periphyton	mg/kg dw	Fall 2010	-	4.8 (1.2) [5]	-	1.4 (0.2) [5]	-	-	-	-	-	-	-	-	-
	mg/kg dw	Fall 2012	-	4.4 (0.7) [8}	-	3.06 (0.3) [5]	-	5.8 (1.1) [5]	-	4.8 [1]	-	-	-	-	-
Benthos - erosional	mg/kg dw	Spring 2009	-	4.5 (2.2) [5]	-	-	-	-	-	5.7 (0.8) [5]	-	-	-	-	-
	mg/kg dw	Fall 2010	-	10.9 (0.7) [5]	-	3.5 (0.2) [5]	-	-	-	-	-	-	-	-	-
	mg/kg dw	Fall 2012	-	4.4 (0.7) [8]	-	2.2 (0.3) [5]	-	5.7 (2.4) [5]	-	6.3 (1.5) [5]	-	-	-	-	-
Benthos - depositional	mg/kg dw	Spring 2009	7.8 (1.9) [5]	-	-	-	-	-	9.8 (3.1) [5]	-	-	-	-	-	-
	mg/kg dw	Spring 2012	6.0 (0.7) [5]	-	-	-	-	-	16.4 (6.4) [5]	-	7.1 (1.6) [5]	2.5 (0.7) [5]	0.7 (0.1) [5]	0.6 (0.1) [5]	2.1 (0.5) [5]
	mg/kg dw	Fall 2012	-	-	2.9 (2.9) [8]	-	1.7 (0.2) [5]	1.2 (0.5) [2]	-	-	-	-	-	-	-

[1] mean (standard deviation) [number of samples / replicates].
[2] sediment samples collected by ponar grab.
[3] sediment samples collected by coring.

Table B.1: Mean selenium concentrations by location - Mount Polley selenium monitoring 2009/2010 and 2012 [1].

Compartment	Units	Period	Polley Lake	Upper Hazeltine Creek	Upper Hazeltine Creek Pond	Lower Hazeltine Creek	Hazeltine Creek Delta at Quesnel Lake	Upper Edney Creek	Main Embankment Seepage Collection Pond	North Dump Creek	North Dump Creek Delta at Polley Lake	Bootjack Lake	Trio Lake	Frypan Lake	Quesnel Lake - North Arm
			PL	W7	W7 (pond)	W11	DSW11	W8	E4	W4	DSW4	BL	TL	FL	QL
Rainbow Trout - muscle	mg/kg dw	Spring 2009	4.0 (0.3) [5]	4.2 (0.5) [5]	-	-	-	-	-	-	-	-	-	-	-
	mg/kg dw	Fall 2009	3.7 (0.4) [5]	-	-	-	2.1 (0.3) [5]	-	-	-	-	1.5 (0.2) [5]	0.8 (0.1) [5]	0.6 (0.03) [5]	-
	mg/kg dw	Spring 2010	4.7 (0.6) [5]	4.1 (0.5) [5]	-	-	-	-	-	-	-	-	-	-	-
	mg/kg dw	Fall 2010	-	-	-	-	1.9 (0.2) [5]	-	-	-	-	-	-	-	1.8 (0.2) [5]
	mg/kg dw	Spring 2012	3.9 (0.4) [5]	4.0 (0.4) [8]	-	-	1.5 (0.2) [5]	-	-	-	-	1.3 (0.2) [5]	0.5 (0.1) [5]	0.6 (0.1) [5]	1.1 (0.1) [3]
Rainbow Trout - ovary	mg/kg dw	Spring 2009	7.4 (1.2) [5]	7.5 (2.2) [5]	-	-	-	-	-	-	-	-	-	-	-
	mg/kg dw	Spring 2010	7.9 (0.9) [5]	9.3 (1.5) [5]	-	-	4.0 (1.2 [2]	-	-	-	-	-	-	-	-
	mg/kg dw	Spring 2012	7.6 (0.8) [5]	7.5 (0.9) [8]	-	-	2.4 (0.6) [5]	-	-	-	-	3.4 (0.7) [5]	3.7 (1.5) [5]	3.7 (0.3) [5]	3.6 (1.8) [3]
Longnose Sucker - muscle	mg/kg dw	Spring 2009	12.0 (5.3) [5]	-	-	-	-	-	-	-	-	-	-	-	-
	mg/kg dw	Spring 2010	10.0 (1.8) [5]	-	-	-	3.5 (0.6) [5]	-	-	-	-	-	-	-	2.5 (0.3) [5]
	mg/kg dw	Spring 2012	8.2 (1.4) [5]	-	-	-	-	-	-	-	-	1.7 (0.2) [5]	-	-	1.2 (0.1) [2]
Longnose Sucker - ovary	mg/kg dw	Spring 2009	11.3 (3.8) [5]	-	-	-	-	-	-	-	-	-	-	-	-
	mg/kg dw	Spring 2010	11.9 (2.0) [5]	-	-	-	-	-	-	-	-	-	-	-	-
	mg/kg dw	Spring 2012	8.8 (0.4) [5]	-	-	-	-	-	-	-	-	3.0 (0.5) [5]	-	-	2.1 (0.1) [2]
Largescale sucker - muscle	mg/kg dw	Spring 2012	-	-	-	-	2.0 (0.4) [5]	-	-	-	-	-	-	-	-
Largescale sucker - ovary	mg/kg dw	Spring 2012	-	-	-	-	3.6 (0.3) [5]	-	-	-	-	-	-	-	-

[1] mean (standard deviation) [number of samples / replicates].
[2] sediment samples collected by ponar grab.
[3] sediment samples collected by coring.

Table B.2: Selenium concentrations by replicate sample - Mount Polley selenium monitoring 2012 (mg/kg dry weight).

Compartment	Location	Sampling Event	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Mean	Standard Deviation
Sediment	Polley Lake	Spring 2012	5.49	4.71	2.68	5.64	6.52	-	-	-	**5.01**	**1.45**
	Bootjack Lake	Spring 2012	2.24	2.46	2.88	2.44	1.78	-	-	-	**2.36**	**0.40**
	Trio Lake	Spring 2012	1.32	1.24	1.32	1.14	1.12	-	-	-	**1.23**	**0.10**
	Frypan Lake	Spring 2012	1.64	1.66	1.69	1.92	1.87	-	-	-	**1.76**	**0.13**
	Quesnel Lake	Spring 2012	0.39	0.32	0.41	0.40	0.32	-	-	-	**0.37**	**0.04**
	Main Embankment Seepage Collection Pond	Spring 2012	17.10	7.73	10.30	2.47	3.12	-	-	-	**8.14**	**5.97**
	North Dump Creek Delta at Polley Lake	Spring 2012	0.96	0.61	0.74	1.31	1.49	-	-	-	**1.02**	**0.37**
	Upper Hazeltine Creek Pond	Fall 2012	2.09	3.32	3.51	2.75	2.89	2.29	2.21	2.13	**2.65**	**0.56**
	Hazeltine Creek Delta at Quesnel Lake	Fall 2012	1.28	1.49	0.74	1.14	0.97	-	-	-	**1.12**	**0.29**
	Upper Edney Creek	Fall 2012	3.22	3.05	2.87	2.28	2.94	-	-	-	**2.87**	**0.36**
Periphyton	Upper Hazeltine Creek	Fall 2012	3.27	4.31	5.39	4.10	4.39	4.96	5.15	3.83	**4.43**	**0.71**
	Lower Hazeltine Creek	Fall 2012	3.16	3.03	3.26	3.28	2.55	-	-	-	**3.06**	**0.30**
	Upper Edney Creek	Fall 2012	5.13	6.86	5.97	6.59	4.20	-	-	-	**5.75**	**1.09**
	North Dump Creek	Fall 2012	4.75	-	-	-	-	-	-	-	**4.75**	**-**
Benthos (depositional)	Polley Lake	Spring 2012	5.67	6.71	4.93	6.15	6.66	-	-	-	**6.02**	**0.74**
	Bootjack Lake	Spring 2012	3.26	1.24	2.57	2.71	2.51	-	-	-	**2.46**	**0.74**
	Trio Lake	Spring 2012	0.71	0.61	0.83	0.58	0.52	-	-	-	**0.65**	**0.12**
	Frypan Lake	Spring 2012	0.70	0.60	0.64	0.66	0.51	-	-	-	**0.62**	**0.07**
	Quesnel Lake	Spring 2012	2.51	2.57	1.89	2.33	1.34	-	-	-	**2.13**	**0.51**
	Main Embankment Seepage Collection Pond	Spring 2012	14.70	11.50	27.70	13.90	14.40	-	-	-	**16.44**	**6.42**
	Leeches from Main Embankment Seepage Collection Pond	Spring 2012	27.60	2.74	-	-	-	-	-	-	**15.17**	**17.58**
	North Dump Creek Delta at Polley Lake	Spring 2012	7.19	6.65	5.00	7.06	9.34	-	-	-	**7.05**	**1.55**
	Upper Hazeltine Creek Pond	Fall 2012	2.03	0.69	0.73	0.51	1.06	8.31	3.82	5.96	**2.89**	**2.90**
	Hazeltine Creek Delta at Quesnel Lake	Fall 2012	1.43	1.90	1.64	1.86	1.84	-	-	-	**1.73**	**0.20**
	Upper Edney Creek	Fall 2012	0.83	1.50	-	-	-	-	-	-	**1.17**	**0.47**
Benthos (erosional)	North Dump Creek	Fall 2012	7.33	4.27	6.47	8.00	5.24	-	-	-	**6.26**	**1.52**
	Upper Hazeltine Creek	Fall 2012	5.34	4.88	3.34	3.84	4.35	4.64	4.95	3.74	**4.39**	**0.69**
	Lower Hazeltine Creek	Fall 2012	2.43	2.23	1.74	2.23	2.48	-	-	-	**2.22**	**0.29**
	Upper Edney Creek	Fall 2012	4.47	5.87	4.01	9.69	4.26	-	-	-	**5.66**	**2.37**
Rainbow Trout Muscle	Polley Lake	Spring 2012	3.61	4.07	4.46	3.93	3.50	-	-	-	**3.91**	**0.38**
	Bootjack Lake	Spring 2012	1.41	1.27	1.33	1.54	1.14	-	-	-	**1.34**	**0.15**
	Trio Lake	Spring 2012	0.50	0.57	0.46	0.63	0.41	-	-	-	**0.51**	**0.09**
	Frypan Lake	Spring 2012	0.60	0.60	0.49	0.50	0.73	-	-	-	**0.58**	**0.10**
	Quesnel Lake - North Arm	Spring 2012	1.20	1.01	1.13	-	-	-	-	-	**1.11**	**0.10**
	Upper Hazeltine Creek	Spring 2012	3.40	3.98	4.24	3.99	4.15	3.76	4.59	4.12	**4.03**	**0.35**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	1.22	1.76	1.37	1.57	1.58	-	-	-	**1.50**	**0.21**
Rainbow Trout Ovary	Polley Lake	Spring 2012	7.86	8.48	7.54	6.29	7.85	-	-	-	**7.60**	**0.81**
	Bootjack Lake	Spring 2012	3.38	2.48	4.33	3.29	3.46	-	-	-	**3.39**	**0.66**
	Trio Lake	Spring 2012	1.65	5.70	4.23	3.16	3.49	-	-	-	**3.65**	**1.48**
	Frypan Lake	Spring 2012	3.66	3.80	3.61	4.02	3.18	-	-	-	**3.65**	**0.31**
	Quesnel Lake - North Arm	Spring 2012	5.59	3.27	2.06	-	-	-	-	-	**3.64**	**1.79**
	Upper Hazeltine Creek	Spring 2012	7.78	7.07	6.70	8.89	7.31	6.36	8.61	7.59	**7.54**	**0.88**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	1.77	3.26	2.56	2.10	2.13	-	-	-	**2.36**	**0.57**
Longnose Sucker Muscle	Polley Lake	Spring 2012	7.28	9.18	9.70	6.42	8.53	-	-	-	**8.22**	**1.35**
	Bootjack Lake	Spring 2012	1.73	1.96	1.63	1.56	1.48	-	-	-	**1.67**	**0.19**
Longnose Sucker Ovary	Polley Lake	Spring 2012	8.38	8.87	8.46	9.36	9.12	-	-	-	**8.84**	**0.42**
	Bootjack Lake	Spring 2012	2.90	3.81	2.55	3.00	2.77	-	-	-	**3.01**	**0.48**
Largescale Sucker Muscle	Quesnel Lake - North Arm	Spring 2012	1.25	1.06	-	-	-	-	-	-	**1.16**	**0.13**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	2.57	1.78	1.63	2.13	1.85	-	-	-	**1.99**	**0.37**
Largescale Sucker Ovary	Quesnel Lake	Spring 2012	2.00	2.14	-	-	-	-	-	-	**2.07**	**0.10**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	4.07	3.16	3.36	3.55	3.59	-	-	-	**3.55**	**0.34**

Table B.3: Selenium concentrations by replicate sample - Mount Polley selenium monitoring 2009-2010 (mg/kg dry weight).

Compartment	Location	Sampling Event	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Mean	Standard Deviation
Sediment	Polley Lake	Spring 2009	0.8	0.7	1.5	1.6	1.5	**1.2**	**0.43**
		Fall 2009	0.5	2.5	0.5	0.5	3.7	**1.5**	**1.5**
		ALL 2009/2010						**1.4**	**1.0**
	Bootjack Lake	Fall 2009	2.2	2.0	0.5	-	-	**1.6**	**0.94**
	Trio Lake	Fall 2009	1.1	1.2	0.9	-	-	**1.1**	**0.12**
	Frypan Lake	Fall 2009	2.3	1.5	1.9	-	-	**1.9**	**0.41**
	Main Embankment Seepage Collection Pond	Spring 2009	1.2	2.0	0.91	1.9	0.8	**1.4**	**0.55**
	North Dump Creek Delta at Polley Lake	Spring 2009	0.29	0.34	0.38	0.32	0.43	**0.35**	**0.05**
	Upper Hazeltine Creek	Spring 2009	0.54	0.79	1.1	0.60	0.77	**0.77**	**0.23**
		Fall 2010	1.8	0.29	0.28	0.26	0.33	**0.59**	**0.67**
		ALL 2009/2010						**0.68**	**0.48**
	Hazeltine Creek Delta at Quesnel Lake	Fall 2010	0.24	0.34	0.20	0.28	0.28	**0.27**	**0.05**
Periphyton	Upper Hazeltine Creek	Summer/Fall 2010	3.6	5.3	3.5	6.3	5.5	**4.8**	**1.2**
	Lower Hazeltine Creek	Summer/Fall 2010	1.3	1.2	1.5	1.7	1.3	**1.4**	**0.20**
Benthos (depositional)	Polley Lake	Spring 2009	5.7	9.7	9.1	5.7	8.5	**7.8**	**1.9**
	Main Embankment Seepage Collection Pond	Spring 2009	12.0	11.7	8.5	4.9	11.9	**9.8**	**3.1**
Benthos (erosional)	North Dump Creek	Spring 2009	6.5	5.5	5.0	-	-	**5.7**	**0.77**
	Upper Hazeltine Creek	Spring 2009	2.9	7.3	2.1	6.4	3.8	**4.5**	**2.2**
		Summer/Fall 2010	10.8	10.0	10.7	11.2	11.8	**10.9**	**0.66**
		ALL 2009/2010						**7.7**	**3.7**
	Lower Hazeltine Creek	Summer/Fall 2010	3.5	3.6	3.7	3.2	3.6	**3.5**	**0.19**
Rainbow Trout Muscle	Polley Lake	Spring 2009	4.3	3.7	3.8	4.1	4.3	**4.0**	**0.28**
		Fall 2009	4.0	3.9	3.2	4.0	3.5	**3.7**	**0.37**
		Spring 2010	4.8	5.4	4.0	4.2	5.0	**4.7**	**0.56**
		ALL 2009/2010						**4.1**	**0.57**
	Bootjack Lake	Fall 2009	1.8	1.5	1.4	1.5	1.5	**1.5**	**0.16**
	Trio Lake	Fall 2009	0.84	0.72	0.83	1.0	0.80	**0.83**	**0.09**
	Frypan Lake	Fall 2009	0.6	0.6	0.6	0.6	0.6	**0.58**	**0.03**
	Hazeltine Creek Delta at Quesnel Lake	Fall 2009	1.6	1.9	2.2	2.1	2.5	**2.1**	**0.33**
		Summer/Fall 2010	2.2	2.0	1.9	2.0	1.7	**1.9**	**0.18**
		ALL 2009/2010						**2.0**	**0.26**
	Quesnel Lake - North Arm	Summer/Fall 2010	1.8	1.7	1.6	2.2	1.8	**1.8**	**0.25**
	Upper Hazeltine Creek	Spring 2009	3.6	3.7	4.8	4.5	4.6	**4.2**	**0.54**
		Spring 2010	3.6	3.7	4.9	3.9	4.5	**4.1**	**0.54**
		ALL 2009/2010						**4.2**	**0.51**
Rainbow Trout Ovary	Polley Lake	Spring 2009	9.4	6.4	7.0	7.5	6.5	**7.4**	**1.2**
	Polley Lake	Spring 2010	8.8	8.0	7.0	6.9	8.8	**7.9**	**0.92**
	Hazeltine Creek Delta at Quesnel Lake	Summer/Fall 2010	3.2	4.9	-	-	-	**4.0**	**1.2**
	Upper Hazeltine Creek	Spring 2009	4.6	6.3	7.4	10.6	8.4	**7.5**	**2.2**
		Spring 2010	8.3	7.3	11.3	9.7	9.7	**9.3**	**1.5**
		ALL 2009/2010						**8.4**	**2.0**
Longnose Sucker Muscle	Polley Lake	Spring 2009	7.5	7.2	10.4	15.6	19.3	**12.0**	**5.3**
		Spring 2010	8.6	10.6	12.9	8.3	9.7	**10.0**	**1.8**
		ALL 2009/2010						**11.0**	**3.9**
	Hazeltine Creek Delta at Quesnel Lake	Summer/Fall 2010	3.8	2.8	4.4	3.5	3.0	**3.5**	**0.6**
	Quesnel Lake - North Arm	Summer/Fall 2010	2.2	2.1	2.7	2.5	2.9	**2.5**	**0.3**
Longnose Sucker Ovary	Polley Lake	Spring 2009	9.9	8.8	10.9	17.9	9.1	**11.3**	**3.8**
		Spring 2010	8.8	12.3	14.0	11.3	13.1	**11.9**	**2.0**
		ALL 2009/2010						**11.6**	**2.9**

Table B.4: Baseline selenium concentrations in sediment and fish (mg/kg dry weight; from HKP 1996,1997; Beak 2000).

Compartment	Location	Sampling Event	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10	Mean	SD
Sediment	Polley Lake 1	15-May-95 [1]	1.7	1.6	1.9	-	-	-	-	-	-	-	**1.73**	**0.15**
		11-May-96 [1]	2.6	2.4	2.8	-	-	-	-	-	-	-	**2.60**	**0.20**
		31-Oct-96 [1]	1.8	1.6	1.7	-	-	-	-	-	-	-	**1.70**	**0.10**
		30-Aug-99 [2]	1.6	1.9	1.9	-	-	-	-	-	-	-	**1.80**	**0.17**
	Polley Lake 2	15-May-95	1.8	2	1.9	-	-	-	-	-	-	-	**1.90**	**0.10**
		11-May-96	2.5	2.3	2.4	-	-	-	-	-	-	-	**2.40**	**0.10**
		31-Oct-96	1.7	2.1	2.2	-	-	-	-	-	-	-	**2.00**	**0.26**
		30-Aug-99	1.7	1.8	1.7	-	-	-	-	-	-	-	**1.73**	**0.06**
	Polley Lake - ALL	**Baseline**											**1.98**	**0.35**
	Bootjack Lake 1	15-May-95	2.1	1.9	1.9	-	-	-	-	-	-	-	**1.97**	**0.12**
		11-May-96	2.4	2.2	2.3	-	-	-	-	-	-	-	**2.30**	**0.10**
		31-Oct-96	1.6	1.6	1.9	-	-	-	-	-	-	-	**1.70**	**0.17**
		1-Sep-99	<1	<1	<1	-	-	-	-	-	-	-	**<1.00**	**0.00**
	Bootjack Lake 2	15-May-95	1.9	1.6	1.8	-	-	-	-	-	-	-	**1.77**	**0.15**
		11-May-96	3.1	3.1	3.0	-	-	-	-	-	-	-	**3.07**	**0.06**
		31-Oct-96	1.4	1.9	1.5	-	-	-	-	-	-	-	**1.60**	**0.26**
		1-Sep-99	1.5	1.9	1.4	-	-	-	-	-	-	-	**1.60**	**0.26**
	Bootjack Lake - ALL	**Baseline**											**1.88**	**0.60**
	Upper Hazeltine Creek	25-Sep-96	0.6	0.4	0.6	1.4	0.5	0.5	-	-	-	-	**0.67**	**0.37**
	Lower Hazeltine Creek	25-Sep-96	0.2	0.2	0.4	0.8	0.8	0.3	-	-	-	-	**0.45**	**0.28**
Rainbow Trout Muscle	Polley Lake	1995	0.72	0.58	0.67	0.62	0.54	0.69	0.61	0.56	0.64	-	**0.63**	**0.06**
	Bootjack Lake	1995	1.00	1.13	1.03	0.55	-	-	-	-	-	-	**0.93**	**0.26**
Rainbow Trout Liver	Polley Lake	1995	3.47	5.02	9.24	13.0	7.8	26.1	4.75	5.32	4.69	-	**8.82**	**7.13**
	Bootjack Lake	1995	21.0	12.2	7.02	7.06	-	-	-	-	-	-	**11.82**	**6.59**
Longnose Sucker Muscle	Polley Lake	1995	1.02	0.92	0.72	0.88	1.05	0.87	0.89	0.86	0.88	0.97	**0.91**	**0.09**
	Bootjack Lake	1995	1.00	1.06	1.06	1.10	0.89	0.98	0.85	1.06	-	-	**1.00**	**0.09**
Longnose Sucker Liver	Polley Lake	1995	5.29	5.37	4.71	5.53	4.11	4.62	4.43	3.93	5.62	4.92	**4.85**	**0.59**
	Bootjack Lake	1995	2.97	4.28	4.67	5.1	5.39	3.16	4.08	4.07	-	-	**4.22**	**0.85**

[1] sediment samples were collected by Eckman grab in 1995 and 1996.
[2] sediment samples were collected by core in 1999.

Table B.5: Mean selenium concentrations by compartment and location, Mount Polley selenium monitoring, 2009-2012.

Compartment	Location	Mean (mg/kg dw)	Standard Deviation
Sediment	Polley Lake	2.59	2.11
	Bootjack Lake	2.07	0.71
	Trio Lake	1.23	0.10
	Frypan Lake	1.81	0.25
	Main Embankment Seepage Collection Pond	4.76	5.35
	North Dump Creek	0.69	0.43
	Upper Hazeltine Creek	1.55	1.12
	Quesnel Lake	0.37	0.04
	Lower Hazeltine Creek	0.70	0.49
	Upper Edney Creek	2.87	0.36
Periphyton	Upper Hazeltine Creek	4.58	0.92
	Lower Hazeltine Creek	2.24	0.90
	Upper Edney Creek	5.75	1.09
	North Dump Creek	4.75	-
Benthos (depositional)	Polley Lake	6.89	1.64
	Bootjack Lake	2.46	0.74
	Trio Lake	0.65	0.12
	Frypan Lake	0.62	0.07
	Quesnel Lake	2.13	0.51
	Main Embankment Seepage Collection Pond	13.46	7.57
	DSW4 / North Dump Creek	7.05	1.55
	Upper Hazeltine Creek	2.89	2.90
	Lower Hazeltine Creek Delta / Quesnel Lake	1.73	0.20
	Upper Edney Creek	1.17	0.47
Benthos (erosional)	North Dump Creek	6.04	1.26
	Upper Hazeltine Creek	6.23	3.22
	Lower Hazeltine Creek	2.87	0.72
	Upper Edney Creek	5.66	2.37
Rainbow Trout Muscle	Polley Lake	4.08	0.53
	Bootjack Lake	1.42	0.17
	Trio Lake	0.67	0.19
	Frypan Lake	0.58	0.07
	Quesnel Lake - near Hazeltine	1.83	0.34
	Quesnel Lake - North Arm	1.55	0.41
	Upper Hazeltine Creek	4.11	0.44
Rainbow Trout Ovary	Polley Lake	7.63	0.96
	Quesnel Lake - near Hazeltine	2.83	1.05
	Upper Hazeltine Creek	8.00	1.63
	Bootjack Lake	3.39	0.66
	Trio Lake	3.65	1.48
	Frypan Lake	3.65	0.31
	Quesnel Lake - North Arm	3.64	1.79
Longnose Sucker Muscle	Polley Lake	10.09	3.47
	Bootjack Lake	1.67	0.19
	Quesnel Lake - near Hazeltine	2.83	1.25
	Quesnel Lake - North Arm	2.12	0.71
Longnose Sucker Ovary	Polley Lake	10.69	2.67
	Bootjack Lake	3.01	0.48
	Quesnel Lake	2.07	0.10
	Lower Hazeltine Creek	3.55	0.34

Table B.6: Tissue selenium concentrations on wet weight basis - Mount Polley selenium monitoring 2012 (mg/kg wet weight).

Compartment	Location	Sampling Event	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Mean	Standard Deviation
Periphyton	Upper Hazeltine Creek	Fall 2012	0.49	0.46	0.59	0.53	0.38	0.52	0.55	0.56	**0.51**	**0.07**
	Lower Hazeltine Creek	Fall 2012	0.22	0.25	0.33	0.30	0.27	-	-	-	**0.27**	**0.04**
	Upper Edney Creek	Fall 2012	0.76	0.85	0.82	0.74	0.80	-	-	-	**0.80**	**0.04**
	North Dump Creek	Fall 2012	0.12	-	-	-	-	-	-	-	**0.12**	**-**
Benthos (depositional)	Polley Lake	Spring 2012	0.52	0.66	0.52	0.82	0.67	-	-	-	**0.64**	**0.12**
	Bootjack Lake	Spring 2012	0.16	0.09	0.16	0.19	0.15	-	-	-	**0.15**	**0.04**
	Trio Lake	Spring 2012	0.07	0.07	0.08	0.07	0.06	-	-	-	**0.07**	**0.01**
	Frypan Lake	Spring 2012	0.07	0.05	0.06	0.05	0.06	-	-	-	**0.06**	**0.01**
	Quesnel Lake	Spring 2012	0.13	0.17	0.12	0.18	0.05	-	-	-	**0.13**	**0.05**
	Main Embankment Seepage Collection Pond	Spring 2012	1.03	0.89	0.59	1.43	1.09	-	-	-	**1.01**	**0.30**
	Leeches from Main Embankment Seepage Collection Pond	Spring 2012	4.22	0.41	-	-	-	-	-	-	**2.32**	**2.69**
	North Dump Creek Delta at Polley Lake	Spring 2012	0.48	1.21	0.89	1.12	0.80	-	-	-	**0.90**	**0.29**
	Upper Hazeltine Creek Pond	Fall 2012	0.77	0.34	0.36	0.16	0.76	1.31	0.80	1.24	**0.72**	**0.42**
	Hazeltine Creek Delta at Quesnel Lake	Fall 2012	0.13	0.11	0.12	0.18	0.13	-	-	-	**0.14**	**0.02**
	Upper Edney Creek	Fall 2012	0.22	0.30	-	-	-	-	-	-	**0.26**	**0.06**
Benthos (erosional)	North Dump Creek	Fall 2012	0.26	0.67	0.65	0.80	0.19	-	-	-	**0.51**	**0.27**
	Upper Hazeltine Creek	Fall 2012	0.60	0.49	0.45	0.48	0.48	0.48	0.58	0.46	**0.50**	**0.06**
	Lower Hazeltine Creek	Fall 2012	0.21	0.32	0.21	0.16	0.26	-	-	-	**0.23**	**0.06**
	Upper Edney Creek	Fall 2012	0.16	0.34	0.18	0.29	0.16	-	-	-	**0.23**	**0.08**
Rainbow Trout Muscle	Polley Lake	Spring 2012	0.81	0.87	0.95	0.88	0.75	-	-	-	**0.85**	**0.08**
	Bootjack Lake	Spring 2012	0.28	0.27	0.27	0.29	0.25	-	-	-	**0.27**	**0.01**
	Trio Lake	Spring 2012	0.12	0.14	0.12	0.15	0.10	-	-	-	**0.12**	**0.02**
	Frypan Lake	Spring 2012	0.14	0.14	0.11	0.12	0.16	-	-	-	**0.13**	**0.02**
	Quesnel Lake - North Arm	Spring 2012	0.24	0.23	0.24	-	-	-	-	-	**0.24**	**0.00**
	Upper Hazeltine Creek	Spring 2012	0.72	0.85	0.90	0.84	0.90	0.81	1.00	0.88	**0.86**	**0.08**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	0.26	0.40	0.31	0.34	0.34	-	-	-	**0.33**	**0.05**
Rainbow Trout Ovary	Polley Lake	Spring 2012	2.97	3.16	2.84	2.57	3.08	-	-	-	**2.92**	**0.23**
	Bootjack Lake	Spring 2012	1.28	0.94	1.66	1.33	1.30	-	-	-	**1.30**	**0.25**
	Trio Lake	Spring 2012	0.63	1.14	0.80	0.64	0.66	-	-	-	**0.77**	**0.22**
	Frypan Lake	Spring 2012	0.62	0.70	0.64	0.69	0.60	-	-	-	**0.65**	**0.05**
	Quesnel Lake - North Arm	Spring 2012	2.16	0.87	0.77	-	-	-	-	-	**1.27**	**0.78**
	Upper Hazeltine Creek	Spring 2012	2.87	2.67	2.45	3.10	2.74	2.38	2.86	2.67	**2.72**	**0.23**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	0.73	1.31	1.07	0.81	0.88	-	-	-	**0.96**	**0.23**
Longnose Sucker Muscle	Polley Lake	Spring 2012	1.68	1.85	2.08	1.48	1.86	-	-	-	**1.79**	**0.22**
	Bootjack Lake	Spring 2012	0.36	0.41	0.37	0.31	0.30	-	-	-	**0.35**	**0.05**
Longnose Sucker Ovary	Polley Lake	Spring 2012	3.00	3.21	2.86	3.28	3.28	-	-	-	**3.13**	**0.19**
	Bootjack Lake	Spring 2012	0.99	1.24	0.96	1.01	0.87	-	-	-	**1.01**	**0.14**
Largescale Sucker Muscle	Quesnel Lake - North Arm	Spring 2012	0.27	0.23	-	-	-	-	-	-	**0.25**	**0.03**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	0.53	0.44	0.32	0.46	0.39	-	-	-	**0.43**	**0.08**
Largescale Sucker Ovary	Quesnel Lake	Spring 2012	0.75	0.78	-	-	-	-	-	-	**0.76**	**0.02**
	Hazeltine Creek Delta at Quesnel Lake	Spring 2012	1.43	1.10	1.18	1.25	1.32	-	-	-	**1.26**	**0.13**

Table B.7: Sample size requirements for given Critical Effect Size for rainbow trout ovary selenium concentrations from Hazeltine Creek, Mount Polley Mine, 2009-2012.

Year	t_{α} [a]	t_{β} [a]	Mean [Se] (mg/kg dw)	SD	COV [b]	CES [c]		n [d]
						Percent of Mean (%)	Distinguishable Mean [Se] (mg/kg dw)	
2009	1.645	1.282	7.5	2.2	29.3	10	8.3	147
						20	9.0	37
						30	9.8	16
						40	10.5	9
						50	11.3	6
2010	1.645	1.282	9.3	1.5	16.1	10	10.2	45
						20	11.2	11
						30	12.1	5
						40	13.0	3
						50	14.0	2
2012	1.645	1.282	7.5	0.88	11.7	10	8.3	23
						20	9.0	6
						30	9.8	3
						40	10.6	1
						50	11.3	1
2009-2012	1.645	1.282	8.0	1.6	20.4	10	8.8	71
						20	9.6	18
						30	10.4	8
						40	11.2	4
						50	12.0	3

[a] t_{α} and t_{β} are from t two-tailed and one-tailed t-ditribution tables, respectively, with $\alpha = \beta = 0.1$ and ∞ degrees of freedom.

[b] Coefficient of Variation (COV) is expresed as a percentage of the reference mean (COV = SD / reference mean x 100) and is measure of variablity in the sample size calculation.

[c] Critical Effect Size (CES), expressed as percent increase from the mean and as the corresponding distinguishable selenium concentration in mg/kg dw.

[d] n is the number of replicates that would be required to see a significant difference between current selenium concentrations and the CES and is calculated as

$n = 2(t_{\alpha} + t_{\beta})^2(COV/CES)^2$ (EEM Technical Guidance Document, Environment Canada 2011).

Table B.8: ANOVA results for depositional benthic invertebrate tissue selenium, Mount Polley 2012.

Analyte	Normality	Transformation		Overall ANOVA		post-hoc comparisons					
		Site	Type	Significant difference among areas?	p-value	Equal Variance	Test Type	(I) Area	(J) Area	Significant difference between areas?	p-value
Selenium	Yes	1	n/a	Yes	0.00	No	Tamhane's	Polley Lake	Trio Lake	Yes	0.001
		2	n/a						Frypan Lake	Yes	0.002
		3	n/a						Quesnel Lake	Yes	0.001
		4	n/a					Bootjack Lake	Trio Lake		0.100
		5	n/a						Frypan Lake		0.101
		6	n/a						Quesnel Lake		1.000
		7	n/a					DSW4	Trio Lake	Yes	0.015
									Frypan Lake	Yes	0.015
									Quesnel Lake	Yes	0.025
								Lower Hazeltine Creek Delta / Quesnel Lake	Trio Lake	Yes	0.000
									Frypan Lake	Yes	0.001
									Quesnel Lake		0.980

Table B.9: ANOVA results for rainbow trout and longnose sucker muscle tissue selenium, Mount Polley 2012.

Species	Analyte	Normality	Transformation		Overall ANOVA		post-hoc comparisons					
			Site	Type	Significant difference among areas?	p-value	Equal Variance	Test Type	(I) Area	(J) Area	Significant difference between areas?	p-value
Rainbow Trout	Selenium	Yes	1 2 3 4 5 6	n/a n/a n/a n/a n/a n/a	Yes	0.00	Yes	Tukey's	Polley Lake	Frypan Lake	Yes	0.000
										Trio Lake	Yes	0.000
										Quesnel Lake	Yes	0.000
										Lower Hazletine Delta	Yes	0.000
									Bootjack Lake	Frypan Lake	Yes	0.000
										Trio Lake	Yes	0.001
										Quesnel Lake	No	0.873
										Lower Hazletine Delta	No	0.942
									Upper Hazeltine Creek	Frypan Lake	Yes	0.000
										Trio Lake	Yes	0.000
										Quesnel Lake	Yes	0.000
										Lower Hazletine Delta	Yes	0.000
Longnose sucker	Selenium	Yes	1 2 3 4	n/a n/a n/a n/a	Yes	0.00	Yes	Tukey's	Polley Lake	Quesnel Lake	Yes	0.000
										Lower Hazletine Delta	Yes	0.000
									Bootjack Lake	Quesnel Lake	No	0.860
										Lower Hazletine Delta	No	0.916

Table B.10: ANOVA results for rainbow trout and longnose sucker ovary selenium, Mount Polley 2012.

Species	Analyte	Normality	Transformation		Overall ANOVA		post-hoc comparisons					
			Site	Type	Significant difference among areas?	p-value	Equal Variance	Test Type	(I) Area	(J) Area	Significant difference between areas?	p-value
Rainbow Trout	Selenium	Yes	1 2 3 4 5 6	n/a n/a n/a n/a n/a n/a	Yes	0.00	Yes	Tukey's	Polley Lake	Frypan Lake	Yes	0.000
										Trio Lake	Yes	0.000
										Quesnel Lake	Yes	0.000
										Lower Hazletine Delta	Yes	0.000
									Bootjack Lake	Frypan Lake	No	0.999
										Trio Lake	No	0.999
										Quesnel Lake	No	1.000
										Lower Hazletine Delta	No	0.629
									Upper Hazeltine Creek	Frypan Lake	Yes	0.000
										Trio Lake	Yes	0.000
										Quesnel Lake	Yes	0.000
										Lower Hazletine Delta	Yes	0.000
Longnose sucker	Selenium	Yes	1 2 3 4	n/a n/a n/a n/a	Yes	0.00	Yes	Tukey's	Polley Lake	Quesnel Lake	Yes	0.000
										Lower Hazletine Delta	Yes	0.000
									Bootjack Lake	Quesnel Lake	No	0.860
										Lower Hazletine Delta	No	0.196

APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C: DATA QUALITY ASSESSMENT

LIST OF TABLES

after page…

C1.0 INTRODUCTION

Data Quality Assessment (DQA) was conducted on data collected as part of the Mount Polley selenium study in spring and fall 2012. The objective of DQA is to define the overall quality of the data presented in the report (i.e., selenium concentrations), and, by extension, the confidence with which the data can be used to derive conclusions.

C1.1 Background

A variety of factors can influence the chemical and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Inconsistencies in sampling or laboratory methods, use of instruments that are inadequately calibrated or which cannot measure to the desired level of accuracy or precision, and contamination of samples in the field or laboratory are just some of the potential factors that can lead to the reporting of data that do not accurately reflect actual environmental conditions. Depending on the magnitude of the problem, inaccuracy or imprecision have the potential to affect the reliability of any conclusions made from the data. Therefore, it is important to ensure that monitoring programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data.

Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. DQA involves comparison of actual field and laboratory measurement performance to data quality objectives (DQOs) established for a particular study, such as evaluation of method detection limits, blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials).

DQOs were established at the outset of the field program and reflect reasonable and achievable performance expectations (Table C.1). Programs involving a large number of samples and analytes usually result in some results that exceed the DQOs. Overall, the intent of comparing data to DQOs was not to reject any measurement that did not meet the DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of this project.

Table C.1: Data quality objectives for environmental samples.

Quality Control Measure	Quality Control Sample Type	Study Component			
		Water Quality	**Sediment Quality**	**Benthic Tissue Quality**	**Fish Tissue Quality**
Method Detection Limits (MDL)	Comparison actual MDL versus target MDL	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]	MDL for each parameter should be at least as low as applicable guidelines, ideally ≤1/10th guideline value[a]
Blank Analysis	Field or Laboratory Blank	≤ two-times the laboratory MDL	≤ two-times the laboratory MDL	≤ two-times the laboratory MDL	≤ two-times the laboratory MDL
Field Precision	Field Duplicates	n/a	≤ 25% RPD[b]	≤ 25% RPD[b]	≤ 25% RPD[b]
Laboratory Precision	Laboratory Duplicates	n/a	n/a	≤ 30% RPD[b]	≤ 30% RPD[b]
Accuracy	Recovery of Certified Reference Material, Quality Control Standards	n/a	70-130%	70-130%	70-130%

[a] or below predictions, if applicable and no guideline exists for the substance.

[b] RPD - Relative Percent Difference

n/a - not applicable

C1.2 Types of Quality Control Samples

Several types of quality control (QC) samples were assessed based on samples collected (or prepared) in the field and laboratory. These samples, and a description of each, include the following:

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed the same way as regular samples. These samples will reflect any contamination of samples occurring in the field (in the case of field or trip blanks) or the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable although a data quality objective of twice the method detection limit allows for slight “noise” around the detection limit.

- **Field Duplicates** are replicate samples collected from a randomly selected field station using identical collection and handling methods that are then analyzed separately in the laboratory. The duplicate samples are handled and analyzed in an identical manner in the laboratory. The data from field replicate samples reflect natural variability, as well as the variability associated with sample collection methods, and therefore provide a measure of field precision.

- **Laboratory Duplicates** are replicate sub-samples created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.

- **Certified Reference Materials** are samples containing known chemical concentrations that are processed and analyzed along with batches of environmental samples. The sample results are then compared to target results to provide a measure of analytical accuracy. The results are reported as the percent of the known amount that was recovered in the analysis. Reference materials of known metal concentrations (obtained from the National Research Council of Canada [NRC] and the Canada Centre for Mineral and Energy Technology [CANMET]) were processed and analyzed as regular samples to support the analyses of sediment and biological tissues.

C2.0 WATER SAMPLES

C2.1 Method Detection Limits

The specified method detection limit (MDL) for selenium in water was 0.0002 mg/L; however, the method detection limit reported by the analytical laboratory in spring 2012 was 0.0005 mg/L (i.e., ALS job no. L1146751) and greater than the target, whereas for samples submitted in fall 2012, the MDL was 0.0001 mg/L and below the desired limit. Even though the target detection limit was not met in spring 2012, 0.0005 mg/L is well below the guideline level of 0.002 mg/L. Nonetheless, selenium concentration was reported as ≤ 0.0005 mg/L it would have been ideal if the specified method detection limit was reached.

C2.2 Laboratory Blank Sample Analysis

Blank samples analyzed contained very low or non-detectable selenium concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Table C.2).

Table C.2: Laboratory blank results associated with analyses of water samples. Highlighted values did not meet the data quality objective of ≤ 2x the method detection limit.

Analyte	Units	Method Detection Limit	ALS Job Number			
			L1146751	L1218826	L1220058	L1148831
Total Selenium	mg/kg	0.0001 - 0.0005 [a]	ND	ND	ND	ND

[a] MDL was 0.0005 mg/kg only for ALS job no. L1146751 and 0.0001 mg/kg for the remainder.

C3.0 SEDIMENT SAMPLES

C3.1 Method Detection Limits

Target laboratory method detection limits (MDL) for sediment sample analyses were established at levels below potentially applicable sediment quality guidelines of 2 mg/kg dw. All reported laboratory MDLs were at the target concentrations indicating acceptable analytical resolution. Selenium was detectable in all samples analyzed, therefore data were sufficient for the purpose of this study.

C3.2 Laboratory Blank Sample Analysis

The blank samples analyzed contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Table C.3).

C3.3 Field Precision

The field duplicate samples for selenium in sediment all meet the DQO of ≤25% relative percent difference (RPD; Table C.4). The field precision was considered good.

C3.4 Data Accuracy

Recoveries of selenium in certified reference materials met the data quality objective of 70-130% recovery in all samples (Table C.5). This data indicated good analytical accuracy associated with the analysis of sediment samples.

Table C.3: Laboratory blank results associated with analyses of sediment samples. Highlighted values did not meet the data quality objective of ≤ 2x the method detection limit.

Analyte	Units	Method Detection Limit	ALS Job Number									
			L1148801								L1152605	L1223246
Total Selenium	mg/kg	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Selenium	mg/kg	0.1	ND	ND	-	-	-	-	-	-	-	-

ND - Non-Detectable. Indicates analyte concentrations that were less than the MDL during analysis.

Table C.4: Field duplicate results for analysis of sediment samples. Highlighted values did not meet the data quality objective of ≤ 25% relative percent difference (RPD, %).

Analyte	Units	Duplicate 1			Duplicate 2			Duplicate 3			Duplicate 4		
		BOL-1	BOL-6	RPD (%)	FRL-2	FRL-6	RPD (%)	POL-3	POL-6	RPD (%)	QUL-3	QUL-6	RPD (%)
Selenium (Se)	mg/kg	2.24	2.21	1.35	1.66	1.83	9.74	2.68	2.58	3.80	0.41	0.37	10.26

Table C.5: Laboratory accuracy (certified reference material) results for analysis of sediment samples. Highlighted values did not meet the data quality objective of 70 - 130% recovery.

Analyte	Units	Reference Material			
		Material	Result	Target	% Recovery
Selenium (Se)	mg/kg	VA-CANMET-TILL1	0.29	0.32	91
	mg/kg	VA-CANMET-TILL1	0.32	0.32	100
	mg/kg	VA-CANMET-TILL1	0.26	0.32	81
	mg/kg	VA-CANMET-TILL1	0.31	0.32	97
	mg/kg	VA-CANMET-TILL1	0.31	0.32	97
	mg/kg	VA-CANMET-TILL1	0.33	0.32	103
	mg/kg	VA-CANMET-TILL1	0.32	0.32	100
	mg/kg	VA-CANMET-TILL1	0.32	0.32	100
	mg/kg	VA-CANMET-TILL1	0.36	0.32	113
	mg/kg	VA-NRC-PACS2	0.92	0.92	100
	mg/kg	VA-NRC-PACS2	0.93	0.92	101
	mg/kg	VA-NRC-PACS2	0.90	0.92	98
	mg/kg	VA-NRC-PACS2	0.91	0.92	99
	mg/kg	VA-NRC-PACS2	0.92	0.92	100
	mg/kg	VA-NRC-PACS2	0.92	0.92	100
	mg/kg	VA-NRC-PACS2	0.93	0.92	101
	mg/kg	VA-NRC-PACS2	0.93	0.92	101
	mg/kg	VA-NRC-PACS2	0.91	0.92	99

C4.0 FISH, BENTHIC INVERTEBRATE AND PERIPHYTON TISSUE

C4.1 Method Detection Limits

The specified method detection limit (MDL) for selenium in fish and benthic invertebrate tissue was 0.05 mg/kg dw. For fish and periphyton tissue, the achieved MDL was 0.10 mg/kg dw and for benthic tissue it ranged from 0.10 to 0.20 mg/kg dw. Despite the higher than requested MDLs, selenium was detectable in all tissue samples and therefore data were sufficient for the purpose of this project. In addition, a high resolution (HR) analysis was applied to achieve the given MDLs, without which even higher MDLs would have been achieved.

C4.2 Laboratory Blank Sample Analysis

Analysis of laboratory blanks prepared in conjunction with the tissue analyses resulted in non-detectable selenium (Table C.6).

C4.3 Field Precision

Duplicate samples were collected for fish muscle and ovary, and benthic invertebrate tissue samples.

C4.3.1 Fish Tissue Precision

Fish muscle and ovary samples were collected from three species of fish, rainbow trout, longnose sucker and largescale sucker. There were six duplicate tissue samples (five for ovary) for Rainbow Trout and relative percent difference between duplicates were all below 25% (Table C.7). All duplicates for longnose sucker were below the relative percent difference of 25% (Table C.8). Duplicate samples collected for largescale sucker were also below the relative percent difference of 25% (Table C.9).

C4.3.2 Benthic Invertebrate Precision

There were four duplicate samples collected for benthic invertebrates, two of which had relative percent differences greater than 25% (approx. 60% and 75% for the Quesnel Lake and Bootjack Lake field duplicates, respectively; Table C.10). It is uncertain why variability was relatively high, particularly given that all samples were predominantly chironomids. However, this likely reflects true field variability, as the range of difference between replicates at both Bootjack and Quesnel Lakes was consistent with the difference observed between field duplicates (Table C.11).

Table C.6: Laboratory blank results associated with analyses of fish, benthic invertebrate and periphyton tissue samples. Highlighted values did not meet the data quality objective of ≤ 2x the method detection limit.

Analyte	Units	Method Detection Limit	ALS Job Number																
			L1148768														L1150644		
Total Selenium	mg/kg	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table C.7: Field duplicate results for analysis of rainbow trout (RB) tissue samples. Highlighted values did not meet the data quality objective of ≤ 25% relative percent difference.

Analyte	Tissue	Units	Duplicate 1			Duplicate 2			Duplicate 3			Duplicate 4			Duplicate 5			Duplicate 6		
			B-RB-1	B-RB-A	RPD (%)	TRL-RB-1	TRL-RB-6	RPD (%)	POL-RB-3	POL-RB-6	RPD (%)	NA-RB-2	NA-RB-B	RPD (%)	QH-RB-3	QH-RB-C	RPD (%)	HAC-RB-8	HAC-RB-Z	RPD (%)
Selenium (Se)	Muscle	mg/kg	1.41	1.11	23.81	0.50	0.45	10.53	3.93	3.64	7.66	1.20	1.39	14.67	1.22	1.22	0.00	4.24	4.02	5.33
Selenium (Se)	Ovary	mg/kg	3.38	3.30	2.40	1.95	1.65	16.67	6.29	6.41	1.89	-	-	-	1.77	1.80	1.68	6.70	7.47	10.87

Table C.8: Field duplicate results for analysis of longnose sucker (LSU) tissue samples. Highlighted values did not meet the data quality objective of ≤ 25% relative percent difference.

Analyte	Tissue	Units	Duplicate 1			Duplicate 2		
			B-LSU-3	B-LSU-C	RPD (%)	P-LSU-3	P-LSU-C	RPD (%)
Selenium (Se)	Muscle	mg/kg	1.63	1.40	15.18	-	-	-
Selenium (Se)	Ovary	mg/kg	2.55	3.00	16.22	8.46	9.19	8.27

Table C.9: Field duplicate results for analysis of largescale sucker (CSU) tissue samples. Highlighted values did not meet the data quality objective of ≤ 25% relative percent difference.

Analyte	Tissue	Units	Duplicate 1			Duplicate 2		
			NA-CSU-2	NA-CSU-B	RPD (%)	QH-CSU-2	QH-CSU-B	RPD (%)
Selenium (Se)	Muscle	mg/kg	1.06	1.25	16.45	2.57	2.38	7.68
Selenium (Se)	Ovary	mg/kg	2.14	2.00	6.76	4.07	4.08	0.25

Table C.10: Field duplicate results for analysis of benthic invertebrate tissue samples. Highlighted values did not meet the data quality objective of ≤ 25% relative percent difference (RPD).

Analyte	Units	Duplicate 1			Duplicate 2			Duplicate 3			Duplicate 4		
		BOL-2	BOL-6	RPD (%)	FRL-2	FRL-6	RPD (%)	POL-3	POL-6	RPD (%)	QUL-3	QUL-6	RPD (%)
Selenium (Se)	mg/kg	1.24	2.75	75.69	0.60	0.62	3.28	4.93	5.15	4.37	1.89	1.02	59.79

DQO was not achieved.

Table C.11: Variablity in selenium concentrations of replicate samples of benthic invertebrate tissue from Bootjack Lake and Quesnel Lake, expressed as relative percent difference (RPD, %). Highlighted values indicate RPD >25%.

Replicate	Selenium (mg/kg dw)	BOL-2	BOL-3	BOL-4	BOL-5	BOL-6
BOL-1	3.26	89.8	23.7	18.4	26.0	17.0
BOL-2	1.24		69.8	74.4	67.7	75.7
BOL-3	2.57			5.3	2.4	6.8
BOL-4	2.71				7.7	1.5
BOL-5	2.51					9.1
BOL-6	2.75					
		QUL-2	**QUL-3**	**QUL-4**	**QUL-5**	**QUL-6**
QUL-1	2.51	2.4	28.2	7.4	60.8	84.4
QUL-2	2.57		30.5	9.8	62.9	86.4
QUL-3	1.89			20.9	34.1	59.8
QUL-4	2.33				54.0	78.2
QUL-5	1.34					27.1
QUL-6	1.02					

C4.4 Data Precision

The analytical laboratory reported 14 duplicate sample results for selenium in tissue. Relative percent difference between the duplicates was low (4 - 20%), indicating good precision (Table C.12).

C4.5 Data Accuracy

Recoveries of selenium in certified reference materials (VA-NRC-DOLT4 and VA-NRC-TORT2) met the data quality objective in all cases, indicating good accuracy (Table C.13).

Table C.12: Laboratory duplicates results for analysis of fish and benthic invertebrate tissue samples. Highlighted values did not meet the data quality objective of ≤ 30% relative percent difference (RPD).

Analyte	Units	1	2	RPD (%)
Total Selenium	mg/kg	1.27	1.12	13
	mg/kg	2.48	2.73	10
	mg/kg	2.56	2.45	4
	mg/kg	1.78	1.46	20
	mg/kg	6.41	6.71	5
	mg/kg	1.01	1.16	14
	mg/kg	2.06	2.1	2
	mg/kg	4.02	4.41	9
	mg/kg	3.98	4.37	9
	mg/kg	6.66	6.42	4
	mg/kg	27.6	25.5	8
	mg/kg	3.74	3.60	4
	mg/kg	2.23	2.32	4
	mg/kg	2.23	2.18	2

Table C.13: Laboratory accuracy (certified reference material) results for analysis of fish and benthic invertebrate samples. Highlighted values did not meet the data quality objective of 70 - 130% recovery.

Analyte	Units	Reference Material			
		Material	Result	Target	% Recovery
Selenium (Se)	mg/kg	VA-NRC-DOLT4	9.13	8.30	110
	mg/kg	VA-NRC-DOLT4	8.48	8.30	102
	mg/kg	VA-NRC-DOLT4	8.40	8.30	101
	mg/kg	VA-NRC-DOLT4	7.16	8.30	86
	mg/kg	VA-NRC-DOLT4	7.83	8.30	94
	mg/kg	VA-NRC-DOLT4	7.70	8.30	93
	mg/kg	VA-NRC-DOLT4	8.24	8.30	99
	mg/kg	VA-NRC-TORT2	6.35	5.63	113
	mg/kg	VA-NRC-TORT2	5.25	5.63	93
	mg/kg	VA-NRC-TORT2	5.46	5.63	97
	mg/kg	VA-NRC-TORT2	5.36	5.63	95
	mg/kg	VA-NRC-TORT2	5.14	5.63	91
	mg/kg	VA-NRC-TORT2	5.52	5.63	98
	mg/kg	VA-NRC-TORT2	5.46	5.63	97

C5.0 DATA QUALITY STATEMENT

Overall, the quality of data for the Mount Polley selenium monitoring program was sufficient to serve the project objectives.

APPENDIX D

SUPPORTING DATA

Appendix Table D.1: In-situ water quality data collected during the Mount Polley selenium monitoring, 2012.

Area	Location ID	Date and time	Northing	Easting	Weather	Depth (m)	Secchi depth (m)	Probe depth	Temperature (°C)	Dissolved oxygen		pH	Sp. conductance (µS/cm)	Comments
										mg/L	% sat			
Bootjack Lake	B1a	5/16/2012 8:45	5823528	590049	overcast, ~8°C	19.0	2.1	Surface	6.24	11.43	92.3	7.40	79	calibrated DO
								Bottom	5.46	9.72	77.0	6.81	80	
	B2a	5/13/2012 14:30	5821647	591263	few clouds, ~20°C	17.5	2.7	Surface	8.66	11.12	95.6	7.33	79	
								Bottom	5.22	9.76	77.1	6.89	80	
	BOL-1	5/15/2012 11:08	5821590	591051	cloudy, ~10°C	11.9	-	Surface	10.90	8.80	78.1	7.44	79	
								Bottom	5.80	8.86	71.3	7.22	79	
	BOL-2	5/15/2012 12:17	5820967	591977	few clouds, ~12°C	12.2	-	Surface	10.30	10.38	93.3	7.41	79	calibrated DO
								Bottom	5.70	8.65	69.2	6.93	93	
	BOL-3	5/15/2012 13:44	5821502	591805	partly cloudy, ~ 15°C	11.8	-	Surface	10.16	11.51	102.8	7.36	79	calibrated DO
								Bottom	6.09	10.71	86.3	7.06	92	
	BOL-4	5/15/2012 15:11	5823321	590556	partly cloudy, ~18°C	11.8	-	Surface	10.67	10.14	91.3	7.34	79	calibrated DO
								Bottom	5.69	8.70	7.05	6.93	79	
	BOL-5	5/16/2012 10:24	5823593	590007	few clouds, ~10°C	12.2	-	Surface	6.11	12.94	104.4	7.14	79	
								Bottom	5.60	11.57	91.9	6.95	80	
Frypan Lake	FRL-1	5/11/2012 13:48	5827124	591632	clear, ~8°C	9.5	-	Surface	10.82	10.03	90.7	7.57	104	
								Bottom	3.90	3.98	30.3	6.9	136	
	FRL-2	5/11/2012 14:37	5827301	591536	sunny, ~10°C	9.2	-	Surface	11.23	10.65	97.2	7.57	104	
								Bottom	3.92	4.29	32.7	6.9	133	
	FRL-3	5/11/2012 15:51	5827270	591382	sunny, ~12°C	9.6	-	Surface	11.45	9.82	90.1	7.58	104	
								Bottom	3.93	4.48	32.6	6.95	133	
	FRL-4	5/12/2012 9:00	5827199	591349	clear, ~5°C	9.3	-	Surface	10.33	10.59	94.6	7.46	104	
								Bottom	3.99	4.84	36.9	6.84	131	
	FRL-5	5/12/2012 9:23	5827107	591427	clear, ~8°C	9.2	-	Surface	10.30	10.73	95.8	7.55	103	
								Bottom	4.20	4.57	35.1	6.88	131	
	FRL-W	5/11/2012 13:18	5827153	591379	sunny, ~10°C	12.0	1.7	Surface	10.54	10.22	91.8	7.56	103	
								Bottom	3.86	1.24	9.5	6.66	144	
Hazeltine Creek	W7	5/16/2012 10:10	5819045	596972	few clouds, ~10°C	-	-	-	9.0	-	-	8.04	205	-
	W11	5/3/2012 11:29	5817534	601577	-	-	-	-	5.5	-	-	7.75	101	-
MESCP	E4-1	5/16/2012 13:30	5818393	595723	few clouds, ~15°C	1.7	> depth of pond	Surface	12.83	9.68	92.2	8.41	970	
								Bottom	12.41	9.86	92.5	8.38	988	
	E4-2	5/16/2012 14:15	5818437	595782	few clouds, ~15°C	1.5	-	Surface	13.45	9.27	89.1	8.48	974	
								Bottom	12.79	9.47	89.1	8.46	987	
	E4-3	5/16/2012 14:34	5818412	595803	few clouds, ~15°C	1.6	-	Surface	12.82	9.09	86.1	8.49	993	
								Bottom	12.41	9.48	89.1	8.5	998	
	E4-4	5/16/2012 14:50	5818375	595755	few clouds, ~15°C	1.6	-	Surface	13.03	9.04	86.1	840	993	
								Bottom	12.39	9.74	91.5	8.43	1001	
	E4-5	5/16/2012 15:13	5818370	595797	few clouds, ~15°C	1.7	-	Surface	12.93	9.09	86.3	8.36	996	
								Bottom	12.33	9.84	92.3	8.46	1000	

Appendix Table D.1: In-situ water quality data collected during the Mount Polley selenium monitoring, 2012.

Area	Location ID	Date and time	Northing	Easting	Weather	Depth (m)	Secchi depth (m)	Probe depth	Temperature (°C)	Dissolved oxygen		pH	Sp. conductance (µS/cm)	Comments
										mg/L	% sat			
Polley Lake	P1	5/8/2012 12:45	5824693	593708	partly cloudy, ~10°C	33.5	2.6	Surface	6.34	12.14	98.4	7.96	191	
								Bottom	4.00	10.66	81.3	7.54	197	
	P2a	5/7/2012 13:17	5822183	595166	sunny, ~15°C	32.6	4.1	Surface	4.6	11.29	87.5	7.74	196	
								Bottom	3.43	7.07	53.1	7.36	236	
	POL-1	5/9/2012 15:31	5825674	593203	cloudy, light snow, ~5°C	19.8	-	Surface	4.88	11.67	91.2	7.79	193	
								Bottom	3.72	9.78	74.2	7.59	198	
	POL-2	5/9/2012 16:47	5824182	594371	partly cloudy, ~5°C	19.3	-	Surface	4.43	10.94	84.4	7.79	196	moderate waves
								Bottom	4.36	10.84	83.5	7.75	197	
	POL-3	5/10/2012 11:11	5822625	594689	cloudy, ~5°	19.5	-	Surface	5.26	11.44	90.3	7.85	185	calibrated meter
								Bottom	4.81	11.24	87.7	7.78	185	
	POL-4	5/10/2012 13:20	5821775	595533	some clouds, ~10°C	19.9	-	Surface	5.88	11.46	91.8	8.09	184	
								Bottom	5.25	10.72	84.6	7.78	184	
	POL-5	5/10/2012 14:28	5821612	595367	partly cloudy, ~10°C	20.2	-	Surface	6.28	11.80	95.5	8.14	183	
								Bottom	5.25	11.34	89.4	7.87	185	
	DSW4-1	5/8/2012 14:27	5824698	593453	partly cloudy, ~10°C	7.8	-	Surface	6.15	13.62	109.8	7.82	192	
								Bottom	5.3	13.35	105.6	7.94	193	
	DSW4-2	5/9/2012 9:59	5824672	593462	partly cloudy, ~8°C	9.4	-	Surface	6.38	11.85	96.1	-	192	moderate waves
								Bottom	4.88	11.6	90.2	7.68	194	
	DSW4-3	5/9/2012 11:33	5824659	593475	few clouds, ~10°C	9.3	-	Surface	6.39	12.11	98.3	8.03	191	
								Bottom	5.53	11.8	93.7	8.04	192	
	DSW4-4	5/9/2012 12:13	5824641	593486	few clouds, ~12°C	9.7	-	Surface	6.52	11.78	96	8.02	191	
								Bottom	5.49	11.51	91.4	8.03	193	
	DSW4-5	5/9/2012 13:10	5824614	593504	partly cloudy, ~12°C	9.7	-	Surface	6.4	11.99	97.4	8.15	191	
								Bottom	5.55	11.91	94.6	8.07	193	
Quesnel Lake north arm	QUL-1	5/14/2012 12:36	5848649	647891	few clouds, ~10°C	9.5	-	Surface	7.12	11.13	92.0	7.46	108	
								Bottom	5.72	11.23	89.6	7.38	108	
	QUL-2	5/14/2012 13:16	5848661	648078	few clouds, ~10°C	10.0	-	Surface	7.81	10.49	88.1	7.52	112	
								Bottom	6.06	10.82	87.1	7.39	133	
	QUL-3	5/14/2012 13:53	5848667	648135	few clouds, ~15°C	10.2	-	Surface	7.77	10.54	88.5	7.51	112	
								Bottom	5.81	11.48	91.8	7.44	114	
	QUL-4	5/14/2012 14:55	5848657	647979	few clouds, ~15°C	9.9	-	Surface	7.11	10.81	87.4	7.49	108	
								Bottom	5.89	10.99	88.1	7.4	113	
	QUL-5	5/14/2012 15:16	5848620	647825	few clouds, ~18°C	9.6	-	Surface	6.62	7.42	10.94	89.3	103	
								Bottom	5.43	10.91	86.4	7.39	115	
Trio Lake	TRL-1	5/12/2012 12:54	5821096	588538	clear, ~12°C	6.2	-	Surface	8.05	10.07	84.8	7.03	64	
								Bottom	6.43	9.2	74.9	6.87	64	
	TRL-2	5/12/2012 14:46	5821568	588507	sunny, ~15°C	6.1	-	Surface	10.04	10.65	94.4	7.25	64	
								Bottom	7.2	6.74	80.7	7	65	
	TRL-3	5/12/2012 15:19	5821504	588348	sunny, ~15°C	6.3	-	Surface	9.34	10.11	88.2	7.14	64	
								Bottom	7.14	9.6	79.3	7.01	64	
	TRL-4	5/13/2012 8:42	5821331	588320	few clouds, ~5°C	6.0	-	Surface	9.44	11.19	97.9	7.25	64	
								Bottom	6.91	10.49	86.2	7	64	
	TRL-5	5/13/2012 9:23	5821154	588311	sunny, ~10°C	5.9	-	Surface	9.28	11.3	93.4	7.25	64	
								Bottom	6.6	10.14	81.8	6.98	64	
	TRL-W	5/12/2012 12:42	5821301	588471	clear ~12°C	7.9	2.2	Surface	8.43	9.88	84.3	7.09	64	
								Bottom	6.46	8.55	69.6	6.73	65	

Table D.2: Fishing summary of all areas by area, Mount Polley 2012

Area	Species	Caught	Retained	Released alive	Mortalities other than retained	Overall CPUE[a]
Bootjack Lake	Largescale sucker	10	0	6	4	0.0003
	Longnose sucker	50	39	11	0	0.0015
	Rainbow trout	23	14	9	0	0.0007
	Total	83	53	26	4	0.0025
Frypan Lake	Rainbow trout	36	23	13	0	0.0013
Polley Lake	Longnose sucker	68	32	36	0	0.0013
	Rainbow trout	30	22	8	0	0.0006
	Total	98	54	44	0	0.0019
Quesnel Lake at Hazeltine Creek mouth	Burbot	1	0	1	0	0.0000
	Lake trout	7	0	5	2	0.0001
	Largescale sucker	28	23	4	1	0.0004
	Longnose sucker	9	3	6	0	0.0001
	Mtn. whitefish	15	0	12	3	0.0002
	Peamouth chub	41	3	24	14	0.0005
	Rainbow trout	13	12	1	0	0.0002
	Total	114	41	53	20	0.0014
Quesnel Lake north arm	Largescale sucker	3	2	1	0	0.0001
	Mountain whitefish	6	0	5	1	0.0001
	Rainbow trout	7	7	0	0	0.0001
	Total	16	9	6	1	0.0003
Trio Lake	Rainbow trout	29	14	15	0	0.0010
W7 (Hazeltine Creek)	Rainbow trout	20	17	3	0	0.0670[b]
Total, all areas		396	211	160	25	0.0014[c]

[a] Gill netting catch per unit effort (caught / [ft^2 * h]) unless noted otherwise

[b] Electrofishing catch per unit effort (caught / s)

[c] Total CPUE for gill netting; does not include W7 fish

Table D.3: Fish meristic data, Mount Polley selenuim monitoring, 2012.

Area	Species	Processing date	Fish ID	Total length (cm)	Fork length (cm)	Body weight (g)	Age structure collected[a]	Sex[b]	Age	Gonad weight (g)	Liver weight (g)	Abnormalities
Bootjack Lake	Longnose sucker	8-May-12	B-LSU-1	42.6	43.9	1030	Sc, Pf	F	13	147.23	20.01	-
			B-LSU-2	43.5	41.8	960	Sc, Pf	F	12	120.65	19.69	-
			B-LSU-3	52	55.3	1890	Sc, Pf	F	17	94.6	19.11	-
			B-LSU-4	46.9	43.5	1100	Sc, Pf	F	12	140.19	22.19	-
			B-LSU-5	46.7	44.5	1190	Sc, Pf	F	13	143.28	18.6	-
			B-LSU-6	47.3	44.4	1160	-	M	-	-	-	-
			B-LSU-7	38.1	36.8	635	-	M	-	-	-	-
			B-LSU-8	34.3	33	475	-	IM	-	-	-	-
			B-LSU-9	39	38	718	-	M	-	-	-	-
			B-LSU-10	37.5	36	525	-	F?	-	-	-	-
			B-LSU-11	34.7	33.2	442	-	F?	-	-	-	-
			B-LSU-12	37.8	36.2	680	-	M	-	-	-	-
			B-LSU-13	40.4	39	825	-	M	-	-	-	-
			B-LSU-14	42	40.1	895	-	F?	-	-	-	-
			B-LSU-15	42	40.4	890	-	F?	-	-	-	-
			B-LSU-16	43.6	42	970	-	F?	-	-	-	-
			B-LSU-17	37.7	36.3	593	-	M	-	-	-	-
			B-LSU-18	44.8	43.1	1095	-	F?	-	-	-	-
			B-LSU-19	42.1	39.9	895	-	F?	-	-	-	-
	Rainbow trout	8-May-12	B-RB-1	33.5	32.8	380	Sc, O	F	6	60.82	3.71	-
			B-RB-2	33.2	35.3	375	-	M	-	-	-	-
			B-RB-3	31.6	30	285	-	M	-	-	-	-
			B-RB-4	33.1	31.5	335	-	M	-	-	-	-
			B-RB-5	31.1	30	305	Sc, O	F	4	42.05	3.11	-
			B-RB-6	30.6	29.5	275	-	M	-	-	-	-
			B-RB-7	31.4	30	277	Sc, O	F	6	21.33	7.58	-
			B-RB-8	30.5	29.3	212	-	M	-	-	-	-
			B-RB-9	27.9	26	187	-	M	-	-	-	-
			BOL-RB-1	29.6	28.3	232	Sc, O	F	6	28.242	2.842	worms
			BOL-RB-2	30.1	28.1	234	-	IF	-	0.942	2.842	-
		13-May-12	BOL-RB-3	35.6	33.8	360	-	M	-	-	-	-
			BOL-RB-4	32.2	30.8	288	Sc, O	F	4	39.806	2.227	-
			BOL-RB-5	33.2	31.4	292	-	M	-	-	-	-
Frypan Lake	Rainbow trout	11-May-12	FRL-RB-1	29.1	27.2	196	Sc, O	F	5	1.017	2.011	-
			FRL-RB-2	28.3	26.2	168	Sc, O	F	4	0.699	2.125	-
			FRL-RB-3	27.6	25.7	164	Sc, O	F	-	0.791	1.429	-
			FRL-RB-4	25.4	23.5	138	Sc, O	F	4	0.585	1.654	-
			FRL-RB-5	26.8	24.8	152	Sc, O	F	4	0.644	1.350	-

[a] Sc = scales, O = otoliths, Pf = pectoral fin ray
[b] M = male, F = female, I = immature, ? = unknown

Table D.3: Fish meristic data, Mount Polley selenuim monitoring, 2012.

Area	Species	Processing date	Fish ID	Total length (cm)	Fork length (cm)	Body weight (g)	Age structure collected[a]	Sex[b]	Age	Gonad weight (g)	Liver weight (g)	Abnormalities
Polley Lake	Longnose sucker	1-May-12	P-LSU-1	43.5	41.5	1000	Pf	F	11	176.87	17.85	-
			P-LSU-2	42.0	39.5	820	Pf	F	9	144.05	11.45	-
			P-LSU-3	44.5	42.5	1080	Pf	F	11	204.71	26.16	-
			P-LSU-4	46.3	44.4	1340	Pf	F	11	201.54	33.12	-
			P-LSU-5	45.0	43	1050	Pf	F	13	171.73	21.40	-
			P-LSU-6	47.5	45.3	1360	-	F	-	-	-	-
			P-LSU-7	22	20.7	120	-	IM	-	-	-	-
			P-LSU-8	46.3	44.4	1270	-	F	-	-	-	-
			P-LSU-9	46.5	44.3	1160	-	F	-	-	-	-
			P-LSU-10	44	42.2	1050	-	F	-	-	-	-
			P-LSU-11	46.6	44.3	1370	-	F	-	-	-	-
			P-LSU-12	44.2	42.5	1100	-	F	-	-	-	-
			P-LSU-13	47.5	45.1	1470	-	F	-	-	-	-
			P-LSU-14	41.8	38.7	590	-	F	-	-	-	-
			P-LSU-15	42.2	39.7	865	-	M	-	-	-	-
			P-LSU-16	43	40.3	565	-	M	-	-	-	-
			P-LSU-17	36	34.5	560	-	F	-	-	-	-
			P-LSU-18	44.7	42.8	1010	-	M	-	-	-	-
			P-LSU-19	36.3	34.6	565	-	F	-	-	-	-
			P-LSU-20	38	36.3	620	-	F	-	-	-	-
			P-LSU-21	41.3	39.9	865	-	F	-	-	-	-
			P-LSU-22	43.4	41.6	985	-	F	-	-	-	-
			P-LSU-23	46.4	44.9	1280	-	F	-	-	-	-
			P-LSU-24	43.2	40.5	865	-	F	-	-	-	-
			P-LSU-25	40.5	39.5	785	-	F	-	-	-	-
			P-LSU-26	42.2	39.8	825	-	M	-	-	-	-
	Rainbow trout	1-May-12	P-RB-1	40.7	39.9	650	-	M	-	-	-	-
			P-RB-2	31.0	30.5	280	-	M	-	-	-	-
			P-RB-3	31.0	30	250	-	M	-	-	-	-
			P-RB-4	32.5	32	380	-	M	-	-	-	-
			P-RB-5	34.0	33	370	-	M	-	-	-	-
			P-RB-6	34.5	34	370	-	M	-	-	-	-
			P-RB-7	30.5	29.5	280	-	F	5	38.66	3.18	worms, cysts
			P-RB-8	31.3	32	310	-	M	-	-	-	-
			P-RB-9	31.7	30.3	270	-	IM	-	-	-	-
			P-RB-10	31.0	29.8	290	-	M	-	-	-	-
			P-RB-11	32.0	31.3	300	-	M	-	-	-	-
			P-RB-12	29.5	28	270	O	F	5	32.78	4.37	worms, cysts
			P-RB-13	31.5	29.9	105	-	IM	-	-	-	-
			P-RB-14	30.8	30	270	-	M	-	-	-	-
		8-May-12	POL-RB-1	33.8	31.9	320	-	M	-	-	-	-

[a] Sc = scales, O = otoliths, Pf = pectoral fin ray
[b] M = male, F = female, I = immature, ? = unknown

Table D.3: Fish meristic data, Mount Polley selenuim monitoring, 2012.

Area	Species	Processing date	Fish ID	Total length (cm)	Fork length (cm)	Body weight (g)	Age structure collected[a]	Sex[b]	Age	Gonad weight (g)	Liver weight (g)	Abnormalities
Polley Lake	Rainbow trout	10-May-12	POL-RB-2	31.4	29.7	270	-	F	5	46.253	2.112	worms
			POL-RB-3	31.4	29.5	284	Sc, O	F	5	42.695	3.443	-
			POL-RB-4	30.3	28.4	226	-	F	5	31.946	2.497	worms
Quesnel Lake at Hazeltine Creek mouth	Largescale sucker	3-May-12	QH-CSU-1	40.6	38.4	735	-	IM	-	-	-	-
			QH-CSU-2	50.5	48.1	1420	Sc, Pf	F	14	102.72	57.82	-
			QH-CSU-3	37	35.4	580	-	IM	-	-	-	-
			QH-CSU-4	34.9	33.2	475	-	IM	-	-	-	-
			QH-CSU-5	35.3	33.7	470	-	IM	-	-	-	-
			QH-CSU-6	36	34	495	-	IM	-	-	-	-
			QH-CSU-7	30.6	28.5	360	-	IM	-	-	-	-
			QH-CSU-8	34.7	32.4	490	-	M	-	-	-	-
			QH-CSU-9	38.4	36.2	575	-	IF	-	-	-	-
			QH-CSU-10	32.7	31.1	380	-	IF	-	-	-	-
			QH-CSU-11	32	30.4	360	-	IM	-	-	-	-
			QH-CSU-12	29.7	27.9	290	-	IM	-	-	-	-
			QH-CSU-13	34.8	32.9	425	-	IM	-	-	-	-
			QH-CSU-14	21.7	20.1	110	-	IM	-	-	-	-
		7-May-12	QH-CSU-15	32.8	31.2	380	-	IM	-	-	-	-
			QH-CSU-16	54.3	52	2200	Sc, Pf	F	20	214.22	48.07	-
			QH-CSU-17	50.9	47.5	1615	Sc, Pf	F	15	232.49	39.93	-
			QH-CSU-18	37.1	34.7	480	-	IM	-	-	-	-
			QH-CSU-19	36.4	34.8	550	-	IF	-	-	-	-
			QH-CSU-20	38.3	36	575	-	IM	-	-	-	-
		15-May-12	QH-LSU-5	54.8	51	2100	Sc, Pf	F	21	277.459	33.640	-
			QH-LSU-6	48.6	46.2	1300	Sc, Pf	F	15	180.746	24.150	-
	Rainbow trout	2-May-12	QH-RB-1	34.2	32	340	-	F	5	-	-	-
			QH-RB-2	53.6	51	1170	-	F	-	-	-	-
		3-May-12	QH-RB-3	41.4	40	755	Sc, O	F	5	121.1	13.59	worms
			QH-RB-4	41.3	40.6	725	Sc, O	F	5	101.38	5.39	-
			QH-RB-5	53.2	52.4	1760	Sc, O	F	5	270.42	33.87	worms
		15-May-12	QH-RB-5	43.8	41.4	685	-	IF	-	-	-	-
			QH-RB-6	41.1	38.6	550	-	M	-	-	-	-
			QH-RB-7	39.4	37.3	530	-	IF	-	-	-	-
			QH-RB-8	39.4	37.1	490	Sc, O	F	6	4.895	4.276	-
			QH-RB-9	41	38.6	560	Sc, O	F	5	6.772	5.774	-
			QH-RB-10	41	38.7	540	Sc, O	F	-	-	-	-
			QH-RB-11	39.4	37.6	470	Sc, O	F	-	-	-	-

[a] Sc = scales, O = otoliths, Pf = pectoral fin ray
[b] M = male, F = female, I = immature, ? = unknown

Table D.3: Fish meristic data, Mount Polley selenuim monitoring, 2012.

Area	Species	Processing date	Fish ID	Total length (cm)	Fork length (cm)	Body weight (g)	Age structure collected[a]	Sex[b]	Age	Gonad weight (g)	Liver weight (g)	Abnormalities
Quesnel Lake north arm	Largescale sucker	9-May-12	NA-CSU-1	48.2	46.2	1315	-	M	-	-	-	-
			NA-CSU-2	47	45	1295	-	F	15	143.87	18.9	-
	Rainbow trout	9-May-12	NA-RB-1	59	58.1	2415	-	M	-	-	-	-
			NA-RB-2	49	47	780	-	F	7	63.75	15.68	worms
			NA-RB-3	42.6	40.4	720	-	F	6	3.27	5.83	-
			NA-RB-4	37	39.1	535	-	M	-	-	-	worms
			NA-RB-5	36.1	34.8	467	-	M	-	-	-	-
			NA-RB-6	38.2	36	515	-	IF	-	1.7	-	-
		15-May-12	QUL-RB-1	40.2	38	650	Sc, O	F	-	127.137	6.502	-
Trio Lake	Rainbow trout	12-May-12	TRL-RB-1	41.2	38.8	690	Sc, O	F	4	129.458	7.583	-
			TRL-RB-2	32.4	29.8	300	Sc, O	F	3	0.631	3.191	-
			TRL-RB-3	29.6	28.3	256	Sc, O	F	3	0.485	3.065	-
			TRL-RB-4	30.6	29	262	Sc, O	F	4	0.746	2.318	-
			TRL-RB-5	28.5	26.6	210	Sc, O	F	3	0.496	1.921	-
W7 (Hazeltine Creek)	Rainbow trout	15-May-12	HAC-RB-1	31.6	29.3	277	-	M	-	-	-	-
			HAC-RB-2	30.1	28.4	241	Sc, O	F	5	33.205	2.158	worms
			HAC-RB-3	30.2	28.4	252	-	M	-	-	-	-
			HAC-RB-4	31.0	28.8	274	-	M	-	-	-	-
			HAC-RB-5	30.6	28.7	268	-	M	-	-	-	-
			HAC-RB-6	29.0	27.4	238	-	M	-	-	-	-
			HAC-RB-7	29.5	27.5	268	Sc, O	F	5	30.234	2.752	worms
			HAC-RB-8	30.0	28.2	282	Sc, O	F	6	57.407	3.259	worms
			HAC-RB-9	30.5	29.4	244	Sc, O	F	5	34.323	2.539	worms
			HAC-RB-10	30.5	28.9	260	Sc, O	F	5	45.543	2.514	worms
			HAC-RB-11	30.8	28.9	270	Sc, O	F	5	44.644	2.155	worms
			HAC-RB-12	27.5	25.6	204	Sc, O	F	5	35.315	1.385	worms
			HAC-RB-13	33.8	31.6	230	-	F	-	-	-	-
			HAC-RB-14	29.5	27.8	220	-	F	-	-	-	-
			HAC-RB-15	26.0	24.5	152	-	F	-	-	-	-
			HAC-RB-16	28.4	26.5	218	Sc, O	F	5	35.431	1.927	worms
			HAC-RB-17	30.0	28.5	192	-	M	-	-	-	-

[a] Sc = scales, O = otoliths, Pf = pectoral fin ray
[b] M = male, F = female, I = immature, ? = unknown