QUINSAM COAL

Volume I

2011-2012 Annual Water Quality Monitoring Report

Covering Waste Management Permit-07008

2011/2012 ANNUAL WATER QUALITY MONITORING REPORT

COVERING WASTE MANAGEMENT PERMIT

PE-07008

REPORTING PERIOD FROM APRIL 1, 2011 TO MARCH 31, 2012

QUINSAM COAL CORPORATION

P.O. BOX 5000

CAMPBELL RIVER, B.C.

V9W 5C5

Executive Summary

The water management systems for the North and South mine areas are separated geographically by the Quinsam River Valley. The systems consist of a series of diversion ditches, sumps, settling ponds, and collection ponds.

The North Mine monitoring stations include: 2 North Portal Sump, 2 North Pit Sump (WP), Settling Pond #4 (WD), Middle Quinsam Lake Inlet (WA), the tributary to Middle Quinsam Lake, Culvert into Middle Quinsam Lake (WC), and South Dyke Pond. Recently added stations include the plant ditch seep (PDS), the water from the plant ditch seep as it flows through into Middle Quinsam Lake (PDS_R), and Quinsam River Downstream Site 1 (QRDS1).

The South Mine monitoring stations include: Settling Pond #1 (SPD), 3 South Pit (3S), 3S77 Audit Pit (3S-77), 4 South Inflow (4S-In), 4 South Upper (4S-Up), 4 South Under the Pad (4S-UPAD), 4 South Ditch (4S Lower), roadside creek (SPC), Long Lake Outlet (LLO), No Name Lake Outlet (NNO), Middle Quinsam Lake Outlet (WB), and the culvert into Long Lake (LLE).

The 7 South sampling locations include 7 South (7S) and 7 South Quinsam River (7SQR).

During this reporting year, samples were collected from more than 35 locations and more than 7,000 analyses were performed. All sampling was conducted in accordance with the Effluent Permit PE-07008 and recommendations by the Environmental Technical Review Committee (ETRC). The samples were collected as specified by the Ministry of Environment Sampling Guidelines for field collections and the QA/QC procedures outlined by Golder Associates Inc. in 2004.

Maxxam Analytics performs all analytical requirements for water quality and sediment analysis. Maxxam Analytics is a qualified independent laboratory based in Burnaby, B.C. and is also the laboratory of choice for the Ministry of Environment in Nanaimo.

There are two permitted mine effluent points, one at SPD (South mine area) and the other at WD (North mine area). Both are equipped with continuous flow meters which ensures the consistent recording of the water discharged at the decant system throughout the year. Automatic samplers are coupled with these meters to collect the requisite water quality samples.

At WD all permit parameters remained below the applicable permit requirements, with the exception of four TSS sample results. For three of the four exceedances it was determined that the elevated TSS results were likely due to a build-up of scale in the sample containers used to

collect composite water samples. The sampling procedures have been modified to reduce this source of error. The fourth TSS exceedance coincided with heavy rainfall on both the days leading up to and the day of the exceedance. Heavy precipitation can increase surface runoff and therefore influence the TSS levels recorded at the settling ponds.

According to the 4 Year Annual Averages results (Table 78-1 to 79-2) included in Section 1, the majority of parameters analyzed in the sample results have shown decreases from last year's averages. Some exceptions are iron, mercury and cadmium.

The results at SPD were also all within permit limits with the exception of one TSS sample. The precipitation data form that period does not indicate heavy rainfall, however the 52 samples preceding this exceedance and the 44 samples following it all indicate TSS levels below the detection limit. This suggests that the exceedance is an exception and may be due to sampling error or an error in the analytical process.

The averages for total and dissolved metals at SPD have all decreased since last year, with a significant decrease in the concentrations of total and dissolved iron. Many of the other parameters monitored at this site have decreased or remained similar to annual averages recorded last year.

The analytical results from the receiving environment water monitoring stations have indicated similar trends to the past years. While most of the parameters monitored at these sites remain within the limits specified in the BC MoE Water Quality Guideline criteria reports, some results fell outside their respective threshold concentrations. These include acidity at LLO and sulphate, mercury, and manganese at MQL and LLM. The elevated mercury levels noted in the lake samples were deemed to be the result of equipment contamination. These issues have been resolved and, consequently, more consistent (lower) water quality results have been observed.

Sulphate levels at LLM have been studied as part of an ongoing monitoring process. Water emanating from the Long Lake Seep may be contributing to the changes noted in the water quality results at LLM. In 2010 Quinsam Coal retained Golder Associates to create a bench scale treatment system aimed at determining what combination of substrate could be used in a bioreactor cell to sequester sulphate. The results of this test would be implemented on a larger scale to treat water from the 2 South underground workings in order to mitigate the potential impacts of the Long Lake Seep. A passive treatment system was designed according to the results of these studies and has been installed in the last year. The system will be initiated in the 2012/2013 reporting year, with results to follow.

The effluent from the Middle Point Coal Storage and Barge Loading Facility was sampled in accordance with the requirements of the Ministry of Water, Land and Air Protection Permit PE-

17181. Results of the 2011/2012 monitoring period indicate that all of the water quality samples were below permit guidelines, with the exception of one sample with a pH value above the permit limit.

The last ETRC meeting was conducted on December 8, 2011. Recommendations were forwarded by the various groups in relation to changes to the annual report and additional monitoring. These recommendations have been incorporated and implemented, as necessary.

This report was prepared by Erin Webb, Environmental Technician for Quinsam Coal Corporation. We hope that the information in this report meets the requirements and expectations of the MoE and ETRC.

Sincerely,

Erin Webb

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1.0 INTRODUCTION

The Quinsam Coal Mine is located in the Quinsam River Watershed, approximately twenty-eight road kilometers southwest of Campbell River. The land occupied by the Quinsam Coal mining operation consists of approximately 143 hectares. Quinsam Coal is the only coal mine located on Vancouver Island and it is the only underground coal operation in British Columbia. The mine is operated by Quinsam Coal Corporation (QCC) and is owned by the parent company Hillsborough Resources Limited (Hillsborough).

The coal produced at the Quinsam mining operation is High Volatile Bituminous "A" thermal coal. The coal is processed at an onsite Preparation Plant and transported by B-train highway trucks to the Middle Point Barge Terminal, north of Campbell River where it is shipped, via barge, to customers and to Texada Island where larger ships are loaded at the LaFarge Texada load-out facility.

Due to its location adjacent to Middle Quinsam Lake, the Quinsam River, No Name Lake and Long Lake, strict effluent and waste quality standards have been established as part of the Mine Operating Permits issued by the Ministry of Environment (MOE) (formerly the Ministry of Water, Land and Air Protection) and the Ministry of Energy and Mines (formerly the Ministry of Energy Mines and Petroleum Resources). Quinsam Coal has maintained an environmental management system defined by the requirements of Waste Management Permit PE-07008 and has worked with the regulators to minimize the effects of the mining operation on the environment.

Sulphate concentrations in receiving environment surface waters (e.g., Long Lake) have continued to be a focal point for the water quality monitoring program at the Quinsam mine. Although there is no permitted sulphate concentration limit for the mine effluent, monitoring of sulphate at the designated water quality monitoring stations around the site is conducted as part of the permit PE-07008 monitoring program. A Provincial Ambient Water Quality Guideline of 100 mg/L for sulphate was established in November 2000, which applies to the receiving environment at the Quinsam Mine. QCC continues to assess sources of sulphate and management options to mitigate sulphate concentrations in mine effluents and in the receiving environment.

This report outlines the results of the 2011/12 Environmental Monitoring Program conducted by QCC in accordance with the requirements of Waste Management Permit PE-07008. Sample collection during the 2011/12 monitoring year was generally performed by QCC staff, except for

sampling of groundwater monitoring wells and specific environmental projects, which were conducted by environmental consultants, such as Golder Associates LTD. and Lorax Environmental LTD.

2.0 WATER MANAGEMENT SYSTEM

Settling ponds, sumps and ditches were developed to treat and manage water from underground workings and from surface runoff and to ensure the protection of the receiving environment in the surrounding watershed.

The surface water management system uses thirty and fifty-eight horse power electric pumps to extract water from the pits or underground workings and deliver to the treatment systems. As part of the dewatering system from underground to surface, the underground workings use 6 x 58 HP, 3 x 140 HP and 4 x 250 HP pumps, with a total pumping capacity of approximately 500 L/sec. There are 3 x 125 HP surface well pumps capable of pumping 115 L/sec each, located above the 1 Mains, 5 Mains 6 Mains area.

The critical pumps in the North water management system have redundant systems in place, such as generators, and are connected to the B.C. Hydro power-lines.

2.1 THE NORTH WATER MANAGEMENT SYSTEM

The North water management system consists of the 2 North underground sumps and surface sumps. The water is pumped into these sumps and given time to settle before it is pumped up to the surface. There are 3 underground pump stations, these include, 6 Mains, 5 Mains, and 1 Mains. 5 Mains and 6 Mains pump stations receive water, by gravity, from the developed/depillared area of 4 Mains including all of 7 Mains areas. This water is pumped directly to the surface through vertical wells into the Brinco Brook wetlands located upstream from Settling Pond #4, or alternately to the 2 North Portal Sump. The pump station at 1 Mains collects water, by gravity, from the remaining developed/depillared sections of 4 Mains. The water from 1 Mains is pumped into a reservoir (dam), referred to as the 3 Mains pump station, which also collects water from the former mine workings (gobs). 3 x 250 HP pumps, extract 1500 gal/min

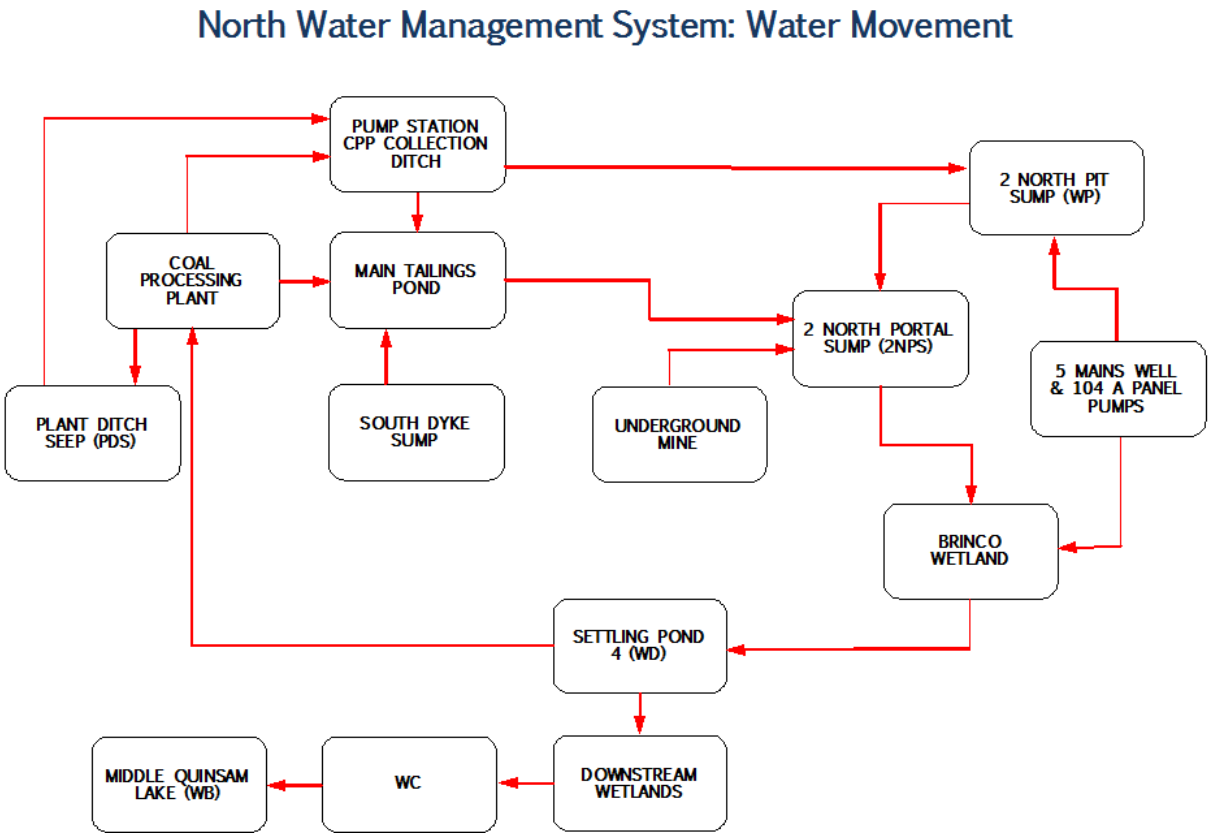
each and axial pumps carry the water from the underground dam to surface and into the Brinco Brook wetland, or alternately to the 2 North Portal Sump.

The 2 North Portal Sump is located outside the portal entry, it is a settling pond that collects water from underground sumps, seepage from the tailings dam and some surface runoff in the North mine area (Appendix VII, Photo 6).

The perimeter collection ditch, formerly the coal wash plant ditch, is a collection ditch that was previously used to collect all of the water and runoff from the 2 North areas and directed it into the 2 North Pit Sump (Photo 3).

In September, 2010 following a permit amendment through the MOE a 15 cm pipeline and a 58 HP pump was installed at the Coal Preparation Plant Tailings Pump Box, diverting the wash plant water from the wash plant ditch to the tailings impoundment. This pipeline eliminates the wash plant processing water from flowing into the plant ditch. The 2 North Pit Sump is no longer used for wash plant effluent as of September, 2010.

Settling Pond #4 is the final settling pond in the North water management system, where water is retained prior to being released into the receiving environment. Settling Pond #4 also provides process feed water to the Coal Preparation Plant. The decant riser (monitoring station WD) located at Settling Pond # 4 is the permitted North water management system discharge point (Photo 1-2). Prior to entering Middle Quinsam Lake the water flows through a meadow/wetland that provides additional settling time and a natural filtering of the minesite effluent before it enters Middle Quinsam Lake.



2.2 THE SOUTH WATER MANAGEMENT SYSTEM

All surface runoff from the South mine area, including the 3 South Pit, 4 South underground mine operations, catchment ditches, roadside ditches and catchment sumps is discharged through the South water management system at Settling Pond #1.

The 3 South Pit (Photo 17) collects waters from the 2 South and 1 South areas as well as surface run-off in the 3 south areas. From 1998 until 2010 when it reached its capacity for PAG-CCR, this pit has been used as a permanent sub-aqueous disposal facility for high sulfur reject materials generated from the mine operations. The water from this pit is pumped into Settling Pond #1 (Photo 13-14).

There are several sumps in the 4 south underground mine that collect underground water allowing it time to settle before it is pumped to surface, then stage pumped to Settling Pond #1. The water from the 4 South mine has not been pumped since mid-October 2010.

Settling Pond #1 is the final point of water collection in the South water management system before the water is discharged to the receiving environment. The decant riser (Monitoring Station SPD) located at settling pond #1 is the South water management system discharge point. The mine effluent travels from the Settling Pond #1 decant (SPD) through a series of meadow/wetland systems allowing for more settling time before entering Long Lake.

In October of 2010, a siphon pipeline was installed from Settling Pond # 1 extending to the 3 South Pit. This pipeline, allows for water to be siphoned from Settling Pond #1 into 3 South Pit when required.

2.3 WATER MANAGEMENT SYSTEM MAINTENANCE

The water management system involves the maintenance of haul roads, roadside ditches, catchment ditches, ponds, culverts, pumps and water lines through the mine site.

All of the catchment ditches, roadside ponds and culverts are regularly inspected and maintained as required. Some of the regular maintenance around the mine site includes the removal of debris from culverts, the replacement of silt fences and straw bales and the removal of sediment build-up from the catchment ditches and ponds. Pumps and water lines are inspected daily and maintained as part of the daily routine surface inspection performed by the surface foreman.

During 2011, the following repairs and maintenance occurred:

- Repairs to the drainage ditch and pipeline system between 2-South and 3-South
- Installation of a pump and line at 4-South to divert water away from a pond near the portal
- Annual maintenance of roadside ditches

3.0 MATERIALS AND METHODS: ENVIRONMENTAL MONITORING PROGRAM

For this reporting year (2011/12), all of the water samples collected were analyzed in accordance with Permit PE-07008. Field sampling was conducted in accordance with the methodologies as described in "*The British Columbia Field Sampling Manual for Continuous Monitoring of Air-Emissions, Water, Soil, Sediment, and Biological Samples 2003 Edition*".

Quinsam Coal contracts Maxxam Analytics of Burnaby B.C. for the analysis of all water quality samples. The periphyton and phytoplankton samples continue to be subcontracted to Stantec for sample analysis.

3.1 ENVIRONMENTAL MONITORING EQUIPMENT

An ISCO 4210 flow meter equipped with a paper chart plotter connected to a Sonic Depth Sensor is used to measure flow volumes at the two permitted discharge sites, Settling Pond #1 and Settling Pond #4. The equipment is calibrated and inspected on a regular basis. The batteries are replaced regularly in order to minimize the potential loss of information due to battery failure and the paper charts are replaced regularly. Daily reports from the flow meter are printed and include maximum and average flow volumes for each day. The information that is taken from the flow meter is recorded in a spreadsheet. This information can be found in tables 3-1 to 3-2 and 18-1 and 18-2.

The ISCO 12-volt automatic composite samplers are connected to the ISCO 4210 flow meters and sonic depth sensors (Photos 1-2, 13-14). The composite samplers were calibrated and placed in working order in March of 2009. The automatic sampler is programmed to take a 40 mL sample every 30 minutes in the event of an overflow or flow >0.054 m^3/s for WD decant and >0.046 m^3/s for SPD decant. The automatic sampler will continue to take samples for the duration of flows exceeding 0.054 m^3/s and 0.046m^3/s for WD decant and SPD decant, respectively. There are three effluent control orifices that can be used on the settling pond decant riser structures. A 545 mm orifice is used at Settling Pond # 1 and a 375mm or a 525 mm orifice is used at Settling Pond # 4. The 525 mm orifice is used at Settling Pond # 4 during periods of high precipitation, in order to manage the high water inflow rates into Settling Pond # 4. Ker Priestman and

Associates (KPA) and McElhanney Consulting formulated the calculations for the different orifice sizes and flows. The purpose of the orifices is to regulate the flow in order to detain water for a minimum of ten hours to allow for settling of suspended solids.

The Minisonde 5 Hydrolab and the 3 L Alpha Sampler was used for lake monitoring until July of 2010. Prior to the commencement of the lake analysis the Hydrolab was calibrated by Campbell Scientific of Edmonton, AB. QCC staff calibrated the Hydrolab periodically during the sampling season. For the sampling sessions from July 2010 onward, a YSI 600 was rented from Pine Environmental of Burnaby B.C., for all lake monitoring.

Davis Vantage Pro 2 weather monitor is located outside the office building. The Davis Vantage Pro 2 records rain, wind, barometric changes and temperature.

3.2 EFFLUENT WATER QUALITY SAMPLING

3.2.1 *PERMITTED DISCHARGE POINTS*

QCC monitors water quality at the Mine regularly through several designated sampling stations. There are two permitted discharge points where the mine water is discharged into the receiving environment: (SPD) Settling Pond #1 Decant, which is located in the South Mine Area and Settling Pond #4 Decant (WD), located in the North Mine Area. These sites are regulated by permit PE-07008 for both quality and quantity.

Water Quantity: Both of these monitoring stations are equipped with flow meters, which measure and record the flow at one minute intervals. In order to comply with permit PE-07008 the sampling frequency is based on the decant flow volume. The permitted maximum allowable rate of discharge at Settling Pond #1, SPD Decant is 0.46 m^3/s and Settling Pond #4 WD Decant is 0.32 m^3/s. Sampling of the two monitoring stations is based on the settling pond's decant flow levels which includes a daily composite sample when decant flow is >0.054m^3/s and a weekly sample when decant flow is <0.054 m^3/s for Settling Pond # 4. For Settling Pond # 1 a daily composite sample is required for decant flow of >0.046 m^3/s and a weekly sample for decant flow <0.046 m^3/s.

Water Quality: In 2009, the ISCO 12-Volt automatic samplers were calibrated and placed in working order at the two settling ponds. The automated sampler is connected to the flow meter and takes a composite sample at a decant flow of >0.054 m^3/s. When there is no decant flow a weekly sample is taken. These samples are analyzed for total suspended solids on a weekly basis.

3.2.2 *MONITORING STATIONS*

Effluent water quality samples are collected from numerous designated monitoring stations around the mine site as shown in the site maps (Appendix XI) Water Monitoring Stations.

The North Mine Area monitoring stations include: 2 North Portal Sump (2-N-P-Sump), 2 North Pit Sump CCR Cover (WP), Settling Pond #4 (WD), Middle Quinsam Lake Inlet (WA), culvert into Middle Quinsam Lake (WC) and South Dyke Pond. The sulphate monitoring sites for the north area include D1 and D2. The 2N Bio-pass cells have been discontinued since the wash plant effluent was redirected to the tailings dam.

The South Mine area monitoring stations include: Settling Pond # 1 (SPD), 3 South Pit (3S), Long Lake Seep (LLS), 3S77 Audit Pit (3S77), 4 South Pipe to SPD (4S-P-SPD) (only sampled when pumping from underground), 4 South Mine Coal Storage Pad (4S Lower), Culvert downstream end at access road (SPC), Long Lake Outlet (LLO), No Name Lake Outlet (NNO), Middle Quinsam Lake Outlet (WB), and the culvert into Long Lake (LLE). Settling Pond #1 currently receives water from the 3 South Pit and the overland flow from the surrounding areas.

After discharging through the decant at Settling Pond #1, the effluent flows through a series of meadows and wetlands before discharging through the culvert at LLE into Long Lake. The point that the effluent enters the lake (LLE) is approximately 50 meters downstream of Long Lake Outlet (LLO) monitoring station.

The receiving water monitoring stations are:

- Middle Quinsam Lake: Center of Middle Quinsam Lake (MQL), Middle Quinsam Lake Inlet (WA) and Middle Quinsam Lake Outlet (WB),

- No Name Lake: No Name Lake Outlet (NNO),
- Long Lake: Center of Long Lake (LLM) and the outflow from Long Lake (LLO).

In addition, there are eight groundwater monitoring stations that are monitored on a quarterly basis by Golder associates. These wells include MW00 1S and 1D, and MW00 6S and 6D located in the North area down gradient of the wash plant ditch. The 2 South / 3 South monitoring wells include MW00-2, MW00-3, MW00-4 and MW00-5.

3.2.3 *Additional Monitoring Stations 2011-2012*

Quinsam Coal sometimes conducts additional monitoring at specific sites within the water management system. In the 2011/2012 monitoring year, one additional site was monitored at 7 South Quinsam River (7SQR).

The 7SQR sampling location was introduced to further monitor water quality downstream from the 7 South Portal site. After the water leaves the 7 South portal area it flows downstream via 'stream 1' towards the 7 South (7S) sampling station introduced in the 2010/2011 sampling year. From here it flows through a wetland area before entering the Quinsam River. 7SQR is located at a point downstream from where the water flowing from 7 South would enter the river.

3.2.4 *Water Collection*

The Environmental Department at the Quinsam Coal Mine performs daily, weekly and monthly routine sampling at approximately 30 sampling sites around the Quinsam watershed. Sampling and laboratory analysis of water from many of the sampling sites is carried out in accordance with existing permit provisions. Field sampling and collections were conducted in accordance with the methodologies as described in "*The British Columbia Field Sampling Manual for Continuous Monitoring of Air- Emissions, Water, Soil, Sediment, and Biological Samples 2003 Edition".*

All water samples collected for this monitoring year were collected using clean, laboratory supplied bottles, labeled and shipped using overnight courier services to ALS Environmental and

Maxxam Analytics. Most samples that were to be analyzed for the dissolved metals and dissolved Phosphorus were filtered and preserved in the field.

3.2.5 *WATER ANALYSIS*

Maxxam Analytical performs all of the laboratory analysis for QCC. QCC is required by permit PE-07008 to perform specific analysis on certain effluent samples. Each site has a different set of parameters required for analysis by permit. The parameters requested for effluent monitoring include the following:

- pH (standard units);
- Specific Conductance (µS/cm);
- Total suspended solids (TSS)
- Total dissolved solids (TDS) (mg/L);
- Alkalinity (mg/L as $CaCO_3$);
- Hardness (mg/L as $CaCO_3$);
- Sulphate (mg/L);
- Ammonia nitrogen,
- Nitrate/nitrite combined as nitrogen (mg/L);
- Total and dissolved phosphate (mg/L);
- Total and dissolved metals (mg/L);
- Oil and grease (for stations SPD and WD only) (mg/L); and
- Rainbow trout bioassays (for stations SPD and WD only).

3.2.6 *PERMITTED LIMITS*

The two permitted discharge sites, Settling Pond 1 (SPD) and Settling Pond 4 (WD) have permit limits for the following parameters:

- pH: 6.0-8.5 (SPD), 6.0-8.0 (WD);

- TSS: 25 mg/L (daily composite sample), 35 mg/L (hourly composite sample);
- Ammonia nitrogen: 1.0 mg/L;
- Dissolved phosphate: 0.03 mg/L;
- Dissolved aluminum: 0.5 mg/L;
- Dissolved copper: 0.02 mg/L;
- Dissolved iron: 0.3 mg/L (WD), 0.5 mg/L (SPD)
- Dissolved lead: 0.05 mg/L;
- Dissolved zinc: 0.1 mg/L (WD), 0.2 mg/L (SPD);
- Oil and grease: 10 mg/L
- Bioassays: no mortalities at 100% effluent concentration after 96 hours.

[1] *The required analysis for nitrate nitrogen and nitrite nitrogen were combined as per the permit amendment of July 2004.*

The MOE based the specified permit limits on water quality objectives developed for the Middle Quinsam Lake area in the report entitled "Campbell River Area, Middle Quinsam Lake Sub-Basin Water Quality Assessment and Objectives," dated November 1989.

The required metals analyses were performed using the recommended CCME/BC WQG analytical package for both total and dissolved metals at monitoring stations SPD and WD. Additionally a metals analysis was performed on all water samples within QCC water management system, which included a metals scan of thirty-one total metals and thirty-one dissolved metals. The type of analysis used for the dissolved metals was developed by ALS Environmental to analyze for a lower detection limit of metals. These samples were analyzed following the CCME/BC WQG analytical protocols. They were developed by ALS to comply with the most rigorous federal and British Columbia provincial guidelines for water quality proposed by the ETRC for both monitoring sites SPD and WD. This analytical package is used for the analysis of both total and dissolved metals at all monitoring stations as per the recommendations of the ETRC.

3.2.7 *DISCHARGE RATES*

The permitted maximum and average rate of discharge for Settling Pond #1 is 0.46m^3/s and 0.10m^3/s respectively. The maximum and average rate of discharge for Settling Pond #4 is 0.32m^3/s and 0.08m^3/s respectively. The authorized discharge period is for 365 d/a.

4.0 GROUNDWATER MONITORING WELLS

Quinsam Coal contracted the services of Golder Associates Ltd. to complete a hydrogeological assessment of sulphate in the groundwater in 2000. Eight groundwater monitoring wells were installed at the mine site by Golder in 2000. Two of the groundwater monitoring wells are multi-level monitoring wells (MW00-1 and MW00-6), which are located in the North Mine Area, down slope of the wash plant ditch. MW00-6 is located between the wash plant ditch and MW00-1. Details are provided in Appendix VI.

Single level groundwater monitoring wells MW00-2, MW00-3, MW00-4 and MW00-5 are located in the 2- South - 3 South areas. MW00-2 is located on the edge of the access road to the 3 South Pit, MW00-3, is located next to the 3 South Pit area, near the south end of Long Lake. MW00-4 and MW00-5 monitoring wells are located near MW00-3 in the former 2 South Pit and waste dump south of Long Lake.

The 5 South wells consist of 4 stations that were implemented as part of the baseline study for the 5 South/10 Mains mining operations in 2006. In order to provide baseline groundwater quality information in the 5 South “Phase 2” development area and to assess potential groundwater level changes during mining of ‘Phase 1”, additional drill holes and monitoring wells were included in the monitoring program. In 2005-06 a coal exploration program was carried out in the 5 South areas by QCC. In 2010, QCC obtained Golder to perform a hydrogeological assessment of groundwater monitoring wells and drill holes. As part of this, three drill holes were completed as monitoring wells these include: QU-05-15-MW1, QU-05-16-MW4 and QU-06-01-MW5 and one drill hole QU-05-14-MW2, remained as an open borehole.

Monitoring well (QU-05-16-MW4, and QU-06-01-MW5) are situated in the 5 South/11 mains development areas along the TimberWest Coal 600 logging road.

Monitoring well QU-05-15-MW1 and drill hole QU-05-14-MW2 are located in the 2-4 South Main Haul Road, located southwest of the 5 South development area.

During this reporting period several ground water monitoring wells were installed to support the 7-South (and related waste management plans) Mine Permit Amendment. In 7-South, four (QU-08-05, QU-08-08, QU-08-10, QU-08-13) previously installed exploration boreholes were developed as water quality monitoring wells.

The 4-South groundwater investigation included the installation, development and sampling of four new wells (QU-10-07, QU-10-08, QU-10-09, QU-11-01) and one previously installed borehole (QU-78-161).

The 2-North/5-South groundwater investigation included the installation, development and sampling of six new wells (QU-10-10, QU-10-11, QU-10-13, QU-11-03, QU-11-05, QU-11-09) and two previously installed boreholes (QU-05-13, QU-08-21).

4.1 GROUNDWATER COLLECTION & ANALYSIS

Collection of groundwater samples from the groundwater wells is performed quarterly by Golder Associates Ltd. Monitoring and sample collection for this report period were carried out in 2011/12 on May 12, 2011; July 12, 2011; November 3, 2011; and January 12, 2012. Methods for the 2011/12 groundwater sampling are outlined in the four Golder reports titled "*May 2011 Quarterly 2 North / 3 South Groundwater Monitoring Event, Quinsam Mine, Campbell River, BC*," "*July 2011 Quarterly 2 North / 3 South Groundwater Monitoring Event, Quinsam Mine, Campbell River, BC,*" "*November 2011 Groundwater Monitoring Program, Quinsam Mine, Campbell River, BC*," and *"2011/12 Annual Groundwater Monitoring Summary, 2 North, 3 South Areas Quinsam Mine, B.C*,". Laboratory analysis of the groundwater samples was performed by ALS Environmental.

A copy of the final report is provided in Appendix VI.

5.0 RECEIVING ENVIRONMENT WATER MONITORING STATIONS

The receiving environment water monitoring stations include stations located at Middle Quinsam Lake and Long Lake. The monitoring sites for the center of both lakes include Middle Quinsam Lake (MQL) and Long Lake (LLM), also included on both lakes are surface sulphate grab samples at designated locations on the surface of the lakes LL1-3 and MQL 1-6. The inflow to Middle Quinsam Lake (WA) and outflow from Middle Quinsam Lake (WB), No Name Lake (NNO), Long Lake (LLO), are also incorporated as part of the receiving water monitoring stations.

5.1 LAKE WATER COLLECTION

Lake water samples were collected by Quinsam Coal Staff from Long Lake and Middle Quinsam Lake for the months of April to September 2011. As in previous years, QCC's 12' aluminum boat with an outboard motor was used for all lake sampling events. All sampling procedures were carried out in accordance with permit PE -07008 and following the protocols outlined in the *British Columbia Field Sampling Manual for Continuous Monitoring of Air, Air-Emissions, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition.*

The lake sample collection includes depth profiles at 1 m, 4 m, 9 m and 1 m from bottom. The permitted parameters required to collect for analysis include: physical parameters, temperature, pH, dissolved oxygen, and specific conductance. Water chemistry samples are also collected at each of the depths (1, 4, 9 and 1 m from bottom). Samples for biological testing are collected at all depths except for the 1 m from bottom sample. A clear glass 3 L Alpha sampler, which allows for the accurate collection of replicate samples, is used for all sample collection. Depth profiling was recorded using a YSI 600. Depth profiling is recorded to determine the characteristics of the water in each lake at 1m intervals. The depth that the light penetrates the water or the transparency of the water was measured and recorded using a secchi disk.

The collection of Chlorophyll "A" and Pheopigment for depths of 1, 4 and 9 meters are collected in accordance with permit PE-07008. The sampling procedures include the collection of samples in 1L bottles at each of the stated depths including two 1L replicates for Chlorophyll "A" at each depth. The samples used for species count and identification are collected at 1, 4 and 9 m depths and preserved with Lugols solution. For details on the analysis of Chlorophyll "A" and Pheopigment see Appendix II.

Periphyton sampling at Long Lake Outlet (LLO) and at Middle Quinsam Lake Outlet (WB) took place between May 2011 and July 2011. The procedure used to collect the samples involves the placement of 4, 12 inch square glazed porcelain tiles, (2 at each site) placed in the outflows of each lake (LLO and WB). The tiles are placed in the flowing water and left for a period of six weeks. At the cessation of the six weeks the tiles are removed and the algal growth is carefully scraped off into collection jars. These samples are then shipped on ice to Maxxam Analytics. The species count and identifications are subcontracted through Maxxam to Stantec for analysis. For details on the analysis of Periphyton see Appendix II.

5.2 LAKE WATER ANALYSIS

Lake water quality monitoring focuses on the addition of large quantities of nutrients and the addition of sediment resulting from large land disturbances and traffic, and significant changes to lake water chemistry. As there are no permit limits for the lake monitoring stations, the lake water quality is compared to the Water Quality Objectives for Middle Quinsam Lake sub basin. In order to make accurate assessments of the lake water quality, the parameters that are monitored include the physical, chemical and biological aspects.

5.3 PHYSICAL WATER PARAMETERS

Physical water analyses performed at the center of Middle Quinsam and Long Lake includes:

- Dissolved oxygen (mg/L);
- Temperature (Celsius); and
- Light Extinction

5.4 CHEMICAL PARAMETERS

Generally, the same chemical water analysis is performed on the lake water samples as the mine effluent water samples, except for the additional requirement for kjeldahl nitrogen at Middle Quinsam Lake and Long Lake. An analysis of both total and dissolved metals for lake samples is performed, although the permit only requires total metals for lake samples. In addition to the required analysis, all total and dissolved metal concentrations were analyzed for parameters as per the CCME/BC WQG analytical package.

5.5 BIOLOGICAL PARAMETERS

The biological monitoring program was designed to monitor changes in algal species as a means of detecting possible Lake nutrification that would lead to algae blooms. In the past 12 years, the focus has been on monitoring changes in lake species that may be influenced by increasing sulphate concentrations. The following biological analyses are performed on the Middle Quinsam Lake and Long Lake water samples as required by permit PE-07008;

- Phytoplankton (chlorophyll “a” and pheopigment)
- Phytoplankton (counts and identification to species)

The following biological analysis is performed on the two river sites, Middle Quinsam Lake Outlet and Long Lake Outlet as required by permit PE-07008;

- Periphyton (chlorophyll “a” and pheopigment)
- Phytoplankton (counts and identification to species)

6.0 ENVIRONMENTAL INSPECTION PROCEDURES

6.1 WATER MANAGEMENT SYSTEM INSPECTION

QCC environmental staffs perform a routine inspection of the North and South portions of the mine water management system while conducting sampling duties.

For the North system, the inspection includes visually inspecting the culvert under the main road (Brinco Brook to Settling Pond 4) to ensure that the water is still flowing with no obstructions. A visual inspection of the (Settling Pond 4) main dam is performed to ensure the integrity of the dam structure. The main dam Settling Pond #4 decant is set up with a flow meter and automatic sampler. The flow meter measures and records the level of the water as it is decanting. This is checked to ensure it is still functioning normally and the report for that day is printed ensuring compliance with the permit PE-07008. The automatic sampler is inspected and the daily TSS composite samples are collected.

The South Mine Area inspection includes ensuring all of the pumping stations are functioning and the ponds are contained as well as the roadside sumps and silt fences. The pumping stations for the South Mine Area include South Dyke pond, 1 South Pit Sump and 3 South Pit Pond. The main dam Settling Pond #1 is visually inspected ensuring the integrity of the dam structure. The flow meter at the settling pond is inspected to ensure it is functioning normally. The report from the flow meter is printed ensuring compliance with the permit PE -07008; TSS composite samples are collected as required.

6.2 ROUTINE SURFACE INSPECTIONS

Routine weekly inspections are performed by QCC Environmental Department for all lake inlet and outlet water levels and pit water levels. Each of these sites is set up with staff gauges and the numbers are recorded on a weekly basis. Preventative measures are taken to avoid potential spills, seeps and acid rock drainage generation through inspections that are performed on the coarse and fine refuse material storage areas, haul road conditions, petroleum product storage areas, pumps and surface disturbance areas. These are performed by the Surface Maintenance

Foreman, Environmental Department staff and the contractor for QCC site maintenance. If a problem is detected at any of the inspected sites, it is reported immediately and the proper action is taken to mitigate the problem.

7.0 ENVIRONMENTAL SYSTEMS INSPECTIONS AND AUDITS

To ensure sustainability of the surrounding environment QCC participates with the ETRC, MEMPR and the MOE in regular site inspections and audits on the environmental performance of the Quinsam coal mine operation. QCC along with the participating parties have worked together since the start of mining operations to minimize the environmental impact of the Quinsam Coal Mine. This approach considers responsible environmental planning and management services allowing the Quinsam Coal Mine to uphold its primary environmental goals. These goals include minimizing environmental impacts, being environmentally sustainable and protecting environmental resources.

In the past QCC has had environmental consultants performing audits on the mine site. For example in 1996 Powers Environmental Services from Vancouver, B.C. performed an environmental audit on Quinsam Coal Mine; this audit concluded that "QCC was operating their coal production and trans-shipment facilities in an environmentally responsible manner." At that time it was found that "QCC had effective environmental management systems for mining waste" (Powers Environmental Services, 1996). This audit reviewed QCC's environmental monitoring program, policies and practices and made suggestions in accordance to the findings of the audit. In 2008, Golder Associates Ltd. conducted an audit with respect to quality assurance and quality control (QA/QC) of the environmental sampling program. Quinsam Coal relies heavily on outside consultants in environmental monitoring studies in order to benefit from third party objectivity and keep abreast of the latest methods used in managing the environmental impacts of the operation.

7.1 ENVIRONMENTAL TECHNICAL REVIEW COMMITTEE MEETING

On an annual basis, the Environmental Technical Review Committee (ETRC) meets to discuss the annual report on Water Quality Monitoring. Committee members include representatives from various environmental ministries and relevant groups, including the Ministry of Environment, the Ministry of Energy, Mines and Petroleum Resources, Environment Canada, Department of Fisheries and Oceans, City of Campbell River and QCC.

The 2011 meeting with the ETRC took place on December 8, 2011 at the Quinsam Mine site. The purpose of the meeting was to review the QCC 2010-11 Annual Water Quality Monitoring Report for completeness, identify issues and potential changes to the monitoring program and agree on recommendations to be made to the Ministry of Environment. The meeting minutes and recommendations from the ETRC are included in Appendix V. The recommended actions outlined in the report and subsequent follow-up by QCC are as follows**:**

Recommended Action 1

Provide one hard copy of the annual report to each ETRC agency member, plus an extra copy to the City for public sign out. The extra copy to the City will be returned to QCC after the public ETRC meeting to be forwarded to the library.

QCC Follow-up:

QCC will ensure that each ETRC agency member has a copy of the annual report. An additional copy will be made available to the City of Campbell River.

Recommended Action 2

Be consistent in the text when describing data. Include the range of the data (min – max) and the frequency of exceedances of either permit limits or water quality guidelines or objectives. When describing the frequency of exceedances, be sure the total number of samples collected is specified (e.g. 0 out of 6 samples exceeded the permit limit). Ensure tables include

highlighting to identify exceedances of permit and water quality objectives and guidelines, including cadmium.

QCC Follow-up:

The annual report has been formatted to include the above mentioned changes.

Recommended Action 3

Ensure comparisons to water quality guidelines and objectives are done correctly. Maximum guidelines/objectives can only be compared to individual results (not averages). Comparisons to average WQO or guidelines can only be done for data sets where 5 weekly samples were collected over a 30 day period, at minimum.

QCC Follow-up:

The report data now reflects the appropriate comparisons. Maximum guidelines are compared to individual results and comparisons to the average water quality objectives are only made where at least 5 weekly samples were collected over a 30 day period.

Recommended Action 4

Summarize actions taken as a result of issues raised during the public ETRC meeting.

QCC Follow-up:

The following actions were requested during the public ETRC meeting:

1. In subsequent Annual Reports, when writing about when mining commenced, ensure reference is given to the location of the mine being referred to.

Response: *Noted*.

2. In subsequent Annual Reports, ensure table font size is appropriate for the printed tables.

Response: The annual report has been formatted to ensure that all tables and graphs are an appropriate size and to ensure that the data included is legible.

3. Provide Leona Adams, of the CREC / Campbell River Estuary Protection Group, with information on the estimated lifespan of the liner used in the creation of the polishing pond for the biochemical reactor cells.

Response: QCC has not yet prepared and delivered this information.

Recommended Action 5

Report out on 4S/LLE iron investigation and address the issue. Ensure mine impacted water goes to treatment.

QCC Follow-up:

The report findings will be discussed as part of the 2012 ETRC meeting.

Recommended Action 6

Continue to ensure low level analysis for metals is done at the labs, with special attention to cadmium.

QCC Follow-up:

Low level analysis for metals has continued over the sampling year with special attention to cadmium.

Recommended Action 7

Provide a figure or slide at the public meeting showing the locations of the 2009 sediment samples and the related concentrations.

QCC Follow-up:

A figure, prepared and presented by Kathleen Russell, was offered at the public meeting to demonstrate the locations of the 2009 sediment samples and the related sampling results.

Recommended Action 8

Conduct an in depth review of the trend analysis report, communicate with the report authors, and make edits as needed. Circulate the final version of the report to the ETRC.

QCC Follow-up:

This report has been completed. Refer to Appendix X

7.2 MINISTRY OF ENVIRONMENT COMPLIANCE REVIEW RECORDS

The Ministry of the Environment conducts annual inspections of the environmental management system. On September 27, 2011 a review was conducted with the following recommendations and QCC's follow up. This information is also available in Appendix V.

Recommended Follow-Up:

1) Confirm the leak at the 5S surface water injection site was corrected.

QCC Follow-up: The leak at the 5S surface water injection site has been corrected.

2) Clear vegetation from the culvert to SP4 (east side of main haul road), to allow for visual inspections.

QCC Follow-up: The vegetation at the culvert at SP4 has been cleared to allow for visual inspections.

3) Consider whether a permit amendment will be required for the pumping rate to Settling Pond 4 prior to initiation of underground tailings injection. Regardless of whether an amendment is required, submit an explanation of how flows through the settling pond will change due to input of water from underground tailings injection.

QCC Follow-up: Flows through Settling Pond 4 are expected to stay within the permit limits (0.32 m3/s maximum and 0.08 m3/s average) due to input of water from the underground tailings injection. The current practice of pumping tailings to the tailings storage facility has the decanted water reporting to Settling Pond 4 via the 2-North Portal Sump pumping system. Once the underground tailings injection starts it is anticipated that the same volume of decanted water will be pumped from the underground workings to Settling Pond 4.

4) Notify MOE when the plant site collection box is close to overtopping and report overflows from the collection box to the plant site ditch, in accordance with permit section 2.1.4.

QCC Follow-up: Noted. Regular inspections are made of the collection box and sediment build up. Regular clean-outs ensure the collection box has the needed capacity to prevent overflows to the plant site ditch. A pump is in place in the sump below the plant site collection ditch to manage seepage from the ditch.

5) Continue sampling the seepage water collecting downgradient of the plant site ditch. In the 2011/12 Annual Report include an assessment of changes to water quality at this location since cessation of use of the ditch to convey water from the coal prep plant.

QCC Follow-up: The monitoring program at this site has been maintained. Assessment of changes to the water quality at this location will be conducted in the spring of 2013. The recent dry summer months have led to several gaps in water quality data. Conducting the analysis in the spring will allow for sufficient data to more accurately assess the progress at this site.

6) Continue the water quality study around the 4 South pad. If the pad is determined to be contributing runoff to the 2/4 South Haul Rd ditch the water must be rerouted to mine water management system, in accordance with permit section 3.10.

QCC Follow-up: This monitoring program has been maintained.

8.0 REPORT FORMAT

Quarterly monitoring reports and annual monitoring reports are submitted to the Regional Waste Manager as required by permit PE-07008. The quarterly reports typically include a narrative and data tables as they pertain to the permit. Annual reports include an annual summary of the water quality monitoring with reference to the historical trends, data analysis, and interpretation. Analytical results include chemical, physical, and biological water quality analysis.

In an attempt to make the annual report more organized, the current reporting year's results and the historical information are included in separate sections of this report.

This year the MOE and the ETRC have not requested any changes to the reporting format.

9.0 2011- 2012 EFFLUENT QUALITY RESULTS AND DISCUSSION

The north and south mine water management systems are separated geographically by the Quinsam River valley and are thus influenced by different sources. The South Mine Area water quality is not influenced by any of the North Mine Area water circuit, and the North Mine water quality is not influenced by any of the South Mine Area water circuit.

The main contributors to the effluent quality for the North Mine Area come from the 2/3 North underground mining operations, the coal washing process, temporary waste and coal product stockpiles, the main tailings facility and un-reclaimed surface disturbance.

Large scale mining in the South Mine Area ceased in April 30, 1999. Since then, there has been a small amount of coal mined (approximately 20,000 tones) from the 4 South mine in 2003, 2004 and 2005. Water originating from the inactive 4 South Mine, 3 South Pit and the un-reclaimed land are the main contributors to the effluent flows and quality in the south area.

The 2011/12 water quality data for the north and south area monitoring stations are presented in the Tables 1 to 4-2, and 16 to 19-2 section of this report.

For a detailed discussion of the North and South Water Management System see Section 2.1.1

9.1 THE NORTH AREA MONITORING STATIONS

The North area monitoring stations include the 2 North Portal Sump, 2 North Pit Sump (WP), Settling Pond #4 (WD), Middle Quinsam Lake Inlet (WA) and the culvert to Middle Quinsam Lake, (WC, the plant ditch seep at the road (PDSR), Middle Quinsam Lake Outlet (WB) and Quinsam River Downstream Site 1 (QRDS1). The sulphate monitoring sites for the North Mine Area include D1 and D2, (Refer to site map Appendix XI).

9.2 THE SOUTH AREA MONITORING STATIONS

The South Mine monitoring stations include: Settling Pond # 1 (SPD), 3 South Pit (3S), 3S77 Aidit Pit, 4 South Pipe to SPD (4S-P-SPD), 4 South Mine Coal Storage Pad runoff (4S Lower), roadside culvert (SPC), Long Lake Outlet (LLO), Culvert into Long Lake (LLE), No Name Lake Outlet (NNO) and additional sites in the 7 South area include: the proposed discharge from 7 South mine portal pond (7S), and 7 South Quinsam River (7S-QR), (Refer to Site Maps, Appendix XI).

9.3 SETTLING POND # 4 (WD)

All permit quality parameters were below the applicable permit criteria during this reporting year for Settling Pond 4. Refer to Tables 1 and Tables 2 - 1 to 2 - 2 for Settling Pond #4 water quality results.

9.3.1 *NUTRIENTS:*

Permit Limits:

Ammonia nitrogen: 1.0 mg/L;

Dissolved phosphorus: 0.03 mg/L;

Nitrite/nitrate nitrogen: no permit requirement.

All permit quality parameters were below the applicable permit criteria for nutrients during this reporting year for Settling Pond 4. Since the development of underground mining in 1992, the nutrient concentrations have remained stable and at low levels, commonly below detection limits. Refer to the historical graphs in the Graph Section (Graphs 6-8) of this report. The nutrient concentrations for Settling Pond # 4 for this reporting year consist of concentration lows to highs and annual averages: ammonia nitrogen ranged between <0.021 mg/L and 0.069 mg/L and averaged 0.042 mg/L; nitrite/nitrate nitrogen ranged between 0.02 mg/L and 0.09 mg/L and averaged 0.048 mg/L, and dissolved phosphorous ranged between <0.005 mg/L and 0.005 m/L and averaged 0.005 mg/L. In summary, ammonia nitrogen was exceeded 0/12 times, and dissolved phosphorous was exceeded 0/12 times.

9.3.2 *TOTAL SUSPENDED SOLIDS (TSS)*

Permit Limit: 25 mg/L Daily Composite,

35 mg/L Hourly Composite

Concentrations of total suspended solids (TSS) were below the applicable permit criteria during this reporting year for Settling Pond 4, with the exception of 4 days. The permit requires that weekly samples be collected from WD during decant flow <0.054m^3/s and daily composite samples be collected during decant flow of >0.054m^3/s. Settling Pond 4 had TSS values that ranged between <2.00 mg/L and 374.00 mg/L and averaged 6.56 mg/L. TSS samples exceeded

permit requirements 4/310[1] times (1.2% of samples). TSS samples collected for this report period were a combination of grab samples and composite samples.

9.3.3 *HARDNESS*

Concentrations of hardness ranged between 273 mg/L and 490 mg/L and averaged 408 mg/L for this monitoring period. Hardness has generally decreased since 1995 as discussed in the historical section (II.4.1.3).

9.3.4 *SULPHATE*

Sulphate concentrations at Settling Pond 4 ranged between 407 mg/L and 1100 mg/L and averaged 689 mg/L this report period. As reported in previous years seasonal trends are apparent from the sulphate data for the monitoring stations, with lower concentrations generally occurring during late winter and early spring and higher concentrations occurring during summer and early fall. Annual cycles in precipitation are likely responsible for the seasonal variations in sulphate concentrations at the mine site.

Graph 17, Precipitation/Sulphate in Settling Pond 4, compares weekly sulphate data to weekly precipitation data for 2011/12. As seen in the graph, sulphate concentrations were higher during

[1] Because the sampling guidelines only require samples within a certain flow range, samples are not required every day. This fraction represents the number of exceedances compared to the number of days where a sample was taken.

low precipitation months and lower during high precipitation months corresponding to the seasonal variation in precipitation.

9.3.5 *pH*

Permit Limit: 6.0 - 8.5.

All permit quality parameters were within the applicable permit criteria range for pH during this reporting year for Settling Pond 4.

pH was sampled on a weekly basis and ranged between 7.86 and 8.19 and averaged 8.05. The pH results showed that pH exceeded permit limits 0/57 times. There has been a slight increase in pH values recorded since the North Mine operation began in 1989. pH has been stable and consistent from year to year since 2001 as seen in Graph 2.

9.3.6 *Alkalinity*

Alkalinity concentrations ranged between 230 mg/L and 1300 mg/L and averaged 363 mg/L.

Alkalinity appears to have a seasonal concentration trend related to precipitation with higher concentrations during the winter and lower concentrations during the summer.

9.3.7 *Dissolved Metals*

Permit Limits:

Dissolved Aluminum: 0.5 mg/L

Dissolved Copper: 0.02 mg/L

Dissolved Iron: 0.3 mg/L

Dissolved Lead: 0.05 mg/L

Dissolved Zinc: 0.1 mg/L

Since the commencement of the underground mining in 1992, the permitted metal concentrations have maintained low and stable, with concentrations most often below detection limits. Concentrations of dissolved metals are monitored at Settling Pond 4 (WD). Graphs (9 -15), present the concentrations of the permitted metals (dissolved aluminum, copper, iron, lead, and zinc) and also those parameters of interest (arsenic and selenium). All of the dissolved metals were well below permit levels, with most concentrations below detection limits.

Dissolved Aluminum concentrations ranged from 0.006 mg/L to 0.024 mg/L and averaged 0.013 mg/L. Dissolved Copper concentrations ranged from 0.0005 mg/L to 0.0013 mg/L and averaged 0.0009 mg/L. Dissolved Iron concentrations ranged from 0.005 mg/L to 0.233 mg/L and averaged 0.042 mg/L. Dissolved Lead concentrations were consistently less than the detection limit of <0.00020 mg/L. Finally, dissolved Zinc concentrations were consistently less than the detection limit of <0.005 mg/L. For all permitted parameters, dissolved aluminum, copper, iron, lead and zinc, results exceeded permit limits 0/12 times.

There have been no observable changes in the dissolved metal concentrations and, as demonstrated by graphs 9-15, there are no significant impacts to water quality from these metals as all of the metals remain near or below detection limits. Dissolved arsenic (Graph 10) and selenium (Graph 14) are with concentrations remaining below detection limits since 1994.

Water hardness and alkalinity are monitored through the concentrations of dissolved calcium, magnesium and sodium contributions. Dissolved calcium, magnesium and sodium are graphed together (Graph 16) for a simple comparison of contributions of these parameters. Dissolved calcium, magnesium and sodium show annual average concentrations of 138 mg/L, 16 mg/L and 324 mg/L, respectively. Graph 16, indicates the similarity in trends between the three dissolved metals. As with other parameters there are seasonal concentration trends dependent on the

amount of precipitation. The yearly trend indicates lower concentrations during the winter months and higher concentration in the late summer/early fall months.

9.3.8 *Water Quality Permit Limit Exceedances*

There were four instances where TSS sample results at Settling Pond 4 exceeded the permit limits. During the period of December 8, 9, and 10, daily composite samples reported values of 374 mg/L, 145 mg/L, and 26.5 mg/L. Precipitation data indicates that there were no significant storm events during this period and according to the field sampler, nothing notably different about these sampling occasions. When asked to reanalyze the samples from those dates, Maxxam Laboratories indicated that there was not enough sample left to perform accurate tests. These exceedance events prompted an investigation of the sampling methods and instruments. These inquiries uncovered that the sample containers from the module contained a significant amount of scale. A test was conducted by shaking the sample containers vigorously prior to sampling. The analytical results reported TSS levels more of more than 100 mg/L. As a result of these findings, sampling procedures have been modified to incorporate a shaking of all containers during sampling, and replacement of containers in rotation so that cleaning and flushing with de-ionized water can occur.

The final TSS exceedance occurred on January 20th, 2012 where the daily composite sample reported a value of 60.8 mg/L. Precipitation data for that period shows heavy rainfall on both the days leading up to and the day of the sampling event. From January 13th to January 20th, 60.86mm of precipitation fell. Heavy precipitation can increase surface runoff and therefore affect the TSS levels of the settling pond.

9.3.9 *Discharge Volumes and flows*

Flows remained below the permitted maximum daily discharge of 0.32 m^3/ second (Tables 3-1 to 3-2) during this report period. The rate of discharge at WD reached a maximum of (0.183 m^3/day) on April 5, 2010.

The higher discharges at WD occur during the winter months when larger water volumes are pumped from the 2 North underground mine during periods of high precipitation. It is required that the mine be continuously dewatered during the high rainfall periods, in order to maintain mine operations and for the safety of the workers underground.

The daily average discharge limit was established by the Ministry of Environment as a way to calculate permit fees and is not a permit limit related to environmental sensitivity. Therefore, average discharges that are greater than the limit set by the permit are not considered permit exceedances.

9.3.10 *BIOASSAYS (SETTLING PONDS #1 AND SETTLING POND # 4)*

Permit Limits: Rainbow Trout Bioassay *(Oncorhynchus mykiss)*: No mortalities at 100% effluent concentration after 96 hours.

All 96 hour bioassays performed for this report had 100% survival rates for Settling Ponds #1 and Settling Pond # 4. Bioassay samples were collected from the Settling Pond #1 and Settling Pond #4 decants. Samples were collected in 20 Liter plastic containers and immediately shipped to Maxxam Analytics in Burnaby for analysis. Samples were collected in December 2011 and January, and February of 2012 in accordance with the requirements of PE-07008. Maxxam conducted 96-hour pass/fail toxicity tests (LC50) with rainbow trout on all of the samples using a 100% survival rate as an indication of a pass (Appendix I).

9.4 **2 NORTH PIT SUMP (WP) CCR COVER**

Water quality results for the 2 North Pit Sump are presented in Tables 7 to 8-4. In September of 2010 following an amendment to permit PE- 07008 work was underway to remove the fines from the sump in order for it to be used as a PAG CCR disposal site. The amendment to the permit changed the monitoring schedule from a weekly to a monthly frequency. For the current year pH ranged from 7.88 to 8.27 and averaged 8.09, sulphate ranged from 171 mg/L to 1020 mg/L and

averaged 665.68 mg/L and alkalinity ranged from 80.4 mg/L to 374 mg/L and averaged 236.76 mg/L.

Since the permit amendment there has been no wash plant water conveyed into the wash plant ditch that used to report to 2 North Pit Sump. There is no water exiting the sump into the Brinco Brook wetland. All surface and wash plant water is pumped up to the tailings dam, which then reports to the 2-North Portal Sump or South Dyke Sump.

9.5 NORTH PORTAL SUMP (2-N-P-SUMP)

Following the permit amendment mentioned above, the 2 North Portal Sump has been the main settling sump for the North mine water. This is where water rests prior to it being pumped into Brinco Brook, and then flowing into Settling Pond 4. The permit requires this sump to be tested once per week for pH, biweekly for dissolved phosphate and bimonthly for dissolved iron. The results of these parameters sampled this year include pH ranging from 7.81 to 8.2 and averaging 8.01. Dissolved phosphate ranged from 0.005 mg/L to 0.0077 mg/L and averaged 0.0053 mg/L. Sulphate concentrations ranged from 564 mg/L to 1200 mg/L and averaged 997.12 mg/L. Concentrations of dissolved iron ranged from 0.005 mg/L to 0.0131 mg/L and averaged 0.007 mg/L.

9.6 CULVERT INTO MIDDLE QUINSAM LAKE (WC)

The wetland upstream of WC that the water flows through contributes to the additional water retention and acts as a natural filtering system to the effluent before it enters Middle Quinsam Lake. The TSS concentration at the culvert into Middle Quinsam Lake ranged from 4.0 mg/L to 8.0 mg/L and averaged 4.17mg/L. The pH ranged from 8.05 to 8.51 and averaged 8.27. Nitrite /Nitrate combined as N ranged from 0.02 mg/L to 0.084 mg/L and averaged 0.048 mg/L. Dissolved Phosphorus values were consistently below the reportable detection limit of <0.005mg/L. Annual sulphate concentrations from WC ranged from 307 mg/L to 840 mg/L and averaged 631.2 mg/L. Historically, the meadows and wetlands around the mine site have contributed apparent natural treatment and removal of sulphate and other salts in the mine discharge water. Tables 5 to 6-2, present the water quality at monitoring station WC (Appendix VII, Photo 4).

9.7 PLANT DITCH SEEP

The plant ditch water was rerouted to the tailings pond via a pipeline. Since then there has been no water, except surface runoff, conveyed through the plant ditch, which greatly reduced to almost eliminate the amount of seepage below the ditch. Due to the topography of the location, which is a naturally depressed area, surface runoff from rain water continues to collect there during heavy rain storms.

For this reporting year monitoring of the plant ditch seep (PDS) commenced in June of 2011, until March, 2012. The results of the analysis included concentrations of sulphate ranging from 191 mg/L to 1100 mg/L and averaged 483.25 mg/L. Concentrations of hardness ranged from 248 mg/L to 1180 mg/L and averaged 537 mg/L. Concentrations of alkalinity ranged from 122 mg/L to 330 mg/L and averaged 189.8 mg/L and pH ranged from 7.33 to 7.94 and averaged 7.7. The diversion of plant ditch water to the tailings dam seems to have led to lower concentrations of almost all monitored parameters.

In the last year concentrations of total and dissolved metals, such as iron, have decreased compared to the previous year. Concentrations of total and dissolved salts, such as manganese, calcium, sodium and potassium have also decreased. (Tables 65-1 to 66-1).

In the 2010/2011 sampling year, another sampling location was selected in an effort to characterize water consisting of inputs from surface runoff, groundwater and the plant ditch seep prior to entering Middle Quinsam Lake (Appendix XI). This site was labeled Plant Ditch Seep_Road (PDS_R). The concentration of sulphate ranged 271 mg/L to 780 mg/L and averaged 547.8 mg/L. Concentrations of hardness ranged from 307 mg/L to 842 mg/L and averaged 596.8 mg/L. Concentrations of alkalinity ranged from 104 mg/L to 220 mg/L and averaged 166.9 mg/L and pH ranged from 7.84 to 8.30and averaged 8.09.

At PDS_R, total and dissolved metals were found in low concentrations, most below detection limits. (Tables 61 to 62-2).

9.8 SOUTH DYKE SUMP

The South Dyke Sump receives waters from the tailings dam, which is then returned to the tailings facility where the seepage from the dam is collected and introduced to the North water management system at the 2 North Portal Sump.

The water quality at the South Dyke Sump has been monitored on a weekly basis since late February 2005 as per the request by MEMNG. Weekly sulphate concentrations ranged between 862 mg/L to 1800 mg/L and averaged 1556.2 mg/L, pH ranged between 7.72 to 8.25 and averaged 8.05, and alkalinity ranged between 172 mg/L to 345 mg/L averaging 279.85 mg/L at the South Dyke Sump during this report period. Results of the South Dyke Sump water quality monitoring are presented in Tables 41 to 42-2. (Appendix VII, Photo 11).

9.9 QUINSAM RIVER DOWNSTREAM SITE 1 (QRDS1)

Sampling was initiated on November 8, 2011; the results for pH ranged from 7.26 to 7.76 and averaged 7.55. Sulphate ranged from 7.3 mg/L to 45.7 mg/L and averaged 20.18 mg/L. Dissolved arsenic ranged from 0.0001 mg/L to 0.0002 mg/L and averaged 0.00015 mg/L. Finally, dissolved iron concentrations ranged from 0.021 mg/L to 0.051 mg/L and averaged 0.030 mg/L. Results are displayed in Tables 52 to 53-2.

10.0 THE SOUTH WATER MANAGEMENT SYSTEM

10.1 SETTLING POND #1 (SPD/SP1)

Refer to Tables 16-1 to 17-2 for Settling Pond #1 water quality results. All parameters were below permit limits this reporting period.

10.1.1 *NUTRIENTS*

Permit Limits:

Ammonia nitrogen: 1.0 mg/L;

Dissolved phosphorous: 0.03 mg/L;

Nitrite/nitrate nitrogen: not a permit requirement.

All samples reported below the applicable permit criteria for nutrients during this reporting year for Settling Pond #1. For this report period, ammonia nitrogen ranged between 0.007 mg/L and 0.044 mg/L and averaged 0.028 mg/L, dissolved phosphorous ranged between <0.005 mg/L and 0.013 mg/L and averaged 0.006 mg/L and nitrite/nitrate nitrogen consistently measured <0.02 mg/L (Graphs 23-25). In summary, both ammonia nitrogen and dissolved phosphorous results exceeded permit limits 0/12 times. Generally there has been a decrease in nutrients since 1995 as detailed in section (II.4.2.1).

10.1.2 *TOTAL SUSPENDED SOLIDS (TSS)*

Permitted Limits: TSS permitted for 25 mg/L

All but one sample reported below the applicable permit criteria for TSS during this reporting year for Settling Pond #1. Weekly samples were collected during decant flow of <0.046 m^3/s and daily samples were collected during decant flow of >0.046 m^3/s (Table 19-1 to 19-2). For this report period TSS ranged between <1.0 mg/L and 65.6 mg/L and averaged 4.39 mg/L. One sample, collected on February 21st, 2012, exceeded the permit criteria for TSS with a value of 65.6 mg/L TSS. Therefore, TSS results at Settling Pond #1 exceeded permit criteria 1/167 times (0.6% of samples). The trends for TSS have been generally decreasing since 1999 (Graph 20), with the average less than 5.0 mg/L. TSS samples collected for this report period were a combination of grab samples and composite samples.

10.1.3 *HARDNESS*

Hardness concentrations ranged between 158 mg/L and 481 mg/L and averaged 298 mg/L. The general trend from 1997 (Graph 18) has been a gradual increase in concentrations but the

concentrations have remained comparable since 2008, decreasing slightly as detailed in section (II.4.2.3).

10.1.4 *SULPHATE*

Sulphate is sampled on a weekly basis from Settling Pond #1. Sulphate concentrations for this report period ranged between 16.5 mg/L to 447 mg/L and averaged 215 mg/L. The 3 South Pit is the main contributors to Settling Pond #1 and any variations in their sulphate concentrations will be reflected in the recorded values for Settling Pond #1.

The sulphate concentrations recorded at Settling Pond #1 are significantly lower than Settling Pond #4 but show a similar trend in seasonality. Settling Pond 4, demonstrates a seasonal trend in sulphate concentration with an increase in concentrations during the summer and early fall and a decrease during the winter and early spring. When a historical comparison is made for sulphate and hardness concentration trends between Settling Pond #1 and Settling Pond #4 it is evident that the trends are similar.

Weekly sulphate and precipitation are compared in Graph 34 for Settling Pond # 1. It is notable from the graph that the general trend in sulphate concentrations increases with less precipitation and decreases with more precipitation, similar to Settling Pond 4. The spikes seen in this graph represent the increased inputs from 3 South Pit Pond when pumping is initiated.

10.1.5 *ALKALINITY*

Alkalinity ranged between 8.4 mg/L to 100 mg/L and averaged 66.7 mg/L. Alkalinity at Settling Pond #1 decant demonstrates a seasonal trend different than Settling Pond # 4 decant (Graph 21). As indicated in the historical data section higher concentrations are apparent during the higher precipitation months (winter and early spring) and lower concentrations are seen during the drier portions of the year (summer and early fall).

10.1.6 *pH*

Permit Limit: 6.00 to 8.50

pH ranged between 6.65 to 8.11 and averaged 7.76 for Settling Pond 1. The pH results exceeded the permit limit 0/53 times. Average pH has remained within a range of 8.20 to 7.50 since year 2000 (Graph 19). Within a given year, the general trend appears to be a decrease in pH during the late winter months increasing during the summer months.

10.1.7 *Dissolved Metals*

Permit Limits:

Dissolved Aluminum: 0.5 mg/L

Dissolved Copper: 0.02 mg/L

Dissolved Iron: 0.5 mg/L

Dissolved Lead: 0.05 mg/L

Dissolved Zinc: 0.2 mg/L

The permitted metals (dissolved aluminum, copper, lead and zinc) were below the applicable permit criteria for during this reporting year for Settling Pond #1.

Concentrations of dissolved metals have generally been low or undetectable (Graph 26-32). Iron, which is normally slightly above detection limits, demonstrates seasonal trends similar to sulphate with the concentration highs during summer months and concentration lows during winter months.

Dissolved Aluminum concentrations ranged from 0.004mg/L to 0.058 mg/L and averaged 0.018 mg/L. Dissolved Copper concentrations ranged from 0.0006 mg/L to 0.0037 mg/L and averaged 0.0011 mg/L. Dissolved Iron concentrations ranged from 0.01 mg/L to 0.11 mg/L and averaged 0.061 mg/L. Dissolved Lead concentrations ranged from <0.00020 mg/L to 0.0005

mg/L and averaged 0.00023 mg/L. Finally, Dissolved Zinc concentrations were consistently less than the detection limit of <0.005 mg/L. For all permitted parameters, dissolved aluminum, copper, iron, lead and zinc, results exceeded permit limits 0/12 times.

Dissolved calcium, magnesium and sodium showed annual average concentrations of 97.25 mg/L, 13.46 mg/L and 8.32 mg/L, respectively. In the historical graph (Graph 33) for dissolved calcium, magnesium and sodium it is evident that Settling Pond # 1 has seasonal variation trends similar to Settling Pond # 4. Settling Pond #1 has lower concentrations of dissolved calcium, magnesium and sodium during the winter months and higher concentrations in the late summer/early fall months.

As seen from the historical trend graphs dissolved arsenic and selenium concentrations (Graphs 27 and 31) have been below detection limits or just above since 1994, when the collection of data began.

10.1.8 *Water Quantity Permit Limit Exceedances*

There was one permit exceedance during this sampling period at Settling Pond 1. On February 21, 2012 the sampling results indicated a TSS concentration of 65.6 mg/L. The precipitation data from that period does not indicate any heavy rainfall. The 52 samples preceding the exceedance and 44 samples following it all indicate TSS values below the detection limit. This suggests that the exceedance is an exception and may be due to a sampling error or perhaps an error in the analytical process.

10.1.9 *Discharge Volumes and Limits*

Flows remained below the permitted maximum daily discharge of 0.46 m^3/second during this report period (Tables 18-1 & 18-2). The daily discharge peaked at Settling Pond #1 on May 28th, 2011 (0.0531 m^3/s) during this report period.

10.2 SOUTH PIT CULVERT (SPC)

The mine effluent travels from the Settling Pond #1 decant (SPD) through a meadow/wetland system before reaching the SPC monitoring station. The monitoring station is located before the mine effluent mixes with the disturbed and undisturbed water from 4 South Lower ditch and the surrounding area.

Traditionally the concentrations of TSS and sulphate have been lower at SPC than at the source of the culvert flows (Settling Pond #1). For this reporting period, the concentration of sulphate ranged from 0.5 mg/L to 134 mg/L and averaged 60.8 mg/L. The pH results ranged from 7.0 to 7.88 and averaged 7.46, while hardness results ranged from 41.2 mg/L to 139 mg/L and averaged 71.7 mg/L. Concentrations of dissolved phosphorous ranged from 0.005 mg/L to 0.093 mg/L and averaged 0.083 mg/L. Dissolved iron concentrations ranged from 0.005 mg/L to 0.178 mg/L with an average concentration of 0.092 mg/L and TSS concentrations ranged from 2 mg/L to 93 mg/L with an average of 5.8 mg/L. There are no current mining activities in the South Mine Area.

Tables 28 to 29-2 present the water quality at monitoring station SPC.

10.3 3 SOUTH - 77 AUDIT PIT

The water from the 3S-77 pit was rerouted out of the 4 South Mine and allowed to flow its original route, under the 4 South pad and down the 4S-Lower ditch into LLE. Tables (47 to 48-2) display the water quality and metals analysis data for 3S-77 (Appendix VII, Photo 16). Sulphate concentrations ranged between 152 mg/L to 342 mg/L averaging 209.05 mg/L. The pH ranged from 7.24 to 7.85 averaging 7.61, and alkalinity ranged between 37.9 mg/L to 92 mg/L averaging 57.59 mg/L. Concentrations of total and dissolved metals were all below permit limits for mine discharge water. Most total and dissolved metals were below detection limits. Concentrations of total arsenic averaged 0.0009 mg/L, dissolved arsenic averaged 0.0009 mg/L, total iron averaged 0.075 mg/L, and dissolved iron averaged 0.040 mg/L. The water entering 3S-77 pit is originating from the wetland meadow that Settling Pond 1 flows through. The flow path that the wetland/meadow originally took, bypassed the 3S-77 pit prior to Timberwest clear-cutting this

area. This flow path will be reestablished in Aug 2011 directing all the water from the wetland meadow into the fire pond and then to SPC. The water from 3S-77 will be directed on the same flow path.

10.4 4 SOUTH

In April of 1999, large-scale mining at the 4 South Mine ceased. Since then, there has been no coal stockpiled at the storage pad except for the temporary stockpiling of small amounts of coal that were mined in 2003, 2004 and 2005.

The 4 South Portal Pond is used as a staging pond for water pumped from the 4 South underground mine to Settling Pond # 1 and contributes to the water quality and quantity in Settling Pond #1, depending on the scale of pumping operations at the 4 South Mine. Monthly samples have been collected from the 4 South Portal Pond since October, 2001. Over the last few years, pumping has only occurred during heavy rains allowing the 4 South mine to flood. Samples were only collected when the pump was pumping to Settling Pond #1.

With the approval of the ETRC, the 4 South Portal Pond sampling location was changed from the 4 South Portal Pond to the point of discharge from the pipe that routes water from the 4 South Portal Pond into Settling Pond # 1. This location is considered more representative of the quality of water entering the pond from the 4 South underground mine, (2008/09 ETRC).

10.5 4 SOUTH IRON INVESTIGATION

In December of 2011, following the ETRC meeting in Nov. 2010, an investigation to determine the source of the higher iron concentrations was initiated within the vicinity of the 4 South Areas. In order to measure any effluent contributions from the 4 South coal pad on water quality, it was requested through the ETRC and MoE that QCC monitor water quality for pH, sulphate and dissolved iron within the vicinity of the coal storage pad.

Four sampling locations were chosen as the main water sources flowing into the 4 South pad area .These include, 4 South Inflow, 4 South Upper, 4 South Under the Pad and 4 South Lower. 4 South Inflow was selected as it represents water exiting the 3S-77 Adit pit, a portion of the wetland that Settling Pond 1 drains into and surface runoff in the surrounding area. If this water were high in concentrations of iron, then further sampling would have been initiated to identify the upstream source as one of the three contributing factors.
4 South Upper was selected as it is the collection point of 4 South Inflow, a larger portion of the wetland that Settling Pond 1 discharges into and surface runoff from the surrounding area. This is the last sampling location prior to the water entering the culvert that flows under the 4 South coal pad. 4 South Under the Pad represents water exiting the culvert after it flows under the pad prior to flowing under the culvert at the entrance way into the 4 South Pad. 4 South Lower represents water that discharges directly out of the culvert under the entrance of the 4 South Pad.

It was requested through the MoE that further sampling be performed in order to establish a clear understanding source of the iron contributions in the area. This report was submitted and the sampling program has been maintained on a monthly basis since it began.

As a result of this investigation the water discharging from Settling Pond 1 into the wetland/meadow will be redirected so that no water will flow under the 4 South Pad and only rain water will flow down the 4S-Lower ditch. This is intended to reduce the higher concentrations of sulphate and iron that is mobilized as the water flows under the 4 South Pad and down the 4S-Lower ditch.

10.6 **4 SOUTH LOWER**

The 4 South Lower water is monitored for potential chemical constituents emanating from the 4 South Pad and surrounding area as it enters the ditch. The annual concentrations of sulphate ranged from 83.3 mg/L to 230 mg/L and averaged 156.83 mg/L. Alkalinity ranged from 27.2 mg/L to 68 mg/L and averaged 42.35 mg/L. pH ranged from 6.95to 7.81 and averaged 7.49 and dissolved iron ranged from 0.005 mg/L to 1.13 mg/L and averaged 0.354 mg/L.

10.7 CULVERT INTO LONG LAKE (LLE)

LLE is the last point of settling for mine effluent in the south area water management system before the water is discharged into Long Lake. The source inputs for LLE include natural runoff from upstream ponds and mine discharge waters originating from Settling Pond #1. Settling pond #1 SPD decant flows through a series of meadow/wetland systems before reaching the SPC monitoring station and then into LLE, which is a natural settling pond. LLE is a seasonal wetland subject to dying out during summer months. The addition of LLE to the monitoring stations allows for the calculation of effluent loading rates into Long Lake. This is determined through the measurement of the flow from the culvert LLE discharges through, prior to entering Long Lake. The results of the water chemistry are included in Tables 43 to 44-2. Concentrations of nutrients including ammonia nitrogen; dissolved phosphate and nitrite/nitrate nitrogen are all below permit limits for mine discharge water for all sampling events. The measurements for pH were within the permitted mine limits for pH, which ranged from 7.01 to 7.64 and average 7.34. Sulphate concentrations ranged from 14 mg/L to 400 mg/L and averaged 138 mg/L.

Overall, dissolved metal concentrations remained low, often below detection limits. Aluminum concentrations ranged from 0.008 mg/L to 0.078 mg/L, averaging 0.0353 mg/L; copper concentrations ranged from 0.0003 mg/L to 0.002 mg/L, averaging 0.00094 mg/L; lead concentrations ranged from 0.0002 mg/L to 0.0005 mg/L, averaging 0.00022 mg/L; and zinc concentrations ranged from 0.005 mg/L to 0.013 mg/L, averaging 0.00562 mg/L. Concentrations of dissolved iron ranged from 0.136 mg/L to 12.6 mg/L averaging 1.56 mg/L. Concentrations of dissolved arsenic ranged from 0.0007mg/L to 0.005 mg/L averaging 0.00132 mg/L.

10.8 3 SOUTH PIT (3-S)

The 3 South Pit collects waters from the 2 South and 1 South areas as well as surface run-off in the 3 South vicinity. In October, 2011 a siphon pipeline was installed from Settling Pond #1 extending to the 3 South Pit. This pipeline was installed in order to maintain water levels in 3 South Pit and in order to circulate any water throughout the system by means of stage pumping.

Since 1998 this pit has been used as a permitted subaqueous Potentially Acid Generating Coarse Coal Reject (PAG-CCR) disposal facility for high sulfur reject materials generated at the mine site. In September of 2010, QCC was issued approval for the subaqueous PAG-CCR disposal into the 2 North Pit.

In July, 2010 the 3 South Pit reached its storage capacity for PAG-CCR disposal with a total volume of (196,793) tones of PAG-CCR.

In order to monitor and assess the sulphate concentrations in groundwater within the vicinity of the 3 South Pit, monitoring wells were installed in 2000. These wells have been monitored on a quarterly basis since 2011 by Golder Associates.

Results of the weekly sampling at the 3 South Pit for this report period are presented in Tables 20 to 21-3 and Graphs 38-40.

The concentrations of alkalinity, sulphate, and pH have remained relatively consistent in recent years. All of the parameters follow a seasonal variation dependent of the amount of precipitation for that year.

For the 2011/12 report period, weekly sulphate concentrations at the 3 South Pit ranged between 111 mg/L to 640 mg/L and averaged 470.5 mg/L. pH ranged between 7.38 to 8.00 and averaged 7.80 for this report period. Alkalinity concentrations ranged between 26.8 mg/L to 90 mg/L and averaged 68.7 mg/L. Hardness concentrations ranged between 187 mg/L to 679 mg/L and averaged 475 mg/L.

Total and dissolved metals were below the Water Quality Guidelines for this reporting year. Total arsenic ranged from 0.0001 mg/L to 0.0005 mg/L and averaged 0.003 mg/L; and dissolved arsenic ranged from 0.001 mg/L to 0.0005mg/L and averaged 0.003 mg/L. These values generally fall below the Water Quality Guidelines of 0.005 mg/L set out for total arsenic concentrations (Appendix VII Photo 17).

11.0 7 SOUTH MONITORING STATIONS

The 7 South monitoring stations included in this year's sampling program include 7 South (7S) and 7 South Quinsam River (7SQR). Both of these sites will be used to develop baseline conditions and characterize water quality prior to the development of the approved 7 South Mine. The new location 7S is the projected effluent discharge point of 7 South Portal Site before it discharges into the lower wetland and subsequently the Quinsam River. This site is an intermittent (seasonal) drainage that drains the surface area of the proposed 7 South Portal site. This drainage would provide the flow path for surface catchment water from the 7 South portal footprint, including the waste overburden storage site and raw coal stockpile area. The site was established as a monitoring station during the 3rd quarter of 2010 on November 16th.

11.1 7 SOUTH QUINSAM RIVER (7SQR)

For this reporting year, pH ranged from 7.26 to 7.61 and 7.47 averaged, and hardness ranged from 19.8 mg/L to 50mg/L and averaged 32.11 mg/L. Most of the nutrient parameters were below detection limits. Sulphate concentrations ranged from 7 mg/L to 32 mg/L and averaged 20.38 mg/L. Most of the total and dissolved metals were below detection limits. Tables (49 to 50-3) show the results of the analysis performed (Appendix VII, Photo 23).

11.2 7 SOUTH (7S)

This year, pH values ranged from 6.86 to 7.53 and averaged 7.25. Hardness ranged from 11.5 mg/L to 24.5 mg/L and averaged 15.77 mg/L. Dissolved phosphorous remained below the detection limit of <0.005 mg/L. Sulphate results ranged from <0.5 mg/L to 2.7 mg/L and averaged 0.93 mg/L.

12.0 GROUNDWATER

Prior to commencement of operations and up to the present time, ground water monitoring wells have been used to establish baseline groundwater data, pre-development hydrogeological information, and groundwater quality and gradient. An initial series of 15 holes were developed as part of a baseline groundwater assessment as detailed in the report “Hydrological Evaluation, Brown Erdman & Associates. August 1982", previously reported to MoE.

Currently monitoring wells are installed in the Quinsam 2 & 3 South, 2 north, and 5 south operating areas. In the 2010/11 a third site (P-3-1) was added to provide additional information on groundwater levels and quality at 5 South.

Based on recommendations provided in a study by AGRA Earth & Environmental in 1999, Golders Associates was contracted to implement a ground water monitoring program. In 2000 three wells were installed as detailed in the report “Preliminary Groundwater Assessment", (Golder Associates, report dated July 2000).

These included;

MW00-1S and MW00-1D: the multilevel well located down slope of the plant wash water ditch

MW00-2: Located on the main access road to 3 south Pit

MW00-3: Located in the 2 south pit near the southern extent of Long Lake

The Phase II monitoring wells were installed in 2001 based on the preliminary find as detailed in the "Phase II Groundwater Assessment”, by Golder Associates, dated April 2001.

MW00-4 and MW00-5 were installed in the 2 south pit areas in close proximity to the MW00-3. The additional wells were installed within voids from the underground workings of the 2 south No.2 mains.

MW00-6 an additional multilevel well located down slope of the plant ditch between the ditch and MW00-1

The 5 south wells consist of 4 stations that were implemented as part of the baseline study for the 5 south/10 mains mining operations in 2006. Two holes (QU-05-16-MW4, and QU-06-01-MW5) are in the 5 mains/11 mains development situated along the TimberWest Coal 600 road.

Two additional holes are situated along the 2-4 south main haul roads: QU-05-15-MW1, and QU-05-14-MW2. Drillhole P3-1 is located in the 5 south area and was one of the original Brown-Erdman wells drilled in 1981. The piezometer tubes in this well are still functional.

12.1 BASELINE GROUNDWATER SAMPLING

Baseline ground water sampling was conducted by Brown, Erdman, & Associates LTD, in 1981 and 1982 as a part of the documentation for pre-mine conditions. Of the original wells documented, 77-30, and 78-198C are within the 3S/2S area of operations. Well number 77-30 is located approximately midpoint between the current monitored wells MW00-2 and MW00-5.

In 2006 Golder conducted a review of data for these original wells and concluded that the baseline data was generally suitable for comparison with recent monitoring data in the 2S/3S area as the wells are within comparable stratigraphic units. Golder concluded that there has been an increase in recorded values particularly sulphate, calcium, iron, manganese, potassium, and sodium. Correspondingly there have been recorded decreases in some metals and anions, Aluminum, Arsenic, Chloride, and Fluoride.

Baseline values for conductivity in groundwater at wells 78-198c and 77-30 were 446 and 307 (µs/cm) respectively. Concentrations of hardness were recorded as 1.8 and 146 mg/L, and bicarbonate alkalinity was 230 and 177 mg/L, respectively. Sulphate and fluoride demonstrated baseline concentrations of 2.5 and 10 mg/L Sulphate, and 1.4 and a low of 0.13 mg/L Fluoride.

Most of the dissolved metals sampled were lower or less than detection limits with the exceptions of a few notable elements including Arsenic, Iron, and the metallic salts Calcium and Sodium.

12.2 GROUNDWATER LEVELS

12.2.1 *2 SOUTH / 3 SOUTH- MONITORING WELLS: MW00-2 TO MW00-5*

The following statements were summarized from the "2011/2012 Annual Groundwater Monitoring Summary, 2 North, 3 South Areas Quinsam Mine." The complete report can be found in Appendix VI.

Following a landslide that occurred at the Long Lake Seep in approximately January 2006, the groundwater elevation has declined within the 2/3 South groundwater monitoring wells MW00-3 and MW00-5 by approximately 1m to 2m; however, they continue to demonstrate a seasonal variation.

In 2011 the three portal entrances to the 2-South underground workings were plugged (pressure grouted concrete seals). Graph IV-5 in Appendix VI indicates that the plugs could be having an effect on the water levels in MW00-3 and MW00-4

In 2011, QCC decided to advance borehole QU11-11 within the 2 South underground workings and use this as a dewatering well for the proposed sulphate mitigation cells. Groundwater level monitoring for this location was included in the current monitoring program to provide additional information on groundwater elevations within the former 2 South underground workings.

2 North- Monitoring Wells: MW00-1 and MW00-6 (Shallow and Deep)

The ground water levels in the 2 North area, MW00-1 and MW-006 exhibit significantly different responses in annually or seasonal fluctuations. MW00-1 demonstrates a limited response in ground water elevation and a slight seasonal response at a shallower depth. MW00-6 has an evident seasonality with clearly evident fluctuations in both the deeper and shallow portions.

* *summarized from Golder Groundwater monitoring reports 2011/12*

12.3 GROUND WATER QUALITY

Monitoring wells demonstrated relatively consistent results during the 2011/12 monitoring events, as noted in previous years. The monitoring events occurred on the following dates: May 12, 2011, July 12, 2011, November 3, 2011, and January 12, 2012. The following is a summary of Golder's assessment for the 2010/11 sampling events as presented in Appendix VI.

12.3.1 *2 SOUTH/3 SOUTH*

The Water Quality results from MW00-2, MS00-4 and MW00-5 are similar in measured values and seasonal variations as noted in previous years.

Sulphate concentration trends measured in the 2011/2012 season are relatively consistent when compared to results since approximately 2004.

Sulphate concentrations at MW00-4 declined in 2011/2012 compared with previous years and continue to have a slight downward trend. Conversely, sulphate concentrations at MW00-5 have continued to have a slight upward trend in concentration since approximately 2004, with strong seasonal responses.

The seasonal variations noted at MW00-5 may be correlated with the oxidation of the underground workings during summer months when ground water levels are low, as well as the mobilization of the sulphate from oxidized sulphides during the winter months when the ground water levels rise. Other contributing factors to high sulphate loadings and the slight upward trend seen at MW00-3, MW00-4 and MW00-5 could include the nearby 3S overburden stockpiles and seepage from the 3 South pit into the 2 South / 3 South underground workings.

The pH results from the 2011/12 sampling events remain near neutral to slightly basic (6.7 to 7.3). The values observed in this sampling season were generally consistent with the pH range observed since 2001.

Chloride concentrations have continued to decline since March 2010. The chloride concentrations in monitoring well MW00-4 were low and stable in 2011/2012.

Concentrations of dissolved metals were generally low or below detection limits altogether, with the exception of dissolved iron results from MW00-5. Here the dissolved iron exceeded the permit criteria limit of 0.05 mg/L

* *summarized from Golder Groundwater monitoring reports 2011/12*

12.3.2 *2 North Wash Plant Ditch Area*

The sampling results for sulphate during this monitoring period had seasonal patterns similar to those observed since 2001. A slight downward trend in sulphate levels has been noted this year, likely due to the cessation of the Wash Plant ditch flows after September 12, 2010. Sulphate concentrations in shallow monitoring wells MW00-1S and MW00-6S have reported the lowest concentrations since 2000 and 2001 respectively.

MW00-6D demonstrates more seasonal fluctuation associated with precipitation than MW00-1, and also has a greater variability for the sulphate. Sulphate concentrations at MW00-6 are higher, on average, than sulphate concentrations at MW00-1D, perhaps due to MW00-1 being ~10 m deeper and therefore less influenced from the Wash Plant ditch seepage.

An apparent pH gradient, ranging from circum-neurtal (~6.7 to 7.4) at MW00-1S and MW00-6S to generally more alkaline (~8.5-9.3) at MW00-1D and MW00-6D was observed once again during the 2011/2012 sampling season. The groundwater appears to have stabilized during the monitoring period.

Chloride concentrations fluctuated seasonally throughout the 2011/2012 sampling events. Concentrations in deep monitoring wells were low and stable this year.

Concentrations of dissolved metals in shallow groundwater were generally higher than the deeper groundwater, consistent with a monitoring trend since 2000. However, concentrations of some dissolved metals (aluminum, arsenic, and molybdenum) at MW00-1D were higher in the deep monitoring wells compared with the shallow wells.

* *summarized from Golder Groundwater monitoring reports 2011/12*

13.0 Exploration Drilling 2011-12

In the 2011/2012 reporting year, drilling and coring occurred at 7-South, Area 5, and 4-South/6-South.

There were 55 drill holes completed between April 1, 2011 through March 31, 2012. Eleven of these holes were for either monitoring wells, or dewatering purposes of existing workings, while the remainder were for exploration purposes. The dewatering wells were drilled in 2-North as well as 4-South, and the monitoring wells were drilled in 2-South, 7-South, and Area 5. Of the 55 drill holes, 15 of the sites were prepared on pre-existing mine roads and/or pads, while the remaining 40 pads had new disturbances for either the pad only, or both the pad and the access road.

Table 1: Exploration Drill Holes 2011, Areas Disturbed and Purpose

Drill ID	Areas Disturbed	Purpose
QU-11-01	No, existing road	Groundwater Monitoring well
QU-11-02	Yes, new pad installed	Groundwater Monitoring well
QU-11-03	Yes, new pad installed	Groundwater Monitoring well
QU-11-04	No, existing road	Geotechnical investigation
QU-11-05	Yes, new pad and access road installed	Groundwater Monitoring well
QU-11-06	Yes, new pad and access road installed	Groundwater Monitoring well
QU-11-07	No, existing road	Geotechnical investigation
QU-11-08	Yes, new pad installed	Geotechnical investigation
QU-11-09	Yes, new pad and access road installed	Groundwater Monitoring well
QU-11-10	Yes, new pad installed	Geotechnical investigation
QU-11-11	No, existing road	Groundwater Monitoring well
QU-11-12	No, existing road	Geotechnical investigation
QN-11-13	Yes, new pad installed	Geotechnical investigation
QN-11-14	Yes, new pad installed	Geotechnical investigation
QN-11-15	Yes, new pad installed	Geotechnical investigation
QN-11-16	Yes, new pad installed	Geotechnical investigation
QN-11-17	Yes, new pad installed	Geotechnical investigation
Qu-11-18	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-19	Yes, new pad and access road installed	Geotechnical investigation

Qu-11-20	Yes, new pad installed	Geotechnical investigation
Qu-11-21	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-22	No, existing road	Geotechnical investigation
Qu-11-23	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-24	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-25	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-26	Yes, new road installed	Geotechnical investigation
Qu-11-27	No, existing road	Geotechnical investigation
Qu-11-28	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-29	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-30	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-31	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-32	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-33	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-34	Yes, new pad installed	Geotechnical investigation
Qu-11-35	Yes, new pad and access road installed	Geotechnical investigation
Qu-11-36	Yes, new pad installed	Geotechnical investigation
Qu-11-36MW	No, existing road	Groundwater Monitoring well
Qu-11-37	Yes, new pad installed	Geotechnical investigation
Qu-11-38	Yes, new pad and access road installed	Geotechnical investigation
MW-11-07	No, existing road	Groundwater Monitoring well
MW-11-08	Yes, new pad and access road installed	Groundwater Monitoring well
MW-11-09	Yes, new pad and access road installed	Groundwater Monitoring well
Qu-12-01	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-02	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-03	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-04	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-05	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-06	No, existing road	Geotechnical investigation
Qu-12-07	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-08	Yes, new pad and access road installed	Geotechnical investigation
Qu-12-09	No, existing road	Geotechnical investigation
Qu-12-10	No, existing road	Geotechnical investigation
Qu-12-11	No, existing road	Geotechnical investigation
Qu-12-12	No, existing road	Geotechnical investigation
Qu-12-13	No, existing road	Geotechnical investigation

14.0 RECEIVING ENVIRONMENT RESULTS AND DISCUSSION

Receiving water monitoring stations are located in Middle Quinsam Lake and Long Lake, and include the center of Long Lake (LLM) and Middle Quinsam Lake (MQL) and the surface of these two lakes at designated locations (LL1-3 and MQL 1-6). Outflow from Long Lake (LLO), Middle Quinsam Lake (WB) and No Name Lake (NNO) are part of the receiving water monitoring stations. The seep into Long Lake is also included as part of the receiving water monitoring stations.

The water quality objectives for Middle Quinsam Lake Sub-basin are compared to the receiving environment where applicable. These objectives are not applied to the individual results but applied for comparison purposes only. Objectives for Middle Quinsam Lake Sub-basin were applied as a part of the Province of British Columbia, Ministry of Environment (MOE) mandate to manage water bodies. The water quality objectives were created to provide a list of objectives to protect water quality and adapted to fit the specific water bodies of interest. The objectives take into consideration the natural local water quality, water uses, water movement, waste discharges and socio-economic factors. These water quality objectives do not have any legal status: they are aimed at providing resource managers direction in order to protect the water bodies in question. These objectives are used as standards against which to measure the water quality of a particular water body in question and are used as a standard against which to measure the water quality of a particular lake or river (MOE. 2009).

Total suspended solids (TSS) results that are recorded weekly for sites (NNO, LLO, WA and WB) were graphed using a running average of 5 weekly samples and compared to the water quality objectives of the Middle Quinsam Lake Sub-basin for the 30-day mean. These results are presented in (Graphs 59-62).

14.1 **Seep into Long Lake**

The seep into Long Lake monitoring station (LLS) is a bedrock groundwater seep, which has been monitored in order to assess groundwater quality in the Long Lake area. The groundwater

wells installed in 2000 in the 2-3 South area are monitored and the water quality data can be compared to the Long Lake seep water quality data. The seep is considered to be representative for the down gradient of the groundwater quality near the end of the bedrock aquifer flow path near the limits of the 2-3 South area and Long Lake.

14.1.1 *SEEP FLOW*

In December 2002, QCC installed a weir at the seep before it flows into the Long Lake as per the recommendations of the ETRC.

Following the landslide event, multiple seeps developed and diverted the main seep flow away from the weir. Due to the alteration of the seep flow away from the weir, flow measurements were measured on a monthly basis since March 2009 (with the exception of January, 2010). QCC staff reconstructed a new weir, LLS Weir 1, and were able to record measurements from the old weir (LLS Weir 2). The measurements for 2011/12 are shown on the following page.

Date	***LLS Weir 1**	***LLS Weir 1**	Flow	Flow	Flow
	(mm)	**(ft)**	**ft3/sec**	**m3/sec**	**m3/month**
1-Apr-11	30	0.10	0.10	0.00	7323.53
1-Jun-11	2	0.01	0.00	0.00	128.45
1-Nov-11	20	0.07	0.05	0.00	4013.35
1-Dec-11	40	0.13	0.15	0.00	11199.17
1-Jan-12	30	0.10	0.10	0.00	7323.53
1-Feb-12	40	0.13	0.15	0.00	11199.17
1-Mar-12	30	0.10	0.10	0.00	7323.53

Date	*LLS Weir 2	*LLS Weir 2	Flow	Flow	Flow
	(mm)	(ft)	ft3/sec	m3/sec	m3/month
1-Apr-11	26	0.09	0.08	0.00	5924.76
1-Jun-11	27	0.09	0.09	0.00	6265.61
1-Nov-11	28	0.09	0.09	0.00	6612.44
1-Dec-11	29	0.10	0.09	0.00	6965.13
1-Jan-12	30	0.10	0.10	0.00	7323.53
1-Feb-12	31	0.10	0.10	0.00	7687.55
1-Mar-12	32	0.10	0.11	0.00	8057.06

Bottom = 30.2cm=0.991ft width= 0.991 ft
Top = 30.5 cm
1cuft=0.0283cum
Note: we assume 30 days a month in our calculation
***LLS WEIR 1: New Weir**
***LLS WEIR 2: Old Weir**

14.1.2 *SEEP WATER QUALITY*

During this reporting period monthly water quality samples were collected from the seep (Tables 30 to 31-2). The analytical parameters included pH, alkalinity, hardness, sulphate and total and dissolved metals. The monthly pH ranged from 7.65 to 8.03 and averaged 7.87, which was comparable to the previous year's average of 7.60. Alkalinity ranged between 190 mg/L and 220 mg/L and averaging 204 mg/L, a t decrease from the previous year's average of 253 mg/L. Hardness ranged between 417 mg/L and 547 mg/L and averaged 456 mg/L, a decrease compared to last year's average of 654 mg/L. Finally, sulphate ranged between 380 mg/L and 582 mg/L and averaged 451 mg/L, a decrease compared to the previous year's average of 625 mg/L.

Samples for total and dissolved metals are collected from the seep. These include Aluminum, Copper, Iron, Lead, and Zinc, all of which are at low concentrations, except for total and dissolved iron concentrations, which are relatively high, in all sampling events. Dissolved Calcium,

Magnesium and Sodium concentrations are also relatively high at the Long Lake Seep (Table 31-1 and 31-2). The Long Lake Seep is not a permitted site but the concentrations of these parameters have been compared to the permit for observation purposes only.

Water chemistry at the LLS may be influenced by groundwater in the 2/3 South area and, potentially, by water quality in the 3 South Pit. The extent to which the water chemistry at the seep is influenced by these waters has yet to be identified.

14.2 LAKE CHARACTERISTICS

Thermal stratification occurs in Long Lake and Middle Quinsam Lake during the summer months resulting in little vertical mixing in the water column. This effect is more pronounced in Long Lake due to the greater depths and low summer flushing rates.

Both Middle Quinsam and Long Lake water quality data suggests an increase in sulphate with depth. Studies by MELP (2000)[2] discuss how this trend is influenced by thermal stratification and seasonal flushing of the shallow water depths. The increase in sulphate with depth could be correlated with colder, denser ground-water.

[2](MELP) Ministry of the Environment Lands and Parks. More recently referred to as the Ministry of the Environment (MOE)

14.3 **Middle Quinsam Lake**

14.3.1 *CHEMICAL AND PHYSICAL WATER QUALITY*

The 2011/12 chemical and physical water quality data for Middle Quinsam Lake (MQL) are presented in Tables 13 to 15.

The water chemistry of MQL varies due to the irregularity in flushing, dilution and vertical mixing within the lake. Different sources contribute and influence the water chemistry in MQL. The source waters include Middle Quinsam Lake upstream inlet (WA), Long Lake outflow (LLO), Settling Pond #4 (WD, WC) and undefined groundwater inputs. Data from the 1985 Baseline Monitoring Report for sulphate and pH from 1983 and 1984 are presented in Table 40. Graphs representing hardness, pH and sulphate data from the baseline years and from the mine production years of 1996 to 2011 are presented in Graphs 42-44.

14.3.2 *THERMOCLINES*

For this reporting period the thermocline zone has followed a similar trend as in previous years. The thermocline was distinct in April between the depths of 9 to 10 meters. The thermocline was much less distinct for the months of May, June and July. In the month of May the declines in water temperature are never greater than 1 degree Celsius per meter. The greatest difference of 0.86 degrees occurs between the depths of 9 and 10 meters. In June, the largest declines in water temperature occur between the depths of 5 and 7 meters and in July the largest declines occur between 5 and 8 meters. By August the decline is more distinct between the depths of 5 and 6 meters. Finally, in September the thermocline is very distinct between the depths of 7 and 8 meters. Compared with the previous year, the thermocline in MQL was located at deeper depths only during the months of April and May, whereas the remainder of the sampling season showed the thermocline to be at higher depths compared to the previous year.

The hypolimnetic dissolved oxygen (DO) concentration was measured at all depths and was usually within the water quality objectives of a minimum of 3 mg/L for all sampling events. For

most months, the bottom one or two meters have dissolved oxygen values that are below the water quality objectives. April is an exception to this trend, with no measured depths exhibiting values lower than 3 mg/L. The very bottom depths are not representative of the hypolimnetic zone due to the depth and the drop in the dissolved oxygen, which is representative of the lake bottom. These concentrations were not considered when comparing the DO results to the water quality objectives.

14.3.3 *pH*

Overall, annual pH values for all depths at Middle Quinsam Lake ranged between 7.06 and 7.68. Annual average pH for April thru September 2011 was 7.50 at 1m, 7.48 at 4 meters, 7.48 at 9 meters and 7.29 at the 1 m above bottom depth (13 meters), which were decreases from all of the previous year's averages.

Historically, pH has been in the range of 7.6 to 7.9, as seen in Graph 43. This year's average pH falls within the range of existing historical trends. .

14.3.4 *Sulphate/Hardness*

From April to September 2011, sulphate concentrations averaged 15.00 mg/L at the 1m depth, 15.48 mg/L at the 4m depth, 43.00 mg/L at the 9m depth and 115.67 mg/L 1 m from bottom. Annual average sulphate concentration for all depths was 41.76 mg/L.

Hardness concentrations averaged 23.29 mg/L at the 1m depth, 29.75 mg/L at the 4m depth, 49.88 mg/L at the 9m depth and 118.75 mg/L at the 1m from bottom depth. The annual average of hardness for all depths was 56.21 mg/L.

Sulphate concentrations were lower than the water quality guidelines of (100mg/L) for all depths with the exception of the measurements 1m from bottom. The measurements at 1m from bottom were above the guidelines in all months except May. Sulphate concentrations averaged 15.5 mg/L at 1 meter, 14.37 mg/L at 4 meters, 42.41 mg/L at 9 meters, and 115.67 at 1 meter from

bottom. The overall sulphate average for all depths was 41.76 mg/L. Sulphate results show that samples exceeded the water quality guidelines 6/30 times (20% of samples).

Historically Middle Quinsam Lake has not exceeded the water quality guidelines except on a few individual samples.

The trends noted this year are roughly consistent with the historical trends of alternating years of high and low sulphate/hardness.

14.3.5 *Total Suspended Solids*

During this sampling period, TSS results were consistently below the detection limit of 4 mg/L. The results exceeded guidelines 0/30 times.

14.3.6 *Nutrients*

The results for the annual average concentrations of ammonia nitrogen (0.021 mg/L), kjeldahl nitrogen (0.138 mg/L), dissolved phosphate (0.005 mg/L), total phosphate (0.005 mg/L) and nitrite/nitrate nitrogen (0.02 mg/L) remained similar to last year at all depths. There were no peak levels of concern for this report period. Nutrients have historically been present at low concentrations at Middle Quinsam Lake as discussed in the historical section of this report Section (II.4.5). The water quality objectives for total phosphorous at Middle Quinsam Lake are concentrations ≤0.006 mg/L. While the annual average (0.0054 mg/L) fell below this guideline, there were three occasions where the total phosphorous exceeded the water quality guideline: in May, July, and August, at a depth of 1m, with total phosphorous concentrations of 0.006, 0.006, and 0.014 respectively. Therefore, sample results exceeded water quality guidelines 2/30 times (6.7% of samples).

14.3.7 *Total and Dissolved Metals*

Total and dissolved metal concentrations remain low in Middle Quinsam Lake, most below detection limits. Concurrent with historical trends, the metal concentrations indicate that the

annual averages of total calcium, copper, iron, lead, magnesium, sodium, and zinc and dissolved aluminum have remained similar as in previous years, with some of the concentrations of aluminum, lead and calcium decreasing with depth as compared to previous years. Total and dissolved arsenic regularly reported at less than the laboratory detection limits of 0.0001 and less than the water quality objectives for total arsenic of 0.005 mg/L for at all depths throughout all sampling events. All of the metals were below the water quality objectives for this sampling event with the exception of total mercury and manganese. Total manganese levels were higher than the water quality objective at 1m from the bottom in the months of July, August and September. However the annual average for manganese at all depths was 0.0340 and falls below the water quality objective of 0.0500 for this parameter. Sample results exceeded water quality guidelines 3/30 times (10% of samples) this season. Mercury was higher than the water quality objectives at all depths in April, June, July and August; higher at most depths in May; and higher at 1m from the bottom in September. The annual average for total mercury was measured as (0.00075 mg/L). The water quality objective for total mercury is (≤0.0001 mg/L). Mercury samples exceeded water quality guidelines 19/30 times (63% of samples). Elevated mercury results led to an investigation of the potential sources of contamination and concluded that the elevation levels at Middle Quinsam Lake were almost exclusively attributed to equipment contamination (specifically an alpha water sampler used to collect lentic samples). In recent months (April-May 2012), a new non-leaching sampler was used to collect the lake samples; over this period, all total and dissolved mercury levels have been below the detection limit. The results of the investigation will be discussed further during the 2012 ETRC meeting.

14.3.8 *Biological Monitoring*

The results of the phytoplankton, phaeopigment, chlorophyll “A”, phytoplankton counts, and identification are presented in Appendix III. The results of the periphyton analysis at the outlet of Middle Quinsam Lake (WB) are presented in Appendix IV.

14.3.9 *PHAEOPIGMENT AND CHLOROPHYLL "A"*

A common pigment to all algae is "Chlorophyll "A" which is a good indicator of biomass. Phaeopigment is the result of the degradation of chlorophyll "A" and large numbers of phaeopigment are indicative of the end of an algal bloom (G3 Consulting, 2002, personal communication). Together with the phytoplankton data, phaeopigment and chlorophyll "A" data are used to monitor the changes in the biomass.

During the 2011/12 report period, chlorophyll "A" had the greatest concentrations in May, June and July at Middle Quinsam Lake. Concentrations of phaeopigment peaked in April, June and July. Chlorophyll "A" peaked in May at 3.1 mg/m^3 at a depth of 9 meters, in June at 1.3 mg/m^3 at a depth of 9 m and in July at 2.1 mg/m^3 at 9m. Concentrations of phaeopigment peaked in April at 1.2 mg/m^3 at a depth of 1 m, in June at 1.5 mg/m^3 at 4 m and in July at 1.2 mg/m^3 at a depth of 4 m.

The Chlorophyll "A" and the phaeopigment results shown indicate that phytoplankton blooms occurred in June and July at all depths sampled. Summer blooms are common in Middle Quinsam Lake due to the summer "turning" which distributes the nutrients throughout the lake that normally remain close to bottom.

14.3.10 *COUNTS AND IDENTIFICATION*

The following is a summary of the Stantec phytoplankton reports and data:

Species abundance was within the range as seen in previous years for all months sampled in 2011 and were greatest at the 9 meter depth in April;, at the 4 meter depth in May, August and September; and at the 1 meter depth in June and July. Total species abundance was within the range sampled in previous years for all months sampled in 2009 except for a lower abundance value at 9m in May during July and at 1m depth in during August.

The most abundant phytoplankton species during all months was the small (<3µm) chrysoflagellates *Ochromonas spp.* and *Chromulina spp.,* at all three depths. This species composition is representative for Middle Quinsam Lake.

Stantec concludes it is common for the total species abundance and composition to show discrepancy from one year to another. This could possibly be from the surrounding mining activity having an effect on the conditions of the lake or natural influences, for example when the lakes turn over in the autumn and spring. However, Middle Quinsam Lake's species abundance, composition and diversity continue to indicate oligotrophic conditions.

The complete analyses performed through Stantec are provided in Appendix III.

14.3.11 *PERIPHYTON (ARTIFICIAL SUBSTRATE)*

Two sets of artificial substrates were placed in the water for a single six week period at sites WB and LLO. The substrates were collected in July of 2011. The sample from LLO was exposed to the elements for a few days over the course of the six week period when water levels dropped suddenly. This did not affect the appearance of the preserved sample when it was compared to the sample collected at the WB site. Complete results by Stantec are provided in Appendix II for the identification to species. The following is a summary of the phaeopigment identification report (for WB and LLO) completed by Stantec:

Duplicate samples were collected at WB and LLO from adjacent artificial substrates. All samples had results consisting mainly of diatoms (>99%) with some green algae material. Samples contained fine sediment consisting of diatoms, detritus and green algae.

Common species evident at WB included *Achnanthes* spp., *Gomphonema angustatum* and *Navicula* spp. The most predominant species, however, were *Eunotia pectinalis* var. *minor* and *Achnanthes minutissima* were the most predominant species evident at this site.

The predominant species for the LLO sample was similar in composition containing predominantly *Eunotia pectinalis var. minor* and *Achnanthes minutissima* which was similar to the

previous year's predominant species for LLO. The common species included *Gomphonema* spp*., Eunotia spp.,* and *Gomphonema angustatum.*

The species observed in 2011 have been observed in previous years.

Stantec concludes that all species found are common in coastal streams in B.C. and were found during the late 1970's in the lower section of the Quinsam River.

14.4 INLET (WA) AND OUTLET (WB) OF MIDDLE QUINSAM LAKE

Middle Quinsam Lake's inlet (WA) and outlet (WB) offer an opportunity to assess the possible effects that mine operations may have had on lake water quality when a comparison is made of the two monitoring stations. WA (inlet to Middle Quinsam Lake) water quality data offers information on water quality that has not been influenced by mine operations. Data obtained from station WB (outlet of Middle Quinsam Lake) provides information on lake water quality after the addition with the various inputs from WA, groundwater, Long Lake and mine site effluent. Water quality data for stations WA and WB are presented in Tables 9 to 10-4, and 11 to 12-2. The historical trend graph for pH at WA is found on Graph 41.

Nutrients, TSS and most total metals are present in low concentrations which are consistent with previously reported results. A comparison of the two stations demonstrates that increases in total calcium, magnesium and sodium are typical for both sites; slight increases in total iron are sometimes observed in Middle Quinsam Lake Outlet (WB) compared to Middle Quinsam Lake inlet (WA). Increases in conductivity and hardness correlate to increases in the metal concentrations. Sulphate concentrations have consistently shown an increase between WA and WB. The pH is sometimes higher at WB than at WA, but more frequently is higher at WA. For a more detailed discussion see.

For the 2011/12 report period, sulphate concentrations for WA ranged from 0.05 mg/L to 32.0 mg/L and averaged 2.21 mg/L. Sample results exceeded water quality guidelines 0/60 times. At

WB sulphate concentrations ranged from 9.3 mg/L to 54.4 and averaged 21.37 mg/L. These sample results exceeded water quality guidelines 0/55 times. These results indicate higher initial sulphate levels at WA compared to last year's results, whereas lower concentrations were observed at WB when compared to last year.

During this report period, pH values at WA ranged from 7.09 to 7.70 and averaged 7.41, a slight decrease from the previous year's average of 7.96. The pH values at WB ranged from 7.19 to 7.77 and averaged 7.54, also an decrease from the previous year's annual average of 7.72.

The TSS results at WA ranged from 1 mg/L to 5 mg/L and had an annual average of 3.93 mg/L, a decrease from last year's average of 5.43 mg/L. The TSS results exceeded the water quality guidelines 0/60 times. Results are presented in Graphs 60.

At WB, the TSS results range from 1 mg/L to 7 mg/L and had an annual average of 3.91 mg/L. The TSS results for WB exceeded the water quality guidelines 0/55 times. Results are presented in Graph 62.

All total and dissolved metals for each site were within the water quality objectives. Results for total and dissolved metals at WA exceeded water quality objectives 0/60 times, and at WB, 0/55 times.

14.4.1 *Lake Inlet and Outlet Flows*

In order to establish flow curves for the Quinsam Lake outlet (WB) and Long Lake outlet (LLO), Via-Sat Consulting was contracted by QCC in March of 1998, and they collected four discharge measurements from both stations over a period of eight months. Staff gauge readings and flows for this report period at monitoring stations WB, LLO and WA are presented in Table 71. After a heavy rain storm in November of 2010 the staff gauges at WA and WB were both washed out. The gauge was not replaced at WA but was replaced at WB in March when the water levels were lower. Flow data for the Quinsam River at Argonaut Bridge (WA) was provided by the Water Survey of Canada, mean discharges values are included in Tables 72-1 to 72-3.

QCC obtained the services of Via-Sat Data Systems in 2007 to collect updated data for the Long Lake Outlet and the Middle Quinsam Lake Outlet discharge curves. The flow measurements were updated in October, 2008. The calculation curve used LLO ($y=13.093 * B^2$ -3.6553 B5+0.2677) as updated by Via-sat. The calculation curve previously used at WB is no longer a valid formula given that the original staff gauge was washed out and needs to be replaced.

The upstream flow for WA is controlled by the B.C. Hydro diversion dam; therefore, the precipitation in the area would influence the flows at LLO significantly more than it would influence the flows at WB and WA. The annual total precipitation for this report period was 1810.73 mm, higher than the previous year's total of 1138.6mm. The average annual flow for WA was 2.43m^3/s.

The hydrometric station at WB is currently being installed. This station will be modified to record continuous flow, record hydrometric data and stage-discharge relationships.

14.5 **Long Lake**

Settling Pond #1 discharges water into a series of meadows and wetlands/marshlands before flowing through the culvert beneath the South Mine Area haul road and discharging near the east end (foot) of Long Lake.

14.5.1 *CHEMICAL AND PHYSICAL WATER QUALITY*

Physical water quality results for Long Lake for the 2011/12 report period are presented in Tables 36 to 38. Sulphate concentrations in Long Lake are generally higher than in Middle Quinsam Lake and have been a focus of monitoring over the past several years. Increased pH in Long Lake compared to background levels has also been a focus of interest.

Long Lake water chemistry is influenced by flushing, dilution and vertical mixing of the lake and by inflows from Settling Pond #1 effluent, No Name Lake (NNO) and groundwater, and the seep into Long Lake (LLS). It would be difficult to isolate the causes in lake chemistry that occur during a sampling season as inflows may not necessarily have an immediate effect on the overall lake

water quality. Over the past several years, there has been no mining activity in the South Mine Area apart from the extraction of approximately 20,000 tonnes of coal from the 4 South mine in 2003, 2004 and 2005 and the deposition of a small amount of 4 South coal refuse into the 3 South Pit in 2000, 2003, 2004 and 2005. In the first half of 2010 haul trucks were actively hauling coarse coal refuse from the coal wash plant and depositing it into the 3 south pit PAG-CCR pond. This occurred until July, 2010, when the 2 South pit reached its capacity for PAG-CCR disposal.

14.5.2 *THERMOCLINES*

Long Lake temperatures recorded for this report period demonstrate that the shallow sampling depths (1 and 4 meters) were situated above or just within the thermo cline (4 meter depth) and the 9 meter sampling depth was beneath or just within the thermocline. The thermocline was located between 3 and 5 meters in April and August; between 2 and 4 meters in May, June and July; and between 5 and 6 meters in September. In comparison to the previous year, the thermocline in Long Lake was located at comparable depths for all sampling months. Some variation in temperature at the same depth over the years is expected, and may perhaps be caused by aspects such as variations in air temperature and seasonal turn over.

The hypolimnetic dissolved oxygen was below the water quality objectives of 3 mg/L during the months of August and September. One measurement in August at 20 meters and two measurements in September at 19 and 20 meters depth fell below the water quality objective (Table 38).

14.5.3 *PH*

For this reporting year, pH averages for 1m, 4m, 9m and bottom depths were 7.48, 7.52, 7.51 and 7.55 respectively, which represent slight decreases from the previous year's averages at all depths except 1m from the bottom where there was a slight increase from 7.46. pH was within the range suggested in the water quality objectives and exceeded the objectives 0/30 times[3]. (Tables 36-38).

14.5.4 *SULPHATE/HARDNESS*

For the 2011/11 report period, sulphate concentrations averaged 57.17 mg/L, 108 mg/L, 147 mg/L and 152 mg/L at the 1 m, 4 m, 9 m, and 1m from bottom depths, respectively. Average sulphate concentrations, shown in Graph 49, were lower at the uppermost depths and higher at the bottom depths, as compared to the previous year's sulphate concentrations. The concentrations of sulphate from the previous year for 1m, 4m, 9m and 1 m from bottom were 68 mg/L, 87 mg/L, 138 mg/L and 139 mg/L respectively. Concentrations of sulphate were higher than the water quality guidelines of 100 mg/L during most sampling events except the 1m depth during all sampling events, and the 4 meter depth in September. Results for sulphate tests were higher than the water quality guidelines 20/30 times (66.66% of samples).

Hardness concentrations averaged 70.8 mg/L at 1m, 111.5 mg/L at 4m, 155.5 mg/L at 9m, and 158.8 mg/L at bottom depths. Average hardness concentrations (Graph 47) decreased marginally at all depths in comparison to the 2010.

[3] This proportion is based on 6 sampling months, with 4 sampling depths/month and one replicate sample per month. Each sampling date, depth and replicate is considered a separate 'sampling event' for the purposes of this comparison.

Long Lake water chemistry is influenced by five possible sources. These include the drainage from No Name Lake, the Long Lake Seep (LLS), drainage from Settling Pond #1, local groundwater inflows, and surface runoff from the local catchment area.

The increase in precipitation during the reporting period is inferred to have increased the amount of lake flushing. The increased flushing may have influenced the pH, hardness and sulphate concentrations in the water chemistry of Long Lake. Long Lake is more influenced by the amount of precipitation than MQL and the sources that feed Long Lake can contribute to the variation of the chemical constituents within the lake.

The seasonal trend for sulphate and hardness concentrations in Long Lake was generally consistent with previous years. There were decreases in overall pH, sulphate and hardness measurements.

14.5.5 *NUTRIENTS*

The annual average kjeldahl nitrogen increased in 2011, with an average of 0.15 mg/L whereas in 2010 the annual average was 0.13 mg/L. Ammonia nitrogen also increased with an average value of 0.022 mg/L, compared to the previous year's average of 0.006. The annual averages for dissolved phosphorous and nitrite/nitrate nitrogen remained the same at 0.005 mg/L and 0.06 mg/L respectively There were no peak levels of concern for this report period. Concentrations of total phosphorus were below the objective for Long Lake (≤ 0.007 summer average) at all depths measured with the exception of the 1 meter depth in May and August when measurements were 0.007 and 0.009 respectively.

14.5.6 *TOTAL METALS*

Total metal concentrations remain low in Long Lake. Total magnesium, sodium, copper, lead and zinc concentrations remained the same as the previous year with no peak levels of concern for this reporting year. Some of the metal salts (eg calcium, magnesium, and sodium) were marginally higher this sampling season. Arsenic values ranged from 0.0002 mg/L to 0.0006 mg/L

and averaged 0.0003 mg/L. Recorded values were greater than water quality objectives 0/25 times.

Concentrations of total manganese were also above the water quality objectives for the samples taken at 1 meter above the bottom in all sampling months. There were also a few samples taken at the 4m and 9m depth that ranked above the water quality objective of 0.05 mg/L. Concentrations ranged from 0.006 mg/L to 0.367 mg/L, with the maximum concentration measured in September at 1m from bottom. The average concentration of total manganese for this sampling year was 0.0990 mg/L. Sampling results exceeded water quality guidelines 11/25 times (44% of samples).

Total mercury concentrations for the season ranged from 0.00002 mg/L to 0.00284 mg/L. Annual concentrations of total mercury (0.0006 mg/L) measured as an average of all depths were above the objective of ≤ 0.0001 mg/L. Total mercury results exceeded the water quality guidelines 21/25 times (84% of samples). As was the case with Middle Quinsam Lake, elevated mercury results led to an investigation of the potential sources of contamination, the results of which will be discussed during the 2012 ETRC meeting. All other water quality objectives were acheived for Long Lake when compared to the objectives for Middle Quinsam Lake sub-basin.

14.6 BIOLOGICAL MONITORING

The results of the Phytoplankton, phaeopigment and Chlorophyll "A" analyses at the center of Long Lake are presented in Table 36 and the results of the Phytoplankton counts and identification are presented in Appendix III. The results of the periphyton analysis at the outlet of Long Lake (LLO) are presented in Appendix IV.

14.6.1 *PHAEOPIGMENT AND CHLOROPHYLL "A"*

During the 2011/12 report period, concentrations of chlorophyll "A" peaked in May with 2.1 mg/m^3 at 4 m, and again in June with 1.5 mg/m^3 at 4 m and 9 m. Phaeopigment peaked in April with 1.8 mg/m^3 at 4 m depth, and again in September with 2.0 mg/m^3 at 4 m depth (Graph 50). The concentration peak for Chlorophyll "A" increased from the previous year's peak of 1.15

mg/m^3 and the phaeopigment concentration peak also increased from the previous year's peak of 0.846 mg/m3.

The Chlorophyll "A" and the phaeopigment data indicates that phytoplankton blooms occurred in the spring and midsummer at 1m, 4m and 9 m depths. Spring and midsummer blooms are common in Long Lake due to the spring and summer "turning" that distributes the nutrients throughout the lake that normally remain close to bottom.

14.6.2 *COUNTS AND IDENTIFICATION*

The following is a summary of the Stantec phytoplankton reports and data:

Total species abundance was within the range sampled in previous years for all months sampled in 2011. Total abundance was greatest at the 4 m depth in April, at the 4 m depth in May and June, 4 m and 9 m depths in July, 1 m depth in August and the 4 m depth in September.

Species composition was typical for Long Lake, and as usual, the small *chrysoflagellates Ochromonas spp*. and *Chromulina* spp. were predominant during all months;

Stantec concludes that the temporal variations in phytoplankton abundance and composition are to be expected. These may be results of changing lake conditions related to discharges from mining activity (e.g. changes in sulphate or nutrients availability, shifts in pH) or to natural variation (e.g. Timing of sampling related to autumn and spring overturns). Abundance, species composition and species diversity continue to indicate oligotrophic conditions. Changes in the phytoplankton community composition in recent years indicate that shifts in nutrient dynamics of Long Lake may be occurring.

The complete results by Stantec are provided in Appendix III.

14.6.3 *PERIPHYTON (ARTIFICIAL SUBSTRATE)*

Two sets of artificial substrates were placed in the water for a single six week period at sites WB and LLO. The substrates were collected in July of 2011. The sample from LLO was exposed to the elements for a few days over the course of the six week period when water levels dropped suddenly. This did not affect the appearance of the preserved sample when it was compared to the sample collected at the WB site. Complete results by Stantec are provided in Appendix II for the identification to species. The following is a summary of the phaeopigment identification report (for WB and LLO) completed by Stantec:

Duplicate samples were collected at WB and LLO from adjacent artificial substrates. All samples had results consisting mainly of diatoms (>99%) with some green algae material. Samples contained fine sediment consisting of diatoms, detritus and green algae.

Common species evident at WB included *Achnanthes* spp., *Gomphonema angustatum* and *Navicula* spp. The most predominant species, however, were *Eunotia pectinalis* var. *minor* and *Achnanthes minutissima* were the most predominant species evident at this site.

The predominant species for the LLO sample was similar in composition containing predominantly *Eunotia pectinalis var. minor* and *Achnanthes minutissima* which was similar to the previous year's predominant species for LLO. The common species included *Gomphonema* spp*., Eunotia spp.,* and *Gomphonema angustatum.*

The species observed in 2011 have been observed in previous years.

Stantec concludes that all species found are common in coastal streams in B.C. and were found during the late 1970's in the lower section of the Quinsam River.

14.7 LONG LAKE OUTLET (LLO) AND NO NAME OUTLET (NNO)

In order to comply with permit requirements and provide information on potential influences of inputs to the water quality, the outlet of Long Lake (LLO) and the outlet of No Name Lake (NNO) are monitored on a weekly basis. The flow from No Name Lake enters into the west end of Long Lake and flow from LLO discharges to Middle Quinsam Lake near the Middle Quinsam Lake outlet, water quality monitoring at NNO and LLO provides information on the two lakes. Water quality data for stations LLO and NNO are presented in (Tables 32 to 35-4) and the historical trend graphs for pH and sulphate for LLO and NNO (Graphs 52, 53 and 57, 58).

In the 2011/12 report period, the pH values at LLO ranged from 7.04 to 7.84 with an average pH of 7.45. Here, pH values exceeded the water quality guidelines 0/51 times. Sulphate ranged in concentration from 14.8 mg/L to 89 mg/L with an average concentration of 47.67 mg/L a slight decrease from the previous year's average of 57 mg/L. For this sampling season, sulphate levels exceeded water quality guidelines 0/51 times.

In 2011/12, the pH values at NNO ranged from 6.84 to 7.6 and averaged 7.20. This represents a slight decrease from last year's average pH at NNO, which was 7.25. The pH values at NNO exceeded water quality guidelines 0/56 times. Sulphate results ranged in concentration from 0.5 mg/L to 13.2 mg/L and averaged 5.04 mg/L, which has slightly decreased from the previous year's average of 6.36 mg/L. The sulphate concentrations at NNO exceeded the water quality guidelines 0/56 times.

Total suspended solids that are recorded weekly for both NNO and LLO and these data sets were were graphed using a running average of 5 weekly samples. These include Graphs 59 and 61, for NNO and LLO, respectively. The running 30-day median was never greater than the WQO of ≤ 5 mg/L for either site. At NNO, laboratory results exceeded the water quality guidelines 0/56 times and at LLO results exceeded the guidelines 0/51 times.

All total and dissolved metals were within the WQO and most were below laboratory detection limits. Total and dissolved Arsenic was below laboratory detection limits of 0.0005 mg/L and the WQO for total arsenic of 0.05 mg/L. At NNO, sample results exceeded the water quality guidelines 0/56 times and at LLO results exceeded the guidelines 0/51 times.

Both LLO and NNO have similar trends in pH, both have pH highs during the summer and early fall months and pH lows during the winter months. Sulphate concentrations and pH at the two outlets were much higher at LLO than at NNO, suggesting that there is a significant difference in the factors that influence water quality at these two monitoring stations.

14.8 WATER QUALITY AND DATA GAPS

Currently Quinsam Coal conducts in excess of 7,000 water quality analyses on an annual basis and some errors occur in the sampling, shipping, analysis and recording process. The following results summarize the water quality data that were miss-reported or missed during this report period:

QCC is required to collect a composite water sample at our 2 permitted sites when the decant flow at each site is within a certain range. The following dates represent times when flow volumes require a sample and the TSS sample was not taken from Settling Pond #4.

May: 28, 29, 31

Jun: 1-5

Jul 19-25, 28

Aug 6, 7, 26-29

Nov 19, 26, 27, 30

Dec 11, 17-19, 21-25, 27

Jan 25, 26

Feb 8, 10-13, 15

Flow data was missed at SPD from January 1-March 31, 2012 due to equipment failure. The probability of an overflow was low at SPD during this time. Given the equipment failure, QCC environmental staff took daily grab samples for all days of missed data to ensure that we continued to operate within the limits of our permits.

Water gauge data at WA was missing between August 25th and October 31st. This Data was therefore supplemented with data from Environment Canada.

The staff gauge at WB was washed away during a high volume flow event and is now being replaced by a hydrometric station that will continuously record flow.

15.0 QUALITY ASSURANCE / QUALITY CONTROL PROGRAM

All replicate sampling was performed in compliance with the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2003 Edition and with the recommendations made in the April 30, 2004 Golder Associates Ltd. (Golder) Technical Memorandum entitled "Quality Control for Surface Water Sampling at Quinsam Coal".

As per these recommendations and in accordance with the Quality Assurance/Quality Control (QA/QC) program, one field replicate sample was collected per sampling event. Four field blank samples were also analyzed throughout this monitoring year. RPD values were calculated in accordance with the B.C. field sampling manual. Replicate field samples were calculated for concentrations at or greater than five times the reported DL, the relative percent difference of these should not exceed 20%.

The acceptability criteria used for the field blank samples was calculated in accordance with the quality assurances guidelines of the B.C. Field Sampling Manual, which states that the field blank contamination should not be significantly greater in concentration nor occurrence than laboratory method blanks contamination. Where the laboratory method blanks should not exceed the detection limit reported by the laboratory for the associated (same batch) samples. If the RPD value is greater than 20% then the field blank result should not exceed two times the laboratory detection limit. Calculations of the RPD results for the field blank samples were calculated with the mean detection limit for those parameters with RPD values greater than 20%.

During this report period, replicate water samples were collected from monitoring stations WA, WC, WD, WP, WB, NNO, SPD, LLE, SPC, 3 South Pit, 3S77, 4S Lower, 2NPS, MQL1, MQL4, MQL9, LLM1, LLM4, 7 South, and QRDS1 as well as four field blank samples (Tables 74-1 to 77-4).

Replicate samples were within the acceptable range for all samples during this report period excluding those samples with RPD values greater than 20%, displayed in the table below:

Table 1: Parameters for Samples collected with RPD Values Greater than 20%

SAMPLE ID	DATE COLLECTED	PARAMETER WITH RPD VALUES GREATER THAN 20%
WA	04-APR	Ammonia Nitrogen
LLE	04-JUL	
LLM4	13-APR	
NNO	06-JUN	Hardness
NNO	06-JUN	Alkalinity – Total as CaCO3
QRDS1	04-AUG	
NNO	26-SEP	Sulfate
3S	02-MAY	Acidity (to pH 8.3)
3S	13-JUN	
WP	30-AUG	
MQL4	02-MAY	
MQL9	13-JUN	
2NPS	14-SEP	
2NPS	07-DEC	
2NPS	07-FEB	
WP	30-AUG	Total Aluminum
QRDS1	04-AUG	
NNO	06-JUN	

WP	30-AUG	Total Iron
NNO	06-JUN	
WA	04-APR	
WP	30-AUG	Total Manganese
NNO	06-JUN	
NNO	06-JUN	Total Potassium
WA	04-APR	Total Sodium
WA	04-APR	Total Strontium
NNO	06-JUN	Total Calcium
MQL4	12-APR	Dissolved Iron

16.0 2010 SULPHATE BENCH SCALE BIOREACTORS

In April 2011, QCC contracted Golder Associates to perform a bench scale test designed with 6 bioreactor cells, each with a different combination of substrate. This was aimed at determining what combination of substrates would produce the best results in reducing sulphate and sequestering sulfide. Further expansion and design of a "scaled-up" bio-cells project was underway in 2011/2012. The results from the bench scale test will determine what bioreactor cell will be used in the larger design to treat water from the 2 South underground workings in order to mitigate the impacts of the Long Lake Seep. Further information on the bench scale test can be found in Appendix IX.

The results of the bench scale test have led to the installation of the passive treatment system (PTS) that was constructed and commissioned in 2012. This system includes:

- A biochemical reactor cell (BCR) designed to convert sulphate to sulphide

- A sulphide polishing cell designed to sequester the sulphide from the BCR cell effluent
- An aeration an settling pond system designed to capture any remaining total and dissolved metals.

Construction has been completed and the commissioning of the various components is underway.

17.0 SEDIMENT STUDIES

Over the 2011/2012 monitoring year, no new sediment studies occurred, other than those related to the 7-South Mine Permit and Effluent Permit Amendments.

18.0 DISPOSAL OF WASTE OIL AND SOLVENTS

Waste oil and solvents are stored in fully contained metal barrels on a concrete pad located on site and recycled by Newalta Corporation. During the 2011/12 reporting year approximately 6500 L of used oil and waste oily water was collected for recycling.

19.0 METAL RECYCLING

Scrap metal at the mine site is recycled by Steel-Pacific Recycling. There are designated metal containers for the scrap metal, which is removed from the minesite when the containers are full.

20.0 ATTAINMENT MONITORING PROGRAM

In 2010, Quinsam Coal participated in an attainment monitoring program, which is a joint venture between the Ministry of Environment and Quinsam Coal for the Upper Quinsam watershed area. This was conducted by MOE staff and QCC staff. The sampling program ran for two five-week periods from August to September and October to November. QCC incorporated this monitoring into their receiving environment monitoring program as part of the regular monitoring for five weeks.

The attainment monitoring program is a biannual event (spring and fall). The monitoring stations included in the study consisted of the receiving environments Quinsam River at Middle Quinsam Lake inflow at the Argonaut Main (WA), Quinsam River at Middle Quinsam Lake Outflow (WB), Long Lake Outlet (LLO), and No Name Outlet (NNO). The monitoring followed the MOE's guidelines for the 5 in 30 day monitoring events. This allowed for the average of the 5 weekly samples in 30 days to be calculated for the MOE database. The parameters analyzed included the physical tests, anions, cations, nutrients, total and dissolved metals, and biological parameters. The results from this monitoring event increased the knowledge base of the upper Quinsam watershed.

Quinsam Coal looks forward to discussing opportunities to continue this program in 2013.

21.0 ANCILLARY PROGRAMS

21.1 MIDDLE POINT BARGE

On January 12, 2005 Permit PE-17181 was issued as per the requirements of the Ministry of Water, Land, and Air Protection, which stipulated that the effluent from the Middle Point Coal Storage and Barge Loading Facility required routine sampling. All of the water samples collected for the 2011/12 monitoring year indicate that all of the water quality samples collected for TSS, pH and oil and grease were below the permit limits of 50 mg/L TSS, 6.5 – 8.5 pH and 10 mg/L oil and grease, with the exception of one TSS result. pH results at Middle Point ranged from 5.59 to

8.16, while averaging 7.75. These results exceeded permit limits 0/49 times. The TSS results ranged in concentration from 1 mg/L to 9.5 mg/L and averaged 3.82 mg/L. On January 12, 2012, the pH value was lower than the allowable limit with a result of 5.59. The pH results exceeded permit limits 1/49 times (2% of samples). Finally, oil and grease concentrations ranged from 1 mg/L to 3 mg/L with an average of 1.7 mg/L. These results exceeded permit limits 0/49 times.

All but one of the TSS results were within the permit limits which might suggest that the secondary treatment system that was installed in June 2002 has effectively reduced the TSS in the effluent to well below the permit limit. The results of the effluent quality and flow volumes are presented in Tables 51-1 and 51-2.

22.0 UNDERGROUND SAMPLINGS 3-MAINS

To better evaluate the water quality issues and inputs into the North Mine Water Management System, samples are also collected from the mined out areas underground. Underground samples were taken from 3 Mains Underground about every 2 months throughout the sampling year. Results of these samples included pH ranging from 7.67 to 8.04 and averaging 7.86, concentrations of hardness ranging from 433 mg/L to 619 mg/L and averaging 537 mg/L, concentrations of alkalinity ranging from 390 mg/L to 410 mg/L and averaging 384, and concentrations of sulphate ranging from 1050 mg/L to 1310 mg/L, averaging 1150 mg/L. Total and dissolved metals were mostly below laboratory detection limits with the exception of both total and dissolved boron, barium and lithium, measuring just above laboratory detection limits. The higher concentrations are measured in iron, sodium, magnesium, manganese, and potassium. The analytical results are shown in (Tables 54-55).

22.0 PRECIPITATION AT THE MINE SITE

The total precipitation recorded for the mine site during the report period was 1810.73mm (Table 70). The annual precipitation for this report period was significantly higher than the previous year's total of 1138.60 mm.

It should be noted that sampling results can be correlated with precipitation values. When reviewing the graphical and statistical data, the clear relationship between low precipitation and run-off and comparatively higher levels of chemical constituents such as sulphates and salts is evident.

Most of the precipitation data collected for this sampling year was gathered from a weather station on site. On occasion the weather station did not record the precipitation data correctly, due to power outages or equipment failure. For those days where data could not be collected at the mine site, precipitation data from the weather station at the Campbell River Airport was used instead. Table 70 indicates which data were collected on site and which were augmented.

22.1 PETROLEUM PRODUCT STORAGE

Bulk fuel for the underground equipment is located in a concrete sump behind the maintenance shop which drains to an oil/water separator. Bulk fuel for the surface equipment is located in an earth-bermed area located just south of the coal preparation plant. A 2200 l diesel tank is located at the emergency back-up generator at the Main Fan installation on the 2 North high wall. Smaller fuel storage tanks are in use in various locations on the site.

22.2 SEWAGE AND GREY WATER DISPOSAL

Sewage is collected in an underground septic tank which is pumped out by a contractor and transported off-site to proper disposal facilities in Campbell River. Grey water from the mine dry sinks and showers is piped into the fine refuse disposal area in the 2 North Pit void.

On February 2, 2009 a site inspection was performed by a local environmental health officer from the Vancouver Island Health Authority. The inspection was performed in order to renew the

previous water license permit. Permit # 5327 was issued on March 26, 2009 for the year of 2010/11 operating water license permit for the premises.

22.3 SPILLS

Two incidences of reportable spills occurred this year:

Incident 1: May 15, 2011

PEP DRIG:110468 – 3 South Pit

At approximately 5:00 PM on May 15th, 2011, a power pole supporting three pole-top transformers broke in half, spilling approximately 200-243 L of UNIVIS BIO 40 hydraulic fluid onto the ground. This fluid then drained into the 3 South pit pond. The Environmental Technician was notified on Monday the 16th at 11:00 am. The technician immediately responded to cleanup the spill. The spill was reported to PEP at approximately 2:30 pm on Monday May 16th, 2011. The hydraulic fluid was tested for PCBs and the results showed that the fluid was PCB free material. Vancouver Island Power Lines Inc. were at the scene when the environmental technician arrived on Monday. The old pole was removed and a new pole was installed.

Corrective Actions:

The pumps were shut off immediately with no water leaving the 3 South pit pond. An absorbent floating boom was deployed, trapping the majority of the spilled oil in a confined area. Approximately eight bags, containing 200 absorbent pads, were applied to the surface of the water in the 3 South pit pond. The pads were removed when saturated and placed in drums. Fresh pads were applied until no further hydraulic fluid was observed on the surface of the water and the pads no longer showed absorbed fluid. This took place over a period of one week. The contaminated soils were relocated to an area for further remediation.

To prevent further occurrences poles must be inspected before instillation. Also, multiple anchor lines should be used to support the pole at the terminus of the line.

Incident 2: May 17, 2011

PEP DRIG:110474

At approximately 7:00 AM on May 17, 2011, a Man Carrier was entering the warehouse to fuel up. The man carrier bumped into the bulkhead drain fitting at the bottom of a tote containing 1125 L of hydraulic fluid. Approximately 190 L of hydraulic fluid spilled onto the contained concrete pad. The Environmental Technician was notified on Tuesday the 17th at 7:30 AM and immediately responded to the cleanup of the spill. The spill was reported to PEP at approximately 2:30 PM on Tuesday May 17th, 2011. The fluid was pumped out of the concrete pad that had been contaminated via a vacuum truck from Walco Industries. The vacuum truck removed the contaminated mud from the concrete pad and the oil water separator. Newalta was called to pump the container of waste hydraulic fluid.

Corrective Actions:

The oil water separator valve was closed and pumps were installed to pump the fluid back into a container. Newalta and Walco were called to assist in the clean-up of the spill.

To prevent future spills, the shop foreman will host a meeting with all employees to remind them to be aware of their surroundings while operating equipment. Once a new fueling station is operational (scheduled for 2012), the risk of fuel spills at the warehouse will be reduced.

23.0 MINE OPERATION PLANS FOR 2012/13

Operating Plans for 2012/13 include the following:

- Continued development mining and depillaring in 2-North and 5-South mines.
- Development of the 7-South mining area.

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TABLE 1
SETTLING POND 4 WATER QUALITY
2011/12 EMS ID E207409
COMPANY IDENTITY - WD

Parameter	April					May					June					Site Description	
Sample Date	4	11	18	18*	25	3	9	13	23	30	6	13	20	27	PERMIT	GPS (m)	
Conductivity (umhos/cm	1860	1960	1990	1980	2090	2050	2110	2030	2250	2210	2250	2150	2130	2150	-	Minegrid	
Hardness CaCO3	438	-	-	-	-	460	-	-	-	-	490	-	-	-	-	Northing	Easting
pH	8.00	8.07	8.09	8.10	8.07	7.96	8.01	8.04	8.01	8.05	8.03	7.91	8.04	8.10	6.0-8.5	104021.8	99422.313
Total Suspended Solids	<4.0	8.0	6.0	6.0	6.0	2.0	4.0	<4	9.0	4.0	5.0	<4	<4	<4	25	UTM ZONE 10	
Total Dissolved Solids	1200	-	-	-	-	1500	-	-	-	-	1600	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	5.1	6.5	2.6	2.9	1.5	7.9	7.7	8	4.9	2.7	3.9	4.5	2.7	-	-	5534384	321270
Alkalinity - Total CaCO3	290	330	340	350	370	310	340	350	320	300	310	290	340	330	-		
Ammonia Nitrogen	0.030	-	-	-	-	0.041	-	-	-	-	0.051	-	-	-	1		
Nitrate and Nitrite as N	0.08	-	-	0.06	-	0.03	-	-	-	-	<0.02	-	-	-	-	Permitted Discharge	
Dissolved Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	0.03	From Settling Pond	
Total Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	4 Decant North Mine	
Sulphate	680	710	710	710	660	710	770	710	1100	800	800	780	730	810	-	Water	
Oils and Grease	<1	-	-	-	-	<1	-	-	-	-	<1	-	-	-	10		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100		

Parameter	July				August						September					Site Description	
Sample Date	5	11	18	26	5	8	15	15*	22	30	7	14	21	26	PERMIT	GPS (m)	
Conductivity (umhos/cm	2230	2310	2270	2190	2200	2310	2270	2280	2300	2270	2300	2300	2280	2100	-	Minegrid	
Hardness CaCO3	468	-	-	-	470	-	-	-	-	453	-	-	-	-	-	Northing	Easting
pH	7.95	8.07	7.95	8.01	8.05	8.01	7.99	8.07	8.05	8.12	8.05	8.12	8.14	8.13	6.0-8.5	104021.8	99422.313
Total Suspended Solids	<4	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	UTM ZONE 10	
Total Dissolved Solids	1500	-	-	-	1700	-	-	-	-	1600	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	9.40	7.30	9.90	3.10	2.60	3.40	7.80	7.00	9.30	0.90	4.80	1.80	2.20	2.90	-	5534384	321270
Alkalinity - Total CaCO3	320	330	330	340	320	310	320	330	340	330	300	300	310	310	-		
Ammonia Nitrogen	0.049	-	-	-	0.021	-	-	-	-	0.028	-	-	-	-	1		
Nitrate and Nitrite as N	0.09	-	-	-	<0.02	-	-	-	-	<0.02	-	-	-	-	-	Permitted Discharge	
Dissolved Phosphorous	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	0.03	From Settling Pond	
Total Phosphorous	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	-	4 Decant North Mine	
Sulphate	860	870	860	780	810	870	780	790	770	870	800	850	820	740	-	Water	
Oils and Grease	<1	-	-	-	<1	-	-	-	-	<1	-	-	-	-	10		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100		

Parameter	October					November						December				Site Description	
Sample Date	6	11	17	17*	24	3	8	14	22	29	30	7	13	20	26	PERMIT	GPS (m)
Conductivity (umhos/cm	2240	2220	2160	2130	2160	2200	2220	2160	1560	1930	1930	1820	1830	1910	1840	-	Minegrid
Hardness CaCO3	462	-	-	-	-	441	-	-	-	-	-	346	-	-	-	-	Northing Easting
pH	8.09	8.13	8.02	8.09	8.11	8.07	8.03	8.19	8.10	7.86	7.86	8.09	7.99	7.96	8.00	6.0-8.5	104021.85 99422.313
Total Suspended Solids	6.0	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	4.3	5.7	5.7	<4	25	UTM ZONE 10
Total Dissolved Solids	1600	-	-	-	-	1500						1220	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	2.2	0.7	2.9	3.9	4.3	7.7	10.5	3.1	<0.5	3.2	<0.5	2.7	2.8	4.9	2.8	-	5534384 321270
Alkalinity - Total CaCO3	330	340	340	350	350	360	355	366	247	285	285	346	357	338	337	-	
Ammonia Nitrogen	0.030	-	-	-	-	0.035	-	-	-	-	-	0.040	-	-	-	1	
Nitrate and Nitrite as N	<0.02	-	-	-	-	<0.02	-	-	-	-	-	0.066	-	-	-	-	Permitted Discharge
Dissolved Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	0.03	From Settling Pond 4
Total Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	-	-	0.0064	-	-	-	-	Decant North Mine
Sulphate	810	830	720	700	740	770	800	755	-	720	720	614	557	628	557	-	Water
Oils and Grease	<1	-	-	-	-	<1	-	-	-	-	-	<1	-	-	-	10	
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	>100	-	-	-	>100	100	

Parameter	January					February					March					Site Description	
Sample Date	3	10	17	24	31	7	14	21	21*	28	7	13	20	27	PERMIT	GPS (m)	
Conductivity (umhos/cm	1810	1640	1750	1870	1430	1680	1670	1720	1720	1750	1670	1550	1560	1630	-	Minegrid	
Hardness CaCO3	273	-	-	-	-	287	-	-	-	-	311	-	-	-	-	Northing	Easting
pH	8.12	8.00	8.11	8.02	8.16	8.11	8.01	8.12	8.14	8.03	8.12	8.16	8.10	8.09	6.0-8.5	104021.8	99422.313
Total Suspended Solids	-	10.5	<4.0	4.5	<4.0	<4.0		5	<4.0	5	<4.0	<4.0	4	<4.0	25	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	1150	-	-	-	-	1120	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	3.0	2.7	2.7	1.5	3.2	7.0	3.1	4.1	2.5	0.6	0.7	2.2	3.3	-	5534384	321270
Alkalinity - Total CaCO3	358	346	368	283	272	340	297	344	342	325	333	337	351	352	-		
Ammonia Nitrogen	0.069	-	-	-	-	0.060	-	-	-	-	0.052	-	-	-	1		
Nitrate and Nitrite as N	0.051	-	-	-	-	0.071	-	-	-	-	0.074	-	-	-	-	Permitted Discharge	
Dissolved Phosphorous	<0.0050	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	0.03	From Settling Pond	
Total Phosphorous	0.0062	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	4 Decant North Mine	
Sulphate	538	459	482	534	407	491	508	493	434	522	492	428	407	442	-	Water	
Oils and Grease	<1.0	-	-	-	-	<1.0	-	-	-	-	<1.0	-	-	-	10		
Bio Assays (%)	-	-	-		-	-	-	-	-	>100	-	-	-	>100	100		

Results expressed in milligrams per litre except where noted.
Bioassays are 96-hour survival rate for Rainbow Trout.
* Field replicate sample.
Bold indicates permit exceedence.

TABLE 2-1

SETTLING POND 4 METALS ANALYSIS

2011/12 EMS ID E207409

COMPANY IDENTITY - WD

Parameter	April	May	June	July	August		September	
Sample Date	4	3	7	5	5	30	7	**Permit**
Total Metals								
Aluminum	0.052	0.050	0.056	0.058	0.031	0.024	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0011	0.0010	0.0008	0.0016	0.0011	0.0013	-	-
Barium	0.024	0.023	0.021	0.023	0.019	0.019	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	0.71	0.85	0.89	0.97	0.99	1.03	-	-
Cadmium	0.00003	0.00001	0.00007	<0.00001	0.00004	0.00002	-	-
Calcium	148	157	163	145	141	153	-	-
Chromium	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	-	-
Cobalt	0.001	0.0018	0.0013	0.0008	<0.0005	<0.0005	-	-
Copper	0.0015	0.0015	0.0016	0.0011	0.001	0.0011	-	-
Iron	0.188	0.237	0.257	0.176	0.166	0.166	-	-
Lead	<0.0002	<0.0002	<0.0002	0.0005	0.0003	<0.0002	-	-
Lithium	0.006	0.007	-	-	0.008	0.008	-	-
Magnesium	16.6	16.7	20.0	17.4	15.9	15.6	-	-
Manganese	0.072	0.080	0.080	0.062	0.039	0.033	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	0.001	0.001	0.001	0.002	0.001	0.001	-	-
Nickel	0.005	0.006	0.006	0.003	0.002	0.002	-	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	2.98	3.58	4.11	4.08	3.71	3.92	-	-
Selenium	0.0004	0.0003	0.0002	0.0002	0.0002	<0.0001	-	-
Silicon	2.5	2.3	2.0	2.2	2.0	2.3	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	254	314	349	355	336	333	-	-
Strontium	1.15	1.25	1.44	1.33	1.24	1.32	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Dissolved Metals								
Aluminum	0.018	0.006	0.024	0.008	0.006	0.007	-	**0.5**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	**-**
Arsenic	0.0008	0.0008	0.0006	0.0012	0.0008	0.0009	-	**-**
Barium	0.025	0.021	0.020	0.024	0.022	0.019	-	**-**
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	**-**
Bismuth	-	-	-	-	-	-	-	**-**
Boron	0.74	0.91	0.93	1.04	1.08	1.10	-	**-**
Cadmium	0.00002	0.00001	0.00002	<0.00001	<0.00003	<0.00001	-	**-**
Calcium	151	152	166	156	158	154	-	**-**
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	**-**
Cobalt	0.001	0.0016	0.0011	0.0007	<0.0005	<0.0005	-	**-**
Copper	0.0009	0.0013	0.0010	0.0011	0.0009	0.0006	-	**0.02**
Iron	0.005	0.233	0.008	<0.005	0.005	<0.005	-	**0.30**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	**0.05**
Lithium	0.006	0.006	-	-	0.008	0.008	-	**-**
Magnesium	16.3	16.8	20.2	19.2	18.4	16.6	-	**-**
Manganese	0.068	0.074	0.074	0.061	0.039	0.025	-	**-**
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**-**
Molybdenum	<0.001	0.001	0.001	0.002	0.001	0.001	-	**-**
Nickel	0.005	0.006	0.004	0.004	0.002	0.002	-	**-**
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Potassium	2.85	3.52	4.24	4.56	4.26	4.14	-	**-**
Selenium	0.0004	0.0002	0.0003	0.0002	0.0002	<0.0001	-	**-**
Silicon	-	-	-	-	-	-	-	**-**
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**-**
Sodium	248	308	362	390	371	359	-	**-**
Strontium	-	-	-	-	-	-	-	**-**
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	**-**
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Uranium	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-	**-**
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**0.1**
Zirconium	-	-	-	-	-	-	-	**-**

Results expressed in milligrams per litre.

* indicates field replicate sample.

TABLE 2-2

SETTLING POND 4 METALS ANALYSIS

2011/12 EMS ID E207409

COMPANY IDENTITY - WD

Parameter / Sample Date	October 6	November 3	December 7	January 6	February 7	March 7	Permit
Total Metals							
Aluminum	0.031	0.014	0.176	0.175	0.049	0.081	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0008	0.0010	0.0019	0.0021	0.0018	0.0021	-
Barium	0.022	0.019	0.020	0.025	0.025	0.026	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	0.99	0.94	0.94	0.76	0.83	0.96	-
Cadmium	<0.00005	0.00003	0.00002	0.00002	0.00002	<0.00001	-
Calcium	156.0	149.0	118.0	90.2	96.3	104.0	-
Chromium	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	0.0013	0.0028	0.0007	0.0011	-
Copper	0.0006	0.0009	0.0029	0.0039	0.0011	0.0015	-
Iron	0.113	0.201	0.439	0.530	0.235	0.417	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	0.009	0.007	0.006	0.008	0.006	0.007	-
Magnesium	17.7	16.8	12.9	11.7	11.2	12.2	-
Manganese	0.014	0.034	0.086	0.097	0.054	0.066	-
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	<0.000002	-
Molybdenum	0.001	0.001	0.001	<0.001	0.001	0.001	-
Nickel	0.003	0.002	0.006	0.006	0.002	0.004	-
Potassium	4.00	3.88	3.13	2.79	2.81	2.83	-
Selenium	0.0002	0.0002	0.0003	0.0001	0.0001	0.0002	-
Silicon	2.5	2.6	2.6	2.7	2.8	3.0	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	322	352	285	283	275	271	-
Strontium	1.250	1.230	0.976	0.773	0.840	0.877	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	0.014	0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Dissolved Metals							
Aluminum	0.006	0.007	0.0168	0.0239	0.0238	0.0109	**0.5**
Antimony	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	**-**
Arsenic	0.0007	0.0008	0.00072	0.00083	0.00156	0.00144	**-**
Barium	0.019	0.019	0.0195	0.0248	0.0265	0.0237	**-**
Beryllium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	**-**
Bismuth	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	**-**
Boron	0.960	0.980	0.814	0.774	0.973	0.801	**-**
Cadmium	0.00002	<0.00001	<0.00001	0.000021	<0.000010	<0.000010	**-**
Calcium	166	146	110	97.5	102	102	**-**
Chromium	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	**-**
Cobalt	<0.0005	<0.0005	0.00107	0.0026	0.00064	0.00091	**-**
Copper	0.0005	0.0006	0.00085	0.00096	0.00104	0.00057	**0.02**
Iron	0.007	0.01	<0.005	0.0116	0.092	0.0063	**0.3**
Lead	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	**0.05**
Lithium	0.008	0.007	0.0058	0.0081	0.0067	0.0065	**-**
Magnesium	19.2	16.7	12.2	12.2	12.0	12.2	**-**
Manganese	0.001	0.032	0.0823	0.093	0.0578	0.0613	**-**
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	<0.000002	**-**
Molybdenum	0.0010	0.0010	0.0010	<0.0010	0.0010	<0.0010	**-**
Nickel	0.0020	0.0020	0.0040	0.0056	0.0022	0.0032	**-**
Phosphorus	-	-	-	-	-	-	**-**
Potassium	4.18	4.32	3.09	2.87	3.01	2.89	**-**
Selenium	0.0002	0.0001	0.0002	0.00011	<0.00010	0.00016	**-**
Silicon	2.90	2.80	2.50	2.78	3.08	2.87	**-**
Silver	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	**-**
Sodium	367	345	276	290	295	274	**-**
Strontium	1.310	1.290	0.950	0.793	0.925	0.851	**-**
Thallium	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	**-**
Tin	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	**-**
Titanium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	**-**
Uranium	0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	**-**
Vanadium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	**-**
Zinc	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	**0.1**
Zirconium	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	-

Results expressed in milligrams per litre.

* indicates field replicate sample.

TABLE 3-1
WATER QUANTITY FOR SETTLING POND 4
2011/12 EMS ID E207409
COMPANY IDENTITY-WD

Date	April Max. (m3/s)	April Daily (m3/s)	May Max. (m3/s)	May Daily (m3/s)	June Max. (m3/s)	June Daily (m3/s)	July Max. (m3/s)	July Daily (m3/s)	August Max. (m3/s)	August Daily (m3/s)	September Max. (m3/s)	September Daily (m3/s)	Permit m3/s
1	0.1828	0.1749	0.1199	0.0580	0.1442	0.1040	0.0675	0.0290	0.0657	0.0085	0.0411	0.0126	
2	0.1828	0.1600	0.1669	0.1420	0.1315	0.0676	0.0914	0.0504	0.0809	0.0393	0.0539	0.0235	
3	0.1647	0.1417	0.1763	0.1243	0.1295	0.0419	0.0889	0.0561	0.0808	0.0508	0.0757	0.0477	
4	0.1669	0.1492	0.1439	0.1194	0.1322	0.0517	0.1120	0.0630	0.0830	0.0631	0.0874	0.0529	
5	0.1828	0.1817	0.1531	0.1225	0.1334	0.0558	0.1248	0.0510	0.0853	0.0632	0.0816	0.0445	
6	0.1828	0.1828	0.1470	0.1161	0.0005	0.0001	0.0862	0.0377	0.0805	0.0495	0.0499	0.0149	
7	0.1828	0.1828	0.1683	0.1518	0.1463	0.0872	0.0792	0.0317	0.0818	0.0321	0.0301	0.0031	
8	0.1828	0.1725	0.1494	0.0919	0.1447	0.0885	0.0011	0.0001	0.0750	0.0444	0.0000	0.0000	
9	0.1322	0.0638	0.1322	0.0638	0.1566	0.1272	0.0661	0.0225	0.0789	0.0357	0.0000	0.0000	
10	0.0885	0.0552	0.0885	0.0552	0.1469	0.0926	0.1387	0.0846	0.0869	0.0447	0.0000	0.0000	
11	0.1334	0.1071	0.1334	0.1071	0.1457	0.0830	0.1654	0.0995	0.0999	0.0542	0.0000	0.0000	
12	0.1328	0.1050	0.1328	0.1050	0.1372	0.0709	0.1046	0.0431	0.0838	0.0435	0.0000	0.0000	
13	0.1339	0.0935	0.1339	0.0935	0.1308	0.0885	0.1116	0.0637	0.0823	0.0391	0.0000	0.0000	
14	0.0616	0.0237	0.0616	0.0237	0.0599	0.0599	0.0999	0.0492	0.0761	0.0370	0.0000	0.0000	
15	0.0615	0.0248	0.0615	0.0248	0.1486	0.1418	0.1037	0.0670	0.0778	0.0293	0.0000	0.0000	
16	0.1683	0.1488	0.1207	0.0000	0.1506	0.1435	0.1354	0.0728	0.0634	0.0212	0.0000	0.0000	
17	0.1665	0.1367	0.0000	0.0000	0.1256	0.0479	0.0813	0.0408	0.0611	0.0196	0.0000	0.0000	
18	0.1798	0.1670	0.0737	0.0377	0.1220	0.0680	0.0790	0.0444	^	^	0.0000	0.0000	
19	0.1828	0.1673	0.1383	0.1059	0.1514	0.0942	0.0812	0.0399	0.0776	0.0463	0.0000	0.0000	
20	0.1450	0.1353	0.1450	0.1353	0.1386	0.0924	0.0723	0.0362	0.0814	0.0354	0.0360	0.0071	
21	0.1791	0.1427	0.1346	0.1219	0.1349	0.0840	0.1181	0.0744	0.0818	0.0503	0.0454	0.0147	
22	0.1757	0.1542	0.0666	0.0096	0.1374	0.0815	0.0804	0.0738	0.0824	0.0464	0.0434	0.0183	
23	0.1794	0.1286	0.0000	0.0000	0.1271	0.0667	0.1001	0.0469	0.0785	0.0362	0.0503	0.0206	
24	0.1430	0.0778	0.0000	0.0000	0.1292	0.0693	0.0800	0.0408	0.0760	0.0450	0.0572	0.0223	
25	0.1398	0.0587	0.0000	0.0000	0.1435	0.1051	0.0829	0.0390	0.0816	0.0486	0.0868	0.0449	
26	0.1474	0.1025	0.0000	0.0000	0.1649	0.1401	0.0809	0.0467	^	^	0.0925	0.0743	
27	0.1554	0.1427	0.0000	0.0000	0.1704	0.1421	0.0814	0.0313	^	^	0.1328	0.1227	
28	0.1466	0.1232	0.0768	0.0265	No Data	No Data	0.0445	0.0112	^	^	0.1322	0.0760	
29	0.0771	0.0404	0.0998	0.0547	No Data	No Data	0.0615	0.0057	^	^	0.0930	0.0670	
30	0.1329	0.0823	0.0707	0.1459	0.1459	0.0707	0.0852	0.0400	^	^	0.0876	0.0471	
31	-	-	0.0686	0.1341	-	-	0.0088	0.0004	0.0718	0.0240			
Monthly Max	0.1828		0.1763		0.1704		0.1654		0.0999		0.1328		**0.32**
Monthly Avg		0.1222		0.0679		0.0845		0.0464		0.0406		0.0238	**0.08***
Annual Avgerage: 0.09													

*365-day average
^ missing data

TABLE 3-2
WATER QUANTITY FOR SETTLING POND 4
2011/12 EMS ID E207409
COMPANY IDENTITY-WD

Date	October Max. (m3/s)	October Daily (m3/s)	November Max. (m3/s)	November Daily (m3/s)	December Max. (m3/s)	December Daily (m3/s)	January Max. (m3/s)	January Daily (m3/s)	February Max. (m3/s)	February Daily (m3/s)	March Max. (m3/s)	March Daily (m3/s)	Permit m3/s
1	0.0827	0.0512	0.0805	0.0411	0.1828	0.1602	0.1667	0.1504	0.1828	0.1670	0.1739	0.1306	
2	0.1021	0.0822	0.0839	0.0406	0.1828	0.1637	0.1657	0.1533	0.1828	0.1750	0.1828	0.1694	
3	0.1127	0.0558	0.1101	0.0542	0.1828	0.1708	0.1645	0.1475	0.1828	0.1743	0.1701	0.1464	
4	0.1156	0.0704	0.0932	0.0536	0.1828	0.1321	0.1828	0.1803	0.1828	0.1736	0.1828	0.1770	
5	0.1420	0.1202	0.0921	0.0467	0.1528	0.1097	0.1828	0.1569	0.1792	0.1575	0.1828	0.1828	
6	0.0957	0.0570	0.0897	0.0431	0.0842	0.0334	0.1828	0.1764	0.1828	0.1605	0.1828	0.1668	
7	0.1043	0.0577	0.0892	0.0423	0.0000	0.0000	0.1828	0.1707	0.1020	0.1700	0.1828	0.1817	
8	0.1119	0.0736	0.1264	0.0940	0.0807	0.0143	0.1828	0.1729	0.1828	0.1618	0.1828	0.1586	
9	0.1109	0.0580	0.1106	0.0524	0.1234	0.0858	0.1828	0.1746	0.1407	0.1301	0.1828	0.1828	
10	0.1101	0.0625	0.1087	0.0524	0.1334	0.1031	0.1828	0.1619	0.1564	0.1399	0.1828	0.1828	
11	0.1019	0.0658	0.1095	0.0559	0.1429	0.1278	0.1828	0.1544	0.1318	0.1200	0.1828	0.1684	
12	0.0893	0.0768	0.0837	0.0486	0.1320	0.0871	0.1828	0.1707	0.1510	0.1267	0.1806	0.1449	
13	0.0938	0.0694	0.0958	0.0515	0.1387	0.1132	0.1828	0.1625	0.1725	0.1261	0.0936	0.0844	
14	0.0907	0.0503	0.1022	0.0550	0.1528	0.1280	0.1828	0.1786	0.1828	0.1822	0.1350	0.1067	
15	0.0872	0.0471	0.1105	0.0574	0.1287	0.0963	0.1828	0.1759	no data	no data	0.1828	0.1772	
16	0.0905	0.0444	0.1295	0.1107	0.0971	0.0632	0.1828	0.1780	0.1817	0.1457	0.1828	0.1828	
17	0.0865	0.0435	0.1288	0.0681	0.1105	0.0818	0.1807	0.1758	0.1567	0.1470	0.1828	0.1828	
18	0.1245	0.0527	0.1308	0.0800	0.1295	0.0858	0.1766	0.1704	0.1828	0.1589	0.1828	0.1763	
19	0.1119	0.0560	0.1304	0.1072	0.1199	0.0833	0.1410	0.0837	0.1792	0.1572	0.1828	0.1828	
20	0.0868	0.0435	0.1263	0.0773	0.0882	0.0746	0.1209	0.0613	0.1828	0.1796	0.1828	0.1828	
21	0.1336	0.0932	0.1307	0.0904	0.0936	0.0672	0.1351	0.1116	0.1828	0.1452	0.1828	0.1681	
22	0.1284	0.0777	0.1685	0.1456	0.1202	0.0666	0.1489	0.1335	0.1404	0.0940	0.1828	0.1710	
23	0.0843	0.0502	0.1828	0.1537	0.1453	0.0766	0.1382	0.0922	0.1703	0.1409	0.1828	0.1776	
24	0.0807	0.0486	0.1707	0.1528	0.1607	0.1401	0.1431	0.1205	0.1719	0.1473	0.1828	0.1661	
25	0.0806	0.0317	0.1756	0.1579	0.1487	0.1409	0.1310	0.1240	0.1828	0.1640	0.1828	0.1777	
26	0.0829	0.0301	0.1828	0.1708	0.1442	0.1377	0.1655	0.1272	0.1828	0.1756	0.1771	0.1713	
27	0.0692	0.0276	0.1828	0.1778	0.1445	0.1170	0.1454	0.1351	0.1828	0.1827	0.1751	0.1435	
28	0.0755	0.0301	0.1828	0.1716	0.1508	0.1395	0.1555	0.1376	0.1828	0.1823	0.1828	0.1805	
29	0.0000	0.0000	0.1828	0.1538	0.1555	0.1309	0.1828	0.1662	0.1606	0.1177	0.1828	0.1588	
30	0.0000	0.0000	0.1828	0.1730	0.1704	0.1506	0.1828	0.1720			0.1828	0.1827	
31	0.0726	0.0287			0.1548	0.1395	0.1828	0.1809			0.1828	0.1602	
Monthly Max	0.1420		0.1828		0.1828		0.1828		0.1828		0.1828		**0.32**
Monthly Avg		0.0534		0.0926		0.1039		0.1502		0.1527		0.1653	**0.08***
Annual Average: 0.09													

*365-day average
^ missing data

TABLE 4-1

SETTLING POND 4 DAILY TSS

2011/12 EMS ID E207409

COMPANY IDENTITY - WD

FOR DECANT FLOW > 0.054 m3/s AND < 0.29 m3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Apr-12	4.00	1-May-12	<4.00	1-Jun-12	^
2-Apr-12	7.00	2-May-12	<4.00	2-Jun-12	^
3-Apr-12	<4.00	3-May-12	<4.00	3-Jun-12	^
4-Apr-12	<4.00	4-May-12	<4.00	4-Jun-12	^
5-Apr-12	<4.00	5-May-12	<4.00	5-Jun-12	^
6-Apr-12	<4.00	6-May-12	<4.00	6-Jun-12	<4.00
7-Apr-12	<4.00	7-May-12	<4.00	7-Jun-12	<4.00
8-Apr-12	<4.00	8-May-12	<4.00	8-Jun-12	<4.00
9-Apr-12	<4.00	9-May-12	<4.00	9-Jun-12	<4.00
10-Apr-12	<4.00	10-May-12	<4.00	10-Jun-12	<4.00
11-Apr-12	<4.00	11-May-12	<4.00	11-Jun-12	<4.00
12-Apr-12	<4.00	12-May-12	<4.00	12-Jun-12	<4.00
13-Apr-12	<4.00	13-May-12	<4.00	13-Jun-12	<4.00
14-Apr-12	<4.00	14-May-12	<4.00	14-Jun-12	<4.00
15-Apr-12	<4.00	15-May-12	11.00	15-Jun-12	<4.00
16-Apr-12	<4.00	16-May-12	4.00	16-Jun-12	<4.00
17-Apr-12	<4.00	17-May-12	1.00	17-Jun-12	<4.00
18-Apr-12	<4.00	18-May-12	2.00	18-Jun-12	<4.00
19-Apr-12	<4.00	19-May-12	4.00	19-Jun-12	<4.00
20-Apr-12	6.00	20-May-12	2.00	20-Jun-12	<4.00
21-Apr-12	<4.00	21-May-12	4.00	21-Jun-12	<4.00
22-Apr-12	<4.00	22-May-12	6.00	22-Jun-12	<4.00
23-Apr-12	<4.00	23-May-12	-	23-Jun-12	<4.00
24-Apr-12	<4.00	24-May-12	-	24-Jun-12	<4.00
25-Apr-12	<4.00	25-May-12	-	25-Jun-12	<4.00
26-Apr-12	<4.00	26-May-12	-	26-Jun-12	<4.00
27-Apr-12	<4.00	27-May-12	-	27-Jun-12	<4.00
28-Apr-12	<4.00	28-May-12	^	28-Jun-12	4.00*
29-Apr-12	<4.00	29-May-12	^	29-Jun-12	4.00*
30-Apr-12	<4.00	30-May-12	4.00*	30-Jun-12	9.00
		31-May-12	^		
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jul-12	6	1-Aug-12	<4.00	1-Sep-12	-
2-Jul-12	<4.00	2-Aug-12	5.00	2-Sep-12	<4.00
3-Jul-12	<4.00	3-Aug-12	5.00	3-Sep-12	<4.00
4-Jul-12	<4.00	4-Aug-12	<4.00	4-Sep-12	<4.00
5-Jul-12	3.00	5-Aug-12	<4.00	5-Sep-12	<4.00
6-Jul-12	2.00	6-Aug-12	^	6-Sep-12	-
7-Jul-12	4.00	7-Aug-12	^	7-Sep-12	-
8-Jul-12	-	8-Aug-12	<4.00	8-Sep-12	-
9-Jul-12	2.00	9-Aug-12	<4.00	9-Sep-12	-
10-Jul-12	2.00	10-Aug-12	<4.00	10-Sep-12	-
11-Jul-12	<4.00	11-Aug-12	5.00	11-Sep-12	-
12-Jul-12	<4.00	12-Aug-12	<4.00	12-Sep-12	-
13-Jul-12	<4.00	13-Aug-12	<4.00	13-Sep-12	-
14-Jul-12	<4.00	14-Aug-12	<4.00	14-Sep-12	<4.00
15-Jul-12	<4.00	15-Aug-12	3.00	15-Sep-12	-
16-Jul-12	<4.00	16-Aug-12	3.00	16-Sep-12	-
17-Jul-12	<4.00	17-Aug-12	10.00	17-Sep-12	-
18-Jul-12	<4.00	18-Aug-12	4.00	18-Sep-12	-
19-Jul-12	^	19-Aug-12	3.00	19-Sep-12	-
20-Jul-12	^	20-Aug-12	2.00	20-Sep-12	-
21-Jul-12	^	21-Aug-12	2.00	21-Sep-12	<4.00
22-Jul-12	^	22-Aug-12	1.00	22-Sep-12	-
23-Jul-12	^	23-Aug-12	7.00	23-Sep-12	-
24-Jul-12	^	24-Aug-12	5.00	24-Sep-12	<4.00
25-Jul-12	^	25-Aug-12	5.00	25-Sep-12	<4.00
26-Jul-12	<4.00	26-Aug-12	^	26-Sep-12	<4.00
27-Jul-12	<4.00	27-Aug-12	^	27-Sep-12	1.00
28-Jul-12	-	28-Aug-12	^	28-Sep-12	<1.00
29-Jul-12	5.00	29-Aug-12	^	29-Sep-12	2.00
30-Jul-12	<4.00	30-Aug-12	<4.00	30-Sep-12	<4.00
31-Jul-12	-	31-Aug-12	<4.00		
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.

Note: Maximum and average rates of discharge are 0.32m3/s and 0.08m3/s respectively. The authorised discharge period is 365 days

TABLE 4-2
SETTLING POND 4 DAILY TSS
2011/12 EMS ID E207409
COMPANY IDENTITY - WD
FOR DECANT FLOW > 0.054 m^3/s AND < 0.32 m^3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Oct-12	1.00	1-Nov-12	<4.00	1-Dec-12	<4.00
2-Oct-12	1.00	2-Nov-12	<4.00	2-Dec-12	<4.00
3-Oct-12	6.00	3-Nov-12	<4.00	3-Dec-12	<4.00
4-Oct-12	2.00	4-Nov-12	<4.00	4-Dec-12	<4.00
5-Oct-12	7.00	5-Nov-12	<4.00	5-Dec-12	4.00
6-Oct-12	6.00*	6-Nov-12	<4.00	6-Dec-12	<4.00
7-Oct-12	<4.00	7-Nov-12	<4.00	7-Dec-12	4.30
8-Oct-12	<4.00	8-Nov-12	<4.00	8-Dec-12	**374.00**
9-Oct-12	<4.00	9-Nov-12	<4.00	9-Dec-12	**145.00**
10-Oct-12	<4.00	10-Nov-12	<4.00	10-Dec-12	**26.50**
11-Oct-12	<4.00	11-Nov-12	<4.00	11-Dec-12	^
12-Oct-12	<4.00	12-Nov-12	<4.00	12-Dec-12	11.00
13-Oct-12	<4.00	13-Nov-12	<4.00	13-Dec-12	5.70
14-Oct-12	<4.00	14-Nov-12	<4.00	14-Dec-12	4.00
15-Oct-12	<4.00	15-Nov-12	17.50	15-Dec-12	<4.00
16-Oct-12	<4.00	16-Nov-12	5.70	16-Dec-12	6.00
17-Oct-12	<4.00	17-Nov-12	<4.00	17-Dec-12	^
18-Oct-12	<4.00	18-Nov-12	<4.00	18-Dec-12	^
19-Oct-12	<4.00	19-Nov-12	^	19-Dec-12	^
20-Oct-12	<4.00	20-Nov-12	<4.00	20-Dec-12	5.70*
21-Oct-12	<4.00	21-Nov-12	15.50	21-Dec-12	^
22-Oct-12	<4.00	22-Nov-12	5.00	22-Dec-12	^
23-Oct-12	<4.00	23-Nov-12	<4.00	23-Dec-12	^
24-Oct-12	<4.00	24-Nov-12	<4.00	24-Dec-12	^
25-Oct-12	<4.00	25-Nov-12	<4.00	25-Dec-12	^
26-Oct-12	<4.00	26-Nov-12	^	26-Dec-12	^
27-Oct-12	<4.00	27-Nov-12	^	27-Dec-12	^
28-Oct-12	<4.00	28-Nov-12	<4.00	28-Dec-12	5.20*
29-Oct-12	<4.00	29-Nov-12	4.60	29-Dec-12	4.00*
30-Oct-12	<4.00	30-Nov-12	^	30-Dec-12	4.00*
31-Oct-12	<4.00			31-Dec-12	<4.00*
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jan-12	<4.00	1-Feb-12	<4.00	1-Mar-12	<4.00
2-Jan-12	<4.00	2-Feb-12	<4.00	2-Mar-12	<4.00
3-Jan-12	<4.00	3-Feb-12	<4.00	3-Mar-12	<4.00
4-Jan-12	6.00	4-Feb-12	<4.00	4-Mar-12	<4.00
5-Jan-12	4.30	5-Feb-12	<4.00	5-Mar-12	4.50
6-Jan-12	<4.00	6-Feb-12	<4.00	6-Mar-12	<4.00
7-Jan-12	6.50	7-Feb-12	11.50	7-Mar-12	<4.00
8-Jan-12	7.00	7-Feb-12	<4.00*	7-Mar-12*	<4.00*
9-Jan-12	8.30	8-Feb-12	^	8-Mar-12	<4.00
10-Jan-12	9.20	9-Feb-12	7.80	9-Mar-12	<4.00
10-Jan-12*	10.50*	10-Feb-12	^	10-Mar-12	<4.00
11-Jan-12	7.50	11-Feb-12	^	11-Mar-12	<4.00
12-Jan-12	10.30	12-Feb-12	^	12-Mar-12	<4.00
13-Jan-12	6.50	13-Feb-12	^	13-Mar-12	5.00
14-Jan-12	9.50	14-Feb-12	5.80	13-Mar-12*	<4.00*
15-Jan-12	11.00	14-Feb-12*	9.20	14-Mar-12	4.20
16-Jan-12	<4.00	15-Feb-12	^	15-Mar-12	4.30
17-Jan-12	<4.00	16-Feb-12	8.50	16-Mar-12	6.00
17-Jan-12*	<4.00*	17-Feb-12	<4.00	17-Mar-12	6.50
18-Jan-12	11.00	18-Feb-12	5.70	18-Mar-12	8.20
19-Jan-12	<4.00	19-Feb-12	<4.00	19-Mar-12	8.20
20-Jan-12	**60.80**	20-Feb-12	<4.00	20-Mar-12	<4.00
21-Jan-12	6.00	21-Feb-12	7.00	20-Mar-12*	4.00*
22-Jan-12	6.50	21-Feb-12	5.00*	21-Mar-12	<4.00
23-Jan-12	4.20	21-Feb-12*	<4.00*	22-Mar-12	<4.00
24-Jan-12	<4.00	22-Feb-12	9.30	23-Mar-12	<4.00
24-Jan-12*	4.50*	23-Feb-12	<4.00	24-Mar-12	<4.00
25-Jan-12	^	24-Feb-12	<4.00	25-Mar-12	<4.00
26-Jan-12	^	25-Feb-12	<4.00	26-Mar-12	<4.00
27-Jan-12	4.00	26-Feb-12	<4.00	27-Mar-12	<4.00
28-Jan-12	4.50	27-Feb-12	<4.00	27-Mar-12*	<4.00*
29-Jan-12	4.80	28-Feb-12	<4.00	28-Mar-12	<4.00
30-Jan-12	7.00	28-Feb-12*	5.00*	29-Mar-12	<4.00
31-Jan-12	<4.00	29-Feb-12	<4.00	30-Mar-12	<4.00
31-Jan-12*	<4.00*			31-Mar-12	<4.00
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.
Note: Maximum and average rates of discharge are 0.32m^3/s and 0.08m^3/s respectively. The authorised discharge period is 365 days

* Indicates grab sample.
^ Indicates missing sample.
RED indicates permit violation.
Results are expressed in milligrams per liter.

TABLE 5
NORTH PIT CULVERT WATER QUALITY
2011/12 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter	April					May					June				Site Description	
Sample Date	4	11	11*	18	25	3	9	13	23	30	6	13	20	27	GPS (m)	
Conductivity (umhos/cm)	1700	1790	1740	1930	1930	1920	1960	1830	1990	1700	2030	2120	2090	2050	Minegrid	
Hardness CaCO3	371	-	-	-	-	398	-	-	-	-	426	-	-	-		
pH	8.13	8.3	8.31	8.31	8.29	8.27	8.23	8.24	8.37	8.43	8.29	8.16	8.21	8.26	Northing	Easting
Total SuspendedSolids	<4	<4	<4	<4	<4	5	<4	<4	8	-	<4	<4	7	<4	104324	98878
Acidity (to pH 8.3)	1.4	<0.5	<0.5	0.7	<0.5	-	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	-	UTM ZONE 10	
Alkalinity - Total $CaCO_3$	280	310	310	320	330	-	300	300	290	250	280	280	320	310	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5534129	320702
Nitrite/Nitrate Nitrogen	0.06	0.06	0.06	0.06	0.07	0.03	-	0.07	-	-	0.04	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Dissolved Phosphorous	<0.005	-	-	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	-	<0.005	-		
Total Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-		
Sulphate	570	620	610	690	650	640	710	660	770	550	720	780	740	740		

Parameter	July				August					September				Site Description	
Sample Date	5	11	18	25	2	8	15	22	30	7	13	20	26	GPS (m)	
Conductivity (umhos/cm)	2090	2190	2110	2150	2100	2200	2220	2250	2230	2270	2230	2190	1960	Minegrid	
Hardness CaCO3	384	-	-	-	367	-	-	-	390	-	-	-	-		
pH	8.2	8.26	8.25	8.27	8.25	8.28	8.33	8.31	8.3	8.25	8.34	8.37	8.35	Northing	Easting
Total SuspendedSolids	<4	4	<4	5	<4	<4	<4	<4	<4	<4	<4	<4	<4	104324	98878
Acidity (to pH 8.3)	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	1.1	<0.5	UTM ZONE 10	
Alkalinity - Total $CaCO_3$	310	310	300	310	300	310	290	300	300	280	290	280	270	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	5534129	320702
Nitrite/Nitrate Nitrogen	<0.02	-	-	-	0.06	-	0.03	0.02	0.03	-	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Dissolved Phosphorous	<0.005	-	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	-	-	<0.005	-		
Total Phosphorous	-	-	-	-	-	-	-	-	<0.005	-	-	-	-		
Sulphate	740	790	770	780	760	800	790	840	800	810	810	790	690		

Parameter	October				November					December				Site Description	
Sample Date	5	11	17	24	2	8	14	22	29	5	13	20	28	GPS (m)	
Conductivity (umhos/cm)	2090	2050	2050	2020	2020	2070	1880	1490	1430	1740	1850	1670	1630	Minegrid	
Hardness CaCO3	452	-	-	-	384	-	-	-	-	330	-	-	-		
pH	8.31	8.27	8.28	8.32	8.33	8.2	8.36	8.17	8.12	8.23	8.05	8.26	8.28	Northing	Easting
Total SuspendedSolids	<4	<4	<4	<4	<4	<4	<4	4.2	<4	<4	<4	<4	<4	104324	98878
Acidity (to pH 8.3)	<0.5	<0.5	1.3	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	UTM ZONE 10	
Alkalinity - Total $CaCO_3$	300	300	300	320	310	317	298	234	210	332	312	304	309	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	5534129	320702
Nitrite/Nitrate Nitrogen	<0.02	-	-	-	<0.02	-	-	-	-	0.048	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Dissolved Phosphorous	<0.005	-	<0.005	-	<0.005	-	0.0055	-	<0.005	<0.005	-	<0.005	-		
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	780	760	700	720	710	728	651	501	502	573	618	518	473		

Parameter	January					February					March				Site Description	
Sample Date	3	10	17	24	31	7	14	21	28	28*	7	13	20	27	GPS (m)	
Conductivity (umhos/cm)	1690	1520	1650	1450	1490	1640	1430	1660	1630	1630	1500	1300	1510	1510	Minegrid	
Hardness CaCO3	279	-	-	-	-	275	-	-	-	-	273	-	-	-		
pH	8.3	8.34	8.15	8.36	8.35	8.16	8.25	8.26	8.18	8.17	8.28	8.51	8.22	8.23	Northing	Easting
Total SuspendedSolids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	4	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	104324	98878
Acidity (to pH 8.3)	<0.5	<0.5	1.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	UTM ZONE 10	
Alkalinity - Total $CaCO_3$	335	313	337	273	281	321	291	308	303	304	310	292	303	329	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5534129	320702
Nitrite/Nitrate Nitrogen	0.062	-	-	-	-	0.084	-	-	-	-	0.062	-	-	-	Input to Middle Quinsam Lake, Culvert at Middle Quinsam Lake Road	
Dissolved Phosphorous	<0.0050	-	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-	-	<0.0050	-	<0.0050	<0.0050		
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	505	427	458	412	428	492	399	502	486	487	513	307	405	412		

Results expressed in milligrams per litre except for where noted
* Field replilcate sample

TABLE 6-1

NORTH PIT CULVERT METALS ANALYSIS

2011/12 EMS ID- E207411

COMPANY IDENTITY - WC

Parameter	April	May	June	July	August		September
Sample Date	4	**3**	6	5	2	30	6
Total Metals							
Aluminum	0.03	0.043	0.028	0.034	0.04	0.017	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0006	0.0006	0.0006	0.0006	0.0008	0.0007	-
Barium	0.021	0.024	0.025	0.02	0.023	0.021	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	0.64	0.81	0.82	0.9	0.98	1.01	-
Cadmium	<0.00001	0.00001	0.00006	<0.00001	0.00007	0.00004	-
Calcium	125	135	142	126	120	131	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Copper	0.0008	0.001	0.0043	0.0006	0.0006	0.0012	-
Iron	0.083	0.126	0.088	0.079	0.111	0.078	-
Hardness	371	398	426	384	367	390	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	0.005	0.006	-	-	0.006	0.007	-
Magnesium	14.4	15.1	17.3	17.1	16.2	15.2	-
Manganese	0.033	0.043	0.037	0.04	0.046	0.032	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	0.001	<0.001	0.001	0.001	0.001	-
Nickel	0.002	0.003	0.002	0.001	0.002	0.001	-
Phosphorus	-	-	-	-	-	-	-
Potassium	2.72	3.37	3.56	3.97	3.81	3.62	-
Selenium	0.0003	0.0002	0.0001	0.0001	0.0001	0.0001	-
Silicon	2.3	1.7	1.6	1.6	2.5	2.8	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	242	298	315	364	349	324	-
Strontium	0.966	1.12	1.23	1.15	1.17	1.23	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	0.0001	<0.0001	<0.0001	0.0002	0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Dissolved Metals							
Aluminum	0.015	0.017	0.016	0.018	0.02	0.007	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	-
Barium	0.023	0.022	0.024	0.022	0.025	0.021	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	0.67	0.84	0.88	0.89	1.02	1.11	-
Cadmium	0.00005	0.00002	0.00003	<0.00001	<0.00003	<0.00001	-
Calcium	121	129	140	137	136	141	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Copper	0.0009	0.0017	0.001	0.0004	0.001	0.002	-
Iron	0.009	0.04	0.018	0.027	0.022	0.015	-
Hardness	-	-	-	418	413	424	
Lead	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	-
Lithium	0.005	0.005	-	-	0.006	0.007	-
Magnesium	14.3	14.8	18	18.4	17.8	17.3	-
Manganese	0.023	0.023	0.009	0.01	0.01	0.017	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	0.001	0.001	0.001	0.001	<0.001	-
Nickel	0.003	0.002	0.001	<0.001	0.001	<0.001	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Potassium	2.67	3.23	3.72	4.4	4.35	4.17	-
Selenium	0.0003	0.0002	0.0001	0.0001	0.0002	<0.0001	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	241	283	327	399	371	372	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-

Results expressed in milligrams per litre.

TABLE 6-2
NORTH PIT CULVERT METALS ANALYSIS
2011/12 EMS ID- E207411
COMPANY IDENTITY - WC

Parameter / Sample Date	October 5	November 2	December 5	January 3	February 7	March 7
Total Metals						
Aluminum	0.007	0.012	0.066	0.043	0.045	0.076
Antimony	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0005	0.0004	0.001	0.0009	0.001	0.0013
Barium	0.022	0.016	0.02	0.019	0.02	0.021
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	1.00	0.82	0.91	0.85	0.76	0.75
Cadmium	<0.00005	0.00002	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	149	128	111	93.9	92.5	91.1
Chromium	<0.001	<0.001	0.001	0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.0004	0.0003	0.0013	0.0014	0.0007	0.0011
Iron	0.028	0.061	0.173	0.169	0.111	0.239
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.008	0.005	0.007	0.006	0.006	0.006
Magnesium	19.4	15.6	13	10.8	10.8	11
Manganese	0.005	0.021	0.02	0.017	0.013	0.029
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	0.001	0.001	<0.001	0.001
Nickel	<0.001	<0.001	0.004	0.003	0.001	0.002
Potassium	4.24	3.51	2.95	2.48	2.54	2.54
Selenium	0.0001	<0.0001	0.0002	0.0001	0.0001	0.0002
Silicon	2.7	2.4	2.8	2.7	2.6	2.8
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	351	320	288	246	252	244
Strontium	1.27	1.08	0.98	0.832	0.804	0.786
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.005	<0.005	<0.005	<0.0005	<0.0005	<0.0005
Dissolved Metals						
Aluminum	0.005	0.023	0.0175	0.0117	0.0121	0.0122
Antimony	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0004	0.0003	0.00064	0.00068	0.00091	0.00086
Barium	0.017	0.015	0.0189	0.019	0.0214	0.0199
Beryllium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Boron	0.84	0.8	0.812	0.887	0.874	0.672
Cadmium	<0.00001	0.00001	0.000015	<0.000010	<0.000010	<0.000010
Calcium	127	115	106	102	101	93.1
Chromium	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Copper	0.0003	0.0007	0.00131	0.0053	0.00069	0.00063
Iron	0.008	0.016	0.0064	0.0055	0.0072	0.0088
Lead	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	0.006	0.005	0.006	0.0064	0.006	0.0058
Magnesium	16.9	14.1	12.2	11.7	12	10.7
Manganese	<0.001	0.009	0.0146	0.0101	0.0124	0.0165
Mercury	<0.00002	<0.00002	<0.00001	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	0.0011	<0.0010	<0.0010
Nickel	<0.001	0.001	0.003	0.0014	0.0014	0.0016
Potassium	3.69	3.52	2.82	2.68	2.88	2.73
Selenium	<0.0001	<0.0001	0.0001	<0.00010	0.00015	0.00011
Silicon	2.5	2.5	2.94	2.88	2.79	2.74
Silver	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	322	285	268	268	280	242
Strontium	1.13	1.07	0.917	0.826	0.894	0.762
Thallium	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.0050

Results expressed in milligrams per litre.

TABLE 7
2 NORTH PIT SUMP WATER QUALITY
2011/12 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	April				May				June				Site Description	
													GPS (m)	
Sample Date	4	11	18	25	3	9	16	23	7	13	20	27	Minegrid	
Conductivity (umhos/cm)	1850	-	-	-	1900	-	-	-	2040	-	-	-	Northing	Easting
Hardness (as CaCO3)	520	-	-	-	550	-	-	-	464	-	-	-	103726	99663
pH	8.02	-	-	-	8	-	-	-	8.2	-	-	-	UTM ZONE 10	
Total SuspendedSolids	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	4.7	-	-	-	1.9	-	-	-	0.7	-	-	-	5534400	321651
Alkalinity - Total CaCO3	210	-	-	-	210	-	-	-	220	-	-	-	PAG-CCR	
Sulphate	730	-	-	-	790	-	-	-	820	-	-	-	Storage Pond	

Parameter	July				August				September			Site Description	
												GPS (m)	
Sample Date	5	11	18	25	4	9	30	30*	13	20	27	Minegrid	
Conductivity (umhos/cm)	2220	-	-	-	2110	-	2210	2200	-	-	-	Northing	Easting
Hardness (as CaCO3)	474	-	-	-	388	-	343	349	-	-	-	103726	99663.3
pH	7.89	-	-	-	8.07	-	8.16	8.19	-	-	-	UTM ZONE 10	
Total SuspendedSolids	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-	-	5534400	321651
Alkalinity - Total CaCO3	260	-	-	-	230	-	200	200	-	-	-	PAG-CCR	
Sulphate	910	-	-	-	830	-	900	930	-	-	-	Storage Pond	

Parameter	October				November						December				Site Description	
															GPS (m)	
Sample Date	6	11	17	24	2	2*	8	14	22	29	7	13	20	28	Minegrid	
Conductivity (umhos/cm)	2170			2120	2120	2130	2100	2070	581	1690	1920	1850	2370	1700	Northing	Easting
Hardness (as CaCO3)	429			487	424	414	479	449	131	463	377	334	629	373	103726	99663
pH	8.04			8.05	8.05	8.06	8	8.12	7.88	8	8.07	8.09	7.99	8.04	UTM ZONE 10	
Total SuspendedSolids				4			<4	13.5	15	14.5		6.7	7.5	9.5	Northing	Easting
Acidity (to pH 8.3)	1.7			2.2	4.3	5.2	7.1	2.7	<0.5	1.1	2.2	1.6	4.2	2.4	5534400	321651
Alkalinity - Total CaCO3	280			280	270	280	296	288	80.4	224	374	355	258	284	PAG-CCR Storage	
Sulphate	790			830	850	840	820	758	171	689	631	559	1020	568	Pond	

Parameter	January						February				March					Site Description	
																GPS (m)	
Sample Date	6	6*	10	17	24	31	7	14	21	28	7	7*	14	20	27	Minegrid	
Conductivity (umhos/cm)	1580	1640	1790	1710	1380	656	1240	1310	1640	1600	1550	1550	1510	1520	1560	Northing	Easting
Hardness (as CaCO3)	579	594	663	352	213	169	244	335	449	455	442	416	584	474	500	103726	99663.25
pH	8.16	8.14	7.9	8.03	8.26	7.98	8.21	8.06	8.21	8.16	8.27	8.27	8.18	8.21	8.13	UTM ZONE 10	
Total SuspendedSolids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.2	1.9	4.2	1	<0.5	0.9	1	1.4	1.5	<0.5	<0.5	1	1.3	1.7	1.7	5534400	321651
Alkalinity - Total CaCO3	227	241	259	241	202	97.3	183	179	249	244	239	241	215	218	215	PAG-CCR Storage	
Sulphate	658	658	725	581	444	187	419	488	572	568	563	561	625	563	585	Pond	

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 8-1

2 NORTH PIT SUMP METALS ANALYSIS

2011/12 EMS ID- E207412

COMPANY IDENTITY - WP

Parameter	April	May	June	July	August		
Sample Date	4	**3**	7	5	4	30	30*
Total Metals							
Aluminum	0.103	0.057	0.047	0.35	0.068	0.026	0.033
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	<0.0005	<0.0005
Arsenic	0.0037	0.0047	0.0042	0.005	0.0029	0.0014	0.0014
Barium	0.045	0.041	0.044	0.031	0.029	0.023	0.022
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.6	0.7	0.81	0.94	0.99	1.03	1.01
Cadmium	0.00004	0.00002	0.00003	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	186	188	152	160	110	101	102
Chromium	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Cobalt	0.0039	0.0028	0.0017	0.0021	0.0011	0.0006	0.0006
Copper	0.0016	0.0011	0.0007	0.0032	0.0016	0.0006	0.0007
Iron	0.215	0.114	0.083	0.582	0.147	0.035	0.057
Hardness	-	-	-	474	388	343	349
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.005	0.006	-	-	0.007	0.007	0.007
Magnesium	21.7	20.6	18.4	19.4	17	15.4	15.5
Manganese	0.147	0.081	0.035	0.101	0.017	0.001	0.002
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	0.003	0.004	0.003	0.004	0.002	0.002	0.002
Nickel	0.014	0.013	0.008	0.009	0.005	0.004	0.003
Phosphorus	-	-	-	-	-	-	-
Potassium	3.58	3.98	4.33	4.74	4.33	4.06	4.09
Selenium	0.001	0.001	0.0008	0.0003	0.0004	0.0003	0.0002
Silicon	2.6	2.4	2.2	2.6	2	2	1.9
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	208	230	288	358	355	328	327
Strontium	1.39	1.49	1.41	1.41	1.21	1.19	1.16
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	0.01	<0.005	<0.005	<0.005
Uranium	0.0003	0.0003	0.0002	0.0002	0.0001	0.0001	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Metals							
Aluminum	0.017	0.007	0.044	0.004	0.012	0.006	0.006
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	<0.0005	<0.0005
Arsenic	0.0032	0.0045	0.0041	0.0045	0.0025	0.0015	0.0015
Barium	0.046	0.039	0.042	0.031	0.03	0.024	0.024
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	-	-	-	-	-	-	-
Boron	0.59	0.73	0.85	1.03	1.05	1.23	1.16
Cadmium	0.00002	0.00001	0.00008	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	174	185	153	155	125	109	110
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	0.0036	0.0025	0.0016	0.0015	0.0009	0.0005	0.0005
Copper	0.001	0.001	0.0019	0.0006	0.0012	0.0011	0.001
Iron	0.025	0.006	0.077	<0.005	0.012	<0.005	<0.005
Hardness	-	-	-	470	344	316	317
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	0.005	-	-	0.008	0.009	0.008
Magnesium	20.7	21.1	19.9	20.9	18.6	17.5	17.8
Manganese	0.134	0.077	0.032	0.082	0.015	0.001	0.001
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	0.002	0.004	0.003	0.004	0.002	0.002	0.002
Nickel	0.014	0.013	0.008	0.008	0.004	0.004	0.004
Potassium	3.33	4.04	4.97	5.17	4.88	4.58	4.65
Selenium	0.0009	0.0011	0.0008	0.0004	0.0004	0.0003	0.0003
Silicon	-	-	-	-	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	198	230	311	383	384	372	378
Strontium	-	-	-	-	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	0.01	<0.005	<0.005	<0.005
Uranium	0.0002	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	0.008	<0.005	<0.005		<0.005
Zirconium	-	-	-	-	-	-	-

Results expressed in milligrams per litre.

* Field Replicate Samples.

TABLE 8-2
2 NORTH PIT SUMP METALS ANALYSIS
2011/12 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	October		November					
Sample Date	5	24	**2**	**2***	**8**	**14**	**22**	**29**
Total Metals								
Aluminum	0.018	0.047	0.13	0.152	0.081	0.279	2.14	0.375
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0035	0.0058	0.0057	0.006	0.0052	0.0046	0.0011	0.0023
Barium	0.034	0.037	0.038	0.038	0.031	0.04	0.015	0.046
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.99	0.9	1	0.93	0.93	0.97	0.24	0.6
Cadmium	<0.00005	0.00008	0.00001	0.00001	0.00001	0.00002	0.00003	0.00002
Calcium	143	166	143	139	164	152	43.7	156
Chromium	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.003	0.003
Cobalt	0.0049	0.004	0.0024	0.0025	0.0019	0.0023	0.0016	0.0061
Copper	0.0009	0.0012	0.0014	0.0014	0.0012	0.0026	0.005	0.0043
Iron	0.04	0.112	0.202	0.19	0.191	0.383	0.958	0.65
Hardness	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.009	0.009	0.008	0.007	0.007	0.007	<0.005	<0.005
Magnesium	17.6	17.6	16.3	16.1	16.9	16.9	5.42	17.9
Manganese	0.031	0.067	0.047	0.047	0.045	0.057	0.063	0.126
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	0.003	0.003	0.003	0.003	0.003	0.003	<0.001	0.002
Nickel	0.017	0.015	0.011	0.012	0.008	0.009	0.004	0.019
Potassium	4.32	4.74	4.06	4.1	4.88	3.94	1.36	2.9
Selenium	0.0005	0.0005	0.0005	0.0004	0.0004	0.0005	0.0002	0.0006
Silicon	2.8	2.7	3	2.8	3	3.1	4	3
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	315	333	317	310	338	313	73	181
Strontium	1.26	1.38	1.32	1.35	1.32	1.38	0.337	1.18
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	0.012	<0.005	0.008	0.094	0.01
Uranium	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	<0.0001	0.0002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.005	-	<0.005	<0.0005	-	<0.005		<0.005
Dissolved Metals								
Aluminum	0.006	0.008	0.008	0.014	0.0057	0.0053	0.0209	0.0086
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0032	0.0062	0.0061	0.0059	0.00467	0.00423	0.0006	0.0019
Barium	0.031	0.033	0.034	0.034	0.0296	0.0339	0.0109	0.0404
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.93	0.99	0.97	0.97	0.901	1.09	0.236	0.636
Cadmium	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	0.00002
Calcium	142	143	139	144	141	134	44.5	164
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	0.0045	0.0035	0.0022	0.0024	0.00182	0.00194	0.00075	0.00538
Copper	0.0006	0.0013	0.0007	0.0008	0.00078	0.00081	0.00164	0.00102
Iron	<0.005	0.005	0.006	0.007	0.0074	0.0102	0.0249	0.0126
Hardness	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.008	0.007	0.007	0.008	0.0073	0.0068	<0.0050	0.0056
Magnesium	17.7	16.8	16.3	16.9	16.7	16.7	5	19.2
Manganese	0.029	0.06	0.044	0.045	0.0405	0.0571	0.0531	0.131
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	0.003	0.003	0.003	0.003	0.0027	0.0027	<0.001	0.002
Nickel	0.017	0.015	0.011	0.011	0.008	0.0088	0.0023	0.0179
Potassium	4.36	4.22	4.73	4.89	4.11	4.14	1.21	3.52
Selenium	0.0005	0.0006	0.0005	0.0006	0.00042	0.0004	0.00021	0.0005
Silicon	2.8	2.6	2.8	2.8	2.75	2.43	1.54	2.37
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	331	307	309	318	323	321	69.5	191
Strontium	1.31	1.31	1.36	1.4	1.33	1.31	0.306	1.22
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	0.0002	0.0002	0.0002	0.0002	0.00019	0.00017	<0.0001	0.00017
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	0.0068	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 8-3
2 NORTH PIT SUMP METALS ANALYSIS
2011/12 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	December				January					
Sample Date	5	13	20	28	6	6*	10	17	24	31
Total Metals										
Aluminum	0.18	0.076	0.087	0.118	0.104	0.097	0.084	0.084	0.467	0.094
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0033	0.0022	0.0004	0.0028	0.0016	0.0015	0.0014	0.0031	0.0032	0.0009
Barium	0.031	0.031	0.013	0.033	0.033	0.033	0.03	0.042	0.036	0.019
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	1.11	1.02	0.89	0.9	0.47	0.48	0.62	0.7	0.5	0.26
Cadmium	<0.00001	0.00003	<0.00001	0.00002	0.00002	0.00003	0.00003	<0.00001	<0.00001	<0.00001
Calcium	130	115	215	126	191	197	217	118	71.9	56.8
Chromium	0.002	<0.001	0.002	0.002	<0.001	<0.001	0.001	<0.001	0.001	<0.001
Cobalt	0.0042	0.0029	0.0006	0.0028	0.0028	0.0028	0.0029	0.0022	0.0015	0.0005
Copper	0.0033	0.0021	0.0008	0.0022	0.0021	0.0019	0.0018	0.0011	0.0017	0.0023
Iron	0.596	0.253	0.299	0.274	0.25	0.264	0.288	0.174	0.284	0.056
Hardness	-	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.007	0.008	0.006	0.006	<0.005	<0.005	<0.005	0.006	0.006	<0.005
Magnesium	12.4	11.6	22.7	14.3	25	24.6	29.4	14.1	8.07	6.48
Manganese	0.12	0.11	0.109	0.119	0.131	0.129	0.141	0.083	0.043	0.046
Mercury	<0.00002	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.002	0.002	<0.001	0.003	0.001	0.001	0.002	0.004	0.01	0.001
Nickel	0.013	0.009	0.003	0.011	0.009	0.009	0.012	0.01	0.006	0.002
Potassium	3.46	3.11	3.83	3.07	2.76	2.68	2.66	2.98	2.18	1.25
Selenium	0.0003	0.0003	0.0004	0.0004	0.0007	0.0006	0.0006	0.0005	0.0009	0.0003
Silicon	3.1	3.1	2.8	2.7	2.8	2.9	3.2	2.4	2	1.4
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	321	288	308	256	150	148	162	233	172	73
Strontium	1.18	1.08	1.6	1.03	1.21	1.2	1.45	1.04	0.668	0.401
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	0.0001	0.0001	0.0001	0.0001	0.0002	0.0003	0.0003	0.0002	0.0002	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	-		-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals										
Aluminum	0.0154	0.0103	0.0081	0.0129	0.0097	0.0101	0.0362	0.0053	0.0062	0.0058
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00165	0.00158	0.00023	0.00247	0.00097	0.00111	0.00104	0.00288	0.00335	0.00079
Barium	0.0287	0.0271	0.0118	0.0313	0.0347	0.0357	0.0319	0.0414	0.0347	0.0179
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.952	1.02	0.794	0.825	0.519	0.532	0.662	0.644	0.533	0.239
Cadmium	0.000029	<0.00001	<0.00001	0.00002	0.000019	0.000039	0.000032	<0.000010	<0.000010	0.000011
Calcium	110	117	222	128	202	207	242	114	78	51.8
Chromium	<0.001	<0.001	<0.001	0.001	<0.0010	<0.0010	0.001	<0.0010	<0.0010	<0.0010
Cobalt	0.00349	0.00276	<0.00050	0.00256	0.00282	0.00286	0.00272	0.00208	0.00112	<0.00050
Copper	0.00085	0.00175	0.00042	0.0503	0.00245	0.00327	0.00161	0.00117	0.00141	0.00155
Iron	0.0081	0.008	0.0083	0.0124	<0.0050	0.007	0.0194	<0.0050	<0.0050	0.0062
Hardness	-	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0072	0.0071	0.0059	0.0056	<0.0050	<0.0050	<0.0050	0.0065	0.0052	<0.0050
Magnesium	11.9	12.7	22.7	14.9	26.1	27.4	28	13.3	8.35	6.34
Manganese	0.114	0.111	0.0959	0.12	0.132	0.139	0.141	0.0798	0.0398	0.0441
Mercury	<0.00002	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.0016	0.0015	<0.001	0.0022	0.001	0.0011	0.0015	0.0043	0.011	0.001
Nickel	0.0104	0.0085	0.0017	0.0098	0.0086	0.0093	0.0102	0.0085	0.005	0.0023
Potassium	3.34	3.37	3.9	3.21	2.73	2.93	2.64	2.84	2.41	1.21
Selenium	0.0002	0.00023	0.00042	0.00049	0.00065	0.00062	0.00066	0.00067	0.00107	0.00028
Silicon	2.76	2.99	2.7	2.75	2.92	3	3.73	2.37	1.66	1.24
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	310	313	300	270	156	162	161	225	189	72
Strontium	1.11	1.05	1.62	0.999	1.3	1.31	1.48	1.11	0.683	0.395
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	0.00013	0.00015	0.00025	0.00025	0.00029	0.00021	0.00015	<0.00010
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 8-4
2 NORTH PIT SUMP METALS ANALYSIS
2011/12 EMS ID- E207412
COMPANY IDENTITY - WP

Parameter	February				March				
Sample Date	7	14	21	28	7	7*	13	20	27
Total Metals									
Aluminum	0.137	1.03	0.035	0.128	0.061	0.086	0.424	0.078	0.272
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0025	0.0019	0.0017	0.0018	0.0014	0.0014	0.0013	0.001	0.0015
Barium	0.038	0.037	0.038	0.038	0.034	0.034	0.029	0.031	0.036
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.44	0.45	0.7	0.72	0.66	0.59	0.53	0.58	0.54
Cadmium	0.00001	0.00004	<0.00001	0.00002	<0.00001	<0.00001	0.00003	0.00001	<0.00001
Calcium	81.5	113	148	151	147	138	194	157	166
Chromium	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Cobalt	0.0014	0.002	0.0019	0.0018	0.0017	0.0016	0.0021	0.0016	0.0019
Copper	0.0017	0.0034	0.001	0.0014	0.001	0.0013	0.0031	0.0011	0.0026
Iron	0.166	0.572	0.129	0.241	0.2	0.23	0.602	0.222	0.362
Hardness	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	9.88	12.8	19	19	18.4	17.4	24.4	20.1	20.7
Manganese	0.06	0.084	0.107	0.098	0.096	0.092	0.184	0.094	0.092
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
Nickel	0.006	0.007	0.008	0.008	0.006	0.006	0.006	0.006	0.008
Potassium	2.12	2.41	2.87	3.04	2.8	2.7	2.84	2.75	2.88
Selenium	0.0008	0.0005	0.0004	0.0005	0.0006	0.0005	0.0004	0.0005	0.0005
Silicon	1.8	3.3	2.8	2.7	2.7	2.7	3.6	2.7	3
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	154	145	204	204	187	181	152	169	160
Strontium	0.682	0.878	1.12	1.18	1.1	1.05	1.2	1.13	1.18
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	0.071	<0.005	<0.005	0.007	<0.005	0.015	<0.005	0.009
Uranium	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals									
Aluminum	0.0057	0.0064	0.006	0.0065	0.0106	0.0103	0.0497	0.0063	0.0054
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0028	0.00145	0.00167	0.00162	0.00138	0.00125	0.00062	0.00109	0.00105
Barium	0.041	0.0323	0.0352	0.0376	0.0323	0.032	0.026	0.0297	0.0309
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.462	0.527	0.687	0.686	0.58	0.587	0.478	0.578	0.535
Cadmium	<0.000010	<0.000010	0.000016	<0.000010	<0.000010	<0.000010	0.000017	0.000024	0.000023
Calcium	89.3	116	150	143	138	144	166	149	163
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00135	0.00123	0.0016	0.00157	0.0016	0.00149	0.00142	0.00158	0.00143
Copper	0.00059	0.00093	0.00115	0.00129	0.00085	0.00082	0.0012	0.00123	0.00184
Iron	<0.0050	<0.0050	0.0081	0.0071	<0.0050	<0.0050	0.0139	0.0061	<0.0050
Hardness	-	-	-	-	-	-	-	-	-
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	10.1	13.1	17.9	18	18.6	18.3	21.8	19.5	21.8
Manganese	0.063	0.0725	0.101	0.0902	0.0905	0.0889	0.161	0.0892	0.0831
Mercury	<0.000010	<0.000010	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum	0.0048	0.0023	0.002	0.0024	0.0022	0.0022	0.0016	0.0023	0.0023
Nickel	0.0053	0.0052	0.0069	0.0068	0.0068	0.0064	0.0047	0.0061	0.0062
Potassium	2.31	2.49	3.06	2.79	2.85	2.8	2.37	2.71	2.95
Selenium	0.00091	0.00055	0.00048	0.00049	0.00047	0.00045	0.00041	0.00047	0.00044
Silicon	1.79	2.21	2.88	2.49	2.43	2.53	2.59	2.55	2.48
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	164	159	196	192	189	188	129	166	168
Strontium	0.774	0.903	1.02	1.1	1.04	1.05	1.12	1.05	1.19
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00018	0.00016	0.00018	0.00023	0.00021	0.00021	0.00026	0.00022	0.00026
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.
* Field Replicate Samples.

TABLE 9
MIDDLE QUINSAM LAKE INLET WATER QUALITY
2011/12 EMS ID - E0126402
COMPANY IDENTITY - WA

Parameter	April					May				June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	4	4*	11	18	25	2	9	13	23	6	13	20	27	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	38	39	39	39	41	39	43	43	42	43	44	45	43	-	-	Minegrid	
Hardness CaCO3	17.6	17.1	-	-	-	19.2	-	-	-	20.2	-	-	-	-	-	Northing	Easting
pH	7.19	7.28	7.44	7.44	7.42	7.09	7.19	7.52	7.31	7.38	7.53	7.39	7.7	-	≥ (6.5)[2] or (6.9)[3]	104805	98179
Total suspended solids	<4	5	<4	<4	<4	<1	<4	<4	<5	<4	<4	<4	<4	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.4	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	16	15	18	17	17	18	17	22	17	18	23	22	24	-	-	5533857	319898
Ammonia Nitrogen	0.014	0.026	-	-	-	0.032	-	-	-	0.043	-	-	-	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North System	
Nitrate and Nitrite as N	<0.02	<0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	-		
Kjeldahl Nitrogen	0.13	0.12	-	-	-	0.12	-	-	-	0.22	-	-	-	-	-		
Dissolved Phosphate	0.006	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-		
Total Phosphate	0.007	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-		
Sulphate	1.7	1.1	32	1.7	0.7	1.6	2.6	1.5	4.5	3.6	1.8	1.7	1.7	100	N/A		

Parameter	July				August							September					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	5	11	18	25	2	8	8*	15	22	22*	30	7	7*	13	20	28	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	42	41	41	42	43	41	42	44	43	42	41	42	42	42	42	40	-	-	Minegrid	
Hardness CaCO3	18.5	-	-	-	18.9	-	-	-	-	-	<50	-	-	-	-	-	-	-	Northing	Easting
pH	7.44	7.35	7.29	7.48	7.38	7.4	7.46	7.54	7.51	7.45	7.53	7.5	7.48	7.56	7.41	7.41	-	≥ (6.5)[2] or (6.9)[3]	104805	98179
Total suspended solids	<4	<1	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	2.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	17	20	17	20	22	21	18	20	18	20	23	20	21	21	17	17	-	-	5533857	319898
Ammonia Nitrogen	0.035	-	-	-	0.008	-	-	-	-	-	0.024	-	-	-	-	-	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North System	
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	-	-	<0.02	-	-	-	-	-	-	-		
Kjeldahl Nitrogen	0.16	-	-	-	0.14	-	-	-	-	-	0.14	-	-	-	-	-	-	-		
Dissolved Phosphate	<0.005	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-	-	-		
Total Phosphate	<0.005	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-	-	-		
Sulphate	2.1	21	0.9	1.4	1	1.3	1	1.4	1.2	1.7	0.5	0.8	0.9	1.3	<0.5	1.2	100	N/A		

Parameter	October						November						December				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	5	11	11*	17	24	24*	2	8	14	22	22*	29	5	13	20	28	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	43	40	40	40	41	40	41	41.8	43.1	36.8	39.6	48	40.8	42.4	41	39.7	-	-	Minegrid	
Hardness CaCO3	18						18.8						17.8				-	-	Northing	Easting
pH	7.63	7.46	7.44	7.23	7.34	7.3	7.3	7.42	7.47	7.24	7.35	7.3	7.31	7.53	7.39	7.35	-	≥ (6.5)[2] or (6.9)[3]	104805	98179
Total Suspended Solids	<4	<4	<4	<4	<4	<4	<4	<4	<4		<4	<4	<4	<4	<4	<4	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	22	21	21	21	18	21	17	20.1	17.1	16.1	15.6	16.8	21.2	21.2	17.6	17	-	-	5533857	319898
Ammonia Nitrogen	-	-	-	-	-	-	0.005	-	-	-	-	-	0.025	-	-	-	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North System	
Nitrate and Nitrite as N	-	-	-	-	-	-	<0.02	-	-	-	-	-	<0.02	-	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	0.19	-	-	-	-	-	0.124	-	-	-	-	-		
Dissolved Phosphorous	-	-	-	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-		
Total Phosphorous	-	-		-		-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-		
Sulphate	0.6	0.9	1.3	<0.5	1.8	1.3	<0.5	1.23	1.65	1.9	1.37	2.24	2	0.69	1.39	1.42	100	N/A		

Parameter	January						February				March					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	10	17	24	31	31*	7	14	21	28	7	7*	14	21	28	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	40.8	41.8	41.8	41.2	39.8	40.1	40.3	39.1	39.1	39.1	36.8	39.3	36.6	40.2	40.5	-	-	Minegrid	
Hardness CaCO3	19	-	-	-	-	-	17.9	-	-	-	16.3	-	-	-	-	-	-	Northing	Easting
pH	7.51	7.48	7.51	7.51	7.45	7.43	7.48	7.43	7.57	7.46	7.31	7.37	7.3	7.47	7.45	-	≥ (6.5)[2] or (6.9)[3]	104805	98178.7
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	1	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	17.3	17.9	17.2	17.1	18	16.7	21.2	15.3	16.9	16.7	16.4	15.7	17	16.8	17.9	-	-	5533857	319898
Ammonia Nitrogen	0.01	-	-	-	-	-	0.0094	-	-	-	0.017	-	-	-	-	-	-	Upper Quinsam River Watershed Quinsam River at Argonaut Road Background Water Quality for the North System	
Nitrate and Nitrite as N	<0.020	-	-	-	-	-	<0.020	-	-	-	<0.020	-	-	-	-	-	-		
Kjeldahl Nitrogen	0.077	-	-	-	-	-	0.112	-	-	-	0.102	-	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-	-		
Sulphate	1	0.73	1.34	0.6	1.02	1.79	2.11	1.33	1.87	1.86	1.36	1.2	<0.50	0.79	1.56	100	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

[2] 30-day 90th percentile

[3]Running 30-day median

^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litreexcept where noted.
* Field replicate samples

TABLE 10-1

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2011/12 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	April		May	June	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	4	4*	2	6	**Max**	**30-Day Mean[1]**
Total Metals						
Aluminum	0.037	0.044	0.029	0.035	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	<0.0001	<0.0001	<0.0001	**0.005***	-
Barium	<0.001	<0.001	<0.001	<0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	5.95	6.31	6.41	6.34	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	**0.05**	-
Copper	0.0007	0.0006	0.0007	0.0009	-	**≤0.002**
Hardness CaCO3	17.6	17.1	19.2	20.2	-	**-**
Iron	0.027	0.038	0.015	0.031	-	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	-	-	-
Magnesium	0.7	0.75	0.73	0.69	-	-
Manganese	0.002	0.003	0.001	0.002	**0.05**	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	**0.025**	-
Phosphorus	0.007	<0.005	<0.005	<0.005	-	-
Potassium	0.07	0.08	0.09	0.14	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	1.9	2	1.9	1.7	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	0.79	1.01	0.64	0.62	-	-
Strontium	0.012	0.015	0.012	0.012	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	**0.03**	-
Dissolved Metals						
Aluminum	0.03	0.027	0.025	0.024	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	<0.0001	0.0001	0.0001	-	-
Barium	<0.001	<0.001	<0.001	<0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	0.00002	-	-
Calcium	5.98	5.77	6.48	6.84	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.001	0.0009	0.0009	0.0009	-	-
Iron	0.012	0.012	0.023	0.016	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	<0.005	-	-	-
Magnesium	0.66	0.64	0.75	0.76	-	-
Manganese	<0.001	0.001	0.001	0.002	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	-	-
Potassium	0.006	<0.005	<0.005	<0.005	-	-
Phosphorus	0.08	0.08	0.1	0.2	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	0.62	0.63	0.69	0.78	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 10-2

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2011/12 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	July	August		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	2	30*	7	**Max**	**30-Day Mean[1]**
Total Metals						
Aluminum	0.026	0.024	0.031	-	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	<0.0001	0.0001	0.0001	-	**0.005***	**-**
Barium	<0.001	<0.001	<0.001	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-	-
Bismuth	<0.001	<0.001	<0.001	-	-	-
Boron	<0.05	<0.05	<0.05	-	-	-
Cadmium	<0.00001	0.00001	<0.00001	-	[2]	-
Calcium	6.17	6.36	6.75	-	-	-
Chromium	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	0.05	**-**
Copper	0.0006	0.0007	0.0008	-	**-**	**≤0.002**
Hardness CaCO3	0.021	0.022	0.033	-	-	**-**
Iron	21.3	19.6	<50	-	-	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	-	0.005	**≤0.003**
Lithium	-	<0.005	<0.005	-	**-**	**-**
Magnesium	0.75	0.74	0.76	-	-	**-**
Manganese	0.002	0.002	0.003	-	0.05	-
Mercury	<0.00002	<0.00002	<0.00002	-	**≤0.0001**	**-**
Molybdenum	<0.001	<0.001	<0.001	-	**-**	**-**
Nickel	<0.001	<0.001	<0.001	-	0.025	**-**
Phosphorus	<0.005	<0.005	<0.005	-	-	-
Potassium	0.06	0.07	0.08	-	**-**	**-**
Selenium	<0.0001	<0.0001	<0.0001	-	-	-
Silicon	1.5	1.6	1.5	-	**-**	**-**
Silver	<0.00002	<0.00002	<0.00002	-	0.0001	-
Sodium	0.61	1.15	1.22	-	**-**	**-**
Strontium	0.012	0.014	0.015	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	-	**-**	**-**
Zinc	<0.005	<0.005	<0.005	-	0.03	-
Dissolved Metals						
Aluminum	0.022	0.028	0.02	-	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	<0.0001	<0.0001	0.0001	-	-	-
Barium	<0.001	<0.001	<0.001	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-	-
Boron	<0.05	<0.05	<0.05	-	-	-
Cadmium	<0.00001	<0.00001	<0.00001	-	-	-
Calcium	7.2	6.58	6.62	-	-	-
Chromium	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	-	-
Copper	0.0009	0.0009	0.001	-	-	-
Iron	0.014	0.015	0.015	-	-	-
Hardness CaCO3	18.5	18.9	<50	-	-	-
Lead	<0.0002	<0.0002	<0.0002	-	-	-
Lithium	-	<0.005	<0.005	-	-	-
Magnesium	0.81	0.77	0.73	-	-	-
Manganese	0.002	0.002	0.001	-	-	-
Mercury	<0.00002	<0.00002	<0.00002	-	-	-
Molybdenum	<0.001	<0.001	<0.001	-	-	-
Nickel	<0.001	<0.001	<0.001	-	-	-
Potassium	<0.005	<0.005	<0.005	-	-	
Phosphorus	0.1	0.11	0.09	-		-
Selenium	<0.0001	<0.0001	<0.0001	-	-	-
Silver	<0.00002	<0.00002	<0.00002	-	-	-
Sodium	0.67	0.61	0.59	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	-	-	-
Zinc	<0.005	<0.005	<0.005	-	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2] Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 10-3

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2011/12 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	October	November	December	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	2	5	**Max**	**30-Day Mean[1]**
Total Metals					
Aluminum	0.023	0.019	0.03	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0002	<0.0001	<0.0001	**0.005***	-
Barium	0.001	<0.001	<0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	5.95	6.36	6	-	-
Chromium	<0.001	<0.001	0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	**0.05**	-
Copper	0.0006	0.0006	0.0008	**-**	-
Iron	0.025	0.018	0.026	**-**	**≤0.002**
Lead	<0.0002	<0.0002	<0.0002	**0.005**	**≤0.3**
Lithium	<0.005	<0.005	<0.005	**-**	**≤0.003**
Magnesium	0.77	0.71	0.69	**-**	**-**
Manganese	0.001	0.002	0.002	**0.05**	-
Mercury	<0.00002	<0.00002	<0.00002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	**0.025**	-
Potassium	0.08	0.08	0.09	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	1.8	1.7	1.8	-	-
Silver	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	0.7	0.64	0.626	-	-
Strontium	0.012	0.01	0.011	**-**	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	**0.03**	-
Zirconium	<0.0005	<0.0005	<0.0005	-	-
Dissolved Metals					
Aluminum	0.019	0.015	0.0184	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0001	<0.0001	<0.0001	-	-
Barium	<0.001	<0.001	<0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	-	-
Calcium	6.54	5.97	6.41	-	-
Chromium	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0005	0.0009	0.00117	-	-
Iron	0.019	0.011	0.008	-	-
Lead	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	<0.005	-	-
Magnesium	0.76	0.67	0.718	-	-
Manganese	<0.001	0.001	<0.001	-	-
Mercury	<0.00002	<0.00002	<0.00001	-	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	-	-
Potassium	0.09	0.12	0.1	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.1	1.7	2	-	-
Silver	<0.00002	<0.00002	<0.00002	-	-
Sodium	0.75	0.66	0.646	-	-
Strontium	0.011	0.011	0.012	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	-	-
Zirconium	<0.0005	<0.0005	<0.0005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 10-4

MIDDLE QUINSAM LAKE INLET METALS ANALYSIS

2011/12 EMS ID-0126402

COMPANY IDENTITY - WA

Parameter	January	February	March	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	3	7	7	**Max**	**30-Day Mean[1]**
Total Metals					
Aluminum	0.09	0.032	0.028	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0001	<0.0001	<0.0001	**0.005***	-
Barium	<0.001	<0.001	<0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	6.5	6.06	5.39	-	-
Chromium	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	**0.05**	-
Copper	0.0009	0.0006	0.0006	**-**	**≤0.002**
Iron	0.134	0.017	0.016	**-**	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	-	-
Magnesium	0.67	0.676	0.688	-	-
Manganese	0.005	<0.001	<0.001	**0.05**	-
Mercury	<0.000010	<0.000010	<0.000002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	**0.025**	-
Potassium	0.07	0.075	0.079	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	2	2	1.7	-	-
Silver	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	0.544	0.605	0.653	-	-
Strontium	0.01	0.01	0.011	**-**	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	**0.03**	-
Zirconium	<0.0005	<0.0005	<0.0005	-	-
Dissolved Metals					
Aluminum	0.0221	0.0252	0.0227	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	<0.00010	<0.00010	<0.00010	-	-
Barium	<0.0010	<0.0010	<0.0010	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	-	-
Calcium	6.67	6.21	5.65	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00245	0.00115	0.00072	-	-
Iron	0.0155	0.0165	0.0154	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.766	0.714	0.633	-	-
Manganese	0.002	<0.0010	<0.0010	-	-
Mercury	<0.000010	<0.000010	<0.000002	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Potassium	0.096	0.121	0.087	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	1.99	1.98	1.92	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	0.972	0.668	0.697	-	-
Strontium	0.012	0.0118	0.0105	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2] Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

TABLE 11
MIDDLE QUINSAM LAKE OUTLET WATER QUALITY
2011/12 EMS ID- E0900504
COMPANY IDENTITY - WB

Parameter	April					May				June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	5	11	18	25	25*	2	9	13	23	6	13	20	27	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	147	146	133	136	136	117	110	93	71	67	73	83	78	-	-	Minegrid	
Hardness CaCO3	34.7	-	-	-	-	34.7	-	-	-	22.6	-	-	-	-	-	Northing	Easting
pH	7.45	7.59	7.53	7.55	7.57	7.24	7.19	7.5	7.47	7.43	7.65	7.43	7.45	-	≥ (6.5)[2] or (6.9)[3]	102049	99542.4
Total Suspended Solids	<4	<4	<4	<4	<4	<1	<4	<4	<5	<4	<4	<4	<4	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	34	37	31	30	30	29	28	26	20	24	24	27	24	-	-	5533299	322922
Ammonia Nitrogen	0.022	-	-	-	-	0.022	-	-	-	0.035	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	0.02	-	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	-		
Kjeldahl Nitrogen	0.08	-	-	-	-	0.18	-	-	-	0.18	-	-	-	-	-		
Dissolved Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-		
Total Phosphorous	<0.005	-	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-		
Sulphate	33	36	28	31	29	25	24	18	11	9.3	12	12	14	100^	N/A		

Parameter	July						August					September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	5	11	11*	18	26	26*	3	8	15	22	30	7	14	20	26	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	88	82	82	85	80	79	87	88	104	102	99	100	87	84	89	-	-	Minegrid	
Hardness CaCO3	28.6	-	-	-	-	-	29.8	-	-	-	<50	-	-	-	-	-	-	Northing	Easting
pH	7.43	7.59	7.57	7.32	7.39	7.59	7.34	7.63	7.57	7.68	7.63	7.71	7.62	7.58	7.51	-	≥ (6.5)[2] or (6.9)[3]	102049	99542.439
Total Suspended Solids	7	<1	<1	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	0.8	<0.5	<0.5	1.4	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	4.2	<0.5	<0.5	1.2	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	26	25	26	26	23	25	27	26	28	28	29	28	32	25	26	-	-	5533299	322922
Ammonia Nitrogen	0.033	-	-	-	-	-	0.041	-	-	-	0.019	-	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	<0.02	-	-	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	-	-		
Kjeldahl Nitrogen	0.13	-	-	-	-	-	0.21	-	-	-	0.18	-	-	-	-	-	-		
Dissolved Phosphorous	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-	-		
Total Phosphorous	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-	-		
Sulphate	15	13	12	14	12	13	13	13	16	17	21	17	14	13	14	100^	N/A		

Parameter	October				November						December				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	5	11	17	24	1	8	14	22	22*	29	6	13	20	28	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	126	114	110	104	121	111	113	107	66.7	68.4	97.1	101	133	137	-	-	Minegrid	
Hardness CaCO3	38	-	-	-	35.2	-	-	-	-	-	28.2	-	-	-	-	-	Northing	Easting
pH	7.55	7.52	7.43	7.5	7.67	7.47	7.58	7.42	7.26	7.37	7.35	7.6	7.63	7.72	-	≥ (6.5)[2] or (6.9)[3]	102049	99542.4
Total Suspended Solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	<0.5	0.5	<0.5	0.7	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	30	29	27	26	28	27.6	25.8	25.6	20.1	20.5	26.2	28.5	30	34.1	-	-	5533299	322922
Ammonia Nitrogen	0.031	-	-	-	0.027	-	-	-	-	-	0.034	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	-	-	<0.02	-	-	-	-	-		
Kjeldahl Nitrogen	0.13	-	-	-	0.21	-	-	-	-	-	0.292	-	-	-	-	-		
Total Phosphorous	<0.005	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-		
Dissolved Phosphorous	<0.005	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-		
Sulphate	26	26	23	19	28	20.9	25	23.9	10.6	12.9	19.3	20.2	30.7	26.3	100^	N/A		

Parameter	January					February				March				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	10	17	24	31	7	14	21	28	7	13	20	27	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	79.3	83.3	107	134	102	117	94.1	132	133	154	183	194	216	-	-	Minegrid	
Hardness CaCO3	23.6	-	-	-	-	30.2	-	-	-	39	-	-	-	-	-	Northing	Easting
pH	7.47	7.53	7.68	7.72	7.54	7.69	7.56	7.72	7.64	7.59	7.77	7.76	7.74	-	≥ (6.5)[2] or (6.9)[3]	102049	99542.4
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	0.6	<0.5	<0.5	<0.5	0.8	0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	22.6	23.7	29.6	32.6	27.6	30	25	31.9	29.5	33.8	36	40	43.6	-	-	5533299	322922
Ammonia Nitrogen	0.019	-	-	-	-	0.012	-	-	-	0.028	-	-	-	-	-	Outflow from Middle Quinsam Lake - Input to Quinsam River	
Nitrate- Nitrite as N	<0.020	-	-	-	-	<0.020	-	-	-	<0.020	-	-	-	-	-		
Kjeldahl Nitrogen	0.114	-	-	-	-	0.104	-	-	-	0.107	-	-	-	-	-		
Total Phosphorous	<0.0050	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-		
Dissolved Phosphorous	<0.0050	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	12	12.7	19.7	25.8	18	23	16.8	28.1	29.5	36.3	45.6	42.4	54.4	100^	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 12-1
MIDDLE QUINSAM LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID-E0900504
COMPANY IDENTITY - WB

Parameter	April	May	June	July	August		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	2	6	4	3	30	6	Max	30-Day Mean[1]
Total Metals									
Aluminum	0.03	0.024	0.025	0.026	0.023	0.019	-	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001	-	**0.005***	-
Barium	0.002	0.002	0.001	0.002	0.001	0.002	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-
Cadmium	0.00004	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	[2]	-
Calcium	11.4	11.6	7.58	9.12	7.83	8.86	-	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	**0.05**	-
Copper	0.0006	0.0007	0.0005	0.0007	0.0006	0.0008	-	-	**≤0.002**
Hardness CaCO3	34.7	34.7	22.6	28.6	29.8	<50	-	-	**-**
Iron	0.035	0.035	0.048	0.055	0.048	0.044	-	-	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	-	-	**-**
Magnesium	1.5	1.37	0.89	1.16	0.97	1.09	-	-	**-**
Manganese	0.004	0.005	0.007	0.012	0.013	0.011	-	**0.05**	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	**0.025**	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Potassium	0.22	0.19	0.1	0.14	0.13	0.22	-	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Silicon	2	1.8	1.7	1.5	1.4	1.4	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**≤0.0001**	-
Sodium	14.6	9.51	2.55	6.13	5.4	7.62	-	**-**	**-**
Strontium	0.068	0.062	0.029	0.04	0.035	0.036	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**0.03**	-
Dissolved Metals									
Aluminum	0.021	0.02	0.021	0.016	0.022	0.014	-	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	<0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	-	-	-
Barium	0.002	0.002	0.002	0.001	0.002	0.002	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-
Cadmium	<0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	-	-	-
Calcium	11.7	11.6	8.37	9.5	10	9.41	-	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-
Copper	0.0009	0.0009	0.0006	0.0008	0.0008	0.0009	-	-	-
Iron	0.021	0.028	0.035	0.035	0.033	0.022	-	-	-
Hardness	-	-	-	27.6	23.6	<50	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	-
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-
Magnesium	1.46	1.46	1.03	1.19	1.18	1.16	-	-	-
Manganese	0.003	0.004	0.007	0.011	0.012	0.006	-	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Potassium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	
Phosphorus	0.23	0.24	0.13	0.21	0.19	0.26	-		-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-	-
Sodium	14.2	9.88	2.87	6.8	6.31	8.04	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2] Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.

TABLE 12-2
MIDDLE QUINSAM LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID-E0900504
COMPANY IDENTITY - WB

Parameter	October	November	December	January	February	March	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	1	6	3	7	7	**Max**	**30-Day Mean[1]**
Total Metals								
Aluminum	0.029	0.015	0.039	0.082	0.032	0.028	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	**0.005***	-
Barium	0.002	0.002	0.002	0.002	0.002	0.003	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	12.7	11.7	9.4	7.86	10.1	12.7	-	-
Chromium	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.05**	-
Copper	0.0006	0.0005	0.0008	0.0008	0.001	0.0005	**-**	**≤0.002**
Iron	0.082	0.052	0.054	0.089	0.031	0.041	**-**	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	1.56	1.49	1.16	0.975	1.19	1.79	-	-
Manganese	0.011	0.011	0.004	0.005	0.003	0.005	**0.05**	-
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	<0.000002	**0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	**0.025**	-
Potassium	0.22	0.19	0.169	0.13	0.182	0.23	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	1.8	1.9	2	2	2.1	2	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	**≤0.0001**	-
Sodium	7.41	7.78	7.87	5.2	10.7	13.5	-	-
Strontium	0.066	0.057	0.038	0.027	0.047	0.071	**-**	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.03**	-
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Dissolved Metals								
Aluminum	0.008	0.012	0.0205	0.0281	0.0223	0.0185	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.0002	0.0002	0.00012	<0.00010	0.00014	0.00013	-	-
Barium	0.002	0.002	0.002	0.0015	0.0018	0.0027	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	-	-
Calcium	13.3	11.2	9.23	8.47	9.97	13.3	-	-
Chromium	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	-	-
Copper	0.0004	0.0008	0.00084	0.0011	0.00104	0.00079	-	-
Iron	0.033	0.034	0.0205	0.0219	0.0191	0.0275	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.59	1.39	1.15	1.1	1.26	1.74	-	-
Manganese	<0.001	0.009	0.004	0.0042	0.0027	0.0036	-	-
Mercury	<0.00002	<0.00002	<0.00001	<0.000010	<0.000010	<0.000002	-	-
Molybdenum	<0.001	<0.001	<0.0001	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.001	<0.001	<0.0001	<0.0010	<0.0010	<0.0010	-	-
Potassium	<0.005	<0.005	<0.005	0.155	0.202	0.25	-	-
Selenium	0.21	0.26	0.166	<0.00010	<0.00010	<0.00010	-	-
Silicon	<0.0001	<0.0001	<0.0001	1.97	2.03	2.13	-	-
Silver	2	2	2.12	<0.000020	<0.000020	<0.000020	-	-
Sodium	<0.00002	<0.00002	<0.00002	5.77	11.2	13.7	-	-
Strontium	7.6	7.56	7.33	0.0334	0.0494	0.0708	-	-
Thallium	0.063	0.058	0.0392	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.00005	<0.00005	<0.00005	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.005	<0.005	<0.005	<0.00010	<0.00010	<0.00010		
Vanadium	<0.0001	<0.0001	<0.0001	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.005	<0.005	<0.005	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.

TABLE 13
MIDDLE QUINSAM LAKE WATER QUALITY
2011/2012 EDM ID E206618
COMPANY IDENTITY - MQL

Parameter	April					May					June					Water Quality Objectives for Middle Quinsam Lake sub-basin		Site Description	
Sample Date	1	4	4*	9	B	1	1*	4	9	B	1	4	4*	9	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	138	140	141	225	334	102	102	110	154	176	56	66	66	112.6	336	-	-	GPS (m)	
Hardness CaCO3	45.8	48.2	42	73.6	135	26.3	-	28.8	40.4	46.5	21.7	22.9	-	31.9	156	-	-		
pH	7.53	7.68	7.6	7.56	7.52	7.27	7.42	7.3	7.25	7.26	7.48	7.48	7.56	7.57	7.33	-	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Total suspended solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	5		
Alkalinity - Total CaCO3	31	34	31	39	43	27	27	27	31	33	23	23	25	30	36	-	-	Northing	Easting
Ammonia Nitrogen	0.011	0.011	0.01	0.034	0.022	<0.005	-	0.008	0.008	0.009	0.015	0.01	-	0.014	0.048	-	-	102325.2	98654
Nitrite/Nitrate Nitrogen	<0.02	<0.02	<0.02	0.03	0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	-	-	UTM ZONE 10	
Kjeldahl Nitrogen	0.12	0.1	0.12	0.15	0.11	0.12	-	0.12	0.12	0.12	0.12	0.13	-	0.24	0.18	-	-	Northing	Easting
Dissolved Phosphorous	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-	5532753	322169
Total Phosphorous	0.005	<0.005	<0.005	0.005	<0.005	0.006	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	≤ 0.0064	Middle of Middle Quinsam Lake	
Sulphate	29	30	28	60	110	19	19	21	34	44	7.7	7.3	7.4	29	170	100^	N/A		
Chlorophyll a (mg/m3)	0.8	<0.5	-	<0.5	-	<0.5	-	0.5	3.1	-	0.7	0.8	-	1.3	-	-	-		
Pheopigment (mg/m3)	1.2	0.7	-	0.8	-	<0.5	-	<0.5	1.2	-	<0.5	1.5	-	<0.5	-	-	-		
Chlorophyll a (mg/m3)*	<0.5	0.8	-	<0.5	-	0.9	-	<0.5	3.2	-	1.2	<0.5	-	1.6	-	-	-		
Pheopigment (mg/m3)*	0.8	<0.5	-	0.7	-	<0.5	-	0.7	<0.5	-	<0.5	1.1	-	<0.5	-	-	-		

Parameter	July					August					September					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	1	4	9	9*	B	1	1*	4	9	B	1	1*	4	9	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	71	67	122	-	277	91	93	91	194	296	76	76	74	183	344	-	-	GPS (m)	
Hardness CaCO3	27.3	24.9	-	49.3	140	29	-	29.3	52.9	123	22.9	-	24.4	51.2	112	-	-		
pH	7.58	7.47	7.54	7.55	7.18	7.61	7.56	7.45	7.44	7.37	7.53	7.53	7.51	7.49	7.06	-	≥ (6.5)[2] or (6.9)[3]	Minegrid	
Total suspended solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	5	<4	<4	<4	25	5		
Alkalinity - Total CaCO3	25	23	29	31	35	27	23	26	31	36	24	25	24	32	36	-	-	Northing	Easting
Ammonia Nitrogen	0.009	0.016	-	0.012	0.046	0.011	-	0.023	0.018	0.061	0.029	-	0.015	0.026	0.047	-	-	102325.2	98654
Nitrite/Nitrate Nitrogen	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	-	<0.02	<0.02	0.03	<0.02	-	<0.02	<0.02	0.02	-	-	UTM ZONE 10	
Kjeldahl Nitrogen	0.13	0.16	-	0.12	0.14	0.1	-	0.1	0.1	0.17	0.16	-	0.16	0.19	0.16	-	-	Northing	Easting
Dissolved Phosphorous	0.005	<0.005	-	<0.005	<0.005	0.01	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	-	-	5532753	322169
Total Phosphorous	0.006	<0.005	-	<0.005	<0.005	0.014	-	<0.005	<0.005	0.005	<0.005	-	<0.005	<0.005	<0.005	-	≤ 0.0064	Middle of Middle Quinsam Lake	
Sulphate	9.8	9.4	39	40	130	15	15	16	50	130	9.5	9.4	9.2	45	110	100^	N/A		
Chlorophyll a (mg/m3)	1	<0.5	-	2.1	-	<0.5	-	0.9	0.6	-	<0.5	0.6	<0.5	0.9	-	-	-		
Pheopigment (mg/m3)	<0.5	1.2	-	<0.5	-	0.9	-	<0.5	0.6	-	1	<0.5	0.8	<0.5	-	-	-		
Chlorophyll a (mg/m3)*	1.1	<0.5	-	0.8	-	0.5	-	<0.5	0.9	-	-	-	0.6	1	-	-	-		
Pheopigment (mg/m3)*	<0.5	1.4	-	0.8	-	<0.5	-	0.8	<0.5	-	-	-	<0.5	<0.5	-	-	-		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

[2] 30-day 90th percentile

[3]Running 30-day median

[4] Objective is for total phosphorus values and applies to an average of summer phosphorous values.

^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 14-1

MIDDLE QUINSAM LAKE METALS ANALYSIS

2011/2012 EMS ID E206618

COMPANY ID - MQL

Sample Date	April					May				June				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	4*	9	B	1	4	9	B	1	4	9	B	Max	30-Day Mean[1]
Total Metals															
Aluminum	0.0350	0.0340	0.0290	0.0300	0.0440	0.0230	0.0220	0.0190	0.0190	0.0250	0.0250	0.0200	0.0120	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	<0.0001	**0.005***	-
Barium	0.0030	0.0030	0.0020	0.0040	0.0070	0.0010	0.0020	0.0020	0.0030	0.0020	0.0010	0.0020	0.0130	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	0.0600	0.0600	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	15.4000	16.2000	14.2000	23.8000	42.9000	8.8000	9.6600	13.3000	15.1000	7.1400	7.5900	10.3000	47.1000	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0500**	-
Copper	0.0007	0.0008	0.0008	0.0007	0.0007	0.0011	0.0006	0.0005	0.0006	0.0012	0.0008	0.0008	0.0004	-	**≤0.002**
Hardness	45.8000	48.2000	42.0000	73.6000	135.0000	26.3000	28.8000	40.4000	46.5000	21.7000	22.9000	31.9000	156.0000	-	-
Iron	0.0350	0.0330	0.0310	0.0350	0.0870	0.0330	0.0330	0.0240	0.0240	0.0380	0.0310	0.0190	0.1180	-	**≤ 0.3**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	**0.0050**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	1.8000	1.8700	1.6000	3.4200	6.8600	1.0500	1.1400	1.7500	2.1700	0.9300	0.9600	1.5100	9.3900	-	-
Manganese	0.0050	0.0050	0.0040	0.0210	0.0900	0.0040	0.0040	0.0070	0.0120	0.0070	0.0070	0.0030	0.2170	**0.0500**	-
Mercury	0.0012	0.0001	0.0001	0.0008	0.0001	0.0020	0.0003	0.0001	0.0002	0.0004	0.0019	0.0006	0.0003	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0250**	-
Phosphorus	0.0050	<0.005	<0.005	0.0050	<0.005	0.0060	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**≤ 0.0064**
Potassium	0.2500	0.2600	0.2300	0.3200	0.3700	0.1500	0.1700	0.2100	0.2200	0.1000	0.1000	0.1700	0.3100	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.6000	2.7000	2.4000	2.8000	3.6000	1.8000	1.9000	1.9000	1.9000	1.7000	1.7000	1.6000	3.0000	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	16.7000	17.5000	14.9000	25.6000	29.4000	7.8500	9.0000	13.0000	14.4000	3.0100	3.3500	9.7800	22.4000	-	-
Strontium	0.0750	0.0770	0.0660	0.1140	0.1690	0.0380	0.0420	0.0620	0.0700	0.0240	0.0250	0.0500	0.1820	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	0.0050	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0300**	-
Dissolved Metals															
Aluminum	0.0200	0.0200	0.0210	0.0170	0.0140	0.0270	0.0220	0.0270	0.0160	0.0180	0.0250	0.0160	0.0040	**0.1000**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0001	<0.0001	-	-
Barium	0.0020	0.0020	0.0020	0.0030	0.0060	0.0020	0.0010	0.0030	0.0030	0.0010	0.0020	0.0020	0.0130	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	<0.05	<0.05	<0.05	0.0600	0.0600	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.0001	0.0000	0.0002	<0.00001	<0.00001	0.0000	0.0000	0.0000	-	-
Calcium	10.9000	11.2000	11.4000	17.3000	30.3000	8.5300	9.0500	11.8000	14.5000	7.9800	7.9300	10.8000	54.4000	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0007	0.0010	0.0009	0.0007	0.0006	0.0009	0.0007	0.0011	0.0005	0.0007	0.0010	0.0008	0.0005	-	-
Iron	0.0170	0.0200	0.0260	0.0170	0.0190	0.0280	0.0210	0.0230	0.0110	0.0210	0.0360	0.0130	0.0160	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	<0.0002	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	1.3700	1.3700	1.4200	2.5200	5.1100	1.0800	1.1100	1.6300	2.0700	0.9000	0.9100	1.5300	10.2000	-	-
Manganese	0.0030	0.0060	0.0050	0.0140	0.0670	0.0040	0.0030	0.0040	0.0070	0.0080	0.0060	0.0020	0.2200	-	-
Mercury	0.0009	0.0001	0.0001	0.0006	0.0001	0.0017	0.0002	0.0001	0.0001	0.0006	0.0011	0.0004	0.0002	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	0.2100	0.2100	0.2100	0.2700	0.3000	0.1700	0.1700	0.2200	0.2000	0.1000	0.1300	0.1900	0.3500	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	12.3000	12.3000	12.9000	18.6000	22.5000	8.7200	9.5100	13.4000	15.1000	3.1300	3.4500	10.7000	24.7000	-	-
Strontium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	0.0050	<0.005	<0.005	<0.005	<0.005	0.0070	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre except where noted.

* Field replicate sample.

TABLE 14-2

MIDDLE QUINSAM LAKE METALS ANALYSIS

2011/2012 EMS ID E206618

COMPANY ID - MQL

Sample Date	July				August				September				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	9	B	1`	4	9	B	1`	4	9	B	Max	30-Day Mean[1]
Total Metals														
Aluminum	0.0260	0.0280	0.0230	0.0170	0.0220	0.0220	0.0160	0.0100	0.0160	0.0170	0.0100	0.0050	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001	**0.005***	-
Barium	0.0010	0.0010	0.0030	0.0100	0.0010	0.0010	0.0030	0.0100	0.0010	0.0010	0.0030	0.0080	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	8.8500	8.2900	15.8000	42.5000	9.7300	9.9900	16.7000	37.3000	7.6600	8.2400	16.5000	34.9000	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0500**	-
Copper	0.0007	0.0007	0.0007	0.0004	0.0006	0.0024	0.0006	0.0006	0.0021	0.0030	0.0025	0.0008	-	**≤0.002**
Iron	0.0610	0.0410	0.0220	0.0860	0.0530	0.0510	0.0230	0.1500	0.0530	0.0600	0.0250	0.0810	-	**≤ 0.3**
Hardness	27.3000	24.9000	49.3000	140.0000	29.0000	29.3000	52.9000	123.0000	22.9000	24.4000	51.2000	112.0000	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	**0.0050**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	1.2700	1.0200	2.3700	8.1400	1.1500	1.0600	2.7400	7.1800	0.9100	0.9200	2.4000	5.9700	-	-
Manganese	0.0120	0.0080	0.0030	0.1440	0.0100	0.0090	0.0070	0.1230	0.0110	0.0100	0.0100	0.1180	**0.0500**	-
Mercury	0.0010	0.0008	0.0004	0.0001	0.0037	0.0010	0.0005	0.0004	<0.00002	<0.00002	<0.00002	<0.00002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0020	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0250**	-
Phosphorus	0.0060	<0.005	<0.005	<0.005	0.0140	<0.005	<0.005	0.0050	<0.005	<0.005	<0.005	<0.005	-	**≤ 0.0064**
Potassium	0.1300	0.1100	0.2000	0.2900	0.1400	0.1200	0.2100	0.2800	0.1200	0.1200	0.1900	0.2500	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	1.8000	1.7000	1.6000	2.9000	1.8000	1.8000	1.3000	2.7000	1.4000	1.5000	1.1000	2.3000	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	5.5300	5.1300	13.8000	22.3000	7.3700	6.7200	15.0000	21.7000	4.6000	4.5400	13.2000	19.2000	-	-
Strontium	0.0320	0.0280	0.0690	0.1600	0.0360	0.0320	0.0770	0.1530	0.0250	0.0260	0.0740	0.1380	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	0.0070	<0.005	0.0060	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0300**	-
Dissolved Metals														
Aluminum	0.0280	0.0290	0.0210	0.0070	0.0200	0.0160	0.0090	<0.003	-	-	-	-	**0.1000**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-
Arsenic	0.0001	0.0001	0.0001	<0.0001	0.0001	0.0001	<0.0001	<0.0001	-	-	-	-	-	-
Barium	0.0020	0.0020	0.0030	0.0100	0.0010	0.0010	0.0030	0.0100	-	-	-	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-	-	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-
Cadmium	0.0001	0.00002	0.00003	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-	-	-	-
Calcium	8.9700	8.5800	16.0000	43.3000	9.1300	9.7800	18.5000	39.3000	-	-	-	-	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-	-	-	-
Copper	0.0017	0.0010	0.0010	0.0008	0.0005	0.0006	0.0005	0.0003	-	-	-	-	-	-
Iron	0.0360	0.0390	0.0340	0.0220	0.0270	0.0280	0.0080	0.0150	-	-	-	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	-	-	-	-
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-
Magnesium	1.0300	1.0300	2.3900	7.8400	1.0700	1.0900	2.9400	7.2700	-	-	-	-	-	-
Manganese	0.0090	0.0080	0.0040	0.1470	0.0070	0.0070	0.0060	0.1240	-	-	-	-	-	-
Mercury	0.0011	0.0006	0.0005	0.0000	0.0024	0.0008	0.0004	0.0002	-	-	-	-	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-
Phosphorus	0.0050	<0.005	<0.005	<0.005	0.0100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	0.1400	0.1300	0.2400	0.3100	0.1400	0.1500	0.2300	0.3100	-	-	-	-	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-	-	-	-
Silicon	1.8000	1.7000	1.6000	2.9000	1.6000	1.7000	1.4000	2.7000	-	-	-	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-	-	-	-	-
Sodium	5.1600	4.9800	13.7000	21.2000	6.7200	6.9000	15.6000	22.2000	-	-	-	-	-	-
Strontium	0.0290	0.0290	0.0690	0.1590	0.0360	0.0360	0.0830	0.1580	-	-	-	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-	-	-	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-	-	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-
Zinc	0.0070	0.0140	0.0110	0.0070	0.0060	<0.005	<0.005	<0.005	-	-	-	-	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3

0.00002 at 60 mg/L CaCO3

0.00003 at 90 mg/L CaCO3

0.00004 at 120 mg/L CaCO3

0.00005 at 150 mg/L CaCO3

0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre except where noted.

* Field replicate sample.

TABLE 15

MIDDLE QUINSAM LAKE WATER QUALITY - FIELD INSTRUMENTS

2011/2012 EMS ID E206618

COMPANY IDENTITY - MQL

Sample Date	April							May							June						
Parameter	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP
Sample Depth (m)	Celcius					mg/L		Celcius		(UMHOS/CM)			mg/L		Celcius		(UMHOS/CM)			mg/L	
1	6.400	7.700	0.146	0.095	98.900	12.290	127.500	10.310	7.620	63	0.057	95.000	10.650	90.000	15.710	7.400	56	0.044	98.100	9.740	65.200
2	6.390	7.650	0.147	0.095	98.900	12.190	130.400	10.050	7.620	63	0.057	94.600	10.660	99.800	15.660	7.420	65	0.044	97.500	9.690	80.300
3	6.360	7.620	0.147	0.096	98.500	12.150	132.800	9.780	7.610	62	0.057	94.200	10.690	107.800	15.650	7.410	65	0.044	97.300	9.670	84.500
4	6.340	7.620	0.148	0.096	98.000	12.100	135.100	9.160	7.580	65	0.061	95.800	11.020	118.100	14.660	7.390	66	0.046	96.900	9.740	89.700
5	6.360	7.610	0.148	0.096	97.800	12.050	137.100	8.410	7.570	71	0.067	96.400	11.310	124.200	14.090	7.380	63	0.044	96.000	9.870	93.700
6	6.390	7.610	0.148	0.096	97.700	12.040	138.600	7.950	7.590	74	0.071	96.100	11.390	131.600	12.180	7.370	66	0.048	98.900	10.640	99.400
7	6.390	7.600	0.148	0.096	97.500	12.010	140.000	7.290	7.550	78	0.077	94.500	11.390	137.600	10.730	7.310	76	0.088	100.200	11.180	105.400
8	6.410	7.590	0.152	0.096	97.000	11.940	143.600	6.790	7.510	84	0.084	90.700	11.060	147.700	9.240	7.270	99	0.091	99.900	11.460	110.300
9	6.180	7.510	0.172	0.108	93.800	11.630	146.500	6.310	7.410	103	0.104	84.700	10.450	155.100	8.490	7.240	113	0.106	96.400	11.260	113.800
10	4.440	7.310	0.285	0.185	89.100	11.400	157.100	5.450	7.170	175	0.181	66.600	8.370	168.700	7.530	7.150	142	0.138	87.300	10.420	119.800
11	4.010	7.170	0.354	0.230	77.900	10.110	162.000	4.930	6.830	278	0.292	26.500	3.380	182.700	7.280	7.070	154	0.152	80.900	9.740	124.400
12	4.190	6.880	0.626	0.408	63.500	7.910	-	4.890	6.750	283	0.299	17.900	2.280	-	6.450	6.800	263	0.263	47.000	5.750	137.200
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.290	6.670	295	0.302	42.300	3.980	143.100
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.140	6.610	317	0.322	23.700	2.900	146.300
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.120	6.670	336	0.323	16.600	2.110	137.000
15.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.060	6.710	319	0.343	3.700	0.420	-27.800
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Secchi Depth (m)	7.00							8.00							8.50						

Sample Date	July							August							September						
Parameter	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP
Sample Depth (m)	Celcius				mg/L			Celcius	UMHOS/CM)			mg/L			Celcius	UMHOS/CM)			mg/L		
1	18.77	71	0.052	98.800	9.2	7.62	126.2	21.37	84	0.059	90.0	7.9	7.82	1553.3	17.48	0.076	0.054	101.500	9.7	8.00	261.0
2	18.08	68	0.051	99.400	9.4	7.50	138.2	21.14	84	0.059	88.8	7.9	7.80	153.2	17.43	0.070	0.053	95.500	9.1	7.72	270.3
3	17.45	66	0.051	97.400	9.3	7.40	150.9	20.97	85	0.059	88.1	7.9	7.75	154.4	17.41	0.069	0.052	94.900	9.1	7.68	271.8
4	16.69	67	0.051	97.300	9.4	7.33	159.8	20.17	82	0.059	87.4	7.9	7.65	156.0	17.46	0.069	0.053	94.100	9.0	7.65	281.7
5	15.94	67	0.053	97.800	9.7	7.31	164.5	18.93	75	0.055	88.7	8.2	7.58	156.5	17.39	0.069	0.052	94.000	9.0	7.64	271.2
6	14.10	64	0.052	101.500	10.5	7.30	168.8	16.00	70	0.055	91.0	9.0	7.56	157.4	17.35	0.069	0.053	93.300	9.0	7.61	274.5
7	11.89	77	0.067	105.000	11.3	7.25	174.8	13.80	84	0.070	93.8	9.8	7.52	159.3	17.05	0.073	0.056	93.700	9.1	7.57	278.7
8	10.05	102	0.093	103.000	11.6	7.19	179.3	11.19	108	0.095	89.6	9.8	7.42	164.0	13.60	0.120	0.100	107.400	11.2	7.40	284.3
9	8.87	122	0.115	95.300	11.1	7.10	183.6	9.44	140	0.129	80.6	9.2	7.23	168.3	11.25	0.146	0.129	101.100	11.0	7.28	286.3
10	7.98	158	0.152	81.400	9.6	6.95	188.8	8.69	168	0.159	70.2	8.2	7.05	170.8	9.93	0.185	0.169	88.700	10.0	7.10	286.2
11	7.33	216	0.213	58.200	7.0	6.77	195.2	8.17	201	0.192	58.6	6.8	6.89	170.5	9.04	0.230	0.215	61.700	7.0	6.88	283.7
12	6.94	263	0.262	38.600	4.6	6.63	200.0	7.70	274	0.240	34.2	3.9	6.68	170.8	8.51	0.259	0.246	45.000	5.1	6.76	287.3
13	6.85	275	0.274	23.500	2.9	6.54	200.10	7.61	250	0.243	22.3	2.7	6.68	170.00	8.38	0.262	0.25	31.200	3.6	6.71	288.20
14	6.82	277	0.276	21.600	2.6	6.54	194.00	7.48	263	0.256	1.2	0.1	6.85	-21.40	8.27	0.263	0.25	24.400	2.8	7	267.80
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.24	0.27	0.26	18.300	2.1	6.80	-2.50
15.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Secchi Depth (m)	8.00							12.00							10.50						

*Hypolimnetic DO= 3 mg/L

Results are a minimum during June, July and August

TABLE 16
SETTLING POND 1 WATER QUALITY
2011/12 EMS ID E218582
COMPANY IDENTITY - SPD

Parameter	April				May						June						Site Description	
Sample Date	4	11	18	25	2	9	16	16*	23	30	6	13	20	20*	27	PERMIT	GPS (m)	
Conductivity (umhos/cm)	794	728	699	691	663	653	618	616	571	646	592	613	604	604	577	-	Minegrid	
Hardness CaCO3	393	-	-	-	332	-	-	-	-	-	250	-	-	-	-	-		
pH	7.89	7.85	7.93	7.85	7.75	7.63	7.89	7.9	7.85	7.88	7.86	7.96	7.9	7.86	7.93	6 to 8.5	Northing	Easting
Total Suspended Solids	<4	<4	<4	<4	3	<4	<4	2	<4	<4	<4	<4	<4	<4	<4	25	100983.8	98152.577
Total Dissolved Solids	520	-	-	-	460	-	-	-	-	-	410	-	-	-	-	-	UTM ZONE 10	
Acidity (to pH 8.3)	2.6	2	1.5	0.9	1.9	1.4	1.5	1.9	1.4	<0.5	0.8	<0.5	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	84	84	78	75	73	72	71	69	65	71	67	74	68	67	68	-	5531548	322943
Ammonia Nitrogen	0.026	-	-	-	0.018	-	-	-	-	-	0.034	-	-	-	-	1		
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	-	-	<0.02	-	-	-	-	-		
Dissolved Phosphorous	<0.005	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	0.03	Permitted Discharge From Settling Pond 1 Decant	
Total Phosphorous	<0.005	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	-	-		
Sulphate	320	270	260	260	220	210	260	240	190	230	190	230	190	200	200	-		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100		
Oil and Grease	<1	-	-	-	<1	-	-	-	-	-	1	-	-	-	-	10		

Parameter	July				August					September				Site Description	
Sample Date	4	11	18	25	3	8	15	22	29	7	14	26	PERMIT	GPS (m)	
Conductivity (umhos/cm)	626	626	622	621	624	627	635	633	626	665	672	598	-	Minegrid	
Hardness CaCO3	307	-	-	-	311	-	-	-	305	-	-	-	-		
pH	7.77	7.82	7.76	7.77	7.84	7.86	7.83	7.83	7.95	8.01	8.11	7.98	6 to 8.5	Northing	Easting
Total Suspended Solids	<4	1	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	100984	98152.6
Total Dissolved Solids	420	1.2	3.7	1	480	<0.5	1.8	2.8	460	1	1.8	<0.5	-	UTM ZONE 10	
Acidity (to pH 8.3)	1.7	1.2	3.7	1	0.5	<0.5	1.8	2.8	2.3	1	1.8	<0.5	-	Northing	Easting
Alkalinity - Total CaCO3	70	66	70	71	78	80	82	85	92	96	100	94	-	5531548	322943
Ammonia Nitrogen	0.039	-	-	-	0.044	-	-	-	0.04	-	-	-	1		
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-		
Dissolved Phosphorous	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	0.03	Permitted Discharge From Settling Pond 1 Decant	
Total Phosphorous	0.005	220	230	220	0.006	230	180	220	<0.005	200	200	180	-		
Sulphate	230	220	230	220	190	230	180	220	200	200	200	180	-		
Bio Assays (%)	-	-	-	-	-	-	-	-	-	-	-	-	100		
Oil and Grease	<1	-	-	-	<1	-	-	-	<1	-	-	-	10		

Parameter	October				November				December					Site Description	
Sample Date	5	11	24	31	8	14	22	29	6	13	20	28	PERMIT	GPS (m)	
Conductivity (umhos/cm)	580	575	631	638	446	546	111	62.6	893	868	671	285	-	Minegrid	
Hardness CaCO3	257			294					481				-		
pH	7.89	7.78	7.75	7.67	7.57	7.78	6.84	6.65	7.57	7.69	7.56	7.54	6 to 8.5	Northing	Easting
Total Suspended Solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	100984	98152.6
Total Dissolved Solids	390			440					660				-	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	0.9	2.3	3.2	4.3	1.2	7.1	2.4	3.1	1.1	3.5	2	-	Northing	Easting
Alkalinity - Total CaCO3	86	70	76	73	52.1	68	22.9	8.42	79.3	77.7	63.3	35.5	-	5531548	322943
Ammonia Nitrogen	0.04			0.007					0.037				1		
Nitrate and Nitrite as N	<0.02			<0.02					<0.020				-		
Total Phosphorous	<0.005			<0.005					<0.005				0.03	Permitted Discharge From Settling Pond 1 Decant	
Dissolved Phosphorous	<0.005			<0.005					<0.005				-		
Sulphate	190	200	220	270	158	196	30.9	16.5	402	365	244	97.9	-		
Bio Assays (%)								>100				>100	100		
Oil and Grease	<1			<1					2.6				10		

Parameter	January						February				March					Site Description	
Sample Date	4	10	17	24	24*	31	6	14	21	28	6	13	21	28	PERMIT	GPS (m)	
Conductivity (umhos/cm)	432	598	815	439	375	409	669	708	608	527	440	564	591	630	-	Minegrid	
Hardness CaCO3	158						294				198				-		
pH	7.57	7.65	7.81	7.79	7.78	7.48	7.83	7.94	7.83	7.82	7.52	7.84	7.82	7.78	6 to 8.5	Northing	Easting
Total Suspended Solids	8.8	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0		<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	25	100983.8	98152.58
Total Dissolved Solids	282						484				300				-	UTM ZONE 10	
Acidity (to pH 8.3)	1.3	1.6	1.3	<0.5	<0.5	1	2.3	2.6	2.3	<0.5	<0.5	0.5	2	1.3	-	Northing	Easting
Alkalinity - Total CaCO3	45.9	52.2	69	45.7	39.7	38.5	66.6	66.2	59.5	57	43.1	56.3	55.6	58.8	-	5531548	322943
Ammonia Nitrogen	0.024						0.012				0.013				1		
Nitrate and Nitrite as N	<0.020						<0.020				<0.020				-		
Total Phosphorous	<0.0050						<0.0050				<0.0050				0.03	Permitted Discharge From Settling Pond 1 Decant	
Dissolved Phosphorous	0.0134						0.0057				<0.0050				-		
Sulphate	160	200	447	156	138	147	254	289	222	192	170	228	160	252	-		
Bio Assays (%)						>100				>100					100		
Oil and Grease	<1					<1					2.6				10		

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 17-1
SETTLING POND 1 METALS ANALYSIS
2011/12 EMS ID- E218582
COMPANY IDENTITY - SPD

Parameter / Sample Date	April 4	May 2	June 6	July 4	August 3	August 30	September 6	Permit
Total Metals								
Aluminum	0.027	0.019	0.028	0.011	0.009	0.007	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0009	0.0007	0.0007	0.0008	0.0013	0.0015	-	-
Barium	0.014	0.014	0.011	0.014	0.017	0.018	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	0.1	0.1	0.06	0.11	0.12	0.12	-	-
Cadmium	0.00002	0.00001	0.00007	0.00008	0.00002	0.00002	-	-
Calcium	130	110	81.6	87.7	86.7	91.3	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0005	0.0005	0.0008	0.0037	0.001	0.0006	-	-
Iron	0.325	0.355	0.256	0.215	0.281	0.305	-	-
Hardness	-	-	-	307	311	305	-	-
Lead	<0.0002	<0.0002	0.0002	0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	-	-
Magnesium	17	14.3	11.3	14.5	13.8	13.6	-	-
Manganese	0.072	0.022	0.024	0.014	0.038	0.042	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	-	-
Nickel	0.003	0.002	0.001	0.002	0.002	0.002	-	-
Phosphorus	<0.005	<0.005	<0.005	0.005	0.006	<0.005	-	-
Potassium	1.05	0.81	0.66	0.75	0.88	0.9	-	-
Selenium	0.0001	<0.0001	0.0002	0.0001	<0.0001	<0.0001	-	-
Silicon	2.4	1.7	1.8	0.7	0.9	1.6	-	-
Silver	<0.00002	<0.00002	<0.00002	0.00002	<0.00002	<0.00002	-	-
Sodium	11.1	8.72	6.73	9.38	9.45	9.93	-	-
Strontium	0.737	0.607	0.484	0.568	0.555	0.564	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	0.0001	0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Dissolved Metals								
Aluminum	0.01	0.007	0.009	0.008	0.008	0.004	-	**0.500**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	**-**
Arsenic	0.0006	0.0005	0.0005	0.0007	0.0011	0.0013	-	**-**
Barium	0.014	0.013	0.012	0.015	0.02	0.018	-	**-**
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	**-**
Boron	0.1	0.09	0.08	0.11	0.12	0.15	-	**-**
Cadmium	0.00001	0.00002	0.00001	0.00001	0.00006	<0.00001	-	**-**
Calcium	132	105	89.4	96.3	99.2	98	-	**-**
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	**-**
Cobalt	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	**-**
Copper	0.0009	0.0007	0.0007	0.001	0.0011	0.0006	-	**0.02**
Iron	0.01	0.033	0.024	0.04	0.094	0.064	-	**0.50**
Hardness	-	-	-	279	273	284	-	**-**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	**0.05**
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	-	**-**
Magnesium	16.3	14.1	12.7	16.2	15.3	14.6	-	**-**
Manganese	0.066	0.015	0.006	0.011	0.036	0.038	-	**-**
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**-**
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	**-**
Nickel	0.003	0.002	0.001	0.001	0.002	0.002	-	**-**
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**0.03**
Potassium	1	0.85	0.75	0.92	1.02	0.94	-	**-**
Selenium	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	**-**
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**-**
Sodium	10.8	8.77	7.55	10	10.4	10.8	-	**-**
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	**-**
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	**-**
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**-**
Zinc	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	-	**0.10**

Results expressed in milligrams per litre.
* Indicates replicate sample.

TABLE 17-2
SETTLING POND 1 METALS ANALYSIS
2011/12 EMS ID- E218582
COMPANY IDENTITY - SPD

Parameter	October		November	December	January	February	March	
Sample Date	5	31	**2**	6	4	6	6	**Permit**
Total Metals								
Aluminum	0.024	0.045	-	0.086	0.581	0.068	0.108	-
Antimony	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0013	0.0009	-	0.0003	0.0006	0.0004	0.0003	-
Barium	0.018	0.016	-	0.014	0.007	0.007	0.006	-
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	-
Boron	0.12	0.09	-	0.13	0.05	0.06	<0.05	-
Cadmium	0.00002	0.00001	-	0.00001	0.00002	<0.00001	0.00001	-
Calcium	83.2	96.8	-	159	50.5	97.4	65.3	-
Chromium	<0.001	<0.001	-	0.001	<0.001	<0.001	<0.001	-
Cobalt	0.0007	0.0006	-	0.0011	0.001	0.0005	0.0006	-
Copper	0.0008	0.0011	-	0.0015	-	0.0006	0.0007	-
Iron	0.404	0.363	-	0.211	0.92	0.238	0.295	-
Lead	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	-
Magnesium	11.9	12.7	-	20.2	7.66	12.3	8.5	-
Manganese	0.204	0.198	-	0.155	0.077	0.051	0.045	-
Mercury	<0.00002	<0.00002	-	<0.000020	<0.000010	<0.000010	<0.000002	-
Molybdenum	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	-
Nickel	0.003	0.003	-	0.004	0.002	0.001	0.001	-
Potassium	0.98	1.09	-	1.13	0.604	0.64	0.457	-
Selenium	<0.0001	<0.0001	-	0.0003	<0.0001	0.0001	<0.0001	-
Silicon	2.4	2.9	-	2.8	2.8	3	2.7	-
Silver	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	8.87	9.11	-	10.2	3.8	5.22	3.98	-
Strontium	0.559	0.571	-	0.906	0.277	0.515	0.332	-
Thallium	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	-	<0.005	0.016	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	0.007	-	<0.005	<0.005	<0.005	<0.005	-
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	-
Dissolved Metals								
Aluminum	0.007	0.01	-	0.0292	0.0582	0.0276	0.0345	**0.5**
Antimony	<0.0005	<0.0005	-	<0.00050	<0.00050	<0.00050	<0.00050	-
Arsenic	0.001	0.0007	-	0.00013	0.00024	0.00026	0.00021	-
Barium	0.016	0.015	-	0.0134	0.0064	0.008	0.0063	-
Beryllium	<0.0001	<0.0001	-	<0.00010	<0.00010	<0.00010	<0.00010	-
Bismuth	<0.001	<0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	-
Boron	0.12	0.1	-	0.122	<0.050	0.065	<0.050	-
Cadmium	0.00002	<0.00001	-	<0.000010	0.000013	0.000011	0.000013	-
Calcium	90.5	92.9	-	146	59.3	92.6	65.8	-
Chromium	<0.001	<0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	-
Cobalt	0.0006	0.0006		0.00094	0.00071	0.00057	0.00054	
Copper	0.0006	0.0006	-	0.00111	0.00371	0.00097	0.0011	**0.02**
Iron	0.097	0.045	-	0.0416	0.105	0.0783	0.101	**0.5**
Lead	<0.0002	0.0005	-	<0.00020	<0.00020	<0.00020	<0.00020	**0.05**
Lithium	<0.005	<0.005	-	<0.0050	<0.0050	<0.0050	<0.0050	-
Magnesium	11.9	12.2	-	19.5	7.92	12.5	8.31	-
Manganese	0.177	0.19	-	0.148	0.073	0.0523	0.0429	-
Mercury	<0.00002	<0.00002	-	<0.000020	<0.000010	<0.000010	<0.000002	-
Molybdenum	<0.001	<0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	-
Nickel	0.003	0.003	-	0.0029	0.0014	0.0014	0.0014	-
Potassium	1.03	1.1	-	1.09	0.607	0.685	0.484	-
Selenium	<0.0001	<0.0001	-	0.00035	<0.00010	0.00018	<0.00010	-
Silicon	2.6	2.9	-	2.85	2.85	2.97	2.63	-
Silver	<0.00002	<0.00002	-	<0.000020	<0.000020	<0.000020	<0.000020	-
Sodium	9.09	8.93	-	9.9	4.13	5.42	4.01	-
Strontium	0.523	0.577	-	0.845	0.3	0.515	0.339	-
Thallium	<0.00005	<0.00005	-	<0.000050	<0.000050	<0.000050	<0.000050	-
Tin	<0.005	<0.005	-	<0.0050	<0.0050	<0.0050	<0.0050	-
Titanium	<0.005	<0.005	-	<0.0050	<0.0050	<0.0050	<0.0050	-
Uranium	<0.0001	<0.0001	-	<0.00010	<0.00010	<0.00010	<0.00010	-
Vanadium	<0.005	<0.005	-	<0.0050	<0.0050	<0.0050	<0.0050	-
Zinc	<0.005	<0.005	-	<0.0050	<0.0050	<0.0050	<0.0050	**0.2**
Zirconium	<0.0005	<0.0005	-	<0.00050	<0.00050	<0.00050	<0.00050	

Results expressed in milligrams per litre.
* Indicates replicate sample.

TABLE 18-1
WATER QUANTITY FOR SETTLING POND 1
2011/12 EMS ID E218582
COMPANY IDENTITY SPD

Date	April Max. (m3/D)	April Daily(m3/D)	May Max. (m3/s)	May Daily (m3/s)	June Max.(m3/s)	June Daily(m3/s)	July Max. (m3/D)	July Daily(m3/D)	August Max. (m3/s)	August Daily (m3/s)	September Max.(m3/s)	September Daily(m3/s)
1	0.00510	0.00119	0.00000	0.00000	0.01350	0.00538	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
2	0.00490	0.00091	0.00000	0.00000	0.00840	0.00307	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
3	0.00260	0.00051	0.00000	0.00000	0.00270	0.00017	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
4	0.00080	0.00003	0.00000	0.00000	0.00470	0.00119	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5	0.00230	0.00027	0.00340	0.00074	0.00330	0.00051	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
6	0.00140	0.00006	0.00000	0.00000	0.00050	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
7	0.00130	0.00010	0.00060	0.00001	0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
8	0.00000	0.00000	0.00090	0.00008	0.00020	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00130	0.00034	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10	0.00000	0.00000	0.00060	0.00002	0.00150	0.00050	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
11	0.00200	0.00029	0.00000	0.00000	0.00100	0.00012	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
12	0.00000	0.00000	0.00030	0.00002	0.00080	0.00080	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
13	0.00000	0.00000	0.00000	0.00000	0.00060	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
15	0.00000	0.00000	0.00860	0.00471	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
16	0.00000	0.00000	0.00370	0.00136	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
17	0.00000	0.00000	0.00130	0.00021	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
22	0.00000	0.00028	0.00140	0.00028	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23	0.00000	0.00000	0.00190	0.00019	0.00060	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
24	0.00000	0.00000	0.01230	0.00321	0.02190	0.00737	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
25	0.00000	0.00000	0.00080	0.00011	0.00520	0.00111	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
26	0.00010	0.00000	0.00060	0.00006	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
27	0.00000	0.00000	0.04160	0.00574	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
28	0.00000	0.00000	0.05310	0.04557	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
29	0.00000	0.00000	0.04980	0.03670	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
30	0.00000	0.00000	0.02400	0.00907	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
31			0.02400	0.00756			0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Monthly Max.	0.00510		0.05310		0.02190		0.00000		0.00000		0.00000	
Monthly Avg.		0.00012		0.00373		0.00069		0.00000		0.00000		0.00000

Note: Flow meter was disabled from January to March due to an equipment malfunction

Water was pumped from Settling Pond 1 to 3 South Pit, leavign minimal water in the settling pond

TABLE 18-2
WATER QUANTITY FOR SETTLING POND 1
2011/12 EMS ID E218582
COMPANY IDENTITY SPD

Date	October Max. (m3/D)	October Daily(m3/D)	November Max. (m3/s)	November Daily (m3/s)	December Max.(m3/s)	December Daily(m3/s)	January Max. (m3/s)	January Daily(m3/s)	February Max. (m3/s)	February Daily (m3/s)	March Max.(m3/s)	March Daily(m3/s)
1	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
2	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
5	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
7	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
12	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
13	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
14	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
15	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
16	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
17	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
18	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
19	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
20	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
21	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
22	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
23	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
24	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
25	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
26	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
27	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
28	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
29	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
30	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
31	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	No Data	No Data	No Data	No Data	No Data	No Data
Monthly Max	0.00000		0.00000		0.00000		0		0		0	
Monthly Avg		0.00000		0.00000		0.00000						

Note: Flow meter was disabled from January to March due to an equipment malfunction

Water was pumped from Settling Pond 1 to 3 South Pit, leavign minimal water in the settling pond

TABLE 19-1
SETTLING POND 1 DAILY TSS
2011/12 EMS ID E218582
COMPANY IDENTITY SPD
FOR DECANT FLOW > 0.046 m3/s AND < 0.46 m3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Apr-12	^	1-May-12	^	1-Jun-12	^
2-Apr-12	^	2-May-12	^	2-Jun-12	^
3-Apr-12	^	3-May-12	3*	3-Jun-12	^
4-Apr-12	<4*	4-May-12	^	4-Jun-12	<4
5-Apr-12	^	5-May-12	^	5-Jun-12	^
6-Apr-12	^	6-May-12	^	6-Jun-12	<4*
7-Apr-12	^	7-May-12	^	7-Jun-12	^
8-Apr-12	^	8-May-12	^	8-Jun-12	^
9-Apr-12	^	9-May-12	<4*	9-Jun-12	^
10-Apr-12	^	10-May-12	^	10-Jun-12	^
11-Apr-12	<4*	11-May-12	^	11-Jun-12	^
12-Apr-12	^	12-May-12	^	12-Jun-12	^
13-Apr-12	^	13-May-12	<4*	13-Jun-12	<4*
14-Apr-12	^	14-May-12	^	14-Jun-12	^
15-Apr-12	^	15-May-12	^	15-Jun-12	^
16-Apr-12	^	16-May-12	^	16-Jun-12	^
17-Apr-12	^	17-May-12	^	17-Jun-12	^
18-Apr-12	<4*	18-May-12	^	18-Jun-12	^
19-Apr-12	^	19-May-12	^	19-Jun-12	^
20-Apr-12	^	20-May-12	^	20-Jun-12	<4*
21-Apr-12	^	21-May-12	^	21-Jun-12	^
22-Apr-12	^	22-May-12	^	22-Jun-12	^
23-Apr-12	^	23-May-12	2*	23-Jun-12	^
24-Apr-12	^	24-May-12	^	24-Jun-12	^
25-Apr-12	<4*	25-May-12	^	25-Jun-12	^
26-Apr-12	^	26-May-12	^	26-Jun-12	^
27-Apr-12	^	27-May-12	^	27-Jun-12	<4*
28-Apr-12	^	28-May-12	^	28-Jun-12	^
29-Apr-12	^	29-May-12	^	29-Jun-12	^
30-Apr-12	^	30-May-12	<4*	30-Jun-12	^
		31-May-12	^		
Permit Limit: 25mg/L					

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Jul-12	^	1-Aug-12	^	1-Sep-12	^
2-Jul-12	^	2-Aug-12	^	2-Sep-12	^
3-Jul-12	^	3-Aug-12	<4*	3-Sep-12	^
4-Jul-12	<4*	4-Aug-12	^	4-Sep-12	^
5-Jul-12	^	5-Aug-12	^	5-Sep-12	^
6-Jul-12	^	6-Aug-12	^	6-Sep-12	^
7-Jul-12	^	7-Aug-12	^	7-Sep-12	<4*
8-Jul-12	^	8-Aug-12	<4*	8-Sep-12	^
9-Jul-12	^	9-Aug-12	^	9-Sep-12	^
10-Jul-12	^	10-Aug-12	^	10-Sep-12	^
11-Jul-12	1*	11-Aug-12	^	11-Sep-12	^
12-Jul-12	^	12-Aug-12	^	12-Sep-12	^
13-Jul-12	^	13-Aug-12	^	13-Sep-12	^
14-Jul-12	^	14-Aug-12	^	14-Sep-12	<4*
15-Jul-12	^	15-Aug-12	<4*	15-Sep-12	^
16-Jul-12	^	16-Aug-12	^	16-Sep-12	^
17-Jul-12	^	17-Aug-12	^	17-Sep-12	^
18-Jul-12	1*	18-Aug-12	^	18-Sep-12	^
19-Jul-12	^	19-Aug-12	^	19-Sep-12	^
20-Jul-12	^	20-Aug-12	^	20-Sep-12	^
21-Jul-12	^	21-Aug-12	^	21-Sep-12	^
22-Jul-12	^	22-Aug-12	<4*	22-Sep-12	^
23-Jul-12	^	23-Aug-12	^	23-Sep-12	^
24-Jul-12	^	24-Aug-12	^	24-Sep-12	^
25-Jul-12	<4*	25-Aug-12	^	25-Sep-12	^
26-Jul-12	^	26-Aug-12	^	26-Sep-12	<4*
27-Jul-12	^	27-Aug-12	^	27-Sep-12	^
28-Jul-12	^	28-Aug-12	^	28-Sep-12	^
29-Jul-12	^	29-Aug-12	<4*	29-Sep-12	^
30-Jul-12	^	30-Aug-12	^	30-Sep-12	^
31-Jul-12	^	31-Aug-12	^		
Permit Limit: 25mg/L					

Note: All TSS results were from composite samples except samples marked with*, * Replicate and Grab samples.

Results are expressed in milligrams per litre.

TABLE 19-2
SETTLING POND 1 DAILY TSS
2011/12 EMS ID E218582
COMPANY IDENTITY SPD
FOR DECANT FLOW > 0.046 m3/s AND < 0.46 m3/s

Date	TSS (mg/L)	Date	TSS (mg/L)	Date	TSS (mg/L)
1-Oct-12	^	1-Nov-12	^	1-Dec-12	<4*
2-Oct-12	^	2-Nov-12	^	2-Dec-12	<4*
3-Oct-12	<4	3-Nov-12	^	3-Dec-12	<4*
4-Oct-12	^	4-Nov-12	^	4-Dec-12	<4*
5-Oct-12	^	5-Nov-12	^	5-Dec-12	<4*
6-Oct-12	^	6-Nov-12	^	6-Dec-12	<4*
7-Oct-12	^	7-Nov-12	^	7-Dec-12	<4*
8-Oct-12	^	8-Nov-12	<4	8-Dec-12	<4*
9-Oct-12	^	9-Nov-12	^	9-Dec-12	^
10-Oct-12	^	10-Nov-12	^	10-Dec-12	^
11-Oct-12	<4	11-Nov-12	^	11-Dec-12	^
12-Oct-12	^	12-Nov-12	^	12-Dec-12	^
13-Oct-12	^	13-Nov-12	^	13-Dec-12	<4*
14-Oct-12	^	14-Nov-12	<4	14-Dec-12	^
15-Oct-12	^	15-Nov-12	^	15-Dec-12	<4*
16-Oct-12	^	16-Nov-12	^	16-Dec-12	^
17-Oct-12	^	17-Nov-12	^	17-Dec-12	^
18-Oct-12	^	18-Nov-12	^	18-Dec-12	^
19-Oct-12	^	19-Nov-12	^	19-Dec-12	^
20-Oct-12	^	20-Nov-12	^	20-Dec-12	<4*
21-Oct-12	^	21-Nov-12	^	20-Dec-12	<4*
22-Oct-12	^	22-Nov-12	<4*	21-Dec-12	<4*
23-Oct-12	^	23-Nov-12	<4*	22-Dec-12	<4*
24-Oct-12	<4	24-Nov-12	<4*	23-Dec-12	<4*
25-Oct-12	^	25-Nov-12	<4*	24-Dec-12	<4*
26-Oct-12	^	26-Nov-12	<4*	25-Dec-12	<4*
27-Oct-12	^	27-Nov-12	<4*	26-Dec-12	<4*
28-Oct-12	^	28-Nov-12	<4*	27-Dec-12	<4*
29-Oct-12	^	29-Nov-12	<4*	28-Dec-12	<4*
30-Oct-12	^	30-Nov-12	<4*	29-Dec-12	<4*
31-Oct-12	<4			30-Dec-12	<4*
				31-Dec-12	<4*
Permit Limit: 25mg/L					

Date	TSS(mg/L)	Date	TSS(mg/L)	Date	TSS(mg/L)
1-Jan-12	<4.0	1-Feb-12	<4.0	1-Mar-12	<4.0
2-Jan-12	<4.0	2-Feb-12	<4.0	2-Mar-12	<4.0
3-Jan-12	<4.0	3-Feb-12	<4.0	3-Mar-12	<4.0
4-Jan-12	8.8	4-Feb-12	<4.0	4-Mar-12	<4.0
4-Jan-12	10.5	5-Feb-12	<4.0	5-Mar-12	<4.0
5-Jan-12	6	6-Feb-12	<4.0	6-Mar-12	<4.0
6-Jan-12	<4.0	6-Feb-12*	<4.0	6-Mar-12	<4.0
7-Jan-12	<4.0	7-Feb-12	<4.0	7-Mar-12	<4.0
8-Jan-12	<4.0	8-Feb-12	<4.0	8-Mar-12	<4.0
9-Jan-12	<4.0	9-Feb-12	<4.0	9-Mar-12	<4.0
10-Jan-12	<4.0	10-Feb-12	<4.0	10-Mar-12	<4.0
10-Jan-12*	<4.0	11-Feb-12	<4.0	11-Mar-12	<4.0
11-Jan-12	<4.0	12-Feb-12	<4.0	12-Mar-12	<4.0
12-Jan-12	<4.0	13-Feb-12	<4.0	13-Mar-12	<4.0
13-Jan-12	<4.0	14-Feb-12	<4.0	13-Mar-12*	<4.0
14-Jan-12	<4.0	15-Feb-12	<4.0	14-Mar-12	<4.0
15-Jan-12	<4.0	16-Feb-12	<4.0	15-Mar-12	<4.0
16-Jan-12	<4.0	17-Feb-12	<4.0	16-Mar-12	<4.0
17-Jan-12	<4.0	18-Feb-12	<4.0	17-Mar-12	<4.0
17-Jan-12*	<4.0	19-Feb-12	<4.0	18-Mar-12	<4.0
18-Jan-12	<4.0	20-Feb-12	<4.0	19-Mar-12	<4.0
19-Jan-12	<4.0	21-Feb-12	<4.0	20-Mar-12	<4.0
20-Jan-12	<4.0	21-Feb-12*	65.6	20-Mar-12*	<4.0
21-Jan-12	<4.0	22-Feb-12	<4.0	21-Mar-12	<4.0
22-Jan-12	<4.0	23-Feb-12	<4.0	22-Mar-12	<4.0
23-Jan-12	<4.0	24-Feb-12	<4.0	23-Mar-12	<4.0
24-Jan-12	<4.0	25-Feb-12	<4.0	24-Mar-12	<4.0
24-Jan-12*	<4.0	26-Feb-12	<4.0	25-Mar-12	<4.0
25-Jan-12	<4.0	27-Feb-12	<4.0	26-Mar-12	<4.0
26-Jan-12	<4.0	28-Feb-12	<4.0	27-Mar-12	<4.0
27-Jan-12	<4.0	28-Feb-12*	<4.0	27-Mar-12	<4.0
28-Jan-12	<4.0	29-Feb-12	<4.0	28-Mar-12	<4.0
29-Jan-12	<4.0			29-Mar-12	<4.0
30-Jan-12	<4.0			30-Mar-12	<4.0
31-Jan-12	<4.0			31-Mar-12	<4.0
31-Jan-12*	<4.0				
Permit Limit: 25mg/L					

Note: All TSS results were from grab samples, * Replicate samples

Results are expressed in milligrams per litre.

TABLE 20
3 SOUTH PIT WATER QUALITY
2011/12 EMS ID- E217015
COMPANY IDENTITY - 3S

Parameter	April				May			June					Site Description	
Sample Date	4	11	18	25	2	2*	9	6	13	13*	20	27	GPS (m)	
Conductivity (umhos/cm)	636	871	1020	875	1000	1010	778	1030	1080	1080	1120	1120	Minegrid	
Hardness CaCO3	317	-	-	-	-	-	-	512	-	-	-	-	Northing	Easting
pH	7.84	7.92	7.94	7.88	7.87	7.65	7.72	7.95	8	7.95	7.94	7.93	101583	97547.5
Acidity (to pH 8.3)	2.8	2.3	2.1	1.7	5.4	16.3	0.9	1.9	2.7	<0.5	1.7	-	UTM ZONE 10	
Alkalinity - Total CaCO3	78	90	82	81	78	77	79	76	81	79	81	76	Northing	Easting
Ammonia Nitrogen	-	-	-	-	0.051	0.023	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	-	-	-	-	<0.02	<0.02	-	<0.02	-	-	-	-	PAG-CCR Storage Pond	
Dissolved Phosphate	-	-	-	-	<0.005	<0.005	-	-	-	-	-	-		
Total Phosphate	-	-	-	-	<0.005	<0.005	-	-	-	-	-	-		
Sulphate	220	360	460	350	420	420	300	420	490	510	480	520		

Parameter	July				August					September				Site Description	
Sample Date	5	11	18	25	3	8	15	22	29	7	14	20	26	GPS (m)	
Conductivity (umhos/cm)	1140	1180	1150	1190	1210	1250	1310	1290	1200	1280	1260	1250	1170	Minegrid	
Hardness CaCO3	572	-	-	-	679	-	-	-	598	-	-	-	-	Northing	Easting
pH	7.81	7.85	7.67	7.79	7.77	7.78	7.63	7.79	7.84	7.83	7.93	7.94	7.77	101583	97547.5
Acidity (to pH 8.3)	2.2	1.4	2.5	0.7	<0.5	<0.5	<0.5	1.8	4.9	2.3	1.2	2.7	1.2	UTM ZONE 10	
Alkalinity - Total CaCO3	70	67	59	56	56	57	61	58	67	67	69	70	68	Northing	Easting
Ammonia Nitrogen	0.052	-	-	-	-	-	-	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	PAG-CCR Storage Pond	
Dissolved Phosphate	<0.005	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphate	<0.005	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	550	570	560	560	630	630	640	600	550	590	610	590	510		

Parameter	October					November				December					Site Description	
Sample Date	3	11	17	24	31	8	14	22	29	7	8	20	20*	28	GPS (m)	
Conductivity (umhos/cm)	1200	1150	1180	1210	1230	1220	1170	491	1190	913	1100	664	727	854	Minegrid	
Hardness CaCO3	574	-	-	-	576	-	-	-	-	486	-	-	-	-	Northing	Easting
pH	7.72	7.81	7.68	7.87	7.92	7.76	7.88	7.38	7.52	7.72	7.63	7.66	7.71	7.8	101583	97547.5
Acidity (to pH 8.3)	1	1.3	2.8	1.4	3.1	4.8	1.5	1.9	3.2	1.4	2	<0.5	1.9	1.7	UTM ZONE 10	
Alkalinity - Total CaCO3	63	73	83	79	81	77.7	82	33.2	80.9	69.3	87	62.2	67.1	69.7	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	-	<0.02	-	-	-	-	PAG-CCR Storage Pond	
Sulphate	590	550	530	600	610	582	550	186	590	454	500	257	279	343		

Parameter	January					February				March				Site Description	
Sample Date	3	10	17	24	31	6	13	21	28	6	13	20	27	GPS (m)	
Conductivity (umhos/cm)	393	1060	979	302	428	408	1010	1040	1110	1060	1150	1190	1230	Minegrid	
Hardness CaCO3	187	-	-	-	-	205	-	-	-	523	-	-	-	Northing	Easting
pH	7.65	7.76	7.89	7.63	7.78	7.72	7.94	7.94	7.92	7.86	7.84	7.84	7.84	101583	97547.5
Acidity (to pH 8.3)	<0.5	2.9	0.9	<0.5	1	1.3	3.3	2.2	1	<0.5	1	1.7	2.2	UTM ZONE 10	
Alkalinity - Total CaCO3	35.1	64.9	75.3	26.8	50.8	30.3	64.5	72.3	73.7	67.6	71.9	73	76.7	Northing	Easting
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	5531548	322943
Nitrate and Nitrite as N	<0.020	-	-	-	-	0.022	-	-	-	<0.020	-	-	-	PAG-CCR Storage Pond	
Sulphate	157	498	449	111	155	170	474	474	505	519	590	611	590		

Results expressed in milligrams per litre except where noted.
* Field replicate sample

TABLE 21-1
3 SOUTH PIT METALS ANALYSIS
2011/12 EMS ID E217015
COMPANY IDENTITY - 3S

Parameter	April	May		June
Sample Date	4	2	2*	6
Total Metals				
Aluminum	0.125	-	-	0.092
Antimony	<0.0005	-	-	<0.0005
Arsenic	0.0001	-	-	0.0002
Barium	0.012	-	-	0.018
Beryllium	<0.0001	-	-	<0.0001
Bismuth	<0.001	-	-	<0.001
Boron	0.09	-	-	0.14
Cadmium	0.00002	-	-	<0.00001
Calcium	105	-	-	170
Chromium	<0.001	-	-	<0.001
Cobalt	0.0006	-	-	0.0005
Copper	0.001	-	-	0.001
Iron	0.202	-	-	0.235
Hardness	-	-	-	-
Lead	<0.0002	-	-	<0.0002
Lithium	<0.005	-	-	-
Magnesium	12.6	-	-	20.6
Manganese	0.026	-	-	0.028
Mercury	<0.00002	-	-	<0.00002
Molybdenum	<0.001	-	-	<0.001
Nickel	0.001	-	-	0.002
Phosphorus	-	<0.005	<0.005	-
Potassium	0.98	-	-	1.78
Selenium	0.0001	-	-	0.0002
Silicon	2.4	-	-	1.3
Silver	<0.00002	-	-	<0.00002
Sodium	8.26	-	-	19.5
Strontium	0.628	-	-	1.05
Thallium	<0.00005	-	-	<0.00005
Tin	<0.005	-	-	<0.005
Titanium	0.011	-	-	<0.005
Uranium	<0.0001	-	-	<0.0001
Vanadium	<0.005	-	-	<0.005
Zinc	<0.005	-	-	0.013
Dissolved Metals				
Aluminum	0.013	-	-	0.068
Antimony	<0.0005	-	-	<0.0005
Arsenic	<0.0001	-	-	0.0003
Barium	0.013	-	-	0.018
Beryllium	<0.0001	-	-	<0.0001
Boron	0.09	-	-	0.16
Cadmium	<0.00001	-	-	0.00006
Calcium	106	-	-	169
Chromium	<0.001	-	-	<0.001
Cobalt	<0.0005	-	-	<0.0005
Copper	0.0012	-	-	0.0015
Iron	0.01	0.02	0.014	0.023
Hardness	-	-	-	-
Lead	<0.0002	-	-	<0.0002
Lithium	<0.005	-	-	-
Magnesium	12.8	-	-	21.8
Manganese	0.024	-	-	0.013
Mercury	<0.00002	-	-	<0.00002
Molybdenum	<0.001	-	-	<0.001
Nickel	0.001	-	-	0.002
Phosphorus	-	<0.005	<0.005	-
Potassium	1.01	-	-	2.03
Selenium	<0.0001	-	-	0.0002
Silver	<0.00002	-	-	<0.00002
Sodium	8.35	-	-	20.7
Thallium	<0.00005	-	-	<0.00005
Tin	<0.005	-	-	<0.005
Titanium	0.011	-	-	<0.005
Uranium	<0.0001	-	-	<0.0001
Vanadium	<0.005	-	-	<0.005
Zinc	<0.005	-	-	0.005

Results expressed in milligrams per litre.

TABLE 21-2
3 SOUTH PIT METALS ANALYSIS
2011/12 EMS ID E217015
COMPANY IDENTITY - 3S

Parameter	July	August		September	
Sample Date	5	3	29	8	15
Total Metals					
Aluminum	-	0.073	0.033	-	-
Antimony	-	<0.0005	<0.0005	-	-
Arsenic	-	0.0003	0.0005	-	-
Barium	-	0.022	0.019	-	-
Beryllium	-	<0.0001	<0.0001	-	-
Bismuth	-	<0.001	<0.001	-	-
Boron	-	0.27	0.25	-	-
Cadmium	-	0.00004	0.00002	-	-
Calcium	-	196	184	-	-
Chromium	-	<0.001	<0.001	-	-
Cobalt	-	<0.0005	<0.0005	-	-
Copper	-	0.001	0.001	-	-
Iron	-	0.3	0.232	-	-
Hardness	572	679	598	-	-
Lead	-	<0.0002	<0.0002	-	-
Lithium	-	0.005	0.005	-	-
Magnesium	-	25.8	22.7	-	-
Manganese	-	0.018	0.019	-	-
Mercury	-	<0.00002	<0.00002	-	-
Molybdenum	-	<0.001	<0.001	-	-
Nickel	-	<0.001	<0.001	-	-
Phosphorus	<0.005	-	-	-	-
Potassium	-	2.76	2.6	-	-
Selenium	-	0.0002	0.0001	-	-
Silicon	-	0.2	0.4	-	-
Silver	-	<0.00002	<0.00002	-	-
Sodium	-	34	31.3	-	-
Strontium	-	1.47	1.29	-	-
Thallium	-	<0.00005	<0.00005	-	-
Tin	-	<0.005	<0.005	-	-
Titanium	-	<0.005	<0.005	-	-
Uranium	-	0.0001	<0.0001	-	-
Vanadium	-	<0.005	<0.005	-	-
Zinc	-	<0.005	<0.005	-	-
Disssolved Metals					
Aluminum	0.056	0.053	0.022	-	-
Antimony	-	<0.0005	<0.0005	-	-
Arsenic	0.0002	0.0002	0.0005	-	-
Barium	0.02	0.023	0.02	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Boron	0.2	0.27	0.29	-	-
Cadmium	<0.00001	0.00003	0.00001	-	-
Calcium	185	225	200	-	-
Chromium	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0007	0.0013	0.0014	-	-
Iron	0.008	0.018	0.028	0.02	0.014
Hardness	-	595	552	-	-
Lead	<0.0002	0.0002	<0.0002	-	-
Lithium	-	0.005	0.006	-	-
Magnesium	27	28.7	24.3	-	-
Manganese	0.008	0.004	0.014	-	-
Mercury	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	0.001	<0.001	0.001	-	-
Phosphorus	<0.005	-	-	<0.005	<0.005
Potassium	2.7	3.09	2.81	-	-
Selenium	0.0002	0.0002	0.0001	-	-
Silver	<0.00002	<0.00002	<0.00002	-	-
Sodium	30.4	34	34.8	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	-	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	0.006	<0.005	-	-

Results expressed in milligrams per litre.

TABLE 21-3
3 SOUTH PIT METALS ANALYSIS
2011/12 EMS ID E217015
COMPANY IDENTITY - 3S

Parameter	October		November	December	January	February	March
Sample Date	5	31	**2**	7	4	6	6
Total Metals							
Aluminum	0.452	0.196	-	0.018	0.403	0.02	0.107
Antimony	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0005	0.0002	-	<0.0001	0.0003	<0.0001	<0.0001
Barium	0.02	0.017	-	0.01	0.01	0.004	0.011
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Boron	0.24	0.2	-	0.13	0.06	0.05	0.18
Cadmium	0.00004	0.00003	-	<0.00001	0.00004	<0.00001	0.00003
Calcium	0.02	0.02	-	0.02	61	69	174
Chromium	<0.001	<0.001	-	0.001	<0.001	<0.001	<0.001
Cobalt	0.0026	0.0007	-	<0.0005	0.0019	0.0006	0.0034
Copper	0.0068	0.0026	-	0.0008	0.0032	0.0005	0.0018
Iron	0.672	0.282	-	0.042	0.443	0.023	0.101
Lead	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.006	0.005	-	<0.005	<0.005	<0.005	0.007
Magnesium	24.2	23.9	-	19.9	8.5	7.95	21.5
Manganese	0.082	0.031	-	0.004	0.053	0.02	0.12
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Nickel	0.006	0.003	-	0.002	0.004	0.001	0.008
Potassium	2.7	2.6	-	1.07	0.618	0.555	1.33
Selenium	0.0001	<0.0001	-	0.0004	0.0001	0.0001	0.0003
Silicon	1	1	-	2.2	1.4	0.8	1.6
Silver	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	30.1	24.6	-	9.67	3.8	4.64	13.2
Strontium	1.39	1.37	-	0.967	0.337	0.4	1.08
Thallium	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Titanium	0.007	<0.005	-	<0.005	0.013	<0.005	<0.005
Uranium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Zinc	0.007	<0.005	-	<0.005	0.007	0.014	0.009
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Disssolved Metals							
Aluminum	0.077	0.052	-	0.0188	0.0146	0.0068	0.032
Antimony	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0003	0.0002	-	<0.0001	<0.00010	<0.00010	0.0001
Barium	0.018	0.018	-	0.0098	0.0089	0.0056	0.0121
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010
Boron	0.25	0.24	-	0.119	0.058	0.06	0.136
Cadmium	0.00005	<0.00001	-	0.000025	0.000033	0.000109	0.000025
Calcium	214	208	-	153	68.2	66.2	183
Chromium	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	0.0017	<0.0005	-	<0.0005	0.00152	0.00066	0.00339
Copper	0.0024	0.0018	-	0.00131	0.00248	0.00066	0.0013
Iron	0.014	0.007	-	0.0192	<0.0050	<0.0050	<0.0050
Lead	<0.0002	<0.0002	-	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	0.006	<0.005	-	<0.005	<0.0050	<0.0050	0.0056
Magnesium	25.7	26.1	-	18.5	8.55	8.13	21.5
Manganese	0.058	0.019	-	0.0042	0.0444	0.0201	0.117
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.005	0.003	-	0.0011	0.0033	0.0015	0.0083
Potassium	2.92	2.79	-	1.13	0.582	0.579	1.34
Selenium	0.0001	0.0002	-	0.00024	0.00012	0.00014	0.00024
Silicon	0.9	1.1	-	2.13	1.14	0.89	1.79
Silver	<0.00002	<0.00002	-	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	31.3	26.4	-	9.69	4	4.8	13.2
Strontium	1.28	1.39	-	0.921	0.363	0.406	1.08
Thallium	<0.00005	<0.00005	-	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Zinc	0.006	<0.005	-	<0.005	0.0053	<0.0050	0.0064
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 22
2-North Portal Sump Water Quality
2011/12 EMS ID-E283433
COMPANY IDENTITY - 2N-P Sump

Parameter	April				May					June				Site Description	
Sample Date	4	8	11	25	3	9	13	23	31	7	13	20	27	GPS (m)	
Conductivity (umhos/cm)	2100	-	2050	2150	2050	-	2130	2320	-	2250	2360	2420	2370	Minegrid	
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-		
pH	8.08	8.05	7.96	7.98	8.01	7.97	7.81	8.1	8.04	8.2	8.11	7.89	8.05	Northing	Easting
Acidity (to pH 8.3)	8.1	-	11	1.1	5.4	-	9.2	5	-	1.8	<0.5	11.6	-	103161	99514
Alkalinity - Total CaCO3	240	-	250	240	240	-	240	260	-	240	250	250	250	UTM ZONE 10	
Ammonia Nitrogen	-	-	-	-	0.069	-	-	-	-	0.024	-	-	-	Northing	Easting
Nitrite/Nitrate Nitrogen	-	-	-	-	0.05	-	-	-	-	<0.02	-	-	-	5533942	322014
Dissolved Phosphorous	-	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	2 North Portal Sump	
Total Phosphorous	-	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-		
Sulphate	870	850	890	900	840	1000	890	1100	-	950	1000	1000	1000		

Parameter	July				August					September				Site Description	
Sample Date	5	11	18	26	5	8	15	22	30	14	14*	21	28	GPS (m)	
Conductivity (umhos/cm)	2500	2490	2430	2490	2650	2610	2570	2580	2620	2660	2660	2650	2500	Minegrid	
Hardness CaCO3	586	-	-	-	716	-	-	-	654	-	-	-	-		
pH	7.95	8.04	8.07	7.97	8	8.02	7.97	8.01	8.13	8.08	8.02	8.1	8.1	Northing	Easting
Acidity (to pH 8.3)	7.7	7.4	8.1	8.3	1	7.2	5.2	10.6	11.5	5.1	3.7	8.4	2.8	103161	99514
Alkalinity - Total CaCO3	260	270	260	270	260	270	260	270	260	260	250	270	280	UTM ZONE 10	
Ammonia Nitrogen	0.093	-	-	-	0.047	-	-	-	0.057	-	-	-	-	Northing	Easting
Nitrite/Nitrate Nitrogen	0.23	-	-	-	0.03	-	-	-	0.03	-	-	-	-	5533942	322014
Dissolved Phosphorous	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	2 North Portal Sump	
Total Phosphorous	0.006	-	-	-	<0.005	-	-	-	-	-	-	-	-		
Sulphate	1100	1100	1000	1100	1200	1100	-	-	1200	1200	1200	1100	1000		

Parameter	October				November					December					Site Description	
Sample Date	6	11	17	24	2	8	14	22	29	7	7*	13	20	28	GPS (m)	
Conductivity (umhos/cm)	2490	2550	2540	2500	2470	2460	2380	1370	2100	2460	2470	2230	1830	2390	Minegrid	
Hardness CaCO3	631	-	-	-	614	-	-	-	-	-	-	-	-	-		
pH	8.03	8.03	8.07	8.04	8.03	8	8.07	7.89	7.82	7.86	7.91	8.04	8.02	7.96	Northing	Easting
Acidity (to pH 8.3)	2.6	4.1	7.4	8.3	2.2	9.6	2.7	1.5	4.8	8.6	4.9	2.8	2.5	13	103161	99514
Alkalinity - Total CaCO3	270	280	270	270	260	276	275	126	225	272	272	343	330	261	UTM ZONE 10	
Ammonia Nitrogen	0.041	-	-	-	0.012	-	-	-	-	0.022	0.036	-	-	-	Northing	Easting
Nitrite/Nitrate Nitrogen	0.03	-	-	-	-	-	-	-	-	0.037	0.034	-	-	-	5533942	322014
Dissolved Phosphorous	-	-	-	-	-	-	-	-	-	<0.005	-	-	-	-	2 North Portal Sump	
Total Phosphorous	-	-	-	-	-	-	-	-	-	<0.005	-	-	-	-		
Sulphate	1100	1100	1000	1100	1100	1030	979	567	933	1130	1140	859	564	1060		

Parameter	January					February					March				Site Description	
Sample Date	6	10	17	24	31	7	7*	14	21	28	7	13	20	27	GPS (m)	
Conductivity (umhos/cm)	2040	2010	2270	2260	2110	2330	2350	2150	2080	2330	2170	2120	2150	2140	Minegrid	
Hardness CaCO3	575	-	-	-	-	793	802	-	-	-	682	-	-	-		
pH	8.05	8.05	8.03	8.02	8.02	8.03	7.99	7.97	8.06	7.98	7.99	8.06	8.01	7.96	Northing	Easting
Acidity (to pH 8.3)	3.9	4.5	3.4	3.9	3.2	5.5	9.3	12.7	10.5	8.8	3.8	3.9	3.5	5	103161	99514
Alkalinity - Total CaCO3	240	262	260	238	259	280	283	232	251	268	270	245	264	251	UTM ZONE 10	
Ammonia Nitrogen	0.0196	-	-	-	-	0.0108	0.0129	-	-	-	0.024	-	-	-	Northing	Easting
Nitrite/Nitrate Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5533942	322014
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 North Portal Sump	
Dissolved Phosphorous	-	-	-	-	-	-	-	-	-	-	0.0077	-	-	-		
Sulphate	867	794	1160	978	890	1150	1110	926	848	1010	1030	966	964	908		

Results expressed in milligrams per litre.
* Field replicate sample.

TABLE 23-1
2-North Portal Sump Metals Analysis
2011/12 EMS ID: E283433
COMPANY IDENTITY - 2N Portal SUMP

Parameter	April	May	June	July	August		September
Sample Date	4	3	7	5	5	30	7
Total Metals							
Aluminum	-	-	-	-	0.124	0.033	-
Antimony	-	-	-	-	<0.0005	<0.0005	-
Arsenic	-	-	-	-	0.0067	0.0021	-
Barium	-	-	-	-	0.02	0.018	-
Beryllium	-	-	-	-	<0.0001	<0.0001	-
Bismuth	-	-	-	-	<0.001	<0.001	-
Boron	-	-	-	-	1.29	1.32	-
Cadmium	-	-	-	-	<0.00003	<0.00003	-
Calcium	-	-	-	-	200	264	-
Chromium	-	-	-	-	<0.001	<0.001	-
Cobalt	-	-	-	-	0.0022	0.0005	-
Copper	-	-	-	-	0.0011	0.0007	-
Iron	-	-	-	-	0.24	0.146	-
Hardness	-	-	-	586	716	654	-
Lead	-	-	-	-	<0.0002	<0.0002	-
Lithium	-	-	-	-	0.009	0.009	-
Magnesium	-	-	-	-	18.7	23.1	-
Manganese	-	-	-	-	0.099	0.076	-
Mercury	-	-	-	-	<0.00002	<0.00002	-
Molybdenum	-	-	-	-	0.003	0.001	-
Nickel	-	-	-	-	0.007	0.002	-
Phosphorus	-	<0.005	<0.005	0.006	<0.005	-	-
Potassium	-	-	-	-	5.19	5.74	-
Selenium	-	-	-	-	0.0001	0.0001	-
Silicon	-	-	-	-	2.8	3.6	-
Silver	-	-	-	-	<0.00002	<0.00002	-
Sodium	-	-	-	-	371	389	-
Strontium	-	-	-	-	1.78	1.93	-
Thallium	-	-	-	-	<0.00005	<0.00005	-
Tin	-	-	-	-	<0.005	<0.005	-
Titanium	-	-	-	-	<0.005	<0.005	-
Uranium	-	-	-	-	0.0002	0.0002	-
Vanadium	-	-	-	-	<0.005	<0.005	-
Zinc	-	-	-	-	<0.005	<0.005	-
Dissolved Metals							
Aluminum	0.009	-	0.006	0.003	0.009	0.006	-
Antimony	-	-	-	-	<0.0005	**<0.0005**	-
Arsenic	0.0011	-	0.0014	0.0061	0.0056	0.0016	-
Barium	0.026	-	0.022	0.025	0.022	0.015	-
Beryllium	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	0.68	-	0.91	1.16	1.39	1.28	-
Cadmium	0.00003	-	0.00002	0.00001	<0.00003	0.00001	-
Calcium	219	-	195	201	249	229	-
Chromium	<0.001	-	<0.001	<0.001	<0.001	<0.001	-
Cobalt	0.0022	-	0.0009	0.0014	0.0024	0.0005	-
Copper	0.0006	-	0.0004	0.0006	0.0006	0.0008	-
Iron	<0.005	-	<0.005	<0.005	0.006	0.016	-
Hardness	639	-	574	-	576	753	-
Lead	<0.0002	-	<0.0002	<0.0002	0.0003	<0.0002	-
Lithium	0.006	-	-	-	0.01	0.009	-
Magnesium	22.4	-	21	20.4	22.6	20.2	-
Manganese	0.127	-	0.069	0.1	0.108	0.083	-
Mercury	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	0.002	-	0.002	0.004	0.002	0.001	-
Nickel	0.009	-	0.004	0.005	0.007	0.002	-
Phosphorus	-	<0.005	<0.005	<0.005	-	-	-
Potassium	3.55	-	4.28	5.32	6.53	5.04	-
Selenium	0.0008	-	0.0006	0.0003	0.0002	0.0001	-
Silver	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	242	-	309	405	441	358	-
Thallium	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	-	<0.005	<0.005	<0.005	<0.005	-
Titanium	-	-	-	-	<0.005	<0.005	-
Uranium	0.0002	-	0.0001	0.0002	0.0002	0.0001	-
Vanadium	<0.005	-	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	-	<0.005	<0.005	<0.005	<0.005	-

Results expressed in milligrams per litre.

TABLE 23-2
2-North Portal Sump Metals Analysis
2011/12 EMS ID: E283433
COMPANY IDENTITY - 2N Portal SUMP

Parameter	October	November	Deccember	
Sample Date	6	2	7	7*
Total Metals				
Aluminum	0.017	0.019	-	-
Antimony	<0.0005	<0.0005	-	-
Arsenic	0.0009	0.0004	-	-
Barium	0.021	0.013	-	-
Beryllium	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	-	-
Boron	1.09	0.97	-	-
Cadmium	<0.00005	0.00002	-	-
Calcium	218	212	-	-
Chromium	<0.001	<0.001	-	-
Cobalt	0.0018	<0.0005	-	-
Copper	0.0005	0.0004	-	-
Iron	0.01	0.175	-	-
Lead	<0.0002	<0.0002	-	-
Lithium	0.008	0.006	-	-
Magnesium	21.1	20.6	-	-
Manganese	0.091	0.079	-	-
Mercury	<0.00002	<0.00002	-	-
Molybdenum	0.001	<0.001	-	-
Nickel	0.005	0.002	-	-
Potassium	4.82	4.56	-	-
Selenium	0.0003	0.0005	-	-
Silicon	3.2	2.9	-	-
Silver	<0.00002	<0.00002	-	-
Sodium	337	349	-	-
Strontium	1.51	1.53	-	-
Thallium	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	-	-
Uranium	0.0001	0.0001	-	-
Vanadium	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	-	-
Zirconium	<0.0005	<0.0005	-	-
Disssolved Metals				
Aluminum	0.013	0.027	0.0088	0.0043
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0007	0.0004	0.00032	0.00032
Barium	0.018	0.012	0.0142	0.0142
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001
Boron	0.99	0.91	0.903	0.85
Cadmium	0.00002	<0.00001	0.000014	0.000023
Calcium	212	190	241	239
Chromium	<0.001	<0.001	<0.001	0.001
Cobalt	0.0016	<0.0005	0.001	0.00108
Copper	0.0004	0.0007	0.00046	<0.0002
Iron	<0.005	0.007	<0.0050	0.0066
Lead	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.007	0.006	0.0068	0.0068
Magnesium	20.7	17.9	23.3	24.3
Manganese	0.081	0.069	0.141	0.147
Mercury	<0.00002	<0.00002	<0.00001	<0.00001
Molybdenum	0.001	0.001	<0.001	<0.001
Nickel	0.005	0.002	0.0039	0.0041
Potassium	4.73	4.45	4.1	4.34
Selenium	0.0003	0.0006	0.00041	0.00035
Silicon	3.3	3.2	3.19	3.17
Silver	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	345	302	309	325
Strontium	1.53	1.48	1.74	1.78
Thallium	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005
Uranium	0.0001	0.0001	0.00016	0.00017
Vanadium	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.005	<0.0005	<0.0005	<0.0005

Results expressed in milligrams per litre.

TABLE 23-3
2-North Portal Sump Metals Analysis
2011/12 EMS ID: E283433
COMPANY IDENTITY - 2N Portal SUMP

Parameter	January	February		March
Sample Date	6	7	7*	7
Total Metals				
Aluminum	0.218	0.202	0.163	0.271
Antimony	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0008	0.0006	0.0005	0.0005
Barium	0.025	0.014	0.013	0.014
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001
Boron	0.68	0.78	0.75	0.78
Cadmium	0.00002	0.00003	0.00003	0.00002
Calcium	198	264	269	234
Chromium	0.001	<0.001	<0.001	<0.001
Cobalt	0.0016	0.0009	0.0007	0.0009
Copper	0.0015	0.0018	0.0011	0.0016
Iron	0.379	0.556	0.316	0.545
Lead	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.006	0.009	0.008	0.007
Magnesium	19.7	32.3	31.6	23.7
Manganese	0.148	0.153	0.146	0.112
Mercury	<0.000010	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001
Nickel	0.005	0.004	0.004	0.003
Potassium	3.12	3.97	3.97	3.63
Selenium	0.0004	0.0002	0.0003	0.0004
Silicon	2.7	3.1	3.1	3.2
Silver	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	213	275	270	262
Strontium	1.41	1.97	1.93	1.56
Thallium	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005
Titanium	0.011	0.011	0.005	0.009
Uranium	0.0001	0.0002	0.0002	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals				
Aluminum	0.0114	0.0041	0.003	0.0136
Antimony	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00053	0.00022	0.00024	0.0004
Barium	0.0265	0.0134	0.0134	0.0127
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.759	0.817	0.801	0.706
Cadmium	0.000019	0.000018	0.000014	<0.000010
Calcium	221	286	282	218
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00135	0.00065	0.00058	0.00066
Copper	0.00087	0.00073	0.00067	0.00058
Iron	<0.0050	0.0056	0.0082	0.0131
Lead	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0068	0.0088	0.0087	0.0062
Magnesium	22.7	31.6	31.4	23.4
Manganese	0.159	0.149	0.148	0.106
Mercury	<0.000010	<0.000010	<0.000010	<0.000002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0044	0.0038	0.0039	0.0024
Potassium	3.68	3.91	3.9	3.64
Selenium	0.00045	0.00033	0.00027	0.00047
Silicon	2.65	3.22	3.11	2.62
Silver	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	249	269	268	266
Strontium	1.52	2.03	2.02	1.5
Thallium	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	0.00013	0.00015	0.00015	0.00012
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 24
4 SOUTH LOWER WATER QUALITY
2011/12
COMPANY IDENTITY - 4S-Lo

Parameter	April				May					June					Site Description: GPS (m) Minegrid Northing / Easting
Sample Date	4	11	18	25	2	9	13	23	23*	6	13	20	27	27*	100983.82 / 98152.577
Conductivity (umhos/cm)	549	548	538	510	493	578	533	529	533	509	507	510	535	538	UTM ZONE 10
Hardness CaCO3	255	-	-	-	216	-	-	-	-	225	-	-	-	-	Northing / Easting
pH	7.48	7.54	7.51	7.55	7.38	7.27	7.66	7.61	7.67	7.67	7.8	7.61	7.73	7.73	553154 / 3229743
Acidity (to pH 8.3)	2.1	1.4	0.9	0.6	2.9	1.4	2.2	1.9	1.6	0.7	<0.5	4.4	-	-	Road side ditch west of the 4 south coal storage pad
Alkalinity - Total CaCO3	37	42	40	38	42	45	49	46	47	50	54	58	59	58	
Sulphate	220	210	200	180	190	230	230	190	190	170	190	180	190	190	

Parameter	July				August				September				Site Description: GPS (m) Minegrid Northing / Easting
Sample Date	4	11	18	26	3	8	15	22	6^	13^	20^	26	100983.82 / 98152.577
Conductivity (umhos/cm)	498	511	503	514	504	505	506	500	-	-	-	452	UTM ZONE 10
Hardness CaCO3	234	-	-	-	248	-	-	-	-	-	-	-	Northing / Easting
pH	7.63	7.81	7.55	7.68	7.78	7.76	7.79	7.72	-	-	-	7.62	553154 / 3229743
Acidity (to pH 8.3)	2	1.7	1.1	1.5	<0.5	<0.5	1.3	1.7	-	-	-	1.8	Road side ditch west of the 4 south coal storage pad
Alkalinity - Total CaCO3	53	63	63	67	68	65	66	65	-	-	-	50	
Sulphate	180	180	170	170	170	170	180	170	-	-	-	160	

Parameter	October					November				December				Site Description: GPS (m) Minegrid Northing / Easting
Sample Date	4	11	17	24	31	8	14	22	29	6	13	20	28	100983.82 / 98152.577
Conductivity (umhos/cm)	367	376	387	409	440	441	420	251	304	341	382	414	400	UTM ZONE 10
Hardness CaCO3	159	-	-	-	178	-	-	-	-	146	-	-	-	Northing / Easting
pH	7.44	7.42	7.23	7.47	7.63	7.15	7.37	7	6.95	7.23	7.23	7.48	7.43	553154 / 3229743
Acidity (to pH 8.3)	1	1.4	4.2	2.4	2.4	9.6	2.5	3.6	3.2	0.8	0.8	1.5	2	Road side ditch west of the 4 south coal storage pad
Alkalinity - Total CaCO3	43	41	41	40	39	35.9	34.3	32.4	29.3	34.8	31.9	32.5	32.2	
Sulphate	140	140	150	160	170	167	165	88.3	115	128	146	153	151	

Parameter	January						February				March				Site Description: GPS (m) Minegrid Northing / Easting
Sample Date	5	10	10	17	24	31	6	14	21	28	6	13	20	27	100983.82 / 98152.577
Conductivity (umhos/cm)	253	323	321	362	312	293	332	313	334	323	297	301	294	294	UTM ZONE 10
Hardness CaCO3	102	-	-	-	-	-	139	-	-	-	121	-	-	-	Northing / Easting
pH	7.27	7.36	7.39	7.49	7.65	7.42	7.45	7.7	7.58	7.56	7.41	7.23	7.14	7.43	553154 / 3229743
Acidity (to pH 8.3)	2.3	3.6	3.6	0.9	<0.5	1.1	3.6	1.6	2.9	1.3	<0.5	<0.5	1.8	2.1	Road side ditch west of the 4 south coal storage pad
Alkalinity - Total CaCO3	27.2	30.5	31.8	31.4	30.1	28.4	31.2	31.6	31.3	30.8	28.2	31	31.1	30.5	
Sulphate	91.1	122	123	144	118	115	129	121	122	123	113	119	110	108	

Results expressed in milligrams per litre except where noted.
* Indicates replicate sample.

TABLE 25-1
4 SOUTH LOWER METALS ANALYSIS
2011/12
COMPANY IDENTITY - 4S-Lo

Parameter / Sample Date	April 4	May 2	June 6	July 4	August 3	September 6
Total Metals						
Aluminum	0.017	0.073	0.014	0.009	0.008	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0001	<0.0001	0.0002	0.0002	0.0002	-
Barium	0.014	0.014	0.015	0.014	0.015	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	0.05	0.09	0.09	0.11	0.11	-
Cadmium	<0.00001	0.00001	0.00002	0.00004	<0.00001	-
Calcium	83.8	71.3	73.7	67.9	69.4	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	0.0006	<0.0005	<0.0005	0.0007	-
Copper	0.0003	0.0004	0.0004	0.0003	0.0002	-
Iron	0.385	0.641	0.343	0.387	0.701	-
Hardness	-	-	-	210	211	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	-	<0.005	-
Magnesium	11	9.31	9.89	9.9	9.11	-
Manganese	0.187	0.432	0.184	0.339	1.01	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	-	-	-	-	-	-
Potassium	0.66	0.64	0.68	0.6	0.62	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	2.7	2.9	2.7	2.5	2.9	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	7.44	8.07	8.27	9.57	9.4	-
Strontium	0.438	0.377	0.418	0.391	0.356	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	0.006	0.01	0.006	<0.005	0.011	-
Dissolved Metals						
Aluminum	0.011	0.015	0.009	0.009	0.005	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0001	0.0002	0.0002	0.0002	0.0002	-
Barium	0.016	0.015	0.015	0.016	0.018	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	0.07	0.09	0.1	0.12	0.12	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	-
Calcium	88	74.7	72.7	75.8	82.2	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	0.0006	<0.0005	<0.0005	0.0008	-
Copper	0.0006	0.0007	0.0003	0.0004	0.0003	-
Iron	0.306	0.636	0.311	0.375	0.507	-
Hardness	-	-	-	234	248	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	-	<0.005	-
Magnesium	10.9	9.61	9.95	10.9	10.4	-
Manganese	0.189	0.398	0.181	0.365	1.08	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	-	-	-	-	-	-
Potassium	0.68	0.7	0.68	0.73	0.76	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	7.48	8.55	8.38	10.8	10.6	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	0.006	0.011	0.006	0.006	0.011	-

Results expressed in milligrams per litre.

TABLE 25-2
4 SOUTH LOWER METALS ANALYSIS
2011/12
COMPANY IDENTITY - 4S-Lo

Parameter	October		November	December	January	February		March
Sample Date	4	31	**2**	6	6	7	7*	7
Total Metals								
Aluminum	0.023	0.029	-	0.058	0.218	0.202	0.163	0.271
Antimony	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0002	0.0001	-	0.0002	0.0008	0.0006	0.0005	0.0005
Barium	0.001	0.012	-	0.01	0.025	0.014	0.013	0.014
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	0.06	-	0.06	0.68	0.78	0.75	0.78
Cadmium	<0.00001	<0.00001	-	<0.00001	0.00002	0.00003	0.00003	0.00002
Calcium	5.95	58.5	-	47.9	198	264	269	234
Chromium	<0.001	<0.001	-	0.001	0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	0.0006	-	0.001	0.0016	0.0009	0.0007	0.0009
Copper	0.0006	0.0007	-	0.0005	0.0015	0.0018	0.0011	0.0016
Iron	0.025	0.551	-	1.39	0.379	0.556	0.316	0.545
Lead	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	-	<0.005	0.006	0.009	0.008	0.007
Magnesium	0.77	7.76	-	6.49	19.7	32.3	31.6	23.7
Manganese	0.001	0.426	-	0.796	0.148	0.153	0.146	0.112
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	-	0.002	0.005	0.004	0.004	0.003
Potassium	0.08	0.5	-	0.412	3.12	3.97	3.97	3.63
Selenium	<0.0001	<0.0001	-	<0.0001	0.0004	0.0002	0.0003	0.0004
Silicon	1.8	3.3	-	3.2	2.7	3.1	3.1	3.2
Silver	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	0.7	8.2	-	6.25	213	275	270	262
Strontium	0.012	0.278	-	0.215	1.41	1.97	1.93	1.56
Thallium	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	-	<0.005	0.011	0.011	0.005	0.009
Uranium	<0.0001	<0.0001	-	<0.0001	0.0001	0.0002	0.0002	0.0001
Vanadium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	0.01	-	0.009	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Disssolved Metals								
Aluminum	0.025	0.021	-	0.034	0.0114	0.0041	0.003	0.0136
Antimony	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0002	0.0001	-	0.00014	0.00053	0.00022	0.00024	0.0004
Barium	0.012	0.012	-	0.01	0.0265	0.0134	0.0134	0.0127
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.09	0.07	-	0.059	0.759	0.817	0.801	0.706
Cadmium	<0.00001	<0.00001	-	0.000012	0.000019	0.000018	0.000014	<0.000010
Calcium	52	57.5	-	46.8	221	286	282	218
Chromium	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.0007	0.0006	-	0.00099	0.00135	0.00065	0.00058	0.00066
Copper	0.0004	0.0005	-	0.00063	0.00087	0.00073	0.00067	0.00058
Iron	0.494	0.455	-	1.13	<0.0050	0.0056	0.0082	0.0131
Lead	<0.0002	<0.0002	-	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	-	<0.005	0.0068	0.0088	0.0087	0.0062
Magnesium	6.69	7.6	-	6	22.7	31.6	31.4	23.4
Manganese	0.438	0.417	-	0.763	0.159	0.149	0.148	0.106
Mercury	<0.000002	<0.00002	-	<0.00001	<0.000010	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	-	0.0025	0.0044	0.0038	0.0039	0.0024
Potassium	0.5	0.56	-	0.407	3.68	3.91	3.9	3.64
Selenium	<0.0001	<0.0001	-	<0.0001	0.00045	0.00033	0.00027	0.00047
Silicon	3.7	3.7	-	3.62	2.65	3.22	3.11	2.62
Silver	<0.00002	<0.00002	-	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	7.26	8.09	-	5.83	249	269	268	266
Strontium	0.272	0.289	-	0.203	1.52	2.03	2.02	1.5
Thallium	<0.00005	<0.00005	-	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	-	<0.0001	0.00013	0.00015	0.00015	0.00012
Vanadium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.011	0.009	-	0.0118	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 26
4 SOUTH INFLOW / UPPER / UNDERPAD WATER QUALITY
2011/12
COMPANY IDENTITY 4SI / 4S-Up / 4SUPAD

Parameters	4SI			4S-Up			4SUPAD		
Sample Date	04-Oct	31-Oct	06-Dec	04-Oct	31-Oct	06-Dec	04-Oct	31-Oct	06-Dec
Conductivity (us/cm)	505.00	593.00	546.00	348.00	431.00	293.00	356.00	436.00	320.00
Hardness (as CaCO3)	241.00	271.00	251.00	163.00	181.00	122.00	153.00	178.00	132.00
pH-L	7.35	7.59	7.42	7.22	7.57	7.23	7.28	7.53	7.09
Acidity (pH=8.3)	2.50	2.20	0.90	1.90	1.40	1.20	2.20	1.30	1.50
Alkalinity-Total CaCO3	67.00	60.00	50.80	41.00	40.00	33.00	43.00	36.00	33.20
Sulphate	190.00	260.00	227.00	130.00	160.00	107.00	140.00	170.00	120.00

Parameters	4SI			4S-Up			4SUPAD		
Sample Date	5-Jan-12	6-Feb-12	6-Mar-13	5-Jan-12	6-Feb-12	6-Mar-13	5-Jan-12	6-Feb-12	6-Mar-13
Conductivity (us/cm)	342	471	423	205	270	244	235	304	273
Hardness (as CaCO3)	143	213	190	79	111	103	93.5	130	114
pH	7.62	7.67	7.37	7.31	7.55	7.15	7.12	7.45	6.98
Acidity (pH=8.3)	0.5	2	<0.5	0.8	2.4	<0.5	2.2	3.8	0.5
Alkalinity-Total CaCO3	42.1	44.1	42.7	24.7	29.7	26.6	24.4	28.9	26.8
Sulphate	120	177	168	68.3	99.9	89.7	84	117	100

Results expressed as milligram per litre except where noted

TABLE 27-1
4 SOUTH INFLOW / UPPER/ UNDERPAD WATER QUALITY
2011/12
COMPANY IDENTITY 4SI / 4S-Up / 4SUPAD

Paramters	4SI			4S-Up			4SUPAD		
Sample Date	04-Oct	31-Oct	06-Dec	04-Oct	31-Oct	06-Dec	04-Oct	31-Oct	06-Dec
Total Metals									
Aluminum	0.021	0.008	0.039	0.013	0.043	0.028	0.055	0.092	0.085
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Barium	0.018	0.017	0.015	0.011	0.012	0.008	0.011	0.012	0.009
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.12	0.12	0.10	0.09	0.06	0.06	0.08	0.06	0.06
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.0000	<0.00001	0.0000	<0.00001
Calcium	78.90	89.00	81.80	53.30	59.40	39.90	50.00	58.50	43.30
Chromium	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006
Copper	0.0006	0.0005	0.0005	0.0004	0.0004	0.0005	0.0004	0.0005	0.0006
Iron	0.062	0.012	0.022	0.032	0.082	0.068	0.522	0.898	1.120
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	10.80	11.90	11.30	7.19	7.84	5.43	6.75	7.78	5.72
Manganese	0.002	<0.001	0.002	0.016	0.022	0.018	0.169	0.198	0.331
Mercury	<0.000002	<0.00002	<0.000020	<0.000002	<0.00002	<0.000020	<0.000002	<0.00002	<0.000020
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	0.00	<0.001	<0.001	0.00	<0.001	<0.001	0.00
Potassium	0.740	0.810	0.654	0.450	0.470	0.386	0.450	0.500	0.368
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	3.90	3.00	2.70	4.00	3.20	2.90	3.70	3.30	3.10
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	10.60	10.70	8.71	7.75	8.56	6.17	7.29	8.36	6.02
Strontium	0.457	0.507	0.473	0.295	0.286	0.198	0.259	0.279	0.203
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009	0.010	0.009
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals									
Aluminum	0.0050	0.0060	0.0068	0.0070	0.0090	0.0108	0.0390	0.0360	0.0591
Antimony	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	<0.00050
Arsenic	0.00020	0.00020	0.00019	0.00020	0.00010	<0.00010	0.00020	0.00010	0.00013
Barium	0.0170	0.0180	0.0158	0.0100	0.0120	0.0075	0.0110	0.0120	0.0089
Beryllium	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010
Bismuth	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Boron	0.110	0.110	0.076	0.080	0.070	0.056	0.090	0.070	0.056
Cadmium	<0.00001	<0.00001	<0.000010	<0.00001	<0.00001	<0.000010	<0.00001	<0.00001	0.00001
Calcium	73.90	86.30	75.10	49.50	59.00	38.30	50.00	57.90	42.00
Chromium	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Cobalt	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	0.00057
Copper	0.00050	0.00070	0.00092	0.00040	0.00050	0.00114	0.00040	0.00040	0.00044
Iron	0.0280	0.0060	0.0083	0.0120	0.0150	0.0083	0.5310	0.5460	0.9170
Lead	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020
Lithium	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050
Magnesium	10.10	11.40	10.30	6.52	7.96	5.32	6.43	7.85	5.88
Manganese	0.0020	<0.001	0.0018	0.0120	0.0130	0.0096	0.1820	0.2010	0.3420
Mercury	<0.000002	<0.00002	<0.000020	<0.000002	<0.00002	<0.000020	<0.000002	<0.00002	<0.000010
Molybdenum	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Nickel	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Potassium	0.690	0.870	0.666	0.430	0.550	0.349	0.460	0.580	0.391
Selenium	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010
Silicon	3.60	3.30	2.84	3.50	3.50	2.96	3.60	3.60	3.40
Silver	<0.00002	<0.00002	<0.000020	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	10.20	10.20	8.07	7.27	8.77	5.85	7.07	8.58	5.97
Strontium	0.458	0.533	0.476	0.271	0.299	0.178	0.267	0.301	0.192
Thallium	<0.00005	<0.00005	<0.000050	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050
Titanium	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050
Uranium	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010
Vanadium	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050
Zinc	<0.005	<0.005	<0.0050	<0.005	<0.005	<0.0050	0.01	0.01	0.01
Zirconium	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	<0.00050	<0.0005	<0.0005	<0.00050

Results expressed as milligram per litre.

TABLE 27-2
4 SOUTH INFLOW / UPPER/ UNDERPAD WATER QUALITY
2011/12
COMPANY IDENTITY 4SI / 4S-Up / 4SUPAD

Paramters	4SI			4S-Up			4SUPAD		
Sample Date	5-Jan-12	6-Feb-12	6-Mar-13	5-Jan-12	6-Feb-12	6-Mar-13	5-Jan-12	6-Feb-12	6-Mar-13
Total Metals									
Aluminum	0.015	0.010	0.010	0.084	0.035	0.010	0.112	0.077	0.088
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001
Barium	0.009	0.011	0.010	0.005	0.007	0.006	0.007	0.009	0.008
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.08	0.07	0.08	<0.05	0.05	0.06	0.05	<0.05	0.05
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	46.6	69.5	61.8	25.9	36.2	33.4	30.9	42.7	37.2
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	0.001	0.0009
Copper	0.0005	0.0003	0.0004	0.0003	0.0004	<0.0002	0.0005	0.0002	0.0003
Iron	0.012	0.008	0.010	0.043	0.071	0.010	0.896	1.480	1.180
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	6.39	9.53	8.69	3.46	5.05	4.85	3.97	5.79	5.16
Manganese	<0.001	<0.001	0.001	0.007	0.03	0.004	0.29	0.478	0.404
Mercury	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	0.001
Potassium	0.473	0.558	0.523	0.265	0.344	0.309	0.297	0.369	0.336
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	2.6	2.6	2.6	2.5	2.8	2.7	3	3.1	3
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	5.46	6.48	5.94	3.86	5.16	4.65	3.58	5.09	4.33
Strontium	0.264	0.388	0.348	0.120	0.167	0.154	0.128	0.184	0.155
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	0.009	0.008
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals									
Aluminum	0.0097	0.0043	0.0053	0.0246	0.0087	0.0081	0.0951	0.0672	0.0737
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00015	0.00019	0.00017	0.00012	0.00012	<0.00010	0.00014	0.00015	0.00011
Barium	0.0082	0.0119	0.0106	0.0058	0.0069	0.0059	0.0081	0.009	0.0083
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.068	0.095	0.071	0.059	0.063	<0.050	0.058	0.06	<0.050
Cadmium	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	0.000011	<0.000010
Calcium	45.1	68.9	62.6	27.9	37.5	31.7	31.1	42.1	36.8
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00086	0.00102	0.00087
Copper	0.00147	0.00055	0.00097	0.00202	0.00081	0.00043	0.00111	0.00064	0.00041
Iron	<0.0050	<0.0050	<0.0050	0.0102	0.0078	<0.0050	0.843	1.45	1.12
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	5.93	9.9	8.3	3.7	5.32	4.4	4.28	6.01	4.98
Manganese	<0.0010	<0.0010	<0.0010	0.0064	0.0048	0.0022	0.304	0.485	0.393
Mercury	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	0.0012	0.0013
Potassium	0.476	0.577	0.542	0.371	0.413	0.315	0.335	0.397	0.342
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	2.33	2.63	2.5	2.71	2.72	2.58	3.02	2.98	2.92
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	5.13	6.83	5.81	4.35	5.59	4.44	3.9	5.45	4.2
Strontium	0.232	0.408	0.341	0.121	0.175	0.143	0.14	0.192	0.153
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0123	0.012	0.0084
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed as milligram per litre.

TABLE 28

SOUTH PIT CULVERT WATER QUALITY

2011/12 EMS ID- E217014

COMPANY IDENTITY - SPC

Parameter	April				May				June				Site Description	
													GPS (m)	
Sample Date	5	11	18	25	2	9	23	30	6	13	20	27	Minegrid	
Conductivity (umhos/cm)	165	187	132	120	94	73	92	334	168	149	142	119	Northing	Easting
Hardness CaCO3	64.7	-	-	-	41.2	-	-	-	66.1	-	-	-	101316.9	98868.7
pH	7.28	7.34	7.42	7.44	7.16	7	7.29	7.73	7.4	7.62	7.56	7.68	UTM ZONE 10	
Total Suspended Solids	<4	<4	<4	<4	2	<4	5	-	<4	<4	<4	<4	Northing	Easting
Acidity (to pH 8.3)	1.7	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	-	5532321	323105
Alkalinity - Total CaCO3	17	20	16	20	17	15	14	38	22	28	30	43		
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	Input to Long	
Nitrate and Nitrite as N	0.08	0.08	0.09	0.11	0.07	-	-	-	0.07	-	-	-	Lake, Culvert	
Dissolved Phosphate	-	-	<0.005	-	<0.005	-	-	<0.005	<0.005	-	<0.005	-	Downstream of	
Total Phosphate	-	-	-	-	<0.005	-	-	<0.005	-	-	-	-	Settling Pond 1	
Sulphate	55	64	40	33	26	16	23	120	55	41	35	9		

Parameter	July				August					September				Site Description	
														GPS (m)	
Sample Date	4	11	18	26	3	8	15	22	29	6^	13^	20^	28	Minegrid	
Conductivity (umhos/cm)	125	131	112	100	107	114	116	124	128	-	-	-	46	Northing	Easting
Hardness CaCO3	57.4	-	-	-	51.8	-	-	-	57	-	-	-	-	101316.9	98868.7
pH	7.49	7.63	7.69	7.52	7.63	7.64	7.47	7.69	7.88	-	-	-	7.17	UTM ZONE 10	
Total Suspended Solids	<4	2	<4	<4	<4	<4	93	<4	4	-	-	-	<4	Northing	Easting
Acidity (to pH 8.3)	1	0.5	1.4	<0.5	<0.5	<0.5	1	1.5	0.6	-	-	-	<0.5	5532321	323105
Alkalinity - Total CaCO3	33	40	34	32	36	39	37	43	51	-	-	-	13		
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Long	
Nitrate and Nitrite as N	0.13	-	-	-	0.09	-	0.17	0.36	0.21	-	-	-	-	Lake, Culvert	
Dissolved Phosphate	<0.005	-	<0.005	0.005	<0.005	-	0.005	0.006	<0.005	-	-	-	-	Downstream of	
Total Phosphate	-	-	-	-	0.01	-	-	-	-	-	-	-	-	Settling Pond 1	
Sulphate	30	23	22	15	16	16	16	14	16	-	-	-	<0.5		

Parameter	October					November					December				Site Description	
															GPS (m)	
Sample Date	5	11	17	24	31	8	8*	14	22	29	6	13	20	28	Minegrid	
Conductivity (umhos/cm)	52	210	186	302	304	179	178	262	163	325	319	256	244	204	Northing	Easting
Hardness CaCO3	22.3	-	-	-	133	-	-	-	-	-	139	-	-	-	101316.9	98868.7
pH	7.26	7.4	7.24	7.43	7.53	7.36	7.27	7.53	7.15	7.4	7.29	7.46	7.36	7.38	UTM ZONE 10	
Total Suspended Solids	<4	<4	<4	<4	<4	<4	<4	<4	4.5	<4	<4	<4	<4	<4	Northing	Easting
Acidity (to pH 8.3)	<0.5	<0.5	1.2	<0.5	1.9	1.5	1.9	0.7	1.2	<0.5	0.6	<0.5	0.6	<0.5	5532321	323105
Alkalinity - Total CaCO3	14	26	23	33	30	21.6	21.4	31.8	15.8	24.1	25.3	25.6	22.7	22.5		
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Long	
Nitrate and Nitrite as N	<0.02	-	-	-	0.03	-	-	-	-	-	0.028	-	-	-	Lake, Culvert	
Dissolved Phosphate	<0.005	-	<0.005	-	<0.005	-	-	0.0934	-	0.0097	<0.005	-	<0.005	-	Downstream of	
Total Phosphate	0.011	-	-	-	<0.005	-	-	-	-	-	<0.005	-	-	-	Settling Pond 1	
Sulphate	4	69	56	120	120	58	57.8	95.2	49.3	134	122	98	90.1	67.4		

Parameter	January					February				March				Site Description	
														GPS (m)	
Sample Date	5	10	17	24	31	7	14	21	28	7	13	20	27	Minegrid	
Conductivity (umhos/cm)	224	321	277	220	237	241	279	242	175	225	227	273	232	Northing	Easting
Hardness CaCO3	82	-	-	-	-	101	-	-	-	96.5	-	-	-	101316.9	98868.7
pH	7.43	7.51	7.35	7.54	7.53	7.63	7.59	7.64	7.52	7.41	7.56	7.57	7.47	UTM ZONE 10	
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	Northing	Easting
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	<0.5	0.7	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	1.2	1	5532321	323105
Alkalinity - Total CaCO3	22.7	27.9	11.8	22.5	25	24.5	29.1	26.3	21.7	24.5	26	27.6	25.2		
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	Input to Long	
Nitrate and Nitrite as N	<0.020	-	-	-	-	0.032	-	-	-	<0.020	-	-	-	Lake, Culvert	
Dissolved Phosphate	<0.0050	-	<0.0050	-	<0.0050	<0.0050	-	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050	Downstream of	
Total Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	Settling Pond 1	
Sulphate	82	123	96.9	75.4	82.1	90	107	87.9	54.6	80.6	85.7	107	81.5		

Results expressed in milligrams per litre except where noted.

* Field replicate sample.

^ Dry No Sample

TABLE 29-1
SOUTH PIT CULVERT METALS ANALYSIS
2011/12 EMS ID- E217014
COMPANY IDENTITY - SPC

Parameter	April		May		June		July	August		September
Sample Date	5	18	2	23	6	20	4	3	29	6
Total Metals										
Aluminum	0.079	-	0.111	-	0.103	-	0.133	0.079	0.152	-
Antimony	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0003	-	0.0005	-	0.0006	-	0.0008	0.0008	0.001	-
Barium	0.006	-	0.005	-	0.009	-	0.007	0.006	0.007	-
Beryllium	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Boron	<0.05	-	<0.05	-	<0.05	-	<0.05	<0.05	<0.05	-
Cadmium	<0.00001	-	0.00001	-	<0.00001	-	0.00002	<0.00001	0.00002	-
Calcium	20.9	-	13.2	-	21.3	-	17.9	14.2	19.1	-
Chromium	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	<0.0005	<0.0005	-
Copper	0.0005	-	0.001	-	0.0006	-	0.0008	0.0005	0.0009	-
Iron	0.116	-	0.214	-	0.213	-	0.315	0.226	0.324	-
Hardness	-	-	-	-	-	-	56.9	44.7	60	-
Lead	<0.0002	-	<0.0002	-	0.0002	-	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	-	<0.005	-	-	-	-	<0.005	<0.005	-
Magnesium	3.04	-	2.03	-	3.14	-	2.98	2.23	3.06	-
Manganese	0.003	-	0.007	-	0.011	-	0.015	0.007	0.022	-
Mercury	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Nickel	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Phosphorus	-	-	<0.005	-	-	-	-	0.01	-	-
Potassium	0.26	-	0.25	-	0.22	-	0.18	0.13	0.22	-
Selenium	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.0001	<0.0001	-
Silicon	2.3	-	1.8	-	1.8	-	1.7	2.3	3.5	-
Silver	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	<0.00002	<0.00002	-
Sodium	2.51	-	2.39	-	2.96	-	3.13	2.45	3.41	-
Strontium	0.12	-	0.08	-	0.131	-	0.116	0.092	0.116	-
Thallium	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Titanium	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Uranium	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Zinc	<0.005	-	0.007	-	<0.005	-	<0.005	<0.005	<0.005	-
Dissolved Metals										
Aluminum	0.066	-	0.068	-	0.071	-	0.062	0.069	0.045	-
Antimony	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	<0.0005	**<0.0005**	-
Arsenic	0.0003	-	0.0005	-	0.0005	-	0.0007	0.0008	0.0008	-
Barium	0.006	-	0.004	-	0.009	-	0.007	0.007	0.006	-
Beryllium	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.0001	<0.0001	-
Boron	<0.05	-	<0.05	-	<0.05	-	<0.05	<0.05	<0.05	-
Cadmium	0.00001	-	<0.00001	-	<0.00001	-	0.00001	0.00002	0.00004	-
Calcium	22.3	-	12.3	-	23	-	17.9	16.3	18	-
Chromium	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	<0.0005	<0.0005	-
Copper	0.0013	-	0.0008	-	0.0007	-	0.0009	0.0021	0.0008	-
Iron	0.096	-	0.133	-	0.131	-	0.15	0.178	0.073	-
Hardness	-	-	-	-	-	-	57.4	51.8	57	-
Lead	<0.0002	-	<0.0002	-	<0.0002	-	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	-	<0.005	-	-	-	-	<0.005	<0.005	-
Magnesium	3.09	-	1.98	-	3.61	-	3.08	2.71	2.88	-
Manganese	0.003	-	0.002	-	0.002	-	0.003	0.003	0.004	-
Mercury	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Nickel	<0.001	-	<0.001	-	<0.001	-	<0.001	<0.001	<0.001	-
Phosphorus	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Potassium	0.3	-	0.23	-	0.27	-	0.2	0.19	0.26	-
Selenium	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.0001	<0.0001	-
Silver	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	<0.00002	<0.00002	-
Sodium	2.56	-	2.34	-	3.45	-	3.25	2.93	3.26	-
Thallium	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Titanium	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Uranium	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Zinc	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-
Zirconium	-	-	-	-	-	-	-	-	-	-

Results expressed in milligrams per litre.

TABLE 29-2
SOUTH PIT CULVERT METALS ANALYSIS
2011/12 EMS ID- E217014
COMPANY IDENTITY - SPC

Parameter	October		November	December	January	February		March
Sample Date	5	31	**2**	6	6	7	7*	7
Total Metals								
Aluminum	0.023	0.041	-	0.055	0.218	0.202	0.163	0.271
Antimony	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0002	0.0004	-	0.0003	0.0008	0.0006	0.0005	0.0005
Barium	0.001	0.014	-	0.01	0.025	0.014	0.013	0.014
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	-	<0.05	0.68	0.78	0.75	0.78
Cadmium	<0.00001	<0.00001	-	<0.00001	0.00002	0.00003	0.00003	0.00002
Calcium	5.95	43	-	45.1	198	264	269	234
Chromium	<0.001	<0.001	-	0.001	0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	-	<0.0005	0.0016	0.0009	0.0007	0.0009
Copper	0.0006	0.0004	-	0.0005	0.0015	0.0018	0.0011	0.0016
Iron	0.025	0.075	-	0.095	0.379	0.556	0.316	0.545
Lead	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	-	<0.005	0.006	0.009	0.008	0.007
Magnesium	0.77	6.14	-	6.44	19.7	32.3	31.6	23.7
Manganese	0.001	0.003	-	0.004	0.148	0.153	0.146	0.112
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	-	0.002	0.005	0.004	0.004	0.003
Potassium	0.08	0.39	-	0.431	3.12	3.97	3.97	3.63
Selenium	<0.0001	<0.0001	-	<0.0001	0.0004	0.0002	0.0003	0.0004
Silicon	1.8	3.3	-	3.1	2.7	3.1	3.1	3.2
Silver	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	0.7	5.72	-	4.42	213	275	270	262
Strontium	0.012	0.235	-	0.268	1.41	1.97	1.93	1.56
Thallium	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	-	<0.005	0.011	0.011	0.005	0.009
Uranium	<0.0001	<0.0001	-	<0.0001	0.0001	0.0002	0.0002	0.0001
Vanadium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Disssolved Metals								
Aluminum	0.128	0.034	-	0.0412	0.0114	0.0041	0.003	0.0136
Antimony	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0005	0.0003	-	0.00023	0.00053	0.00022	0.00024	0.0004
Barium	0.005	0.015	-	0.0099	0.0265	0.0134	0.0134	0.0127
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	<0.05	0.05	-	<0.050	0.759	0.817	0.801	0.706
Cadmium	0.00001	<0.00001	-	<0.00001	0.000019	0.000018	0.000014	<0.000010
Calcium	6.68	42.9	-	44.3	221	286	282	218
Chromium	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	-	<0.0005	0.00135	0.00065	0.00058	0.00066
Copper	0.0009	0.0005	-	0.00081	0.00087	0.00073	0.00067	0.00058
Iron	0.199	0.051	-	0.0641	<0.0050	0.0056	0.0082	0.0131
Lead	<0.0002	<0.0002	-	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	-	<0.005	0.0068	0.0088	0.0087	0.0062
Magnesium	1.27	6.09	-	6.15	22.7	31.6	31.4	23.4
Manganese	0.004	0.002	-	0.0041	0.159	0.149	0.148	0.106
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	-	<0.001	0.0044	0.0038	0.0039	0.0024
Potassium	0.17	0.42	-	0.417	3.68	3.91	3.9	3.64
Selenium	<0.0001	<0.0001	-	<0.0001	0.00045	0.00033	0.00027	0.00047
Silicon	3.3	3.6	-	3.29	2.65	3.22	3.11	2.62
Silver	<0.00002	<0.00002	-	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	1.85	5.73	-	4.31	249	269	268	266
Strontium	0.041	0.253	-	0.25	1.52	2.03	2.02	1.5
Thallium	<0.00005	<0.00005	-	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	-	<0.0001	0.00013	0.00015	0.00015	0.00012
Vanadium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 30
SEEP INTO LONG LAKE AND LONG LAKE MIDDLE SEEP WATER QUALITY
2011/12
COMPANY IDENTITY - LLS AND LLSM

Stations	LLS (Long Lake Seep)								
Parameter / Sample Date	April	May	June	July	August	August	October	November	December
	4	3	6	4	3	29	1	2	30
Conductivity(umhos/cm)	1260	1200	1150	1200	1190	1210	1200	1310	1360
Hardness (as CaCO3)	449	432	421	466	498	443	417	431	547
pH	7.99	7.80	8.03	7.70	7.82	7.90	8.02	7.95	7.65
Acidity (to PH 8.3)	11.9	08.2	4.5	8.30	2.70	12.50	1.20	11.70	7.90
Alkalinity-Total (as CaCO3)	190	190	190	210	210	210	220	220	196
Sulphate	470	420	380	440	450	400	410	510	582

Stations	LLSM (Long Lake Middle Seep)		
Parameter / Sample Date	January	February	March
	6	7	6
Conductivity(umhos/cm)	1120	1270	1190
Hardness (as CaCO3)	415	508	438
pH	7.87	7.97	8.04
Acidity (to PH 8.3)	3.7	7.3	<0.5
Alkalinity-Total (as CaCO3)	157	191	181
Sulphate	429	562	439

Results expressed in milligrams per litre except where noted.

TABLE 31-1
SEEP INTO LONG LAKE METALS ANALYSIS
2011/12
COMPANY IDENTITY - LLS

LLSM (Long Lake Middle Seep)									
Parameter / **Sample Date**	**April** 4	**May** 3	**June** 6	**July** 4	**August** 3	**August** 29	**October** 1	**November** 2	**December** 30
Total Metals									
Aluminum	0.005	0.004	0.022	0.004	<0.003	0.008	0.017	0.016	0.035
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0004	0.0007	0.0028	0.0011	0.0021	0.0036	0.0028	0.0034	0.002
Barium	0.019	0.019	0.019	0.019	0.021	0.019	0.022	0.022	0.022
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.51	0.5	0.49	0.5	0.54	0.5	0.56	0.54	0.58
Cadmium	0.00001	0.00004	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	0.00001
Calcium	157	153	147	143	153	143	148	150	192
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	0.0005	0.0007	0.0005	0.0007	0.0007	0.0008	0.0009	0.0009
Copper	<0.0002	0.0002	0.0005	<0.0002	<0.0002	<0.0002	0.0004	0.0004	0.001
Iron	0.187	0.322	2.27	0.636	0.984	1.78	1.03	1.29	0.718
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.02	0.019	-	-	0.02	0.017	0.02	0.02	0.022
Magnesium	13.7	12	13	12.4	12.2	10.6	11.8	14	16.6
Manganese	0.116	0.168	0.228	0.242	0.34	0.328	0.35	0.377	0.313
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.004
Potassium	2.09	1.86	1.93	1.95	1.96	1.75	2.04	2.48	2.29
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	2.2	2.4	2.5	2.3	2.5	2.3	2.5	2.5	3
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	94.5	85.5	80.2	87.7	90.2	80.4	90.2	93.7	97.8
Strontium	1.62	1.44	1.4	1.39	1.42	1.32	1.57	1.71	1.85
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Metals									
Aluminum	0.003	0.004	0.015	0.037	0.009	<0.003	0.006	0.011	0.0198
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0003	0.0005	0.0007	0.001	0.0018	0.0023	0.0027	0.0035	0.00226
Barium	0.019	0.02	0.018	0.022	0.024	0.021	0.021	0.022	0.0215
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Boron	0.51	0.52	0.45	0.53	0.59	0.6	0.56	0.6	0.559
Cadmium	0.00001	<0.00001	<0.00001	0.00001	0.00003	<0.00001	0.00003	<0.00001	0.00004
Calcium	179	169	158	163	176	156	170	173	185
Chromium	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	0.0006	<0.0005	0.0006	0.0009	0.0008	0.0008	0.0009	0.00097
Copper	0.0005	0.0003	0.0004	0.0068	0.0006	0.0004	0.0013	0.0003	0.00223
Iron	0.018	0.023	0.249	0.539	0.843	0.968	1.01	1.29	0.569
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.019	0.018	-	-	0.021	0.021	0.018	0.02	0.02
Magnesium	13.4	13	13.5	14.7	14.2	12.9	13.1	15.2	15.7
Manganese	0.111	0.171	0.187	0.269	0.377	0.37	0.353	0.402	0.322
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.004	0.002	0.002	0.001	0.002	0.001	0.001	0.002	0.003
Potassium	1.99	2.11	2.03	2.43	2.43	2.15	2.31	2.63	2.32
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.000045
Sodium	93.4	95.7	82.4	108	103	99.1	98.4	101	93.9
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	0.642	<0.005	<0.005	-	-	-

Results expressed in milligrams per litre.

TABLE 31-2
SEEP INTO LONG LAKE METALS ANALYSIS
2011/12
COMPANY IDENTITY - LLS

	LLSM (Long Lake Middle Seep)			LLS (Long Lake Seep)		
Parameter / **Sample Date**	**January 6**	**February 7**	**March 6**	**January 6**	**February 7**	**March 6**
Total Metals						
Aluminum	0.118	0.019	0.072	0.093	0.017	0.041
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0014	0.0017	0.0017	0.0015	0.0026	0.0052
Barium	0.018	0.018	0.019	0.017	0.018	0.019
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.41	0.54	0.57	0.39	0.56	0.57
Cadmium	0.00002	0.00001	<0.00001	0.00002	<0.00001	<0.00001
Calcium	144	178	153	127	185	167
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	0.0014	0.0009	0.0015	0.0013	0.0008	0.0012
Copper	0.0012	0.0003	0.0007	0.0016	0.0003	0.0005
Iron	0.815	0.593	0.651	0.632	0.712	1.22
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.017	0.019	0.021	0.016	0.019	0.022
Magnesium	13.5	15.4	13.7	12.8	15.5	14.8
Manganese	0.224	0.211	0.189	0.218	0.261	0.311
Mercury	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.004	0.003	0.004	0.004	0.003	0.003
Potassium	1.99	2.15	1.95	1.87	2.17	2.11
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	2.6	2.6	2.4	2.2	2.7	2.6
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	70.5	87.9	80.7	68	91.5	91.4
Strontium	1.21	1.61	1.41	1.18	1.64	1.54
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Metals						
Aluminum	0.0172	0.008	0.0132	0.0139	0.0067	0.0059
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.00108	0.00126	0.00144	0.00138	0.00205	0.00356
Barium	0.0193	0.0191	0.0191	0.0186	0.0198	0.0184
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	-	-	-
Boron	0.432	0.579	0.474	0.436	0.579	0.533
Cadmium	0.000033	0.000014	0.000011	0.000027	<0.000010	0.000016
Calcium	99.5	179	164	120	195	180
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00153	0.00093	0.00124	0.00159	0.00089	0.00123
Copper	0.00425	0.00052	0.00094	0.00217	0.0004	0.00075
Iron	0.271	0.308	0.356	0.316	0.4	0.63
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	0.0182	0.0195	0.0183	0.0184	0.0202	0.0196
Magnesium	13.8	15.6	13.9	14.5	16.1	15
Manganese	0.224	0.214	0.183	0.255	0.274	0.308
Mercury	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.004	0.0029	0.0037	0.0042	0.003	0.003
Potassium	2.4	2.2	2.02	2.17	2.32	2.19
Selenium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	1.83	2.81	2.76	-	-	-
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	73.2	90.9	80	77.4	95.7	93
Strontium	1.31	1.69	1.43	-	-	-
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Results expressed in milligrams per litre.

TABLE 32
LONG LAKE OUTLET WATER QUALITY
2011/12 EMS ID-E19412
COMPANY IDENTITY - LLO

Parameter	April				May				June				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	5	11	18	25	2	9	13	23	6	13	20	27	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	156	196	207	205	176	182	172	159	120	131	156	155	-	-	Minegrid	
Hardness CaCO3	53.1	-	-	-	63.5	-	-	-	40.2	-	-	-	-	-	Northing	Easting
pH	7.27	7.46	7.49	7.49	7.31	7.23	7.46	7.54	7.49	7.41	7.4	7.43	-	≥ (6.5)[2] or (6.9)[3]	101489	99155.8
Total Suspended Solids	<4	<4	<4	<4	<1	<4	<4	<5	<4	<4	<4	<4	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	1.5	0.9	0.9	<0.5	<0.5	-	<0.5	1.7	<0.5	<0.5	<0.5	-	-	-	Northing	Easting
Alkalinity - Total CaCO3	24	33	31	28	29	<0.5	26	23	22	25	29	27	-	-	5532654	323139
Ammonia Nitrogen	0.019	-	-	-	0.025	29	-	-	0.027	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	0.03	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-		
Sulphate	47	59	71	63	55	54	53	45	28	39	40	46	100^	N/A		

Parameter	July				August					September				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	4	11	18	26	3	8	15	22	29	7	14	20	26	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	173	178	189	192	202	211	230	229	228	257	266	277	277	-	-	Minegrid	
Hardness CaCO3	65.1	-	-	-	74.2	-	-	-	84	-	-	-	-	-	-	Northing	Easting
pH	7.47	7.6	7.39	7.53	7.53	7.61	7.63	7.64	7.64	7.69	7.84	7.74	7.67	-	≥ (6.5)[2] or (6.9)[3]	101489	99155.8
Total Suspended Solids	<4	2	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	1.2	<0.5	1.5	<0.5	<0.5	<0.5	<0.5	1.3	0.9	<0.5	<0.5	1.9	<0.5	-	-	Northing	Easting
Alkalinity - Total CaCO3	29	27	32	33	33	35	36	37	40	40	42	40	42	-	-	5532654	323139
Ammonia Nitrogen	0.038	-	-	-	0.043	-	-	-	0.023	-	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	-	-		
N-TKN	0.22	-	-	-	0.3	-	-	-	0.19	-	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-	-		
Sulphate	49	52	55	54	58	60	64	70	70	72	80	89	85	100^	N/A		

Parameter	October				November					December				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	5	11	17	24	1	8	14	22	29	6	13	20	28	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	224	167	161	164	178	184	169	164	70.2	93.5	113	118	135	-	-	Minegrid	
Hardness CaCO3	77.4	-	-	-	63.5	-	-	-	-	34.5	-	-	-	-	-	Northing	Easting
pH	7.61	7.55	7.37	7.31	7.45	7.55	7.61	7.37	7.04	7.1	7.35	7.3	7.42	-	≥ (6.5)[2] or (6.9)[3]	101489	99155.8
Total Suspended Solids	<4	<4	<4	<4	<4	<4	<4	4.2	10.3	<4	<4	<4	<4	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	0.5	1.3	0.9	2.3	2.5	<0.5	1.1	0.7	<0.5	<0.5	0.9	<0.5	0.5	-	Northing	Easting
Alkalinity - Total CaCO3	36	30	30	33	28	32.2	27.1	23.8	10	15.8	17	16.2	21.6	-	-	5532654	323139
Ammonia Nitrogen	0.069	-	-	-	0.018	-	-	-	-	0.036	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	-	<0.020	-	-	-	-	-		
N-TKN	0.19	-	-	-	0.31	-	-	-	-	0.267	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	-		
Sulphate	67	47	41	44	52	51.2	47.5	46.7	19.5	26	28.2	31.1	38.7	100^	N/A		

Parameter	January					February				March				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Descripiton	
Sample Date	5	10	17	24	31	7	14	21	28	3	13	20	27	Max mg/L	30-Day Mean[1] mg/L	GPS (m)	
Conductivity (umhos/cm)	83.8	64.9	93.5	172	83.6	107	82.2	120	139	121	138	138	228	-	-	Minegrid	
Hardness CaCO3	31.1	-	-	-	-	36.4	-	-	-	43.5	-	-	-	-	-	Northing	Easting
pH	7.11	7.21	7.24	7.57	7.3	7.48	7.4	7.52	7.55	7.27	7.47	7.42	7.59	-	≥ (6.5)[2] or (6.9)[3]	101489	99155.8
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	5	<4.0	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	1.4	<0.5	0.6	<0.5	1.1	1	1.4	1.1	<0.5	<0.5	<0.5	1.1	1	0.5	-	Northing	Easting
Alkalinity - Total CaCO3	12.9	11	14.4	24.4	14	16.4	14.9	17.3	23.1	17.5	22.2	22.7	31.2	-	-	5532654	323139
Ammonia Nitrogen	0.0079	-	-	-	-	0.01	-	-	-	0.033	-	-	-	-	-	Long Lake Outflow - Tributary to Middle Quinsam Lake	
Nitrate - Nitrite as N	<0.020	-	-	-	-	0.024	-	-	-	0.023	-	-	-	-	-		
N-TKN	0.117	-	-	-	-	0.154	-	-	-	0.126	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-		
Total Phosphorus	<0.0050	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	23	14.8	27.6	49.3	20.3	29.5	23	32.5	37.4	30.4	38.3	35.3	71.2	100^	N/A		

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 33-1
LONG LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E219412
COMPANY IDENTITY - LLO

Parameter	April	May	June	July	August		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	2	6	4	3	29	6	**Max**	**30-Day Mean[1]**
Total Metals									
Aluminum	0.035	0.03	0.031	0.017	0.013	0.02	-	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	0.0002	0.0002	0.0004	0.0004	0.0006	0.0006	-	**0.005***	-
Barium	0.004	0.005	0.004	0.006	0.006	0.007	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	<0.05	0.06	<0.05	0.05	0.06	0.07	-	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	[2]	-
Calcium	18	21.5	13.1	20.3	21.8	29.2	-	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	0.05	-
Copper	0.0003	0.0004	0.0023	0.0004	0.0007	0.0004	-	-	**≤0.002**
Hardness CaCO3	53.1	63.5	40.2	61.5	65.7	87	-	-	**-**
Iron	0.061	0.064	0.081	0.077	0.061	0.063	-	-	**≤ 0.3**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	**0.005**	**≤ 0.003**
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-
Magnesium	2.02	2.4	1.83	2.65	2.75	3.33	-	-	-
Manganese	0.017	0.019	0.015	0.015	0.01	0.022	-	0.05	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	**-**	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	0.025	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Potassium	0.25	0.29	0.18	0.25	0.32	0.38	-	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Silicon	2.8	2.8	2.4	2.4	2.4	2.8	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	0.0001	-
Sodium	7.45	9.17	4.31	7.53	9.01	11.4	-	-	-
Strontium	0.131	0.165	0.09	0.153	0.171	0.212	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	0.03	-
Dissolved Metals									
Aluminum	0.028	0.02	0.02	0.01	0.011	0.007	-	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	0.0002	0.0003	0.0004	0.0005	0.0006	0.0006	-	-	-
Barium	0.004	0.004	0.004	0.006	0.007	0.007	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Boron	<0.05	0.06	<0.05	0.05	0.07	0.08	-	-	-
Cadmium	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	-	-
Calcium	17.5	21.1	14.4	21.4	24.6	28	-	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-	-
Copper	0.0007	0.0007	0.0005	0.0005	0.0007	0.0005	-	-	-
Iron	0.034	0.044	0.056	0.045	0.041	0.031	-	-	-
Hardness	-	-	-	65.1	74.2	84	-	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-	-
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-
Magnesium	1.99	2.34	1.89	2.83	3.12	3.34	-	-	-
Manganese	0.017	0.015	0.011	0.009	0.004	0.007	-	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Potassium	0.26	0.31	0.19	0.3	0.38	0.4	-	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-	-
Sodium	7.3	8.96	4.34	8.71	10.1	11.8	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate samples.

TABLE 33-2
LONG LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E219412
COMPANY IDENTITY - LLO

Parameter	October	November	December	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	1	6	**Max**	**30-Day Mean[1]**
Total Metals					
Aluminum	0.025	0.028	0.065	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0006	0.0006	0.0004	0.005*	-
Barium	0.007	0.006	0.004	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	0.07	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	26	21	11.2	-	-
Chromium	<0.001	<0.001	0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	0.05	-
Copper	0.0007	0.0009	0.0007	-	**≤0.002**
Iron	0.088	0.096	0.153	-	**≤ 0.3**
Hardness	-	-	-	-	-
Lead	<0.0002	<0.0002	<0.0002	**0.005**	**≤ 0.003**
Lithium	<0.005	<0.005	<0.005	-	-
Magnesium	3.01	2.68	1.57	-	-
Manganese	0.014	0.02	0.014	**0.05**	-
Mercury	<0.00002	<0.00002	<0.00002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	0.001	**0.025**	-
Potassium	0.35	0.37	0.206	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.7	3	3.1	-	-
Silver	<0.00002	<0.00002	<0.00002	0.0001	-
Sodium	10.5	7.99	3.67	-	-
Strontium	0.213	0.145	0.067	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	0.03	-
Zirconium	<0.0005	<0.0005	<0.0005	-	-
Dissolved Metals					
Aluminum	0.011	0.019	0.043	0.1	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0005	0.0006	0.00035	-	-
Barium	0.006	0.006	0.0036	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	0.07	0.06	<0.05	-	-
Cadmium	0.00001	<0.00001	<0.00001	-	-
Calcium	27.1	20.9	11.3	-	-
Chromium	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0007	0.0008	0.0008	-	-
Iron	0.039	0.063	0.0836	-	-
Lead	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	<0.005	-	-
Magnesium	3.19	2.7	1.63	-	-
Manganese	0.007	0.018	0.0136	-	-
Mercury	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	-	-
Potassium	0.37	0.44	0.238	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.9	3.2	3.3	-	-
Silver	<0.00002	<0.00002	<0.00002	-	-
Sodium	11.2	8.19	3.63	-	-
Strontium	0.193	0.151	0.0701	-	-
Thallium	<0.00005	<0.00005	<0.000050	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	-	-
Zirconium	<0.0005	<0.0005	<0.0005	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2] Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate samples.

TABLE 33-3
LONG LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E219412
COMPANY IDENTITY - LLO

Parameter	January	February	March	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	7	6	**Max**	**30-Day Mean[1]**
Total Metals					
Aluminum	0.095	0.125	0.055	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0003	0.0004	0.0004	**0.005***	-
Barium	0.003	0.004	0.004	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	9.89	11.7	14.2	-	-
Chromium	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	0.05	-
Copper	0.0007	0.0012	0.0009	-	**≤0.002**
Iron	0.135	0.162	0.118	-	**≤0.3**
Lead	<0.0002	0.0004	<0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	-	-
Magnesium	1.54	1.77	1.96	-	-
Manganese	0.008	0.014	0.016	0.05	-
Mercury	<0.000010	<0.000010	<0.000002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	0.025	-
Potassium	0.229	0.178	0.2	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.7	2.8	2.9	-	-
Silver	<0.00002	<0.00002	<0.00002	0.0001	-
Sodium	2.12	4.07	4.47	-	-
Strontium	0.053	0.08	0.096	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	0.007	<0.005	**0.03**	-
Zirconium	<0.0005	<0.0005	<0.0005	-	-
Dissolved Metals					
Aluminum	0.0568	0.034	0.0304	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00025	0.00028	0.00035	-	-
Barium	0.0035	0.0035	0.0036	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	-	-
Calcium	10.5	12.7	14	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00219	0.00128	0.00109	-	-
Iron	0.0704	0.0752	0.0568	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	1.62	1.78	1.85	-	-
Manganese	0.0064	0.0129	0.0109	-	-
Mercury	<0.000010	<0.000010	<0.000002	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Potassium	0.204	0.235	0.253	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.77	3.03	2.84	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	2.19	4.12	4.28	-	-
Strontium	0.0537	0.0841	0.0907	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-

[1] 30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

^Cr (VI) ^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

Results expressed in milligrams per litre

[2] Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate samples.

TABLE 34
NO NAME LAKE OUTLET WATER QUALITY
2011/12 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	April				May					June					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	4	11	18	25	3	9	9*	13	23	6	6*	13	20	27	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	27	37	58	54	50	51	53	48	46	41	42	42	46	41	-	-	Minegrid	
Hardness $CaCO_3$	9.9	-	-	-	22.2	-	-	-	-	16.1	28.8	-	-	-	-	-	Northing	Easting
pH	6.89	7.05	7.07	7.16	7.14	6.95	6.96	7.24	7.1	7.31	7.09	7.34	7.32	7.22	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4	<4	<4	<4	<1	<4	<4	<4	<1	<4	<4	<4	<4	<4	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	1.3	2	1	<0.5	-	0.7	1.3	0.7	<0.5	<0.5	<0.5	<0.5	0.6	-	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	8.8	11	11	11	-	13	11	12	12	15	12	16	14	14	-	-	5531308	321786
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No Name Lake Background Water Quality	
Nitrate/ Nitrite as N(mg/L)	<0.02	-	-	-	-	-	-	-	-	<0.02	<0.02	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	0.006	-	-	-	-	-	-	-	-	<0.005	0.008	-	-	-	-	-		
Sulphate	1.9	6.1	13	10	11	9.2	9.1	8.1	7	5.1	5.2	8.2	5.9	5	100^	N/A		

Parameter	July				August					September					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	4	11	18	25	3	8	15	22	30	7	14	20	26	26*	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	41	43	45	42	45	45	45	46	45	47	50	50	51	50	-	-	Minegrid	
Hardness $CaCO_3$	18.3	-	-	-	19.7	-	-	-	<50	-	-	-	-	-	-	-	Northing	Easting
pH	7.23	7.32	7.31	7.34	7.28	7.54	7.3	7.37	7.33	7.5	7.6	7.41	7.26	7.37	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4	<1	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	0.7	<0.5	1.3	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	13	14	15	15	18	17	15	16	17	16	17	16	14	16	-	-	5531308	321786
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No Name Lake Background Water Quality	
Nitrate/ Nitrite as N(mg/L)	<0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-	-	-	-		
Dissolved Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	-	-	-	-		
Sulphate	4.7	4.3	3.7	4.1	4.2	4.5	3.6	4.3	4.1	5	4.5	5.7	5.6	7.9	100^	N/A		

Parameter	October					November				December					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	11	17	24	31	8	14	22	29	6	13	13*	20	28	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	52	50	53	50	55	64.7	61.5	53.6	23.2	24.1	28.4	25.6	28.6	27.3	-	-	Minegrid	
Hardness $CaCO_3$	21.4	-	-	-	23	-	-	-	-	10	-	-	-	-	-	-	Northing	Easting
pH	7.25	7.3	7.22	7.14	7.22	7.07	7.24	7.07	6.84	6.92	7.24	7.12	7.21	7.19	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	0.6	1	0.6	0.6	2.2	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	15	15	15	14	15	14.5	13.6	13.2	7.29	8.61	10.1	9.67	10.3	10.7	-	-	5531308	321786
Ammonia Nitrogen		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No Name Lake Background Water Quality	
Nitrate/ Nitrite as N(mg/L)	<0.02	-	-	-	<0.02	-	-	-	-	<0.02	-	-	-	-	-	-		
Dissolved Phosphorus		-	-	-	<0.005	-	-	-	-		-	-	-	-	-	-		
Total Phosphorus		-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	-	-		
Sulphate	7.2	6.1	6.8	6.1	9	11.2	13.2	10.2	5.01	1.19	<0.50	<0.50	1.44	1.24	100^	N/A		

Parameter	January					February					March				Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Sample Date	3	10	17	24	31	8	14	14*	21	28	6	13	20	27	Max	30-Day Mean[1]	GPS (m)	
Conductivity (umhos/cm)	24.2	19.8	23.3	-	26	23.6	22	21.7	22.9	27.2	27.6	-	28.2	49.7	-	-	Minegrid	
Hardness $CaCO_3$	10.2	-	-	-	-	8.59	-	-	-	-	10.3	-	-	-	-	-	Northing	Easting
pH	7.06	6.95	7.17	-	7.15	7.38	7.14	7.18	7.18	7.17	7.2	-	7.1	7.11	N/A	≥ (6.5)[2] or (6.9)[3]	101767	97267.6
Total Suspended Solids	<4.0	<4.0	<4.0	-	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	-	<4.0	<4.0	25	≤ 5	UTM ZONE 10	
Acidity (to pH 8.3)	<0.5	0.9	<0.5	-	0.7	<0.5	1.4	1.3	0.6	<0.5	<0.5	-	1	<0.5	-	-	Northing	Easting
Alkalinity - Total $CaCO_3$	9.5	7.47	9.01	-	9.37	10.9	8.32	8.91	8.3	9.99	8.31	-	10.4	12.4	-	-	5531308	321786
Ammonia Nitrogen	0.0095	-	-	-	-	0.025	-	-	-	-	0.014	-	-	-	-	-	No Name Lake Background Water Quality	
Nitrate/ Nitrite as N(mg/L)	<0.020	-	-	-	-	0.029	-	-	-	-	0.025	-	-	-	-	-		
Kjeldahl Nitrogen	0.167	-	-	-	-	0.117	-	-	-	-	0.116	-	-	-				
Dissolved Phosphorus	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	<0.0050	-	-	-	-	<0.0050	-	-	-	-	<0.0050	-	-	-	-	-		
Sulphate	0.53	<0.50	<0.50	-	<0.50	<0.50	0.96	1.01	1.95	2.37	1.85	-	0.89	9.84	100^	N/A		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
[2] 30-day 90th percentile
[3]Running 30-day median
^The sulphate limit is a guideline rather than a site-specific objective

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 35-1
NO NAME LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	April	May	June		Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	4	3	6	6*	Max	30-Day Mean[1]
Total Metals						
Aluminum	0.066	0.038	0.031	0.047	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0002	0.0002	0.0004	0.0003	**0.005***	**N/A**
Barium	0.001	0.002	0.001	0.002	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001		-
Bismuth	<0.001	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	0.00001	<0.00001	0.00001	[2]	-
Calcium	2.95	6.78	4.85	9.83	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	0.05	-
Copper	0.0005	0.0007	0.0006	0.0007	**-**	**≤0.002**
Hardness CaCO3	9.9	22.2	16.1	28.8	**-**	**-**
Iron	0.085	0.063	0.077	0.143	**-**	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	<0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	-	-	-	-
Magnesium	0.62	1.29	0.96	1.02	-	-
Manganese	0.009	0.013	0.005	0.007	**0.05**	**N/A**
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	**≤0.0001**	**N/A**
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	**0.025**	**N/A**
Phosphorus	0.006	-	<0.005	0.008	-	-
Potassium	0.07	0.11	0.08	0.1	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.6	2.9	2.7	2.8	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	**0.0001**	**N/A**
Sodium	0.76	1.44	1.11	1.32	-	-
Strontium	0.01	0.033	0.019	0.022	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	**0.03**	**N/A**
Dissolved Metals						
Aluminum	0.034	0.029	0.032	0.03	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0002	0.0002	0.0003	0.0003	-	-
Barium	0.001	0.002	0.001	0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	-	-
Calcium	3.02	6.33	5	5.12	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.001	0.0015	0.0009	0.0009	-	-
Iron	0.032	0.063	0.061	0.057	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	-	-	-	-
Magnesium	0.63	1.19	1.01	1.06	-	-
Manganese	0.005	0.011	0.005	0.005	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	-	-
Phosphorus	<0.005	-	-	-	-	
Potassium	0.1	0.13	0.15	0.16	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	0.8	1.34	1.19	1.25	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate sample.

TABLE 35-2
NO NAME LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	July	August		September	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	4	3	30	6	**Max**	**30-Day Mean[1]**
Total Metals						
Aluminum	0.028	0.018	0.027	-	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	0.0004	0.0004	0.0004	-	**0.005***	**-**
Barium	0.001	0.001	0.002	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-	-
Bismuth	<0.001	<0.001	<0.001	-	-	-
Boron	<0.05	<0.05	<0.05	-	-	-
Cadmium	<0.00001	<0.00001	0.00003	-	[2]	-
Calcium	4.99	4.87	5.82	-	-	-
Chromium	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	0.05	**-**
Copper	0.0005	0.0007	0.0017	-	**-**	**≤0.002**
Iron	0.074	0.057	0.08	-	**-**	**≤ 0.3**
Hardness CaCO3	17.6	16.4	<50	-	**-**	**-**
Lead	<0.0002	<0.0002	0.0002	-	**0.005**	**<0.003**
Lithium	-	<0.005	<0.005	-	**-**	**-**
Magnesium	1.24	1.03	1.18	-	-	**-**
Manganese	0.005	0.004	0.008	-	**0.05**	-
Mercury	<0.00002	<0.00002	<0.00002	-	**≤0.0001**	**-**
Molybdenum	<0.001	<0.001	<0.001	-	**-**	**-**
Nickel	<0.001	<0.001	<0.001	-	**0.025**	**-**
Phosphorus	<0.005	<0.005	<0.005	-	-	-
Potassium	0.14	0.1	0.25	-	**-**	**-**
Selenium	<0.0001	<0.0001	<0.0001	-	-	-
Silicon	2.5	2.1	2.3	-	**-**	**-**
Silver	<0.00002	<0.00002	<0.00002	-	**0.0001**	**-**
Sodium	2.77	1.22	1.84	-	**-**	**-**
Strontium	0.021	0.022	0.023	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	<0.005	<0.005	-	-	-
Titanium	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	-	**-**	**-**
Zinc	<0.005	<0.005	0.007	-	**0.03**	-
Dissolved Metals						
Aluminum	0.021	0.024	0.018	-	**0.1**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	-	-	-
Arsenic	0.0004	0.0004	0.0005	-	-	-
Barium	0.002	0.002	0.002	-	-	-
Beryllium	<0.0001	<0.0001	<0.0001	-	-	-
Boron	<0.05	<0.05	<0.05	-	-	-
Cadmium	<0.00001	<0.00001	<0.00001	-	-	-
Calcium	5.38	5.9	7.54	-	-	-
Chromium	<0.001	<0.001	<0.001	-	-	-
Cobalt	<0.0005	<0.0005	<0.0005	-	-	-
Copper	0.0008	0.0014	0.0012	-	-	-
Iron	0.058	0.05	0.133	-	-	-
Hardness CaCO3	18.3	19.7	<50	-	-	-
Lead	<0.0002	<0.0002	<0.0002	-	-	-
Lithium	-	<0.005	<0.005	-	-	-
Magnesium	1.19	1.22	1.22	-	-	-
Manganese	0.005	0.003	0.014	-	-	-
Mercury	<0.00002	<0.00002	<0.00002	-	-	-
Molybdenum	<0.001	<0.001	<0.001	-	-	-
Nickel	<0.001	<0.001	<0.001	-	-	-
Phosphorus	-	-	-	-	-	-
Potassium	0.21	0.17	0.16	-	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-	-
Silver	<0.00002	<0.00002	<0.00002	-	-	-
Sodium	1.46	1.63	1.83	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-	-
Tin	<0.005	0.005	0.025	-	-	-
Titanium	<0.005	<0.005	<0.005	-	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-	-
Vanadium	<0.005	<0.005	<0.005	-	-	-
Zinc	<0.005	<0.005	<0.005	-	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate sample.

TABLE 35-3
NO NAME LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter / Sample Date	October 3	October 31	November 2	December 6	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L) Max	30-Day Mean[1]
Total Metals						
Aluminum	0.05	0.073	-	0.066	-	-
Antimony	<0.0005	<0.0005	-	<0.0005	-	-
Arsenic	0.0004	0.0003	-	0.0002	0.005*	-
Barium	0.002	0.002	-	0.001	-	-
Beryllium	<0.0001	<0.0001	-	<0.0001	-	-
Bismuth	<0.001	<0.001	-	<0.001	-	-
Boron	<0.05	<0.05	-	<0.05	-	-
Cadmium	<0.00001	0.00001	-	<0.00001	[2]	-
Calcium	6.48	7.14	-	2.91	-	-
Chromium	<0.001	<0.001	-	<0.001	-	-
Cobalt	<0.0005	<0.0005	-	<0.0005	0.05	-
Copper	0.0012	0.0008	-	0.0006	-	**≤0.002**
Iron	0.109	0.098	-	0.086	-	**≤0.3**
Lead	<0.0002	<0.0002	-	<0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	-	<0.005	-	-
Magnesium	1.27	1.25	-	0.669	-	-
Manganese	0.019	0.018	-	0.004	0.05	-
Mercury	<0.00002	<0.00002	-	<0.00002	≤0.0001	-
Molybdenum	<0.001	<0.001	-	<0.001	-	-
Nickel	<0.001	0.001	-	<0.001	**0.025**	-
Potassium	0.15	0.12	-	0.099	-	-
Selenium	<0.0001	<0.0001	-	<0.0001	-	-
Silicon	2.5	3.3	-	3.2	-	-
Silver	<0.00002	<0.00002	-	<0.00002	0.0001	-
Sodium	1.54	1.4	-	0.828	-	-
Strontium	0.033	0.031	-	0.01	-	-
Thallium	<0.00005	<0.00005	-	<0.00005	-	-
Tin	<0.005	<0.005	-	<0.005	-	-
Titanium	<0.005	<0.005	-	<0.005	-	-
Uranium	<0.0001	<0.0001	-	<0.0001	-	-
Vanadium	<0.005	<0.005	-	<0.005	-	-
Zinc	<0.005	<0.005	-	<0.005	0.03	
Zirconium	<0.0005	<0.0005	-	<0.0005		-
Dissolved Metals						
Aluminum	0.022	0.037	-	0.0507	0.1	≤0.05
Antimony	<0.0005	<0.0005	-	<0.0005	-	-
Arsenic	0.0004	0.0004	-	0.00018	-	-
Barium	0.001	0.002	-	<0.001	-	-
Beryllium	<0.0001	<0.0001	-	<0.0001	-	-
Bismuth	<0.001	<0.001	-	<0.001	-	-
Boron	<0.05	<0.05	-	<0.05	-	-
Cadmium	<0.00001	<0.00001	-	0.000027	-	-
Calcium	6.55	7.86	-	3.04	-	-
Chromium	<0.001	<0.001	-	<0.001	-	-
Cobalt	<0.0005	<0.0005	-	<0.0005	-	-
Copper	0.0007	0.0015	-	0.00152	-	-
Iron	0.055	0.08	-	0.0551	-	-
Lead	<0.0002	<0.0002	-	<0.0002	-	-
Lithium	<0.005	<0.005	-	<0.005	-	-
Magnesium	1.24	1.38	-	0.652	-	-
Manganese	0.008	0.018	-	0.0032	-	-
Mercury	<0.00002	<0.00002	-	<0.00002	-	-
Molybdenum	<0.001	<0.001	-	<0.001	-	-
Nickel	<0.001	<0.001	-	<0.001	-	-
Potassium	0.16	0.31	-	0.166	-	-
Selenium	<0.0001	<0.0001	-	<0.0001	-	-
Silicon	2.8	3.4	-	3.09	-	-
Silver	<0.00002	<0.00002	-	<0.00002	-	-
Sodium	1.48	1.84	-	0.992	-	-
Strontium	0.027	0.035	-	0.0101	-	-
Thallium	<0.00005	<0.00005	-	<0.00005	-	-
Tin	<0.005	<0.005	-	<0.005	-	-
Titanium	<0.005	<0.005	-	<0.005	-	-
Uranium	<0.0001	<0.0001	-	<0.0001	-	-
Vanadium	<0.005	<0.005	-	<0.005	-	-
Zinc	<0.005	<0.005	-	<0.005	-	-
Zirconium	<0.0005	<0.0005	-	<0.0005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate sample.

TABLE 35-4
NO NAME LAKE OUTLET METALS ANALYSIS
2011/12 EMS ID- E217017
COMPANY IDENTITY - NNO

Parameter	January	February	March	Water Quality Objectives for Middle Quinsam Sub-Basin (mg/L)	
Sample Date	5	7	6	**Max**	**30-Day Mean[1]**
Total Metals					
Aluminum	0.048	0.046	0.037	-	-
Antimony	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0002	0.0002	0.0002	**0.005***	**N/A**
Barium	<0.001	<0.001	<0.001	-	-
Beryllium	<0.0001	<0.0001	<0.0001		-
Bismuth	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	2.86	2.44	2.92	-	-
Chromium	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	0.05	-
Copper	0.0004	0.001	0.0004	-	**≤0.002**
Iron	0.049	0.051	0.052	-	**≤0.3**
Lead	<0.0002	<0.0002	<0.0002	**0.005**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	-	-
Magnesium	0.73	0.605	0.732	-	-
Manganese	0.002	0.002	0.004	0.05	-
Mercury	<0.000010	<0.000010	<0.000002	**≤0.0001**	**N/A**
Molybdenum	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	**0.025**	**N/A**
Potassium	0.126	0.055	0.062	-	-
Selenium	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.9	2.7	2.5	-	-
Silver	<0.00002	<0.00002	<0.00002	**0.0001**	**N/A**
Sodium	0.956	0.781	0.935	-	-
Strontium	0.01	0.008	0.011	-	-
Thallium	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	**0.03**	**N/A**
Zirconium	<0.0005	<0.0005	<0.0005	-	-
Dissolved Metals					
Aluminum	0.0384	0.0379	0.0355	**0.1**	**≤0.05**
Antimony	<0.00050	<0.00050	<0.00050	-	-
Arsenic	0.00017	0.00019	0.00016	-	-
Barium	<0.0010	0.0013	0.0012	-	-
Beryllium	<0.00010	<0.00010	<0.00010	-	-
Bismuth	<0.0010	<0.0010	<0.0010	-	-
Boron	<0.050	<0.050	<0.050	-	-
Cadmium	<0.000010	<0.000010	<0.000010	-	-
Calcium	3.09	2.87	3.3	-	-
Chromium	<0.0010	<0.0010	<0.0010	-	-
Cobalt	<0.00050	<0.00050	<0.00050	-	-
Copper	0.00306	0.0011	0.00088	-	-
Iron	0.0366	0.0407	0.0445	-	-
Lead	<0.00020	<0.00020	<0.00020	-	-
Lithium	<0.0050	<0.0050	<0.0050	-	-
Magnesium	0.662	0.656	0.683	-	-
Manganese	0.002	0.0018	0.0036	-	-
Mercury	<0.000010	<0.000010	<0.000002	-	-
Molybdenum	<0.0010	<0.0010	<0.0010	-	-
Nickel	<0.0010	<0.0010	<0.0010	-	-
Potassium	0.064	0.067	0.078	-	-
Selenium	<0.00010	<0.00010	<0.00010	-	-
Silicon	2.89	2.9	2.78	-	-
Silver	<0.000020	<0.000020	<0.000020	-	-
Sodium	0.911	1.09	1.13	-	-
Strontium	0.0097	0.0111	0.0128	-	-
Thallium	<0.000050	<0.000050	<0.000050	-	-
Tin	<0.0050	<0.0050	<0.0050	-	-
Titanium	<0.0050	<0.0050	<0.0050	-	-
Uranium	<0.00010	<0.00010	<0.00010	-	-
Vanadium	<0.0050	<0.0050	<0.0050	-	-
Zinc	<0.0050	<0.0050	<0.0050	-	-
Zirconium	<0.00050	<0.00050	<0.00050	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.
^Cr (VI) ^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.
Results expressed in milligrams per litre

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

Results expressed in milligrams per litre.
* Field replicate sample.

TABLE 36

LONG LAKE MIDDLE WATER QUALITY

2011/2012 EMS ID E206619

COMPANY IDENTITY - LLM

Parameter	April					May					June					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Parameter	1	4	4*	9	B	1	1 *	4	9	B	1	4	4*	9	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	213	353	358	434	445	164	160	344	439	450	120	255	279	-	279	-	-	**GPS (m)**	
Hardness CaCO3	72.2	125	129	153	165	56.4	-	116	163	158	52.7	125	-	161	164	-	-		
pH	7.44	7.46	7.59	7.41	7.41	7.21	7.2	7.3	7.36	7.37	7.7	7.69	7.73	7.66	7.71	-	≥ (6.5)[2] or (6.9)[3]	**Minegrid**	
Total suspended solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	5		
Aciditiy	0.8	1.2	1.8	1.4	2.1	-	-	-	-	-	-	-	-	-	-	-	-	**Northing**	**Easting**
Alkalinity - Total CaCO3	30	49	49	53	56	27	23	46	54	53	25	44	45	54	54	-	-	101569.7	98617
Ammonia Nitrogen	0.037	0.027	0.017	0.023	0.01	0.012	-	0.011	0.012	0.012	0.01	0.014	-	0.01	0.007	-	-	**UTM ZONE 10**	
Nitrite/Nitrate Nitrogen	0.02	0.03	0.03	0.04	0.05	<0.02	-	<0.02	0.05	0.08	<0.02	<0.02	-	0.05	0.08	-	-	**Northing**	**Easting**
Kjeldahl Nitrogen	0.15	0.15	0.15	0.05	0.09	0.18	-	0.28	0.13	0.12	0.23	0.19	-	0.11	0.12	-	-	5532271	322752
Dissolved Phosphorous	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	≤ 0.0064		
Total Phosphorous	0.007	<0.005	<0.005	<0.005	<0.005	0.009	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-		
Sulphate	68	120	120	150	160	52	46	110	150	160	36	120	110	150	150	100^	N/A	**Middle of Middle Long Lake**	
Chlorophyll a (mg/m3)	1.4	0.9	-	0.8	-	1.4	-	2	<0.5	-	0.9	1.4	-	1.2	-	-	-		
Pheopigment (mg/m3)	<0.5	1.8	-	0.8	-	<0.5	-	0.8	<0.5	-	0.6	1.1	-	0.9	-	-	-		
Chlorophyll a (mg/m3)*	<0.5	-	-	1.2	-	0.8	-	2.1	<0.5	-	0.5	1.5	-	1.5	-	-	-		
Pheopigment (mg/m3)*	1.5	-	-	<0.5	-	<0.5	-	0.5	<0.5	-	1.1	<0.5	-	<0.5	-	-	-		

Parameter	July					August					September					Water Quality Objectives for Middle Quinsam Lake sub-basin mg/L		Site Description	
Parameter	1	4	4*	9	B	1	1 *	4	9	B	1	4	4*	9	B	Max	30-Day Mean[1]		
Conductivity (umhos/cm)	0.169	0.276	-	0.275	0.274	214	211	351	437	440	277	277	277	434	435	-	-	**GPS (m)**	
Hardness CaCO3	67.8	111	-	149	157	76	-	115	152	149	99.7	-	77.1	155	160	-	-		
pH	7.39	7.4	7.58	7.4	7.41	7.68	7.31	7.68	7.62	7.72	7.46	7.61	7.73	7.59	7.67	-	≥ (6.5)[2] or (6.9)[3]	**Minegrid**	
Total suspended solids	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	25	5		
Aciditiy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**Northing**	**Easting**
Alkalinity - Total CaCO3	31	46	46	52	54	35	34	45	52	52	39	43	42	55	56	-	-	101569.7	98617
Ammonia Nitrogen	0.033	0.025	-	0.035	0.026	<0.005	-	0.017	0.014	0.005	0.057	-	0.024	0.049	0.037	-	-	**UTM ZONE 10**	
Nitrite/Nitrate Nitrogen	<0.02	<0.02	<0.02	0.05	0.08	<0.02	-	<0.02	0.05	0.08	<0.02	-	<0.02	0.04	0.1	-	-	**Northing**	**Easting**
Kjeldahl Nitrogen	0.17	0.2	-	0.17	0.12	0.11	-	0.1	0.09	0.09	0.26	-	0.15	0.2	0.19	-	-	5532271	322752
Dissolved Phosphorous	0.005	<0.005	-	<0.005	<0.005	0.009	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	-	≤ 0.0064		
Total Phosphorous	0.006	<0.005	-	0.008	<0.005	0.01	-	0.006	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	-	-		
Sulphate	50	110	110	140	140	58	60	110	150	140	79	78	80	140	160	100^	N/A	**Middle of Middle Long Lake**	
Chlorophyll a (mg/m3)	1.2	1	-	1.8	-	0.6	<0.5	0.7	1	-	<0.5	<0.5	<0.5	<0.5	-	-	-		
Pheopigment (mg/m3)	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	0.7	1	-	<0.5	0.7	2	0.7	-	-	-		
Chlorophyll a (mg/m3)*	<0.5	1.3	-	1.4	-	-	-	0.8	1	-	-	-	<0.5	<0.5	-	-	-		
Pheopigment (mg/m3)*	0.8	<0.5	-	<0.5	-	-	-	<0.5	1.1	-	-	-	<0.5	<0.5	-	-	-		

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes.

[2] 30-day 90th percentile

[3]Running 30-day median

[4] Objective is for total phosphorus values and appilies to an average of summer phosphorous values.

^The sulphate limit is a guideline rather than a site-specific objective

TABLE 37-1
LONG LAKE MIDDLE METALS ANALYSIS
2011/2012 EMS ID E206619
COMPANY IDENTITY - LLM

Sample Date	April					May				June				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	4*	9	B	1`	4	9	B	1`	4	9	B	Max	30-Day Mean[1]
Total Metals															
Aluminum	0.0380	0.0320	0.0300	0.0310	0.0330	0.0340	0.0280	0.0260	0.0290	0.0320	0.0190	0.0230	0.0980	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0002	0.0002	0.0002	0.0002	0.0003	0.0004	0.0003	0.0003	0.0003	0.0005	0.0003	0.0002	0.0002	**0.005***	-
Barium	0.0050	0.0070	0.0070	0.0090	0.0120	0.0050	0.0070	0.0090	0.0110	0.0050	0.0070	0.0090	0.0120	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	0.0600	0.1200	0.1300	0.1500	0.1500	<0.05	0.1000	0.1400	0.1400	<0.05	0.1000	0.1400	0.1500	-	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00005	0.00003	0.00002	0.00002	<0.00001	<0.00001	<0.00001	<0.00001	[2]	-
Calcium	24.6000	43.2000	44.5000	52.4000	56.7000	18.8000	39.9000	56.7000	54.2000	17.4000	43.0000	55.1000	56.3000	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0500**	-
Copper	0.0010	0.0008	0.0006	0.0007	0.0006	0.0005	0.0006	0.0005	0.0005	0.0005	0.0004	0.0006	0.0005	-	**≤0.002**
Hardness	72.2000	125.0000	129.0000	153.0000	165.0000	56.4000	116.0000	163.0000	158.0000	52.7000	125.0000	161.0000	164.0000	-	**≤ 0.3**
Iron	0.0550	0.0570	0.0560	0.0600	0.0710	0.0670	0.0660	0.0630	0.0670	0.0920	0.0410	0.0410	0.0580	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	**0.0050**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	2.6300	4.1400	4.4300	5.3400	5.7700	2.3000	3.9400	5.3400	5.5600	2.2600	4.2500	5.6700	5.7600	-	-
Manganese	0.0330	0.0680	0.0720	0.1570	0.3270	0.0260	0.0420	0.1700	0.2410	0.0160	0.0080	0.0960	0.2110	**0.0500**	-
Mercury	0.0014	0.0004	0.0004	0.0001	0.0002	0.0017	0.0001	0.0003	0.0001	0.0004	0.0012	0.0000	0.0001	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0250**	-
Phosphorous	0.0070	<0.005	<0.005	<0.005	<0.005	0.0090	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**≤0.0074**
Potassium	0.3400	0.5600	0.6000	0.7100	0.7200	0.2800	0.5200	0.7100	0.7200	0.2300	0.5500	0.7500	0.7400	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.9000	3.1000	3.2000	3.2000	3.3000	2.7000	2.9000	3.3000	3.2000	2.9000	3.0000	3.4000	3.6000	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	11.7000	21.0000	22.2000	26.4000	26.5000	8.6600	20.5000	28.9000	29.3000	6.0200	20.3000	27.6000	27.2000	-	-
Strontium	0.2010	0.3690	0.3870	0.4690	0.4980	0.1460	0.3330	0.4610	0.4760	0.1200	0.3510	0.4710	0.4750	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0300**	-
Dissolved Metals															
Aluminum	0.0230	0.0200	0.0190	0.0190	0.0170	0.0380	0.0150	0.0320	0.0150	0.0180	0.0110	0.0110	0.0110	**0.1000**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002	0.0004	0.0003	0.0002	0.0002	-	-
Barium	0.0040	0.0070	0.0070	0.0080	0.0100	0.0040	0.0060	0.0080	0.0090	0.0040	0.0070	0.0090	0.0110	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	0.0700	0.1300	0.1300	0.1400	0.1500	0.0500	0.1200	0.1600	0.1500	<0.05	0.1100	0.1500	0.1500	-	-
Cadmium	<0.00001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	<0.00001	<0.00001	<0.00001	0.0000	-	-
Calcium	22.7000	42.2000	41.4000	50.5000	51.8000	19.0000	39.6000	52.1000	51.8000	15.7000	39.0000	51.8000	52.7000	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0005	0.0009	0.0008	0.0005	0.0006	0.0006	0.0013	0.0005	0.0024	0.0004	0.0004	0.0004	0.0006	-	-
Iron	0.0300	0.0230	0.0210	0.0250	0.0270	0.0300	0.0190	0.0210	0.0230	0.0540	0.0140	0.0130	0.0130	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	2.4400	4.1000	4.0800	4.7900	5.3000	2.2000	3.8200	4.8900	5.0700	2.0500	4.1700	5.2000	5.3500	-	-
Manganese	0.0280	0.0600	0.0580	0.1230	0.2790	0.0120	0.0190	0.1010	0.1620	0.0110	0.0030	0.0420	0.1250	-	-
Mercury	0.0010	0.0003	0.0002	0.0000	0.0002	0.0018	0.0001	0.0002	0.0001	0.0003	0.0012	0.0000	0.0000	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Phosphorous	<0.005	<0.005	<0.005	<0.005	<0.005	0.0070	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	0.3100	0.5500	0.5400	0.6200	0.6500	0.2500	0.4900	0.6400	0.6400	0.2100	0.5200	0.6700	0.6800	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	11.0000	21.5000	21.1000	24.3000	25.0000	7.4900	18.1000	24.4000	24.1000	5.4000	19.6000	26.0000	26.1000	-	-
Strontium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period. These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.

^Cr (VI)

^^Cr (III)

*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 37-2
LONG LAKE MIDDLE METALS ANALYSIS
2011/2012 EMS ID E206619
COMPANY IDENTITY - LLM

Sample Date	July				August				September				Water Quality Objectives for Middle Quinsam Sub-Basin mg/L	
Parameter	1	4	9	B	1	4	9	B	1	4	9	B	Max	30-Day Mean[1]
Total Metals														
Aluminum	0.0240	0.0180	0.0220	0.0190	0.0200	0.0170	0.0160	0.0180	0.0090	0.0070	0.0120	0.0110	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	0.0005	0.0003	0.0003	0.0003	0.0006	0.0003	0.0002	0.0002	0.0006	0.0006	0.0002	0.0002	**0.005***	-
Barium	0.0060	0.0070	0.0090	0.0110	0.0060	0.0070	0.0080	0.0110	0.0070	0.0070	0.0090	0.0100	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Boron	0.0600	0.1000	0.1300	0.1300	0.0700	0.1100	0.1500	0.1400	0.0900	0.0900	0.1300	0.1400	-	-
Cadmium	0.00002	0.00002	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	<0.00001	[2]	-
Calcium	23.0000	38.2000	51.6000	54.4000	25.3000	39.0000	51.9000	50.5000	33.7000	24.8000	53.5000	56.0000	-	-
Chromium	0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0500**	-
Copper	0.0005	0.0005	0.0021	0.0023	0.0004	0.0017	0.0005	0.0005	0.0020	0.0009	0.0014	0.0021	-	**≤0.002**
Iron	0.0790	0.0310	0.0480	0.0820	0.0620	0.0340	0.0260	0.0470	0.0370	0.0230	0.0360	0.0360	-	**≤ 0.3**
Hardness	67.8000	111.0000	149.0000	157.0000	76.0000	115.0000	152.0000	149.0000	99.7000	77.1000	155.0000	160.0000	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0038	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	**0.0050**	**≤0.003**
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Magnesium	2.5300	3.7600	4.9500	5.0700	3.1400	4.2600	5.4300	5.4300	3.7500	3.6600	5.3200	4.8200	-	-
Manganese	0.0090	0.0120	0.0430	0.1950	0.0060	0.0080	0.0210	0.3160	0.0070	0.0070	0.0160	0.3670	**0.0500**	-
Mercury	0.0011	0.0003	0.0003	0.0002	0.0028	0.0005	0.0002	0.0001	<0.00002	-	<0.00002	<0.00002	**≤0.0001**	-
Molybdenum	<0.001	<0.001	<0.001	0.0050	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0250**	-
Phosphorous	0.0060	<0.005	0.0080	<0.005	0.0100	0.0060	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	**≤0.0074**
Potassium	0.2800	0.4900	0.6600	0.6700	0.3200	0.5100	0.6600	0.6600	0.4000	0.3800	0.6500	0.5900	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	2.6000	2.4000	3.1000	3.4000	2.8000	2.6000	3.4000	3.6000	2.6000	1.9000	3.2000	3.7000	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	**0.0001**	-
Sodium	8.8600	19.2000	26.2000	26.2000	10.8000	20.1000	26.2000	25.9000	14.7000	14.4000	26.2000	24.1000	-	-
Strontium	0.1620	0.3310	0.4450	0.4580	0.1930	0.3340	0.4390	0.4340	0.2590	0.2590	0.4310	0.4490	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	0.0100	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0070	**0.0300**	-
Dissolved Metals														
Aluminum	0.0110	0.0110	0.0140	0.0140	0.0090	0.0070	0.0110	0.0060	0.0060	-	0.0080	0.0050	**0.1000**	**≤0.05**
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	-	-
Arsenic	0.0005	0.0003	0.0002	0.0002	0.0006	0.0003	0.0002	0.0002	0.0006	-	0.0002	0.0002	-	-
Barium	0.0050	0.0070	0.0080	0.0100	0.0060	0.0070	0.0090	0.0110	0.0070	-	0.0090	0.0080	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	-	-
Boron	0.0500	0.1100	0.1500	0.1500	0.0700	0.1200	0.1500	0.1500	0.0900	-	0.1500	0.1500	-	-
Cadmium	0.0000	0.0000	0.0000	0.0000	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	-	<0.00001	<0.00001	-	-
Calcium	24.0000	43.9000	55.7000	55.4000	26.8000	40.7000	51.1000	48.7000	33.7000	-	55.9000	54.4000	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005	<0.0005	-	-
Copper	0.0010	0.0008	0.0010	0.0007	0.0004	0.0003	0.0006	0.0004	0.0013	-	0.0011	0.0008	-	-
Iron	0.0480	0.0170	0.0160	0.0430	0.0360	0.0120	0.0080	<0.005	0.0120	-	0.0080	<0.005	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-
Magnesium	2.7700	4.2700	5.2900	5.4700	3.1000	4.4200	5.3900	5.4400	3.5900	-	5.3000	5.1700	-	-
Manganese	0.0040	0.0030	0.0130	0.1040	<0.001	0.0040	0.0100	0.0520	<0.001	-	0.0090	0.0010	-	-
Mercury	0.0007	0.0001	0.0001	0.0001	0.0029	0.0004	0.0002	0.0001	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	-	-
Phosphorous	0.0050	<0.005	<0.005	<0.005	0.0090	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	0.3000	0.5600	0.7200	0.7400	0.3100	0.5400	0.6800	0.6900	0.4100	-	0.7000	0.7000	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	-	-
Silicon	2.8000	2.9000	3.4000	3.7000	2.8000	2.6000	3.2000	3.4000	2.8000	-	3.5000	4.0000	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002	-	-
Sodium	8.4900	19.6000	25.2000	26.0000	10.3000	20.9000	26.3000	26.7000	13.7000	-	25.8000	25.5000	-	-
Strontium	0.1620	0.3420	0.4590	0.4720	0.1980	0.3630	0.4640	0.4740	0.2460	-	0.4400	0.4380	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	-	-

[1]30-day average objectives apply to values calculated from 5 weekly samples taken in a 30 day period.
These objectives do not apply to the individual results provided in the table, but are provided for comparison purposes only.
^Cr (VI)
^^Cr (III)
*The Water Quality Guidelines are used for Arsenic for a more stringent comparison.

[2]Max concentration is based on Hardness
0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 38

LONG LAKE MIDDLE WATER QUALITY - FIELD INSTRUMENTS

2011/2012 EMS ID E206619

COMPANY IDENTITY - LLM

Sample Date				April							May					June						
Parameter	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP	TEMP.	pH	COND.	TDS	% Sat.	D.O.	ORP
Sample Depth (m)	Celcius					mg/L		Celcius		(UMHOS/CM)			mg/L		Celcius		(UMHOS/CM)			mg/L	
1	6.310	7.340	0.231	0.151	90.100	11.110	173.600	11.050	7.410	99.000	0.088	132.100	14.500	102.800	17.140	7.380	120.000	0.091	97.600	9.390	87.800
2	6.300	7.300	0.232	0.151	89.600	11.050	173.700	10.750	7.390	108.000	0.096	130.500	14.460	102.300	16.730	7.360	129.000	0.098	97.100	9.410	90.900
3	6.150	7.150	0.332	0.211	81.600	10.090	178.400	8.460	7.150	179.000	0.170	117.000	13.720	112.300	13.480	7.180	190.000	0.160	97.400	10.140	104.800
4	5.420	7.040	0.391	0.254	74.200	9.360	180.400	5.880	7.020	218.000	0.224	95.200	11.810	134.300	10.160	7.070	255.000	0.231	94.000	10.550	114.600
5	4.420	6.990	0.441	0.287	69.700	9.000	181.400	5.000	6.980	220.000	0.231	84.200	10.710	140.200	7.280	6.990	285.000	0.280	82.400	9.880	122.200
6	4.040	6.970	0.448	0.291	65.000	8.480	182.000	4.530	6.960	220.000	0.235	77.200	9.950	143.800	6.030	6.970	283.000	0.288	73.500	9.100	125.300
7	4.080	6.970	0.453	0.294	65.000	8.500	181.600	4.340	6.950	221.000	0.238	72.500	9.390	146.500	5.350	6.940	280.000	0.292	65.000	8.200	128.600
8	4.030	6.970	0.456	0.296	64.800	8.460	181.400	4.270	6.940	222.000	0.239	70.400	9.140	148.000	4.920	6.920	279.000	0.294	59.400	7.580	130.900
9	3.980	6.970	0.461	0.300	64.200	8.410	181.200	4.210	9.630	222.000	0.240	67.600	8.800	149.500	4.780	6.900	279.000	0.295	57.100	7.330	132.700
10	3.920	6.970	0.462	0.300	63.700	8.350	181.200	4.200	6.930	223.000	0.240	64.800	8.430	151.000	4.700	6.900	279.000	0.296	56.200	7.220	134.000
11	3.960	6.970	0.464	0.302	63.200	8.260	180.600	4.160	6.930	223.000	0.240	63.600	8.280	152.200	4.650	6.890	279.000	0.297	54.800	7.060	134.800
12	3.940	6.970	0.467	0.303	62.800	8.230	180.100	4.140	6.920	223.000	0.241	62.000	8.090	153.300	4.560	6.870	280.000	0.298	52.300	6.730	136.600
13	3.940	6.970	0.466	0.303	62.600	8.210	180.100	4.140	6.920	223.000	0.241	59.800	7.810	154.700	4.520	6.870	279.000	0.298	51.400	6.640	137.800
14	3.920	6.970	0.468	0.304	62.500	8.200	180.200	4.110	6.920	223.000	0.241	58.900	7.680	155.400	4.450	6.860	279.000	0.299	49.600	6.410	139.400
15	3.920	6.970	0.468	0.304	62.400	8.180	180.000	4.110	6.920	223.000	0.241	57.700	7.530	156.400	4.420	6.850	279.000	0.299	48.500	6.280	139.900
16	3.910	6.970	0.469	0.304	62.100	8.140	180.000	4.110	6.920	223.000	0.241	55.700	7.270	157.200	4.410	6.840	279.000	0.299	46.500	6.020	141.100
17	3.900	6.980	0.470	0.306	61.400	8.050	178.100	4.110	6.920	223.000	0.241	54.200	7.080	158.200	4.410	6.840	280.000	0.299	45.500	5.890	141.800
18	3.900	7.000	0.470	0.305	62.000	8.130	176.800	4.110	6.910	223.000	0.241	53.400	6.960	159.200	4.410	6.830	279.000	0.299	43.900	5.680	142.800
18.6								4.140	6.930	224.000	0.242	44.600	5.780	-					-		
19	3.910	7.000	0.470	0.305	61.900	8.130	175.800	-	-	-	-	-	-	-	4.410	6.830	279.000	0.299	43.000	5.570	143.700
20	3.900	7.000	0.471	0.306	61.800	8.110	174.800	-	-	-	-	-	-	-	4.420	6.820	279.000	0.299	40.900	5.300	144.000
20.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.430	6.800	279.000	0.299	28.400	3.600	84.000
21	3.930	7.020	0.470	0.306	64.900	8.490	186.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Secchi Depth (m)	4.5m							6.5m													

Sample Date				July						August						September						
Parameter	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP	TEMP.	COND.	TDS	% Sat.	D.O.	pH	ORP
Sample Depth (m)	Celcius				mg/L			Celcius	UMHOS/CM)			mg/L			Celcius	UMHOS/CM)			mg/L		
1	18.66	0	0.125	92.700	8.7	7.34	138.1	20.55	0.20	0.140	88.4	7.9	7.76	173.3	16.60	0.247	0.191	87.800	8.5	7.78	220.0
2	18.64	0	0.125	92.800	8.7	7.34	138.7	20.46	0.20	0.141	86.7	7.8	7.70	173.7	16.60	0.247	0.191	87.400	8.5	7.72	226.4
3	16.75	0	0.169	92.500	9.0	7.19	163.4	19.66	0.22	0.162	85.8	7.9	7.44	182.3	16.59	0.247	0.191	87.200	8.5	7.70	229.1
4	11.70	0	0.240	92.100	10.0	7.01	176.4	14.48	0.289	0.235	87.8	8.9	6.94	203.8	16.57	0.247	0.192	86.900	8.5	7.68	231.8
5	8.29	0	0.276	81.400	9.5	6.89	184.2	10.50	0.298	0.268	78.5	8.7	6.85	207.6	14.88	0.347	0.280	90.200	9.1	7.20	233.5
6	6.61	0	0.283	71.900	8.8	6.84	187.5	7.95	0.29	0.278	69.5	8.2	6.85	207.2	10.60	0.327	0.295	86.600	9.0	7.10	234.4
7	5.62	0	0.287	62.500	7.8	6.78	190.4	6.57	0.28	0.281	62.2	7.6	6.83	208.1	8.26	0.312	0.298	67.100	7.8	7.05	236.6
8	5.25	0	0.289	56.800	7.2	6.75	191.8	5.81	0.28	0.283	54.5	6.8	6.81	207.8	6.80	0.301	0.300	61.800	7.5	6.99	239.6
9	5.01	0	0.290	53.400	6.8	6.73	192.6	5.43	0.27	0.284	51.5	6.4	6.77	207.7	6.03	0.295	0.300	54.500	6.8	6.95	242.1
10	4.94	0	0.290	50.500	6.5	6.72	193.2	5.21	0.27	0.285	45.8	5.8	6.78	207.8	5.70	0.293	0.301	51.100	6.4	6.92	243.2
11	4.86	0	0.290	48.400	6.2	6.71	193.4	5.09	0.27	0.285	43.1	5.5	6.75	207.8	5.52	0.292	0.302	47.300	5.9	6.90	243.8
12	4.79	0	0.290	48.000	6.2	6.70	193.5	5.00	0.27	0.285	42.0	5.4	6.78	208.1	5.39	0.291	0.302	42.000	5.3	6.88	244.3
13	4.71	0	0.291	47.200	6.1	6.70	193.2	4.91	0.27	0.285	40.0	5.1	6.76	208.1	5.23	0.289	0.302	39.200	5.0	6.86	244.3
14	4.65	0	0.291	45.300	5.8	6.69	193.2	4.83	0.27	0.286	38.1	4.8	6.78	207.5	5.08	0.289	0.303	35.800	4.6	6.84	244.1
15	4.60	0	0.292	43.900	5.7	6.69	193.2	4.72	0.27	0.286	34.6	4.4	6.78	206.3	4.98	0.287	0.303	42.000	5.4	6.83	243.8
16	4.55	0	0.292	41.500	5.3	6.68	193.0	4.65	0.27	0.287	32.9	4.2	6.77	206.1	4.93	0.287	0.303	39.800	5.9	6.81	243.0
17	4.52	0	0.292	39.000	5.0	6.67	192.6	4.64	0.27	0.287	30.6	3.9	6.78	204.8	4.89	0.287	0.302	25.400	3.2	6.81	242.7
18	4.51	0	0.292	37.800	4.9	6.67	192.4	4.62	0.27	0.287	29.1	3.7	6.77	204.8	4.88	0.287	0.303	24.000	3.1	6.80	243.0
19	4.51	0	0.292	35.300	4.6	6.66	192.4	4.62	0.27	0.287	25.7	3.3	6.80	204.8	4.87	0.287	0.302	21.800	2.8	6.79	243.6
20	4.52	0	0.292	34.300	4.4	6.65	190.80	4.63	0.27	0.287	1.3	0.2	7.22	-87.00	4.87	0.287	0.30	20.600	2.6	6.80	243.60
21	4.52	0	0.293	26.800	3.4	6.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Secchi Depth (m)	7 m							8 m							8 m						

*Hypolimnetic DO= 3 mg/L

Results are a minimum during June, July and August

TABLE 39
LONG LAKE MIDDLE HISTORICAL SULPHATE AND pH
2011/2012 EMS ID E206619
COMPANY IDENTITY - LLM

Parameter	Sulphate							
Year	1983				1984			
Depth	1	2	3	4	1	2	3	4
Month								
April	-	-	-	-	1	-	1	1
May	1.00	1.00	1.00	1.00	1.00	-	-	1.00
June	1.00	1.00	1.00	1.00	1.10	-	1.40	1.30
July	1.00	-	1.00	1.00	1.60	1.00	-	1.20
August	1.00	1.00	-	1.00	-	-	-	-
September	1.00	-	-	1.30	-	-	-	-

Parameter	pH							
Year	1983				1984			
Depth	1	2	3	4	1	2	3	4
Month								
April	-	-	-	-	7.00	-	6.80	6.70
May	-	-	-	-	-	-	-	6.50
June	7.10	6.70	6.70	6.50	7.30	-	6.90	6.70
July	6.50	-	6.10	6.30	7.20	6.70	-	6.60
August	7.20	6.90	-	6.60	7.40	7.10	-	6.70
September	6.80	-	-	6.30	7.00	-	-	6.70

Notes: Results expressed in milligrams per litre.
For background data, depth 1 is from the 1 meter depth, depth 2 is from the 3, 5, and 6 meter depths, depth 3 is from the 9, 10, and 11 meter depths and depth 4 is from the 12 and 13 meter depths.

TABLE 40
MIDDLE QUINSAM LAKE HISTORICAL SULPHATE AND pH
2011/2012 EMS ID E206618
COMPANY IDENTITY - MQL

Parameter	Sulphate							
Year	1983				1984			
Depth	1	2	3	4	1	2	3	4
Month								
April	-	-	-	-	1.00	1.00	7.20	1.00
May	1.00	1.00	-	-	1.00	1.00	-	1.00
June	1.00	1.00	-	-	1.70	-	1.40	1.30
July	1.00	1.00	1.00	-	1.50	1.50	-	1.50
August	1.00	-	2.00	-	-	-	-	-
September	1.80	1.50	-	2.00	-	-	-	-

Parameter	pH							
Year	1983				1984			
Depth	1	2	3	4	1	2	3	4
Month								
April	-	-	-	-	7.20	7.30	6.80	7.10
May	-	-	-	-	7.50	7.40	-	7.20
June	7.40	7.40	-	-	7.60	-	7.60	7.60
July	7.10	7.30	7.20	-	7.70	7.80	-	7.10
August	7.30		7.10	-	7.70	-	-	7.30
September	7.10	7.30	-	6.60	6.80	6.70	-	6.90

Notes: Results expressed in milligrams per litre.
For background data, depth 1 is from the 1 meter depth, depth 2 is from the 3, 5, and 6 meter depths, depth 3 is from the 9, 10, and 11 meter depths and depth 4 is from the 12 and 13 meter depths.

TABLE 41

SOUTH DYKE SUMP QUALITY

2011/12

COMPANY IDENTITY - SDS

Parameter	April				May				June				Site Description
													GPS (m)
													Minegrid
Sample Date	4	11	18	25	2	9	13	23	6	13	20	27	Northing / Easting
Conductivity (umhos/cm)	3400	3320	3380	3420	3200	3030	2240	2800	3330	3320	3450	3340	102553 / 99305
Hardness CaCO3	1480	-	-	-	1380	-	-	-	1390	-	-	-	UTM ZONE 10
pH	8.04	8.12	8.03	8.05	8.02	8.07	8.03	8.2	8.04	7.91	7.97	8	Northing / Easting
Acidity (to pH 8.3)	14.8	11.1	15	9.7	15.2	8.2	5.4	4.9	8.5	7.4	8.9	-	5533411 / 322376
Alkalinity - Total $CaCO_3$	260	310	320	320	290	270	210	240	270	270	300	300	Extreme South
Sulphate	1700	1700	1700	1600	1500	1500	1200	1400	1700	1600	1600	1700	End of 2 North Pit

Parameter	July				August					September				Site Description
														GPS (m)
														Minegrid
Sample Date	5	11	18	26	5	8	15	22	30	7	14	20	26	Northing / Easting
Conductivity (umhos/cm)	3290	3350	2260	3430	3300	3350	3350	3300	3400	3440	3460	3460	2180	102553 / 99305
Hardness CaCO3	1430	-	-	-	1610	-	-	-	1420	-	-	-	-	UTM ZONE 10
pH	7.9	8.01	8.15	7.98	7.98	8	8	8.05	8.09	8.03	8	8.16	8.04	Northing / Easting
Acidity (to pH 8.3)	9.8	10.5	1.7	12.1	4.4	8.9	10.2	11.1	16.6	3	4.9	8.1	4.4	5533411 / 322376
Alkalinity - Total $CaCO_3$	240	300	190	290	300	260	280	310	280	240	250	290	200	Extreme South
Sulphate	1700	1700	1100	1700	1700	1700	1600	1600	1800	1700	1800	1800	960	End of 2 North Pit

Parameter	October				November					December					Site Description
															GPS (m)
															Minegrid
Sample Date	5	11	17	24	2	8	14	22	29	7	14	20	28	29	Northing / Easting
Conductivity (umhos/cm)	2640	2430	3420	3390	3360	3450	3400	2320	3390	3460	3430	3360	2370	3070	102553 / 99305
Hardness CaCO3	1200	-	-	-	1350	-	-	-	-	1460	-	-	-	1410	UTM ZONE 10
pH	8.05	7.95	8	7.92	7.99	7.97	8.11	7.72	8.01	8.11	8.05	8.1	8.17	8.15	Northing / Easting
Acidity (to pH 8.3)	4	4.1	7.8	4.4	8.1	20.4	4.9	7.9	4.6	9.2	3.9	7.9	3.7	8.7	5533411 / 322376
Alkalinity - Total $CaCO_3$	250	220	310	320	310	341	345	172	316	341	330	335	223	308	Extreme South
Sulphate	1300	1200	1700	1800	1700	1800	1740	1180	1800	1780	1670	1640	1130	1530	End of 2 North Pit

Parameter	January					February				March				Site Description
														GPS (m)
Sample Date	5	10	17	24	31	7	14	21	28	6	13	20	27	Minegrid
Conductivity (umhos/cm)	2890	3260	3300	1900	3120	3250	3070	3060	3150	3080	2540	2860	2500	Northing / Easting
Hardness CaCO3	1100	-	-	-	-	1430	-	-	-	1250	-	-	-	102553 / 99305
pH	8.11	8.13	8.16	8.25	8.16	8.05	7.95	8.13	8.07	8.18	8.19	8.07	8.03	UTM ZONE 10
TSS	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing / Easting
Acidity (to pH 8.3)	4.3	7.5	4.3	<0.5	3.2	12.2	10.2	8.9	4.8	4.4	1.1	4.3	4.8	5533411 / 322376
Alkalinity - Total $CaCO_3$	282	326	315	180	312	307	266	297	294	304	244	281	233	Extreme South
Sulphate	1490	1590	1730	862	1530	1700	1600	1520	1560	1530	1340	1490	1250	End of 2 North Pit

Results expressed in milligrams per litre except where noted.

* Field replicate sample.

TABLE 42-1
SOUTH DYKE SUMP METALS ANALYSIS
2011/12
COMPANY IDENTITY - SDS

Parameter	April	May	June	July	August		September
Sample Date	4	2	6	5	5	30	6
Total Metals							
Aluminum	0.143	0.262	0.029	0.035	0.013	0.007	-
Antimony	<0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0001	0.0002	0.0002	0.0002	0.0001	<0.0001	-
Barium	0.019	0.019	0.017	0.015	0.013	0.014	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	0.92	0.87	0.88	0.89	0.9	1	-
Cadmium	0.00007	<0.00005	0.00009	<0.00003	<0.00003	<0.00003	-
Calcium	473	440	435	409	429	518	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	0.0048	0.0032	0.0018	<0.0005	0.001	0.0006	-
Copper	0.0023	0.0035	0.0006	0.0007	0.0005	0.0007	-
Iron	0.52	0.641	0.087	0.093	0.058	0.07	-
Hardness	-	-	-	1340	1350	1650	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	0.01	0.009	-	-	0.008	0.009	-
Magnesium	72.6	67.3	73.1	78	67.5	86.5	-
Manganese	0.924	0.729	0.539	0.152	0.41	0.396	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	0.011	0.007	0.006	0.003	0.005	0.004	-
Phosphorus	-	-	-	-	-	-	-
Potassium	5.5	5.45	5.6	5.64	5.09	6.32	-
Selenium	0.0005	0.0003	0.0003	0.0002	0.0001	<0.0001	-
Silicon	4.4	4.1	4.1	2.3	4.1	4.7	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	335	307	322	334	307	352	-
Strontium	3.25	3.01	3.12	3.04	2.88	3.55	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	-
Dissolved Metals							
Aluminum	0.03	0.018	0.024	0.006	0.008	0.006	-
Antimony	<0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0002	0.0003	0.0002	0.0002	0.0001	0.0002	-
Barium	0.019	0.017	0.018	0.016	0.015	0.012	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	0.85	0.92	0.88	0.9	0.98	0.98	-
Cadmium	<0.00005	0.00002	0.00002	0.00002	<0.00003	<0.00003	-
Calcium	465	440	436	437	509	444	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	0.0041	0.0026	0.0017	<0.0005	0.0011	0.0006	-
Copper	0.0052	0.0013	0.0007	0.0011	0.0006	0.0006	-
Iron	0.077	0.014	0.046	<0.005	0.024	0.023	-
Hardness	-	-	-	1430	1610	1420	-
Lead	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	0.009	0.008	-	-	0.009	0.009	-
Magnesium	70.5	67.9	78	82.5	82.3	76.3	-
Manganese	0.858	0.687	0.515	0.124	0.468	0.348	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	0.011	0.006	0.006	0.003	0.005	0.004	-
Potassium	5.27	5.54	5.93	6.02	6.4	5.36	-
Selenium	0.0005	0.0004	0.0004	0.0001	0.0002	<0.0001	-
Silicon	4.4	4	4.3	2.7	4.7	3.9	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	322	313	342	358	366	318	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	-

Results expressed in milligrams per litre.

TABLE 42-2
SOUTH DYKE SUMP METALS ANALYSIS
2011/12
COMPANY IDENTITY - SDS

Parameter	October	November	December		January	February	March
Sample Date	5	2	7	29	5	7	7
Total Metals							
Aluminum	0.26	0.803	0.027	0.066	0.204	0.06	0.091
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0003	0.0007	0.0002	0.0004	0.0004	0.0003	0.0001
Barium	0.031	0.018	0.019	0.021	0.022	0.016	0.018
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.72	0.86	1.07	0.82	0.7	0.86	0.96
Cadmium	0.00006	0.00002	0.00003	<0.00002	0.00008	0.00003	0.00002
Calcium	386	427	470	453	349	462	400
Chromium	<0.001	0.002	0.001	0.002	<0.001	<0.001	<0.001
Cobalt	0.0056	0.0041	0.0057	0.0056	0.0131	0.006	0.0069
Copper	0.0029	0.0045	0.0018	0.0013	0.003	0.0013	0.0009
Iron	0.315	1.05	0.133	0.192	0.363	0.261	0.216
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.008	0.009	0.01	0.009	0.013	0.01	0.009
Magnesium	58.2	69.2	68.4	68.1	55.7	66.8	60.3
Manganese	0.783	0.637	0.874	0.805	0.794	0.768	0.715
Mercury	<0.00002	<0.00002	<0.00002	<0.00001	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.015	0.011	0.015	0.014	0.028	0.014	0.015
Potassium	4.8	5.79	5.39	5.46	5.01	5.38	5.03
Selenium	0.0008	0.0002	0.0005	0.0006	0.0025	0.0006	0.001
Silicon	4.3	5.5	4.1	4.6	3.7	4.5	4.1
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	217	325	340	303	261	334	297
Strontium	2.62	3.12	3.22	2.86	2.32	2.96	2.78
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	0.01	0.043	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.014	0.009	0.008	0.008	0.019	0.013	0.013
Zirconium	<0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals							
Aluminum	0.034	0.046	0.0215	0.018	0.0261	0.0202	0.0301
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0003	0.0001	0.0001	0.00013	0.00013	0.00021	0.00016
Barium	0.027	0.016	0.0197	0.0217	0.0218	0.0168	0.0186
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Boron	0.64	0.92	0.922	0.946	0.669	0.938	0.789
Cadmium	0.00005	0.00004	0.000016	0.000025	0.000062	0.000032	0.000022
Calcium	408	418	433	409	375	432	419
Chromium	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	0.0051	0.0034	0.00547	0.00541	0.0125	0.00585	0.00657
Copper	0.0019	0.0025	0.00101	0.00973	0.0023	0.00129	0.00078
Iron	0.04	0.038	0.0398	0.0196	0.0203	0.0533	0.0364
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	0.007	0.009	0.0103	0.0085	0.0127	0.0098	0.01
Magnesium	59.4	69.3	67.2	64.3	53.8	65.9	58
Manganese	0.734	0.605	0.847	0.774	0.757	0.763	0.671
Mercury	<0.00002	<0.00002	<0.00002	<0.00001	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Nickel	0.014	0.01	0.0133	0.0137	0.0266	0.0143	0.015
Potassium	5.09	6.91	5.25	5.06	4.85	5.37	4.88
Selenium	0.0008	0.0002	0.0005	0.0006	0.00244	0.00064	0.00104
Silicon	4.6	4.7	4.49	4.46	3.73	4.2	3.89
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	224	321	328	286	258	331	290
Strontium	2.27	3.28	3.08	2.74	2.23	3.08	2.68
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Uranium	0.0002	0.0002	0.0002	0.0002	0.00014	0.00016	0.00014
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zinc	0.012	0.007	0.0085	0.0071	0.0144	0.0126	0.0112
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre.

TABLE 43
LLE-0649 WATER QUALITY
2011/12
COMPANY IDENTITY- LLE

Parameter	April				May				June				Site Description	
Sample Date	5	8	11	25	2	9	13	23	8	14	21	28	GPS (m)	
Conductivity (umhos/cm)	254	269	274	278	242	263	182	245	279	305	373	430	Minegrid	
Hardness CaCO3	99.7	-	-	-	103	-	-	-	113	-	-	-	Northing	Easting
pH	7.26	7.18	7.26	7.26	7.01	7.21	7.23	7.3	7.35	7.6	7.39	7.41	101389	99552
Total Suspended Solids	<4	<4	7	<4	2	<4	<4	<4	<4	<4	<4	<4	UTM ZONE 10	
Total Dissolved Solids	140	-	-	-	160	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	2	1.4	3	<0.5	2	1.5	<0.5	5.4	0.6	<0.5	0.6	-	5532912	323456
Alkalinity - Total CaCO3	22	27	27	28	28	26	29	28	32	39	38	43		
Ammonia Nitrogen	0.017	-	-	-	0.035	-	-	-	0.031	-	-	-		
Nitrate and Nitrite as N	0.05	-	-	-	0.04	-	-	-	<0.02	-	-	-		
Kjeldahl Nitrogen	0.16	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	0.006	-	-	-		
Sulphate	98	96	100	93	85	99	54	90	93	110	130	160		

South Mine Area, Last Sampling Point Above Long Lake

Parameter	July					August					September				Site Description	
Sample Date	4	4*	11	18	26	3	8	15	22	29	7	14	20	26	GPS (m)	
Conductivity (umhos/cm)	475	478	681	246	393	726	978	953	945	956	976	982	982	85	Minegrid	
Hardness CaCO3	223	223	-	106	-	378	-	-	-	486	-	-	-	-	Northing	Easting
pH	7.32	7.3	7.38	7.4	7.36	7.28	7.16	7.24	7.1	7.37	7.51	7.43	7.5	7.27	101389	99552
Total Suspended Solids	<4	<4	3	<4	<4	15	31	27	28	35	24	28	29	5	UTM ZONE 10	
Total Dissolved Solids	300	300	-	-	-	570	-	-	-	710	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	3.9	4.3	4.6	4.5	3.1	4.7	21.1	13.6	31.5	25.3	17.4	22.4	20.3	0.6	5532912	323456
Alkalinity - Total CaCO3	47	49	56	42	49	69	88	94	100	110	120	120	130	22		
Ammonia Nitrogen	0.054	0.042	-	-	-	0.12	-	-	-	0.18	-	-	-	-		
Nitrate and Nitrite as N	<0.02	<0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.005	<0.005	-	-	-	<0.005	-	-	-	0.01	-	-	-	-		
Total Phosphorus	0.005	<0.005	-	-	-	0.009	-	-	-	0.013	-	-	-	-		
Sulphate	170	180	260	74	130	260	400	360	350	390	360	380	360	14		

South Mine Area, Last Sampling Point Above Long Lake

Parameter	October					November				December				Site Description	
Sample Date	5	11	17	24	31	8	14	22	29	6	13	20	28	GPS (m)	
Conductivity (umhos/cm)	110	196	254	253	287	253	277	183	280	345	427	268	238	Minegrid	
Hardness CaCO3	46.9	-	-	-	124	-	-	-	-	147	-	-	-	Northing	Easting
pH	7.17	7.38	7.32	7.28	7.38	7.37	7.51	7.11	7.16	7.11	7.23	7.3	7.33	101389	99552
Total Suspended Solids	14	<4	7	<4	<4	<4	<4	4.2	<4	<4	<4	<4	<4	UTM ZONE 10	
Total Dissolved Solids	74	-	-	-	180	-	-	-	-	232	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1	1.3	2.5	1.8	3	5.1	0.7	1.6	1.3	2.1	2.9	1.1	<0.5	5532912	323456
Alkalinity - Total CaCO3	24	31	33	31	35	30.9	30.3	21.6	21.9	29	33.8	22.1	23.9		
Ammonia Nitrogen	-	-	-	-	0.031	-	-	-	-	0.1	-	-	-		
Nitrate and Nitrite as N	-	-	-	-	0.02	-	-	-	-	0.03	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	0.02	-	-	-	-	0.03	-	-	-		
Dissolved Phosphorus	-	-	-	-	<0.005	-	-	-	-	0.0135	-	-	-		
Total Phosphorus	-	-	-	-	0.006	-	-	-	-	0.0052	-	-	-		
Sulphate	27	61	77	87	100	82.4	101	62	109	129	151	93.3	86.9		

South Mine Area, Last Sampling Point Above Long Lake

Parameter	January					February				March				Site Description	
Sample Date	5	11	17	24	31	8	14	22	29	6	13	20	27	GPS (m)	
Conductivity (umhos/cm)	184	296	337	214	213	245	256	263	195	207	204	258	262	Minegrid	
Hardness CaCO3	73.2	-	-	-	-	98.4	-	-	-	88.5	-	-	-	Northing	Easting
pH	7.34	7.5	7.39	7.52	7.41	7.51	7.57	7.64	7.48	7.42	7.5	7.44	7.37	101389	99552
Total Suspended Solids	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	UTM ZONE 10	
Total Dissolved Solids	112	-	-	-	-	212	-	-	-	152	-	-	-	Northing	Easting
Acidity (to pH 8.3)	0.6	<0.5	2	<0.5	0.8	1.7	1.5	1.5	0.6	<0.5	<0.5	1.3	1.1	5532912	323456
Alkalinity - Total CaCO3	17.8	25.9	24.8	20.6	22	23.4	26.1	26.8	20.4	22.9	23.3	25.5	24.3		
Ammonia Nitrogen	0.013	-	-	-	-	0.014	-	-	-	0.023	-	-	-		
Nitrate and Nitrite as N	<0.020	-	-	-	-	0.031	-	-	-	<0.020	-	-	-		
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-		
Total Phosphorus	0.0062	-	-	-	-	<0.0050	-	-	-	<0.0050	-	-	-		
Sulphate	63.1	113	124	70.7	72.2	89.7	98.5	96.5	67.3	70.8	74.7	93.9	97.7		

South Mine Area, Last Sampling Point Above Long Lake

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 44-1
LLE-0649 METALS ANALYSIS
2011/12
COMPANY INDENTITY - LLE

Parameter	April	May	June	July		August		September
Sample Date	5	2	6	4	4*	3	29	7
Total Metals								
Aluminum	0.064	0.104	0.066	0.027	0.031	0.061	0.026	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0008	0.0011	0.0015	0.0013	0.0013	0.0032	0.0055	-
Barium	0.014	0.02	0.018	0.031	0.029	0.06	0.085	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	<0.05	<0.05	<0.05	0.07	0.07	0.11	0.13	-
Cadmium	0.00002	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.00003	-
Calcium	31.7	32.6	36.4	62	63	99.6	163	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	0.0013	-
Copper	0.0005	0.0009	0.0006	0.0007	0.0005	0.0006	0.0003	-
Iron	0.208	0.515	0.407	1.06	1.07	6.49	13.2	-
Hardness	-	-	-	197	199	316	515	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	-	-	<0.005	<0.005	-
Magnesium	5	5.12	5.49	10.3	10.1	16.3	26	-
Manganese	0.05	0.071	0.069	0.108	0.104	0.551	1.43	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	<0.005	<0.005	0.006	0.005	<0.005	0.009	0.013	-
Potassium	0.38	0.39	0.39	0.34	0.31	0.62	1.14	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	2.5	2.4	2.4	2.3	2.3	3.6	5.9	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	4	4.93	5	9.41	8.91	13.3	20.8	-
Strontium	0.197	0.2	0.223	0.4	0.394	0.654	1.03	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Disssolved Metals								
Aluminum	0.041	0.035	0.04	0.013	0.014	0.008	0.023	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0007	0.001	0.0015	0.0013	0.0014	0.0015	0.005	-
Barium	0.015	0.019	0.019	0.035	0.034	0.066	0.077	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	<0.05	<0.05	0.05	0.08	0.08	0.11	0.15	-
Cadmium	<0.00001	<0.00001	<0.00001	0.00001	0.00001	0.00002	<0.00001	-
Calcium	34	31.2	39	70.5	69.8	120	155	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.001	0.0013	-
Copper	0.001	0.0007	0.0008	0.0005	0.0005	0.0011	0.0003	-
Iron	0.166	0.355	0.315	1.05	1.03	2.06	12.6	-
Hardness	-	-	-	223	223	378	486	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	-	-	<0.005	<0.005	-
Magnesium	4.89	5.11	5.78	11.4	11.8	19.1	24.4	-
Manganese	0.047	0.069	0.069	0.116	0.119	0.614	1.32	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	-
Potassium	0.37	0.38	0.42	0.38	0.4	0.81	1.08	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	2.6	2.3	2.5	-	-	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	3.78	4.96	5.33	10.6	10.7	15.3	23.4	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 44-2
LLE-0649 METALS ANALYSIS
2011/12
COMPANY INDENTITY - LLE

Parameter	October		November	December	January	February	March
Sample Date	5	31	2	6	5	7	6
Total Metals							
Aluminum	0.606	0.066	-	0.059	0.141	0.058	0.067
Antimony	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.001	0.0015	-	0.001	0.0005	0.0007	0.0009
Barium	0.011	0.019	-	0.017	0.008	0.01	0.008
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05
Cadmium	0.00002	<0.00001	-	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	14.6	39.8	-	47	24	31.4	28.6
Chromium	<0.001	<0.001	-	0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.0027	0.001	-	0.0008	0.0017	0.0004	0.0004
Iron	1.04	0.861	-	1.3	0.24	0.457	0.196
Lead	0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Magnesium	2.54	6.07	-	7.14	3.24	4.84	4.17
Manganese	0.042	0.219	-	0.142	0.014	0.044	0.022
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Nickel	0.001	<0.001	-	0.002	<0.001	<0.001	<0.001
Potassium	0.5	0.41	-	0.441	0.318	0.324	0.299
Selenium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	4	3.8	-	3.3	2.8	2.7	2.8
Silver	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	2.94	6.01	-	5.89	2.32	3.58	2.91
Strontium	0.093	0.233	-	0.277	0.133	0.178	0.151
Thallium	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Titanium	0.039	<0.005	-	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals							
Aluminum	0.078	0.035	-	0.0376	0.0653	0.0308	0.0382
Antimony	<0.0005	<0.0005	-	<0.0013	<0.00050	<0.00050	<0.00050
Arsenic	0.0006	0.0014	-	0.00082	0.00049	0.00063	0.00088
Barium	0.009	0.018	-	0.0166	0.008	0.0096	0.008
Beryllium	<0.0001	<0.0001	-	<0.00025	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	-	<0.0025	<0.0010	<0.0010	<0.0010
Boron	<0.05	<0.05	-	<0.13	<0.050	<0.050	<0.050
Cadmium	<0.00001	<0.00001	-	<0.000025	<0.000010	<0.000010	<0.000010
Calcium	14.4	38	-	48.2	24.5	31.6	27.2
Chromium	<0.001	<0.001	-	<0.0025	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	-	<0.0013	<0.00050	<0.00050	<0.00050
Copper	0.0011	0.0007	-	0.00147	0.00147	0.00202	0.00059
Iron	0.176	0.65	-	1.27	0.136	0.395	0.162
Lead	<0.0002	<0.0002	-	<0.00050	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	-	<0.013	<0.0050	<0.0050	<0.0050
Magnesium	2.16	5.96	-	6.96	3.57	4.7	4.16
Manganese	0.007	0.209	-	0.142	0.0125	0.0447	0.0212
Mercury	<0.00002	<0.00002	-	<0.00001	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.0025	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	-	<0.0025	<0.0010	<0.0010	<0.0010
Potassium	0.39	0.49	-	0.36	0.355	0.461	0.335
Selenium	<0.0001	<0.0001	-	<0.00025	<0.00010	<0.00010	<0.00010
Silicon	3.5	3.6	-	3.66	2.82	2.94	2.59
Silver	<0.00002	<0.00002	-	<0.00005	<0.000020	<0.000020	<0.000020
Sodium	2.56	5.74	-	6.01	2.63	3.68	2.88
Strontium	0.083	0.237	-	0.272	0.14	0.171	0.15
Thallium	<0.00005	<0.00005	-	<0.00013	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	-	<0.013	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	-	<0.013	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	-	<0.00025	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	-	<0.013	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	-	<0.013	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	-	<0.0013	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre except where noted.
* Field replicate sample.

TABLE 45
7 SOUTH WATER QUALITY
2011/12
COMPANY IDENTITY- 7S

Parameter	April				May					June				Site Descripiton	
Sample Date	4	11	18	25	2	9	13	23	30	6	12	20	29	GPS (m)	
Conductivity (umhos/cm)	32	33	35	39	35	39	37	38	35	39	-	54	-	Minegrid	
Hardness CaCO3	12.4	-	-	-	14.9	-	-	-	-	14.8	-	-	-	Northing	Easting
pH	7.16	7.13	7.25	7.35	7.04	6.99	7.21	7.24	7.3	7.48	-	7.37	-	101595	101815
Total Suspended Solids	<4	<4	<4	<4	3	<4	<4	<5	-	<4	-	<4	-	UTM ZONE 10	
Total Dissolved Solids	18	-	-	-	20	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	1.1	1.4	0.6	0.7	<0.5	0.6	0.8	0.6	<0.5	<0.5	-	2.5	-	5534846	324646
Alkalinity - Total CaCO3	13	14	16	20	16	18	16	16	16	21	-	27	-		
Ammonia Nitrogen	0.012	-	-	-	0.026	-	-	-	-	0.018	-	-	-		
Nitrate and Nitrite as N	0.04	-	-	-	0.04	-	-	-	-	<0.02	-	-	-	7 South Effluent Before Quinsam River Lower Wetland	
Kjeldahl Nitrogen	0.11	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-		
Sulphate	1	<0.5	0.7	<0.5	0.7	<0.5	0.8	<0.5	1.5	1.9	-	1.3	-		

Parameter	July				August				September				Site Descripiton	
Sample Date	4	11^	18^	25^	2^	9^	13^	23^	6^	12^	26^	29^	GPS (m)	
Conductivity (umhos/cm)	54	-	-	-	-	-	-	-	-	-	46	-	Minegrid	
Hardness CaCO3	24.6	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
pH	7.38	-	-	-	-	-	-	-	-	-	7.53	-	101595	101815
Total Suspended Solids	<4	-	-	-	-	-	-	-	-	-	-	-	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	2.2	-	-	-	-	-	-	-	-	-	<0.5	-	5534846	324646
Alkalinity - Total CaCO3	28	-	-	-	-	-	-	-	-	-	21	-		
Ammonia Nitrogen	0.032	-	-	-	-	-	-	-	-	-	-	-		
Nitrate and Nitrite as N	<0.02	-	-	-	-	-	-	-	-	-	-	-	7 South Effluent Before Quinsam River Lower Wetland	
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	-	-	-	-	-	-	-	-		
Total Phosphorus	<0.005	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	2.7	-	-	-	-	-	-	-	-	-	0.7	-		

Parameter	October				November					December				Site Descripiton	
Sample Date	3	11	17	24	1	8	14	14*	29	7	13	22	28	GPS (m)	
Conductivity (umhos/cm)	53	41	45	44	43	45.6	35.2	35.6	-	33.4	32.8	32.8	31.2	Minegrid	
Hardness CaCO3	24.6	-	-	-	17.3	-	-	-	-	12.5	13.1	-	-	Northing	Easting
pH	7.4	7.12	7.42	7.22	7.34	7.19	7.26	7.17	-	7.15	7.34	7.34	7.21	101595	101815
Total Suspended Solids	<4	-	-	-	<4	-	<4		<4	<4	<4	<4	<4	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	3.7	1.2	2.2	0.6	<0.5		<0.5	<0.5	<0.5	<0.5	5534846	324646
Alkalinity - Total CaCO3	25	17	25	20	17	20.9	12.5	12.5	-	12.2	-	13.1	10.3		
Ammonia Nitrogen	0.01	-	-	-	0.014	-	-	-	-	0.01	-	-	-		
Nitrate and Nitrite as N	0.08	-	-	-	0.04	-	-	-	-	0.314	-	-	-	7 South Effluent Before Quinsam River Lower Wetland	
Kjeldahl Nitrogen	0.14	-	-	-	0.21	-	-	-	-	0.188	-	-	-		
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-		
Total Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005		-	-		
Sulphate	2	<0.5	0.6	1.1	-	<0.5	1.3	0.78	-	0.71	0.66	0.66	1.09		

Parameter	January						February				March				Site Descripiton	
Sample Date	3	9	17	17*	24	31	6	14	21	28	7	13	20	27	GPS (m)	
Conductivity (umhos/cm)	32.5	18.2	32.4	31.4	-	-	-	32.4	-	-	30.2	-	28.9	33	Minegrid	
Hardness CaCO3	11.5	-	-	-	-	-	-	-	-	-	12	-	-	-	Northing	Easting
pH	7.32	6.86	7.36	7.29	-	-	-	7.35	-	-	7.13	-	7.2	7.21	101595	101815
Total Suspended Solids	<4.0	-	-	-	-	-	-	<4.0	-	-	<4.0	-	<4.0	<4.0	UTM ZONE 10	
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	<0.5	2.6	<0.5	<0.5	-	-	-	<0.5	-	-	<0.5	-	1	1.6	5534846	324646
Alkalinity - Total CaCO3	11.5	6.51	13.3	12.9	-	-	-	12.2	-	-	10.1	-	11.4	12.6		
Ammonia Nitrogen	0.016	-	-	-	-	-	-	-	-	-	0.015	-	-	-		
Nitrate and Nitrite as N	0.325	-	-	-	-	-	-	-	-	-	0.162	-	-	-	7 South Effluent Before Quinsam River Lower Wetland	
Kjeldahl Nitrogen	0.123	-	-	-	-	-	-	-	-	-	0.115	-	-	-		
Dissolved Phosphorus	<0.0050	-	-	-	-	-	-	-	-	-	<0.0050	-	-	-		
Total Phosphorus	<0.0050	-	-	-	-	-	-	-	-	-	<0.0050	-	-	-		
Sulphate	0.55	<0.50	<0.50	<0.50	-	-	-	<0.50	-	-	1.14	-	<0.50	2.52		

Results are expressed in milligrams per litre except where noted.
^ = No flow/dry

TABLE 46-1
7 SOUTH METALS ANALYSIS
2011/12
COMPANY IDENTITY - 7S

Parameter / Sample Date	April 4	May **2**	June 6	July 4	August 2^	September 6^
Total Metals						
Aluminum	0.043	0.058	0.026	0.11	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	<0.0001	<0.0001	0.0001	-	-
Barium	0.001	0.002	0.001	0.003	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Bismuth	<0.001	<0.001	<0.001	<0.001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	0.00001	0.00001	-	-
Calcium	3.69	4.48	4.41	7.36	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0004	0.0005	0.0004	0.001	-	-
Iron	0.02	0.029	0.008	0.08	-	-
Hardness	-	-	-	24.7	-	-
Lead	<0.0002	<0.0002	<0.0002	0.0004	-	-
Lithium	<0.005	<0.005	-	-	-	-
Magnesium	0.76	0.9	0.92	1.54	-	-
Manganese	<0.001	0.005	<0.001	0.005	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	-	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	0.09	0.08	0.11	0.12	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silicon	3.4	3.8	3.7	4.5	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	1.18	1.3	1.43	2.2	-	-
Strontium	0.013	0.017	0.018	0.03	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	0.006	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	-	-
Dissolved Metals						
Aluminum	0.033	0.022	0.023	0.019	-	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Arsenic	<0.0001	<0.0001	0.0001	<0.0001	-	-
Barium	0.001	0.001	0.001	0.002	-	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Boron	<0.05	<0.05	<0.05	<0.05	-	-
Cadmium	<0.00001	<0.00001	<0.00001	0.00002	-	-
Calcium	3.81	4.7	4.88	7.31	-	-
Chromium	<0.001	<0.001	<0.001	<0.001	-	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Copper	0.0006	0.0004	0.0004	0.0009	-	-
Iron	0.009	0.005	0.006	0.013	-	-
Hardness	-	-	-	24.6	-	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	-	-
Lithium	<0.005	<0.005	-	-	-	-
Magnesium	0.75	0.99	1.02	1.55	-	-
Manganese	<0.001	<0.001	<0.001	0.002	-	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	-
Nickel	<0.001	<0.001	<0.001	<0.001	-	-
Phosphorus	<0.005	<0.005	<0.005	<0.005	-	-
Potassium	0.08	0.1	0.13	0.27	-	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	-	-
Sodium	1.16	1.41	1.62	2.21	-	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	-
Tin	<0.005	<0.005	<0.005	<0.005	-	-
Titanium	<0.005	<0.005	<0.005	0.006	-	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Vanadium	<0.005	<0.005	<0.005	<0.005	-	-
Zinc	<0.005	<0.005	<0.005	<0.005	-	-

Results are expressed in milligrams per litre except where noted.
^ Dry, no flow.

TABLE 46-2
7 SOUTH METALS ANALYSIS
2011/12
COMPANY IDENTITY - 7S

Parameter / Sample Date	October 3	November 1	December 7	January 3	February 6	March 7
Total Metals						
Aluminum	0.029	0.028	0.043	0.064	-	0.071
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005
Arsenic	<0.0001	<0.0001	0.0001	0.0002	-	<0.0001
Barium	0.002	0.001	0.001	0.001	-	0.001
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	-	<0.001
Boron	<0.05	<0.05	<0.05	<0.05	-	<0.05
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	-	<0.00001
Calcium	5.92	5.16	3.81	3.37	-	3.59
Chromium	<0.001	<0.001	0.001	<0.001	-	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005
Copper	0.0005	0.0007	0.0006	0.0005	-	0.0005
Iron	0.011	0.008	0.02	0.025	-	0.054
Lead	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	-	<0.005
Magnesium	1.19	1.06	0.73	0.757	-	0.746
Manganese	<0.001	0.009	<0.001	<0.001	-	<0.001
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	-	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	-	<0.001
Nickel	<0.001	<0.001	0.001	<0.001	-	<0.001
Potassium	0.07	0.17	0.067	0.117	-	0.083
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001
Silicon	4.3	4.1	3.6	3.2	-	3.6
Silver	<0.00002	<0.00002	<0.00002	<0.00002	-	<0.00002
Sodium	1.78	1.6	1.29	1.41	-	1.33
Strontium	0.026	0.018	0.013	0.012	-	0.012
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	-	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	-	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	-	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	-	<0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	-	<0.0005
Dissolved Metals						
Aluminum	0.022	0.025	0.0373	0.0582	-	0.0578
Antimony	<0.0005	<0.0005	<0.0005	<0.00050	-	<0.00050
Arsenic	<0.0001	<0.0001	<0.0001	0.00013	-	<0.00010
Barium	0.002	0.001	<0.0010	0.0012	-	0.0011
Beryllium	<0.0001	<0.0001	<0.0001	<0.00010	-	<0.00010
Bismuth	<0.001	<0.001	<0.001	<0.0010	-	<0.0010
Boron	<0.05	<0.05	<0.05	<0.050	-	<0.050
Cadmium	<0.00001	<0.00001	<0.00001	<0.000010	-	<0.000010
Calcium	7.6	5.43	3.7	4.01	-	3.51
Chromium	<0.001	<0.001	<0.001	<0.0010	-	<0.0010
Cobalt	<0.0005	<0.0005	<0.0005	<0.00050	-	<0.00050
Copper	0.0006	0.0008	0.0008	0.004	-	0.00071
Iron	0.007	0.006	0.0138	0.0213	-	0.0396
Lead	<0.0002	<0.0002	<0.0002	<0.00020	-	<0.00020
Lithium	<0.005	<0.005	<0.005	<0.0050	-	<0.0050
Magnesium	1.31	1.05	0.741	0.794	-	0.697
Manganese	<0.001	0.001	<0.001	0.0011	-	<0.0010
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	-	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.0010	-	<0.0010
Nickel	<0.001	<0.001	<0.001	<0.0010	-	<0.0010
Potassium	0.1	0.12	0.072	0.101	-	0.13
Selenium	<0.0001	<0.0001	<0.0001	<0.00010	-	<0.00010
Silicon	5.8	4.3	3.71	3.84	-	3.38
Silver	<0.00002	<0.00002	<0.00002	<0.000020	-	<0.000020
Sodium	1.88	1.78	1.33	1.49	-	1.39
Strontium	0.024	0.02	0.0136	0.0141	-	0.0129
Thallium	<0.00005	<0.00005	<0.00005	<0.000050	-	<0.000050
Tin	<0.005	<0.005	<0.005	<0.0050	-	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.0050	-	<0.0050
Uranium	<0.0001	<0.0001	<0.0001	<0.00010	-	<0.00010
Vanadium	<0.005	<0.005	<0.005	<0.0050	-	<0.0050
Zinc	<0.005	<0.005	<0.005	<0.0050	-	<0.0050
Zirconium	<0.0005	<0.0005	<0.0005	<0.00050	-	<0.00050

Results are expressed in milligrams per litre except where noted.
^ Dry, no flow.

TABLE 47
3 SOUTH-77 WATER QUALITY
2011/12
COMPANY IDENTITY - 3S77

Parameter	April				May				June					Site Description
Sample Date	2	13	20	27	2	11	19	26	6	12	15	22	29	
Conductivity (umhos/cm)	-	-	-	-	697	-	-	-	575	-	-	-	-	**Minegrid**
Hardness CaCO3	-	-	-	-	352	-	-	-	247	-	-	-	-	**Northing** **Easting**
pH	-	-	-	-	7.52	-	-	-	7.68	-	-	-	-	101060 98505
Total Dissolved Solids	-	-	-	-	490	-	-	-	-	-	-	-	-	**UTM ZONE 10**
Total Suspended Solids	-	-	-	-	3	-	-	-	-	-	-	-	-	**Northing** **Easting**
Acidity (to pH 8.3)	-	-	-	-	4.2	-	-	-	1.6	-	-	-	-	5531876 323093
Alkalinity - Total CaCO3	-	-	-	-	66	-	-	-	64	-	-	-	-	
Ammonia Nitrogen	-	-	-	-	0.024	-	-	-	-	-	-	-	-	
Nitrate - Nitrite as N	-	-	-	-	<0.02	-	-	-	-	-	-	-	-	**20 tonne Bulk Sample Pit in 3 Seam above 4 South Mine**
Kjeldahl Nitrogen	-	-	-	-	0.42	-	-	-	-	-	-	-	-	
Dissolved Phosphate	-	-	-	-	<0.005	-	-	-	-	-	-	-	-	
Total Phosphate	-	-	-	-	<0.005	-	-	-	-	-	-	-	-	
Sulphate	-	-	-	-	250	-	-	-	200	-	-	-	-	

Parameter	July				August				September					Site Description
Sample Date	4	13	20	27	3	11	19	29	6	12	15	22	29	
Conductivity (umhos/cm)	614	-	-	-	629	-	-	641	-	-	-	-	-	**Minegrid**
Hardness CaCO3	296	-	-	-	329	-	-	311	-	-	-	-	-	**Northing** **Easting**
pH	7.42	-	-	-	7.69	-	-	7.85	-	-	-	-	-	101060 98505
Total Suspended Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	**UTM ZONE 10**
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	**Northing** **Easting**
Acidity (to pH 8.3)	7.4	-	-	-	0.9	-	-	7.7	-	-	-	-	-	5531876 323093
Alkalinity - Total CaCO3	78	-	-	-	85	-	-	92	-	-	-	-	-	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	**20 tonne Bulk Sample Pit in 3 Seam above 4 South Mine**
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dissolved Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sulphate	220	-	-	-	220	-	-	220	-	-	-	-	-	

Parameter	October					November				December					Site Description
Sample Date	3	11	17	24	31	8	14	22	29	6	13	20	29	29*	
Conductivity (umhos/cm)	647	-	-	-	618	-	-	-	-	589	-	-	564	522	**Minegrid**
Hardness CaCO3	292	-	-	-	263	-	-	-	-	276	-	-	257	237	**Northing** **Easting**
pH	7.57	-	-	-	7.64	-	-	-	-	7.36	-	-	7.81	7.83	101060 98505
Total Suspended Solids	-	-	-	-	<4	-	-	-	-	-	-	-	-	-	**UTM ZONE 10**
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	368	338	**Northing** **Easting**
Acidity (to pH 8.3)	2.4	-	-	-	3	-	-	-	-	3	-	-	0.6	<0.5	5531876 323093
Alkalinity - Total CaCO3	86	-	-	-	68	-	-	-	-	54.2	-	-	55.6	53.2	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrate - Nitrite as N		-	-	-	-	-	-	-	-	-	-	-	-	-	**20 tonne Bulk Sample Pit in 3 Seam above 4 South Mine**
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dissolved Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sulphate	220	-	-	-	250	-	-	-	-	342	-	-	210	188	

Parameter	January					February				March				Site Description
Sample Date	5	10	17	24	31	7	14	21	28	6	13	20	27	
Conductivity (umhos/cm)	424	493	584	521	438	517	470	519	526	486	-	452	522	**Minegrid**
Hardness CaCO3	175	-	-	-	-	242	-	-	-	213	-	-	-	**Northing** **Easting**
pH	7.63	7.5	7.5	7.79	7.24	7.61	7.83	7.68	7.77	7.64	-	7.32	7.54	101060 98505
Total Suspended Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	**UTM ZONE 10**
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	**Northing** **Easting**
Acidity (to pH 8.3)	1.3	2.8	2.8	<0.5	2.1	2.8	1.6	2.9	0.9	0.8	-	1.8	1.9	5531876 323093
Alkalinity - Total CaCO3	47.9	45.6	53	41.9	37.9	49.6	46.8	45.6	50.8	49.5	-	45.1	51.3	
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrate - Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	**20 tonne Bulk Sample Pit in 3 Seam above 4 South Mine**
Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dissolved Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total Phosphate	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sulphate	152	182	228	197	162	158	187	239	190	186	-	171	227	

Results expressed in milligrams per litre except where noted.
* Field Replicate Sample.

TABLE 48-1
3 SOUTH-77 METALS ANALYSIS
2011/12
COMPANY IDENTITY - 3S77

Parameter	April	May	June	July	August		September
Sample Date	2	2	6	4	3	29	6
Total Metals							
Aluminum	-	0.033	0.011	0.01	0.04	0.045	-
Antimony	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	-	0.0006	0.0004	0.0007	0.0014	0.0021	-
Barium	-	0.022	0.016	0.019	0.022	0.021	-
Beryllium	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	-	0.1	0.09	0.13	0.13	0.11	-
Cadmium	-	<0.00001	0.00007	<0.00001	<0.00001	<0.00001	-
Calcium	-	116	81.7	89.1	90.3	89.3	-
Chromium	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Copper	-	0.0008	0.0011	0.0006	0.0006	0.0004	-
Iron	-	0.094	0.05	0.054	0.127	0.139	-
Hardness	-	-	-	273	278	274	-
Lead	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	-	<0.005	-	-	<0.005	<0.005	-
Magnesium	-	15.4	10.3	12.3	12.8	12.3	-
Manganese	-	0.014	0.005	0.022	0.048	0.079	-
Mercury	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	-	<0.005	-	-	-	-	-
Potassium	-	0.94	1.02	0.88	0.89	0.96	-
Selenium	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	-	3	2.8	2.9	3.1	3.4	-
Silver	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	-	11.3	7.7	12.8	11.5	11.6	-
Strontium	-	0.652	0.45	0.537	0.559	0.536	-
Thallium	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Disssolved Metals							
Aluminum	-	0.01	0.007	0.014	0.005	0.003	-
Antimony	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	-	0.0006	0.0005	0.0008	0.0013	0.0021	-
Barium	-	0.021	0.018	0.022	0.025	0.023	-
Beryllium	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	-	0.09	0.1	0.12	0.14	0.14	-
Cadmium	-	0.00001	0.00007	0.00002	0.00002	<0.00001	-
Calcium	-	112	83	95.7	108	103	-
Chromium	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Copper	-	0.0007	0.0011	0.0009	0.0005	0.0005	-
Iron	-	0.049	0.028	0.035	0.034	0.056	-
Hardness	-	-	-	296	329	311	-
Lead	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	-	<0.005	-	-	<0.005	<0.005	-
Magnesium	-	14.7	11.9	13.9	14.7	13.2	-
Manganese	-	0.013	0.005	0.024	0.046	0.083	-
Mercury	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	-	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	-	<0.005	-	-	-	-	-
Potassium	-	0.94	1.18	1.17	1.05	1.06	-
Selenium	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	-	2.9	2.8	-	-	-	-
Silver	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	-	11.3	8.97	11.7	13.3	12.5	-
Thallium	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	-	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	-	<0.005	<0.005	<0.005	<0.005	<0.005	-

Results expressed in milligrams per litre except where noted.
* Filed replicate sample.

TABLE 48-2
3 SOUTH-77 METALS ANALYSIS
2011/12
COMPANY IDENTITY - 3S77

Parameter	October		November	December	January	February	March
Sample Date	3	31	2	6	5	6	6
Total Metals							
Aluminum	0.006	0.053	-	0.019	0.015	0.01	0.01
Antimony	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0026	0.0007	-	0.0006	0.0002	0.0003	0.0003
Barium	0.022	0.019	-	0.017	0.01	0.012	0.012
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Boron	0.13	0.11	-	0.09	0.07	0.07	0.08
Cadmium	0.00001	0.00001	-	<0.00001	0.00001	<0.00001	<0.00001
Calcium	95.6	85.9	-	90.6	56.8	79.6	69.7
Chromium	<0.001	0.002	-	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.0004	0.0013	-	0.0007		0.0004	0.0004
Iron	0.127	0.034	-	0.138	0.01	0.038	0.019
Lead	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Magnesium	13	11.8	-	12.1	8.15	10.5	9.49
Manganese	0.117	0.017	-	0.02	0.001	0.002	0.002
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	0.002	-	<0.001	<0.001	<0.001	<0.001
Potassium	1.13	0.92	-	0.677	0.614	0.581	0.55
Selenium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	3.7	3	-	3.1	-	2.8	2.5
Silver	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	12.8	10.2	-	8.79	6.05	6.7	6.11
Strontium	0.622	0.557	-	0.519	0.305	0.436	0.39
Thallium	<0.00005	<0.00005	-	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals							
Aluminum	<0.003	0.008	-	0.0123	0.0083	0.0085	0.0082
Antimony	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0026	0.0008	-	0.00046	0.0002	0.0003	0.00024
Barium	0.021	0.02	-	0.016	0.0106	0.0129	0.0114
Beryllium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010
Boron	0.13	0.13	-	0.08	0.073	0.075	0.076
Cadmium	<0.00001	<0.00001	-	<0.00001	<0.000010	<0.000010	<0.000010
Calcium	99.4	91.7	-	82	60.1	76.7	75.7
Chromium	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050
Copper	0.0003	0.001	-	0.00119	0.0018	0.00101	0.00069
Iron	0.074	0.025	-	0.0941	0.0094	0.015	0.0167
Lead	<0.0002	<0.0002	-	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Magnesium	13	12.1	-	11	8	10.5	9.24
Manganese	0.108	0.02	-	0.0197	0.0016	0.0025	0.0023
Mercury	<0.00002	<0.00002	-	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	-	<0.001	<0.0010	<0.0010	<0.0010
Potassium	1.17	1.07	-	0.669	0.589	0.624	0.561
Selenium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010
Silicon	4	3.5	-	2.93	2.39	2.81	2.95
Silver	<0.00002	<0.00002	-	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	13.1	10.8	-	8.47	6.17	6.82	5.99
Strontium	0.58	0.553	-	0.478	0.319	0.429	0.383
Thallium	<0.00005	<0.00005	-	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	-	<0.0001	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	-	<0.005	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	-	0.0184	<0.0050	0.0088	<0.0050
Zirconium	<0.0005	<0.0005	-	<0.0005	<0.00050	<0.00050	<0.00050

Results expressed in milligrams per litre except where noted.
* Filed replicate sample.

TABLE 49
7 SOUTH QUINSAM RIVER WATER QUALITY
2011/12
COMPANY IDENTITY- 7SQR

Parameter	April				May				June					Site Descripiton
Sample Date	4	10	18	25	3	11	18	30	7	8	15	22	29	GPS (m)
Conductivity (umhos/cm)	143	-	128	135	111	-	-	60	65	-	-	-	-	Minegrid
Hardness CaCO3	34.2	-	37.2	37.4	33.6	-	-	26.2	21.6	-	-	-	-	Northing Easting
pH	7.55	-	7.61	7.6	7.28	-	-	7.43	7.47	-	-	-	-	100966 102233
Total suspended solids	72	-	64	70	70	-	-	44	34	-	-	-	-	UTM ZONE 10
Total dissolved solids	<4	-	<4	<4	1	-	-	<4	<4	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	-	<0.5	<0.5	<0.5	-	-	<0.5	<0.5	-	-	-	-	5534805 325400
Alkalinity - Total CaCO3	31	-	30	31	29	-	-	22	23	-	-	-	-	
Ammonia Nitrogen	0.019	-	0.02	0.082	0.042	-	-	0.026	0.047	-	-	-	-	
Nitrate and Nitrite as N	0.03	-	<0.02	<0.02	<0.02	-	-	<0.02	<0.02	-	-	-	-	
Kjeldahl Nitrogen	0.12	-	0.14	0.18	0.26	-	-	-	-	-	-	-	-	Downstream of 7 South
Dissolved Phosphate	<0.005	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	
Total Phosphate	<0.005	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	-	-	-	-	
Sulphate	32	-	29	29	26	-	-	7	7.9	-	-	-	-	

Parameter	July				August				September					Site Descripiton
Sample Date	4	10	18	25	3	11	18	30	7	8	15	22	29	GPS (m)
Conductivity (umhos/cm)	90	-	-	-	88	-	-	99	-	-	-	-	-	Minegrid
Hardness CaCO3	31.3	-	-	-	29.4	-	-	<50	-	-	-	-	-	Northing Easting
pH	7.54	-	-	-	7.54	-	-	7.6	-	-	-	-	-	100966 102233
Total suspended solids	<4	-	-	-	<4	-	-	<4	-	-	-	-	-	UTM ZONE 10
Total dissolved solids	44	-	-	-	58	-	-	64	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	-	-	-	<0.5	-	-	<0.5	-	-	-	-	-	5534805 325400
Alkalinity - Total CaCO3	28	-	-	-	28	-	-	29	-	-	-	-	-	
Ammonia Nitrogen	0.037	-	-	-	0.048	-	-	0.035	-	-	-	-	-	
Nitrate and Nitrite as N	0.05	-	-	-	<0.02	-	-	<0.02	-	-	-	-	-	Downstream of 7 South
Dissolved Phosphate	<0.005	-	-	-	<0.005	-	-	<0.005	-	-	-	-	-	
Total Phosphate	<0.005	-	-	-	<0.005	-	-	<0.005	-	-	-	-	-	
Sulphate	18	-	-	-	15	-	-	18	-	-	-	-	-	

Parameter	October				November					December					Site Descripiton
Sample Date	3	11	17	24	1	8	14	22	29	7	13	20	28	29	GPS (m)
Conductivity (umhos/cm)	94	-	-	-	109	-	-	-	-	98.9	-	-	-	-	Minegrid
Hardness CaCO3	30.9	-	-	-	32.6	-	-	-	-	29.7	-	-	-	-	Northing Easting
pH	7.5	-	-	-	7.43	-	-	-	-	7.26	-	-	-	-	100966 102233
Total suspended solids	<4	-	-	-	<4	-	-	-	-	<4	-	-	-	-	UTM ZONE 10
Total dissolved solids	54	-	-	-	68	-	-	-	-	52	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	-	-	-	<0.5	-	-	-	-	<0.5	-	-	-	-	5534805 325400
Alkalinity - Total CaCO3	27	-	-	-	27	-	-	-	-	25.8	-	-	-	-	
Ammonia Nitrogen	0.44	-	-	-	0.027	-	-	-	-	0.032	-	-	-	-	
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	-	-	-	-	0.022	-	-	-	-	Downstream of 7 South
Dissolved Phosphate	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	
Total Phosphate	0.007	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	-	
Sulphate	17	-	-	-	23	-	-	-	-	23.7	-	-	-	-	

Parameter	January					February				March				Site Descripiton
Sample Date	5	10	17	24	31	9	14	21	28	6	13	20	27	GPS (m)
Conductivity (umhos/cm)	63.7	-	-	-	-	-	-	-	-	125	-	-	-	Minegrid
Hardness CaCO3	19.8	-	-	-	-	-	-	-	-	35.7	-	-	-	Northing Easting
pH	7.28	-	-	-	-	-	-	-	-	7.44	-	-	-	100966 102233
Total suspended solids	<4.0	-	-	-	-	-	-	-	-	<4.0	-	-	-	UTM ZONE 10
Total dissolved solids	38	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	-	-	-	-	-	-	-	-	<0.5	-	-	-	5534805 325400
Alkalinity - Total CaCO3	15.4	-	-	-	-	-	-	-	-	25.6	-	-	-	
Ammonia Nitrogen	0.0081	-	-	-	-	-	-	-	-	0.024	-	-	-	
Nitrate and Nitrite as N	<0.020	-	-	-	-	-	-	-	-	0.024	-	-	-	Downstream of 7 South
Dissolved Phosphate	<0.0050	-	-	-	-	-	-	-	-	<0.0050	-	-	-	
Total Phosphate	<0.0050	-	-	-	-	-	-	-	-	<0.0050	-	-	-	
Sulphate	10.8	-	-	-	-	-	-	-	-	28.9	-	-	-	

Results are expressed in milligrams per litre except where noted.

TABLE 50-1
7 SOUTH QUINSAM RIVER METALS ANALYSIS
2011/12
COMPANY IDENTITY - 7SQR

Parameter	April			May		June
Sample Date	4	18	25	3	30	7
Total Metals						
Aluminum	0.037	0.037	0.03	0.044	0.039	0.061
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0001	0.0002	0.0001	0.0001	0.0002	0.0002
Barium	0.002	0.003	0.002	0.002	0.002	0.001
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.00001	<0.00001	0.00001	<0.00001	0.00002	<0.00001
Calcium	11.4	12.3	12.3	11.2	8.76	7.23
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.0006	0.0006	0.0007	0.0019	0.0168	0.0008
Iron	0.062	0.1	0.069	0.091	0.176	0.102
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	-
Magnesium	1.42	1.58	1.64	1.38	1.05	0.87
Manganese	0.004	0.011	0.005	0.007	0.007	0.007
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	<0.001	<0.001	0.005	<0.001
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	0.22	0.22	0.23	0.46	0.2	0.1
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	2.1	2.1	2.1	1.9	2.2	1.7
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	12.8	12	12.6	10.2	2.52	2.52
Strontium	0.059	0.067	0.064	0.057	0.028	0.023
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	0.006	<0.005
Dissolved Metals						
Aluminum	0.024	0.019	0.017	0.019	0.01	0.02
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0001	0.0002	0.0003	0.0002	0.0014	0.0002
Barium	0.003	0.002	0.002	0.002	0.026	0.001
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.00001	<0.00001	<0.00001	0.00002	0.00002	0.00001
Calcium	11.7	11.8	13	11.3	11.9	8.05
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	0.002	<0.0005
Copper	0.001	0.0011	0.0009	0.0021	0.0009	0.0009
Iron	0.034	0.043	0.047	0.059	0.224	0.048
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	-
Magnesium	1.43	1.52	1.51	1.4	1.15	1.02
Manganese	0.004	0.006	0.007	0.005	0.311	0.005
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Phosphorus	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Potassium	0.25	0.26	0.23	0.46	1.18	0.17
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	12.9	11.5	11.8	9.71	1.68	3.27
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	0.014
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	0.008	0.027

Results are expressed in milligrams per litre except where noted.

TABLE 50-2
7 SOUTH QUINSAM RIVER METALS ANALYSIS
2011/12
COMPANY IDENTITY - 7SQR

Parameter	July	August		September
Sample Date	4	3	30	1
Total Metals				
Aluminum	0.039	0.029	0.034	-
Antimony	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0003	0.0002	0.0002	-
Barium	0.002	0.002	0.002	-
Beryllium	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	-
Boron	0.05	<0.05	<0.05	-
Cadmium	<0.00001	<0.00001	<0.00001	-
Calcium	11.9	8.51	9.18	-
Chromium	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	-
Copper	0.0024	0.001	0.0008	-
Iron	0.098	0.091	0.09	-
Hardness	36.3	25.5	<50	-
Lead	<0.0002	0.0002	<0.0002	-
Lithium	-	<0.005	<0.005	-
Magnesium	1.58	1.03	1.1	-
Manganese	0.01	0.008	0.007	-
Mercury	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	-
Phosphorus	<0.005	<0.005	<0.005	-
Potassium	0.28	0.27	0.2	-
Selenium	<0.0001	<0.0001	<0.0001	-
Silicon	1.7	1.6	1.5	-
Silver	<0.00002	<0.00002	<0.00002	-
Sodium	14.2	6.04	7.66	-
Strontium	0.07	0.038	0.041	-
Thallium	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	-
Dissolved Metals				
Aluminum	0.016	0.024	0.012	-
Antimony	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0002	0.0002	0.0002	-
Barium	0.002	0.002	0.002	-
Beryllium	<0.0001	<0.0001	<0.0001	-
Boron	<0.05	<0.05	<0.05	-
Cadmium	0.00001	0.00002	<0.00001	-
Calcium	10.5	9.83	9.37	-
Chromium	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	-
Copper	0.0009	0.0015	0.0008	-
Iron	0.059	0.063	0.035	-
Hardness	31.3	29.4	<50	-
Lead	<0.0002	<0.0002	<0.0002	-
Lithium	-	<0.005	<0.005	-
Magnesium	1.23	1.17	1.17	-
Manganese	0.007	0.008	0.004	-
Mercury	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	-
Phosphorus	<0.005	<0.005	<0.005	-
Potassium	0.23	0.63	0.22	-
Selenium	<0.0001	<0.0001	<0.0001	-
Silver	<0.00002	<0.00002	<0.00002	-
Sodium	7.11	6.4	7.92	-
Thallium	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	-

Results are expressed in milligrams per litre except where noted.

TABLE 50-3
7 SOUTH QUINSAM RIVER METALS ANALYSIS
2011/12
COMPANY IDENTITY - 7SQR

Parameter / Sample Date	October 3	November 1	December 7	January 5	February 9	March 6
Total Metals						
Aluminum	0.031	0.083	0.052	0.112	0.158	0.043
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0003	0.0002	0.0002	0.0002	<0.0001	0.0002
Barium	0.002	0.002	0.002	0.002	0.001	0.003
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	10.2	10.9	9.81	6.39	1.71	11.7
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.0007	0.001	0.001	0.0008	0.0005	0.0006
Iron	0.108	0.095	0.115	0.134	0.09	0.077
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	1.31	1.31	1.27	0.922	0.514	1.59
Manganese	0.01	0.007	0.006	0.007	0.002	0.005
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	0.0000023
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Potassium	0.21	0.28	0.181	0.202	0.267	0.208
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	1.7	2	2.4	2.1	3.4	2.5
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	6.13	8.04	7.52	4.07	0.961	9.8
Strontium	0.057	0.047	0.043	0.025	0.011	0.062
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	0.007	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals						
Aluminum	0.01	0.015	0.0236	0.0534	0.1	0.0298
Antimony	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0002	0.0002	0.00014	0.00018	<0.00010	0.00016
Barium	0.002	0.002	0.002	0.0019	0.0011	0.0027
Beryllium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Boron	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050
Cadmium	<0.00001	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010
Calcium	10.5	10.9	9.7	6.26	2.01	11.4
Chromium	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Copper	0.0006	0.001	0.0008	0.00308	0.00107	0.00066
Iron	0.049	0.063	0.049	0.036	0.0249	0.0507
Lead	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Magnesium	1.23	1.35	1.28	0.991	0.495	1.58
Manganese	0.005	0.006	0.004	0.0035	<0.0010	0.0034
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Potassium	0.21	0.33	0.19	0.201	0.29	0.239
Selenium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Silicon	1.8	2.1	2.3	2	3.9	2.44
Silver	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	5.72	7.76	7.61	4.4	1.07	9.69
Strontium	0.045	0.048	0.048	0.0277	0.0115	0.0605
Thallium	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 51-1
MIDDLE POINT TERMINAL EFFLUENT QUALITY
2011/12
COMPANY IDENTITY-MP

Parameters Date	T.S.S (mg/L)	PH (mg/L)	Oil&Grease Total - (mg/L)	Estimated Flow m3/h
7-Apr-11	<4	7.75	<2	2
14-Apr-11	<4	7.8	<2	2
21-Apr-11	<4	7.89	<2	2
28-Apr-11	<1	7.67	<3	2
05-May-11	<4	7.66	<2	2
12-May-11	<4	7.76	<2	2
19-May-11	<1	7.65	<3	2
26-May-11	<4	7.90	<3	2
02-Jun-11	<4	8.16	<3	2
13-Jun-11	<4	7.93	<3	2
20-Jun-11	<4	7.63	<3	2
27-Jun-11	<4	7.54	<3	2
30-Jun-11	<4	7.82	<2	2
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH				

Parameter Date	T.S.S (mg/L)	PH (mg/L)	Oil&Grease Total - (mg/L)	Estimated Flow m3/h
11-Jul-11	1	7.73	<2	2
14-Jul-11	<4	7.75	<1	2
21-Jul-11	<4	7.88	<2	2
28-Jul-11	<1	7.79	1	2
04-Aug-11	<4	7.86	<2	2
11-Aug-11	<4	7.84	<2	2
18-Aug-11	<1	7.88	<2	2
30-Aug-11	<4	7.80	<2	2
04-Sep-11	<4	7.79	<2	2
08-Sep-11	<4	7.82	3	2
15-Sep-11	<4	7.77	<1	2
22-Sep-11	<4	7.85	<1	2
29-Sep-11	<4	7.80	<2	2
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH				

Red = permit exceedance

TABLE 51-2
MIDDLE POINT TERMINAL EFFLUENT QUALITY
2011/12
COMPANY IDENTITY-MP

Parameters Date	TSS mg/L	pH	Oil&Grease mg/L
4-Oct-11	<4	7.77	<1
06-Oct-11	<4	7.66	<3
13-Oct-11	<4	7.71	<1
20-Oct-11	<4	7.85	<1
27-Oct-11	<4	7.66	<1
03-Nov-11	<4	7.80	<1
10-Nov-11	<4	7.79	<1
17-Nov-11	<4	7.61	<1
24-Nov-11	<4	7.79	<1
01-Dec-11	<4	7.77	<1
13-Dec-11	<4	7.84	<1
20-Dec-11	<4	7.96	<1
29-Dec-11		7.81	1.1
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH			

Parameters Date	TSS mg/L	pH	Oil&Grease mg/L
5-Jan-12	<4.0	7.94	<1
12-Jan-12	<4.0	**5.59**	<1
26-Jan-12	<4.0	7.94	<1
02-Feb-12	<4.0	7.97	<1
08-Feb-12	<4.0	7.81	<1
16-Feb-12	5.3	7.91	<1
23-Feb-23	<4.0	7.70	<1
01-Mar-12	9.5	7.74	<1
19-Mar-12	-	7.76	<1
26-Mar-12	-	7.60	<1
Note: Permitted for 50mg/L TSS, 10mg/L O&G, and 6.5-8.5 pH			

Red = permit exceedance

TABLE 52
Quinsam River Downstream Site 1 Water Quality
2011/12
COMPANY IDENTITY-QRDS1

Parameter	April				May				June				Site Descripiton
Sample Date	4	11	18	25	2	9	13	23	6	13	20	27	GPS (m)
Conductivity (umhos/cm)	144	142	133	136	112	113	90	64	64	67	83	82	Minegrid
Hardness CaCO3	35.3	-	-	-	33.5	-	-	-	23.2	-	-	-	Northing Easting
pH	7.58	7.63	7.63	7.64	7.26	7.34	7.54	7.54	7.58	7.35	7.56	7.59	102635 101895
Total Suspended Solids	<4	<4	<4	<4	1	<4	<4	<5	<4	-	-	-	UTM ZONE 10
Total Dissolved Solids	74	-	-	-	70	-	-	-	38	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	<0.5	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	5535534 323861
Alkalinity - Total CaCO3	33	34	31	30	30	27	25	21	22	22	29	25	
Ammonia Nitrogen	0.012	-	-	-	0.019	-	-	-	0.046	-	-	-	
Nitrate and Nitrite as N	0.02	-	-	-	<0.02	-	-	-	<0.02	-	-	-	Downstream of 5
Kjeldahl Nitrogen	0.06	-	-	-	0.14	-	-	-	-	-	-	-	South and Barrier
Dissolved Phosphorus	0.005	-	-	-	<0.005	-	-	-	<0.005	-	-	-	Pillar Influences
Total Phosphorus	0.006	-	-	-	<0.005	-	-	-	<0.005	-	-	-	
Sulphate	34	32	30	29	24	22	17	7.4	9.8	7.3	11	13	

Parameter	July				August						September			Site Descripiton
Sample Date	5	11	18	25	4	4*	8	15	22	30	7	14	20	GPS (m)
Conductivity (umhos/cm)	91	84	86	82	88	97	85	96	102	99	101	90	120	Minegrid
Hardness CaCO3	29.3	-	-	-	28.3	28.3	-	-	-	<50	-	-	-	Northing Easting
pH	7.58	7.6	7.51	7.62	7.56	7.53	7.62	7.56	7.74	7.7	7.76	7.7	7.38	102635 101895
Total Suspended Solids	<4	-	<4	-	<4	<4	-	<4	<4	<4	-	-	-	UTM ZONE 10
Total Dissolved Solids	54	-	-	-	52	48	-	-	-	68	-	-	-	Northing Easting
Acidity (to pH 8.3)	1.4	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5535534 323861
Alkalinity - Total CaCO3	25	28	25	25	25	32	26	27	28	30	29	27	30	
Ammonia Nitrogen	0.012	-	-	-	0.044	0.049	-	-	-	0.027	-	-	-	
Nitrate and Nitrite as N	<0.02	-	-	-	<0.02	<0.02	-	-	-	<0.02	-	-	-	Downstream of 5
Dissolved Phosphorus	<0.005	-	-	-	<0.005	<0.005	-	-	-	<0.005	-	-	-	South and Barrier
Total Phosphorus	<0.005	-	-	-	<0.005	<0.005	-	-	-	<0.005	-	-	-	Pillar Influences
Sulphate	16	14	14	13	14	14	13	16	17	18	16	14	24	

Parameter	October				November					December				Site Descripiton
Sample Date	5	11	17	24	2	8	14	22	29	5	13	21	28	GPS (m)
Conductivity (umhos/cm)	111	113	105	107	110	106	110	96.3	62.7	87.7	99.4	122	130	Minegrid
Hardness CaCO3	30.2	-	-	-	31	-	-	-	-	26.7	-	-	-	Northing Easting
pH	7.65	7.54	7.44	7.52	7.51	7.44	7.6	7.47	7.39	7.43	7.55	7.57	7.39	102635 101895
Total Suspended Solids	<4	-	-	-	<4	-	-	-	-	<4.0	-	-	-	UTM ZONE 10
Total Dissolved Solids	60	-	-	-	62	-	-	-	-	48	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	<0.5	1.9	<0.5	0.5	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5535534 323861
Alkalinity - Total CaCO3	27	26	28	26	25	26.5	27	22.8	16.8	23.1	27.4	29.1	29.2	
Ammonia Nitrogen	0.043	-	-	-	0.016	-	-	-	-	-	-	-	-	
Nitrate and Nitrite as N	0.03	-	-	-	<0.02	-	-	-	-	<0.02	-	-	-	Downstream of 5
Dissolved Phosphorus	<0.005	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	South and Barrier
Total Phosphorus	0.007	-	-	-	<0.005	-	-	-	-	<0.005	-	-	-	Pillar Influences
Sulphate	22	24	22	21	23	19.5	22.7	22.2	9.28	18	19.2	27.8	28.8	

Parameter	January					February				March				Site Descripiton
Sample Date	5	10	17	24	31	7	14	21	28	7	14	20	27	GPS (m)
Conductivity (umhos/cm)	94.9	80	104	-	-	-	92.1	128	-	143	-	175	189	Minegrid
Hardness CaCO3	26.1	-	-	-	-	-	-	-	-	40	-	-	-	Northing Easting
pH	7.63	7.45	7.63	-	-	-	7.57	7.61	-	7.58	-	7.72	7.68	102635 101895
Total Suspended Solids	<4.0	-	-	-	-	-	<4.0	<4.0	-	<4.0	-	<4.0	<4.0	UTM ZONE 10
Total Dissolved Solids	54	-	-	-	-	-	-	-	-	-	-	-	-	Northing Easting
Acidity (to pH 8.3)	<0.5	<0.5	<0.5	-	-	-	<0.5	<0.5	-	<0.5	-	0.6	0.7	5535534 323861
Alkalinity - Total CaCO3	25.3	22.9	27.5	-	-	-	26.3	29.9	-	28	-	36.2	38.6	
Ammonia Nitrogen	0.01	-	-	-	-	-	-	-	-	0.012	-	-	-	
Nitrate and Nitrite as N	<0.020	-	-	-	-	-	-	-	-	0.022	-	-	-	Downstream of 5
Dissolved Phosphorus	<0.0050	-	-	-	-	-	-	-	-	<0.0050	-	-	-	South and Barrier
Total Phosphorus	<0.0050	-	-	-	-	-	-	-	-	<0.0050	-	-	-	Pillar Influences
Sulphate	17.2	13.6	18.8	-	-	-	16.8	25.6	-	33.9	-	37.5	45.7	

Results are expressed in milligrams per litre except where noted.

TABLE 53-1
QUINSAM RIVER DOWNSTREAM SITE 1 METALS ANALYSIS
2011/12
COMPANY IDENTITY- QRDS1

Parameter	April	May	June	July	August			September
Sample Date	4	2	6	5	4	4*	30	6
Total Metals								
Aluminum	0.034	0.027	0.031	0.024	0.027	0.022	0.027	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0001	<0.0001	0.0001	0.0002	0.0002	0.0001	0.0002	-
Barium	0.002	0.002	0.001	0.002	0.002	0.002	0.002	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00001	<0.00001	-
Calcium	11.7	11.1	7.83	11.1	8.24	7.95	10.1	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Copper	0.0008	0.0007	0.0008	0.0006	0.0011	0.0012	0.0007	-
Iron	0.039	0.041	0.052	0.049	0.051	0.043	0.064	-
Hardness	-	-	-	33.6	24.6	23.9	<50	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	-
Magnesium	1.51	1.38	0.88	1.41	0.97	0.99	1.19	-
Manganese	0.004	0.004	0.005	0.007	0.005	0.004	0.013	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Potassium	0.25	0.2	0.2	0.17	0.37	0.38	0.26	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	2.1	1.9	1.8	1.7	1.5	1.4	1.7	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	13.7	10	2.65	7.79	5.58	5.6	7.83	-
Strontium	0.066	0.056	0.024	0.053	0.033	0.033	0.043	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Dissolved Metals								
Aluminum	0.021	0.02	0.021	0.018	0.019	0.022	0.013	-
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Arsenic	0.0001	0.0002	0.0001	0.0001	0.0002	0.0001	0.0002	-
Barium	0.002	0.002	0.001	0.002	0.002	0.002	0.002	-
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	0.00001	0.00002	<0.00001	-
Calcium	11.5	11.2	8.19	9.71	9.59	9.4	9.93	-
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Copper	0.0009	0.0007	0.0009	0.0008	0.0012	0.0012	0.0013	-
Iron	0.021	0.026	0.028	0.032	0.034	0.03	0.022	-
Hardness	-	-	-	29.3	28.3	28.3	<50	-
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Lithium	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	-
Magnesium	1.41	1.46	1	1.22	1.06	1.17	1.17	-
Manganese	0.002	0.003	0.004	0.003	0.002	0.003	0.001	-
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nickel	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Phosphorus	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Potassium	0.23	0.22	0.25	0.2	0.43	0.47	0.25	-
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Silicon	2.1	1.8	1.8	-	-	-	-	-
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	-
Sodium	12.8	10.2	3.1	6.95	5.98	6.46	8.18	-
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-

Results are expressed in milligrams per litre except where noted.

TABLE 53-2
QUINSAM RIVER DOWNSTREAM SITE 1 METALS ANALYSIS
2011/12
COMPANY IDENTITY- QRDS1

Parameter / Sample Date	October 5	November 2	December 5	January 5	February 9	March 6
Total Metals						
Aluminum	0.017	0.013	0.051	0.112	0.158	0.043
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0002	0.0002	0.0002	0.0002	<0.0001	0.0002
Barium	0.002	0.002	0.002	0.002	0.001	0.003
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	9.69	10.2	8.81	6.39	1.71	11.7
Chromium	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.0005	0.0007	0.0008	0.0008	0.0005	0.0006
Iron	0.032	0.049	0.065	0.134	0.09	0.077
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Magnesium	1.45	1.35	1.14	0.922	0.514	1.59
Manganese	0.001	0.006	0.004	0.007	0.002	0.005
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	0.0000023
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	<0.001	<0.001	0.003	<0.001	<0.001	<0.001
Potassium	0.18	0.18	0.17	0.202	0.267	0.208
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	1.7	1.8	2.1	2.1	3.4	2.5
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	6.41	7.72	6.59	4.07	0.961	9.8
Strontium	0.052	0.046	0.037	0.025	0.011	0.062
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	0.007	<0.005	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals						
Aluminum	0.012	0.014	0.0223	0.0534	0.1	0.0298
Antimony	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Arsenic	0.0002	0.0002	0.00015	0.00018	<0.00010	0.00016
Barium	0.002	0.002	0.0017	0.0019	0.0011	0.0027
Beryllium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Bismuth	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Boron	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050
Cadmium	0.00002	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010
Calcium	12.4	10.7	8.97	6.26	2.01	11.4
Chromium	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Cobalt	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050
Copper	0.0005	0.0013	0.00115	0.00308	0.00107	0.00066
Iron	0.025	0.031	0.0296	0.036	0.0249	0.0507
Lead	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Lithium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Magnesium	1.61	1.39	1.21	0.991	0.495	1.58
Manganese	<0.001	0.005	0.0023	0.0035	<0.0010	0.0034
Mercury	<0.00002	<0.00002	<0.00002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Nickel	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
Potassium	0.21	0.26	0.228	0.201	0.29	0.239
Selenium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Silicon	2.1	2	2.22	2	3.9	2.44
Silver	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020
Sodium	7.45	8.14	6.61	4.4	1.07	9.69
Strontium	0.055	0.05	0.0384	0.0277	0.0115	0.0605
Thallium	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050
Tin	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Uranium	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Vanadium	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zinc	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050
Zirconium	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 54
UNDERGROUND 3 MAINS WATER QUALITY
2011/12
COMPANY IDENTITY- UG3M

Stations	UG3M												
Parameters	**April**	**May**		**June**	**July**	**August**	**September**	**October**		**November**		**December**	**March**
Sample Date	**6**	**9**	**17**	**1**	**26**	**9**	**1**	**6**	**30**	**10**	**22**	**1**	**13**
Conductivity (umhos/cm)	-	2750	2730	-	2870	-	-	3160	3000	3030	3050	-	2520
Hardness CaCO3	-	536	593	-	587	-	-	564	577	619	549	-	433
pH	-	7.76	7.79	-	7.67	-	-	7.94	7.84	7.98	8.04	-	8.15
Total suspended solids	-	<4	-	-	4	-	-	<4	<4	<4	<4	-	14.5
Total dissolved solids	-	-	-	-	-	-	-	2300	2100	2260	2290	-	1750
Acidity (to pH 8.3)	-	24.9	22.1	-	24.00	-	-	28.9	19.7	<0.5	12.3	-	0.9
Alkalinity - Total CaCO3	-	390	380	-	380	-	-	390	390	400	410	-	382
Ammonia Nitrogen	-	0.13	-	-	-	-	-	0.140	0.176	0.166	0.160	-	-
Nitrate and Nitrite as N	-	<0.02	-	-	-	-	-	<0.02	<0.02	-	-	-	-
Dissolved Phosphate	-	<0.005	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate	-	<0.005	-	-	-	-	-	-	-	-	-	-	-
Sulphate	-	1100	1200	-	1200	-	-	1200	1300	1310	1300	-	1050

Results are expressed in milligrams per litre except where noted.

TABLE 55
UNDERGROUND 3 MAINS METALS ANALYSIS
2011/12
COMPANY IDENTITY-UG3M

Stations	UG3M							
Parameters	May		July	September		November		March
Sample Date	9	17	26	6	30	10	22	13
Total Metals								
Aluminum	0.008	0.034	0.033	0.014	0.013	0.010	0.048	0.226
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0002	0.0004	0.0005	0.0003	0.0002	0.0003	0.0003	0.0002
Barium	0.015	0.017	0.014	0.013	0.014	0.014	0.014	0.012
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.91	1.02	0.97	0.95	0.92	1.00	0.97	0.93
Cadmium	0.00007	<0.00001	0.00002	<0.00001	0.00002	0.00004	<0.00001	0.00005
Calcium	173	193	185	184	183	201	176	140
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	0.0012	0.0023	0.0013	0.0009	<0.0005	<0.0005	0.0006	0.0014
Copper	0.0014	0.0004	0.0007	0.0011	0.0006	0.0006	0.0007	0.003
Iron	0.896	0.893	0.821	0.827	0.763	0.877	0.920	1.95
Lead	<0.0002	<0.0002	0.0006	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.02	-	0.018	0.020	0.022	0.021	0.021	0.019
Magnesium	25.4	26.9	26	25.7	29.2	28.8	26.2	20.2
Manganese	0.318	0.312	0.246	0.319	0.280	0.270	0.251	0.168
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.003	0.004	0.003	0.002	<0.001	<0.001	0.001	0.003
Phosphorus	<0.005	-	-	-	-	-	-	-
Potassium	4.2	4.67	4.07	3.92	4.44	4.40	4.14	3.58
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.0001
Silicon	3.2	3.7	3.1	3.0	3.4	3.6	2.7	3.2
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	510	507	439	446	495	520	472	412
Strontium	1.68	1.73	1.69	1.84	1.88	2.12	1.91	1.32
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zirconium	-	-	-	-	-	-	-	-
Dissolved Metals								
Aluminum	0.004	0.004	0.007	0.006	0.012	<0.003	0.0103	0.0085
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050
Arsenic	0.0002	0.0003	0.0002	<0.0001	0.0001	0.00026	0.00022	<0.00010
Barium	0.013	0.015	0.014	0.014	0.014	0.0142	0.0137	0.0116
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010
Bismuth	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.0010
Boron	0.92	0.97	0.98	0.98	1.00	1.05	1.06	0.968
Cadmium	0.00003	0.00001	0.00002	<0.00003	0.00003	<0.00001	0.000012	0.000034
Calcium	168	162	190	194	193	169	190	136
Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0024	<0.0010
Cobalt	0.0009	0.0017	0.0011	0.0008	<0.0005	<0.0005	0.00066	0.00105
Copper	0.0008	0.0011	0.0008	0.0009	0.0008	0.00039	0.00096	<0.00020
Iron	0.015	0.008	0.014	0.010	0.011	0.0357	0.0157	0.175
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020
Lithium	0.02	-	0.018	0.021	0.021	0.0210	0.0222	0.0182
Magnesium	23.9	24.5	27.1	27.4	28.2	27.8	28.9	20.3
Manganese	0.281	0.287	0.246	0.309	0.287	0.272	0.267	0.155
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010
Nickel	0.002	0.004	0.003	0.002	0.001	0.0017	0.0032	0.0029
Phosphorus	<0.005	-	-	-	-	-	-	-
Potassium	3.97	4.15	4.35	4.29	4.52	4.33	5.26	3.56
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010
Silicon	3.2	3.3	-	3.1	3.2	3.11	3.06	3.13
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020
Sodium	437	461	463	478	499	509	520	409
Strontium	-	-	-	1.78	1.90	2.02	1.90	1.28
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050
Uranium	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050
Zirconium	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 56
UNDERGROUND 4 and 6 WATER QUALITY
2011/12
COMPANY IDENTITY-UG4M and UG6M

Stations	UG4M				UG6M			
Parameters	April	May		June	April	May		June
Sample Date	6	9	17	1	6	9	17	1
Conductivity (umhos/cm)	-	1270	1280	-	-	1200	900	-
Hardness CaCO3	-	99.2	110	-	-	80	74.3	-
pH	-	8.22	8.2	-	-	8.22	8.33	-
Total suspended solids	-	<4	-	-	-	<4		-
Acidity (to pH 8.3)	-	5.1	8.5	-	-	1.4	1.7	-
Alkalinity - Total CaCO3	-	470	460	-	-	440	330	-
Ammonia Nitrogen	-	-	-	-	-	-	-	-
Nitrate and Nitrite as N	-	-	-	-	-	-	-	-
Dissolved Phosphate	-	-	-	-	-	-	-	-
Total Phosphate	-	-	-	-	-	-	-	-
Sulphate	-	190	190	-	-	180	130	-

Results are expressed in milligrams per litre except where noted

TABLE 57-1

UNDERGROUND 4 and 6 METALS ANALYSIS

2011/12

COMPANY IDENTITY-UG4M and UG6M

Stations	UG4M				UG6M			
Parameters	**April**	**May**		**June**	**April**	**May**		**June**
Sample Date	6	9	17	1	6	9	17	1
Total Metals								
Aluminum	-	0.004	0.003	-	-	0.011	0.023	-
Antimony	-	<0.0005	<0.0005	-	-	<0.0005	<0.0005	-
Arsenic	-	0.0048	0.005	-	-	0.003	0.0027	-
Barium	-	0.037	0.038	-	-	0.033	0.025	-
Beryllium	-	<0.0001	<0.0001	-	-	<0.0001	<0.0001	-
Bismuth	-	<0.001	<0.001	-	-	<0.001	<0.001	-
Boron	-	0.85	0.92	-	-	0.78	0.67	-
Cadmium	-	0.00001	<0.00001	-	-	<0.00001	<0.00001	-
Calcium	-	34.4	38.3	-	-	27.6	25.7	-
Chromium	-	<0.001	<0.001	-	-	<0.001	<0.001	-
Cobalt	-	<0.0005	<0.0005	-	-	<0.0005	<0.0005	-
Copper	-	0.0008	0.0003	-	-	0.0012	0.0017	-
Iron	-	0.275	0.313	-	-	0.074	0.164	-
Lead	-	<0.0002	<0.0002	-	-	<0.0002	0.0004	-
Lithium	-	<0.005	-	-	-	<0.005	-	-
Magnesium	-	3.24	3.38	-	-	2.72	2.48	-
Manganese	-	0.086	0.087	-	-	0.018	0.006	-
Mercury	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-
Molybdenum	-	<0.001	<0.001	-	-	0.001	<0.001	-
Nickel	-	<0.001	<0.001	-	-	<0.001	<0.001	-
Phosphorus	-	-	-	-	-	-	-	-
Potassium	-	4.2	2.04	-	-	1.77	1.84	-
Selenium	-	<0.0001	<0.0001	-	-	<0.0001	0.0001	-
Silicon	-	3.2	2.8	-	-	2.6	4	-
Silver	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-
Sodium	-	510	291	-	-	259	206	-
Strontium	-	1.68	0.438	-	-	0.377	0.31	-
Thallium	-	<0.00005	<0.00005	-	-	<0.00005	<0.00005	-
Tin	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Titanium	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Uranium	-	0.0001	<0.0001	-	-	<0.0001	<0.0001	-
Vanadium	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Zinc	-	<0.005	<0.005	-	-	<0.005	0.006	-
Zirconium	-	-	-	-	-	-	-	-
Dissolved Metals								
Aluminum	-	0.003	0.005	-	-	0.009	0.004	-
Antimony	-	<0.0005	<0.0005	-	-	<0.0005	<0.0005	-
Arsenic	-	0.0038	0.0041	-	-	0.0026	0.0026	-
Barium	-	0.033	0.036	-	-	0.03	0.024	-
Beryllium	-	<0.0001	<0.0001	-	-	<0.0001	<0.0001	-
Bismuth	-	-	-	-	-	-	-	-
Boron	-	0.88	0.84	-	-	0.85	0.58	-
Cadmium	-	0.00002	<0.00001	-	-	0.00004	<0.00001	-
Calcium	-	34	34.9	-	-	31	24.2	-
Chromium	-	<0.001	<0.001	-	-	<0.001	<0.001	-
Cobalt	-	<0.0005	<0.0005	-	-	<0.0005	<0.0005	-
Copper	-	0.0054	0.0013	-	-	0.0014	0.0011	-
Iron	-	0.007	0.01	-	-	0.01	<0.005	-
Lead	-	<0.0002	<0.0002	-	-	<0.0002	<0.0002	-
Lithium	-	<0.005	-	-	-	<0.005	-	-
Magnesium	-	3.13	3.17	-	-	2.71	2.33	-
Manganese	-	0.077	0.077	-	-	0.015	0.002	-
Mercury	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-
Molybdenum	-	<0.001	<0.001	-	-	<0.001	<0.001	-
Nickel	-	<0.001	<0.001	-	-	<0.001	<0.001	-
Phosphorus	-	-	-	-	-	-	-	-
Potassium	-	1.95	1.98	-	-	1.75	1.74	-
Selenium	-	<0.0001	<0.0001	-	-	<0.0001	0.0002	-
Silicon	-	2.8	3.2	-	-	3	3.9	-
Silver	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-
Sodium	-	252	263	-	-	229	194	-
Strontium	-	-	-	-	-	-	-	-
Thallium	-	<0.00005	<0.00005	-	-	<0.00005	<0.00005	-
Tin	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Titanium	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Uranium	-	<0.0001	<0.0001	-	-	<0.0001	<0.0001	-
Vanadium	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Zinc	-	<0.005	<0.005	-	-	<0.005	<0.005	-
Zirconium	-	-	-	-	-	-	-	-

Results expressed in milligrams per litre except where noted

TABLE 58
101 PANEL AND 87 PANEL WATER QUALITY
2011/12
COMPANY IDENTITY-101 PANEL AND 87 PANEL

Stations	101 Panel	87 Panel								
Parameters	March	January		February			March			
Sample Date	13	6	30	6	13	21	6	12	19	27
Conductivity (umhos/cm	1330	1420	1480	1460	1480	1560	3090	1440	1530	2020
Hardness CaCO3	114	48.7	55.5	49.5	58.8	66.9	292	54.9	85.7	117
pH	8.28	8.38	8.3	8.32	8.32	8.4	8.16	8.36	8.27	8.28
Total suspended solids	7.3	-	175	28.5	-	<4.0	4.4	5.2	1770	
Total dissolved solids	786	818	820	830	-	872	1990	872	930	1260
Acidity (to pH 8.3)	4.7	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5
Alkalinity - Total CaCO3	454	340	332	334	321	324	300	337	325	325
Ammonia Nitrogen	-	0.016	0.0081	0.05	-	0.03	0.098	-	-	-
Nitrate and Nitrite as N	-	<0.020	<0.020	<0.020	-	0.026	<0.020	-	-	-
Sulphate	189	155	196	185	183	227	1100	233	205	459

Results expressed in milligrams per litre except where noted

TABLE 59
PLANT DITCH SEEP WATER QUALITY
2011/12
COMPANY IDENTITY - PDS

Parameter	April				May				June				Site Description GPS (m)	
													Minegrid	
Sample Date	4^	13	19	26	3^	10	17	25	8	15	22	29	Northing	Easting
Conductivity (umhos/cm)	-	-	-	-	-	-	-	-	2350	-	-	-	103442	99182
Hardness CaCO3	-	-	-	-	-	-	-	-	1180	-	-	-	UTM ZONE 10	
pH	-	-	-	-	-	-	-	-	7.74	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	21	-	-	-	5533844	321591
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	330	-	-	-	Lowest Elevation	
Sulphate	-	-	-	-	-	-	-	-	1100	-	-	-	Below CPP	

Parameter	July				August				September				Site Description GPS (m)	
													Minegrid	
Sample Date	4^	13	19	26	3^	10	17	25	8^	15	22	29	Northing	Easting
Conductivity (umhos/cm)	-	-	-	-	-	-	-	-	-	-	-	-	103442	99182
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	UTM ZONE 10	
pH	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-	-	-	5533844	321591
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	Lowest Elevation	
Sulphate	-	-	-	-	-	-	-	-	-	-	-	-	Below CPP	

Parameter	October				November				December				Site Description GPS (m)	
													Minegrid	
Sample Date	5^	11	17	24	2^	8	22	29	6	13	20	28	Northing	Easting
Conductivity (umhos/cm)	-	-	-	-	-	-	-	-	1150	-	-	-	103442	99182
Hardness CaCO3	-	-	-	-	-	-	-	-	406	-	-	-	UTM ZONE 10	
pH	-	-	-	-	-	-	-	-	7.33	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	15.7	-	-	-	5533844	321591
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	182	-	-	-	Lowest Elevation	
Sulphate	-	-	-	-	-	-	-	-	421	-	-	-	Below CPP	

Parameter	January				February				March				Site Description
Sample Date	6	10	24	31	7^	14	21	28	7	13	20	27	GPS (m)
Conductivity (umhos/cm)	660	-	-	-	-	-	-	-	711	-	-	-	Minegrid
Hardness CaCO3	248	-	-	-	-	-	-	-	314	-	-	-	Northing Easting
pH	7.79	-	-	-	-	-	-	-	7.94	-	-	-	103442 99182
Acidity (to pH 8.3)	2.6	-	-	-	-	-	-	-	2.3	-	-	-	UTM ZONE 10
Alkalinity - Total CaCO3	125	-	-	-	-	-	-	-	122	-	-	-	Northing Easting
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-	5533844 321591
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-	Lowest Elevation
Sulphate	191	-	-	-	-	-	-	-	221	-	-	-	Below CPP

Results are expressed in milligrams per litre.
^Dry No Sample.

TABLE 60-1
PLANT DITCH SEEP METALS ANALYSIS
2011/12
COMPANY IDENTITY-PDS

Parameter / Sample Date	April 2^	May 2^	June 6	July 4^	August 3^	September 1^
Total Metals						
Aluminum	-	-	0.015	-	-	-
Antimony	-	-	<0.0005	-	-	-
Arsenic	-	-	0.0002	-	-	-
Barium	-	-	0.02	-	-	-
Beryllium	-	-	<0.0001	-	-	-
Bismuth	-	-	<0.001	-	-	-
Boron	-	-	0.45	-	-	-
Cadmium	-	-	0.00004	-	-	-
Calcium	-	-	377	-	-	-
Chromium	-	-	<0.001	-	-	-
Cobalt	-	-	0.0006	-	-	-
Copper	-	-	<0.0002	-	-	-
Iron	-	-	2.89	-	-	-
Lead	-	-	<0.0002	-	-	-
Lithium	-	-	-	-	-	-
Magnesium	-	-	59.1	-	-	-
Manganese	-	-	0.974	-	-	-
Mercury	-	-	<0.00002	-	-	-
Molybdenum	-	-	<0.001	-	-	-
Nickel	-	-	<0.001	-	-	-
Phosphorus	-	-	-	-	-	-
Potassium	-	-	3.49	-	-	-
Selenium	-	-	<0.0001	-	-	-
Silicon	-	-	4.3	-	-	-
Silver	-	-	<0.00002	-	-	-
Sodium	-	-	112	-	-	-
Strontium	-	-	2.67	-	-	-
Thallium	-	-	<0.00005	-	-	-
Tin	-	-	<0.005	-	-	-
Titanium	-	-	<0.005	-	-	-
Uranium	-	-	0.0002	-	-	-
Vanadium	-	-	<0.005	-	-	-
Zinc	-	-	<0.005	-	-	-
Dissolved Metals						
Aluminum	-	-	0.005	-	-	-
Antimony	-	-	<0.0005	-	-	-
Arsenic	-	-	0.0002	-	-	-
Barium	-	-	0.021	-	-	-
Beryllium	-	-	<0.0001	-	-	-
Boron	-	-	0.47	-	-	-
Cadmium	-	-	0.00002	-	-	-
Calcium	-	-	370	-	-	-
Chromium	-	-	<0.001	-	-	-
Cobalt	-	-	0.0006	-	-	-
Copper	-	-	0.0005	-	-	-
Iron	-	-	2.12	-	-	-
Lead	-	-	<0.0002	-	-	-
Lithium	-	-	-	-	-	-
Magnesium	-	-	61.3	-	-	-
Manganese	-	-	1.04	-	-	-
Mercury	-	-	<0.00002	-	-	-
Molybdenum	-	-	<0.001	-	-	-
Nickel	-	-	<0.001	-	-	-
Potassium	-	-	3.68	-	-	-
Selenium	-	-	0.0001	-	-	-
Silver	-	-	<0.00002	-	-	-
Sodium	-	-	121	-	-	-
Thallium	-	-	<0.00005	-	-	-
Tin	-	-	<0.005	-	-	-
Titanium	-	-	<0.005	-	-	-
Uranium	-	-	0.0002	-	-	-
Vanadium	-	-	<0.005	-	-	-
Zinc	-	-	<0.005	-	-	-

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 60-2
PLANT DITCH SEEP METALS ANALYSIS
2011/12
COMPANY IDENTITY-PDS

Parameter / Sample Date	October 5^	November 2^	December 6	January 6	February 6^	March 7
Total Metals						
Aluminum	-	-	0.033	0.039	-	0.033
Antimony	-	-	<0.0005	<0.0005	-	<0.0005
Arsenic	-	-	0.0002	0.0002	-	0.0002
Barium	-	-	0.018	0.01	-	0.018
Beryllium	-	-	<0.0001	<0.0001	-	<0.0001
Bismuth	-	-	<0.001	<0.001	-	<0.001
Boron	-	-	0.11	0.1	-	0.11
Cadmium	-	-	0.00002	<0.00001	-	0.00002
Calcium	-	-	128	76.5	-	128
Chromium	-	-	<0.001	<0.001	-	<0.001
Cobalt	-	-	<0.0005	<0.0005	-	<0.0005
Copper	-	-	0.0019	0.0012	-	0.0019
Iron	-	-	0.442	0.118	-	0.442
Lead	-	-	<0.0002	<0.0002	-	<0.0002
Lithium	-	-	<0.005	<0.005	-	<0.005
Magnesium	-	-	20.7	13.9	-	20.7
Manganese	-	-	0.514	0.131	-	0.514
Mercury	-	-	<0.000020	<0.000010	-	<0.000020
Molybdenum	-	-	<0.001	<0.001	-	<0.001
Nickel	-	-	0.002	<0.001	-	0.002
Potassium	-	-	1.9	1.15	-	1.9
Selenium	-	-	<0.0001	<0.0001	-	<0.0001
Silicon	-	-	3.8	3.5	-	3.8
Silver	-	-	<0.00002	<0.00002	-	<0.00002
Sodium	-	-	67.3	45.6	-	67.3
Strontium	-	-	0.657	0.377	-	0.657
Thallium	-	-	<0.00005	<0.00005	-	<0.00005
Tin	-	-	<0.005	<0.005	-	<0.005
Titanium	-	-	<0.005	<0.005	-	<0.005
Uranium	-	-	0.0003	0.0002	-	0.0003
Vanadium	-	-	<0.005	<0.005	-	<0.005
Zinc	-	-	<0.005	<0.005	-	<0.005
Zirconium	-	-	<0.0005	<0.0005	-	<0.0005
Dissolved Metals						
Aluminum	-	-	0.009	0.0269	-	0.009
Antimony	-	-	<0.00050	<0.00050	-	<0.00050
Arsenic	-	-	<0.00010	0.00018	-	<0.00010
Barium	-	-	0.017	0.0112	-	0.017
Beryllium	-	-	<0.00010	<0.00010	-	<0.00010
Bismuth	-	-	<0.0010	<0.0010	-	<0.0010
Boron	-	-	0.11	0.109	-	0.11
Cadmium	-	-	<0.000010	<0.000010	-	<0.000010
Calcium	-	-	124	83.9	-	124
Chromium	-	-	<0.0010	<0.0010	-	<0.0010
Cobalt	-	-	<0.00050	<0.00050	-	<0.00050
Copper	-	-	0.00124	0.00214	-	0.00124
Iron	-	-	0.154	0.069	-	0.154
Lead	-	-	<0.00020	<0.00020	-	<0.00020
Lithium	-	-	<0.0050	<0.0050	-	<0.0050
Magnesium	-	-	19.9	14.8	-	19.9
Manganese	-	-	0.497	0.158	-	0.497
Mercury	-	-	<0.000020	<0.000010	-	<0.000020
Molybdenum	-	-	<0.0010	<0.0010	-	<0.0010
Nickel	-	-	0.001	<0.0010	-	0.001
Potassium	-	-	1.88	1.25	-	1.88
Selenium	-	-	<0.00010	<0.00010	-	<0.00010
Silicon	-	-	3.84	3.73	-	3.84
Silver	-	-	<0.000020	<0.000020	-	<0.000020
Sodium	-	-	65.9	52.1	-	65.9
Strontium	-	-	0.638	0.45	-	0.638
Thallium	-	-	<0.000050	<0.000050	-	<0.000050
Tin	-	-	<0.0050	<0.0050	-	<0.0050
Titanium	-	-	<0.0050	<0.0050	-	<0.0050
Uranium	-	-	0.0003	0.00025	-	0.0003
Vanadium	-	-	<0.0050	<0.0050	-	<0.0050
Zinc	-	-	<0.0050	<0.0050	-	<0.0050
Zirconium	-	-	<0.00050	<0.00050	-	<0.00050

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 61
PLANT DITCH SEEP_ROAD WATER QUALITY
2011/12
COMPANY IDENTITY- PDSR

Parameter / Sample Date	April				May				June				Site Description: GPS (m) Minegrid Northing	Easting
	4	10	18	27	1^	10	18	28	7	15	22	29		
Conductivity (umhos/cm)	1540	-	-	-	-	-	-	-	1790	-	-	-	103655	99061
Hardness CaCO3	733	-	-	-	-	-	-	-	842	-	-	-	UTM ZONE 10	
pH	8.3	-	-	-	-	-	-	-	8.18	-	-	-	Northing	Easting
Acidity (to pH 8.3)	2.6	-	-	-	-	-	-	-	3.3	-	-	-	5533875	321348
Alkalinity - Total CaCO3	190	-	-	-	-	-	-	-	220	-	-	-	In Old Natural Drainage Below Clean Coal Stockpile	
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-		
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	690	-	-	-	-	-	-	-	780	-	-	-		

Parameter / Sample Date	July				August				September				Site Description: GPS (m) Minegrid Northing	Easting
	4^	10	18	27	3^	10	18	28	7^	15	22	29		
Conductivity (umhos/cm)	-	-	-	-	-	-	-	-	-	-	-	-	103655	99061
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	UTM ZONE 10	
pH	-	-	-	-	-	-	-	-	-	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	-	-	-	-	5533875	321348
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	In Old Natural Drainage Below Clean Coal Stockpile	
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-		
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	-	-	-	-	-	-	-	-	-	-	-	-		

Parameter / Sample Date	October				November				December				Site Description: GPS (m) Minegrid Northing	Easting
	5^	11	17	24	2^	8	22	29	6	13	20	28		
Conductivity (umhos/cm)	-	-	-	-	-	-	-	-	1330	-	-	-	103655	99061
Hardness CaCO3	-	-	-	-	-	-	-	-	551	-	-	-	UTM ZONE 10	
pH	-	-	-	-	-	-	-	-	7.84	-	-	-	Northing	Easting
Acidity (to pH 8.3)	-	-	-	-	-	-	-	-	3.7	-	-	-	5533875	321348
Alkalinity - Total CaCO3	-	-	-	-	-	-	-	-	167	-	-	-	In Old Natural Drainage Below Clean Coal Stockpile	
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-		
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	-	-	-	-	-	-	-	-	567	-	-	-		

Parameter / Sample Date	January				February				March				Site Description: GPS (m) Minegrid Northing	Easting
	5	10	24	31	7	14	21	28	7	13	20	27		
Conductivity (umhos/cm)	829	-	-	-	1370	1140	-	-	1180	-	-	-	103655	99061
Hardness CaCO3	307	-	-	-	631		-	-	517	-	-	-	UTM ZONE 10	
pH	7.98	-	-	-	8.11	8.25	-	-	7.99	-	-	-	Northing	Easting
Total Suspended Solids	-	-	-	-	-	6.3	-	-	-	-	-	-	5533875	321348
Acidity (to pH 8.3)	1.1	-	-	-	3.2	10.8	-	-	<0.5	-	-	-	In Old Natural Drainage Below Clean Coal Stockpile	
Alkalinity - Total CaCO3	104	-	-	-	174	163	-	-	150	-	-	-		
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-		
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-		
Sulphate	271	-	-	-	590	428			509	-	-	-		

Results are expressed in milligrams per litre.
^ = Dry, no sample

TABLE 62-1
PLANT DITCH SEEP ROAD METALS ANALYSIS
2011/12
COMPANY IDENTITY-PDSR

Parameter / Sample Date	April 4	May 1^	June 7	July 4^	August 1^	September 7^
Total Metals						
Aluminum	0.647	-	0.1	-	-	-
Antimony	<0.0005	-	<0.0005	-	-	-
Arsenic	0.0003	-	0.0001	-	-	-
Barium	0.024	-	0.031	-	-	-
Beryllium	<0.0001	-	<0.0001	-	-	-
Bismuth	<0.001	-	<0.001	-	-	-
Boron	0.24	-	0.35	-	-	-
Cadmium	0.00002	-	0.00003	-	-	-
Calcium	232	-	263	-	-	-
Chromium	<0.001	-	<0.001	-	-	-
Cobalt	<0.0005	-	<0.0005	-	-	-
Copper	0.0026	-	0.0007	-	-	-
Iron	0.746	-	0.123	-	-	-
Lead	0.0002	-	<0.0002	-	-	-
Lithium	<0.005	-	-	-	-	-
Magnesium	37.5	-	44.8	-	-	-
Manganese	0.022	-	0.003	-	-	-
Mercury	<0.00002	-	<0.00002	-	-	-
Molybdenum	<0.001	-	<0.001	-	-	-
Nickel	<0.001	-	0.001	-	-	-
Phosphorus	-	-	-	-	-	-
Potassium	2.08	-	2.46	-	-	-
Selenium	<0.0001	-	<0.0001	-	-	-
Silicon	4.2	-	3.8	-	-	-
Silver	<0.00002	-	<0.00002	-	-	-
Sodium	75.8	-	90.4	-	-	-
Strontium	1.5	-	1.89	-	-	-
Thallium	<0.00005	-	<0.00005	-	-	-
Tin	<0.005	-	<0.005	-	-	-
Titanium	0.054	-	0.005	-	-	-
Uranium	0.0005	-	0.0008	-	-	-
Vanadium	<0.005	-	<0.005	-	-	-
Zinc	0.011	-	<0.005	-	-	-
Dissolved Metals						
Aluminum	-	-	0.01	-	-	-
Antimony	<0.0005	-	<0.0005	-	-	-
Arsenic	-	-	0.0001	-	-	-
Barium	-	-	0.029	-	-	-
Beryllium	-	-	<0.0001	-	-	-
Boron	-	-	0.36	-	-	-
Cadmium	-	-	0.00002	-	-	-
Calcium	-	-	265	-	-	-
Chromium	-	-	<0.001	-	-	-
Cobalt	-	-	<0.0005	-	-	-
Copper	-	-	0.0008	-	-	-
Iron	-	-	0.007	-	-	-
Lead	-	-	<0.0002	-	-	-
Lithium	-	-	-	-	-	-
Magnesium	-	-	47.3	-	-	-
Manganese	-	-	0.001	-	-	-
Mercury	-	-	<0.00002	-	-	-
Molybdenum	-	-	<0.001	-	-	-
Nickel	-	-	<0.001	-	-	-
Potassium	-	-	2.64	-	-	-
Selenium	-	-	<0.0001	-	-	-
Silver	-	-	<0.00002	-	-	-
Sodium	-	-	96.7	-	-	-
Thallium	-	-	<0.00005	-	-	-
Tin	-	-	<0.005	-	-	-
Titanium	0.054	-	0.005	-	-	-
Uranium	-	-	0.0007	-	-	-
Vanadium	-	-	<0.005	-	-	-
Zinc	-	-	<0.005	-	-	-

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 62-2
PLANT DITCH SEEP ROAD METALS ANALYSIS
2011/12
COMPANY IDENTITY-PDSR

Parameter / Sample Date	October 5^	November 2^	December 6	January 5	February 7	March 7
Total Metals						
Aluminum	-	-	0.014	0.021	0.013	0.011
Antimony	-	-	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	-	-	<0.0001	<0.0001	0.0002	<0.0001
Barium	-	-	0.018	0.011	0.017	0.015
Beryllium	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	-	-	<0.001	<0.001	<0.001	<0.001
Boron	-	-	0.24	0.15	0.2	0.24
Cadmium	-	-	<0.00001	<0.00001	<0.00001	<0.00001
Calcium	-	-	170	95.5	197	160
Chromium	-	-	0.001	<0.001	<0.001	<0.001
Cobalt	-	-	<0.0005	<0.0005	<0.0005	<0.0005
Copper	-	-	0.0005	0.0003	0.0005	0.0003
Iron	-	-	0.012	0.013	<0.005	0.006
Lead	-	-	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	-	-	<0.005	<0.005	<0.005	<0.005
Magnesium	-	-	30.9	16.7	33.7	28.5
Manganese	-	-	<0.001	<0.001	<0.001	<0.001
Mercury	-	-	<0.000020	<0.000010	<0.000010	<0.000002
Molybdenum	-	-	<0.001	<0.001	<0.001	<0.001
Nickel	-	-	0.001	<0.001	<0.001	<0.001
Potassium	-	-	1.77	0.999	1.78	1.48
Selenium	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Silicon	-	-	2.7	2.8	2.9	3.1
Silver	-	-	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	-	-	74.8	38.6	69.5	57.9
Strontium	-	-	1.19	0.566	1.21	0.989
Thallium	-	-	<0.00005	<0.00005	<0.00005	<0.00005
Tin	-	-	<0.005	<0.005	<0.005	<0.005
Titanium	-	-	<0.005	<0.005	<0.005	<0.005
Uranium	-	-	0.0004	0.0002	0.0004	0.0003
Vanadium	-	-	<0.005	<0.005	<0.005	<0.005
Zinc	-	-	<0.005	<0.005	<0.005	<0.005
Zirconium	-	-	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals						
Aluminum	-	-	0.0075	0.0096	0.0095	0.0138
Antimony	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	-	-	<0.00010	<0.00010	<0.00010	0.00023
Barium	-	-	0.0185	0.0117	0.0178	0.0154
Beryllium	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Boron	-	-	0.216	0.169	0.248	0.17
Cadmium	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Calcium	-	-	175	98.6	198	158
Chromium	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Copper	-	-	0.00093	0.00159	0.00063	0.00058
Iron	-	-	<0.0050	<0.0050	0.005	0.006
Lead	-	-	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	-	-	30.3	18.5	35	27.9
Manganese	-	-	<0.0010	0.0013	0.002	<0.0010
Mercury	-	-	<0.000020	<0.000010	<0.000010	<0.000002
Molybdenum	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Potassium	-	-	1.76	1.13	1.82	1.45
Selenium	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Silicon	-	-	3.19	3.05	3.06	2.96
Silver	-	-	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	-	-	72.4	44.4	72.6	56.6
Strontium	-	-	1.16	0.655	1.28	0.972
Thallium	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Tin	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	-	-	0.00039	0.00018	0.00042	0.00032
Vanadium	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	-	-	0.0085	<0.0050	<0.0050	<0.0050
Zirconium	-	-	<0.00050	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.
^ = Dry, no sample

TABLE 63
2 SOUTH PIT WATER QUALITY
2011/12
COMPANY IDENTITY-2SW/2SC/2SE

Parameter	2SW		2SC		2SE	
Sample Date	31-Oct	06-Dec	31-Oct	06-Dec	31-Oct	06-Dec
Conductivity (umhos/cm)	2050	1710	590	1640	1720	1020
pH	4.68	5.72	7.33	7.02	7.80	7.65
Alkalinity-Total CaCO3	<0.5	2.73	34.00	56.90	97.00	75.30
Acidity(pH=8.3)	17.60	24.10	2.20	10.00	8.70	2.40
Hardness (as CaCO3)	1080	1050	266	974	984	556
Sulphate	1300	1080	270	942	1000	487

Parameter	2SW			2SC			2SE		
Sample Date	04-Jan	06-Feb	06-Mar	04-Jan	06-Feb	06-Mar	04-Jan	06-Feb	06-Mar
Conductivity (umhos/cm)	610	1290	1290	779	1460	1320	1050	1110	1030
Hardness (as CaCO3)	290	675	706	375	804	745	537	546	550
pH	7.41	5.96	6.17	6.99	7.54	7.33	7.48	7.87	8
Acidity(pH=8.3)	2.1	8.6	1.1	2.9	7.9	1.2	3.4	3.3	<0.5
Alkalinity-Total CaCO3	33	1.89	2.77	12	62.6	82.4	56	91.5	110
Sulphate	230	770	767	349	834	708	504	529	447

Water at old portals in 2 South Pit
2SW = 2 South West
2SC = 2 South Center
2SE = 2 South East
Results expressed as milligram per litre

TABLE 64-1
2 SOUTH PIT METALS ANALYSIS
2011/12
COMPNAY IDENTITY-2SW/2SC/2SE

Sample Site	2SW		2SC		2SE	
Parameter	**31-Oct**	**06-Dec**	**31-Oct**	**06-Dec**	**31-Oct**	**06-Dec**
Total Metals						
Aluminum	1.42	1.96	0.446	0.133	0.416	0.477
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0039	0.0003	0.0002	0.0002	0.0018	0.0002
Barium	0.037	0.016	0.018	0.011	0.017	0.015
Beryllium	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.22	0.2	0.07	0.22	0.27	0.14
Cadmium	0.00101	0.00087	0.00004	0.00024	0.0003	0.00005
Calcium	375	366	97	341	346	192
Chromium	0.007	0.003	0.002	0.001	<0.001	0.002
Cobalt	0.0962	0.0515	0.0023	0.0019	0.0312	0.0058
Copper	0.0476	0.041	0.0031	0.0014	0.0061	0.0027
Iron	20.5	11.8	0.501	0.134	0.181	0.357
Lead	0.0005	<0.0002	0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.019	0.015	<0.005	0.013	0.017	<0.005
Magnesium	35.7	32.2	5.8	29.9	29.5	18.8
Manganese	3.47	0.766	0.119	0.174	1.07	0.183
Mercury	<0.00002	<0.000020	<0.00002	<0.00002	<0.00002	<0.00002
Molybdenum	<0.001	<0.001	<0.001	<0.001	0.001	0.001
Nickel	0.157	0.112	0.005	0.044	0.053	0.013
Potassium	2.66	1.79	1.79	1.28	1.79	1.07
Selenium	0.0012	0.0013	0.0005	0.0004	0.0003	0.0005
Silicon	6.5	3.9	2.4	5.1	4.2	3.8
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	15.6	12.8	4.57	11.2	16.9	6.87
Strontium	1.45	1.34	0.33	1.32	1.56	0.719
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	0.012	<0.005	0.008	<0.005	<0.005	0.007
Uranium	<0.0001	0.0001	0.0001	<0.0001	0.0001	<0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.237	0.21	0.009	0.06	0.08	0.013
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals						
Aluminum	1.2	1.64	0.058	0.0928	0.032	0.028
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0003	0.00012	<0.0001	0.0018	0.0015	0.00012
Barium	0.035	0.0158	0.016	0.017	0.016	0.0137
Beryllium	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.24	0.174	0.08	0.27	0.3	0.12
Cadmium	0.00112	0.000895	0.00003	0.0003	0.00022	0.000062
Calcium	375	337	96.6	346	320	190
Chromium	0.001	0.0021	0.001	<0.001	<0.001	0.0012
Cobalt	0.101	0.0494	0.002	0.0312	0.0299	0.00546
Copper	0.0385	0.0376	0.0015	0.0061	0.0032	0.00138
Iron	1.76	10.3	0.014	0.181	0.01	0.0253
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.02	0.0145	<0.005	0.017	0.017	<0.005
Magnesium	34.6	31.8	5.67	29.5	27.6	18.1
Manganese	3.42	0.769	0.11	1.07	0.985	0.176
Mercury	<0.00002	<0.00001	<0.00002	<0.00002	<0.00002	<0.00001
Molybdenum	<0.001	<0.001	<0.001	0.001	<0.001	0.001
Nickel	0.162	0.107	0.005	0.053	0.05	0.0123
Potassium	3.02	1.77	2.01	1.79	1.89	1.06
Selenium	0.0015	0.00128	0.0006	0.0003	0.0003	0.00058
Silicon	6.1	4.2	2.1	4.2	4.4	4.07
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.000044
Sodium	15	12.9	4.43	16.9	16.1	6.68
Strontium	1.49	1.24	0.318	1.56	1.55	0.696
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium	<0.0001	<0.0001	0.0001	0.0001	0.0001	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.249	0.222	0.006	0.08	0.07	0.07
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Results expressed as milligrams per litre

TABLE 64-2
2 SOUTH PIT METALS ANALYSIS
2011/12
COMPNAY IDENTITY-2SW/2SC/2SE

Sample Site	2SW			2SC			2SE		
Parameter	**04-Jan**	**06-Feb**	**06-Mar**	**04-Jan**	**06-Feb**	**06-Mar**	**04-Jan**	**06-Feb**	**06-Mar**
Total Metals									
Aluminum	1.61	0.367	0.54	1.18	0.068	0.115	1.03	0.452	0.106
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0011	0.0003	0.0002	0.0006	0.0001	0.0001	0.0001	0.0003	0.0001
Barium	0.018	0.013	0.011	0.022	0.01	0.015	0.013	0.014	0.013
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.06	0.15	0.19	0.07	0.16	0.19	0.15	0.14	0.14
Cadmium	0.00007	0.00038	0.00028	0.00012	0.00015	0.00007	0.00009	0.00007	0.00003
Calcium	99	236	249	130	280	262	189	189	192
Chromium	0.005	<0.001	<0.001	0.003	<0.001	<0.001	0.001	<0.001	<0.001
Cobalt	0.0054	0.0272	0.0198	0.013	0.0007	<0.0005	0.0082	0.0056	0.001
Copper	0.0131	0.0147	0.0179	0.0103	0.0009	0.0009	0.0094	0.0054	0.0012
Iron	3.67	4.31	2.21	1.42	0.057	0.249	0.275	0.35	0.213
Lead	0.0008	0.0003	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	<0.005	0.01	0.009	0.007	0.011	0.008	0.007	0.005	<0.005
Magnesium	10.5	21.1	20.2	12.4	25.7	22	15.6	18.2	17
Manganese	0.173	0.57	0.473	0.344	0.068	0.025	0.206	0.161	0.026
Mercury	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.01	0.055	0.042	0.026	0.025	0.013	0.017	0.011	0.003
Potassium	0.778	1.47	1.69	0.789	1.16	1.11	0.932	0.909	0.877
Selenium	0.0003	0.0009	0.001	0.0004	0.0005	0.0003	0.0005	0.0004	0.0003
Silicon	4.3	3.4	3.6	4.2	4.5	3.9	2.8	3.4	3
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	2.41	16.3	12.6	3.42	11.5	10.2	3.57	6.27	4.63
Strontium	0.372	0.948	0.989	0.437	1.06	0.969	0.634	0.705	0.713
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Titanium	0.045	<0.005	<0.005	0.025	<0.005	<0.005	<0.005	0.008	<0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.026	0.209	0.211	0.045	0.035	0.011	0.024	0.017	0.005
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals									
Aluminum	0.0449	0.173	0.128	0.042	0.0352	0.0151	0.0594	0.0205	0.0066
Antimony	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	<0.00010	0.00024	<0.00010	0.00015	0.00021	<0.00010	0.0001	0.00025
Barium	0.0103	0.0119	0.0109	0.0188	0.0103	0.014	0.0129	0.0139	0.0123
Beryllium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	0.061	0.159	0.132	0.081	0.167	0.151	0.153	0.141	0.126
Cadmium	0.000039	0.000347	0.000285	0.000122	0.000125	0.000079	0.000102	0.000058	0.00003
Calcium	104	234	250	137	276	257	202	197	190
Chromium	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	0.00229	0.0274	0.0195	0.0125	0.00072	<0.00050	0.00865	0.00527	0.00081
Copper	0.00694	0.0116	0.0148	0.0052	0.00037	0.00057	0.00782	0.00169	0.00089
Iron	0.0588	2.58	1.4	0.0085	0.0316	0.0101	<0.0050	0.0105	<0.0050
Lead	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	0.0099	0.0086	0.0076	0.0106	0.008	0.008	0.0053	<0.0050
Magnesium	10.4	20.9	19.6	13.3	24.1	21.7	17.7	18.2	17
Manganese	0.109	0.576	0.453	0.337	0.0672	0.0232	0.219	0.164	0.024
Mercury	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002	<0.000010	<0.000010	<0.000002
Molybdenum	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel	0.0061	0.0551	0.0416	0.0256	0.0246	0.0119	0.0171	0.0114	0.0033
Potassium	0.75	1.34	1.67	0.877	1.06	1.05	1.08	0.913	0.903
Selenium	0.00027	0.00081	0.00089	0.00034	0.00054	0.00039	0.00038	0.00048	0.00042
Silicon	2.71	3.35	3.37	3.3	4.75	3.68	2.74	3.58	2.82
Silver	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	2.63	15	12.2	3.76	10.9	9.86	4.13	6.34	4.68
Strontium	0.388	0.976	0.955	0.471	1.03	0.918	0.676	0.775	0.692
Thallium	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	0.0182	0.205	0.21	0.0448	0.0341	0.012	0.0271	0.0169	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

Results expressed as milligrams per litre

TABLE 65
Toe of Tailings Dam (TTD) and South Dyke Sump (SDS)
Water Quality Comparative Table
2011/12

Parameter / Sample Date	Units	TTD			SDS		
		September 14	December 6	December 29	September 14	December 6	December 29
General Parameters:							
Hardness-Dissolved	mg/L	-	1540.00	1360.00	-	-	1290.00
Hardness (as $CaCO_3$)	mg/L	1610.00	1490.00	1360.00	-	1560.00	1410.00
Acidity (pH 4.5)	mg/L	-	<0.50	<0.50	-	<0.50	<0.50
Acidity (pH 8.3)	mg/L	-	16.10	10.20	-	6.30	8.70
Alkalinity-PP as $CaCo_3$	mg/L	-	-	<0.50	-	-	<0.50
Alkalinity-Total as $CaCo_3$	mg/L	392.00	330.00	342.00	202.00	300.00	308.00
Bicarbonate (HCO_3)	mg/L	-	400.00	418.00	-	360.00	375.00
Carbonate (CO_3)	mg/L	-	<0.50	<0.50	-	<0.50	<0.50
Conductivity-Lab	uS/cm	3610.00	3340.00	3010.00	2750.00	3430.00	3070.00
Conductivity-Field	uS/cm	-	-	3500.00	-	-	3200.00
Dissolved Sulphate(SO_4)	mg/L	1910.00	1900.00	1430.00	1450.00	1800.00	1530.00
Hydroxide (OH)	mg/L	-	<0.50	<0.50	-	<0.50	<0.50
pH-Field	pH Units	-	-	7.60	-	-	8.60
pH-Lab	pH Units	7.85	7.67	8.10	8.06	8.00	8.20
Salinity-Field	mg/L	-	-	1850.00	-	-	1850.00
TDS-Field	mg/L	-	-	2470.00	-	-	2470.00
TDS-Lab	mg/L	-	-	2510.00	-	-	2620.00
Temperature-Field	℃	-	-	8.10	-	-	5.20
Nutrients (N):							
Nitrogen-NH_3	mg/L	-	0.08	-	-	0.05	-
Nitrogen-NO_3	mg/L	-	<0.02	-	-	<0.02	-
NO_2+NO_3	mg/L	-	<0.02	-	-	<0.02	-
Nitrogen-NO_2	mg/L	-	<0.005	-	-	<0.005	-
Nitrogen-Total TKN	mg/L	-	0.12	-	-	0.09	-
Nitrogen-Total	mg/L	-	0.12	-	-	0.09	-
Organics:							
Total Oil & Grease	mg/L	-	-	<1.0	-	-	<1.0
2-Methylnapthalene	ug/L	-	-	<0.05	-	-	-
Acenaphthene	ug/L	-	-	<0.05	-	-	-
Acenaphthylene	ug/L	-	-	<0.05	-	-	-
Acridine	ug/L	-	-	<0.05	-	-	-
Anthracene	ug/L	-	-	<0.01	-	-	-
Benzo(a)anthracene	ug/L	-	-	<0.01	-	-	-
Benzo(a)pyrene	ug/L	-	-	<0.009	-	-	-

Parameter / Sample Date	Units	TDD December 29
Organics:		
Benzo(b&j)fluoranthene	ug/L	<0.05
Benzo(g,h,i)perylene	ug/L	<0.05
Benzo(k)fluoranthene	ug/L	<0.05
Chrysene	ug/L	<0.05
Dibenz(a,h)anthracene	ug/L	<0.05
Fluoranthene	ug/L	<0.02
Fluorene	ug/L	<0.05
High Molecular Weight P	ug/L	<0.05
Indeno(1,2,3-cd)pyrene	ug/L	<0.05
Low Molecular Weight PA	ug/L	<0.50
Naphthalene	ug/L	<0.05
Phenanthrene	ug/L	<0.05
Pyrene	ug/L	<0.02
Quinoline	ug/L	<0.50
Total PAHs	ug/L	<0.50
D10-Anthracene (sur.)	%	97.00
D8-Acenaphthylene (sur.	%	90.00
D8-Naphthalene (sur.)	%	91.00
D9-Acridine (sur.)	%	79.00
Terphenyl-D14 (sur.)	%	106.00

Parameters / Sample Date	TTD	SDS												
	January 5	January 5	January 10	January 17	January 24	January 31	February 7	February 14	February 21	February 28	March 7	March 13	March 20	March 27
Conductivity(UMHOS/CM	2940	2890	3260	3300	1900	3120	3250	3070	3060	3150	3080	2540	2860	2500
Hardness as CaCO3	1120	1100	-	-	-	-	1430	-	-	-	1250	-	-	-
pH	7.79	8.11	8.13	8.16	8.25	8.16	8.05	7.95	8.13	8.07	8.18	8.19	8.07	8.03
Acidity (pH=8.3)	12.2	4.3	7.5	4.3	<0.5	3.2	12.2	10.2	8.9	4.8	4.4	1.1	4.3	4.8
Alkalinity (as CaCO3)	295	282	326	315	180	312	307	266	297	294	304	244	281	233
Sulphate	1450	1490	1590	1730	862	1530	1700	1600	1520	1560	1530	1340	1490	1250

Results expressed as milligram per litre except where noted

TABLE 66-1
TOE OF TAILINGS DAM (TTD) and SOUTH DYKE SUMP (SDS)
METALS ANALYSIS COMPARATIVE TABLE
2011/12

Parameter / Sample Date	TTD January 6	TTD September 14	TTD December 6	TTD December 29
Total Metals				
Aluminum	0.009	<0.050	0.4	0.219
Antimony	<0.0005	<0.0050	<0.0005	<0.0005
Arsenic	0.0002	<0.0050	0.0009	0.0003
Barium	0.013	<0.020	0.022	0.013
Beryllium	<0.0001	<0.010	<0.0001	<0.0001
Bismuth	<0.001	ND	<0.001	<0.001
Boron	0.74	1.16	0.74	0.88
Cadmium	0.00003	<0.00017	0.00003	0.00005
Calcium	382	512	483	444
Chromium	<0.001	<0.01	0.001	0.003
Cobalt	0.0012	<0.0030	0.0091	0.0074
Copper	0.0008	<0.010	0.0033	0.004
Iron	0.355	3.03	10.3	0.618
Lead	<0.0002	<0.005	<0.0002	<0.0002
Lithium	0.008	<0.050	0.007	0.01
Magnesium	40	98.2	69	67.9
Manganese	0.18	1.8	4.64	0.6
Mercury	<0.000010	<0.00001	<0.00002	<0.00001
Molybdenum	<0.001	<0.01	<0.001	<0.001
Nickel	0.005	<0.01	0.011	0.018
Potassium	4.03	8	4.9	5.39
Selenium	0.0019	<0.01	0.0001	0.0005
Silicon	3.7	ND	5.4	4.6
Silver	<0.00002	<0.0002	<0.00002	<0.00002
Sodium	285	398	319	330
Strontium	1.89	ND	2.76	3
Sulphur	-	ND	658	588
Thallium	<0.00005	<0.002	<0.00005	<0.00005
Tin	<0.005	<0.0050	<0.0050	<0.0050
Titanium	<0.005	<0.010	0.009	<0.005
Uranium	0.0001	<0.002	0.0002	0.0002
Vanadium	<0.005	<0.010	<0.005	<0.005
Zinc	<0.005	<0.005	0.005	0.011
Zirconium	<0.0005	ND	ND	<0.0005
Dissolved Metals				
Aluminum	0.0075	<0.050	0.023	0.0213
Antimony	<0.00050	<0.0050	<0.0005	<0.0005
Arsenic	0.00019	<0.0050	0.0005	0.00015
Barium	0.0139	0.021	0.021	0.0143
Beryllium	<0.00010	<0.010	<0.0001	<0.0001
Bismuth	<0.0010	ND	<0.001	<0.001
Boron	0.769	1.08	0.86	0.92
Cadmium	0.000015	<0.00017	0.00027	0.000058
Calcium	406	492	505	430
Chromium	<0.0010	<0.01	<0.001	<0.001
Cobalt	0.00114	<0.0030	0.0084	0.00794
Copper	0.00079	<0.010	0.0004	0.00931
Iron	0.268	1.58	8.08	0.197
Lead	<0.00020	<0.005	<0.0002	<0.0002
Lithium	0.0086	<0.050	0.009	0.01
Magnesium	40.7	91.8	68	69.2
Manganese	0.182	1.65	4.4	0.616
Mercury	<0.000010	<0.00001	<0.00002	<0.00001
Molybdenum	<0.0010	<0.01	<0.001	<0.001
Nickel	0.005	<0.01	<0.01	0.0175
Potassium	4.1	ND	ND	ND
Potassium	-	7.5	4.68	5.31
Selenium	0.00173	<0.01	0.0002	0.00064
Silicon	3.97	ND	4.7	4.65
Silver	<0.000020	<0.0002	<0.00002	<0.00002
Sodium	285	374	289	332
Strontium	2	ND	2.7	3.03
Sulphur	-	ND	649	602
Thallium	<0.000050	<0.002	<0.00005	<0.00005
Tin	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.005	<0.005	<0.005
Uranium	0.00015	<0.002	0.0002	0.00018
Vanadium	<0.0050	<0.010	<0.005	<0.005
Zinc	<0.0050	<0.005	0.005	0.0122
Zirconium	<0.00050	ND	ND	<0.0005

Results are expressed in milligrams per litre except where noted.

TABLE 66-2
TOE OF TAILINGS DAM (TTD) and SOUTH DYKE SUMP (SDS)
METALS ANALYSIS COMPARATIVE TABLE
2011/12

Parameter / Sample Date	SDS January 5	SDS February 7	SDS March 7	SDS December 6	SDS December 29
Total Metals					
Aluminum	0.204	0.06	0.091	0.032	0.066
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Arsenic	0.0004	0.0003	0.0001	0.0003	0.0004
Barium	0.022	0.016	0.018	0.016	0.021
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001	<0.001	<0.001
Boron	0.7	0.86	0.96	1.02	0.82
Cadmium	0.00008	0.00003	0.00002	0.00024	<0.00002
Calcium	349	462	400	493	444
Chromium	<0.001	<0.001	<0.001	<0.001	0.002
Cobalt	0.0131	0.006	0.0069	0.0104	0.0056
Copper	0.003	0.0013	0.0009	0.0007	0.0013
Iron	0.363	0.261	0.216	0.271	0.192
Lead	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Lithium	0.013	0.01	0.009	0.015	0.009
Magnesium	55.7	66.8	60.3	80.2	68.1
Manganese	0.794	0.768	0.715	1.47	0.805
Mercury	<0.000010	<0.000010	<0.000002	<0.00002	<0.00001
Molybdenum	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.028	0.014	0.015	0.026	0.014
Potassium	5.01	5.38	5.03	5.51	5.46
Selenium	0.0025	0.0006	0.001	0.0008	0.0006
Silicon	3.7	4.5	4.1	4.3	4.6
Silver	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Sodium	261	334	297	301	303
Strontium	2.32	2.96	2.78	3.14	2.86
Sulphur	-	-	-	ND	567
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005	<0.0050	<0.0050
Titanium	<0.005	<0.005	<0.005	<0.0050	<0.005
Uranium	0.0002	0.0002	0.0001	0.0002	0.0002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.019	0.013	0.013	0.014	0.008
Zirconium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Dissolved Metals					
Aluminum	0.0261	0.0202	0.0301	0.022	0.018
Antimony	<0.00050	<0.00050	<0.00050	<0.0005	<0.0005
Arsenic	0.00013	0.00021	0.00016	0.0003	0.00013
Barium	0.0218	0.0168	0.0186	0.017	0.0217
Beryllium	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001
Bismuth	<0.0010	<0.0010	<0.0010	<0.001	<0.001
Boron	0.669	0.938	0.789	0.95	0.95
Cadmium	0.000062	0.000032	0.000022	0.00048	0.000025
Calcium	375	432	419	456	409
Chromium	<0.0010	<0.0010	<0.0010	<0.001	<0.001
Cobalt	0.0125	0.00585	0.00657	0.0102	0.00541
Copper	0.0023	0.00129	0.00078	0.001	0.00973
Iron	0.0203	0.0533	0.0364	0.091	0.0196
Lead	<0.00020	<0.00020	<0.00020	<0.0002	<0.0002
Lithium	0.0127	0.0098	0.01	0.016	0.0085
Magnesium	53.8	65.9	58	80.7	64.3
Manganese	0.757	0.763	0.671	1.5	0.774
Mercury	<0.000010	<0.000010	<0.000002	<0.00002	<0.00001
Molybdenum	<0.0010	<0.0010	<0.0010	<0.001	<0.001
Nickel	0.0266	0.0143	0.015	0.026	0.0137
Potassium	4.85	5.37	4.88	ND	ND
Potassium	\	-	-	5.55	5.06
Selenium	0.00244	0.00064	0.00104	0.0008	0.0006
Silicon	3.73	4.2	3.89	4.1	4.46
Silver	<0.000020	<0.000020	<0.000020	<0.00002	<0.00002
Sodium	258	331	290	307	286
Strontium	2.23	3.08	2.68	3.27	2.74
Sulphur	-	-	-	673	547
Thallium	<0.000050	<0.000050	<0.000050	<0.00005	<0.00005
Tin	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050	<0.0050	<0.005
Uranium	0.00014	0.00016	0.00014	0.0002	0.00017
Vanadium	<0.0050	<0.0050	<0.0050	<0.005	<0.005
Zinc	0.0144	0.0126	0.0112	0.013	0.0071
Zirconium	<0.00050	<0.00050	<0.00050	<0.0005	<0.0005

Results are expressed in milligrams per litre except where noted.

TABLE 67
5 SOUTH PORTAL SUMP
2011/12
COMPANY IDENTITY-5SP

Parameters	December			January					February				March			
Sample Date	13	21	28	5	10	17	24	31	7	14	21	28	6	13	20	27
Conductivity(UMHOS/CM)	270	224	168	446	234	2190	926	983	1750	1410	1340	1530	884	177	695	1180
Hardness as CaCO3	-	-	-	112	-	-	-	-	489	-	-	-	279	-	-	-
pH	7.76	7.72	7.49	7.8	7.65	7.78	8.04	8.03	8.18	8.06	8.15	8.05	8.09	7.56	7.83	8.06
Acidity (pH=8.3)	0.8	1	<0.5	<0.5	<0.5	4.5	<0.5	0.5	2.1	4.4	2.7	1.1	<0.5	0.9	1	0.8
Alkalinity (as CaCO3)	73.9	49.9	31.4	53.5	36.7	254	94.2	112	211	161	158	180	106	26.8	80.6	137
Ammonia as Nitrogen	-	-	-	0.0059	-	-	-	-	<0.0050	-	-	-	-	-	-	-
Phosphorous-Dissolved	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0128	-	-
Phosphorous-Total	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0545	-	-
Sulphate	55.5	47.6	36.7	145	47.3	953	259	295	798	534	470	571	278	23.4	175	416
TSS	-	45.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Results expressed as milligram per litre except where noted

TABLE 68
5 South Protal Sump METALS ANALYSIS
2011/12
COMPANY IDENTITY-5SP

Parameter / Sample Date	January 5	February 7	March 6
Total Metals			
Aluminum	0.542	0.316	7.32
Antimony	<0.0005	<0.0005	<0.0005
Arsenic	0.0003	0.0003	0.0022
Barium	0.018	0.023	0.057
Beryllium	<0.0001	<0.0001	<0.0001
Bismuth	<0.001	<0.001	<0.001
Boron	0.1	0.56	0.3
Cadmium	0.00002	0.00002	0.00005
Calcium	37.4	165	92
Chromium	<0.001	<0.001	0.008
Cobalt	0.0012	<0.0005	0.0036
Copper	0.0029	0.0016	0.0214
Iron	0.692	0.475	9.27
Lead	0.0004	<0.0002	0.0007
Lithium	<0.005	0.005	<0.005
Magnesium	4.58	18.6	11.9
Manganese	0.045	0.027	0.141
Mercury	<0.000010	<0.000010	0.0000027
Molybdenum	<0.001	<0.001	<0.001
Nickel	0.003	0.002	0.007
Potassium	0.862	2.71	2.07
Selenium	<0.0001	0.0002	0.0002
Silicon	3.9	3.5	15.3
Silver	<0.00002	<0.00002	<0.00002
Sodium	30.8	185	97.3
Strontium	0.219	1.15	0.589
Thallium	<0.00005	<0.00005	<0.00005
Tin	<0.005	<0.005	<0.005
Titanium	0.031	0.023	0.515
Uranium	<0.0001	0.0001	0.0001
Vanadium	<0.005	<0.005	0.024
Zinc	<0.005	<0.005	0.015
Zirconium	<0.0005	<0.0005	0.0021
Dissolved Metals			
Aluminum	0.0302	0.0079	0.0135
Antimony	<0.00050	<0.00050	<0.00050
Arsenic	<0.00010	<0.00010	0.00012
Barium	0.0164	0.0234	0.0228
Beryllium	<0.00010	<0.00010	<0.00010
Bismuth	<0.0010	<0.0010	<0.0010
Boron	0.105	0.597	0.259
Cadmium	0.000014	<0.000010	0.000011
Calcium	39.9	177	83.4
Chromium	<0.0010	<0.0010	<0.0010
Cobalt	0.00083	<0.00050	<0.00050
Copper	0.00217	0.00057	0.00137
Iron	0.0344	0.0136	0.011
Lead	<0.00020	<0.00020	<0.00020
Lithium	<0.0050	<0.0050	<0.0050
Magnesium	4.89	19.1	9.53
Manganese	0.0373	0.0239	0.0211
Mercury	<0.000010	<0.000010	<0.000002
Molybdenum	<0.0010	<0.0010	<0.0010
Nickel	0.0024	0.0021	0.0017
Potassium	1.09	2.79	1.73
Selenium	<0.00010	0.00037	0.0002
Silicon	3.45	3.42	3.1
Silver	<0.000020	<0.000020	<0.000020
Sodium	33.8	194	96.2
Strontium	0.24	1.19	0.56
Thallium	<0.000050	<0.000050	<0.000050
Tin	<0.0050	<0.0050	<0.0050
Titanium	<0.0050	<0.0050	<0.0050
Uranium	<0.00010	0.00013	<0.00010
Vanadium	<0.0050	<0.0050	<0.0050
Zinc	<0.0050	<0.0050	<0.0050
Zirconium	<0.00050	<0.00050	<0.00050

Results are expressed in milligrams per litre except where noted.

TABLE 69-1
SULPHATE CONCENTRATIONS IN MINESITE WATER
2011/12

Monitoring Station	April						May							June					
Sample Date	4	11	12	13	18	25	2	3	9	10	13	23	30	6	13	14	15	20	27
Catchment Ditch #1	880.0	-	-	-	-	-	-	970.0	-	-	-	-	-	830.0	-	-	-	-	-
Catchment Ditch #2	330.0	-	-	-	-	-	-	330.0	-	-	-	-	-	330.0	-	-	-	-	-
Quinsam Lake #1	-	-	11.0	-	-	-	-	-	18.0	-	-	-	-	-	-	-	22.0	-	-
Quinsam Lake #2	-	-	19.0	-	-	-	-	-	6.4	-	-	-	-	-	-	-	17.0	-	-
Quinsam Lake #3	-	-	28.0	-	-	-	-	-	25.0	-	-	-	-	-	-	-	14.0	-	-
Quinsam Lake #4	-	-	29.0	-	-	-	-	-	19.0	-	-	-	-	-	-	-	8.1	-	-
Quinsam Lake #5	-	-	28.0	-	-	-	-	-	19.0	-	-	-	-	-	-	-	7.7	-	-
Quinsam Lake #6	-	-	28.0	-	-	-	-	-	20.0	-	-	-	-	-	-	-	7.4	-	-
Long Lake #1	-	-	-	27.0	-	-	-	-	-	77.0	-	-	-	-	-	40.0	-	-	-
Long Lake #2	-	-	-	39.0	-	-	-	-	-	62.0	-	-	-	-	-	51.0	-	-	-
Long Lake #3	-	-	-	46.0	-	-	-	-	-	22.0	-	-	-	-	-	45.0	-	-	-
Long Lake Seep	470.0	-	-	-	-	-	-	420.0	-	-	-	-	-	380.0	-	-	-	-	-
SPD	320.0	270.0	-	-	260.0	260.0	210.0	-	-	260.0	-	240.0	190.0	230.0	230.0	-	-	190.0	200.0
3 South Pit	220.0	360.0	-	-	460.0	350.0	420.0	-	300.0	-	-	-	-	420.0	490.0	-	-	480.0	520.0
NNO	1.9	6.1	-	-	13.0	10.0	-	11.0	9.1	-	8.1	7.0	-	5.2	8.2	-	-	5.9	5.0
3S77	-	-	-	-	-	-	250.0	-	-	-	-	-	-	200.0	-	-	-	-	-
4S Lower	220.0	210.0	-	-	200.0	180.0	190.0	-	230.0	-	230.0	190.0	-	190.0	180.0	-	-	180.0	190.0
SPC	55.0	64.0	-	-	40.0	33.0	26.0	-	9.0	-	-	23.0	120.0	55.0	41.0	-	-	20.0	9.0
LLE0649	98.0	100.0	-	-	96.0	93.0	85.0	-	99.0	-	90.0	93.0	-	93.0	110.0	-	-	130.0	160.0
LLO	47.0	59.0	-	-	71.0	63.0	55.0	-	54.0	-	53.0	45.0	-	28.0	39.0	-	-	40.0	46.0
WB	33.0	36.0	-	-	28.0	31.0	25.0	-	24.0	-	18.0	11.0	-	9.3	12.0	-	-	14.0	14.0
South Dyke Pond	1700.0	1700.0	-	-	1700.0	1600.0	1500.0	-	1500.0	-	1200.0	1400.0	-	1700.0	1600.0	-	-	1600.0	1700.0
2N-Portal Sump	870.0	850.0	-	-	900.0	900.0	-	840.0	1000.0	-	890.0	1100.0	-	950.0	1000.0	-	-	1000.0	1000.0
WP	730.0	-	-	-	-	-	-	790.0	-	-	-	-	-	820.0	-	-	-	-	-
WD	680.0	710.0	-	710.0	-	660.0	-	710.0	770.0	-	710.0	1100.0	800.0	800.0	780.0	-	-	730.0	810.0
WC	570.0	610.0	-	-	690.0	650.0	-	640.0	710.0	-	660.0	770.0	550.0	720.0	780.0	-	-	740.0	740.0
WA	1.1	32.0	-	-	1.7	0.7	-	1.6	2.6	-	1.5	4.5	-	3.6	1.8	-	-	1.7	1.7
QRSD1	34.0	32.0	-	-	30.0	29.0	-	24.0	22.0	-	17.0	7.4	-	9.8	7.3	-	-	11.0	13.0
7S	1.0	<0.5	-	-	0.7	<0.5	0.7	-	<0.5	-	0.8	<0.5	1.5	1.9	-	-	-	1.3	-
7SQR	32.0	-	-	-	29.0	29.0	-	26.0	-	-	-	-	7.0	7.9	-	-	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 69-2
SULPHATE CONCENTRATIONS IN MINESITE WATER
2011/12

Monitoring Station	July					August					September				
Sample Date	4	11	12	13	25	2	3	9	23	30	6	13	20	22	27
Catchment Ditch #1	960.0	-	-	-	-	-	-	930.0	-	-	-	-	-	-	770.0
Catchment Ditch #2	^	-	-	-	-	-	-	^	-	-	-	-	-	-	^
Quinsam Lake #1	-	-	16.0	-	-	-	-	-	-	-	-	-	-	4.1	-
Quinsam Lake #2	-	-	14.0	-	-	-	-	-	-	-	-	-	-	8.5	-
Quinsam Lake #3	-	-	13.0	-	-	-	-	-	-	-	-	-	-	7.6	-
Quinsam Lake #4	-	-	12.0	-	-	-	-	-	-	-	-	-	-	9.0	-
Quinsam Lake #5	-	-	12.0	-	-	-	-	-	-	-	-	-	-	9.2	-
Quinsam Lake #6	-	-	12.0	-	-	-	-	-	-	-	-	-	-	11.0	-
Long Lake #1	-	-	49.0	-	-	-	-	-	-	-	-	-	-	80.0	-
Long Lake #2	-	-	53.0	-	-	-	-	-	-	-	-	-	-	81.0	-
Long Lake #3	-	-	50.0	-	-	-	-	-	-	-	-	-	-	82.0	-
Long Lake Seep	440.0	-	-	-	-	450.0	-	-	-	400.0	-	-	-	-	-
SPD	230.0	220.0	-	230.0	-	190.0	230.0	180.0	220.0	200.0	200.0	200.0	-	-	180.0
3 South Pit	550.0	570.0	-	560.0	560.0	630.0	630.0	640.0	600.0	550.0	590.0	610.0	590.0	-	510.0
NNO	4.7	4.3	-	4.1	4.2	4.5	3.6	4.3	4.1	5.0	4.5	5.7	5.6	-	7.9
3S77	220.0	-	-	-	-	220.0	-	-	-	220.0	-	-	-	-	-
4S Lower	180.0	180.0	-	170.0	170.0	170.0	170.0	180.0	170.0	^	^	^	^	-	160.0
SPC	30.0	23.0	-	22.0	15.0	16.0	16.0	16.0	14.0	16.0	^	^	^	-	<0.5
LLE0649	170.0	260.0	-	74.0	130.0	260.0	400.0	360.0	350.0	390.0	360.0	380.0	360.0	-	14.0
LLO	49.0	52.0	-	55.0	54.0	58.0	60.0	64.0	70.0	70.0	72.0	80.0	89.0	-	85.0
WB	15.0	13.0	-	14.0	12.0	13.0	13.0	13.0	16.0	17.0	21.0	17.0	14.0	-	13.0
South Dyke Pond	1700.0	1700.0	-	1100.0	1700.0	1700.0	1700.0	1600.0	1600.0	1800.0	1700.0	1800.0	1800.0	-	960.0
2N-Portal Sump	1100.0	1100.0	-	1000.0	1100.0	1200.0	1100.0	-	-	1100.0	1200.0	1200.0	1100.0	-	1000.0
WP	910.0	-	-	-	-	830.0	-	-	-	900.0	-	-	-	-	-
WD	860.0	870.0	-	860.0	780.0	810.0	870.0	780.0	770.0	870.0	800.0	850.0	820.0	-	740.0
WC	740.0	790.0	-	770.0	780.0	760.0	800.0	790.0	840.0	800.0	810.0	810.0	790.0	-	690.0
WA	2.1	21.0	-	0.9	1.4	1.0	1.3	1.4	1.2	0.5	0.8	1.3	<0.5	-	1.2
QRSD1	16.0	14.0	-	14.0	13.0	14.0	13.0	16.0	17.0	18.0	16.0	14.0	24.0	-	-
7S	2.7	^	^	^	^	^	^	^	^	^	^	^	^	-	0.7
7SQR	18.0	-	-	-	-	15.0	-	-	-	18.0	-	-	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 69-3
SULPHATE CONCENTRATIONS IN MINESITE WATER
2011/12

Monitoring Station / Sample Date	October				November					December			
	6	11	17	24	3	8	14	22	29	7	13	20	28
Catchment Ditch #1	-	-	-	-	910.0	-	-	-	-	454.0	-	-	-
Catchment Ditch #2	-	-	-	-	480.0	-	-	-	-	406.0	-	-	-
Quinsam Lake #1	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #2	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #3	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #4	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #5	-	-	-	-	-	-	-	-	-	-	-	-	-
Quinsam Lake #6	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #1	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #2	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake #3	-	-	-	-	-	-	-	-	-	-	-	-	-
Long Lake Seep	410.0	-	-	-	510.0	-	-	-	-	582.0	-	-	-
SPD	190.0	200.0	-	220.0	270.0	158.0	196.0	30.9	16.5	402.0	365.0	244.0	97.9
3 South Pit	590.0	550.0	530.0	600.0	610.0	582.0	550.0	186.0	590.0	454.0	500.0	257.0	343.0
NNO	7.2	6.1	6.8	6.1	9.0	11.2	13.2	10.2	5.0	1.2	<0.50	1.4	1.2
3S77	220.0	-	-	-	250.0	-	-	-	-	342.0	-	-	210.0
4S Lower	140.0	140.0	150.0	160.0	170.0	167.0	165.0	88.3	115.0	128.0	146.0	153.0	151.0
SPC	4.0	69.0	56.0	120.0	120.0	58.0	95.2	49.3	134.0	122.0	98.0	90.1	67.4
LLE0649	27.0	61.0	77.0	87.0	100.0	82.4	101.0	62.0	109.0	129.0	151.0	93.3	86.9
LLO	67.0	47.0	41.0	44.0	52.0	51.2	47.5	46.7	19.5	26.0	28.2	31.1	38.7
WB	26.0	26.0	23.0	19.0	28.0	20.9	25.0	23.9	10.6	19.3	20.2	30.7	26.3
South Dyke Pond	1300.0	1200.0	1700.0	1800.0	1700.0	1800.0	1740.0	1180.0	1800.0	1780.0	1670.0	1640.0	1530.0
2N-Portal Sump	1100.0	1100.0	1000.0	1100.0	1100.0	1030.0	979.0	567.0	933.0	1130.0	859.0	564.0	1060.0
WP	790.0	-	-	830.0	840.0	820.0	758.0	171.0	689.0	631.0	559.0	1020.0	568.0
WD	810.0	830.0	720.0	740.0	770.0	800.0	755.0	562.0	720.0	614.0	557.0	628.0	557.0
WC	780.0	760.0	700.0	720.0	710.0	728.0	651.0	501.0	502.0	573.0	618.0	518.0	473.0
WA	0.6	0.9	<0.5	1.3	<0.5	1.2	1.7	1.4	2.2	2.0	0.7	1.4	1.4
QRSD1	22.0	24.0	22.0	21.0	23.0	19.5	22.7	22.2	9.3	18.0	19.2	27.8	28.8
7S	2.0	<0.5	0.6	1.1	-	<0.50	1.3	-	-	0.7	-	0.7	1.1
7SQR	17.0	-	-	-	23.0	-	-	-	-	23.7	-	-	-

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 69-4
SULPHATE CONCENTRATIONS IN MINESITE WATER
2011/12

Monitoring Stations	January					February				March			
Sample Date	6	10	17	24	31	7	14	21	28	7	13	20	27
Catchment Ditch #1	162	-	-	-	-	521	-	-	-	472	-	-	-
Catchment Ditch #2	150	-	-	-	-	414	-	-	-	268	-	-	-
2N Portal Sump	867	794	1160	978	890	1150	926	848	1010	1030	966	964	908
3S	157	498	449	111	155	170	474	474	505	519	590	611	590
3S-77	152	182	228	197	162	158	187	239	190	186	-	171	227
4S Lower	91.1	122	144	118	115	129	121	122	123	113	119	110	108
7S	0.55	<0.50	<0.50	-	-	-	<0.50	-	-	1.14	-	<0.50	2.52
7SQR	10.8	<0.50	-	-	-	-	-	-	-	28.9	-	-	-
LLE	63.1	113	124	70.7	72.2	89.7	98.5	96.5	67.3	70.8	74.7	93.9	97.7
LLO	23	14.8	27.6	49.3	20.3	29.5	23	32.5	37.4	30.4	38.3	35.3	71.2
LLS	422	-	-	-	-	593	-	-	-	504	-	-	-
NNO	0.53	<0.50	<0.50	-	<0.50	<0.50	0.96	1.95	2.37	1.85	-	0.89	9.84
QRDS1	17.2	13.6	18.8	-	-	-	16.8	25.6	-	33.9	-	37.5	45.7
SDS	1490	1590	1730	862	1530	1700	1600	1520	1560	1530	1340	1490	1250
SPC	82	123	96.9	75.4	82.1	90	107	87.9	54.6	80.6	85.7	107	81.5
SPD	160	200	447	156	147	254	289	222	192	170	228	160	252
WA	1	0.73	1.34	0.6	1.02	2.11	1.33	1.87	1.86	1.36	1.2	<0.50	1.56
WB	12	12.7	19.7	25.8	18	23	16.8	28.1	29.5	36.3	45.6	42.4	54.4
WC	505	427	458	412	428	492	399	502	486	513	307	405	412
WD	538	459	482	534	407	491	508	493	522	492	428	407	442
WP	658	725	581	444	187	419	488	572	568	563	625	563	585

Results expressed in milligrams per litre.
^ = Dry, no sample

TABLE 70
RAINFALL PRECIPITATION
2011/12

DATE	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Jan	Feb	Mar
1	0.80	8.00	7.40	0.40	0.00	0.40	5.32	0*	0.6*	1.2*	10.15	0*
2	0.00	3.80	0.40	0.00	0.80	0.00	15.4*	2.4*	0*	0.8*	0.2*	8.4*
3	0.00	0.80	0.00	0.00	0.00	0.00	4.6*	0*	0*	38.6*	0.2*	6.4*
4	0.60	5.40	0.00	0.00	0.00	0.00	20.08	0.4*	0.6*	3.04	0.2*	13.2*
5	0.00	1.20	0.00	0.00	0.00	0.00	6.33	0.2*	0*	16.51	0*	0*
6	0.80	10.80	0.00	0.00	0.00	0.00	3.05	0.2*	0*	11.41	0*	0*
7	0.00	2.00	0.00	0.00	0.00	0.00	4.06	2.2*	0*	1.76	1.8*	0*
8	0.00	0.00	0.00	0.00	0.00	0.00	2.4*	6.8*	0*	3.51	8.4*	0.6*
9	1.00	0.60	0.40	0.00	0.20	0.00	3.2*	4.4*	0*	8.86	32.8*	3.6*
10	6.80	0.60	0.40	0.00	0.00	0.30	6.2*	6*	0*	5.83	15.2*	8*
11	2.00	2.20	0.00	0.60	0.00	0.00	5.82	2*	0*	0.00	0.2*	10.8*
12	8.80	1.60	0.00	0.20	0.00	6.60	0.50	9*	0*	0.00	10*	23.2*
13	0.40	0.20	0.60	13.20	0.00	0.00	0.25	0*	0*	0.00	1*	1.4*
14	6.00	12.80	5.60	10.00	2.00	3.00	0*	0*	15.2*	6.81	1*	41.3*
15	1.80	6.80	0.00	18.60	0.30	7.40	0.50	0.2*	11.2*	1.51	7*	2.2*
16	0.00	2.00	0.00	2.60	0.00	0.00	0.25	8.34	1.2*	2.54	13*	1*
17	0.00	0.00	2.40	0.00	0.30	0.30	2.78	2.79	5.2*	11.42	8.2*	0*
18	0.40	0.00	0.00	0.00	0.00	16.80	0.20	11.17	0*	11.19	5.4*	0.2*
19	4.40	0.00	0.00	0.00	8.10	22.60	4.05	0.75	6.6*	10.64	-	18.8*
20	3.60	1.20	0.00	0.20	0.30	9.70	1*	0*	0*	16.75	-	0*
21	0.00	1.80	0.00	0.00	0.00	26.90	5.05	66.28*	0*	0.25	12.6*	0*
22	0.00	4.40	0.00	0.00	0.30	19.80	6.82	5.82*	0*	0.00	0*	5.2*
23	0.40	0.00	9.60	0.00	0.00	1.00	3.04	0.25*	7*	1.27	8.4*	0*
24	0.80	0.00	5.80	0.00	0.00	1.80	0.50	26.14*	3.4*	2.00	16*	0*
25	4.60	3.00	0.00	0.00	0.00	0.30	0.25	3.04*	3.4*	12.89	0*	0*
26	0.60	3.40	0.00	0.00	0.00	0.30	2.76	44.16*	5.4*	0.50	0*	9.8*
27	8.40	9.00	2.40	0.00	0.00	0.50	2.2*	13.44*	24.8*	0.25	0*	7.09
28	0.60	0.20	0.80	0.20	0.00	0.30	6.59	0.25*	7.4*	1.77	22.6*	12.17
29	0.00	5.60	1.20	0.00	0.30	0.30	2.8*	1.26*	18.6*	0.25	0.8*	14.73
30	0.00	1.00	2.20	0.40	0.30	10.70	6.84	0*	1.8*	0.25	-	0.25
31	-	9.00	-	0.00	0.30	-	0*	-	0.4*	0.25	-	1.00
Monthly Total	**52.80**	**97.40**	**39.2**	**46.4**	**13.2**	**129**	**217.5**	**122.8**	**112.8**	**131.5**	**169**	**189.3**
Quarterly Total		**189.40**			**188.6**			**942.9**			**489.8**	
Annual Total	**1810.73**											

Results expressed in millimeters.
Results from April - September are augmented with data from Environment Canada at Campbell River Airport
* Results are from Environment Canada at Campbell River Airport.

TABLE 71
WATER LEVELS AND FLOWS
2011/12

Station Date	WB (m)	WB Flow (m3/s)	LLO (m)	LLO Flow (m3/s)	LLE (m)
4-Apr-11	0.80	4.348	0.21	0.077	50
11-Apr-11	0.70	3.386	0.21	0.077	55
18-Apr-11	0.67	3.090	0.21	0.077	40
25-Apr-11	0.63	2.690	0.12	0.018	30
2-May-11	0.65	2.890	0.10	0.033	40
9-May-11	0.72	3.581	0.09	0.045	60
16-May-11	0.95	5.722	0.09	0.045	70
23-May-11	0.91	5.363	0.08	0.059	60
30-May-11	0.90	5.273	0.06	0.096	50
6-Jun-11	0.90	5.273	0.04	0.142	50
13-Jun-11	0.90	5.273	0.18	0.034	20
20-Jun-11	0.80	4.348	0.15	0.014	30
27-Jun-11	0.64	2.790	0.11	0.024	30
4-Jul-11	0.65	2.890	0.09	0.045	20
18-Jul-11	0.69	3.287	0.13	0.014	25
25-Jul-11	0.55	1.872	0.09	0.045	15
1-Aug-11	0.50	1.349	0.05	0.118	5
8-Aug-11	0.45	0.817	0.03	0.170	10
22-Aug-11	0.41	0.384	0.01	0.232	3
29-Aug-11	0.50	1.349	0.00	0.268	3
14-Sep-11	0.51	1.454	0.00	0.268	2
20-Sep-11	0.48	1.137	0.00	0.268	3
1-Oct-11	0.58	2.182	0.31	0.393	150
5-Oct-11	0.60	2.386	0.30	0.349	100
11-Oct-11	0.60	2.386	0.40	0.900	200
17-Oct-11	0.60	2.386	0.25	0.172	250
1-Oct-11	0.60	1.775	0.30	0.253	0.15
11-Oct-11	0.60	1.775	0.40	0.609	0.10
17-Oct-11	0.60	1.775	0.25	0.145	0.20
24-Oct-11	0.55	1.339	0.24	0.128	0.06
1-Nov-11	0.55	1.339	0.25	0.145	0.06
8-Nov-11	0.55	1.339	0.23	0.112	0.10
14-Nov-11	0.70	2.885	0.35	0.406	0.25
22-Nov-11	0.79	4.235	0.42	0.707	0.24
13-Dec-11	-	-	0.17	0.044	0.06
28-Dec-11	-	-	0.26	0.164	0.12
5-Jan-12	-	-	0.70	3.335	450
10-Jan-12	-	-	0.40	0.609	-
17-Jan-12	-	-	0.21	0.085	60
24-Jan-12	-	-	-	-	170
31-Jan-12	-	-	0.4	0.609	200
6-Feb-12	-	-	0.35	0.406	100
14-Feb-12	-	-	0.34	0.371	115
28-Feb-12	-	-	0.3	0.253	100
6-Mar-12	-	-	0.37	0.480	250
13-Mar-12	-	-	0.34	0.371	250
20-Mar-12	-	-	0.31	0.280	160
27-Mar-12	-	-	0.25	0.145	150

ND: No Data

TABLE 72-1
Quinsam River at Argonaut Bridge Flow Data
2011/12
COMPANY IDENTITY-WA

Date	Flow(m3/s)	Date	Flow(m3/s)	Date	Flow(m3/s)	Date	Flow(m3/s)
1-Apr-11	5.188	1-May-11	3.016	1-Jun-11	8.868	1-Jul-11	3.601
2-Apr-11	5.496	2-May-11	3.026	2-Jun-11	9.614	2-Jul-11	3.209
3-Apr-11	5.194	3-May-11	3.026	3-Jun-11	8.957	3-Jul-11	2.977
4-Apr-11	4.830	4-May-11	3.034	4-Jun-11	8.266	4-Jul-11	2.802
5-Apr-11	4.492	5-May-11	3.066	5-Jun-11	8.234	5-Jul-11	2.705
6-Apr-11	4.168	6-May-11	3.239	6-Jun-11	8.599	6-Jul-11	2.795
7-Apr-11	3.869	7-May-11	3.770	7-Jun-11	9.035	7-Jul-11	2.899
8-Apr-11	3.596	8-May-11	4.231	8-Jun-11	8.530	8-Jul-11	2.859
9-Apr-11	3.378	9-May-11	4.559	9-Jun-11	8.595	9-Jul-11	2.554
10-Apr-11	3.364	10-May-11	5.323	10-Jun-11	8.145	10-Jul-11	2.277
11-Apr-11	3.957	11-May-11	6.370	11-Jun-11	7.257	11-Jul-11	2.140
12-Apr-11	4.183	12-May-11	6.013	12-Jun-11	6.572	12-Jul-11	2.390
13-Apr-11	4.163	13-May-11	5.407	13-Jun-11	6.176	13-Jul-11	2.632
14-Apr-11	3.950	14-May-11	5.156	14-Jun-11	6.027	14-Jul-11	2.666
15-Apr-11	3.734	15-May-11	6.690	15-Jun-11	5.500	15-Jul-11	2.991
16-Apr-11	3.489	16-May-11	9.617	16-Jun-11	5.117	16-Jul-11	3.924
17-Apr-11	3.264	17-May-11	9.567	17-Jun-11	4.956	17-Jul-11	4.787
18-Apr-11	3.124	18-May-11	8.671	18-Jun-11	5.197	18-Jul-11	4.558
19-Apr-11	3.069	19-May-11	7.712	19-Jun-11	5.349	19-Jul-11	4.227
20-Apr-11	3.054	20-May-11	7.480	20-Jun-11	5.313	20-Jul-11	3.768
21-Apr-11	3.038	21-May-11	7.919	21-Jun-11	5.106	21-Jul-11	3.260
22-Apr-11	3.025	22-May-11	8.178	22-Jun-11	5.142	22-Jul-11	2.804
23-Apr-11	3.019	23-May-11	8.575	23-Jun-11	4.478	23-Jul-11	2.401
24-Apr-11	3.004	24-May-11	8.586	24-Jun-11	3.747	24-Jul-11	2.116
25-Apr-11	3.007	25-May-11	8.298	25-Jun-11	3.638	25-Jul-11	1.933
26-Apr-11	3.004	26-May-11	8.185	26-Jun-11	3.533	26-Jul-11	1.835
27-Apr-11	3.025	27-May-11	7.480	27-Jun-11	3.455	27-Jul-11	1.695
28-Apr-11	3.027	28-May-11	6.906	28-Jun-11	3.717	28-Jul-11	1.555
29-Apr-11	3.015	29-May-11	6.505	29-Jun-11	3.997	29-Jul-11	1.447
30-Apr-11	3.003	30-May-11	7.085	30-Jun-11	4.011	30-Jul-11	1.365
		31-May-11	7.457			31-Jul-11	1.291

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 72-2
Quinsam River at Argonaut Bridge Flow Data
2011/12
COMPANY IDENTITY-WA

Date	Flow(m3/s)	Date	Flow(m3/s)	Date	Flow(m3/s)	Date	Flow(m3/s)
1-Aug-11	1.232	1-Sep-11	1.83*	1-Oct-11	1.84*	1-Nov-11	1.940
2-Aug-11	1.190	2-Sep-11	1.81*	2-Oct-11	1.83*	2-Nov-11	1.960
3-Aug-11	1.163	3-Sep-11	1.8*	3-Oct-11	1.85*	3-Nov-11	1.960
4-Aug-11	1.136	4-Sep-11	1.8*	4-Oct-11	1.89*	4-Nov-11	1.960
5-Aug-11	1.120	5-Sep-11	1.8*	5-Oct-11	2.17*	5-Nov-11	1.950
6-Aug-11	1.114	6-Sep-11	1.79*	6-Oct-11	2.13*	6-Nov-11	1.940
7-Aug-11	1.112	7-Sep-11	1.78*	7-Oct-11	2.11*	7-Nov-11	1.940
8-Aug-11	1.112	8-Sep-11	1.78*	8-Oct-11	2.04*	8-Nov-11	1.950
9-Aug-11	1.112	9-Sep-11	1.71*	9-Oct-11	2*	9-Nov-11	1.980
10-Aug-11	1.112	10-Sep-11	1.65*	10-Oct-11	1.99*	10-Nov-11	2.050
11-Aug-11	1.112	11-Sep-11	1.64*	11-Oct-11	2*	11-Nov-11	2.620
12-Aug-11	1.112	12-Sep-11	1.64*	12-Oct-11	2.09*	12-Nov-11	3.600
13-Aug-11	1.112	13-Sep-11	1.63*	13-Oct-11	2.42*	13-Nov-11	3.870
14-Aug-11	1.126	14-Sep-11	1.62*	14-Oct-11	2.61*	14-Nov-11	3.760
15-Aug-11	1.117	15-Sep-11	1.63*	15-Oct-11	2.54*	15-Nov-11	3.470
16-Aug-11	1.112	16-Sep-11	1.62*	16-Oct-11	2.38*	16-Nov-11	3.220
17-Aug-11	1.107	17-Sep-11	1.62*	17-Oct-11	2.23*	17-Nov-11	2.730
18-Aug-11	1.106	18-Sep-11	1.61*	18-Oct-11	2.04*	18-Nov-11	2.170
19-Aug-11	1.106	19-Sep-11	1.6*	19-Oct-11	1.91*	19-Nov-11	2.030
20-Aug-11	1.106	20-Sep-11	1.58*	20-Oct-11	1.84*	20-Nov-11	1.880
21-Aug-11	1.107	21-Sep-11	1.64*	21-Oct-11	1.8*	21-Nov-11	1.970
22-Aug-11	1.382	22-Sep-11	1.62*	22-Oct-11	1.82*	22-Nov-11	6.010
23-Aug-11	1.614	23-Sep-11	1.68*	23-Oct-11	1.82*	23-Nov-11	7.650
24-Aug-11	1.625	24-Sep-11	1.81*	24-Oct-11	1.8*	24-Nov-11	7.360
25-Aug-11	1.65*	25-Sep-11	1.98*	25-Oct-11	1.78*	25-Nov-11	7.240
26-Aug-11	1.64*	26-Sep-11	1.99*	26-Oct-11	1.78*	26-Nov-11	7.290
27-Aug-11	1.64*	27-Sep-11	2.01*	27-Oct-11	1.79*	27-Nov-11	33.400
28-Aug-11	1.63*	28-Sep-11	1.96*	28-Oct-11	1.82*	28-Nov-11	30.300
29-Aug-11	1.75*	29-Sep-11	1.9*	29-Oct-11	1.92*	29-Nov-11	17.500
30-Aug-11	1.84*	30-Sep-11	1.87*	30-Oct-11	1.93*	30-Nov-11	12.300
31-Aug-11	1.83*			31-Oct-11	1.93*		

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 72-3
Quinsam River at Argonaut Bridge Flow Data
2011/12
COMPANY IDENTITY-WA

Date	Flow(m3/s)	Date	Flow(m3/s)	Date	Flow(m3/s)	Date	Flow(m3/s)
1-Dec-11	8.910	1-Jan-12	5.257	1-Feb-12	5.418	1-Mar-12	1.220
2-Dec-11	6.240	2-Jan-12	4.408	2-Feb-12	5.092	2-Mar-12	1.203
3-Dec-11	4.690	3-Jan-12	4.731	3-Feb-12	4.676	3-Mar-12	1.222
4-Dec-11	3.840	4-Jan-12	28.340	4-Feb-12	4.241	4-Mar-12	1.313
5-Dec-11	3.240	5-Jan-12	38.535	5-Feb-12	3.858	5-Mar-12	1.660
6-Dec-11	2.670	6-Jan-12	24.102	6-Feb-12	3.520	6-Mar-12	1.454
7-Dec-11	2.240	7-Jan-12	14.457	7-Feb-12	3.189	7-Mar-12	1.332
8-Dec-11	1.960	8-Jan-12	11.238	8-Feb-12	2.926	8-Mar-12	1.276
9-Dec-11	1.780	9-Jan-12	11.376	9-Feb-12	2.885	9-Mar-12	1.284
10-Dec-11	1.630	10-Jan-12	10.429	10-Feb-12	3.473	10-Mar-12	1.303
11-Dec-11	1.510	11-Jan-12	8.367	11-Feb-12	4.769	11-Mar-12	1.303
12-Dec-11	1.400	12-Jan-12	6.401	12-Feb-12	5.487	12-Mar-12	1.337
13-Dec-11	1.310	13-Jan-12	5.206	13-Feb-12	5.776	13-Mar-12	1.295
14-Dec-11	1.260	14-Jan-12	4.483	14-Feb-12	5.488	14-Mar-12	1.259
15-Dec-11	1.250	15-Jan-12	3.812	15-Feb-12	5.003	15-Mar-12	1.369
16-Dec-11	1.270	16-Jan-12	3.199	16-Feb-12	4.552	16-Mar-12	1.475
17-Dec-11	1.300	17-Jan-12	2.675	17-Feb-12	4.173	17-Mar-12	1.369
18-Dec-11	1.490	18-Jan-12	2.309	18-Feb-12	3.966	18-Mar-12	1.292
19-Dec-11	1.650	19-Jan-12	2.034	19-Feb-12	3.673	19-Mar-12	1.238
20-Dec-11	1.760	20-Jan-12	2.979	20-Feb-12	3.420	20-Mar-12	1.230
21-Dec-11	1.760	21-Jan-12	3.686	21-Feb-12	3.359	21-Mar-12	1.205
22-Dec-11	1.710	22-Jan-12	3.333	22-Feb-12	3.352	22-Mar-12	1.153
23-Dec-11	1.680	23-Jan-12	3.424	23-Feb-12	3.549	23-Mar-12	1.147
24-Dec-11	1.800	24-Jan-12	3.737	24-Feb-12	2.720	24-Mar-12	1.134
25-Dec-11	2.080	25-Jan-12	4.450	25-Feb-12	1.725	25-Mar-12	1.110
26-Dec-11	2.350	26-Jan-12	4.371	26-Feb-12	1.412	26-Mar-12	1.108
27-Dec-11	2.530	27-Jan-12	3.967	27-Feb-12	1.280	27-Mar-12	1.153
28-Dec-11	3.840	28-Jan-12	3.660	28-Feb-12	1.263	28-Mar-12	1.341
29-Dec-11	8.620	29-Jan-12	4.617	29-Feb-12	1.260	29-Mar-12	1.598
30-Dec-11	8.950	30-Jan-12	5.652			30-Mar-12	1.472
31-Dec-11	7.160	31-Jan-12	5.707			31-Mar-12	1.370

Measured in flow (m3/s).
* = data from Environment Canada

TABLE 73
BLANK FIELD SAMPLE
METALS ANALYSIS
2011/2012

Parameter / Sample Date	July 13	July 21	June 15	October 17	Detection Limits
Total Metals					
Aluminum	-	0.005	-	0.005	0.005
Antimony	-	<0.0005	-	<0.0005	0.0005
Arsenic	-	<0.0001	-	<0.0001	0.0001
Barium	-	<0.001	-	<0.001	0.001
Beryllium	-	<0.0001	-	<0.0001	0.0001
Bismuth	-	-	-	<0.001	0.001
Boron	-	<0.05	-	<0.05	0.05
Cadmium	-	<0.00001	-	<0.00001	0.00001
Calcium	-	<0.05	-	<0.05	0.05
Chromium	-	<0.001	-	<0.001	0.001
Cobalt	-	<0.0005	-	<0.0005	0.0005
Copper	-	<0.0002	-	0.0003	0.0002
Iron	-	0.009	-	0.006	0.005
Lead	-	<0.0002	-	<0.0002	0.0002
Lithium	-	<0.005	-	<0.005	0.005
Magnesium	-	<0.05	-	<0.05	0.05
Manganese	-	<0.001	-	<0.001	0.001
Mercury	-	<0.00002	-	<0.00002	0.00002
Molybdenum	-	<0.001	-	<0.001	0.001
Nickel	-	<0.001	-	<0.001	0.001
Potassium	-	<0.05	-	<0.05	0.05
Selenium	-	<0.0001	-	<0.0001	0.0001
Silicon	-	-	-	<0.1	0.1
Silver	-	<0.00002	-	<0.00002	0.00002
Sodium	-	<0.05	-	<0.05	0.05
Strontium	-	-	-	<0.001	0.001
Thallium	-	<0.00005	-	<0.00005	0.00005
Tin	-	<0.005	-	<0.005	0.005
Titanium	-	<0.005	-	<0.005	0.005
Uranium	-	<0.0001	-	<0.0001	0.0001
Vanadium	-	<0.005	-	<0.005	0.005
Zinc	-	<0.005	-	<0.005	0.005
Zirconium	-	-	-	<0.0005	0.0005
Dissolved Metals					
Aluminum	0.003	<0.003	0.004	<0.003	0.003
Antimony	<0.0005	<0.0005	-	<0.0005	0.0005
Arsenic	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Barium	<0.001	<0.001	<0.001	<0.001	0.001
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Bismuth	-	-	-	<0.001	0.001
Boron	<0.05	<0.05	<0.05	<0.05	0.05
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	0.00001
Calcium	0.13	<0.05	0.09	0.06	0.05
Chromium	<0.001	<0.001	<0.001	<0.001	0.001
Cobalt	<0.0005	<0.0005	<0.0005	<0.0005	0.0005
Copper	0.0002	<0.0002	<0.0002	<0.0002	0.0002
Iron	<0.005	<0.005	0.005	<0.005	0.005
Lead	<0.0002	<0.0002	<0.0002	<0.0002	0.0002
Lithium	<0.005	<0.005	<0.005	<0.005	0.005
Magnesium	<0.05	<0.05	<0.05	<0.05	0.05
Manganese	<0.001	<0.001	<0.001	<0.001	0.001
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	0.00002
Molybdenum	<0.001	<0.001	<0.001	<0.001	0.001
Nickel	<0.001	<0.001	<0.001	<0.001	0.001
Potassium	<0.05	<0.05	<0.05	<0.05	0.05
Selenium	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Silicon	-	-	-	<0.1	0.1
Silver	<0.00002	<0.00002	<0.00002	<0.00002	0.00002
Sodium	<0.05	0.28	<0.05	<0.05	0.05
Strontium	-	-	-	<0.001	0.001
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	0.00005
Tin	<0.005	<0.005	<0.005	<0.005	0.005
Titanium	<0.005	<0.005	-	<0.005	0.005
Uranium	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Vanadium	<0.005	<0.005	<0.005	<0.005	0.005
Zinc	<0.005	<0.005	<0.005	<0.005	0.005
Zirconium	-	-	-	<0.0005	0.0005

TABLE 74-1
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2011/12

Sample ID / Parameter / Sample Date	WA		RPD (%)	WA		RPD (%)	WA		RPD (%)	WA		RPD (%)	WA		RPD (%)
	04-Apr	04-Apr*		08-Aug	8-Aug*		22-Aug	22-Aug*		07-Sep	7-Sep*		20-Sep	20-Sep*	
Conductivity (umhos/cm)	39	38	2.6	41	42	-2.4	43	42	2.4	42	42	0.0	42	44	-4.7
Hardness CaCO3	18.9	17.7	6.6	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.28	7.19	1.2	7.4	7.46	-0.8	7.51	7.45	0.8	7.5	7.48	0.3	7.41	7.54	-1.7
Total Suspended Solids	5	4	[1.00]	<4	<4	NC	<4	<4	NC	<4	<4	NC	<4	<4	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	<0.5	<0.5	NC	<0.5	<0.5	NC	<0.5	<0.5	NC	<0.5	<0.5	NC	0.5	0.6	-18.2
Alkalinity-Total as CaCO3	15	16	-6.5	21	18	15.4	18	20	-10.5	20	21	-4.9	17	18	-5.7
Ammonia Nitrogen	0.026	0.014	60.0	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	<0.02	<0.02	NC	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	0.12	0.13	-8.0	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	0.005	0.006	-18.2	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	0.005	0.007	[0.002]	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	1.1	1.7	[0.6]	1.3	1	[0.3]	1.2	1.7	[0.5]	0.8	0.9	-11.8	<0.5	<0.5	NC

Sample ID / Parameter / Sample Date	WA		RPD (%)	WA		RPD (%)	WA		RPD (%)	WA		RPD (%)	WA		RPD (%)
	11-Oct	11-Oct*		24-Oct	24-Oct*		22-Nov	22-Nov*		31-Jan	31-Jan*		20-Mar	20-Mar*	
Conductivity (umhos/cm)	40	40	0.0	41	40	2.5	36.8	39.6	-7.3	39.8	40.1	-0.8	36.6	40.2	-9.4
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.46	7.44	0.3	7.34	7.3	0.5	7.24	7.35	-1.5	7.45	7.43	0.3	7.3	7.47	-2.3
Total Suspended Solids	<4	<4	NC	<4	<4	NC	<4.0	<4.0	NC	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	<0.5	<0.5	NC	<0.5	<0.5	NC	<0.5	<0.5	NC	<0.5	<0.5	NC	1	<0.5	NC
Alkalinity-Total as CaCO3	21	21	0.0	18	21	-15.4	16.1	15.6	25.0	18	16.7	[1.3]	17	16.8	1.2
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	0.9	1.3	[0.4]	1.8	1.3	[0.5]	1.9	1.37	[0.5]	1.02	1.79	[0.77]	<0.50	0.79	NC

Results expresses as milligrams per litre except where noted

TABLE 74-2
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2011/12

Sample ID	NNO		RPD	NNO		RPD	NNO		RPD	NNO		RPD	NNO		RPD
Parameter / Sample Date	09-May	9-May*	(%)	06-Jun	6-Jun*	(%)	26-Sep	26-Sep*	(%)	13-Dec	13-Dec*	(%)	14-Feb	14-Feb*	(%)
Conductivity (umhos/cm)	51	53	-3.8	41	42	-2.4	51	50	-2.0	28.4	25.6	10.4	22	21.7	1.4
Hardness CaCO3	-	-	-	16.1	28.8	-56.6	-	-	-	-	-	-	-	-	-
pH	6.95	6.96	-0.1	7.31	7.09	3.1	7.26	7.37	1.5	7.24	7.12	1.7	7.14	7.18	-0.6
Total Suspended Solids	<4	<4	NC	<4	<4	NC	<4	<4	NC	<4.0	<4.0	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	0.7	1.3	[0.6]	<0.5	<0.5	NC	<0.5	<0.5	NC	<0.5	<0.5	NC	1.4	1.3	7.4
Alkalinity-Total as CaCO3	13	11	16.7	15	12	22.2	14	16	13.3	10.1	9.67	4.4	8.32	8.91	-6.8
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	<0.02	<0.02	NC	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	0.005	0.008	[0.003]	-	-	-	-	-	-	-	-	-
Sulfate	9.2	9.1	1.1	5.1	5.2	-1.9	5.6	7.9	34.1	<0.50	<0.50	NC	0.96	1.01	-5.1

Sample ID	4S-Lo		RPD	4S-Lo		RPD	4S-Lo		RPD	4S-Lo		RPD	LLE		RPD
Parameter / Sample Date	23-May	23-May*	(%)	27-Jun	27-Jun*	(%)	10-Jan	10-Jan*	(%)	27-Mar	27-Mar*	(%)	04-Jul	04-Jul*	(%)
Conductivity (umhos/cm)	529	533	-0.8	538	535	-0.6	323	321	0.6	294	291	1.0	475	478	-0.6
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	223	223	0.0
pH	7.61	7.67	-0.8	7.73	7.73	0.0	7.36	7.39	-0.4	7.43	7.29	1.9	7.32	7.3	0.3
Total Suspended Solids	<5	<5	NC	-	-	-	-	-	-	-	-	-	<4	<4	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	300	300	0.0
Acidity (to PH 8.3)	1.9	1.6	17.1	-	-	-	3.6	3.6	0.0	2.1	1.7	[0.4]	3.9	4.3	0.0
Alkalinity-Total as CaCO3	46	47	-2.2	58	59	1.7	30.5	31.8	-4.2	30.5	31.1	-1.9	47	49	-4.2
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	0.054	0.042	25.0
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	<0.02	<0.02	NC
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	NC
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	0.005	<0.005	NC
Sulfate	190	190	0.0	190	190	0.0	122	123	-0.8	108	102	5.7	170	180	-5.7

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

Results expresses as milligrams per litre except where noted

TABLE 75-1
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2011/12

Sample ID	WB		RPD	WB		RPD	WB		RPD	WB		RPD	3S		RPD
Parameter / Sample Date	25-Apr	25-Apr*	(%)	11-Jul	11-Jul*	(%)	26-Jul	26-Jul*	(%)	29-Nov	29-Nov*	(%)	02-May	2-May*	(%)
Conductivity (umhos/cm)	136	136	0.0	82	82	0.0	80	79	1.3	66.7	68.4	-2.5	1010	1000	1.0
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.55	7.57	-0.3	7.59	7.57	0.3	7.39	7.59	-2.7	7.26	7.37	-1.5	7.65	7.87	-2.8
Total Suspended Solids	<4	<4	NC	<1	<1	NC	<4	<4	NC	<4.0	<4.0	NC	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	<0.5	<0.5	NC	<0.5	<0.5	NC	1.1	<0.5	NC	<0.5	<0.5	NC	16.3	5.4	100.5
Alkalinity-Total as CaCO3	30	30	0.0	25	26	-3.9	23	25	-8.3	20.1	20.5	-2.0	77	78	-1.3
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	0.023	0.051	[0.028]
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	<0.02	<0.02	NC
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	NC
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	NC
Sulfate	31	29	6.7	13	12	8.0	12	13	-8.0	10.6	12.9	[2.3]	420	420	0.0

Sample ID	3S		RPD	3S		RPD	SPD		RPD	SPD		RPD	SPD		RPD
Parameter / Sample Date	13-Jun	13-Jun*	(%)	20-Dec	20-Dec*	(%)	13-May	13-May*	(%)	20-Jun	20-Jun*	(%)	24-Jan	24-Jan*	(%)
Conductivity (umhos/cm)	1080	1080	0.0	664	727	-9.1	618	616	0.3	604	604	0.0	439	375	15.7
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	8.00	7.95	0.6	7.66	7.71	-0.7	7.89	7.9	-0.1	7.9	7.86	-0.5	7.79	7.78	0.1
Total Suspended Solids	-	-	-	-	-	-	<4	<4	NC	<4	<4	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	2.7	0.5	137.5	<0.5	1.9	NC	1.5	1.9	[0.4]	<0.5	<0.5	NC	<0.5	<0.5	NC
Alkalinity-Total as CaCO3	81	79	2.5	62.2	67.1	-7.6	71	69	2.9	68	67	-1.5	45.7	39.7	14.1
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	490	510	-4.0	257	279	-8.2	260	240	8.0	190	200	5.1	156	138	12.2

TABLE 75-2
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
WATER QUALITY
2011/12

Sample ID / Parameter / Sample Date	LLM1		RPD (%)	LLM1		RPD (%)	LLM4		RPD (%)	LLM4		RPD (%)	LLM4		RPD (%)
	10-May	10-May*		12-Aug	12-Aug*		13-Apr	13-Apr*		14-Jun	14-Jun*		14-Jul	14-Jul*	
Conductivity (umhos/cm)	164	160	2.5	214	211	1.4	353	358	-1.4	255	279	-9.0	-	-	-
Hardness CaCO3	-	-	-	-	-	-	125	129	-3.1	-	-	-	-	-	-
pH	7.21	7.2	0.1	7.68	7.31	4.9	7.46	7.59	-1.7	7.69	7.73	-0.5	7.58	7.4	2.4
Total Suspended Solids	<4	<4	NC	<4	<4	NC	<4	<4	NC	<4	<4	NC	<4	<4	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	-	-	-	-	-	-	1.2	1.8	[0.6]	-	-	-	-	-	-
Alkalinity-Total as CaCO3	27	23	16.0	35	34	2.9	49	49	0.0	44	45	-2.2	46	46	0.0
Ammonia Nitrogen	-	-	-	-	-	-	0.027	0.017	**45.5**	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	0.03	0.03	0.0	-	-	-	<0.02	<0.02	NC
Total Kjeldahl Nitrogen	-	-	-	-	-	-	0.15	0.15	0.0	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	<0.005	<0.005	NC	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	<0.005	<0.005	NC	-	-	-	-	-	-
Sulfate	52	46	12.2	58	60	-3.4	120	120	0.0	120	110	8.7	110	110	0.0

Sample ID / Parameter / Sample Date	LLM4		RPD (%)	WB		RPD (%)	WB		RPD (%)	WB		RPD (%)	WB		RPD (%)
	23-Sep	23-Sep*		25-Apr	25-Apr*		11-Jul	11-Jul*		26-Jul	26-Jul*		29-Nov	29-Nov*	
Conductivity (umhos/cm)	277	277	0.0	136	136	0.0	82	82	0.0	80	79	1.3	66.7	68.4	-2.5
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.61	7.73	-1.6	7.55	7.57	-0.3	7.59	7.57	0.3	7.39	7.59	-2.7	7.26	7.37	-1.5
Total Suspended Solids	<4	<4	NC	<4	<4	NC	<1	<1	NC	<4	<4	NC	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	-	-	-	<0.5	<0.5	NC	<0.5	<0.5	NC	1.1	<0.5	NC	<0.5	<0.5	NC
Alkalinity-Total as CaCO3	43	42	2.4	30	30	0.0	25	26	-3.9	23	25	-8.3	20.1	20.5	-2.0
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	78	80	-2.5	31	29	6.7	13	12	8.0	12	13	-8.0	10.6	12.9	[2.3]

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 76-1

REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE

WATER QUALITY

2011/12

Sample ID / Parameter / Sample Date	MQL1		RPD (%)	MQL1		RPD (%)	MQL1		RPD (%)	MQL4		RPD (%)	MQL4		RPD (%)
	25-Apr	25-Apr*		11-Jul	11-Jul*		26-Jul	26-Jul*		29-Nov	29-Nov*		02-May	2-May*	
Conductivity (umhos/cm)	136	136	0.0	82	82	0.0	80	79	1.3	66.7	68.4	-2.5	1010	1000	1.0
Hardness CaCO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH	7.55	7.57	-0.3	7.59	7.57	0.3	7.39	7.59	-2.7	7.26	7.37	-1.5	7.65	7.87	-2.8
Total Suspended Solids	<4	<4	NC	<1	<1	NC	<4	<4	NC	<4.0	<4.0	NC	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	<0.5	<0.5	NC	<0.5	<0.5	NC	1.1	<0.5	NC	<0.5	<0.5	NC	16.3	5.4	100.5
Alkalinity-Total as CaCO3	30	30	0.0	25	26	-3.9	23	25	-8.3	20.1	20.5	-2.0	77	78	-1.3
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	0.023	0.051	[0.028]
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	<0.02	<0.02	NC
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	NC
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	<0.005	NC
Sulfate	31	29	6.7	13	12	8.0	12	13	-8.0	10.6	12.9	[2.3]	420	420	0.0

Sample ID / Parameter / Sample Date	MQL9		RPD (%)	WP		RPD (%)	WP		RPD (%)	WP		RPD (%)	WP		RPD (%)
	13-Jun	13-Jun*		30-Aug	30-Aug*		02-Nov	2-Nov*		06-Jan	6-Jan*		07-Mar	07-Mar*	
Conductivity (umhos/cm)	1080	1080	0.0	2210	2200	0.5	2120	2130	-0.5	1580	1640	-3.7	1550	1550	0.0
Hardness CaCO3	-	-	-	343	349	-1.7	424	414	2.4	579	594		442	416	6.1
pH	8.00	7.95	0.6	8.16	8.19	-0.4	8.05	8.06	-0.1	8.16	8.14	0.2	8.27	8.27	0.0
Total Suspended Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	2.7	0.5	137.5	3.3	7.4	-76.6	4.3	5.2	-18.9	1.2	1.9	[0.7]	<0.5	1	NC
Alkalinity-Total as CaCO3	81	79	2.5	200	200	0.0	270	280	-3.6	227	241	-6.0	239	241	-0.8
Ammonia Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfate	490	510	-4.0	900	930	-3.3	850	840	1.2	658	658	0.0	563	561	0.4

TABLE 76-2

REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE

WATER QUALITY

2011/12

Sample ID / Parameter / Sample Date	2NPS		RPD (%)	2NPS		RPD (%)	2NPS		RPD (%)	WC		RPD (%)	WC		RPD (%)
	14-Sep	14-Sep*		07-Dec	7-Dec*		07-Feb	07-Feb*		11-Apr	11-Apr*		28-Feb	28-Feb*	
Conductivity (umhos/cm)	2660	2660	0.0	2460	2470	-0.4	2330	2350	-0.9	1790	1740	2.8	1630	1630	0.0
Hardness CaCO3	-	-	-	-	-	-	793	802	-1.1	-	-	-	-	-	-
pH	8.08	8.02	0.7	7.86	7.91	-0.6	8.03	7.99	0.5	8.3	8.31	-0.1	8.18	8.17	0.1
Total Suspended Solids	-	-	-	-	-	-	-	-	-	<4	<4	NC	<4.0	<4.0	-
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acidity (to PH 8.3)	5.1	3.7	31.8	8.6	4.9	54.8	5.5	9.3	-51.4	<0.5	<0.5	NC	<0.5	1.2	NC
Alkalinity-Total as CaCO3	260	250	3.9	272	272	0.0	280	283	-1.1	310	310	0.0	303	304	-0.3
Ammonia Nitrogen	-	-	-	0.022	0.036	**[0.014]**	0.0108	0.0129	**[0.0021]**	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	0.037	0.034	8.5	-	-	-	0.06	0.06	0.0	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	<0.0050	<0.0050	NC	-	-	-	-	-	-	-	-	-
Total Phosphorous	-	-	-	<0.0050	<0.0050	NC	-	-	-	-	-	-	-	-	-
Sulfate	1200	1200	0.0	1130	1140	-0.9	1150	1110	3.5	620	610	1.6	486	487	-0.2

Sample ID / Parameter / Sample Date	7S		RPD (%)	7S		RPD (%)	QRDS1		RPD (%)	3S77		RPD (%)	SPC		RPD (%)
	14-Nov	14-Nov*		17-Jan	17-Jan*		04-Aug	4-Aug"		29-Dec	29-Dec*		08-Nov	8-Nov*	
Conductivity (umhos/cm)	35.2	35.6	-1.1	32.4	31.4	3.1	88	97	-9.7	564	522	7.7	179	178	0.6
Hardness CaCO3	-	-	-	-	-	-	28.3	28.3	-	257	237	8.1	-	-	-
pH	7.26	7.17	1.2	7.36	7.29	1.0	7.56	7.53	0.4	7.81	7.83	-0.3	7.36	7.27	1.2
Total Suspended Solids	<4.0	-	NC	-	-	-	<4	<4	NC	-	-	-	<4.0	<4.0	NC
Total Dissolved Solids	-	-	-	-	-	-	52	48	8.0	368	338	8.5	-	-	-
Acidity (to PH 8.3)	0.6	<0.5	NC	<0.5	<0.5	NC	<0.5	<0.5	NC	0.6	<0.5	NC	1.5	1.9	[0.4]
Alkalinity-Total as CaCO3	25	12.5	66.7	13.3	12.9	3.1	25	32	-24.6	55.6	53.2	4.4	21.6	21.4	0.9
Ammonia Nitrogen	-	-	-	-	-	-	0.044	0.049	**[0.028]**	-	-	-	-	-	-
Nitrate/Nitrite as N	-	-	-	-	-	-	<0.02	<0.02	NC	-	-	-	-	-	-
Total Kjeldahl Nitrogen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Phosporous	-	-	-	-	-	-	<0.005	<0.005	NC	-	-	-	-	-	-
Total Phosphorous	-	-	-	-	-	-	<0.005	<0.005	NC	-	-	-	-	-	-
Sulfate	1.3	0.78	[0.52]	<0.50	<0.50	NC	14	14	0.0	210	188	11.1	58	57.8	[0.2]

Results expressed in mg/L except where noted.

* Replicate Sample.

RPD = Relative Percent Difference.

NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.

[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.

Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.

All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 77-1
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
METALS ANALYSIS
2011/12

Sample ID	WP		RPD	WP		RPD	WP		RPD	WP		RPD
Parameter												
Sample Date	30-Aug	30-Aug*		02-Nov	2-Nov*		06-Jan	6-Jan*		07-Mar	7-Mar*	
Total Metals												
Aluminum	0.03	0.03	**-23.73**	0.13	0.152	[0.022]	0.104	0.097	[0.007]	0.061	0.086	[0.025]
Antimony	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Arsenic	0.00	0.00	0.00	0.0057	0.006	NC	0.0016	0.0015	6.5	0.0014	0.0014	0.0
Barium	0.02	0.02	4.44	0.038	0.038	0	0.033	0.033	0	0.034	0.034	0.0
Beryllium	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Bismuth	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Boron	1.03	1.01	1.96	1	0.93	7.3	0.47	0.48	-2.1	0.66	0.59	11.2
Cadmium	<0.00001	<0.00001	NC	0.00001	0.00001	0	0.00002	0.00003	[0.00001]	<0.00001	<0.00001	NC
Calcium	101.00	102.00	-0.99	143	139	2.8	191	197	-3.1	147	138	6.3
Chromium	<0.001	<0.001	NC	0.001	0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt	0.00	0.00	0.00	0.0024	0.0025	NC	0.0028	0.0028	0.0	0.0017	0.0016	6.1
Copper	0.00	0.00	-15.38	0.0014	0.0014	0	0.0021	0.0019	[0.0002]	0.001	0.0013	[0.0003]
Iron	0.04	0.06	**-47.83**	0.202	0.19	6.1	0.25	0.264	-5.4	0.2	0.23	-14.0
Hardness	316.00	317.00	-0.32	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC
Lithium	0.01	0.01	0.00	0.008	0.007	[0.001]	<0.005	<0.005	NC	<0.005	<0.005	NC
Magnesium	15.40	15.50	-0.65	16.3	16.1	1.2	25	24.6	1.6	18.4	17.4	5.6
Manganese	0.00	0.00	**-66.67**	0.047	0.047	0	0.131	0.129	1.5	0.096	0.092	4.3
Mercury	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.000010	<0.000010	NC	<0.000002	<0.000002	NC
Molybdenum	0.00	0.00	0.00	0.003	0.003	0	0.001	0.001	0	0.002	0.002	0.0
Nickel	0.00	0.00	[0.001]	0.011	0.012	-8.7	0.009	0.009	0	0.006	0.006	0.0
Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	4.06	4.09	-0.74	4.06	4.1	-1.0	2.76	2.68	2.9	2.8	2.7	3.6
Selenium	0.00	0.00	[0.0001]	0.0005	0.0004	[0.0001]	0.0007	0.0006	[0.0001]	0.0006	0.0005	[0.0001]
Silicon	2.00	1.90	5.13	3	2.8	6.9	2.8	2.9	-3.5	2.7	2.7	0.0
Silver	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Sodium	328.00	327.00	0.31	317	310	2.2	150	148	1.3	187	181	3.3
Strontium	1.19	1.16	2.55	1.32	1.35	-2.2	1.21	1.2	0.8	1.1	1.05	4.7
Thallium	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC
Tin	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Titanium	<0.005	<0.005	NC	<0.005	0.012	NC	<0.005	<0.005	NC	0.007	<0.005	NC
Uranium	0.00	0.00	0.00	0.0002	0.0002	NC	0.0002	0.0003	[0.0001]	0.0002	0.0002	0.0
Vanadium	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinc	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Zirconium	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Dissolved Metals												
Aluminum	0.01	0.01	0.00	0.008	0.014	[0.006]	0.0097	0.0101	-4.0	0.0106	0.0103	2.9
Antimony	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC
Arsenic	0.00	0.00	0.00	0.0061	0.0059	3.3	0.00097	0.00111	-13.5	0.00138	0.00125	9.9
Barium	0.02	0.02	0.00	0.034	0.034	0	0.0347	0.0357	-2.8	0.0323	0.032	0.9
Beryllium	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC
Bismuth	-	-	-	<0.001	<0.001	NC	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC
Boron	1.23	1.16	5.86	0.97	0.97	0	0.519	0.532	-2.5	0.58	0.587	-1.2
Cadmium	<0.00001	<0.00001	NC	<0.00001	<0.00001	NC	0.000019	0.000039	[0.00002]	<0.000010	<0.000010	NC
Calcium	109.00	110.00	-0.91	139	144	-3.5	202	207	-2.4	138	144	-4.3
Chromium	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC
Cobalt	0.00	0.00	NC	0.0022	0.0024	[0.0002]	0.00282	0.00286	[0.00004]	0.0016	0.00149	[0.00011]
Copper	0.00	0.00	9.52	0.0007	0.0008	[0.0001]	0.00245	0.00327	[0.00082]	0.00085	0.00082	[0.00003]
Iron	<0.005	<0.005	NC	0.006	0.007	[0.001]	<0.0050	0.007	NC	<0.0050	<0.0050	NC
Hardness	343.00	349.00	-1.73	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC
Lithium	0.01	0.01	11.76	0.007	0.008	[0.001]	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Magnesium	17.50	17.80	-1.70	16.3	16.9	-3.6	26.1	27.4	-4.9	18.6	18.3	1.6
Manganese	0.00	0.00	0.00	0.044	0.045	-2.2	0.132	0.139	-5.2	0.0905	0.0889	1.8
Mercury	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.000010	<0.000010	NC	<0.000002	<0.000002	NC
Molybdenum	0.00	0.00	0.00	0.003	0.003	0.0	0.001	0.0011	-9.5	0.0022	0.0022	0.0
Nickel	0.00	0.00	0.00	0.011	0.011	0.0	0.0086	0.0093	-7.8	0.0068	0.0064	6.1
Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	4.58	4.65	-1.52	4.73	4.89	-3.3	2.73	2.93	-7.1	2.85	2.8	1.8
Selenium	0.00	0.00	0.00	0.0005	0.0006	[0.0001]	0.00065	0.00062	[0.00003]	0.00047	0.00045	[0.00002]
Silicon	-	-	-	2.8	2.8	NC	2.92	3	-2.7	2.43	2.53	-4.0
Silver	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.000020	<0.000020	NC	<0.000020	<0.000020	NC
Sodium	372.00	378.00	-1.60	309	318	-2.9	156	162	-3.8	189	188	0.5
Strontium	-	-	-	1.36	1.4	-2.9	1.3	1.31	-0.8	1.04	1.05	-1.0
Thallium	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC	<0.000050	<0.000050	NC	<0.000050	<0.000050	NC
Tin	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Titanium	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Uranium	0.00	0.00	0.00	0.0002	0.0002	0	0.00025	0.00025	0	0.00021	0.00021	0.0
Vanadium	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Zinc	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC
Zinconium	-	-		<0.0005	<0.0005	NC	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 77-2
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
METALS ANALYSIS
2011/12

Sample ID	2NPS		RPD	2NPS		RPD	QRDS1		RPD	LLE		RPD
Parameter												
Sample Date	07-Dec	7-Dec*		07-Feb	7-Feb*		04-Aug	4-Aug*		04-Jul	4-Jul*	
Total Metals												
Aluminum	-	-	-	0.20	0.16	[0.039]	0.03	0.02	20.41	0.03	0.03	-13.79
Antimony	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Arsenic	-	-	-	0.00	0.00	[0.0001]	0.00	0.00	[0.0001]	0.00	0.00	NC
Barium	-	-	-	0.01	0.01	7.41	0.00	0.00	0.00	0.03	0.03	6.67
Beryllium	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Bismuth	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Boron	-	-	-	0.78	0.75	3.92	<0.05	<0.05	NC	0.07	0.07	NC
Cadmium	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	<0.00001	<0.00001	NC
Calcium	-	-	-	264.00	269.00	-1.88	8.24	7.95	3.58	62.00	63.00	-1.60
Chromium	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt	-	-	-	0.00	0.00	[0.0002]	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Copper	-	-	-	0.00	0.00	[0.0007]	0.00	0.00	-8.70	0.00	0.00	[0.0002]
Iron	-	-	-	0.56	0.32	[0.24]	0.05	0.04	17.02	1.06	1.07	-0.94
Hardness	-	-	-	-	-	-	24.60	23.90	2.89	197.00	199.00	-1.01
Lead	-	-	-	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC
Lithium	-	-	-	0.01	0.01	[0.001]	<0.005	<0.005	NC	-	-	-
Magnesium	-	-	-	32.30	31.60	2.19	0.97	0.99	-2.04	10.30	10.10	1.96
Manganese	-	-	-	0.15	0.15	4.68	0.01	0.00	[0.001]	0.11	0.10	3.77
Mercury	-	-	-	<0.000010	<0.000010	NC	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Molybdenum	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Nickel	-	-	-	0.00	0.00	0.00	<0.001	<0.001	NC	<0.001	<0.001	NC
Phosphorus	-	-	-				<0.005	<0.005	NC	0.01	<0.005	NC
Potassium	-	-	-	3.97	3.97	0.00	0.37	0.38	-2.67	0.34	0.31	9.23
Selenium	-	-	-	0.00	0.00	[0.0001]	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Silicon	-	-	-	3.10	3.10	0.00	1.50	1.40	6.90	2.30	2.30	0.00
Silver	-	-	-	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Sodium	-	-	-	275.00	270.00	1.83	5.58	5.60	-0.36	9.41	8.91	5.46
Strontium	-	-	-	1.97	1.93	2.05	0.03	0.03	0.00	0.40	0.39	1.51
Thallium	-	-	-	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC
Tin	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Titanium	-	-	-	0.01	0.01	[0.006]	<0.005	<0.005	NC	<0.005	<0.005	NC
Uranium	-	-	-	0.00	0.00	0.00	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Vanadium	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinc	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Zirconium	-	-	-	<0.0005	<0.0005	NC	-	-	-	-	-	-
Dissolved Metals												
Aluminum	0.01	0.00	[0.0045]	0.00	0.00	[0.0011]	0.02	0.02	-14.63	0.01	0.01	-7.41
Antimony	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Arsenic	0.00	0.00	0.00	0.00	0.00	-8.70	0.00	0.00	[0.0001]	0.00	0.00	-7.41
Barium	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.03	2.90
Beryllium	<0.00010	<0.00010	NC	<0.00010	<0.00010	NC	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Bismuth	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC	-	-	-	-	-	-
Boron	0.90	0.85	6.05	0.82	0.80	1.98	<0.05	<0.05	NC	0.08	0.08	0.00
Cadmium	0.00	0.00	[0.000009]	0.00	0.00	[0.000004]	0.00	0.00	[0.00001]	0.00	0.00	0.00
Calcium	241.00	239.00	0.83	286.00	282.00	1.41	9.59	9.40	2.00	70.50	69.80	1.00
Chromium	<0.0010	0.00	NC	<0.0010	<0.0010	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt	0.00	0.00	[0.0001]	0.00	0.00	[0.00007]	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Copper	0.00	<0.00020	NC	0.00	0.00	[0.00007]	0.00	0.00	0.00	0.00	0.00	0.00
Iron	<0.0050	0.01	NC	0.01	0.01	[0.0026]	0.03	0.03	12.50	1.05	1.03	1.92
Hardness	-	-	-	-	-	-	28.30	28.30	0.00	223.00	223.00	0.00
Lead	<0.00020	<0.00020	NC	<0.00020	<0.00020	NC	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC
Lithium	0.01	0.01	0.00	0.01	0.01	1.14	<0.005	<0.005	NC	-	-	-
Magnesium	23.30	24.30	-4.20	31.60	31.40	0.63	1.06	1.17	-9.87	11.40	11.80	-3.45
Manganese	0.14	0.15	-4.17	0.15	0.15	0.67	0.00	0.00	[0.001]	0.12	0.12	-2.55
Mercury	<0.000010	<0.000010	NC	<0.000010	<0.000010	NC	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Molybdenum	<0.0010	<0.0010	NC	<0.0010	<0.0010	NC	<0.001	<0.001	NC	<0.001	<0.001	NC
Nickel	0.00	0.00	-5.00	0.00	0.00	-2.60	<0.001	<0.001	NC	<0.001	<0.001	NC
Phosphorus	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Potassium	4.10	4.34	-5.69	3.91	3.90	0.26	0.43	0.47	-8.89	0.38	0.40	-5.13
Selenium	0.00	0.00	15.79	0.00	0.00	[0.00006]	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Silicon	3.19	3.17	0.63	3.22	3.11	3.48	-	-	-	-	-	-
Silver	<0.000020	<0.000020	NC	<0.000020	<0.000020	NC	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Sodium	309.00	325.00	-5.05	269.00	268.00	0.37	5.98	6.46	-7.72	10.60	10.70	-0.94
Strontium	1.74	1.78	-2.27	2.03	2.02	0.49	-	-	-	-	-	-
Thallium	<0.000050	<0.000050	NC	<0.000050	<0.000050	NC	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC
Tin	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Titanium	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Uranium	0.00	0.00	[0.00001]	0.00	0.00	0.00	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Vanadium	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinc	<0.0050	<0.0050	NC	<0.0050	<0.0050	NC	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinconium	<0.00050	<0.00050	NC	<0.00050	<0.00050	NC	-	-	-	-	-	-

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 77-3
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
METALS ANALYSIS
2011/12

Sample ID / Parameter / Sample Date	Blank	Dection Limit	RPD	Blank	Dection Limit	RPD	Blank	Dection Limit	RPD	Blank	Dection Limit	RPD
	15-Jun-11			13-Jul			21-Jul			17-Oct		
Total Metals												
Aluminum	-	-	-	-	-	-	0.01	<0.005	0.00	0.005	0.005	0
Antimony	-	-	-	-	-	-	<0.0005	<0.0005	NC	<0.0005	0.0005	NC
Arsenic	-	-	-	-	-	-	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Barium	-	-	-	-	-	-	<0.001	<0.001	NC	<0.001	0.001	NC
Beryllium	-	-	-	-	-	-	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Bismuth	-	-	-	-	-	-	-	-	-	<0.001	0.001	NC
Boron	-	-	-	-	-	-	<0.05	<0.05	NC	<0.05	0.05	NC
Cadmium	-	-	-	-	-	-	<0.00001	<0.00001	NC	<0.00001	0.00001	NC
Calcium	-	-	-	-	-	-	<0.05	<0.05	NC	<0.05	0.05	NC
Chromium	-	-	-	-	-	-	<0.001	<0.001	NC	<0.001	0.001	NC
Cobalt	-	-	-	-	-	-	<0.0005	<0.0005	NC	<0.0005	0.0005	NC
Copper	-	-	-	-	-	-	<0.0002	<0.0002	NC	0.0003	0.0002	[0.0001]
Iron	-	-	-	-	-	-	0.01	0.01	[0.004]	0.006	0.005	[0.001]
Hardness				-	-	-	-	-	-	-	-	-
Lead	-	-	-	-	-	-	<0.0002	<0.0002	NC	<0.0002	0.0002	NC
Lithium	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	0.005	NC
Magnesium	-	-	-	-	-	-	<0.05	<0.05	NC	<0.05	0.05	NC
Manganese	-	-	-	-	-	-	<0.001	<0.001	NC	<0.001	0.001	NC
Mercury	-	-	-	-	-	-	<0.00002	<0.00002	NC	<0.00002	0.00002	NC
Molybdenum	-	-	-	-	-	-	<0.001	<0.001	NC	<0.001	0.001	NC
Nickel	-	-	-	-	-	-	<0.001	<0.001	NC	<0.001	0.001	NC
Phosphorus	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	-	-	-	-	-	-	<0.05	<0.05	NC	<0.05	0.05	NC
Selenium	-	-	-	-	-	-	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Silicon	-	-	-	-	-	-	-	-	-	<0.1	0.1	NC
Silver	-	-	-	-	-	-	<0.00002	<0.00002	NC	<0.00002	0.00002	NC
Sodium	-	-	-	-	-	-	<0.05	<0.05	NC	<0.05	0.05	NC
Strontium	-	-	-	-	-	-	-	-	-	<0.001	0.001	NC
Thallium	-	-	-	-	-	-	<0.00005	<0.00005	NC	<0.00005	0.00005	NC
Tin	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	0.005	NC
Titanium	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	0.005	NC
Uranium	-	-	-	-	-	-	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Vanadium	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	0.005	NC
Zinc	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	0.005	NC
Zirconium	-	-	-	-	-	-	-	-	-	<0.0005	0.0005	NC
Dissolved Metals												
Aluminum	0.00	0.00	[0.001]	0.00	<0.003	NC	<0.003	<0.003	NC	<0.003	0.003	NC
Antimony	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.0005	0.0005	NC
Arsenic	<0.0001	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Barium	<0.001	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	0.001	NC
Beryllium	<0.0001	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Bismuth	-	-	-	-	-	NC	-	-	-	<0.001	0.001	NC
Boron	<0.05	-	-	<0.05	<0.05	NC	<0.05	<0.05	NC	<0.05	0.05	NC
Cadmium	<0.00001	-	-	<0.00001	<0.00001	NC	<0.00001	<0.00001	NC	<0.00001	0.00001	NC
Calcium	0.09	0.05	[0.04]	0.13	0.05	**88.89**	<0.05	<0.05	NC	0.06	0.05	NC
Chromium	<0.001	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	0.001	NC
Cobalt	<0.0005	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC	<0.0005	0.0005	NC
Copper	<0.0002	-	-	0.00	<0.0002	NC	<0.0002	<0.0002	NC	<0.0002	0.0002	NC
Iron	0.01	0.01	[0.00]	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	0.005	NC
Hardness	-	-	-	-	-	NC	-	-	-	-	-	-
Lead	<0.0002	-	-	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC	<0.0002	0.0002	NC
Lithium	<0.005	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	0.005	NC
Magnesium	<0.05	-	-	<0.05	<0.05	NC	<0.05	<0.05	NC	<0.05	0.05	NC
Manganese	<0.001	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	0.001	NC
Mercury	<0.00002	-	-	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.00002	0.00002	NC
Molybdenum	<0.001	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	0.001	NC
Nickel	<0.001	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC	<0.001	0.001	NC
Phosphorus	-	-	-	-	-	NC	-	-	-	-	-	-
Potassium	<0.05	-	-	<0.05	<0.05	NC	<0.05	<0.05	NC	<0.05	0.05	NC
Selenium	<0.0001	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Silicon	-	-	-	-	-	NC	-	-	-	<0.1	0.1	NC
Silver	<0.00002	-	-	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC	<0.00002	0.00002	NC
Sodium	<0.05	-	-	<0.05	0.05	NC	0.28	0.05	**139.39**	<0.05	0.05	NC
Strontium	-	-	-	-	-	NC	-	-	-	<0.001	0.001	NC
Thallium	<0.00005	-	-	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC	<0.00005	0.00005	NC
Tin	<0.005	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	0.005	NC
Titanium	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	0.005	NC
Uranium	<0.0001	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC	<0.0001	0.0001	NC
Vanadium	<0.005	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	0.005	NC
Zinc	<0.005	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	<0.005	0.005	NC
Zinconium	-	-	-	-	-	NC	-	-	-	<0.0005	0.0005	NC

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 77-4
REPLICATE FIELD SAMPLES AND RELATIVE PERCENT DIFFERENCE
METALS ANALYSIS
2011/12

Sample ID	NNO		RPD	3S		RPD	MQL4		RPD	WA		RPD
Parameter												
Sample Date	06-Jun	6-Jun*		02-May	02-May*		12-Apr	12-Apr*		04-Apr	04-Apr*	
Total Metals												
Aluminum	0.03	0.05	**-41.03**	-	-	-	0.03	0.03	15.87	0.04	0.04	-17.28
Antimony	<0.0005	<0.0005	NC	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Arsenic	0.00	0.00	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Barium	0.00	0.00	NC	-	-	-	0.00	0.00	[0.001]	<0.001	<0.001	NC
Beryllium	<0.0001	<0.0001	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Bismuth	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Boron	<0.05	<0.05	NC	-	-	-	<0.05	<0.05	NC	<0.05	<0.05	NC
Cadmium	<0.00001	0.00	NC	-	-	-	<0.00001	<0.00001	NC	<0.00001	<0.00001	NC
Calcium	4.85	9.83	**-67.85**	-	-	-	16.20	14.20	13.16	5.95	6.31	-5.87
Chromium	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt	<0.0005	<0.0005	NC	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Copper	0.00	0.00	-15.38	-	-	-	0.00	0.00	0.00	0.00	0.00	15.38
Iron	0.08	0.14	**-60.00**	-	-	-	0.03	0.03	6.25	0.03	0.04	**-33.85**
Hardness	-	-	-	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	NC	-	-	-	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC
Lithium	-	-	-	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Magnesium	0.96	1.02	-6.06	-	-	-	1.87	1.60	15.56	0.70	0.75	-6.90
Manganese	0.01	0.01	**-33.33**	-	-	-	0.01	0.00	[0.001]	0.00	0.00	[0.001]
Mercury	<0.00002	<0.00002	NC	-	-	-	0.00	0.00	9.52	<0.00002	<0.00002	NC
Molybdenum	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Nickel	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Phosphorus	0.01	0.01	[0.003]	<0.005	<0.005	NC	<0.005	<0.005	NC	0.01	0.01	[0.002]
Potassium	0.08	0.10	**-22.22**	-	-	-	0.26	0.23	12.24	0.07	0.08	-13.33
Selenium	<0.0001	<0.0001	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Silicon	2.70	2.80	-3.64	-	-	-	2.70	2.40	11.76	1.90	2.00	-5.13
Silver	<0.00002	<0.00002	NC	-	-	-	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Sodium	1.11	1.32	-17.28	-	-	-	17.50	14.90	16.05	0.79	1.01	**-24.44**
Strontium	0.02	0.02	-14.63	-	-	-	0.08	0.07	15.38	0.01	0.02	**-22.22**
Thallium	<0.00005	<0.00005	NC	-	-	-	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC
Tin	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Titanium	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Uranium	<0.0001	<0.0001	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Vanadium	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinc	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Zirconium	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Metals												
Aluminum	0.03	0.03	6.45	-	-	-	0.02	0.02	-4.88	0.03	0.03	10.53
Antimony	<0.0005	<0.0005	NC	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Arsenic	0.00	0.00	0.00	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Barium	0.00	0.00	0.00	-	-	-	0.00	0.00	0.00	<0.001	<0.001	NC
Beryllium	<0.0001	<0.0001	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Bismuth	-	-	-	-	-	-	-	-	-	-	-	-
Boron	<0.05	<0.05	NC	-	-	-	<0.05	<0.05	NC	<0.05	<0.05	NC
Cadmium	<0.00001	<0.00001	NC	-	-	-	<0.00001	<0.00001	NC	<0.00001	<0.00001	NC
Calcium	5.00	5.12	-2.37	-	-	-	11.20	11.40	-1.77	5.98	5.77	3.57
Chromium	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Cobalt	<0.0005	<0.0005	NC	-	-	-	<0.0005	<0.0005	NC	<0.0005	<0.0005	NC
Copper	0.00	0.00	0.00	-	-	-	0.00	0.00	10.53	0.00	0.00	NC
Iron	0.06	0.06	6.78	0.02	0.01	[0.006]	0.02	0.03	**-26.09**	0.01	0.01	-0.90
Hardness	-	-	-	-	-	-	-	-	-	-	-	-
Lead	<0.0002	<0.0002	NC	-	-	-	<0.0002	<0.0002	NC	<0.0002	<0.0002	NC
Lithium	-	-	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Magnesium	1.01	1.06	-4.83	-	-	-	1.37	1.42	-3.58	0.66	0.64	3.08
Manganese	0.01	0.01	0.00	-	-	-	0.01	0.01	18.18	0.00	0.00	0.00
Mercury	<0.00002	<0.00002	NC	-	-	-	0.00	0.00	[0.00002]	<0.00002	<0.00002	NC
Molybdenum	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Nickel	<0.001	<0.001	NC	-	-	-	<0.001	<0.001	NC	<0.001	<0.001	NC
Phosphorus	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC	0.01	0.01	18.18
Potassium	0.15	0.16	-6.45	-	-	-	0.21	0.21	0.00	0.08	0.08	0.00
Selenium	<0.0001	<0.0001	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Silicon	-	-	-	-	-	-	-	-	-	-	-	-
Silver	<0.00002	<0.00002	NC	-	-	-	<0.00002	<0.00002	NC	<0.00002	<0.00002	NC
Sodium	1.19	1.25	-4.92	-	-	-	12.30	12.90	-4.76	0.62	0.63	-1.60
Strontium	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	<0.00005	<0.00005	NC	-	-	-	<0.00005	<0.00005	NC	<0.00005	<0.00005	NC
Tin	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Titanium	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Uranium	<0.0001	<0.0001	NC	-	-	-	<0.0001	<0.0001	NC	<0.0001	<0.0001	NC
Vanadium	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinc	<0.005	<0.005	NC	-	-	-	<0.005	<0.005	NC	<0.005	<0.005	NC
Zinconium	-	-	-	-	-	-	-	-	-	-	-	-

Results expressed in mg/L except where noted.
* Replicate Sample.
RPD = Relative Percent Difference.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = Results are the absolute difference between replicate sample concentrations that are less than five times the laboratory detection limit.
Bolded Red = RPD values greater than 20% that are greater than five times the laboratory detection limit.
All results were calculated as per the guidelines of the British Columbia Field Sampling Manual 2009 Edition.

TABLE 78-1
4 YEAR ANNUAL AVERAGES
NORTH AND SOUTH WATER MANAGEMENT SYSTEMS
WATER QUALITY
2011/2012

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake Outlet				Mid Quinsam Lake Inlet				Mid Quinsam Lake 1M			
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Cond-L	**uS/cm**	-	-	-	114.96	139.02	131.94	108.43	42.33	45.35	41.91	41.09	-	-	-	96.86
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.62	7.72	7.63	7.54	7.65	7.96	7.53	7.42	7.52	7.87	7.89	7.50
TSS	**mg/L**	-	**25**	**25**	4	3	3	4	3	5	3	4	3	3	3	4
Alk-T	**mg/L**	-	-	-	25.933	30.425	30.484	28.151	18.948	19.610	24.641	18.620	25.014	31.800	30.483	25.625
N-NH3	**mg/L**	-	-	**2.50**	0.0132	0.0071	0.0149	0.0269	0.0093	0.0053	0.0212	0.0207	0.0227	0.0180	0.0052	0.0150
N-TKN	**mg/L**	-	-	-	0.0999	0.1179	0.1199	0.1598	0.0691	0.0941	0.1214	0.1363	0.0857	0.1102	0.0697	0.1250
NO2+NO3	**mg/L**	-	-	-	0.0227	0.0140	0.0185	0.0200	0.0237	0.0176	0.0201	0.0200	0.0066	0.0063	0.0072	0.0200
P-PO4-D	**mg/L**	-	-	-	0.0024	0.0020	0.1731	-	0.0023	0.0020	0.0024	-	0.0044	0.0025	0.0036	-
P-PO4-T	**mg/L**	-	-	-	0.0046	0.0028	0.0033	-	0.0028	0.0025	0.0029	-	0.0054	0.0070	0.0046	-
SO4-D	**mg/L**	**100.00**	-	**100.00**	25.36	31.07	28.44	21.37	0.56	0.68	1.22	2.21	16.93	32.68	24.43	14.82

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake 4M				Mid Quinsam Lake 9M				Mid Quinsam Lake 1M from B			
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Cond-L	**uS/cm**	-	-	-	-	-	-	111.20	-	-	-	189.00	-	-	-	287.50
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.54	7.88	7.90	7.51	7.63	7.80	7.73	7.49	7.62	7.76	7.73	7.29
TSS	**mg/L**	**25**	**25**	**25**	3	3	3	4	3	3	3	4	3	3	3	4
Alk-T	**mg/L**	-	-	-	25.283	32.617	30.550	26.625	28.443	46.133	31.000	31.857	33.350	44.483	32.300	36.500
N-NH3	**mg/L**	-	-	**2.50**	0.0216	0.0175	0.0051	0.0133	0.0141	0.0175	0.0079	0.0187	0.0247	0.0182	0.0248	0.0388
N-TKN	**mg/L**	-	-	-	0.0873	0.1155	0.0960	0.1271	0.0801	0.1023	0.1150	0.1533	0.0892	0.1183	0.1183	0.1467
NO2+NO3	**mg/L**	-	-	-	0.0064	0.0065	0.0072	0.0200	0.0087	0.0105	0.0097	0.0214	0.0114	0.0147	0.0136	0.0300
P-PO4-D	**mg/L**	-	-	-	0.0031	0.0029	0.0023	-	0.0030	0.0024	0.0023	-	0.0026	0.0025	0.0023	-
P-PO4-T	**mg/L**	-	-	-	0.0045	0.0042	0.0032	-	0.0041	0.0027	0.0037	-	0.0037	0.0031	0.0039	-
SO4-D	**mg/L**	**100.00**	-	**100.00**	17.97	34.63	24.70	16.04	33.00	106.07	28.53	42.43	61.45	132.95	26.90	115.67

	Station Name	WQO	WQO-Av	WWQG	South Pit Culvert				Long Lake Outlet				Long Lake Seep			
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Cond-L	**uS/cm**	-	-	-	273.07	264.19	215.92	188.47	226.96	219.01	187.68	165.07	1598.70	1600.77	1380.00	1237.50
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.65	7.62	7.35	7.46	7.68	7.66	7.44	7.46	7.79	7.59	7.82	7.87
TSS	**mg/L**	**25**	**25**	**25**	3	3	4	4	3	3	3	4	8	5	4	4
Alk-T	**mg/L**	-	-	-	34.990	32.575	20.061	26.318	35.967	32.008	21.867	26.514	254.522	253.692	218.250	199.000
N-NH3	**mg/L**	-	-	**2.50**	0.0076	0.0066	0.0228		0.0110	0.0070	0.0248	0.0291	-	0.0707	0.0417	-
N-TKN	**mg/L**	-	-	-	-	-	0.2303		0.1148	0.1293	0.1425	0.2712	0.1471	0.0763	0.0930	-
NO2+NO3	**mg/L**	-	-	-	0.0997	0.1011	0.0894	0.0947	0.0339	0.0193	0.0849	0.0214	-	0.0582	0.0283	-
P-PO4-D	**mg/L**	-	-	-	0.0033	0.0030	0.0040		0.0026	0.0021	0.0023		-	0.0020	-	-
P-PO4-T	**mg/L**	-	-	-	0.0055	0.0065	0.0073		0.0044	0.0031	0.0063		-	0.0053	-	-
SO4-D	**mg/L**	**100.00**	-	**100.00**	94.05	90.70	74.22	60.82	69.53	66.06	56.46	47.53	633.22	633.08	527.42	465.08

Results expressed in mg/L except where noted

TABLE 78-2
4 YEAR ANNUAL AVERAGES
NORTH AND SOUTH WATER MANAGEMENT SYSTEMS
WATER QUALITY
2011/2012

	Station Name	WQO	WQO-Av	WWQG	Settling Pond #4				North Pit Culvert				Settling Pond # 1			
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Cond-L	**uS/cm**	-	-	-	2189.44	2137.50	1950.32	2011.61	1973.52	1959.03	1819.23	1862.41	670.48	633.36	697.74	591.62
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	8.13	8.08	8.12	8.06	8.25	8.25	8.29	8.27	7.65	7.75	7.61	7.76
TSS	**mg/L**	**25**	**25**	**25**	4	5	5	4	3	3	4	4	4	4	4	4
Alk-T	**mg/L**	-	-	-	301.167	336.000	361.545	328.732	265.857	277.260	283.633	299.547	57.892	63.783	51.029	66.723
N-NH3	**mg/L**	-	-	**2.50**	0.0165	0.0239	0.0189	0.0422	0.0093	0.0097	0.0147	-	0.0151	0.0097	0.0172	0.0278
N-TKN	**mg/L**	-	-	-	0.0745	0.0928	0.1143	0.1200	-	-	0.0950	-	0.2252	0.2143	0.2102	0.2450
NO2+NO3	**mg/L**	-	-	-	0.2691	0.2192	0.0727	0.0478	0.0659	0.0794	0.0937	0.0477	0.0127	0.0110	0.0307	0.0200
P-PO4-D	**mg/L**	-	-	-	0.0025	0.0021	0.0020	-	0.0036	0.0030	0.0032	-	0.0038	0.0024	0.0028	-
P-PO4-T	**mg/L**	-	-	-	0.0046	0.0040	0.0039	-	0.0058	0.0050	0.0060	-	0.0096	0.0071	0.0070	-
SO4-D	**mg/L**	**100.00**	-	**100.00**	862.02	796.19	708.58	688.39	754.33	742.72	662.29	631.24	276.82	264.32	284.02	214.63

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M				Long Lake Middle 4M				Long Lake Middle 9M			
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
Cond-L	**uS/cm**	-	-	-	-	-	-	216.57	-	-	-	336.60	-	-	-	436.00
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.69	7.80	7.79	7.44	7.72	7.69	7.83	7.57	7.72	7.67	7.66	7.51
TSS	**mg/L**	**25**	**25**	**25**	3	3	3	4	3	3	4	4	3	3	4	4
Alk-T	**mg/L**	-	-	-	40.471	38.100	33.867	31.889	51.450	51.450	40.367	45.778	57.014	59.950	55.517	53.333
N-NH3	**mg/L**	-	-	**2.50**	0.0119	0.0203	0.0050	0.0298	0.0112	0.0152	0.0068	0.0193	0.0095	0.0200	0.0052	0.0238
N-TKN	**mg/L**	-	-	-	0.1055	0.1190	0.1738	0.1833	0.1043	0.1092	0.1310	0.1743	0.1044	0.0780	0.1303	0.1250
NO2+NO3	**mg/L**	-	-	-	0.0172	0.0102	0.0069	0.0200	0.0190	0.0164	0.0083	0.0225	0.0509	0.0677	0.0507	0.0467
P-PO4-D	**mg/L**	-	-	-	0.0082	0.0028	0.0056	-	0.0039	0.0031	0.0030	-	0.0040	0.0020	0.0030	-
P-PO4-T	**mg/L**	-	-	-	0.0118	0.0058	0.0078	-	0.0054	0.0044	0.0041	-	0.0056	0.0046	0.0039	-
SO4-D	**mg/L**	**100.00**	-	**100.00**	89.76	75.85	68.25	58.56	128.50	122.88	87.38	110.00	140.71	148.00	137.67	146.67

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M From B				3 South				4S-Lower				LLE		
Parameter		-	-	-	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2009-10**	**2010-11**	**2011-12**
Cond-L	**uS/cm**	-	-	-	-	-	-	442.50	1322.05	1607.26	1523.27	1022.29	627.02	607.05	478.26	421.14	255.77	370.38	377.11
pH-L	**pH Units**	-	**6.90**	**6.0-8.5**	7.63	7.49	7.58	7.55	7.96	7.92	7.84	7.80	7.70	7.52	7.41	7.49	7.49	7.35	7.34
TSS	**mg/L**	**25**	**25**	**25**	3	3	3	4	4	4	7	4	3	3	18	4	5	5	4
Alk-T	**mg/L**	-	-	-	56.152	61.636	56.933	54.167	125.062	124.999	94.667	68.731	54.979	44.763	38.164	42.127	35.207	39.387	40.742
N-NH3	**mg/L**	-	-	**2.50**	0.0128	0.0193	0.0058	0.0162	0.0129	0.0131	0.0268	0.0420	0.0081	0.0190	0.0133	-	0.0308	0.0465	0.0550
N-TKN	**mg/L**	-	-	-	0.0935	0.0976	0.0975	0.1217	-	-	0.1000	-	-	-	0.5933	-	0.2534	0.2655	0.1600
NO2+NO3	**mg/L**	-	-	-	0.0895	0.1027	0.0824	0.0783	0.0199	0.0403	0.0344	0.0202	-	-	0.0211	-	0.0353	0.0426	0.0259
P-PO4-D	**mg/L**	-	-	-	0.0024	0.0021	0.0050	-	0.0022	0.0021	0.0021	-	-	-	-	-	0.0047	0.0050	-
P-PO4-T	**mg/L**	-	-	-	0.0043	0.0029	0.0061	-	0.0043	0.0035	0.0046	-	-	-	-	-	0.0092	0.0088	-
SO4-D	**mg/L**	**100.00**	-	**100.00**	146.58	148.94	139.17	151.67	816.53	850.74	717.29	470.46	259.43	258.22	213.28	155.75	84.15	112.21	137.50

Results expressed in mg/L except where noted

TABLE 79-1

4 YEAR ANNUAL AVERAGES NORTH AND SOUTH MANAGEMENT SYSTEM

METALS ANALYSIS

2011/2012

	Station Name	WQO	WQO-Av	WWQG	Settling Pond # 1				South Pit Culvert				Long Lake Outlet			
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
As-T	**mg/L**	**0.05000**		**0.005**	0.00134	0.00099	0.00113	0.00081	0.18005	0.13915	0.00046	0.00051	0.03383	0.00058	0.00054	0.00043
Cd-T	**mg/L**	*			0.00004542	0.00004158	0.00003094	0.00002500	0.00900170	0.00695519	0.00001483	0.00001167	0.00169508	0.00001725	0.00002036	0.00001000
Cr-T	**mg/L**				0.00242	0.00158	0.00133	0.00100	0.00910	0.00726	0.00100	0.00100	0.00250	0.00100	0.00059	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0036	0.0006	0.0049	0.0006	0.0090	0.0070	0.0004	0.0005	0.0019	0.0003	0.0003	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0029	0.0243	0.0021	0.0011	0.0091	0.0073	0.0008	0.0006	0.0025	0.0011	0.0006	0.0008
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.4005	0.1910	1.3399	0.3473	0.1248	0.1898	0.1706	0.1809	0.1257	0.0736	0.1128	0.0966
Hardness	**mg/L**				348.4	282.9	362.4	298.2	119.9	117.5	106.3	77.7	82.7	77.3	72.0	56.3
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0012	0.0008	0.0005	0.0002	0.0451	0.0349	0.0003	0.0002	0.0088	0.0005	0.0002	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.2517	0.0600	0.5297	0.0785	0.0082	0.0112	0.0090	0.0078	0.0551	0.0218	0.0250	0.0153
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0000214	0.0000192	0.0000239	0.0000175	0.0000200	0.0000186	0.0000167	0.0000175	0.0000200	0.0000192	0.0000171	0.0000175
Ni-T	**mg/L**	**0.025**			0.009	0.002	0.007	0.002	0.045	0.035	0.001	0.001	0.009	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00005	0.00003	0.00003	0.00002	0.00900	0.00696	0.00002	0.00002	0.00168	0.00002	0.00001	0.00002
Zn-T	**mg/L**	**0.03**			0.012	0.015	0.010	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.003	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.02005	0.02219	0.03228	0.01771	0.03462	0.03467	0.05782	0.05986	0.01745	0.02023	0.01884	0.02418
As-D	**mg/L**				0.00129	0.00095	0.00119	0.00060	0.00052	0.00052	0.00036	0.00044	0.00059	0.00057	0.00048	0.00041
B-D	**mg/L**				0.186	0.153	0.147	0.096	0.100	0.100	0.068	0.050	0.117	0.112	0.091	0.058
Ca-D	**mg/L**				114.82	93.38	117.63	97.25	38.97	39.36	33.35	24.97	28.18	26.31	27.42	18.63
Cd-D	**mg/L**				0.00006	0.00003	0.00007	0.00002	0.00012	0.00008	0.00005	0.00001	0.00006	0.00002	0.00002	0.00001
Cu-D	**mg/L**				0.00264	0.00167	0.00161	0.00109	0.00153	0.00129	0.00163	0.00100	0.00103	0.00100	0.00117	0.00087
Fe-D	**mg/L**				0.115	0.069	0.640	0.061	0.061	0.050	0.077	0.104	0.050	0.043	0.049	0.051
Pb-D	**mg/L**				0.00121	0.00079	0.00044	0.00023	0.00050	0.00050	0.00029	0.00020	0.00050	0.00050	0.00018	0.00020
Hg-D	**mg/L**			**0.0001**	0.0000200	0.0000192	0.0000167	0.0000175	0.0000200	0.0000195	0.0000169	0.0000175	0.0000200	0.0000192	0.0000158	0.0000175
Ni-D	**mg/L**				0.00782	0.00214	0.00711	0.00201	0.00101	0.00101	0.00123	0.00100	0.00100	0.00100	0.00069	0.00100
Na-D	**mg/L**				17.98	15.26	28.46	8.32	6.83	6.49	6.54	3.20	13.64	12.36	9.74	7.07
K-D	**mg/L**				2.00	2.00	1.53	0.87	2.00	2.00	0.91	0.30	2.00	2.00	1.02	0.30
Zn-D	**mg/L**				0.0105	0.0050	0.0088	0.0050	0.0050	0.0050	0.0052	0.0050	0.0052	0.0050	0.0031	0.0050

	Station Name	WQO	WQO-Av	WWQG	Long Lake Seep				Settling Pond #4				North Pit Culvert			
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
As-T	**mg/L**	**0.05000**		**0.005**	0.00745	0.00496	0.00277	0.00235	0.00243	0.00250	0.00198	0.00138	0.18354	0.19144	0.05094	0.00075
Cd-T	**mg/L**	*			0.00008726	0.00007192	0.00003892	0.00001417	0.00010117	0.00009317	0.00007717	0.00002750	0.00917375	0.00957035	0.00255042	0.00002583
Cr-T	**mg/L**				0.00500	0.00423	0.00225	0.00100	0.00475	0.00500	0.00300	0.00133	0.00958	0.00978	0.00425	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0026	0.0019	0.0022	0.0008	0.0014	0.0015	0.0013	0.0011	0.0093	0.0096	0.0031	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0050	0.0042	0.0029	0.0005	0.0052	0.0050	0.0033	0.0016	0.0096	0.0098	0.0042	0.0011
Fe-T	**mg/L**		**0.3000**	**1.0000**	3.3443	2.7256	1.5721	0.9818	0.1758	0.1580	0.2367	0.2604	0.0505	0.0661	0.1084	0.1122
Hardness	**mg/L**				651.9	661.2	564.8	479.6	539.5	469.8	449.8	411.3	477.3	491.0	410.1	362.4
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0025	0.0021	0.0010	0.0002	0.0024	0.0025	0.0014	0.0002	0.0460	0.0479	0.0132	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.4784	0.4050	0.3328	0.2710	0.0542	0.0544	0.0634	0.0598	0.0212	0.0292	0.0454	0.0280
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0000200	0.0000192	0.0000158	0.0000175	0.0000200	0.0000192	0.0000150	0.0000175	0.0000200	0.0000200	0.0000167	0.0000175
Ni-T	**mg/L**	**0.025**			0.006	0.005	0.005	0.002	0.005	0.005	0.004	0.004	0.046	0.048	0.015	0.002
Ag-T	**mg/L**	**0.0001**			0.00010	0.00008	0.00005	0.00002	0.00010	0.00014	0.00006	0.00002	0.00918	0.00957	0.00258	0.00002
Zn-T	**mg/L**	**0.03**			0.012	0.005	0.007	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.02500	0.02362	0.02250	0.01119	0.02525	0.02500	0.01808	0.01312	0.02758	0.02554	0.02000	0.01454
As-D	**mg/L**				0.00583	0.00418	0.00209	0.00184	0.00242	0.00250	0.00178	0.00093	0.00250	0.00242	0.00152	0.00060
B-D	**mg/L**				0.770	0.782	0.651	0.539	0.884	0.921	0.938	0.925	0.818	0.824	0.843	0.858
Ca-D	**mg/L**				231.39	235.38	198.42	168.67	181.09	157.44	149.61	138.38	161.23	163.90	135.52	120.68
Cd-D	**mg/L**				0.00009	0.00007	0.00010	0.00002	0.00018	0.00009	0.00015	0.00002	0.00011	0.00009	0.00016	0.00002
Cu-D	**mg/L**				0.00500	0.00423	0.00316	0.00135	0.00517	0.00500	0.00336	0.00086	0.00542	0.00506	0.00300	0.00133
Fe-D	**mg/L**				2.757	1.978	1.115	0.571	0.030	0.030	0.022	0.033	0.030	0.030	0.025	0.015
Pb-D	**mg/L**				0.00250	0.00212	0.00098	0.00020	0.00238	0.00250	0.00135	0.00020	0.00250	0.00242	0.00135	0.00020
Hg-D	**mg/L**			**0.0001**	0.0000207	0.0000192	0.0000150	0.0000175	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Ni-D	**mg/L**				0.00573	0.00489	0.00540	0.00235	0.00475	0.00500	0.00417	0.00351	0.00500	0.00490	0.00342	0.00153
Na-D	**mg/L**				138.17	143.85	108.78	95.08	330.50	336.08	312.58	323.75	304.25	308.97	287.08	304.83
K-D	**mg/L**				2.73	2.73	2.44	2.26	3.35	3.22	3.37	3.66	3.07	3.07	3.15	3.41
Zn-D	**mg/L**				0.0120	0.0052	0.0071	0.0582	0.0053	0.0050	0.0051	0.0050	0.0052	0.0051	0.0050	0.0050

*Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

TABLE 79-2

4 YEAR ANNUAL AVERAGES NORTH AND SOUTH MANAGEMENT SYSTEM

METALS ANALYSIS

2011/2012

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake Outlet				Mid Quinsam Lake Inlet				Mid Quinsam Lake 1M			
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
As-T	**mg/L**	**0.05000**		**0.005**	0.00050	0.00050	0.00035	0.00011	0.00050	0.03375	0.03348	0.00011	0.00050	0.00050	0.00050	0.00010
Cd-T	**mg/L**	*			0.00001700	0.00001700	0.00001512	0.00001250	0.00001700	0.00168175	0.00167472	0.00001000	0.00001700	0.00004000	0.00001700	0.00001000
Cr-T	**mg/L**				0.00100	0.00100	0.00075	0.00100	0.00108	0.00250	0.00210	0.00100	0.00100	0.00100	0.00100	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0003	0.0019	0.0018	0.0005	0.0003	0.0003	0.0003	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0008	0.0007	0.0010	0.0025	0.0023	0.0007	0.0010	0.0010	0.0010	0.0011
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.0514	0.0446	0.0495	0.0512	0.0300	0.0331	0.0238	0.0325	0.0343	0.0352	0.0443	0.0455
Hardness	**mg/L**				37.4	39.8	36.8	33.5	21.1	21.1	19.6	21.2	30.0	40.3	34.6	27.2
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0003	0.0002	0.0005	0.0088	0.0085	0.0002	0.0005	0.0005	0.0005	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.0083	0.0073	0.0093	0.0076	0.0014	0.0027	0.0023	0.0021	0.0052	0.0057	0.0083	0.0082
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0000200	0.0000192	0.0000160	0.0000175	0.0000200	0.0000200	0.0000167	0.0000177	0.0004798	0.0006512	0.0007672	0.0013833
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.009	0.009	0.001	0.001	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00168	0.00168	0.00002	0.00002	0.00002	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.004	0.005	0.005	0.005	0.003	0.005	0.005	0.005	0.005	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.01674	0.01650	0.01726	0.01862	0.02022	0.02143	0.02285	0.02295	0.04099	0.01238	0.01515	0.02260
As-D	**mg/L**				0.00050	0.00050	0.00035	0.00013	0.00050	0.00050	0.00023	0.00010	0.02900	0.00050	0.00050	0.00010
B-D	**mg/L**				0.100	0.100	0.077	0.050	0.100	0.100	0.064	0.050	0.100	0.100	0.100	0.050
Ca-D	**mg/L**				12.42	13.22	11.86	10.50	7.13	7.12	6.44	6.38	9.89	13.37	11.52	9.10
Cd-D	**mg/L**				0.00009	0.00002	0.00002	0.00001	0.00005	0.00002	0.00001	0.00001	0.00144	0.00002	0.00002	0.00003
Cu-D	**mg/L**				0.00109	0.00100	0.00106	0.00082	0.00111	0.00114	0.00084	0.00103	0.00229	0.00100	0.00103	0.00090
Fe-D	**mg/L**				0.037	0.032	0.034	0.028	0.030	0.030	0.021	0.015	0.030	0.030	0.030	0.026
Pb-D	**mg/L**				0.00050	0.00050	0.00031	0.00020	0.00050	0.00050	0.00020	0.00020	0.00757	0.00050	0.00050	0.00024
Hg-D	**mg/L**			**0.00010**	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00025	0.00046	0.00051	0.00133
Ni-D	**mg/L**				0.00100	0.00100	0.00075	0.00100	0.00102	0.00100	0.00058	0.00100	0.00800	0.00100	0.00100	0.00100
Na-D	**mg/L**				9.38	12.14	11.05	8.44	2.24	2.00	1.33	0.69	6.57	13.42	11.05	7.21
K-D	**mg/L**				2.00	2.00	1.55	0.21	2.00	2.00	1.05	0.11	2.00	2.00	2.00	0.15
Zn-D	**mg/L**				0.0050	0.0050	0.0037	0.0050	0.0050	0.0050	0.0030	0.0050	0.0050	0.0050	0.0050	0.0060

	Station Name	WQO	WQO-Av	WWQG	Mid Quinsam Lake 4M				Mid Quinsam Lake 9M				Mid Quinsam Lake 1M from B			
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
As-T	**mg/L**	**0.05000**		**0.005**	0.00050	0.00050	0.00050	0.00011	0.00050	0.00050	0.00050	0.00010	0.00050	0.00050	0.00050	0.00010
Cd-T	**mg/L**	*			0.00001700	0.00002233	0.00001700	0.00001286	0.00001700	0.00001700	0.00001700	0.00001000	0.00001700	0.00001700	0.00001700	0.00001000
Cr-T	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0005
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0010	0.0013	0.0010	0.0010	0.0010	0.0010	0.0010	0.0012	0.0010	0.0006
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.0353	0.0347	0.0395	0.0400	0.0316	0.0367	0.0300	0.0247	0.0302	0.0448	0.0563	0.0910
Hardness	**mg/L**				29.9	41.6	34.8	28.9	40.3	95.3	35.8	46.2	64.6	128.4	36.5	117.5
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.0050	0.0056	0.0087	0.0067	0.0046	0.0118	0.0077	0.0085	0.0114	0.0376	0.1080	0.1173
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0003107	0.0004187	0.0003427	0.0006014	0.0002434	0.0002077	0.0000863	0.0003867	0.0000720	0.0000767	0.0002162	0.0001817
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.01380	0.01443	0.01647	0.02217	0.01110	0.00798	0.01365	0.01800	0.00818	0.00740	0.01468	0.00880
As-D	**mg/L**				0.00050	0.00050	0.00050	0.00010	0.00050	0.00050	0.00050	0.00010	0.00050	0.00050	0.00050	0.00010
B-D	**mg/L**				0.100	0.100	0.100	0.050	0.100	0.100	0.100	0.052	0.100	0.100	0.100	0.052
Ca-D	**mg/L**				9.90	13.77	11.57	9.66	13.18	31.18	11.90	14.88	20.73	41.37	12.07	36.36
Cd-D	**mg/L**				0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00004	0.00002	0.00002	0.00002	0.00001
Cu-D	**mg/L**				0.00100	0.00195	0.00100	0.00087	0.00100	0.00105	0.00102	0.00082	0.00100	0.00122	0.00120	0.00054
Fe-D	**mg/L**				0.030	0.030	0.031	0.028	0.030	0.030	0.030	0.019	0.030	0.030	0.031	0.017
Pb-D	**mg/L**				0.00050	0.00050	0.00050	0.00020	0.00050	0.00050	0.00050	0.00026	0.00050	0.00050	0.00050	0.00020
Hg-D	**mg/L**			**0.00010**	0.00017	0.00030	0.00021	0.00048	0.00014	0.00014	0.00005	0.00039	0.00004	0.00005	0.00012	0.00011
Ni-D	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00103	0.00100
Na-D	**mg/L**				6.95	14.22	11.18	8.34	11.57	33.12	13.55	14.40	16.97	32.92	12.83	21.14
K-D	**mg/L**				2.00	2.00	2.00	0.17	2.00	2.00	2.00	0.23	2.00	2.00	2.00	0.29
Zn-D	**mg/L**				0.0050	0.0050	0.0050	0.0065	0.0050	0.0050	0.0050	0.0062	0.0050	0.0050	0.0050	0.0054

TABLE 79-3

4 YEAR ANNUAL AVERAGES NORTH AND SOUTH MANAGEMENT SYSTEM

METALS ANALYSIS

2011/2012

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M				Long Lake Middle 4M				Long Lake Middle 9M			
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
As-T	**mg/L**	**0.05000**		**0.005**	0.00063	0.00062	0.00056	0.00047	0.00058	0.00059	0.00054	0.00031	0.00057	0.00050	0.00050	2010-12
Cd-T	**mg/L**	*			0.00001700	0.00001767	0.00001700	0.00001833	0.00001700	0.00001700	0.00001700	0.00001429	0.00001700	0.00001983	0.00001700	0.00023333
Cr-T	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00100	0.00001
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0010
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0010	0.0008	0.0010	0.0010	0.0012	0.0008	0.0010	0.0010	0.0012	0.0005
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.0712	0.0577	0.0552	0.0653	0.0740	0.0718	0.0570	0.0440	0.0964	0.0535	0.0578	0.0010
Hardness	**mg/L**				97.2	89.6	87.8	66.2	137.8	135.4	110.5	119.8	149.1	163.5	156.7	0.0
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0005	0.0002	0.0005	0.0005	0.0005	0.0007	0.0005	0.0005	0.0008	151.6000
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.0165	0.0082	0.0108	0.0162	0.0399	0.0304	0.0177	0.0310	0.2159	0.2675	0.0868	0.0002
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0008103	0.0002685	0.0011537	0.0012417	0.0003795	0.0002470	0.0005035	0.0004917	0.0004067	0.0000763	0.0001160	0.0838333
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00100
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.000
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.03544	0.01043	0.01330	0.01750	0.00602	0.00663	0.01272	0.01383	0.00629	0.00618	0.01160	0.00583
As-D	**mg/L**				0.02909	0.00060	0.00056	0.00043	0.00057	0.00058	0.00055	0.00025	0.00056	0.00050	0.00050	0.01583
B-D	**mg/L**				0.117	0.117	0.107	0.063	0.147	0.144	0.103	0.120	0.156	0.163	0.150	0.000
Ca-D	**mg/L**				34.61	30.57	29.98	23.86	47.98	47.01	38.17	41.13	52.04	56.85	54.60	0.15
Cd-D	**mg/L**				0.00144	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00002	0.00002	0.00002	52.85000
Cu-D	**mg/L**				0.00233	0.00105	0.00270	0.00070	0.00100	0.00100	0.00220	0.00075	0.00100	0.00100	0.00228	0.00002
Fe-D	**mg/L**				0.034	0.038	0.032	0.035	0.035	0.039	0.031	0.018	0.041	0.033	0.030	0.015
Pb-D	**mg/L**				0.00757	0.00050	0.00050	0.00020	0.00050	0.00050	0.00050	0.00020	0.00050	0.00050	0.00050	0.00068
Hg-D	**mg/L**			**0.0001**	0.0004268	0.0001670	0.0007298	0.0010714	0.0001633	0.0001155	0.0003607	0.0003214	0.0001633	0.0000345	0.0000705	0.0002000
Ni-D	**mg/L**				0.00800	0.00100	0.00100	0.00100	0.00105	0.00103	0.00100	0.00100	0.00100	0.00100	0.00103	0.00009
Na-D	**mg/L**				17.10	15.58	12.63	9.54	24.13	23.96	16.50	20.13	26.46	28.32	25.87	0.00
K-D	**mg/L**				2.00	2.00	2.00	0.30	2.00	2.00	2.00	0.53	2.00	2.00	2.00	25.33
Zn-D	**mg/L**				0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.6717

	Station Name	WQO	WQO-Av	WWQG	Long Lake Middle 1M From B				3 South				4S-Lower				LLE		
Parameter					**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2009-10**	**2010-11**	**2011-12**
As-T	**mg/L**	**0.05000**		**0.005**	0.00050	0.00050	0.00052	0.00025	0.18481	0.12340	0.00113	0.00024	0.20000	0.17783	0.03155	0.00015	0.06153	0.00243	0.00156
Cd-T	**mg/L**	*			0.00001637	0.00001591	0.00001700	0.00001167	0.00923731	0.00615540	0.00006181	0.00002500	0.01000000	0.00889078	0.00156123	0.00001364	0.00301270	0.00003147	0.00001385
Cr-T	**mg/L**				0.00100	0.00100	0.00100	0.00100	0.00962	0.00795	0.00238	0.00100	0.01000	0.00900	0.00481	0.00100	0.00370	0.00127	0.00100
Co-T	**mg/L**	**0.0500**		**0.11**	0.0003	0.0003	0.0003	0.0005	0.0093	0.0072	0.0024	0.0012	0.0100	0.0091	0.0035	0.0007	0.0033	0.0010	0.0006
Cu-T	**mg/L**		**0.0020**	**0.0400**	0.0010	0.0010	0.0012	0.0011	0.0096	0.0080	0.0039	0.0020	0.0100	0.0090	0.0068	0.0004	0.0039	0.0019	0.0009
Fe-T	**mg/L**		**0.3000**	**1.0000**	0.1137	0.0647	0.1443	0.0602	0.1392	0.1452	0.3212	0.2532	0.7000	1.8779	2.7717	0.7768	0.7653	2.3161	2.0803
Hardness	**mg/L**				160.1	163.4	159.7	152.0	880.7	902.2	731.1	486.6	-	301.20	239.9	184.7	117.2	179.9	165.2
Pb-T	**mg/L**	**0.0050**	**0.0030**		0.0005	0.0005	0.0005	0.0002	0.0463	0.0315	0.0010	0.0002	0.0500	0.0445	0.0081	0.0002	0.0154	0.0004	0.0002
Mn-T	**mg/L**	**0.0500**		**1.6000**	0.6295	1.0881	0.6015	0.2762	0.1467	0.1512	0.1492	0.0401	0.1860	1.7128	0.2912	0.5201	0.0916	0.2016	0.2205
Hg-T	**mg/L**	**0.0001**		**0.001**	0.0000591	0.0000520	0.0000612	0.0001150	0.0000200	0.0000191	0.0000200	0.0000170	-	0.00	0.0000255	0.0000156	0.0000186	0.0000180	0.0000177
Ni-T	**mg/L**	**0.025**			0.001	0.001	0.001	0.001	0.047	0.034	0.006	0.003	0.050	0.045	0.011	0.001	0.016	0.002	0.001
Ag-T	**mg/L**	**0.0001**			0.00002	0.00002	0.00002	0.00002	0.00924	0.00616	0.00005	0.00002	0.01000	0.00889	0.00156	0.00002	0.00301	0.00002	0.00002
Zn-T	**mg/L**	**0.03**			0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.008	0.014	0.105	0.024	0.009	0.005	0.006	0.005
Al-D	**mg/L**	**0.1**	**0.1**	**0.1**	0.02070	0.00803	0.01012	0.01133	0.02738	0.02682	0.01975	0.03756	-	0.02620	0.01902	0.02514	0.04047	0.04211	0.03514
As-D	**mg/L**				0.01475	0.00254	0.00050	0.00020	0.00223	0.00230	0.00103	0.00020	-	0.00061	0.00026	0.00015	0.00212	0.00195	0.00130
B-D	**mg/L**				0.160	0.164	0.150	0.150	0.349	0.357	0.332	0.170	-	0.128	0.102	0.080	0.102	0.075	0.071
Ca-D	**mg/L**				54.89	56.61	55.75	52.47	299.66	306.84	247.74	161.58	-	99.65	76.35	60.75	38.55	57.86	52.67
Cd-D	**mg/L**				0.00073	0.00012	0.00002	0.00001	0.00011	0.00010	0.00015	0.00003	-	0.00003	0.00014	0.00001	0.00002	0.00005	0.00001
Cu-D	**mg/L**				0.00164	0.00109	0.00217	0.00092	0.00446	0.00464	0.00399	0.00146	-	0.00122	0.00106	0.00057	0.00154	0.00153	0.00092
Fe-D	**mg/L**				0.030	0.030	0.031	0.017	0.030	0.033	0.025	0.014	-	1.550	0.279	0.681	0.578	1.620	1.500
Pb-D	**mg/L**				0.00404	0.00101	0.00050	0.00020	0.00223	0.00230	0.00097	0.00020	-	0.00061	0.00029	0.00020	0.00050	0.00032	0.00022
Hg-D	**mg/L**			**0.0001**	0.0000297	0.0000228	0.0000353	0.0000767	0.0000200	0.0000205	0.0000163	0.0000173	-	0.0000189	0.0000169	0.0000147	0.0000190	0.0000160	0.0000171
Ni-D	**mg/L**				0.00453	0.00150	0.00113	0.00100	0.00527	0.00602	0.00599	0.00256	-	0.00291	0.00123	0.00124	0.00100	0.00102	0.00111
Na-D	**mg/L**				27.67	28.45	26.77	25.57	73.32	73.03	91.29	19.79	-	12.66	14.25	7.35	6.25	9.03	7.32
K-D	**mg/L**				2.00	2.00	2.00	0.68	3.46	3.49	3.33	1.91	-	2.00	1.16	0.56	2.00	1.13	0.47
Zn-D	**mg/L**				0.0050	0.0050	0.0050	0.0050	0.0052	0.0053	0.0061	0.0054	-	0.1026	0.0178	0.0097	0.0050	0.0051	0.0056

*Max concentration is based on Hardness

0.00001 at 30 mg/L CaCO3
0.00002 at 60 mg/L CaCO3
0.00003 at 90 mg/L CaCO3
0.00004 at 120 mg/L CaCO3
0.00005 at 150 mg/L CaCO3
0.00006 at 210 mg/L CaCO3

GRAPHS

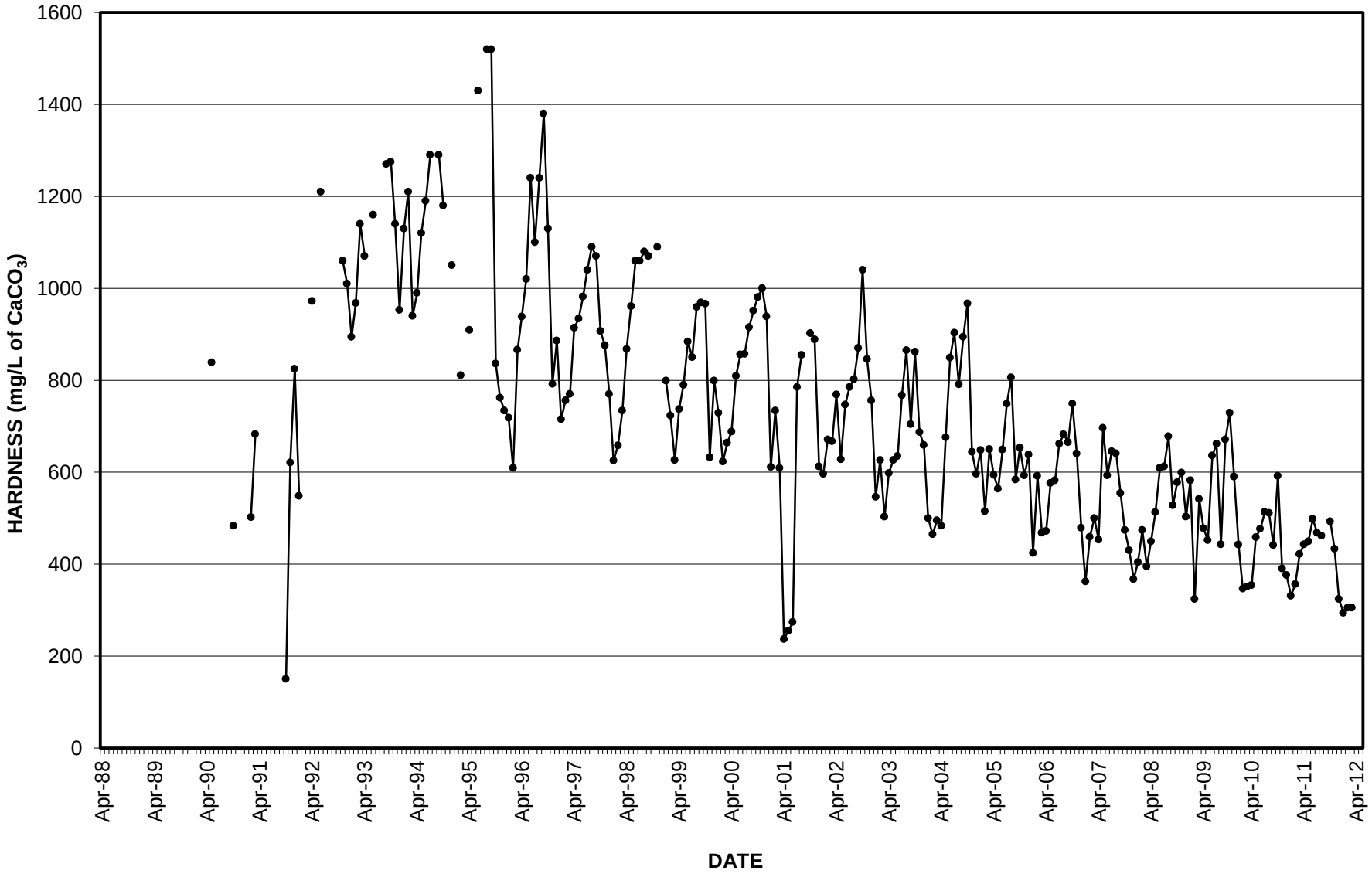
Graph 1	Hardness Settling Pond 4
Graph 2	pH Settling Pond 4
Graph 3	Total Suspended Solids Pond 4
Graph 4	Alkalinity Settling Pond 4
Graph 5	Sulphate Settling Pond 4
Graph 6	Ammonia Nitrogen Settling Pond 4
Graph 7	Nitrate Nitrogen Settling Pond 4
Graph 8	Dissolved Phosphate Settling Pond 4
Graph 9	Dissolved Aluminum Settling Pond 4
Graph 10	Dissolved Arsenic Settling Pond 4
Graph 11	Dissolved Copper Settling Pond 4
Graph 12	Dissolved Iron Settling Pond 4
Graph 13	Dissolved Lead Settling Pond 4
Graph 14	Dissolved Selenium Settling Pond 4
Graph 15	Dissolved Zinc Settling Pond 4
Graph 16	Dissolved Calcium/Magnesium/Sodium Settling Pond 4
Graph 17	Precipitation/Sulphate Settling Pond 4
Graph 18	Hardness Settling Pond 1
Graph 19	PH Settling Pond 1
Graph 20	Total Suspended Solids Settling Pond 1
Graph 21	Alkalinity Settling Pond 1
Graph 22	Sulphate Settling Pond 1
Graph 23	Ammonia Nitrogen Settling Pond 1
Graph 24	Nitrate Nitrogen Settling Pond 1
Graph 25	Dissolved Phosphate Settling Pond 1
Graph 26	Dissolved Aluminum Settling Pond 1
Graph 27	Dissolved Arsenic Settling Pond 1
Graph 28	Dissolved Copper Settling Pond 1
Graph 29	Dissolved Iron Settling Pond 1
Graph 30	Dissolved Lead Settling Pond 1
Graph 31	Dissolved Selenium Settling Pond 1
Graph 32	Dissolved Zinc Settling Pond 1
Graph 33	Dissolved Calcium/Magnesium/Sodium Settling Pond 1
Graph 34	Precipitation/Sulphate Settling Pond 1
Graph 35	PH North Pit Sump (WP)
Graph 36	Alkalinity North Pit Sump (WP)
Graph 37	Sulphate North Pit Sump (WP)
Graph 38	PH 3 South Pit
Graph 39	Alkalinity 3 South Pit
Graph 40	Sulphate 3 South Pit
Graph 41	Middle Quinsam Lake Inlet (WA) pH
Graph 42	Middle Quinsam Lake Hardness
Graph 43	Middle Quinsam Lake PH
Graph 44	Middle Quinsam Lake Sulphate
Graph 45	Middle Quinsam Lake Phytoplankton Abundance

Graph 46 Middle Quinsam Lake Cryptomonas Obovoidea
Graph 47 Long Lake Hardness
Graph 48 Long Lake PH
Graph 49 Long Lake Sulphate
Graph 50 Long Lake Chlorophyll A
Graph 51 Long Lake Phytoplankton Abundance
Graph 52 Long Lake Outlet PH
Graph 53 Long Lake Outlet Sulphate
Graph 54 Seep Into Long Lake (LLS) pH
Graph 55 Seep Into Long Lake (LLS) Alkalinity
Graph 56 Seep Into Long Lake (LLS) Sulphate
Graph 57 No Name Lake PH
Graph 58 No Name Lake Sulphate
Graph 59 No Name Lake Average Total Suspended Solids
Graph 60 Middle Quinsam Lake Inflow Average Total Suspended Solids
Graph 61 Long Lake Outflow Average Total Suspended Solids
Graph 62 Middle Quinsam Lake Outflow Average Total Suspended Solids

GRAPH 1

HARDNESS

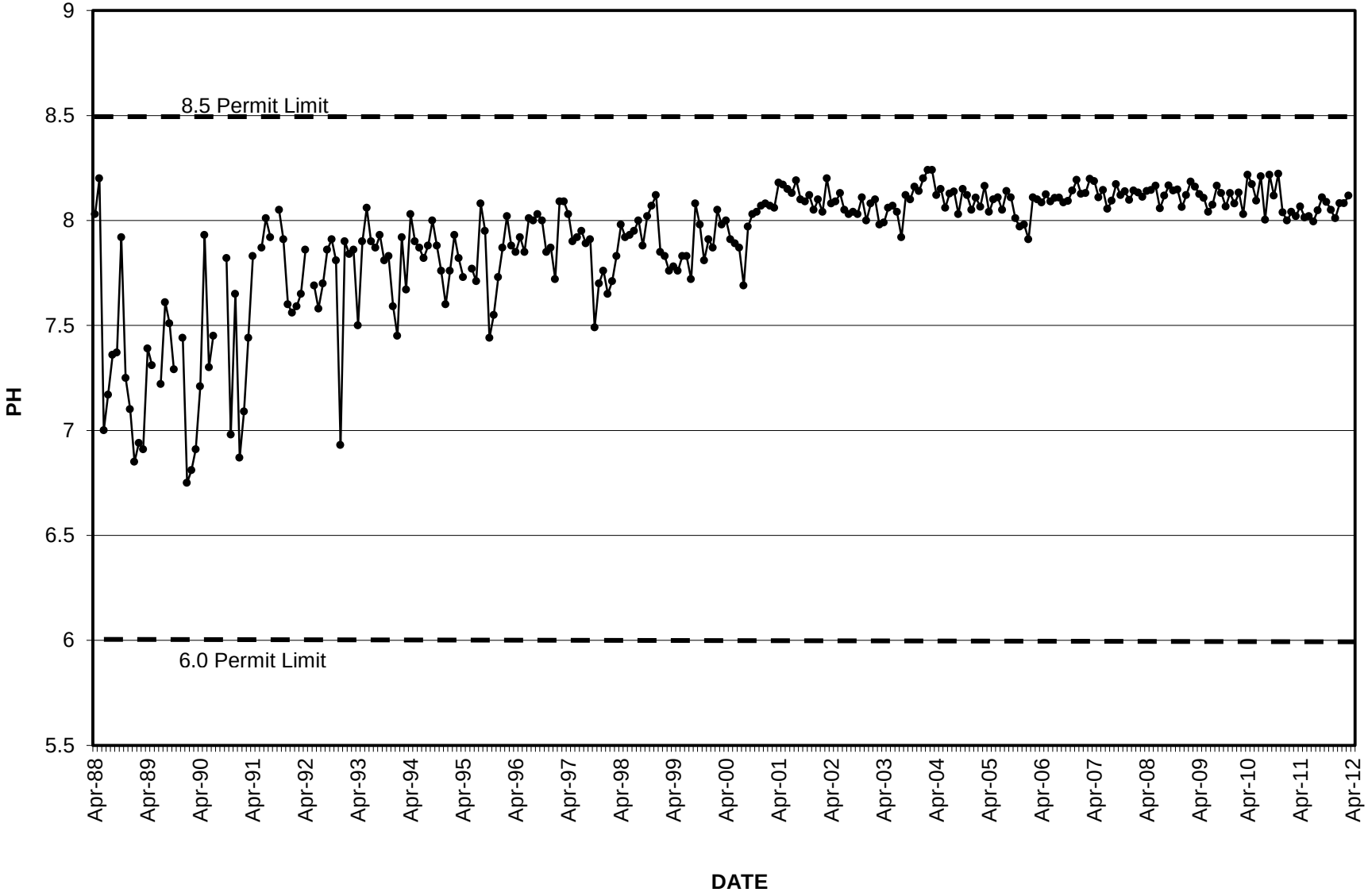
SETTLING POND 4



GRAPH 2

PH

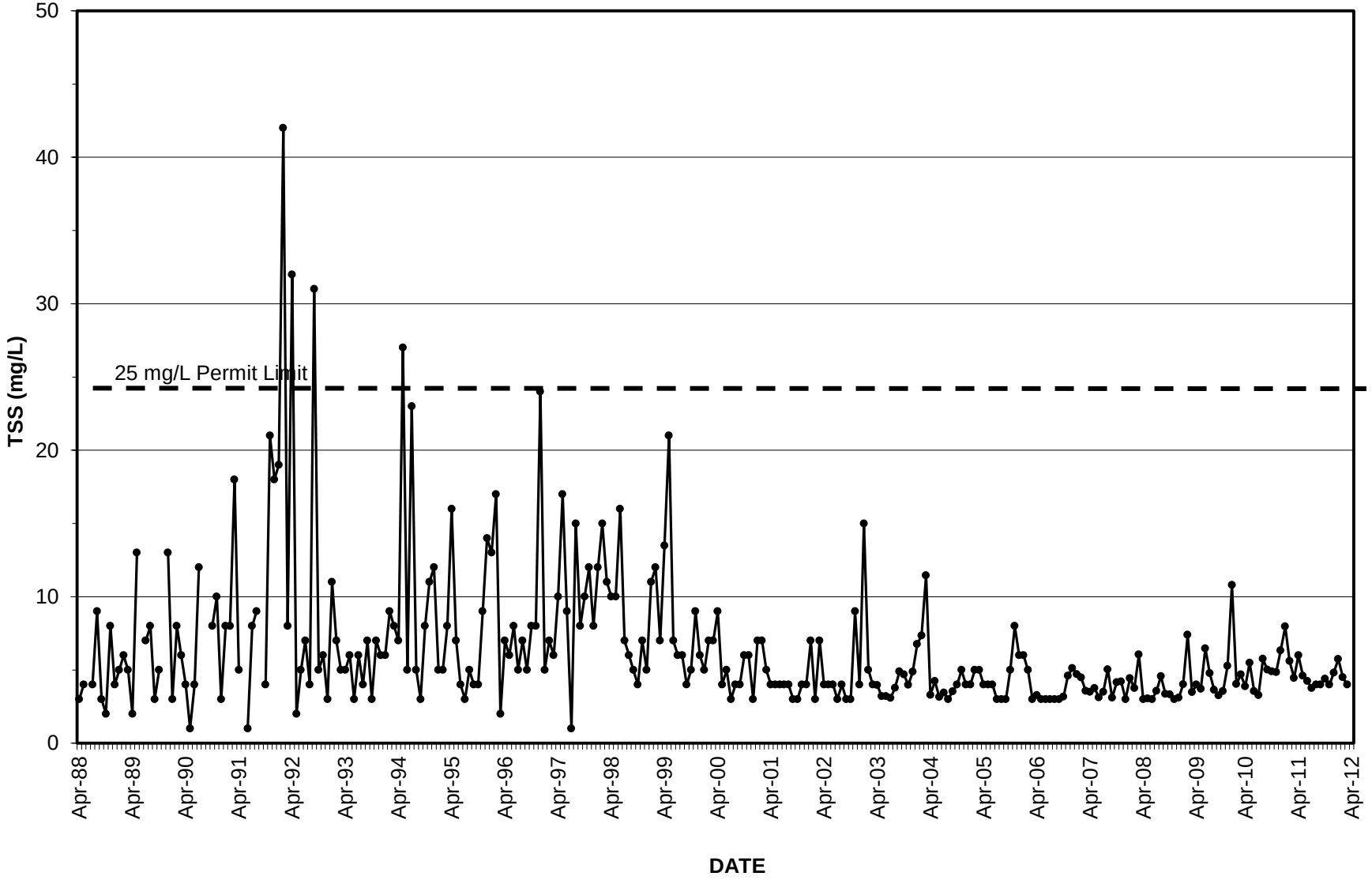
SETTLING POND 4



GRAPH 3

TOTAL SUSPENDED SOLIDS

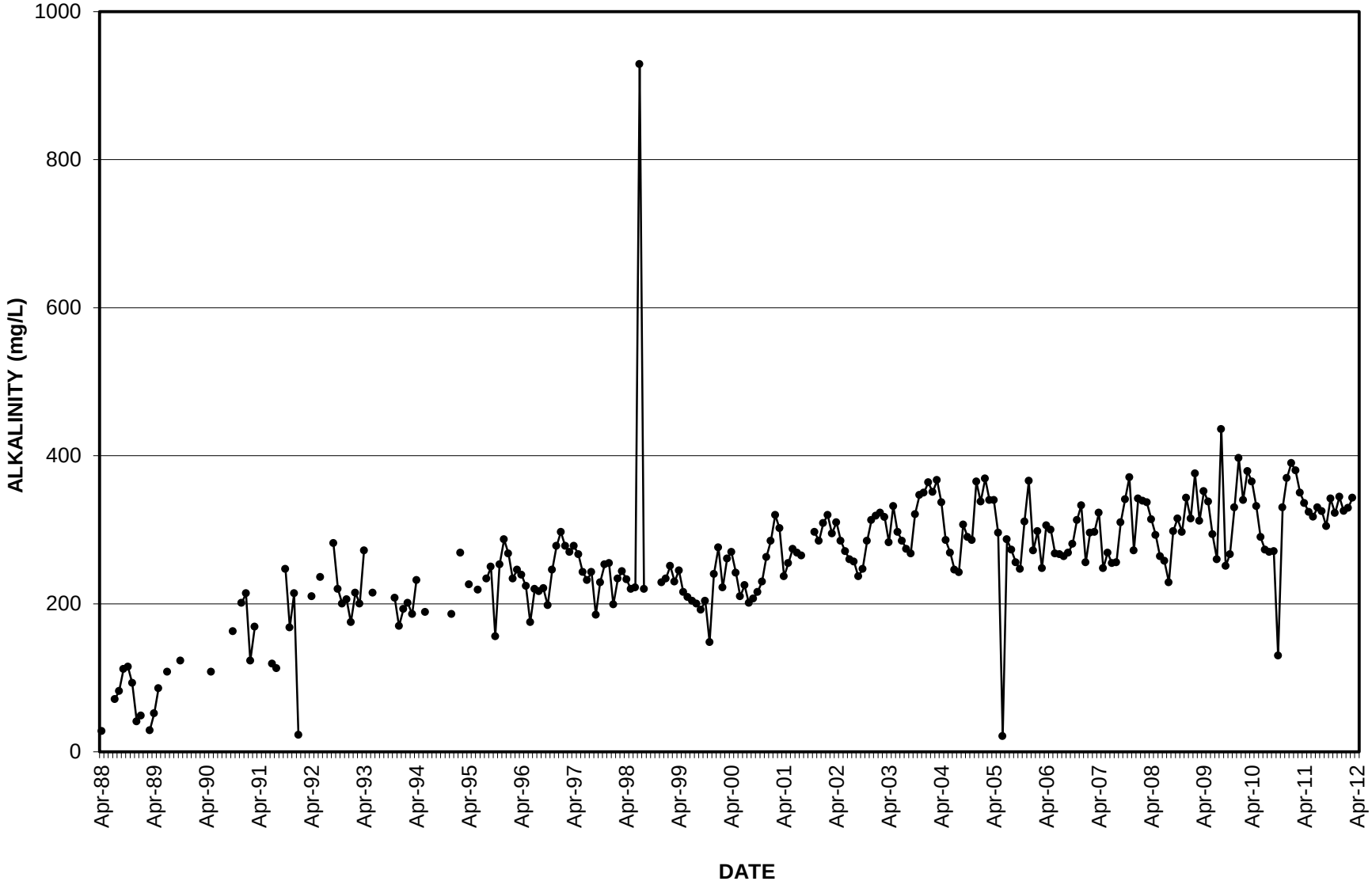
SETTLING POND 4



GRAPH 4

ALKALINITY

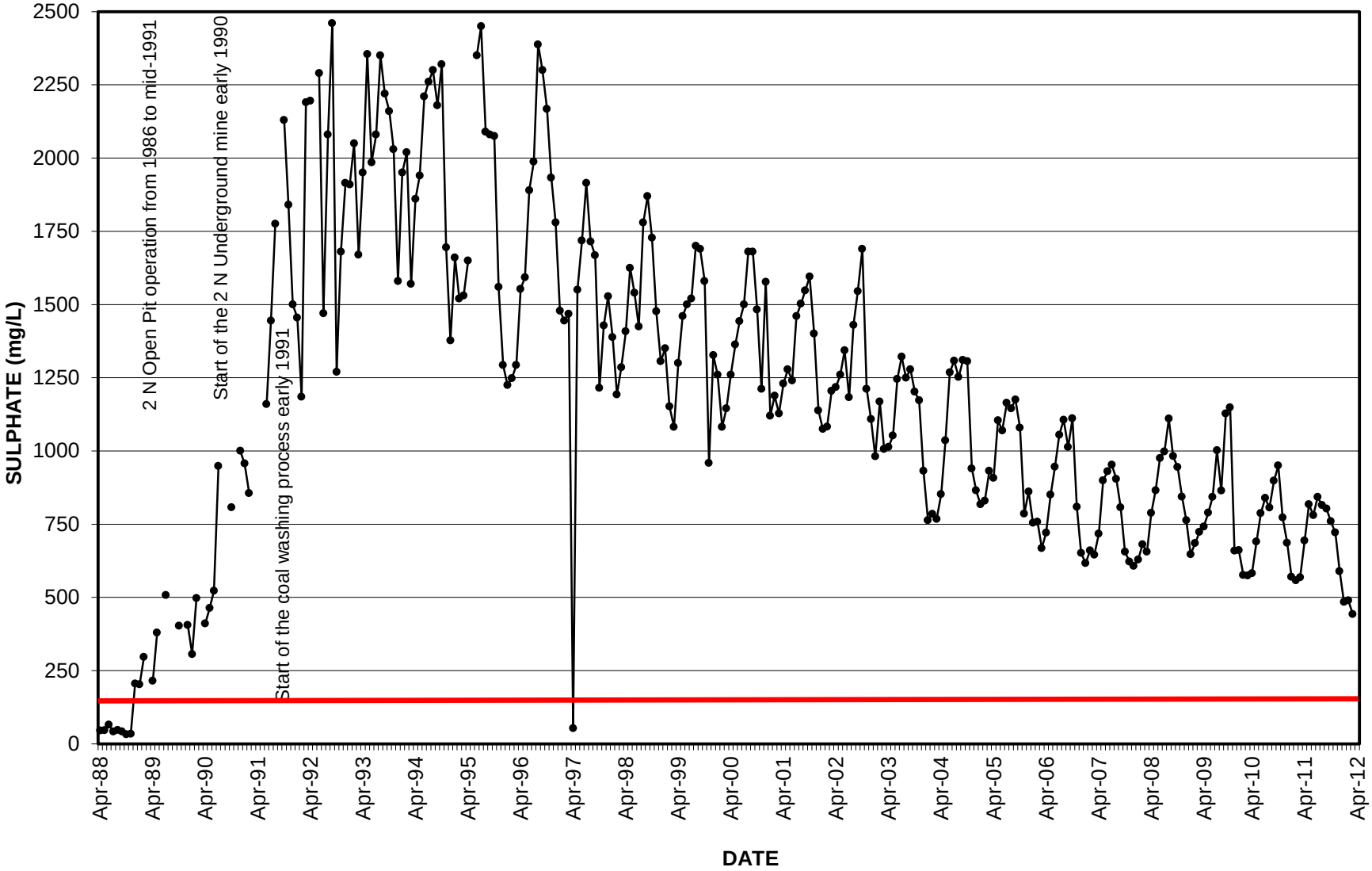
SETTLING POND 4



GRAPH 5

SULPHATE

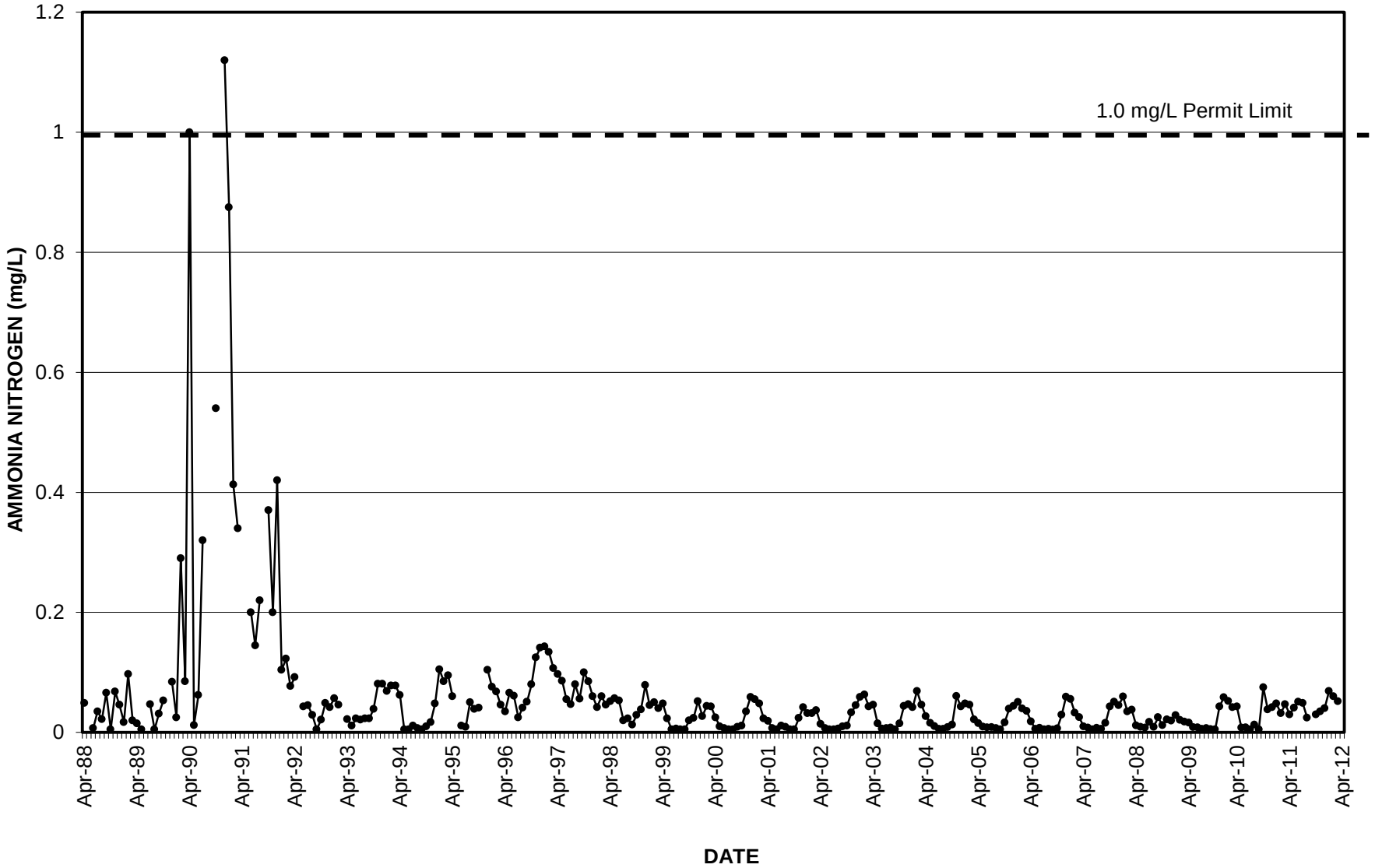
SETTLING POND 4



GRAPH 6

AMMONIA NITROGEN

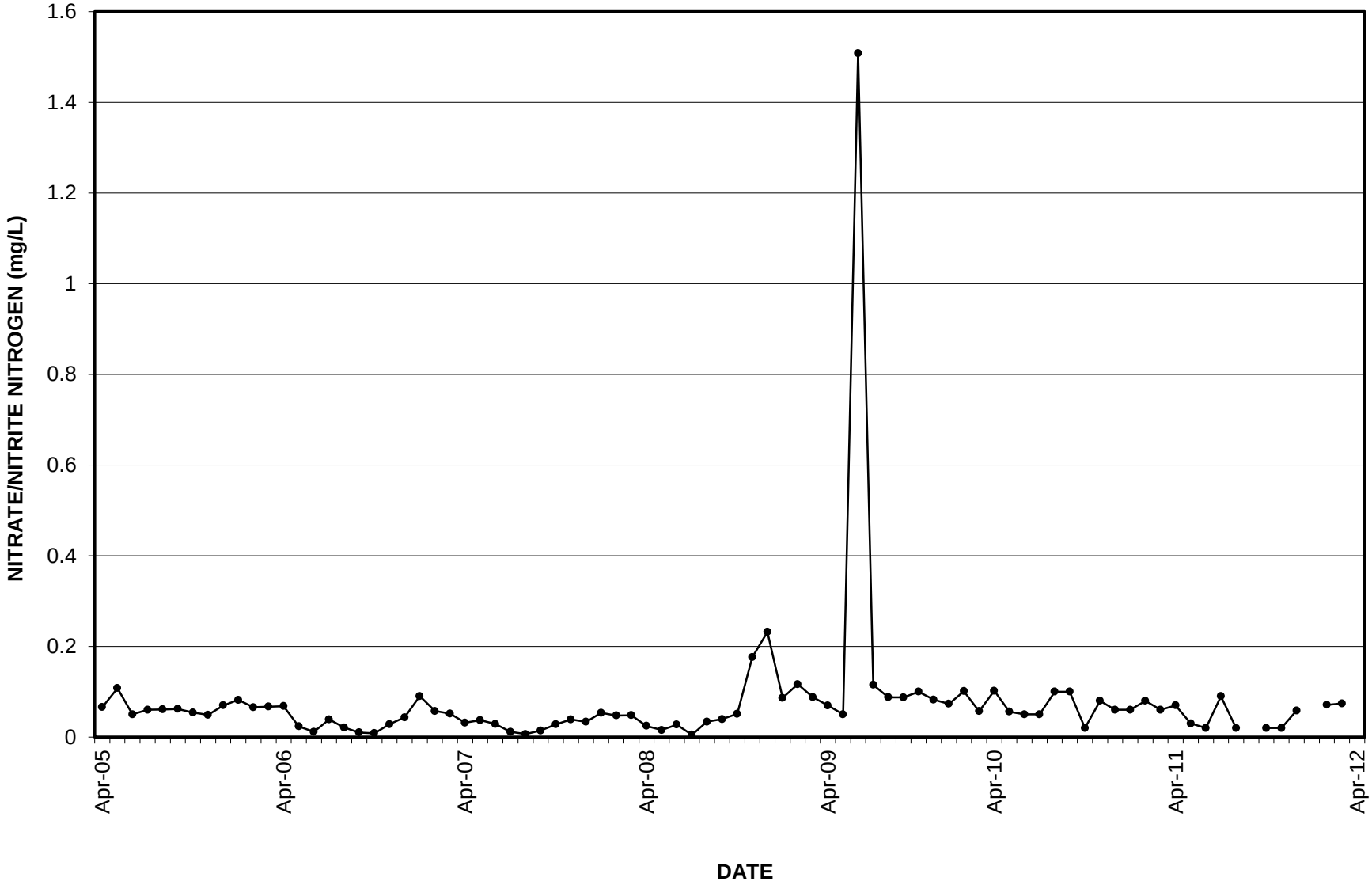
SETTLING POND 4



GRAPH 7

NITRATE/NITRITE NITROGEN

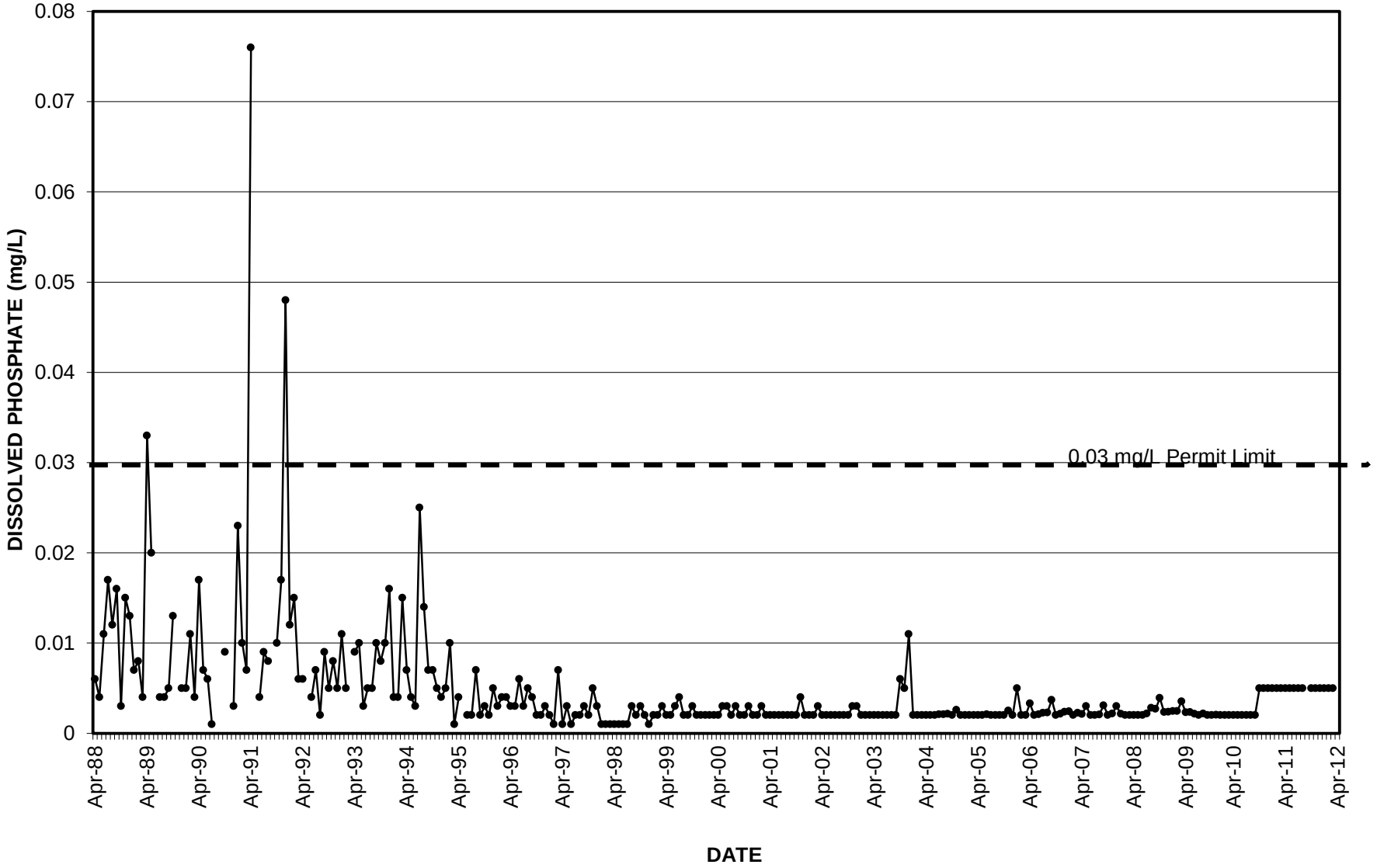
SETTLING POND 4



GRAPH 8

DISSOLVED PHOSPHOROUS

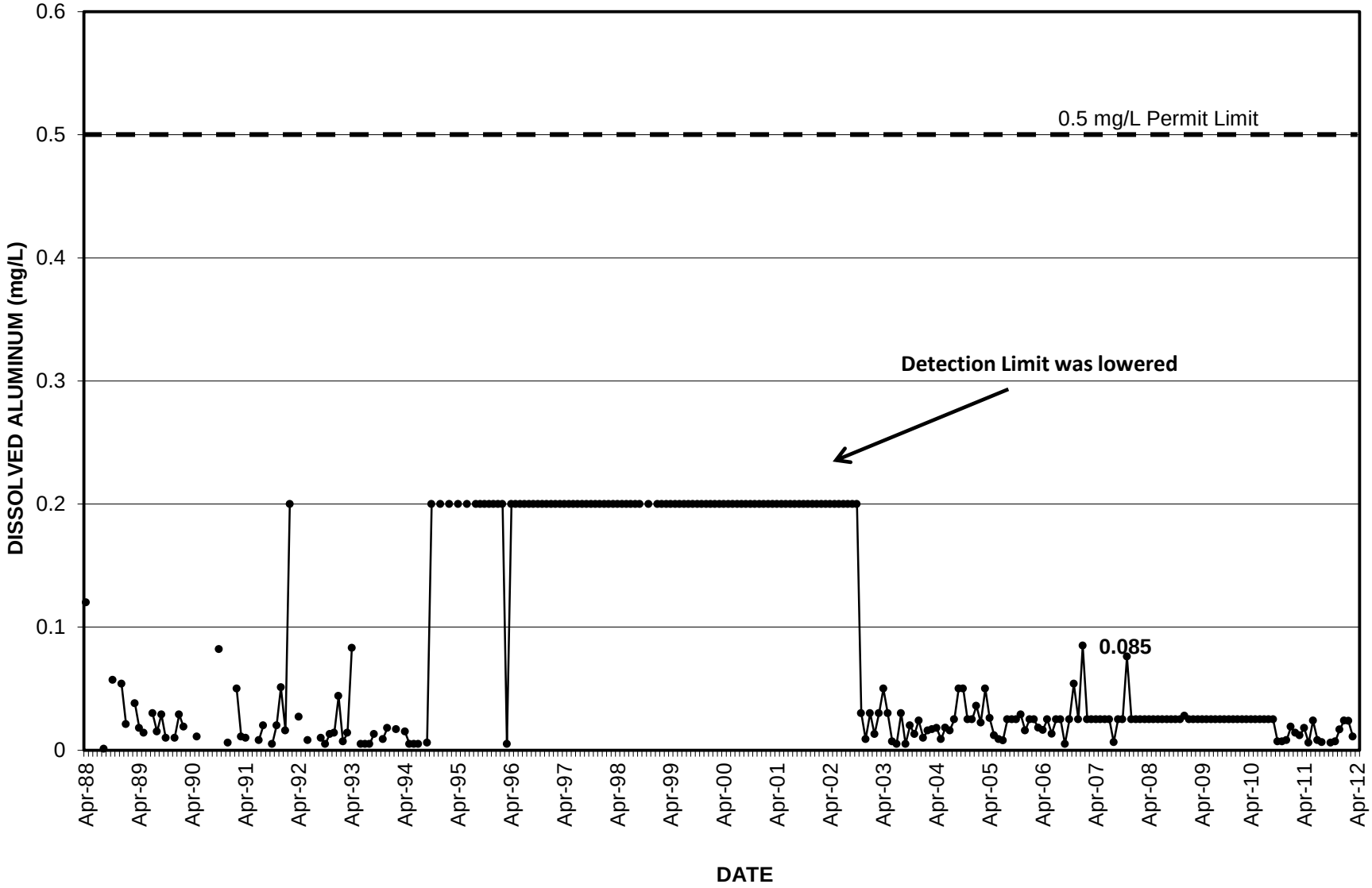
SETTLING POND 4



GRAPH 9

DISSOLVED ALUMINUM

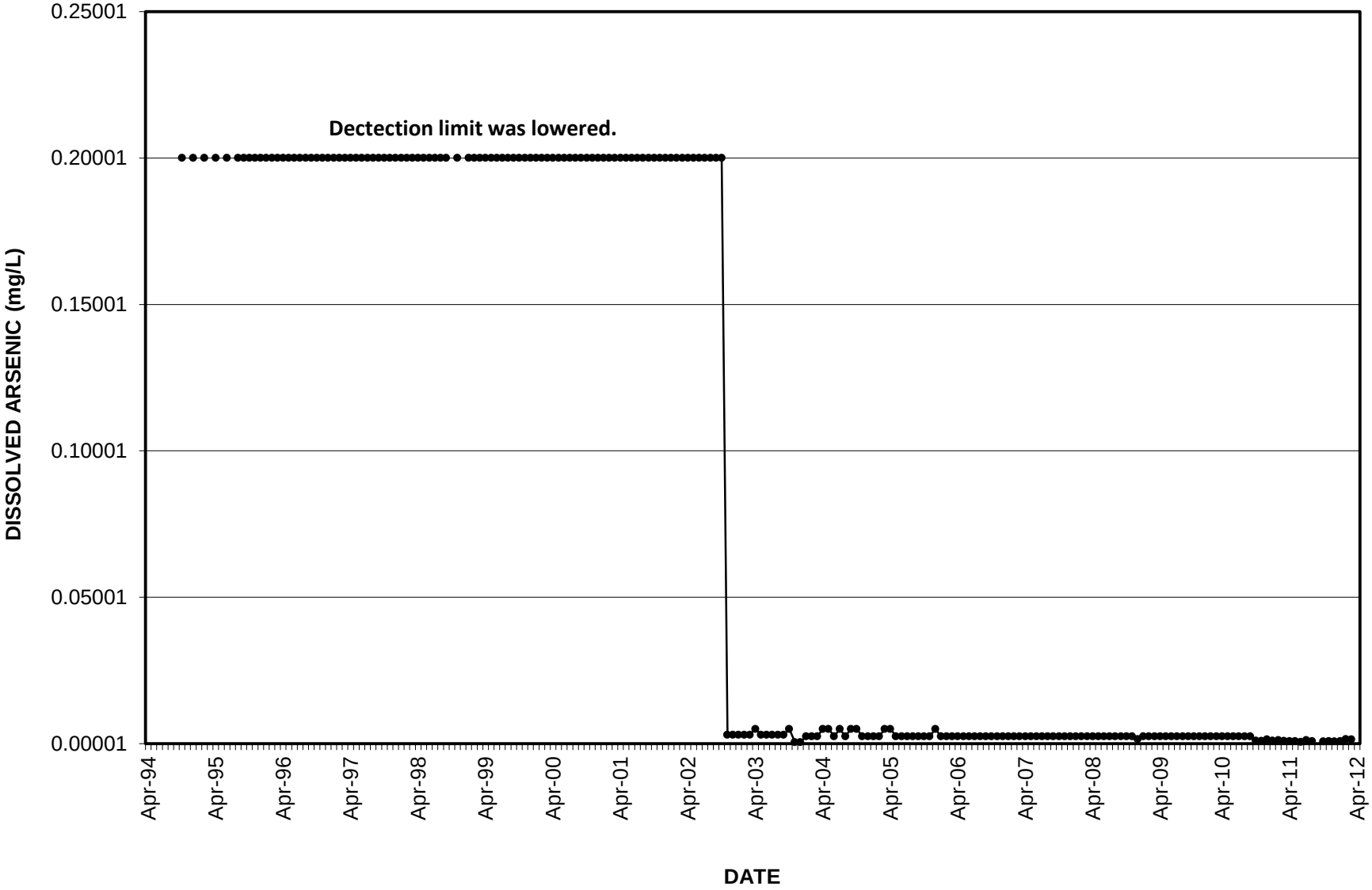
SETTLING POND 4



GRAPH 10

DISSOLVED ARSENIC

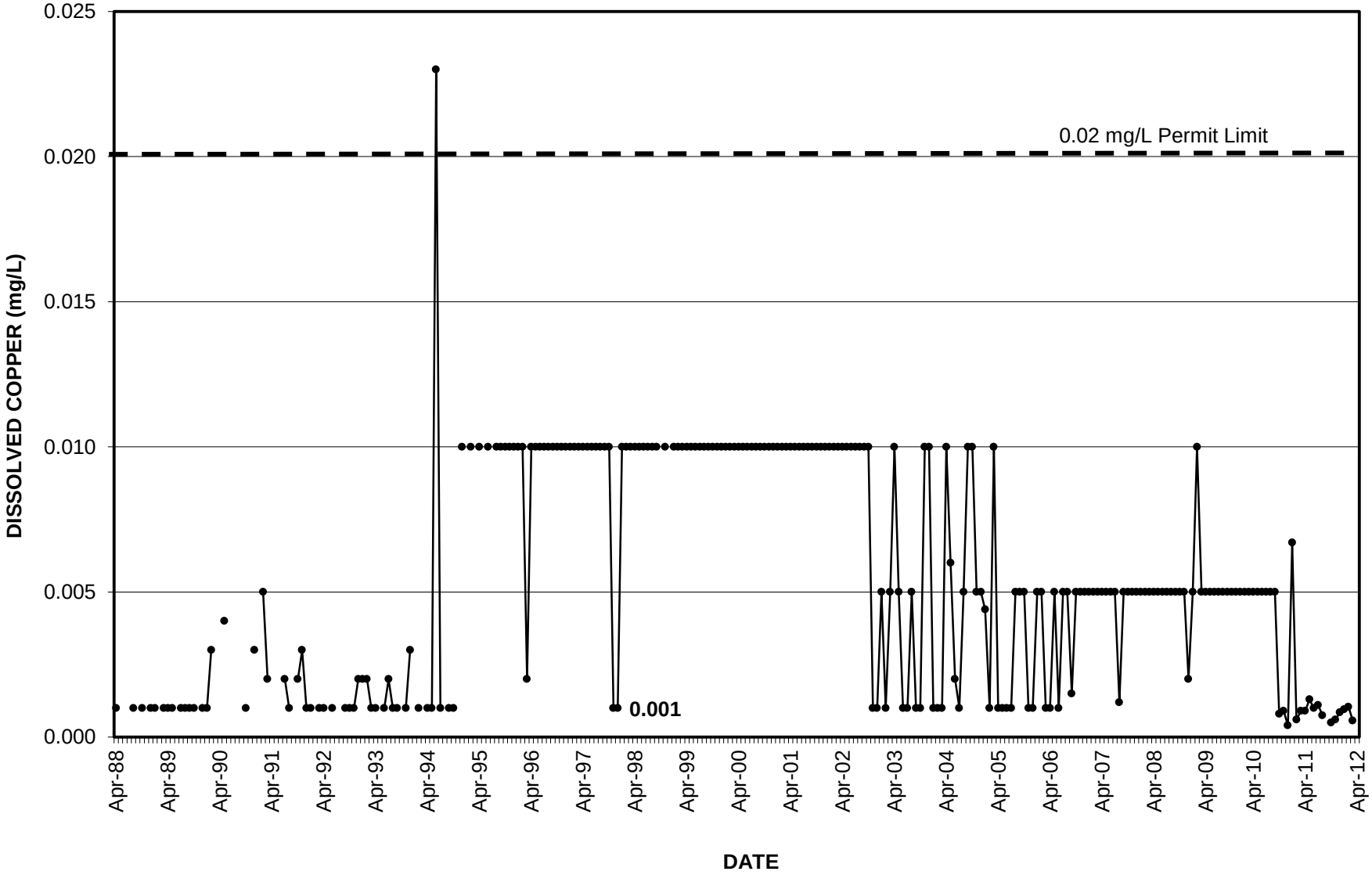
SETTLING POND 4



GRAPH 11

DISSOLVED COPPER

SETTLING POND 4

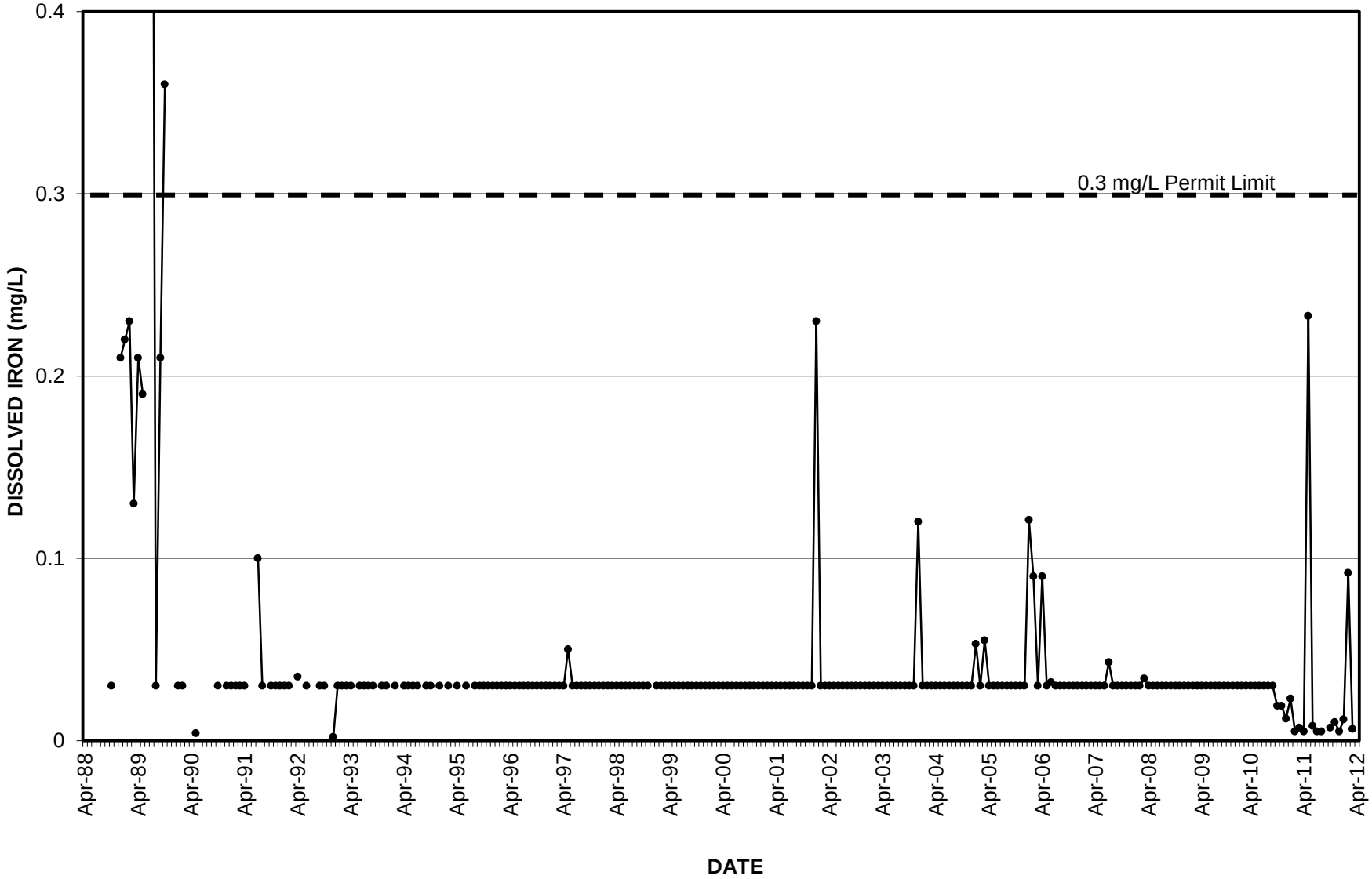


Most values expressed as 0.01 mg/L
are actually less than dectection limits
of 0.01 mg/L and 0.001 mg/L.
The dectection limits were decreased in late 2002.

GRAPH 12

DISSOLVED IRON

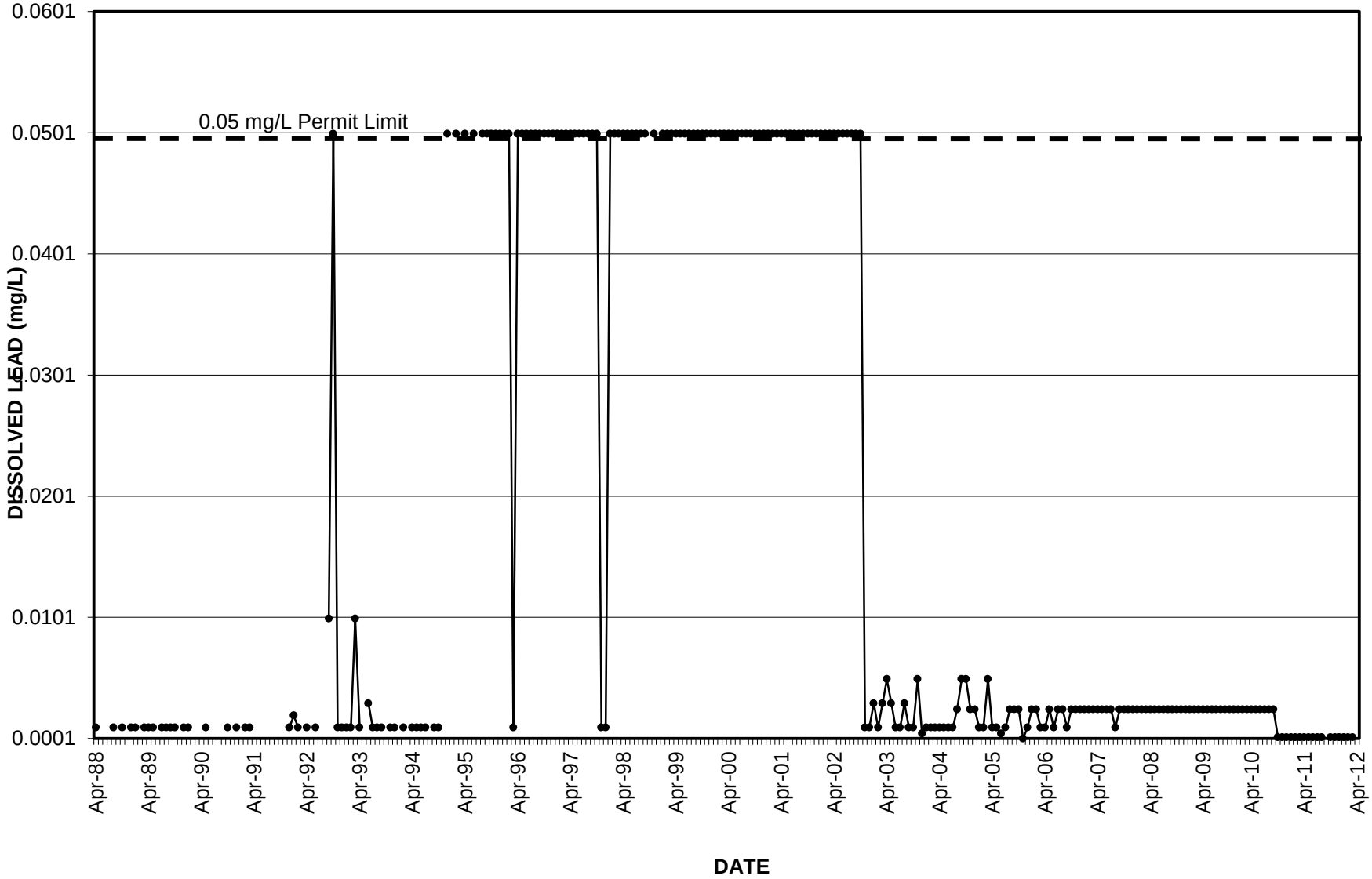
SETTLING POND 4



GRAPH 13

DISSOLVED LEAD

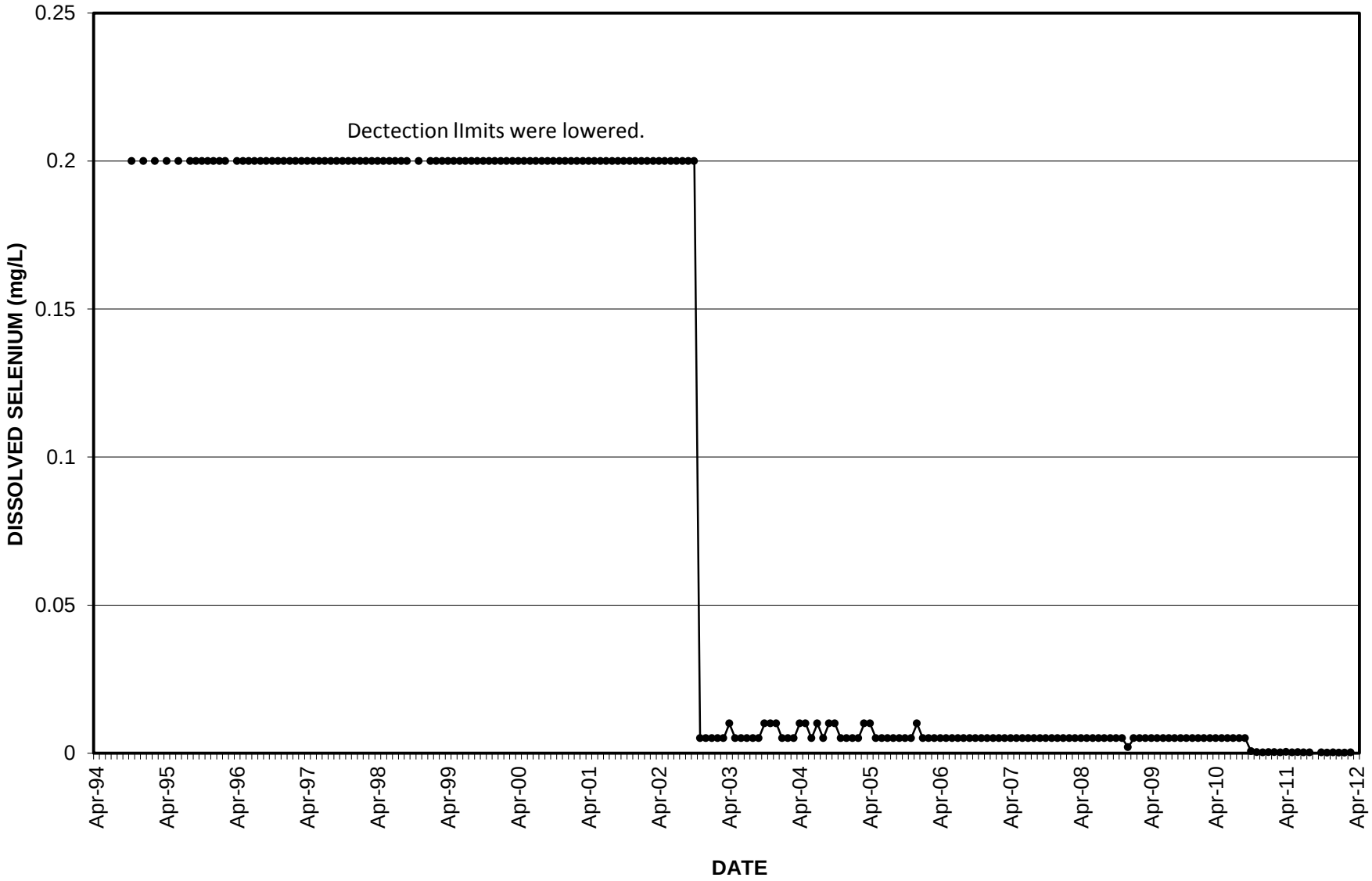
SETTLING POND 4



GRAPH 14

DISSOLVED SELENIUM

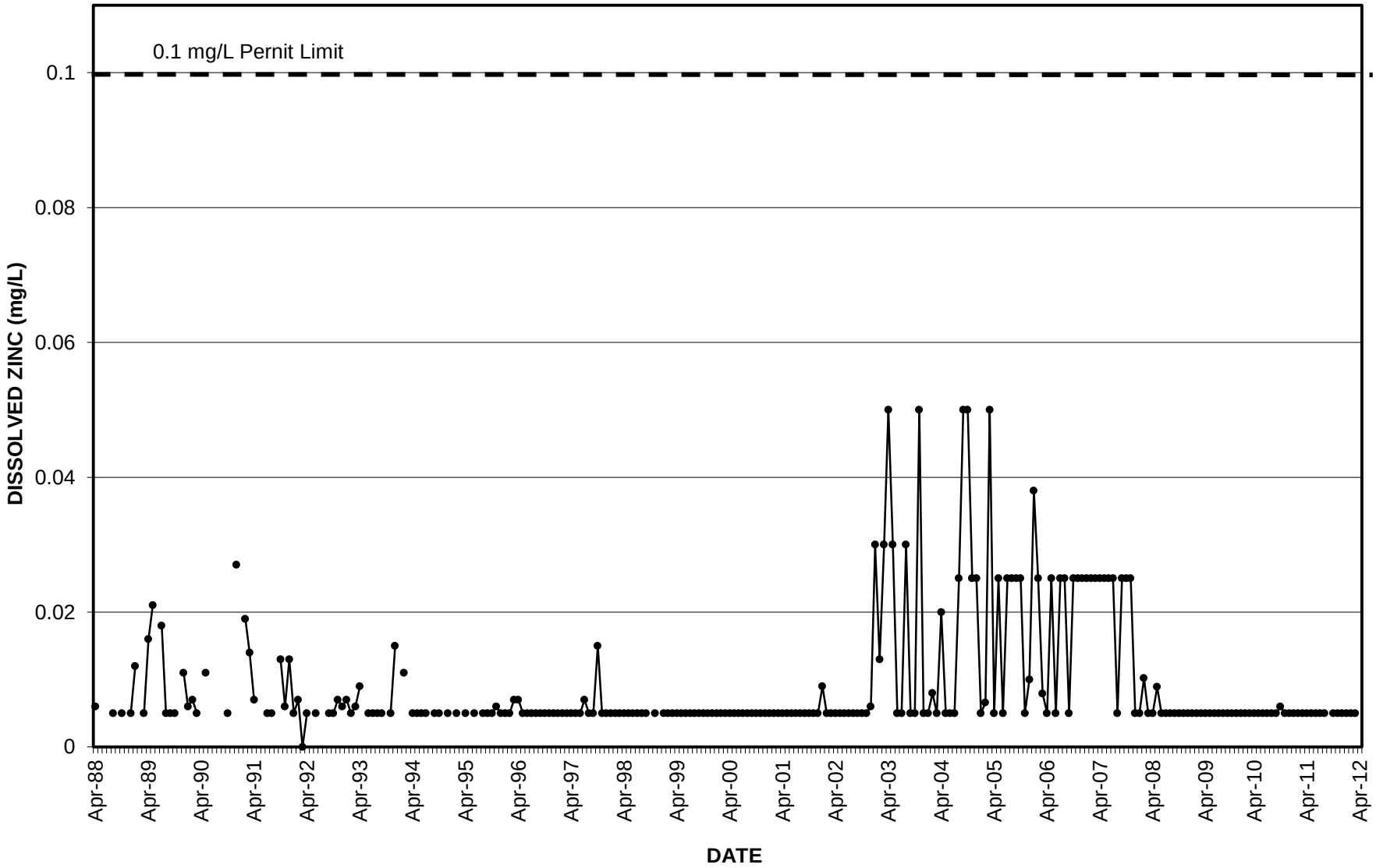
SETTLING POND 4



Graph 15

DISSOLVED ZINC

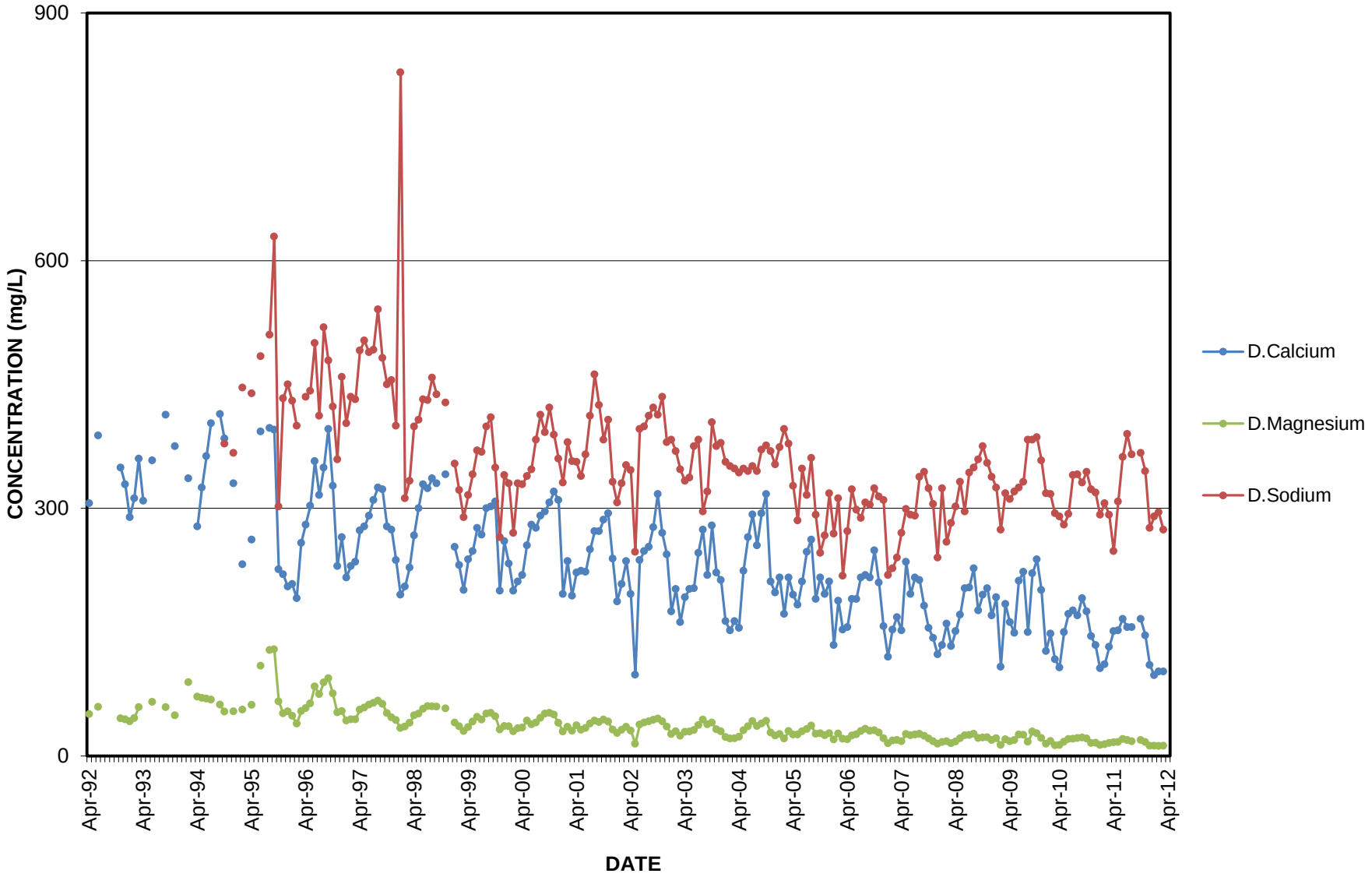
Settling Pond 4



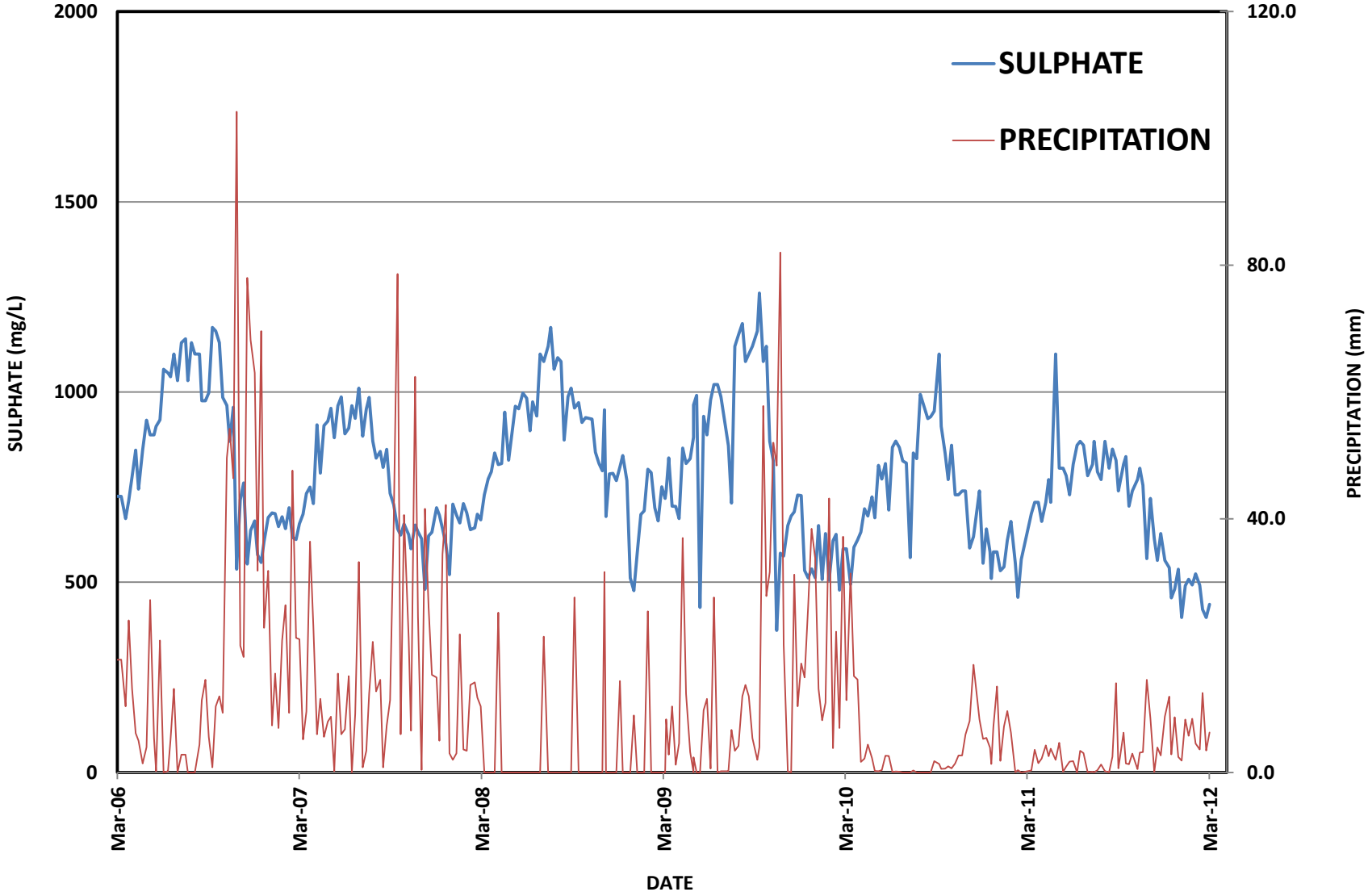
GRAPH 16

DISSOLVED CALCIUM/MAGNESIUM/SODIUM

SETTLING POND 4



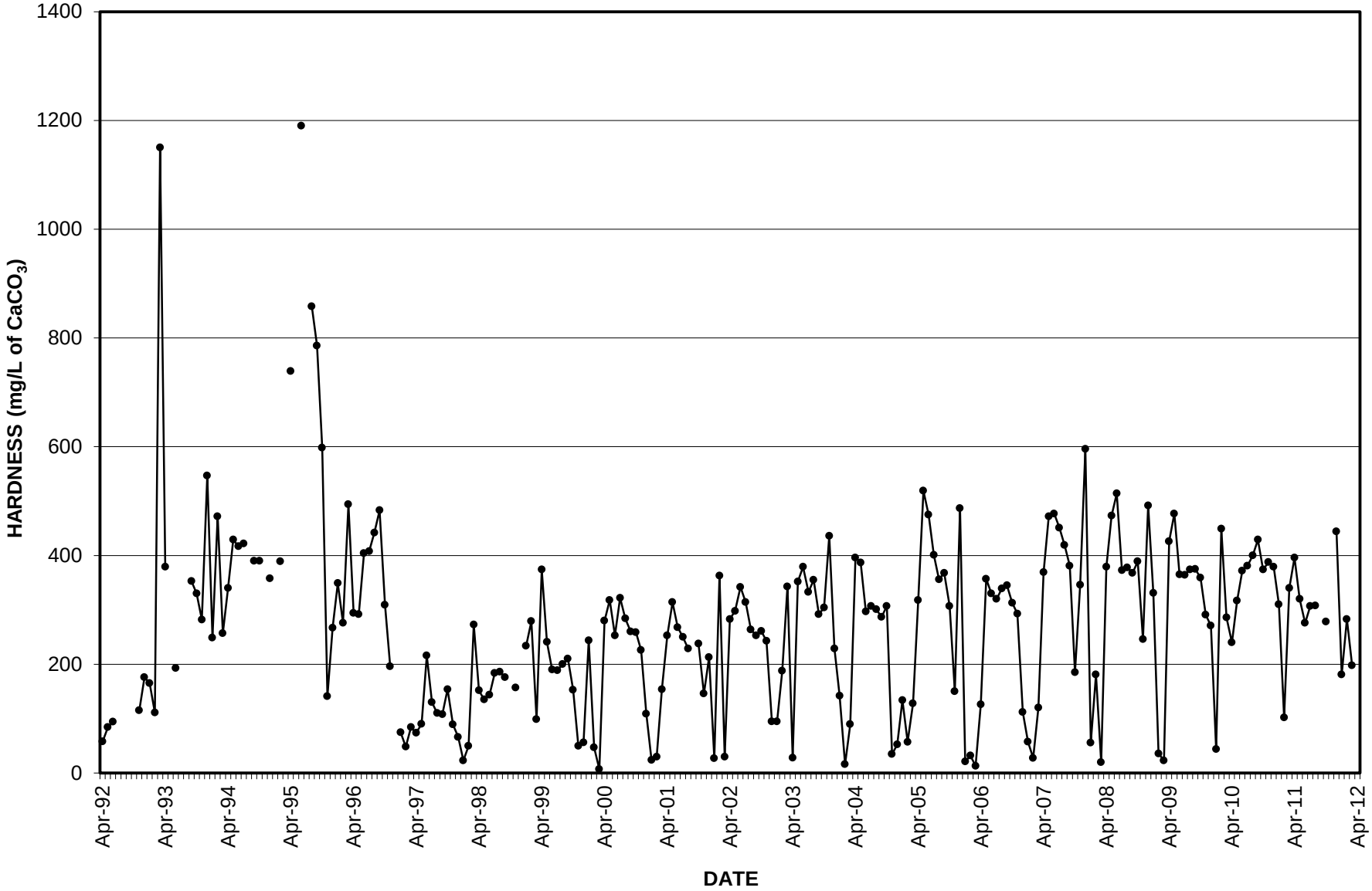
GRAPH 17
PRECIPITATION/SULPHATE
SETTLING POND 4



GRAPH 18

HARDNESS

SETTLING POND 1

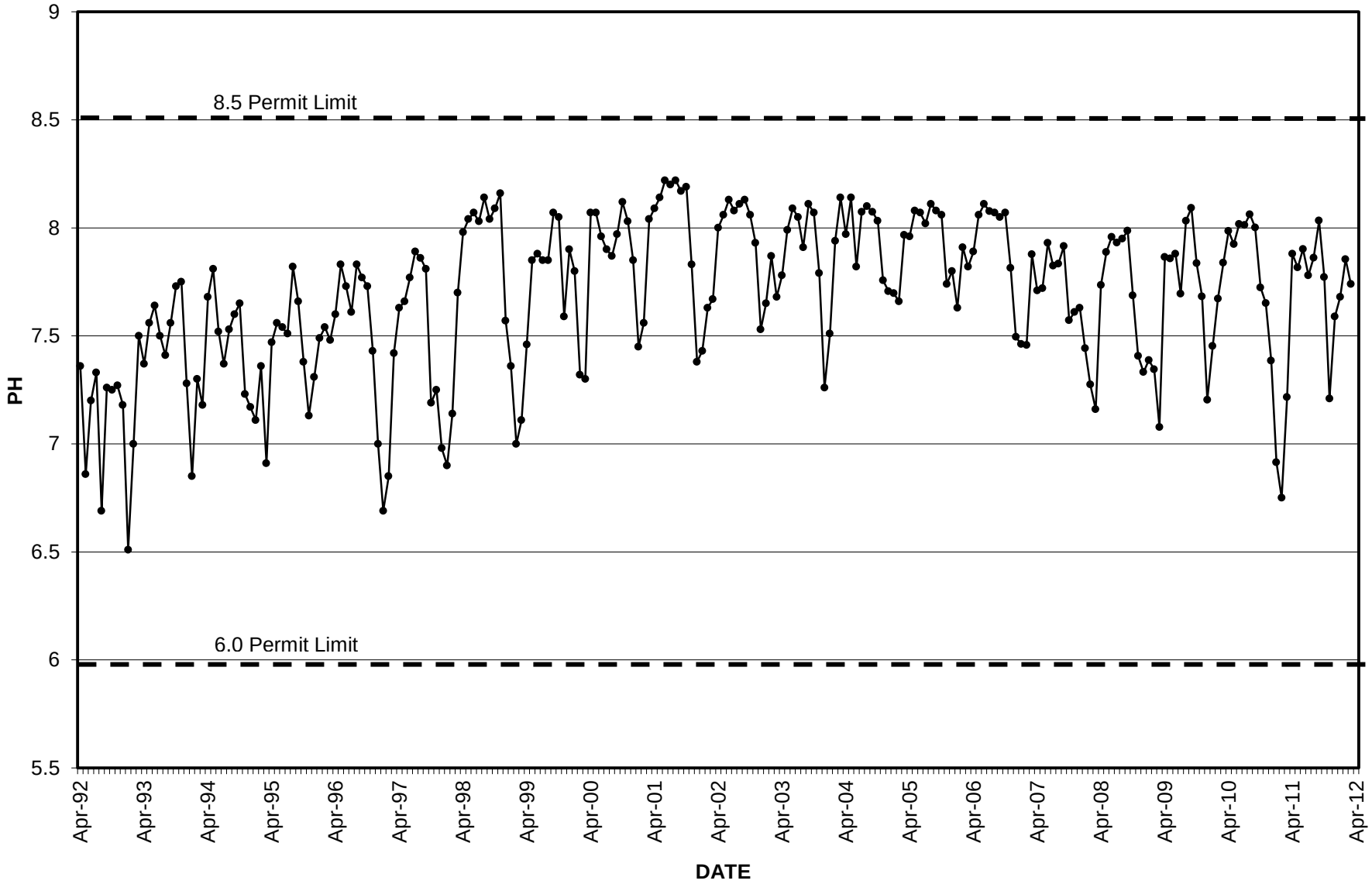


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 19

PH

SETTLING POND 1

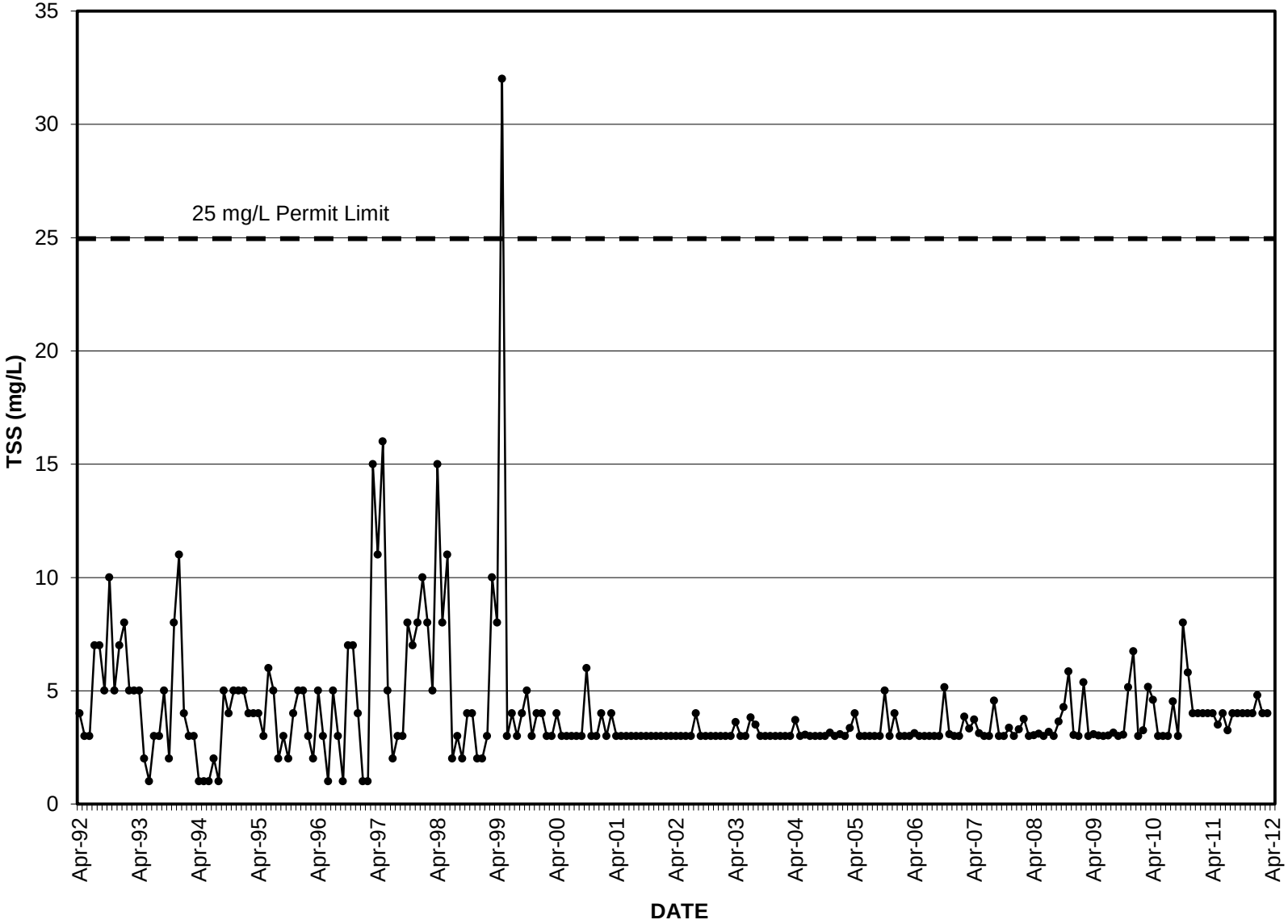


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 20

TOTAL SUSPENDED SOLIDS

SETTLING POND 1

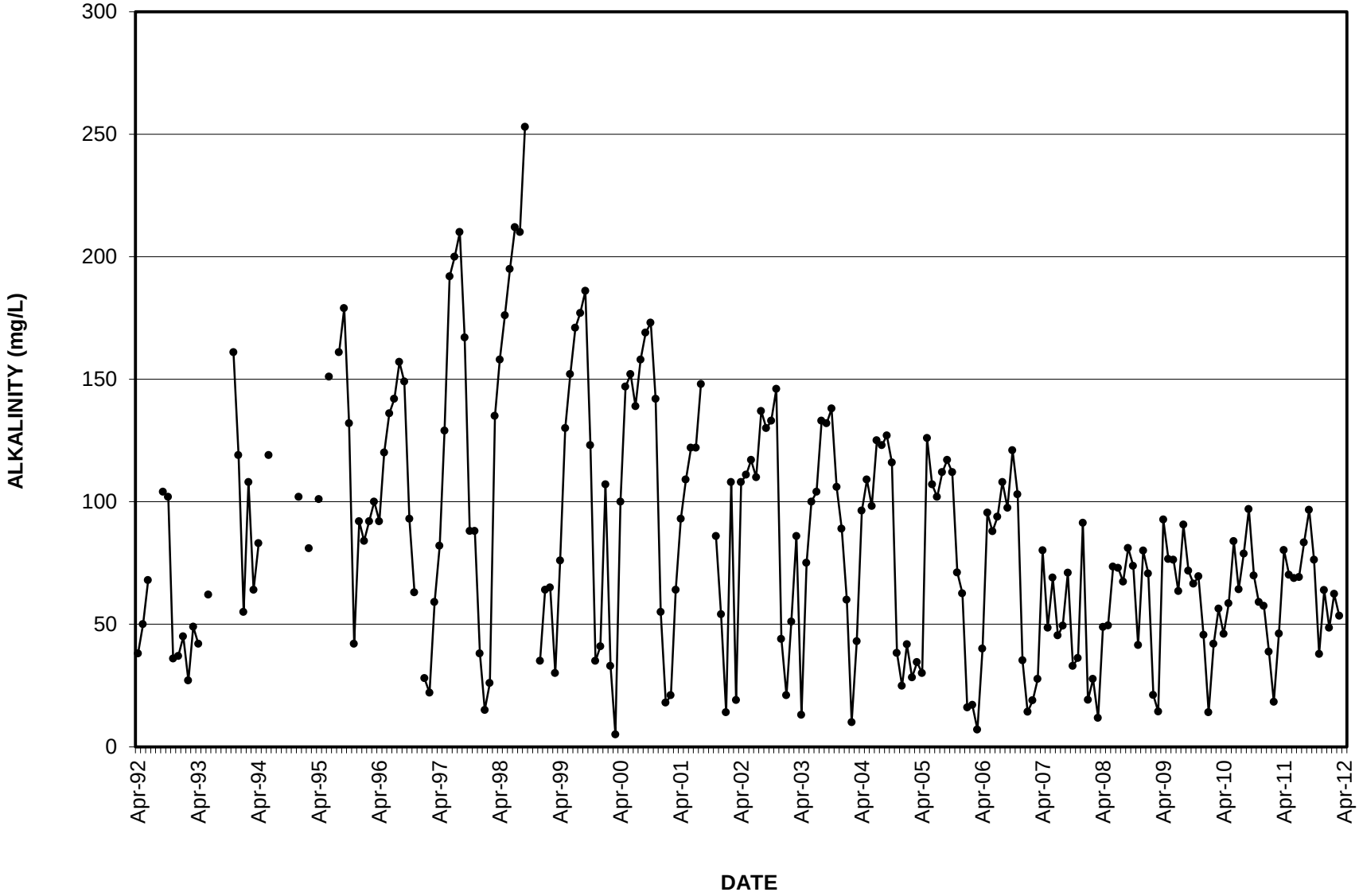


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 21

ALKALINITY

SETTLING POND 1

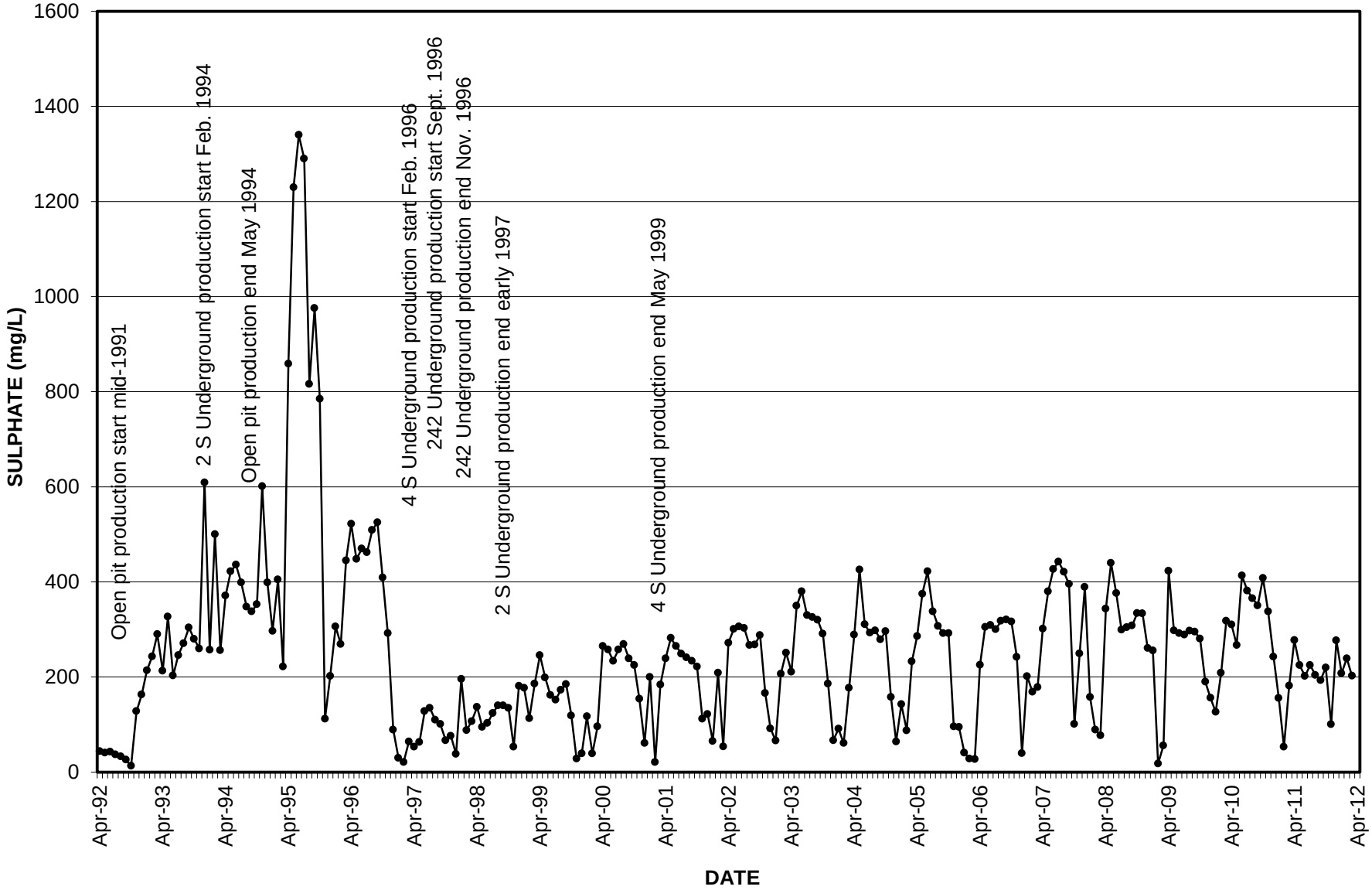


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 22

SULPHATE

SETTLING POND 1

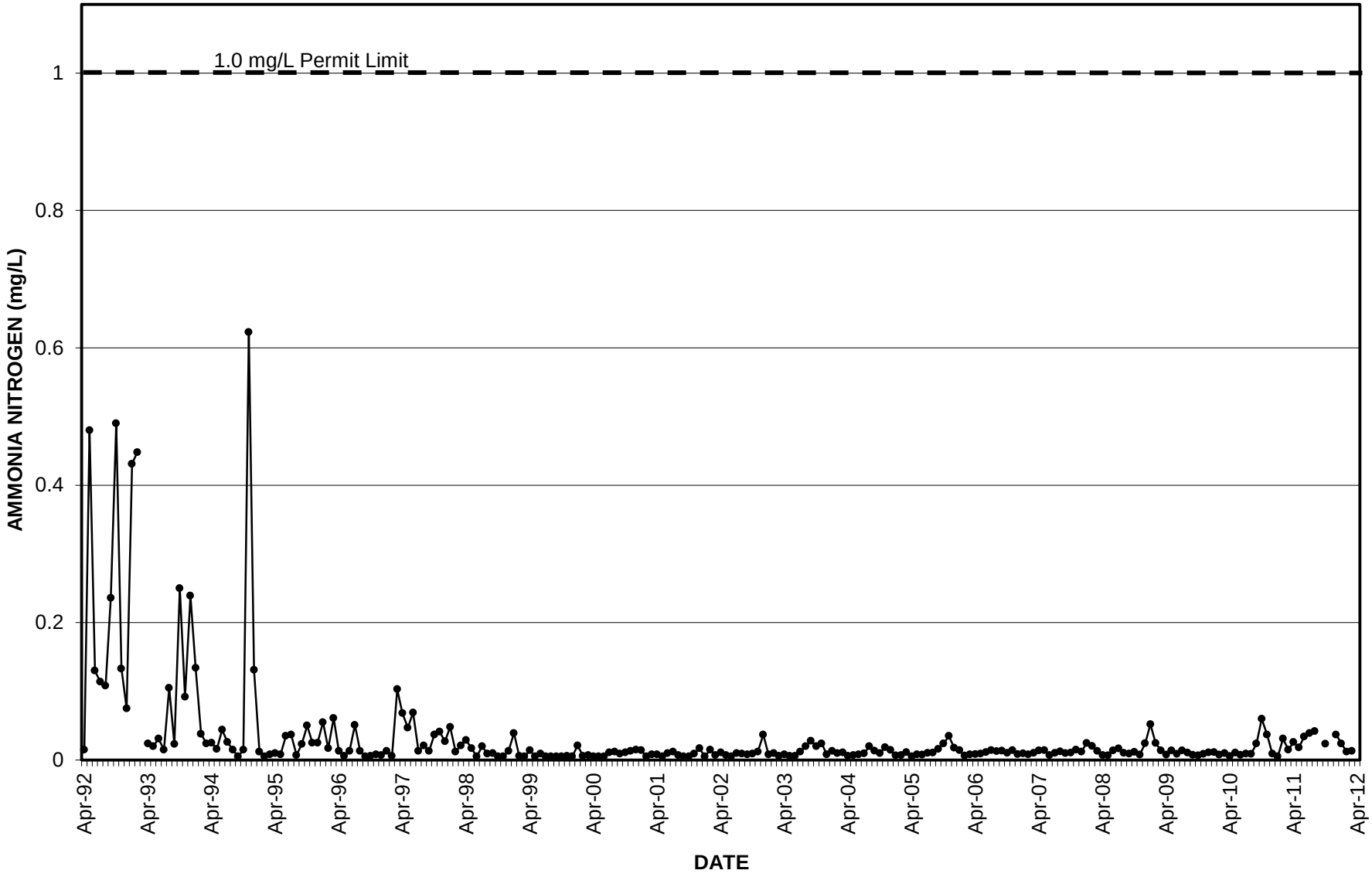


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 23

AMMONIA NITROGEN

SETTLING POND 1

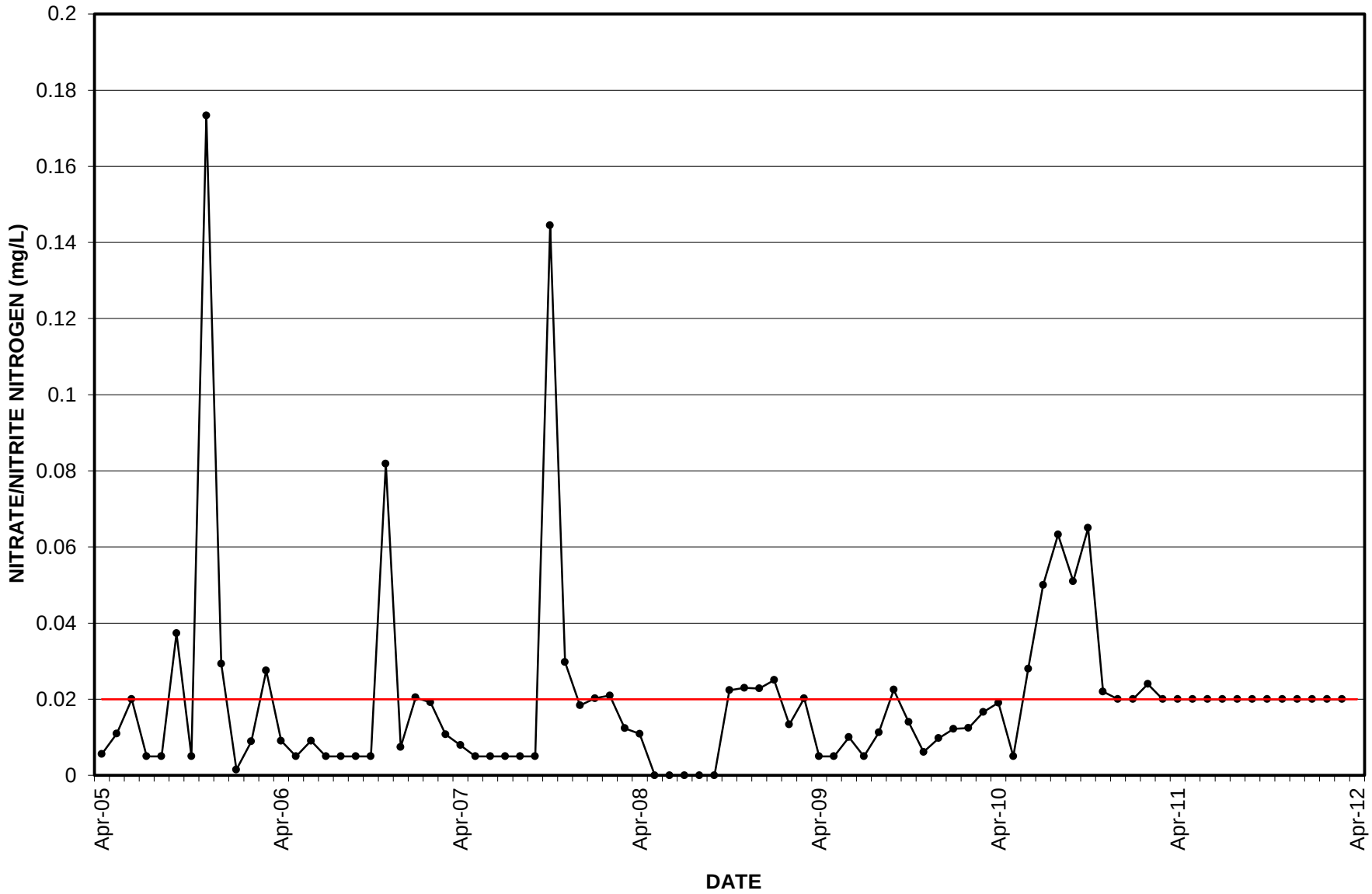


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 24

NITRATE/NITRITE NITROGEN

SETTLING POND 1

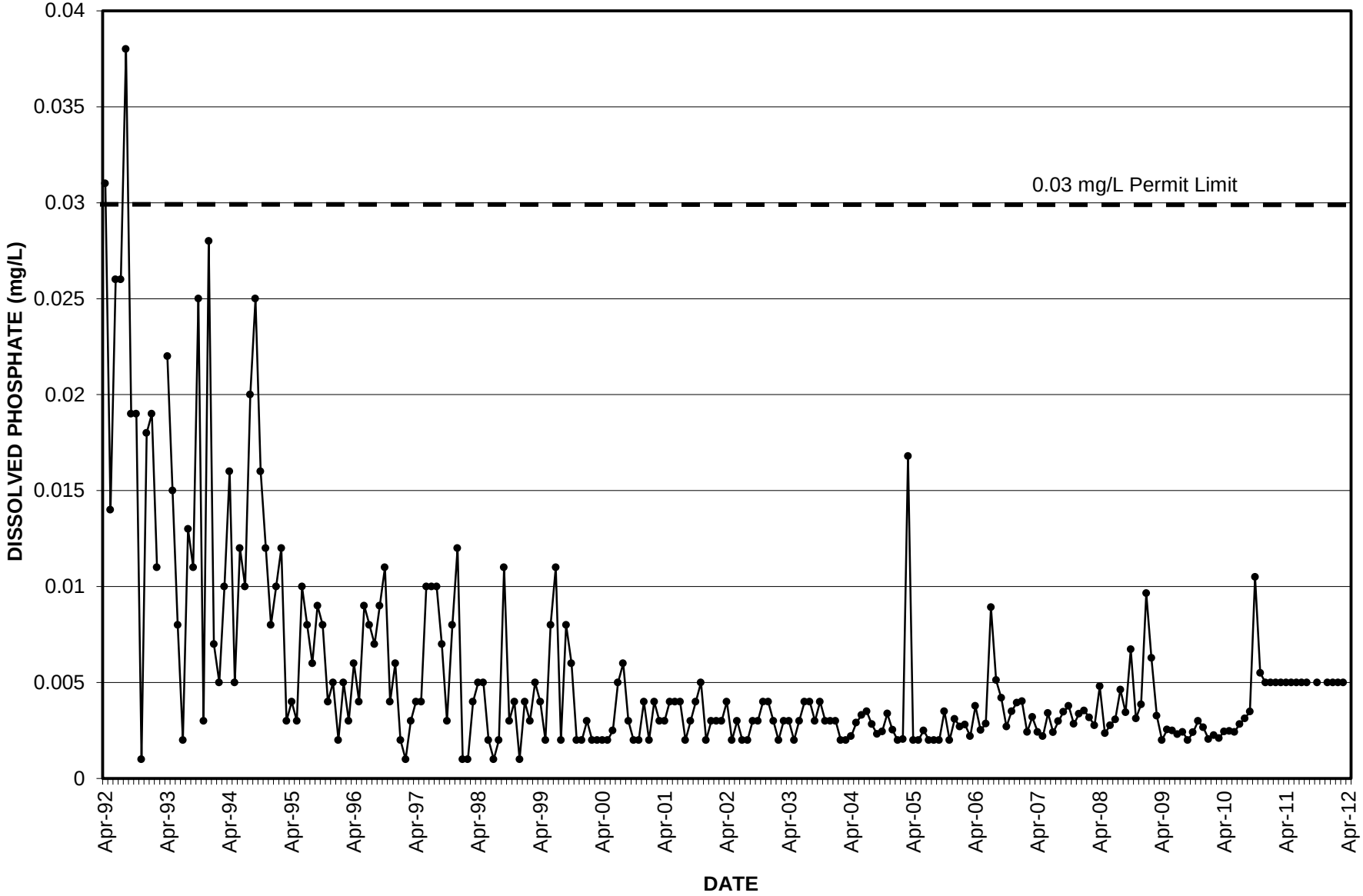


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 25

DISSOLVED PHOSPHOROUS

SETTLING POND 1

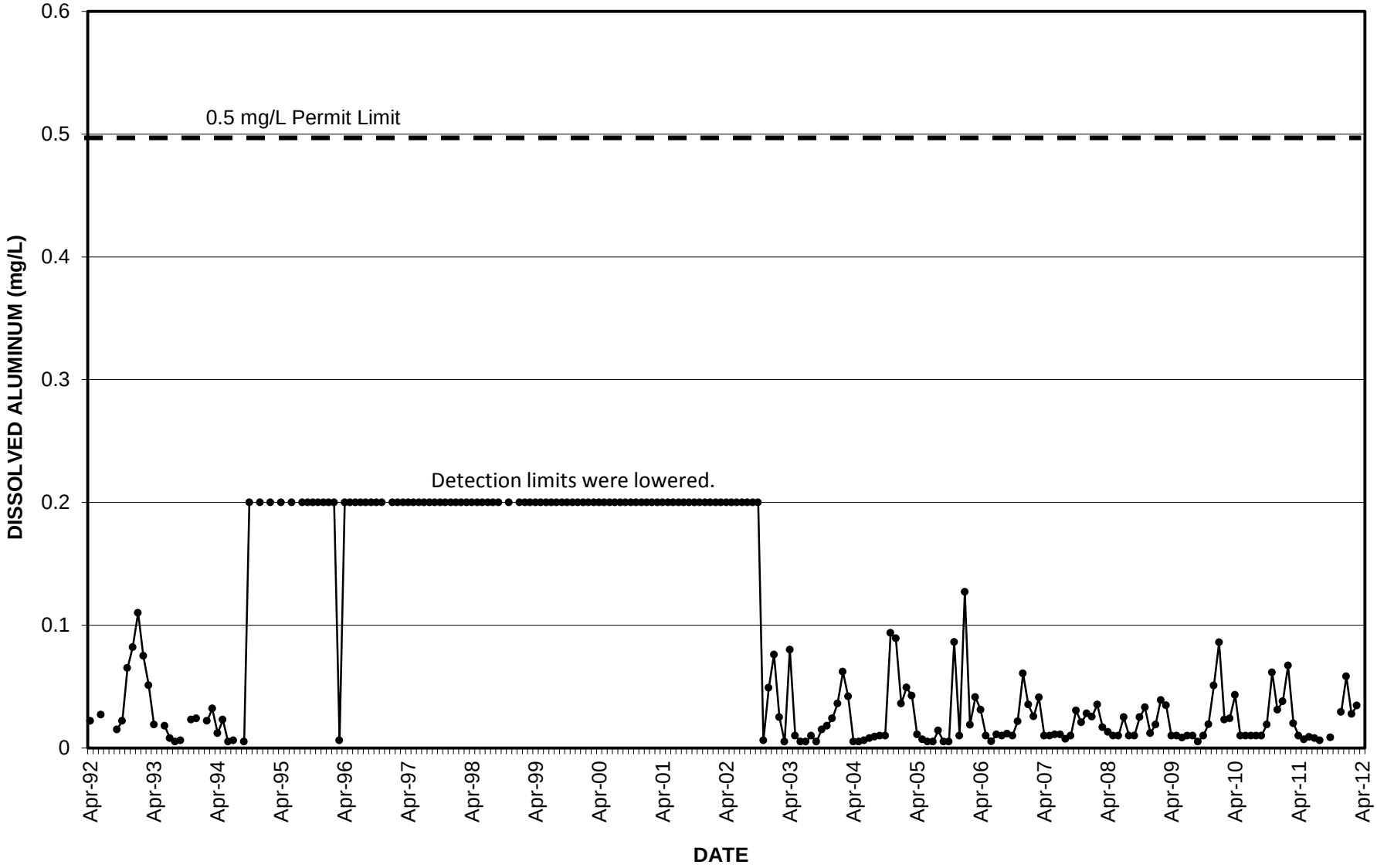


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 26

DISSOLVED ALUMINUM

SETTLING POND 1

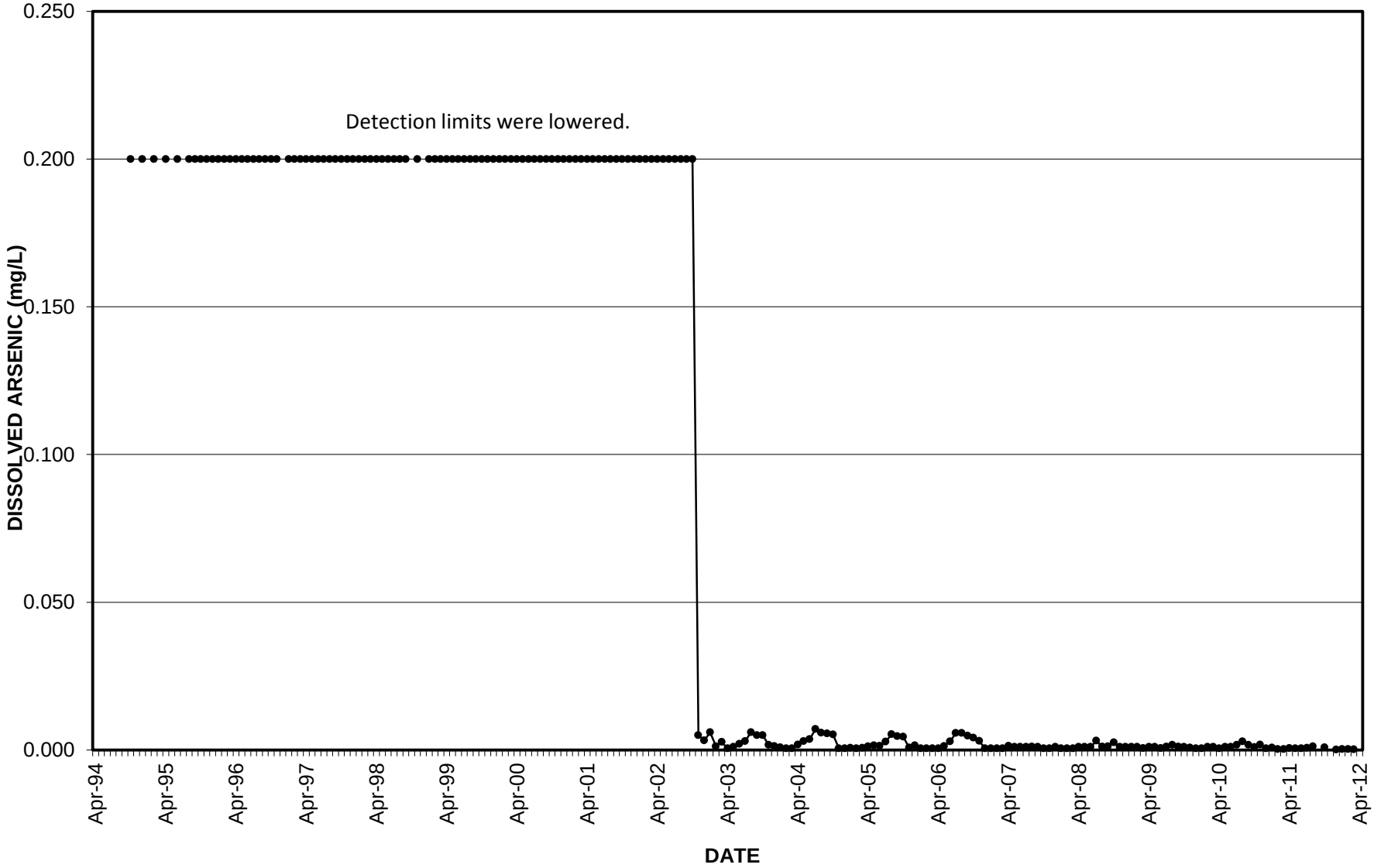


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 27

DISSOLVED ARSENIC

SETTLING POND 1

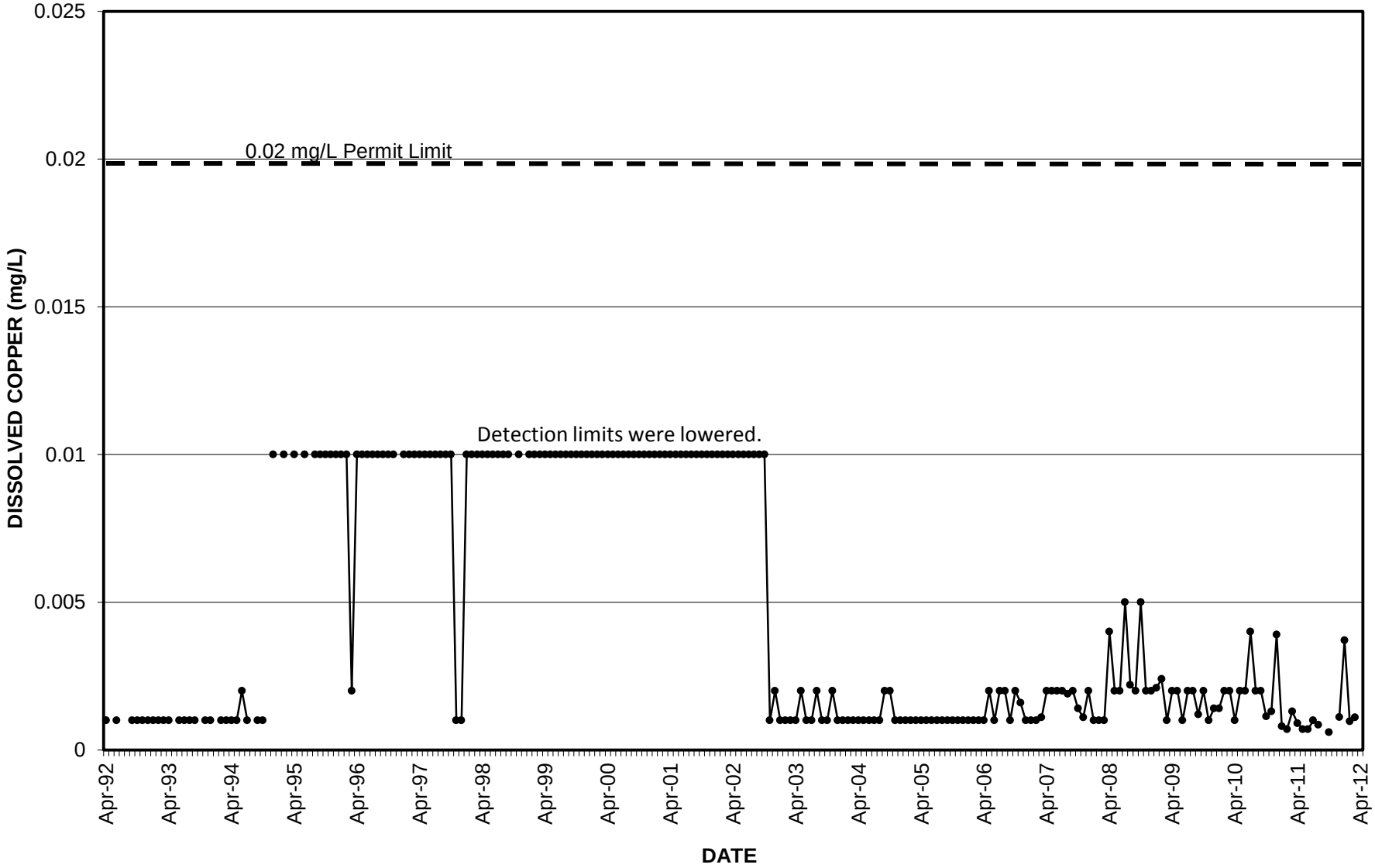


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 28

DISSOLVED COPPER

SETTLING POND 1

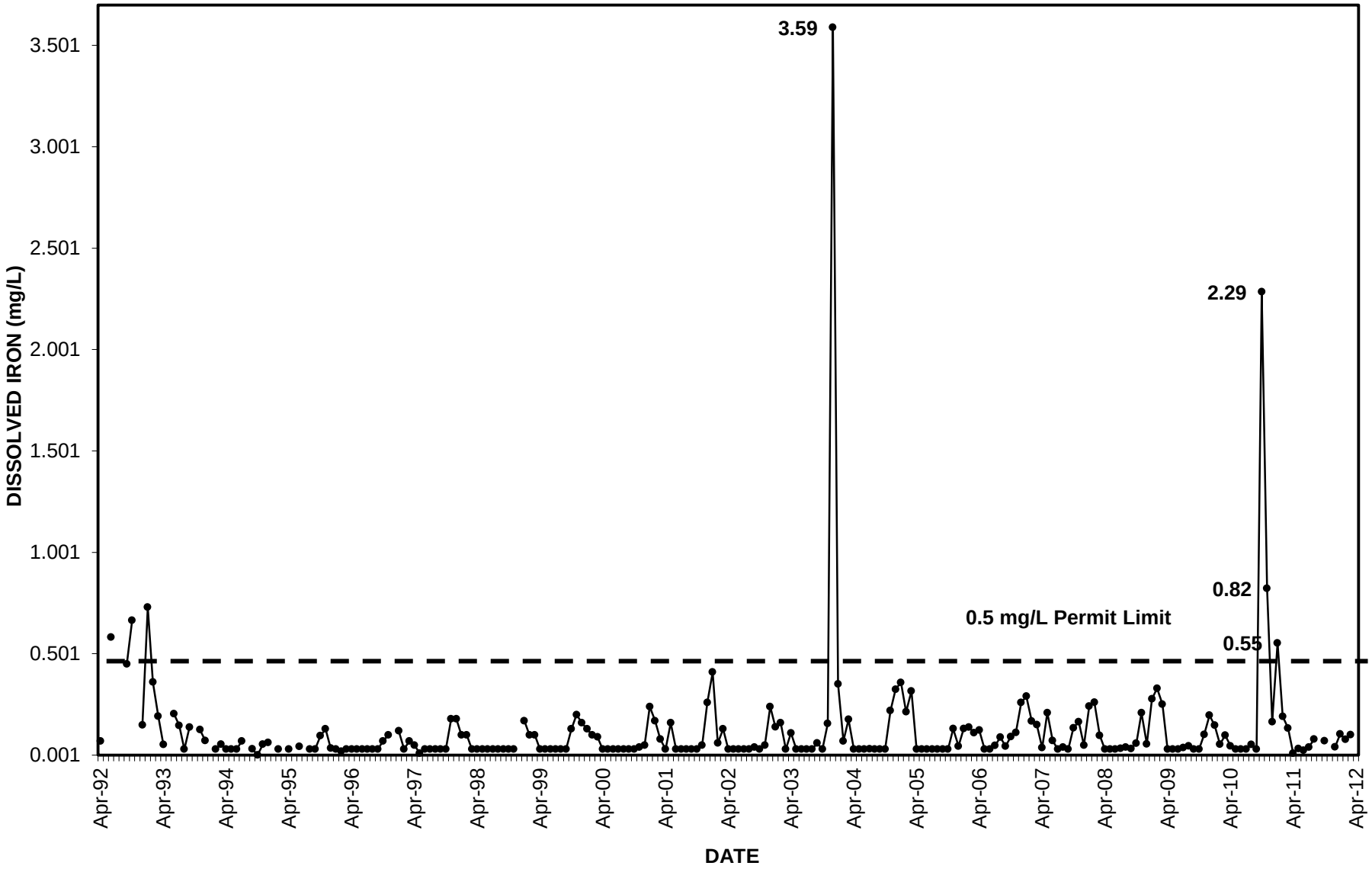


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 29

DISSOLVED IRON

SETTLING POND 1

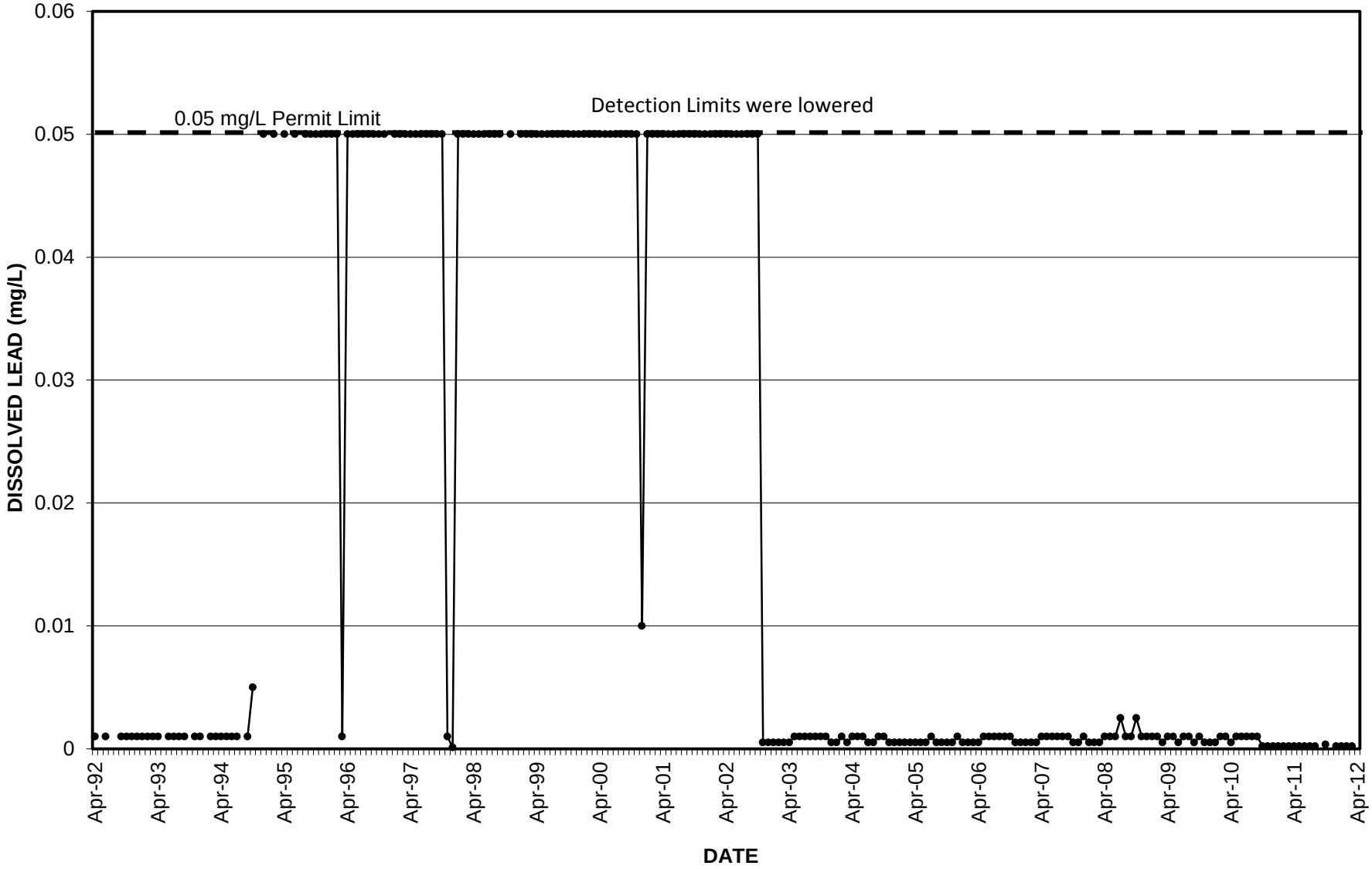


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 30

DISSOLVED LEAD

SETTLING POND 1

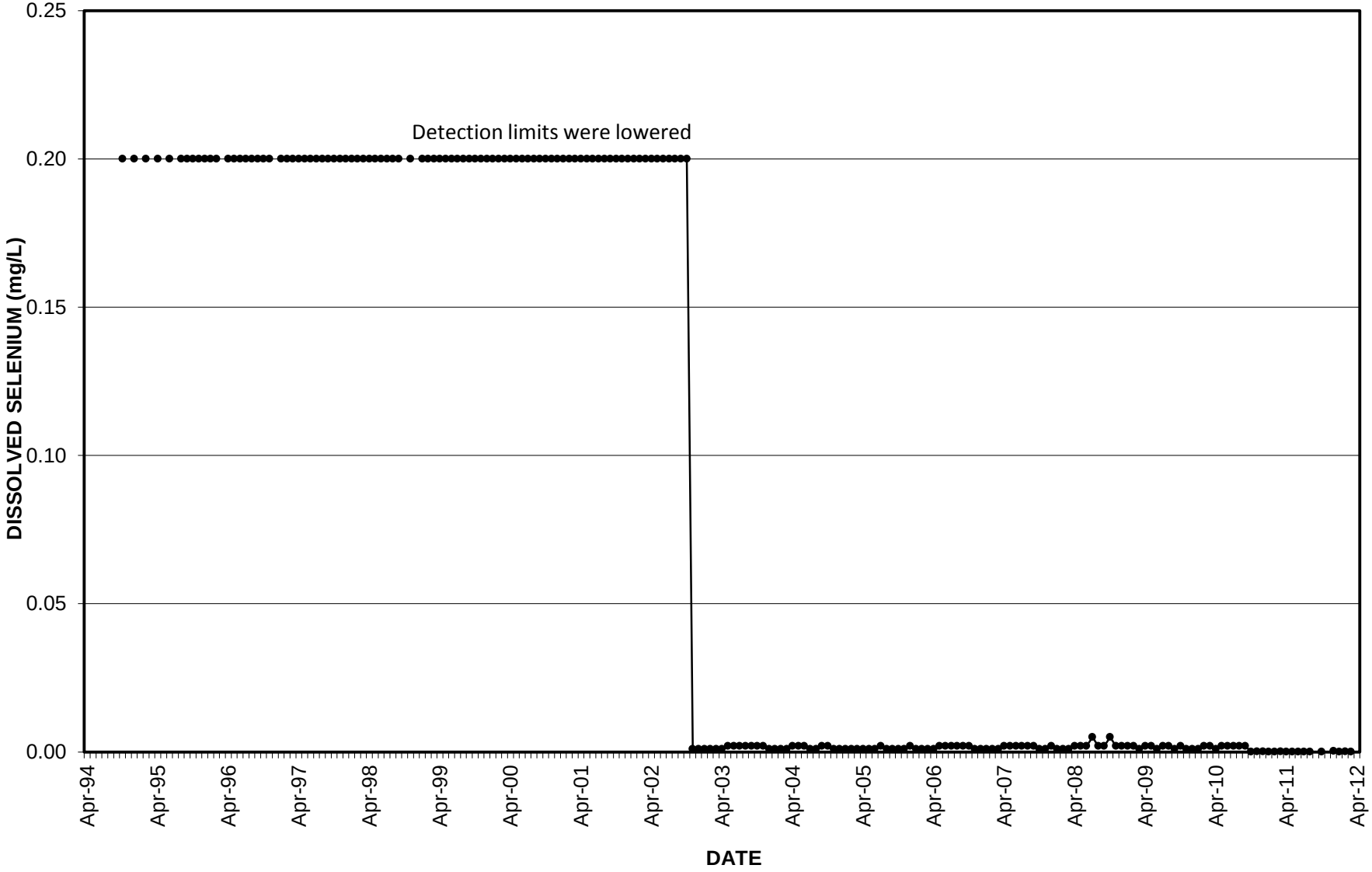


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 31

DISSOLVED SELENIUM

SETTLING POND 1

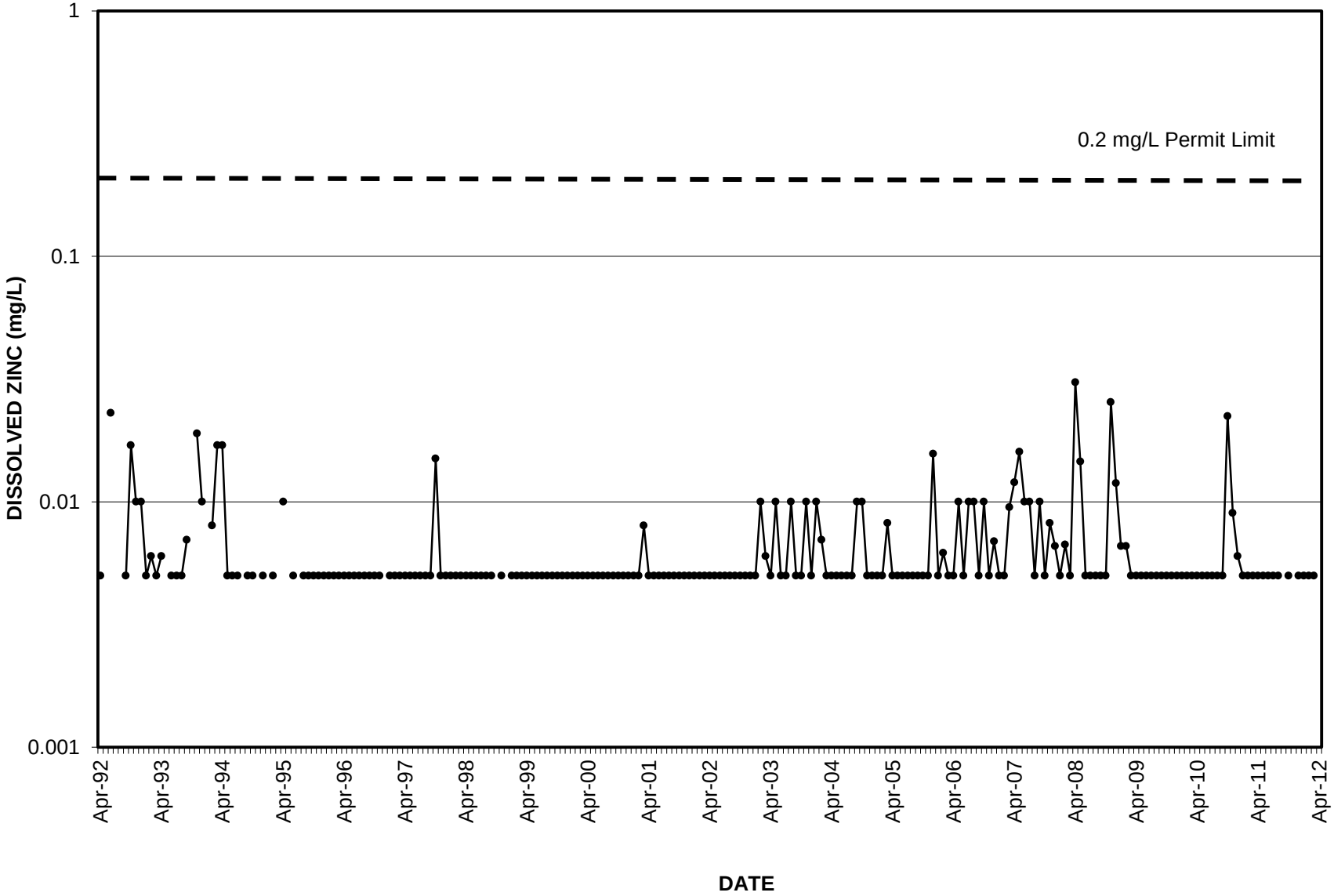


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 32

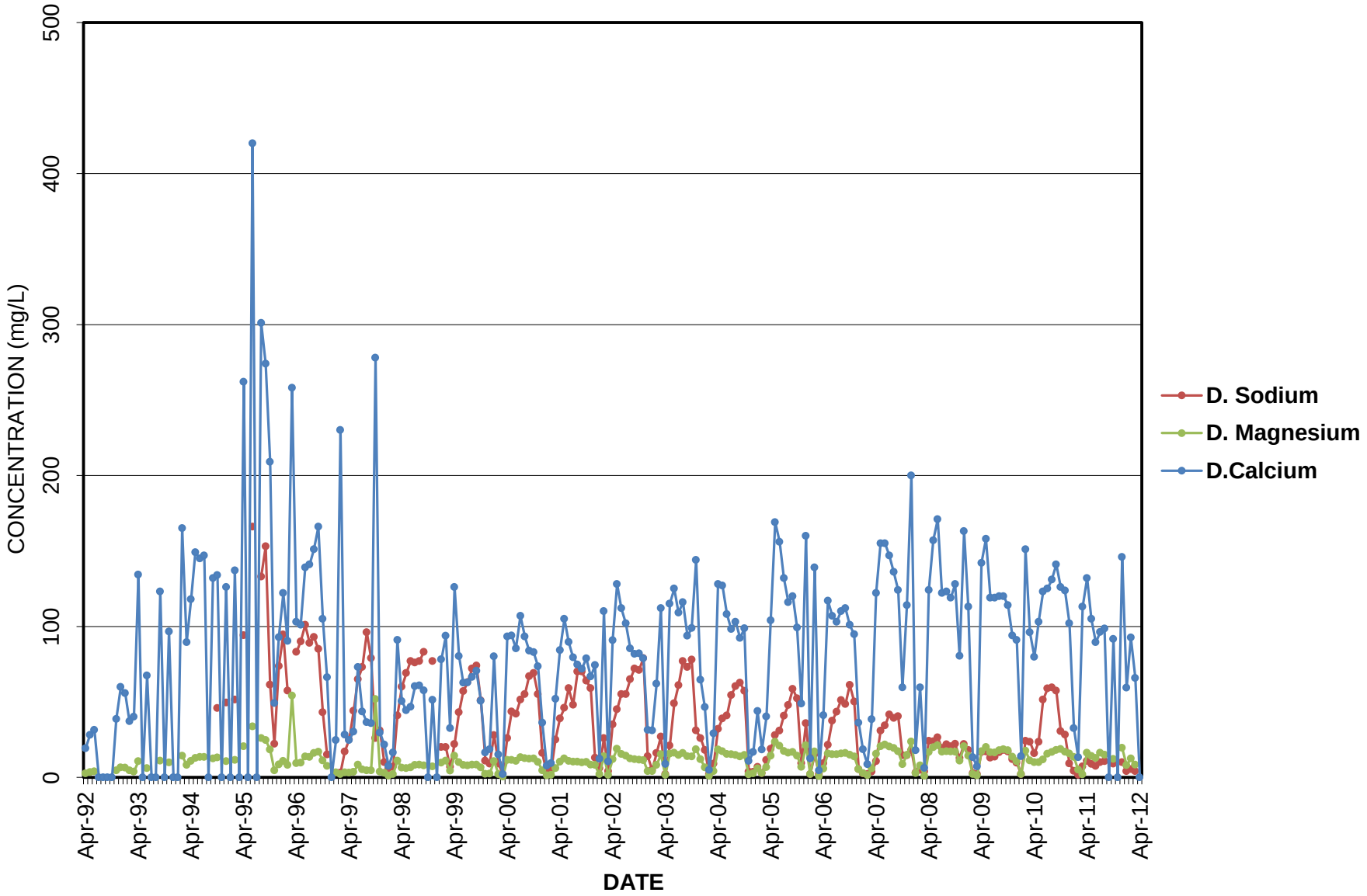
DISSOLVED ZINC

SETTLING POND 1



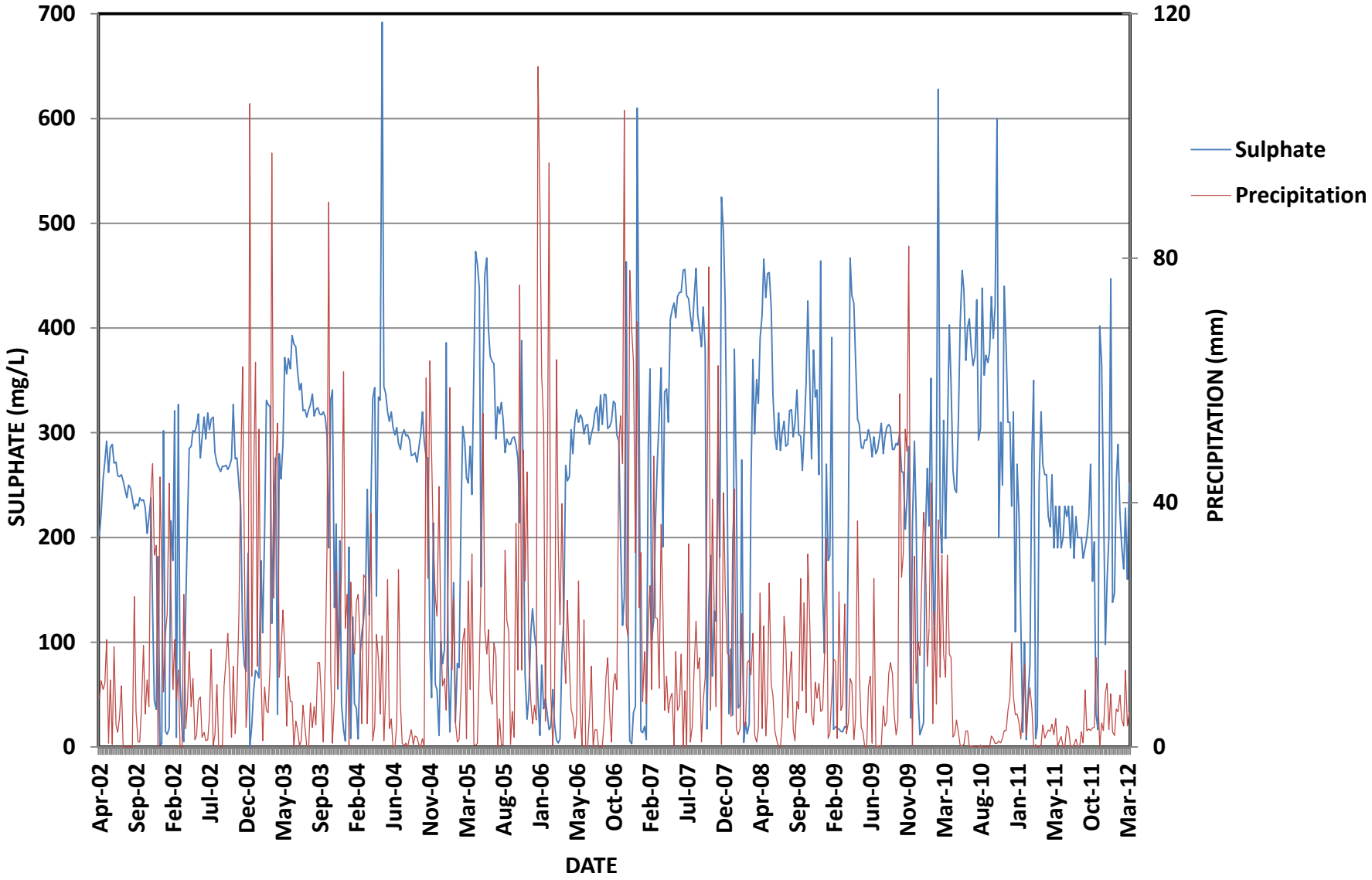
Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 33
DISSOLVED CALCIUM/MAGNESIUM/SODIUM
SETTLING POND 1



Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 34
PRECIPITATION/SULPHATE
SETTLING POND 1

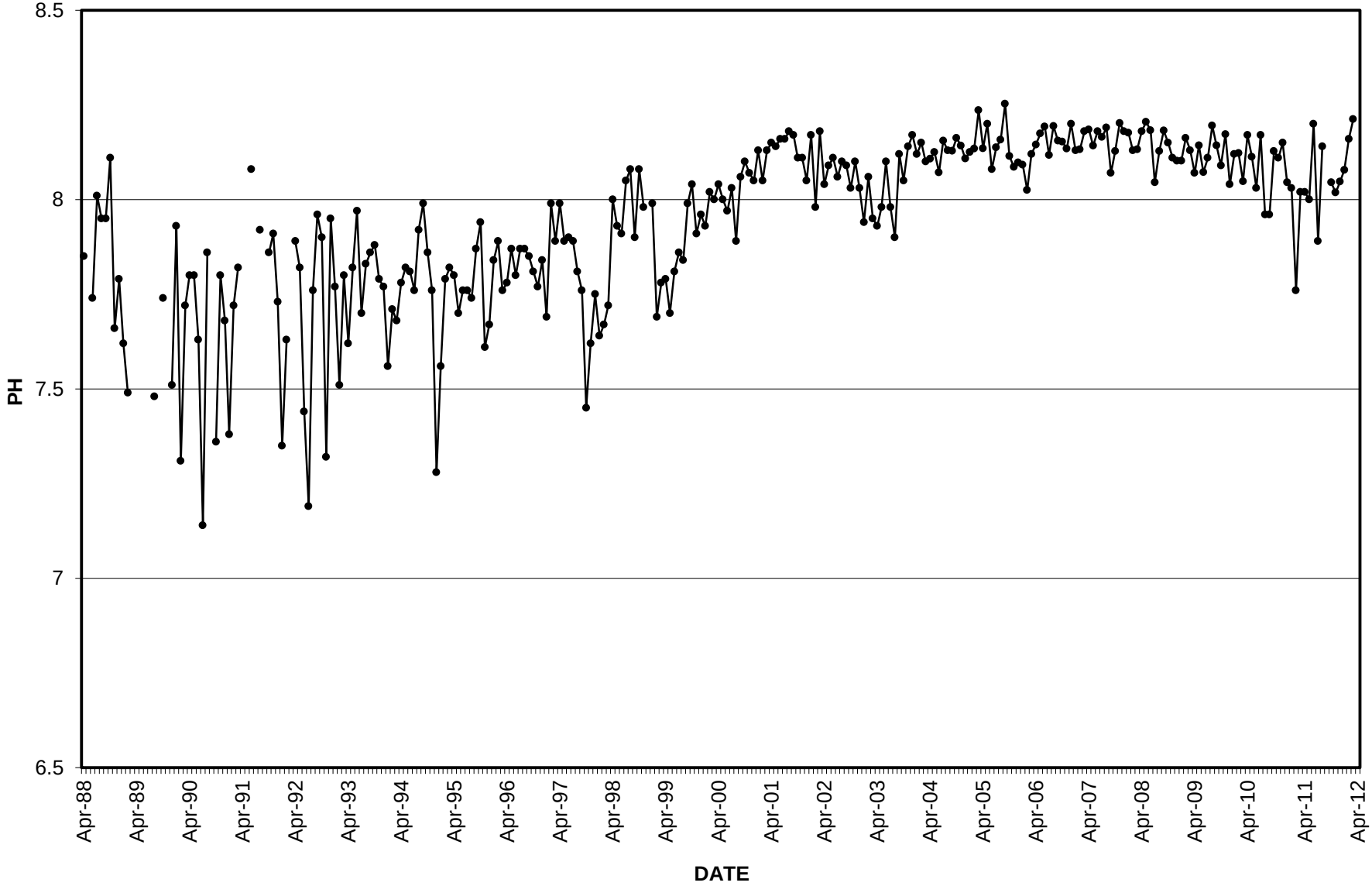


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 35

PH

NORTH PIT SUMP (WP)

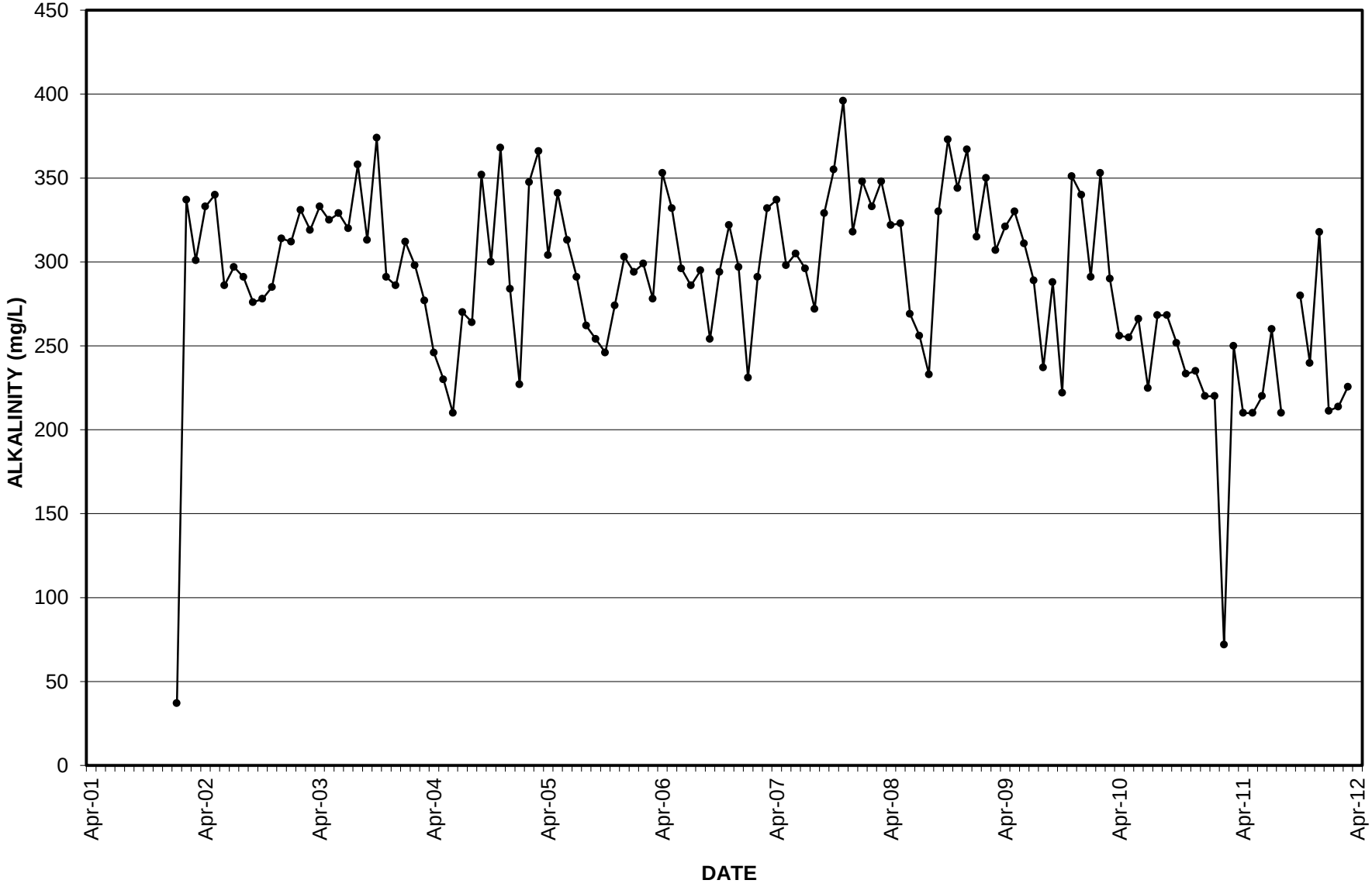


Data points are monthly averages.

GRAPH 36

ALKALINITY

NORTH PIT SUMP (WP)

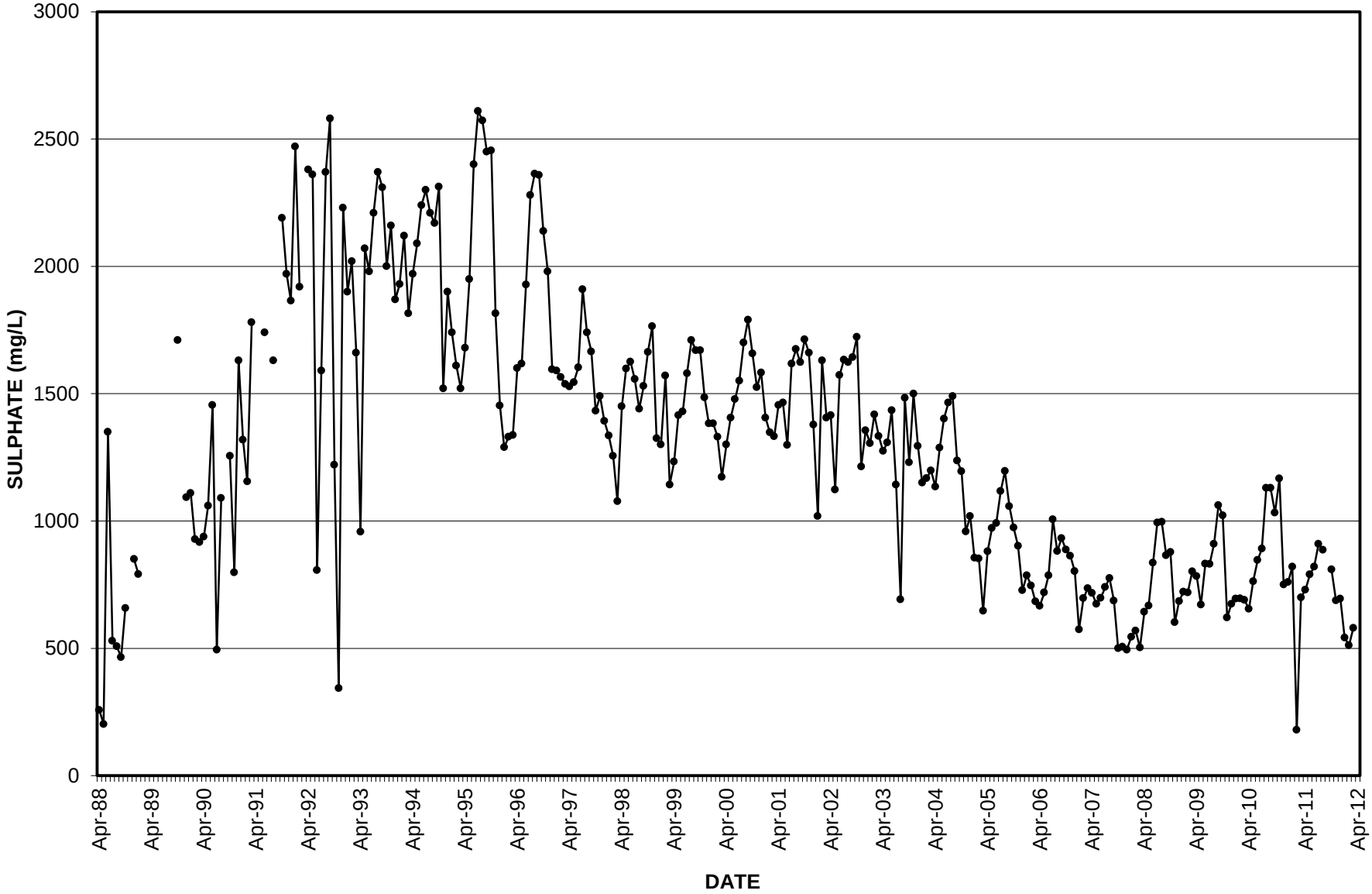


Data points are monthly averages.

GRAPH 37

SULPHATE

NORTH PIT SUMP (WP)

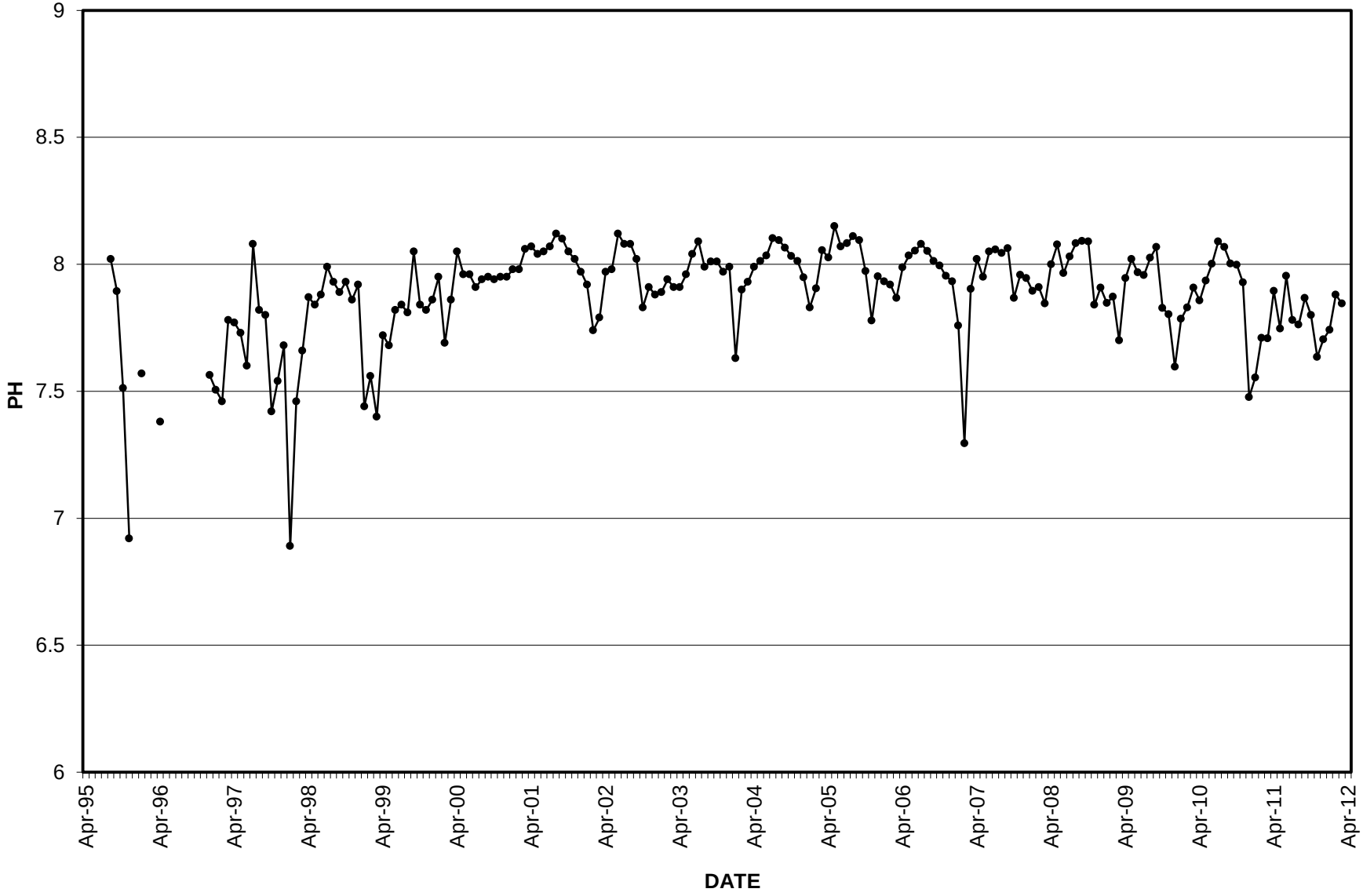


Data points are monthly averages.

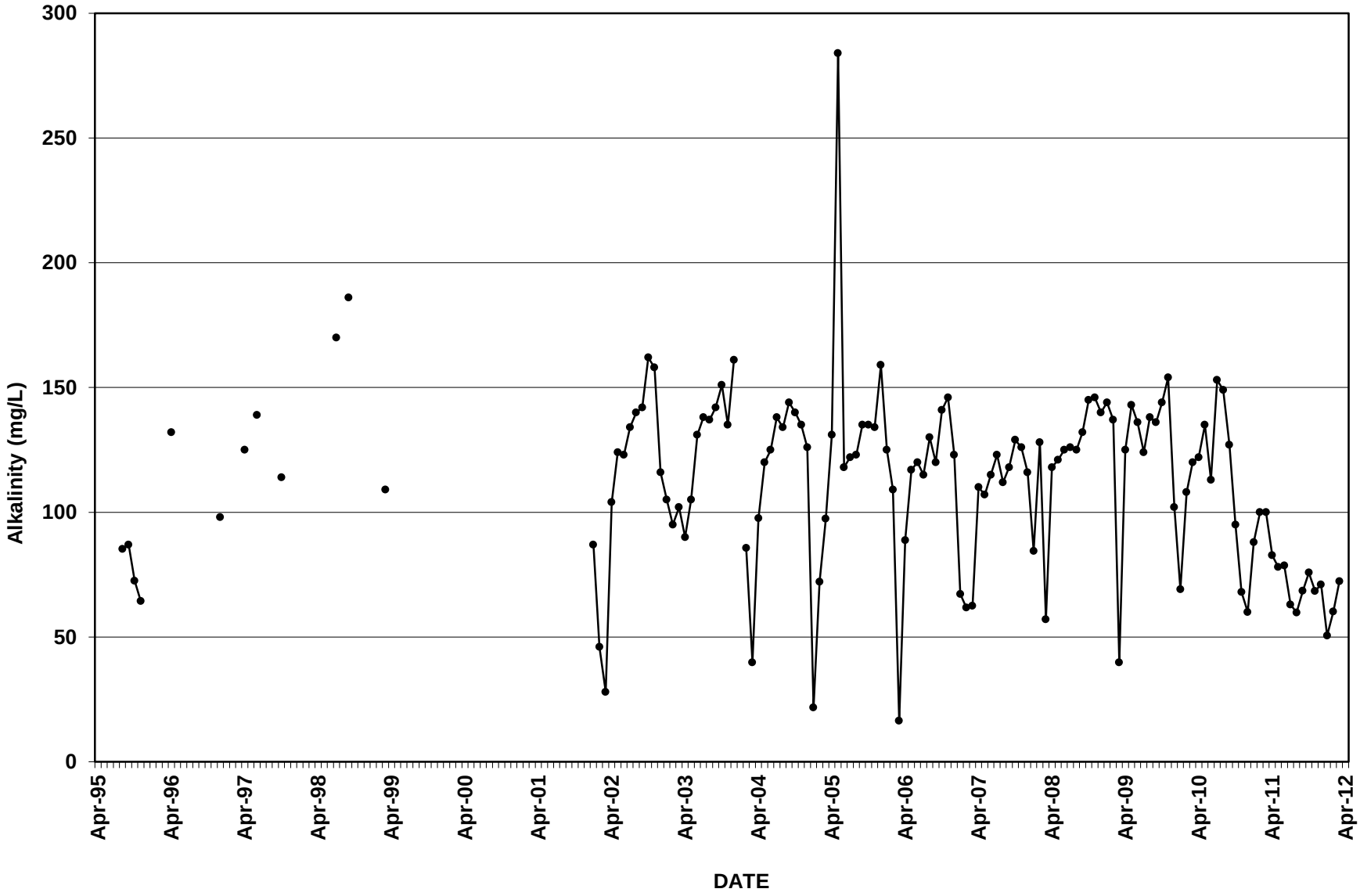
GRAPH 38

PH

3 SOUTH PIT



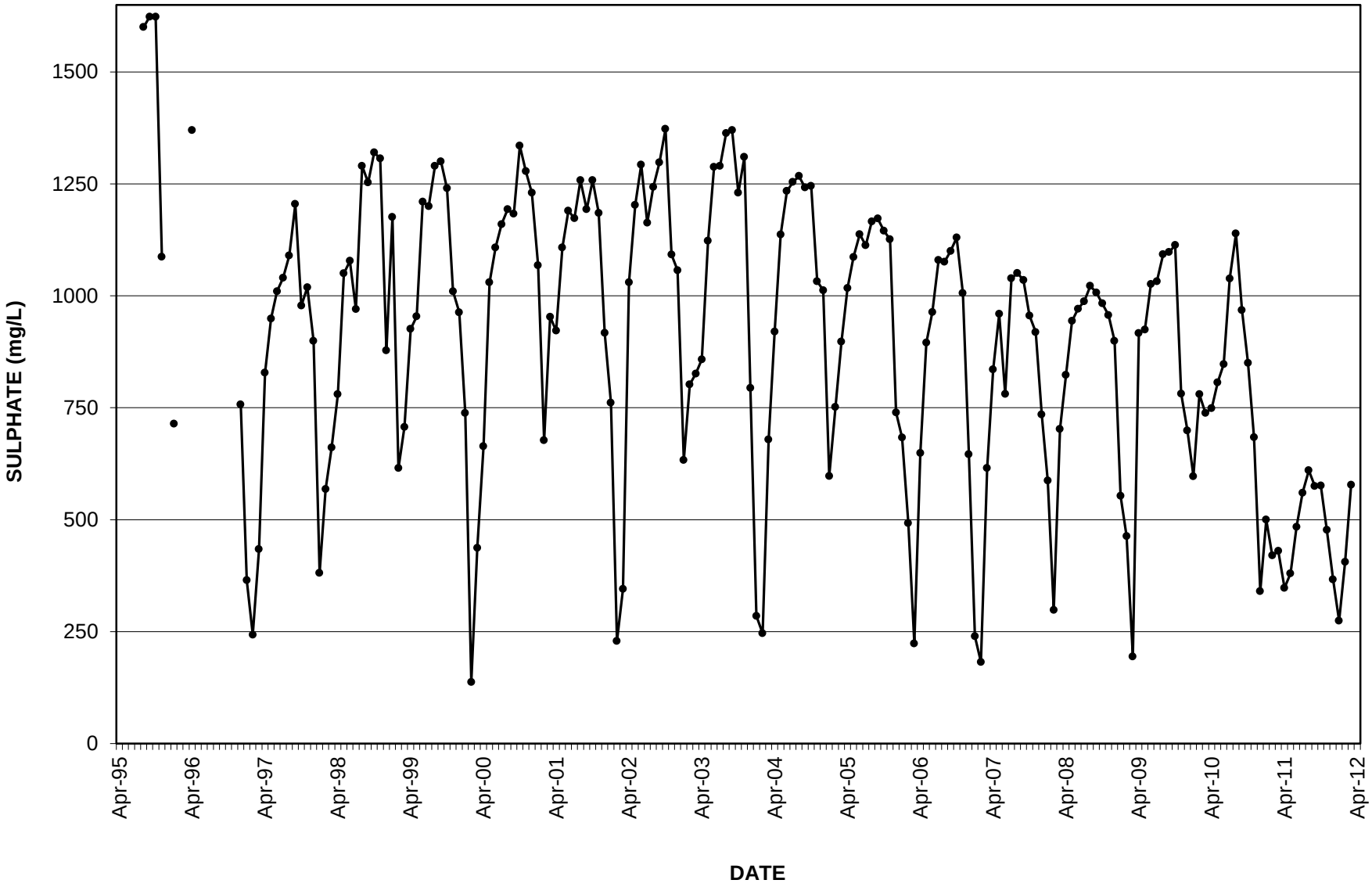
GRAPH 39
Alkalinity
3 SOUTH PIT



GRAPH 40

SULPHATE

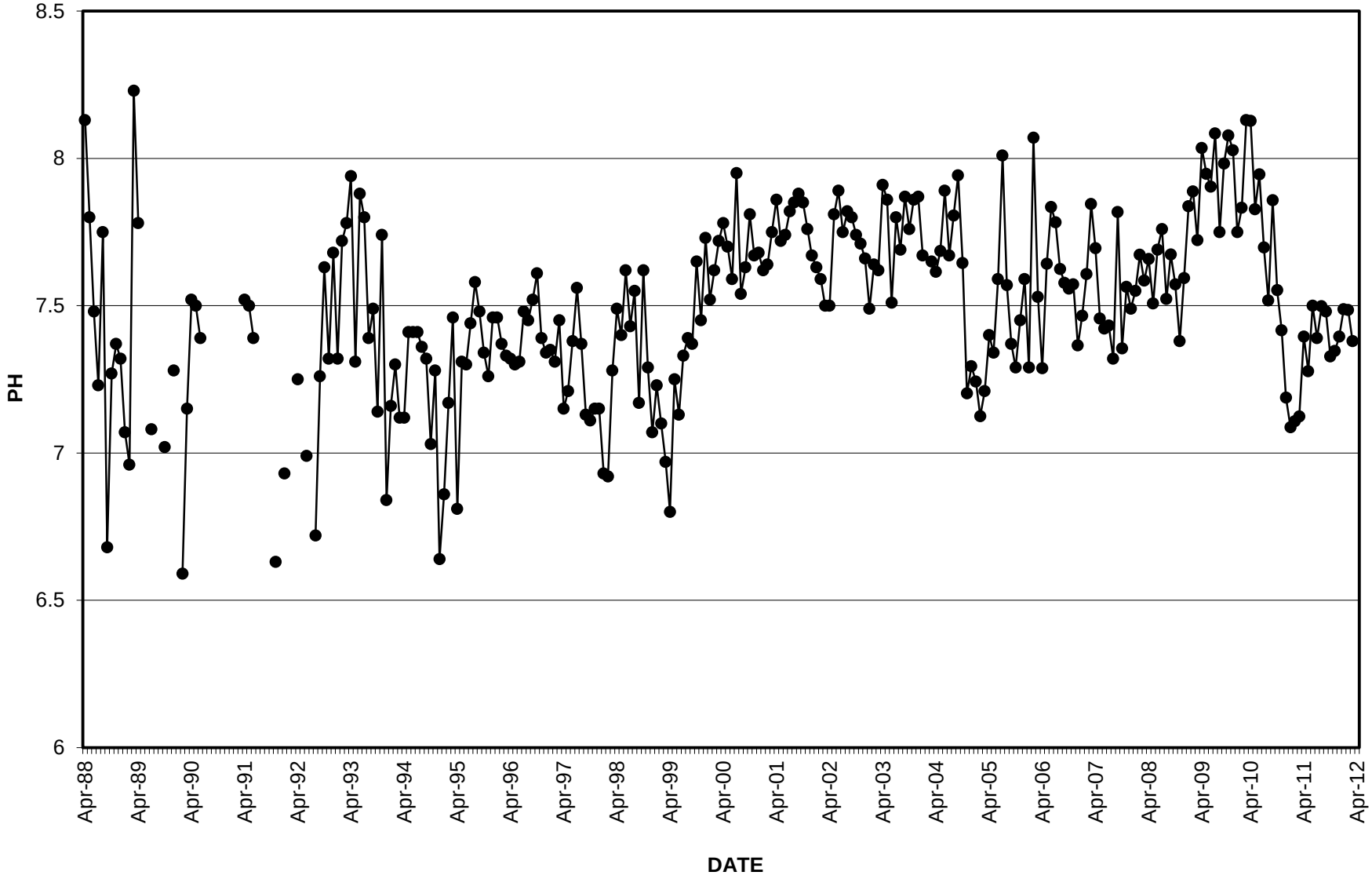
3 SOUTH PIT



GRAPH 41

pH

MIDDLE QUINSAM LAKE INLET (WA)

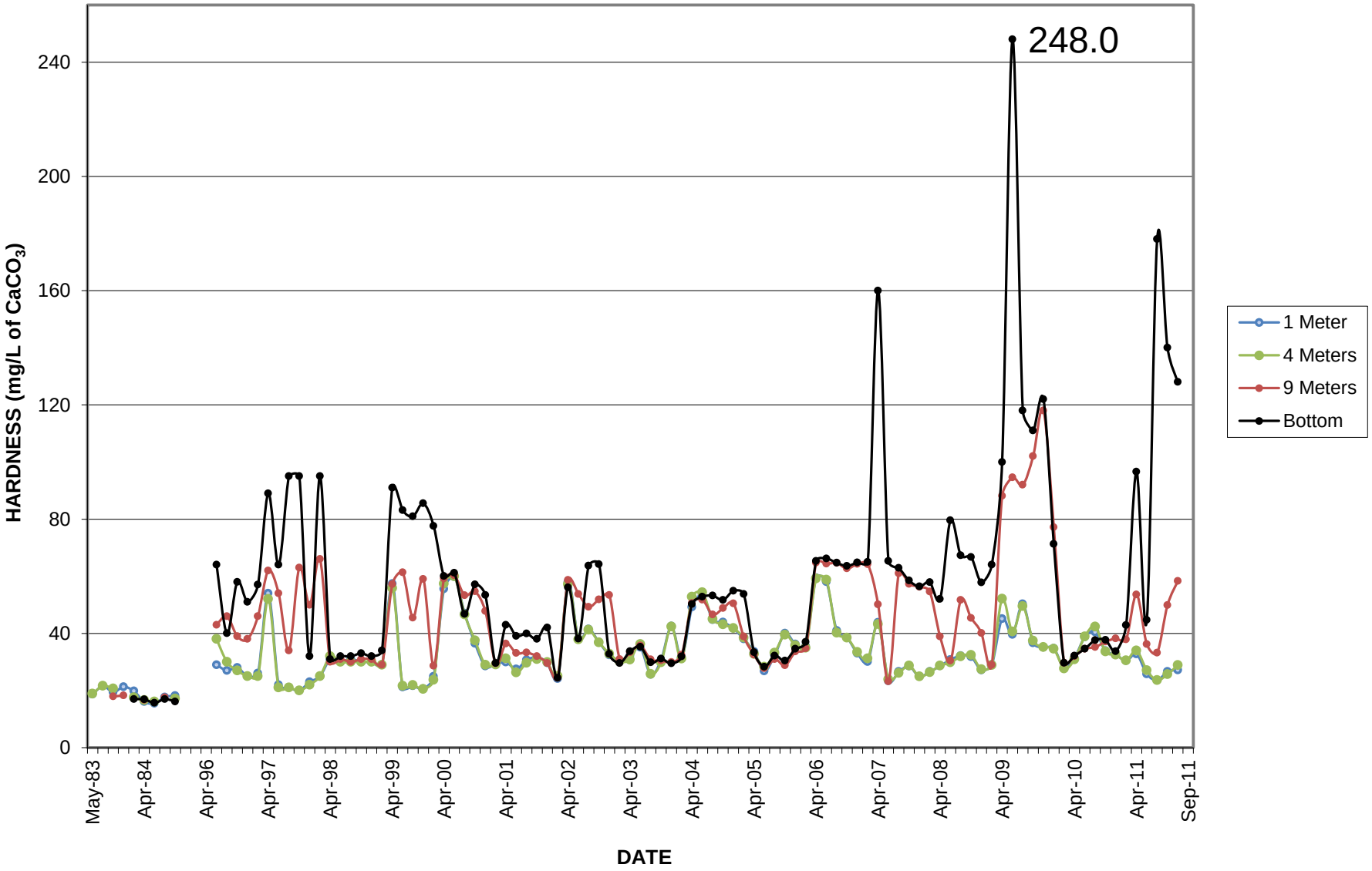


Data point are monthly averages.

GRAPH 42

MIDDLE QUINSAM LAKE

HARDNESS

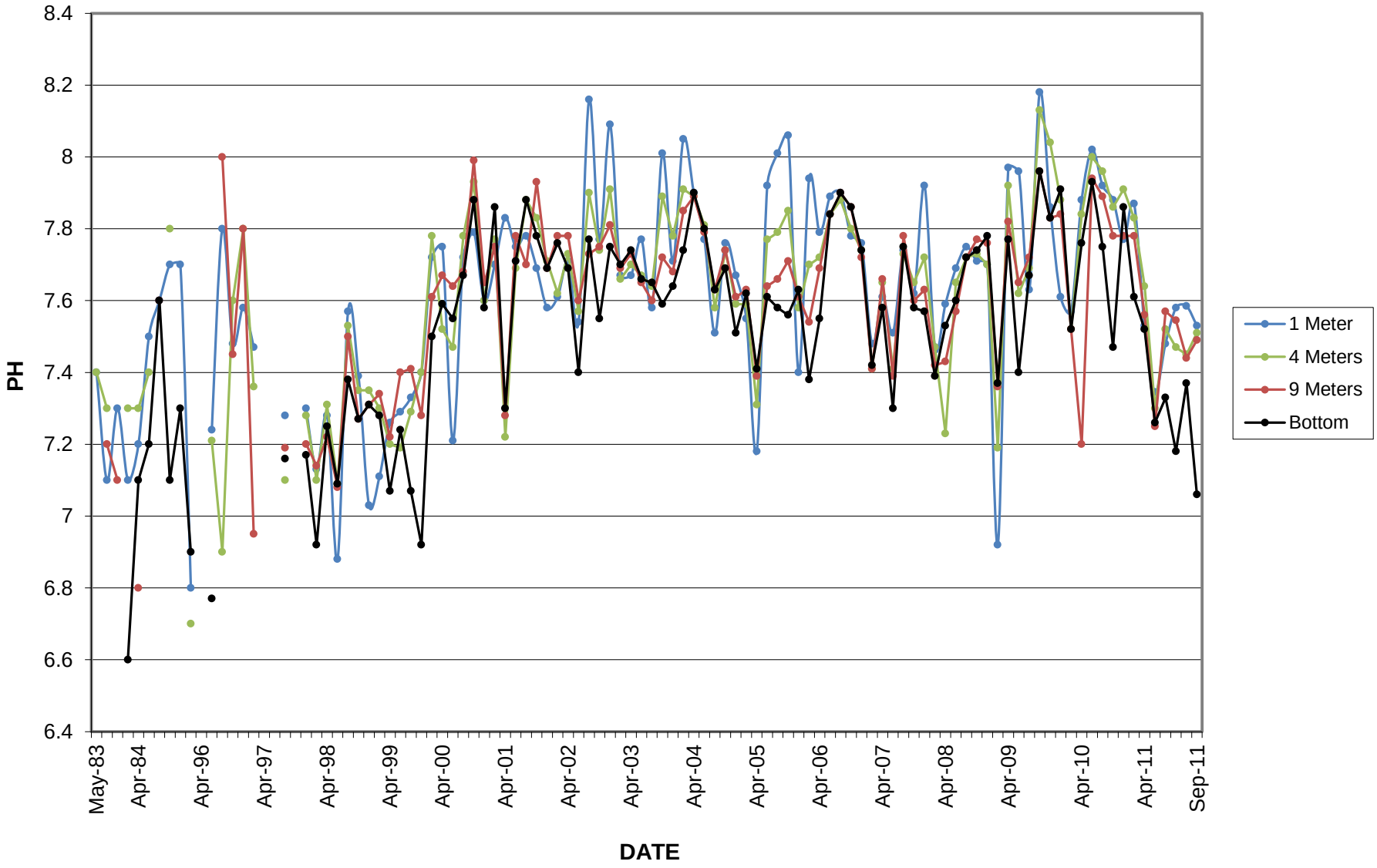


Note: The data for 1 meter depth closely mimics the data for 4 meters.
The line representing the data for 1 meter is mostly obscured
by the line representing the data for 4 meters.

GRAPH 43

MIDDLE QUINSAM LAKE

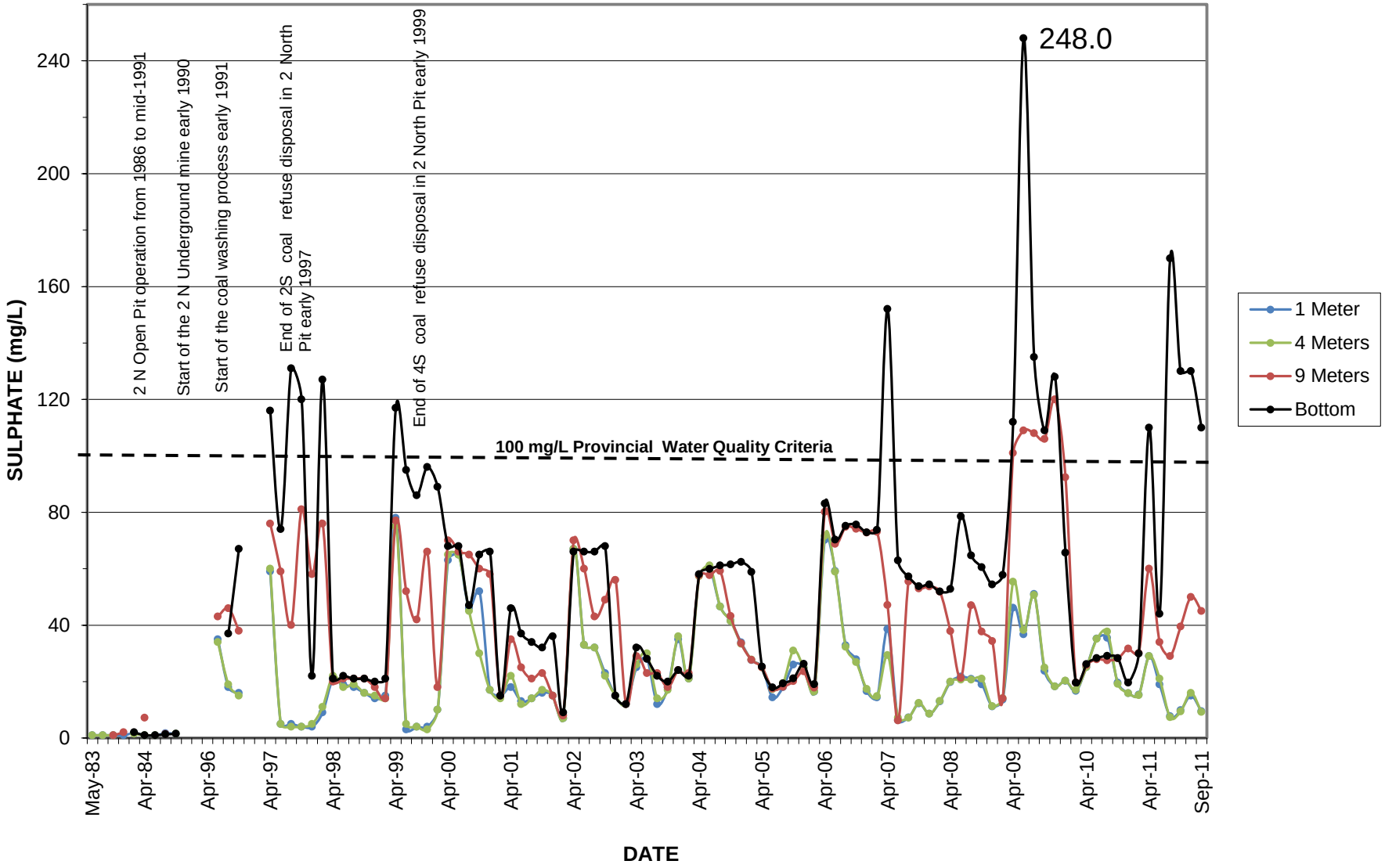
PH



GRAPH 44

MIDDLE QUINSAM LAKE

SULPHATE

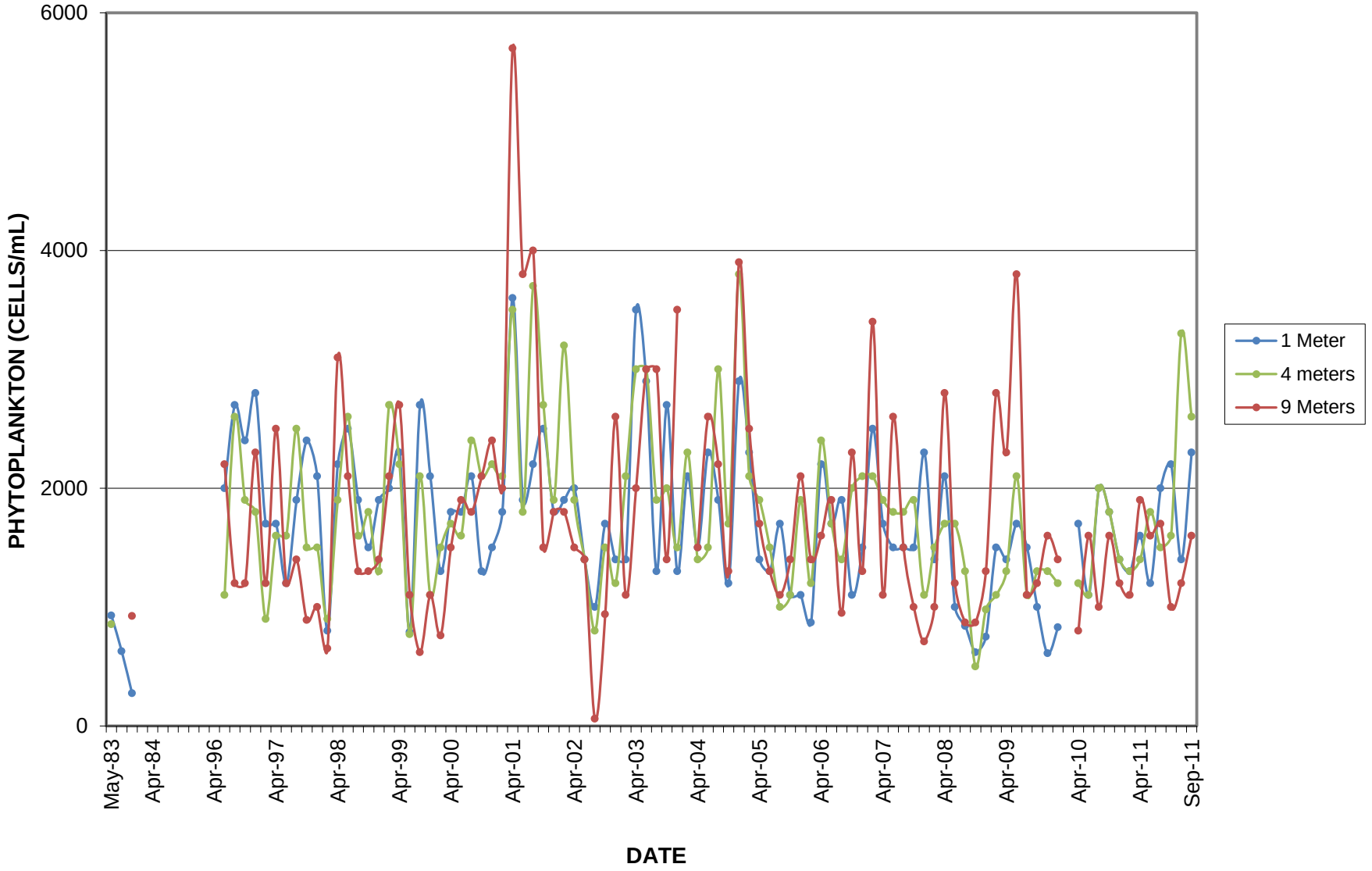


Note: The data for 1 meter depth closely mimics the data for 4 meters.
The line representing the data for 1 meter is mostly obscured
by the line representing the data for 4 meters.

GRAPH 45

MIDDLE QUINSAM LAKE

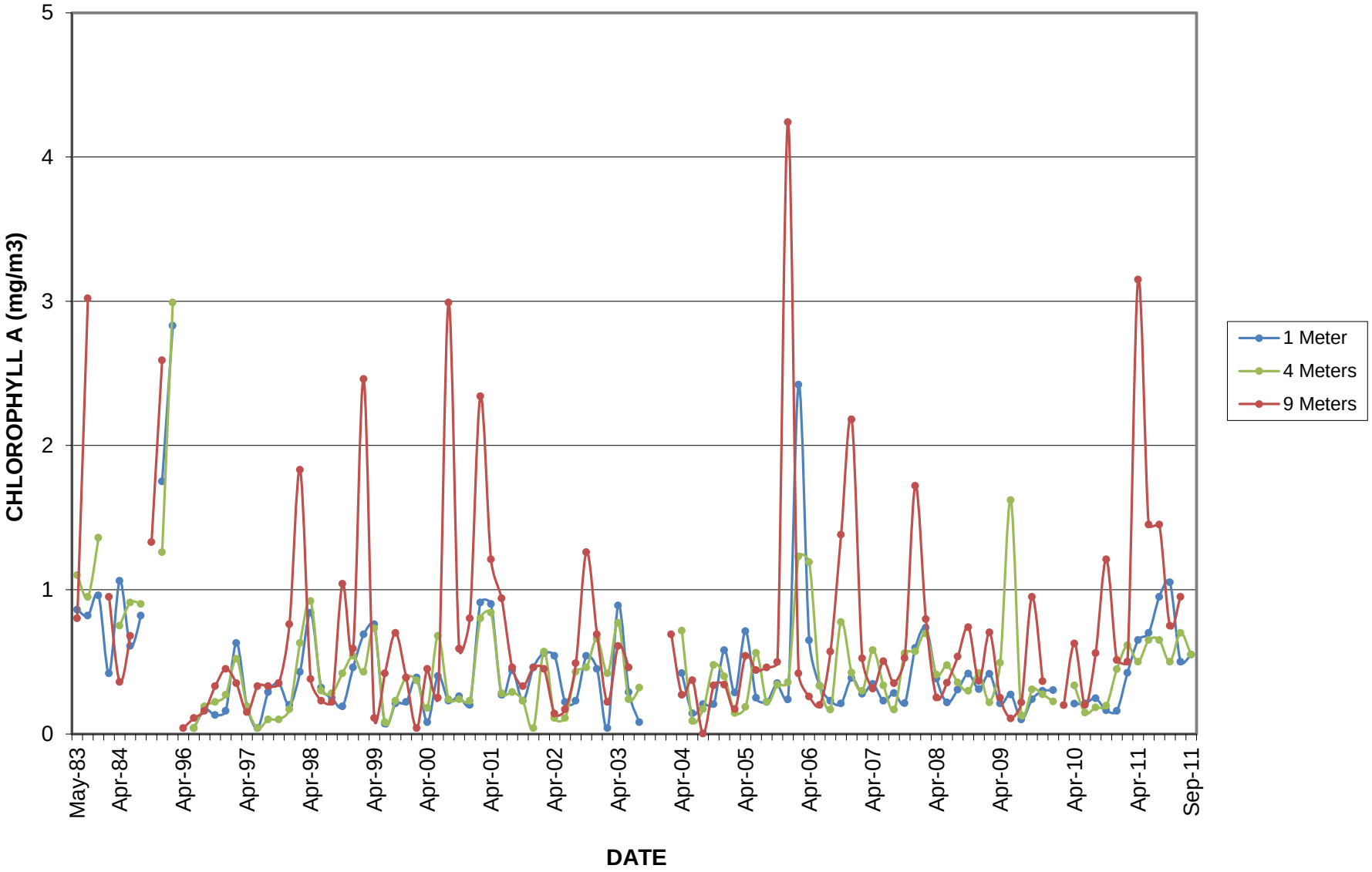
PHYTOPLANKTON ABUNDANCE



GRAPH 46

MIDDLE QUINSAM LAKE

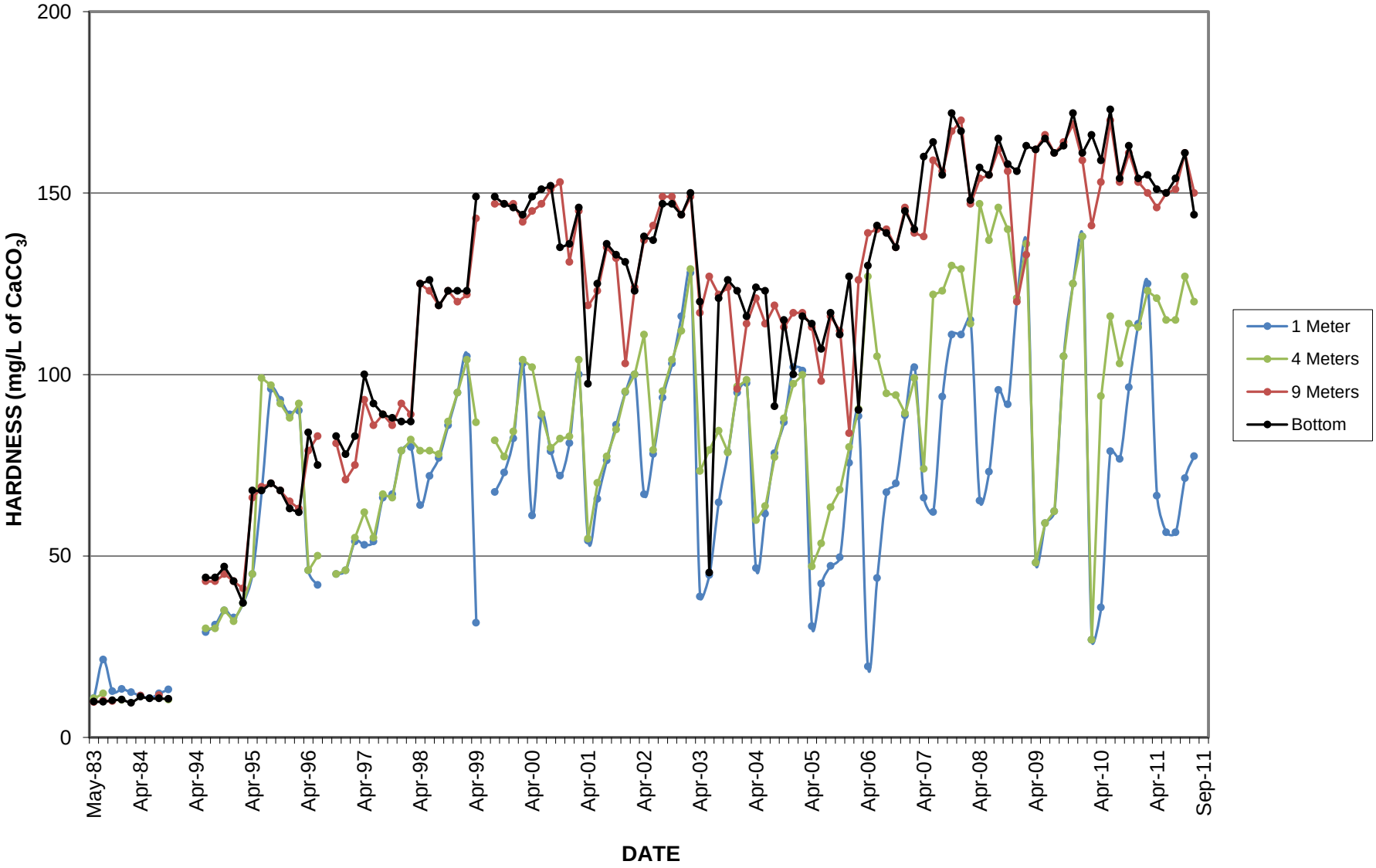
CHLOROPHYLL A



GRAPH 47

LONG LAKE

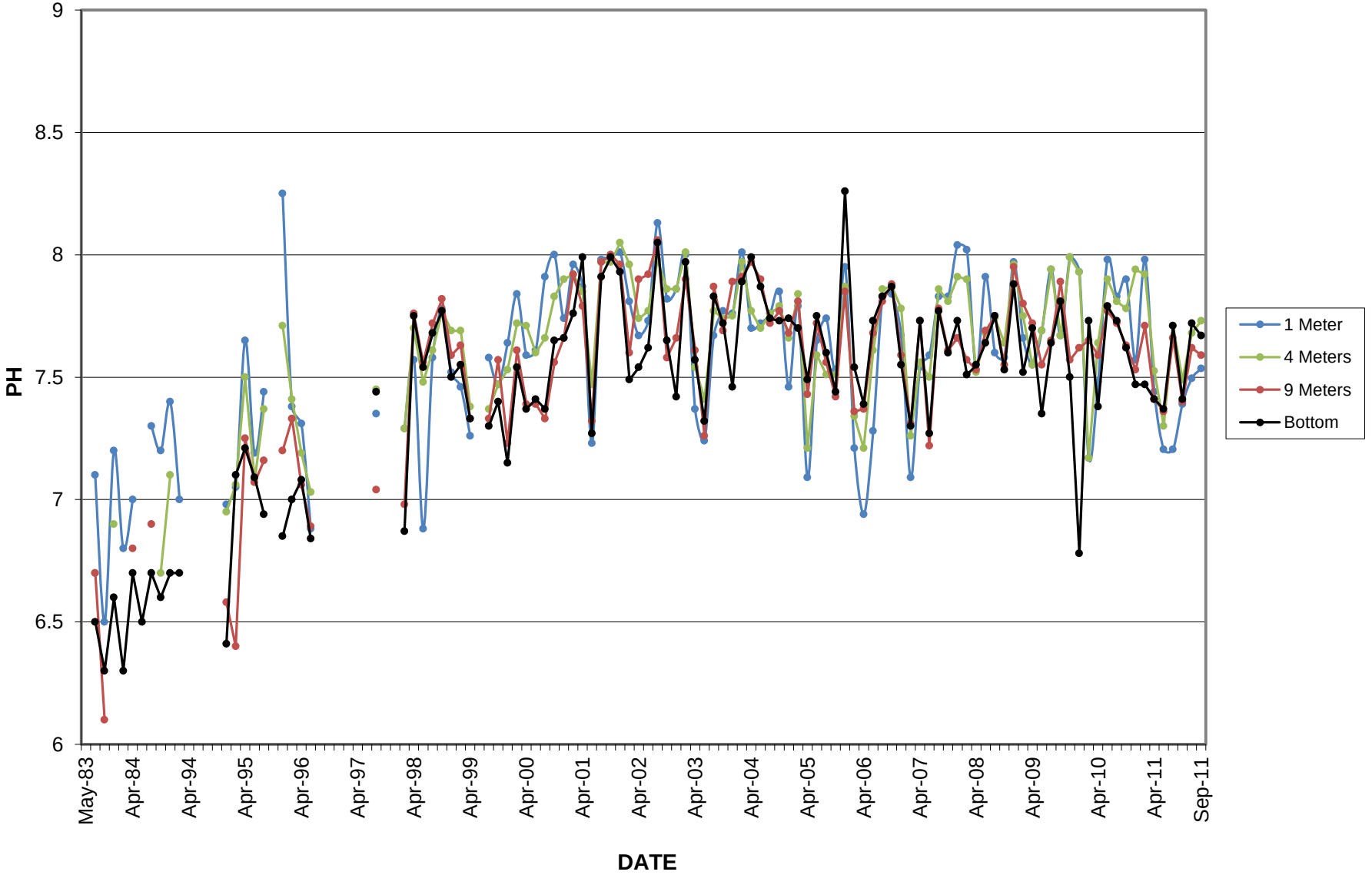
HARDNESS



GRAPH 48

LONG LAKE

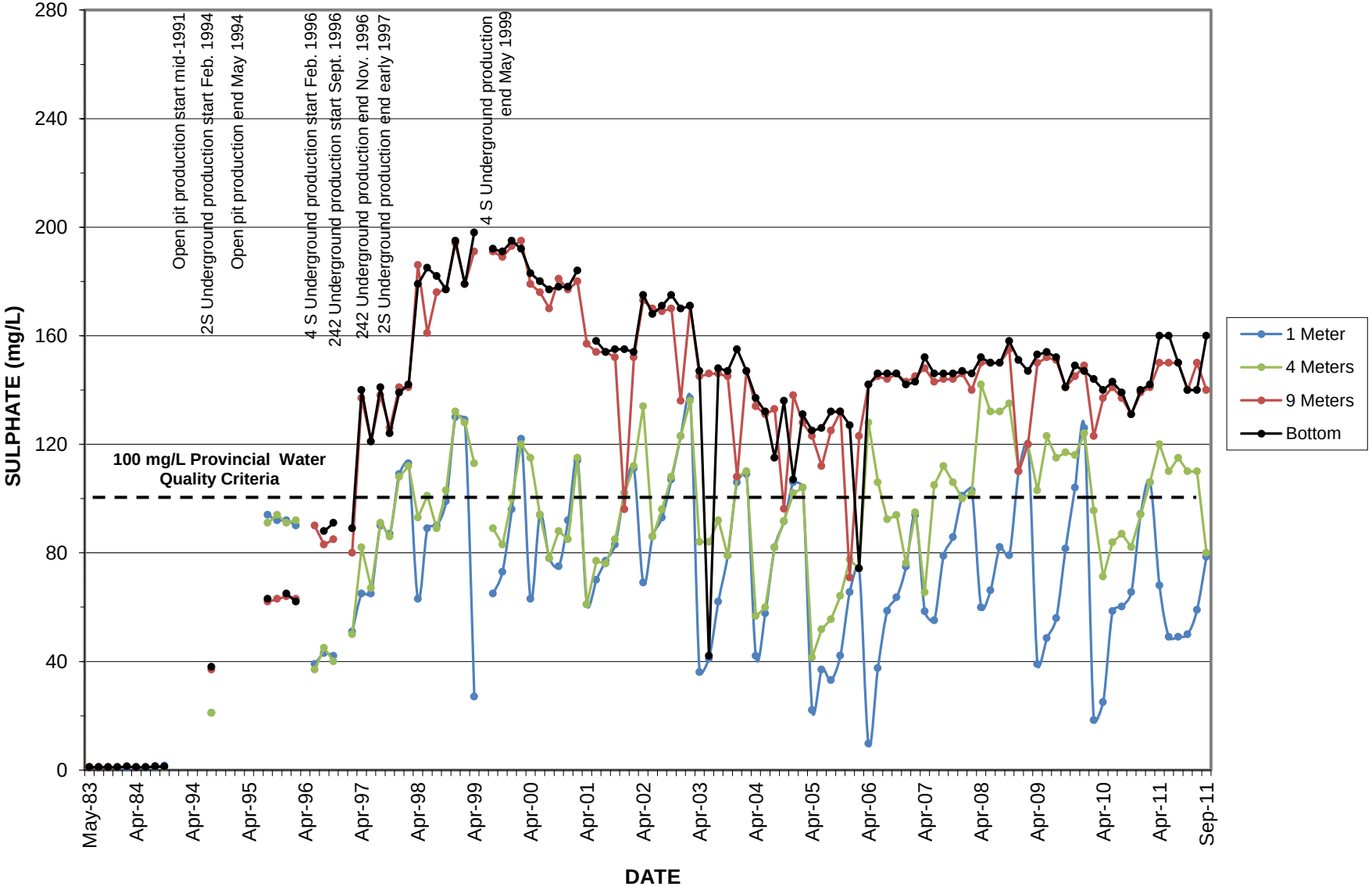
PH



GRAPH 49

LONG LAKE

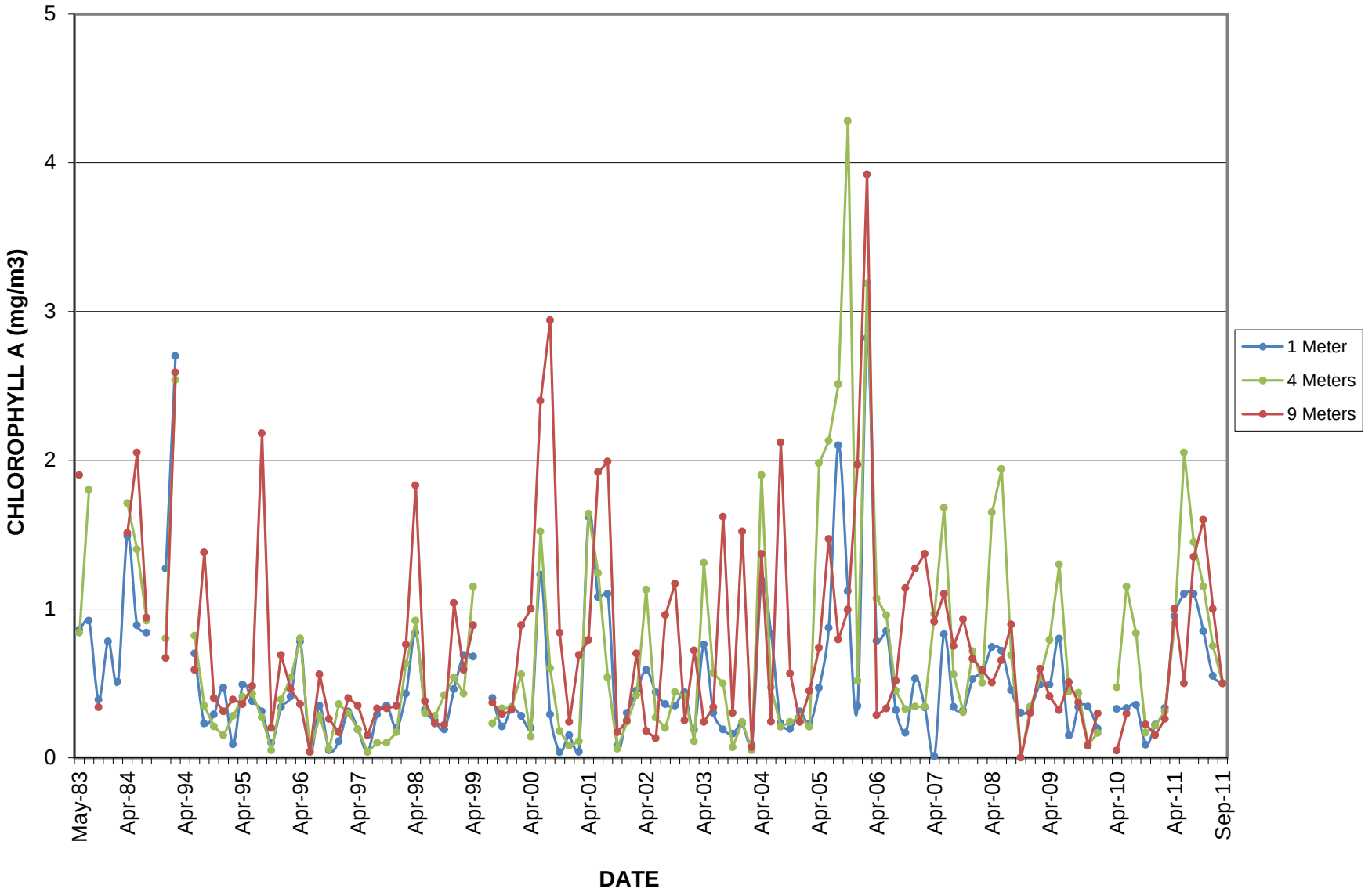
SULPHATE



GRAPH 50

LONG LAKE

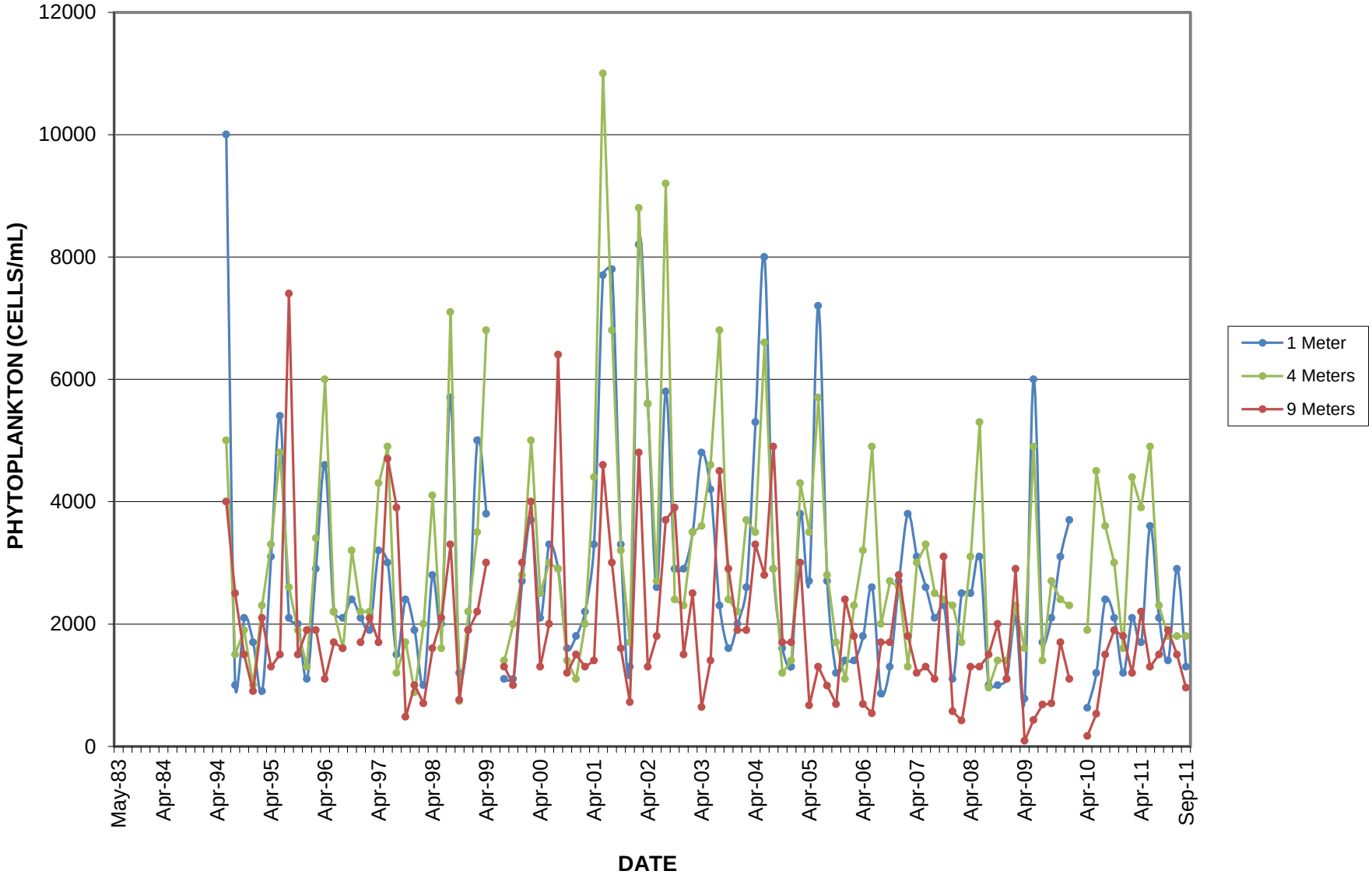
CHLOROPHYLL A



GRAPH 51

LONG LAKE

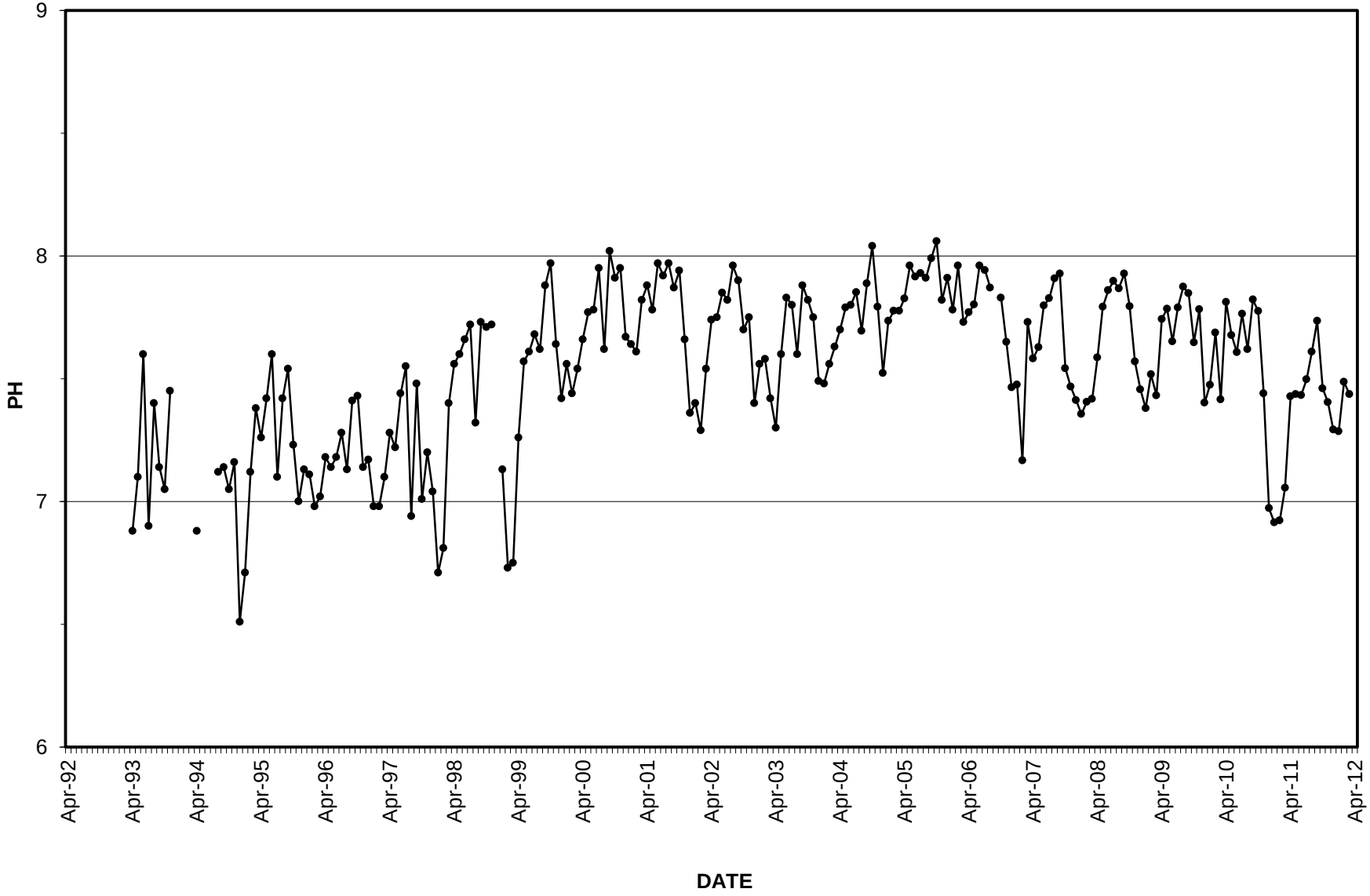
PHYTOPLANKTON ABUNDANCE



GRAPH 52

LONG LAKE OUTLET

PH

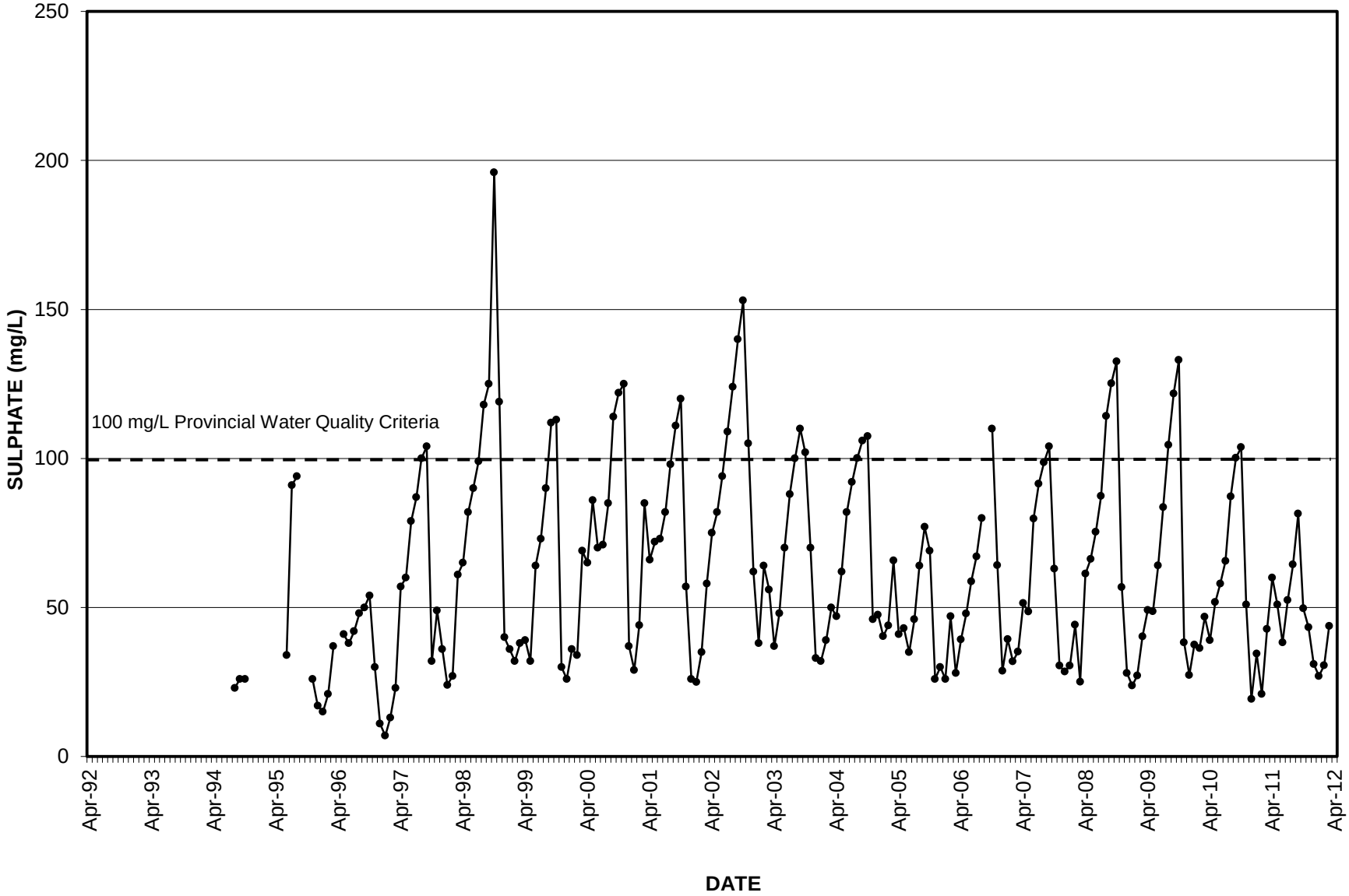


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 53

LONG LAKE OUTLET

SULPHATE

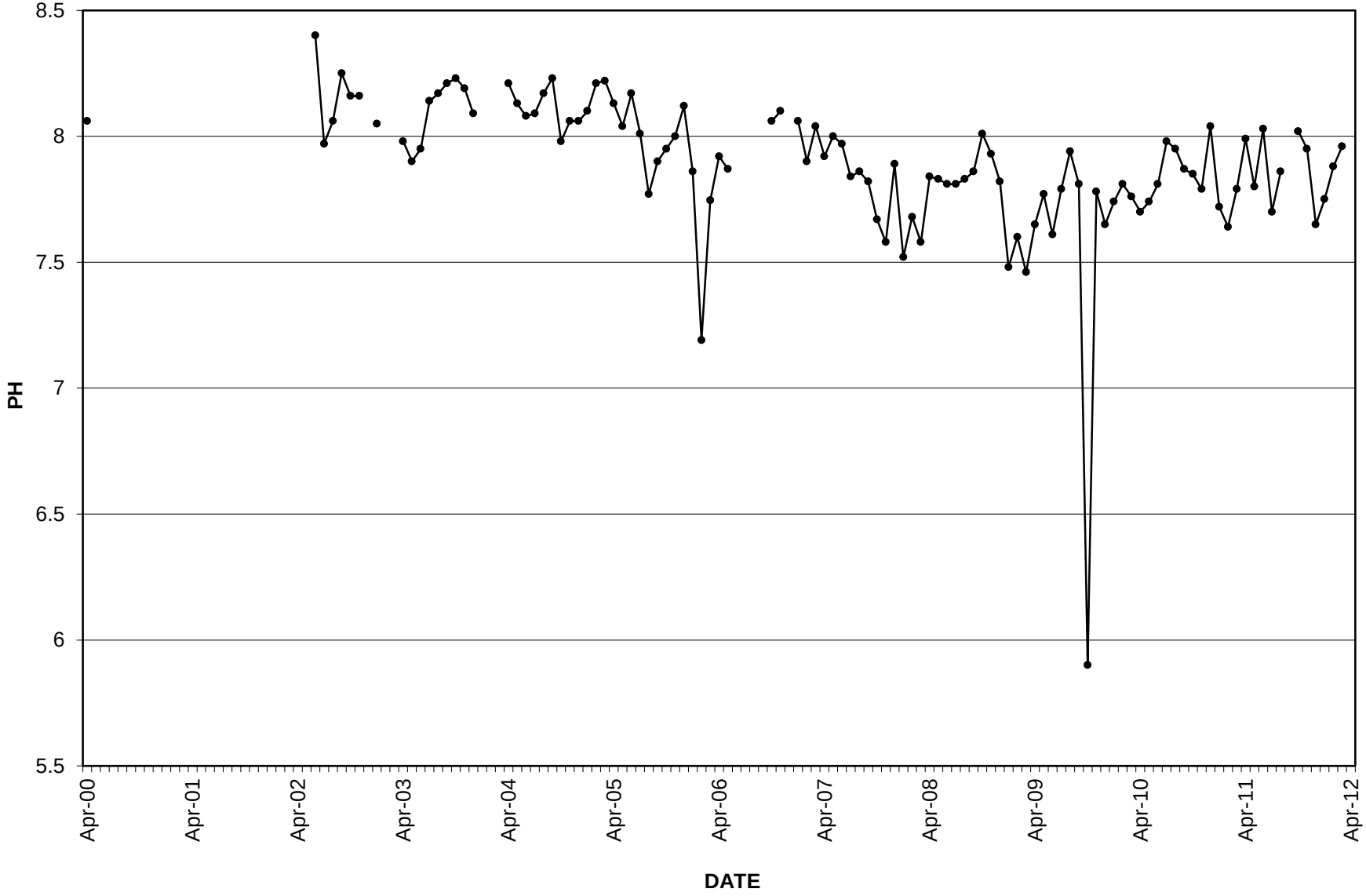


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 54

PH

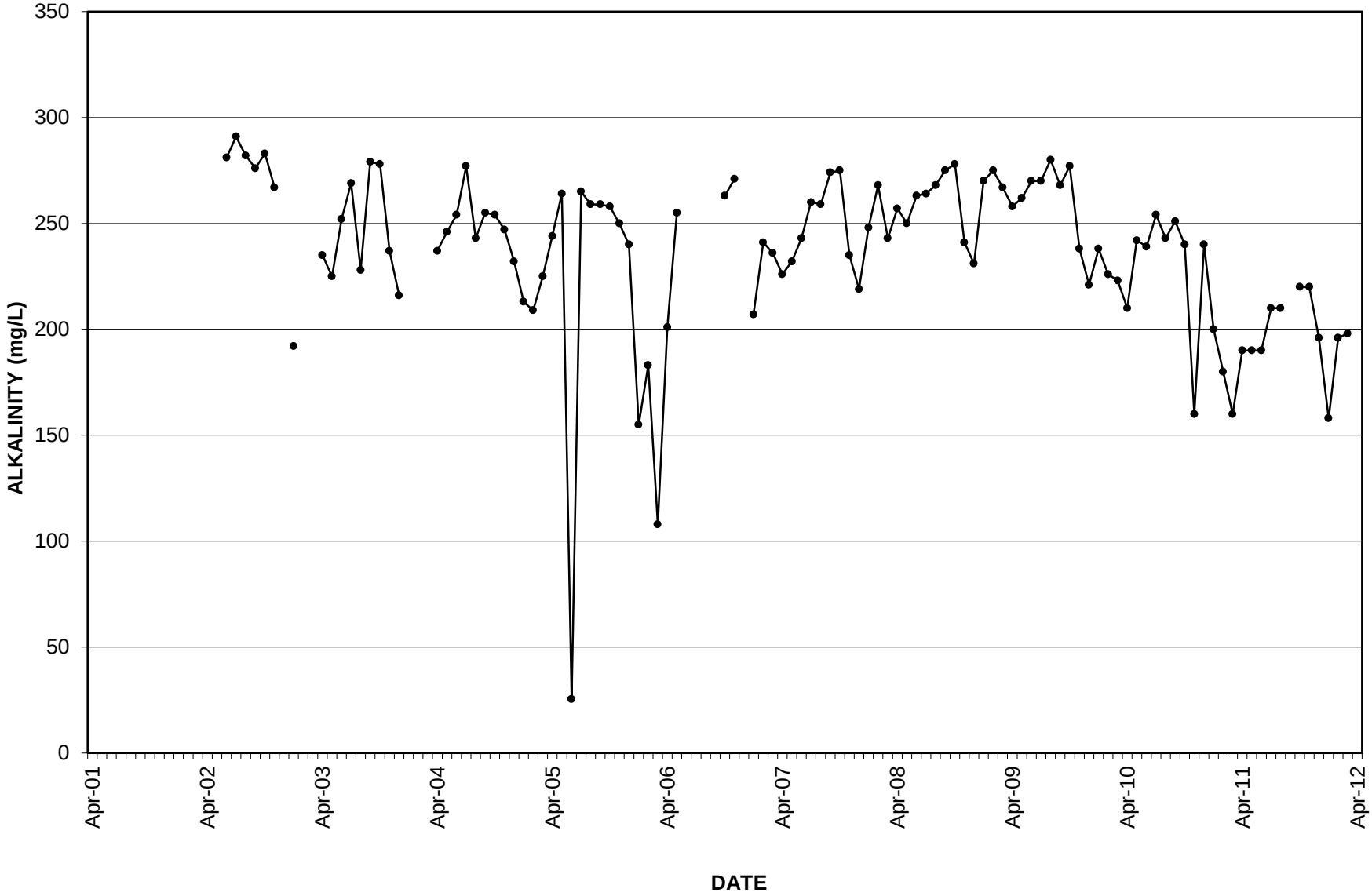
SEEP INTO LONG LAKE (LLS)



GRAPH 55

ALKALINITY

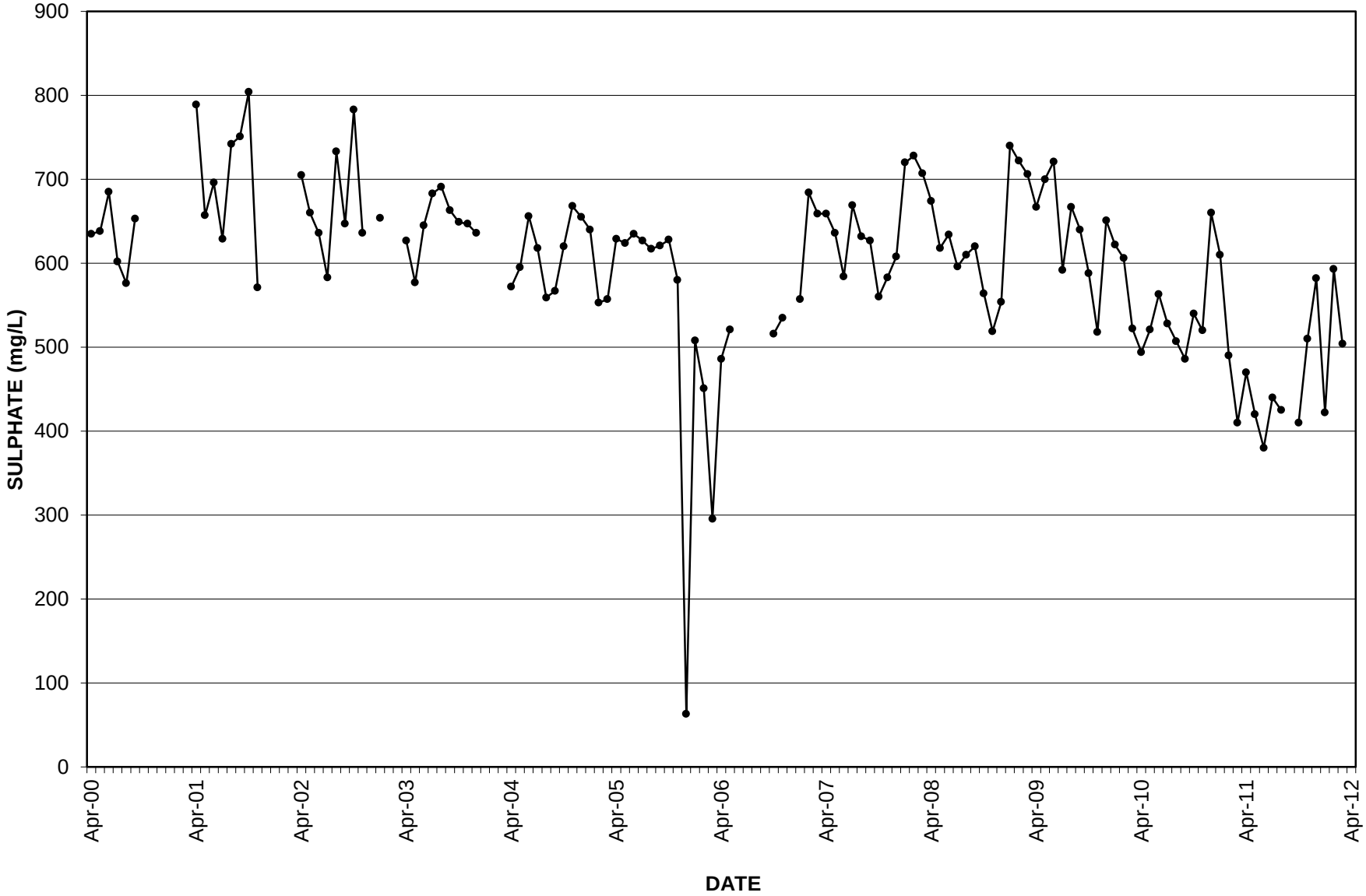
SEEP INTO LONG LAKE (LLS)



GRAPH 56

SULPHATE

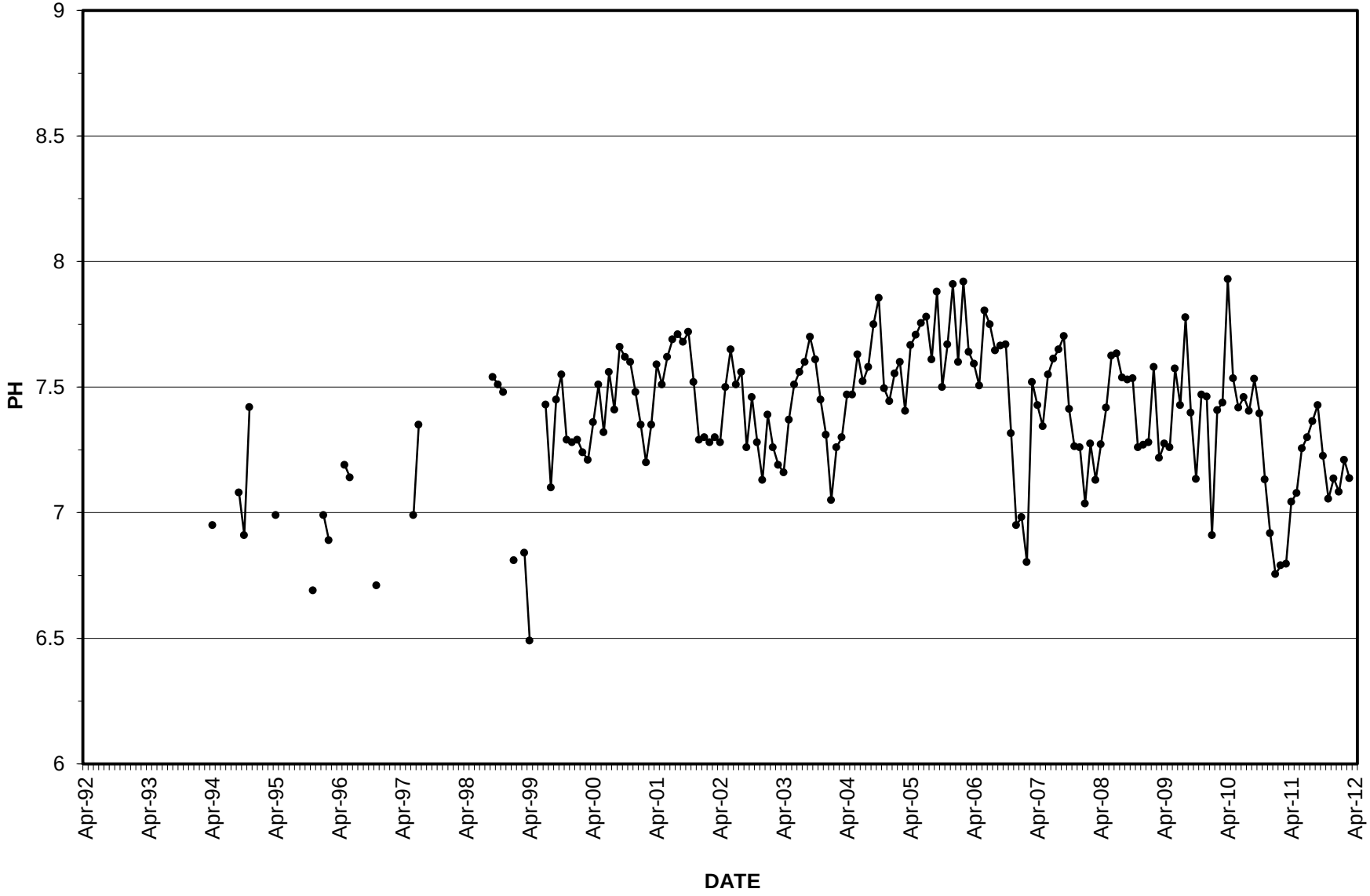
SEEP INTO LONG LAKE (LLS)



GRAPH 57

NO NAME LAKE OUTLET

PH

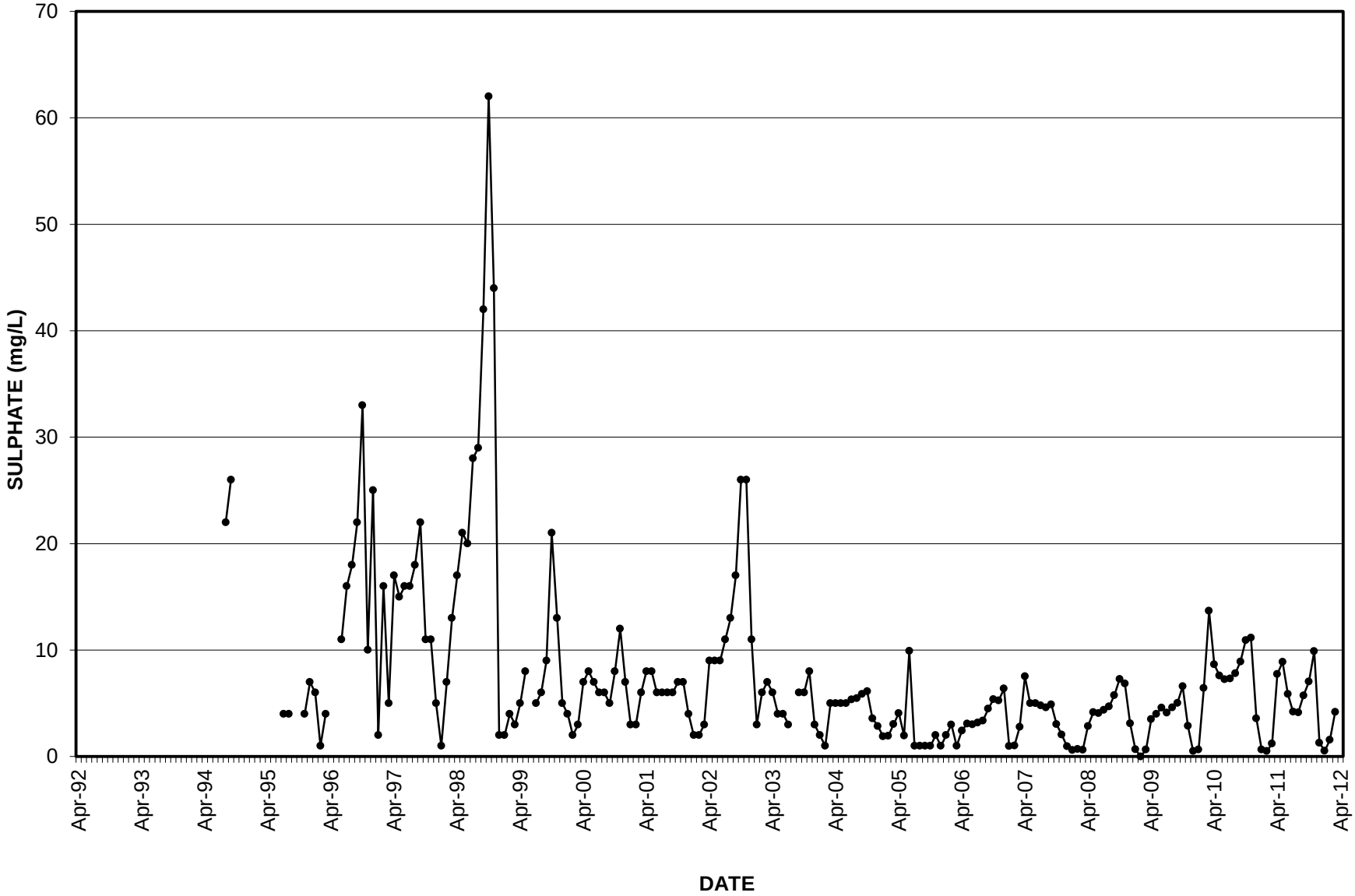


Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 58

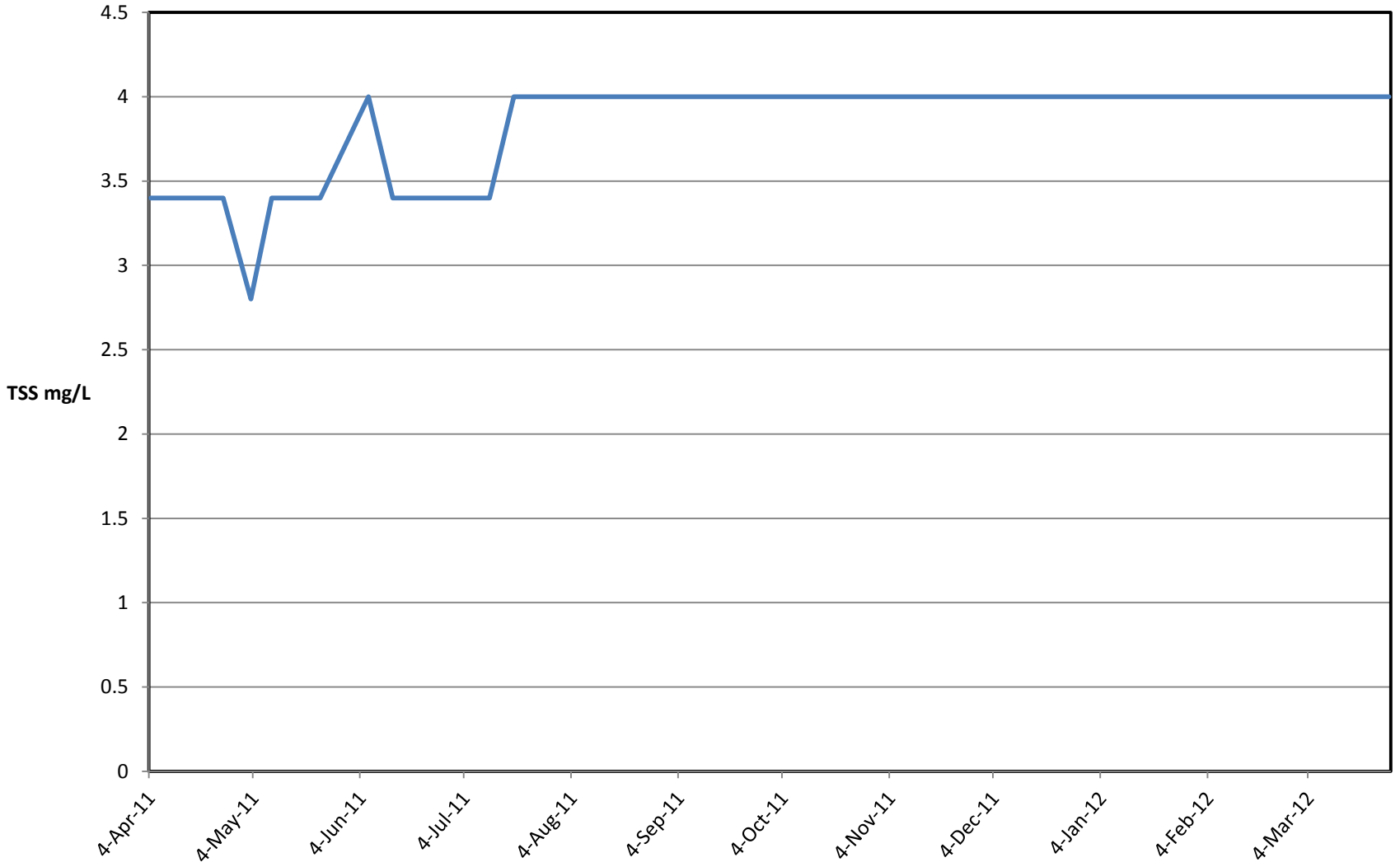
NO NAME LAKE OUTLET

SULPHATE



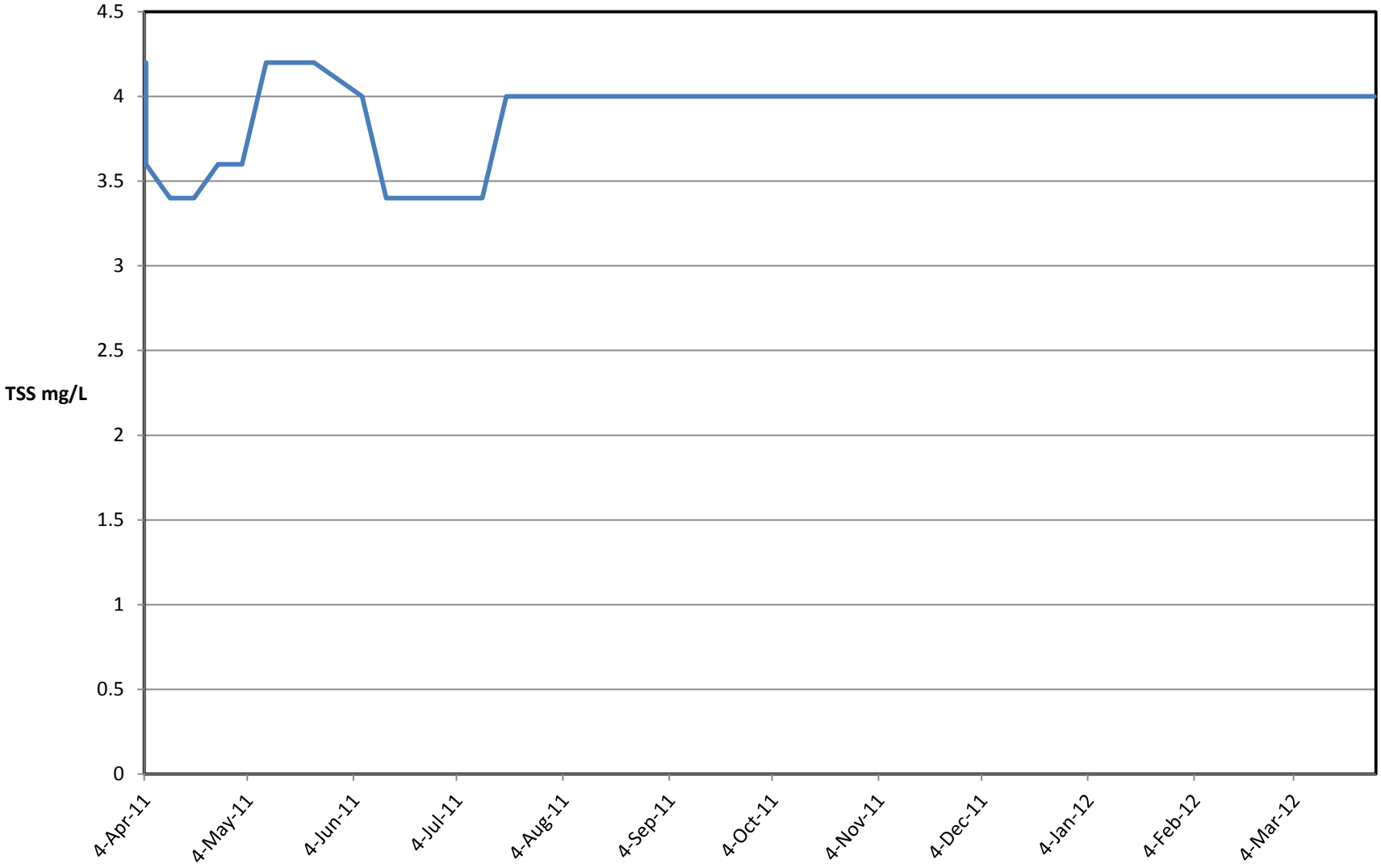
Most values expressed as 0.01 mg/L and 0.001 mg/L are less than the detection limits of 0.01 mg/L and 0.001 mg/L.
The detection limit decreased in late 2002.

GRAPH 59
NNO
TSS (mg/L)



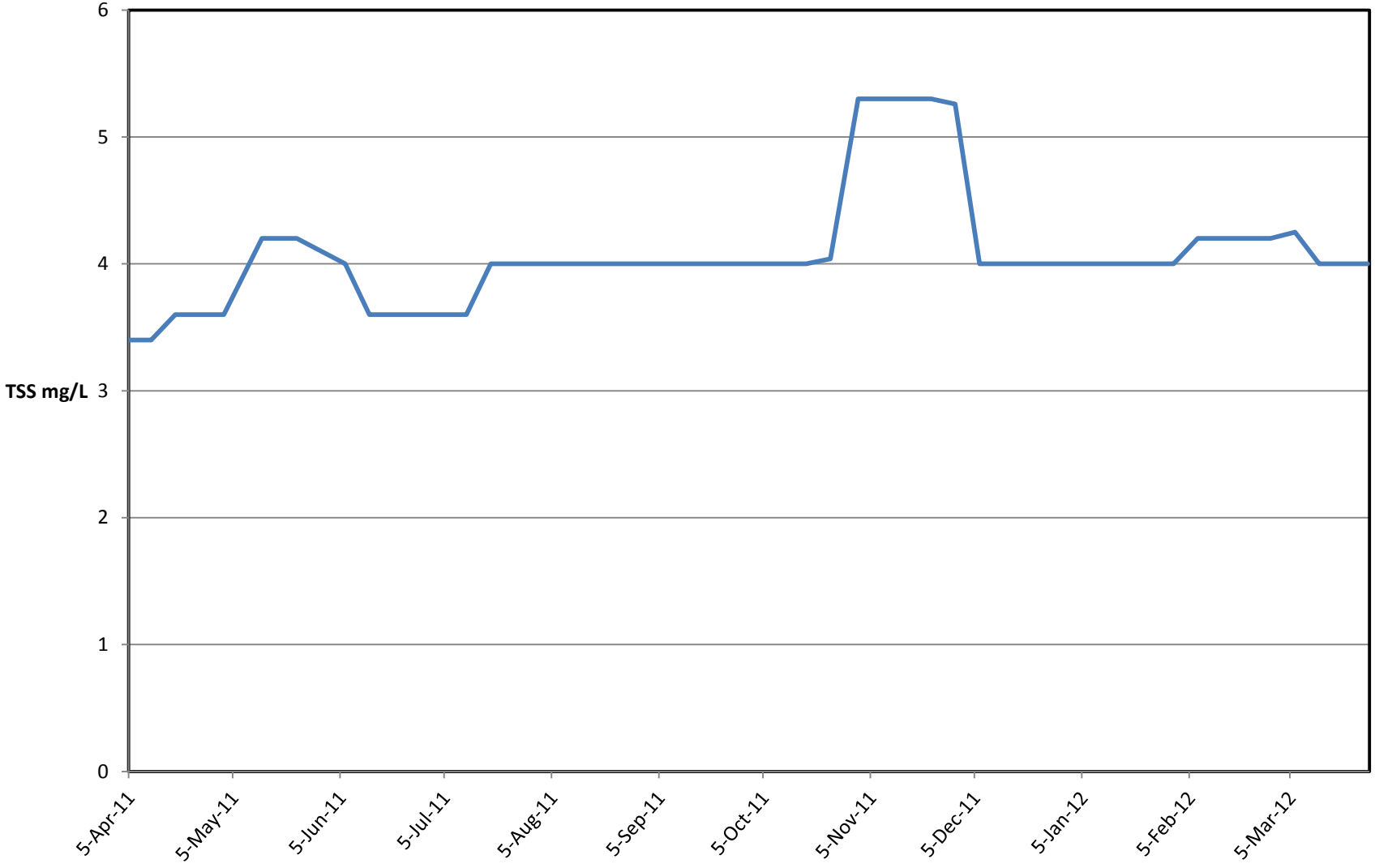
Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

GRAPH 60
WA
TSS (mg/L)



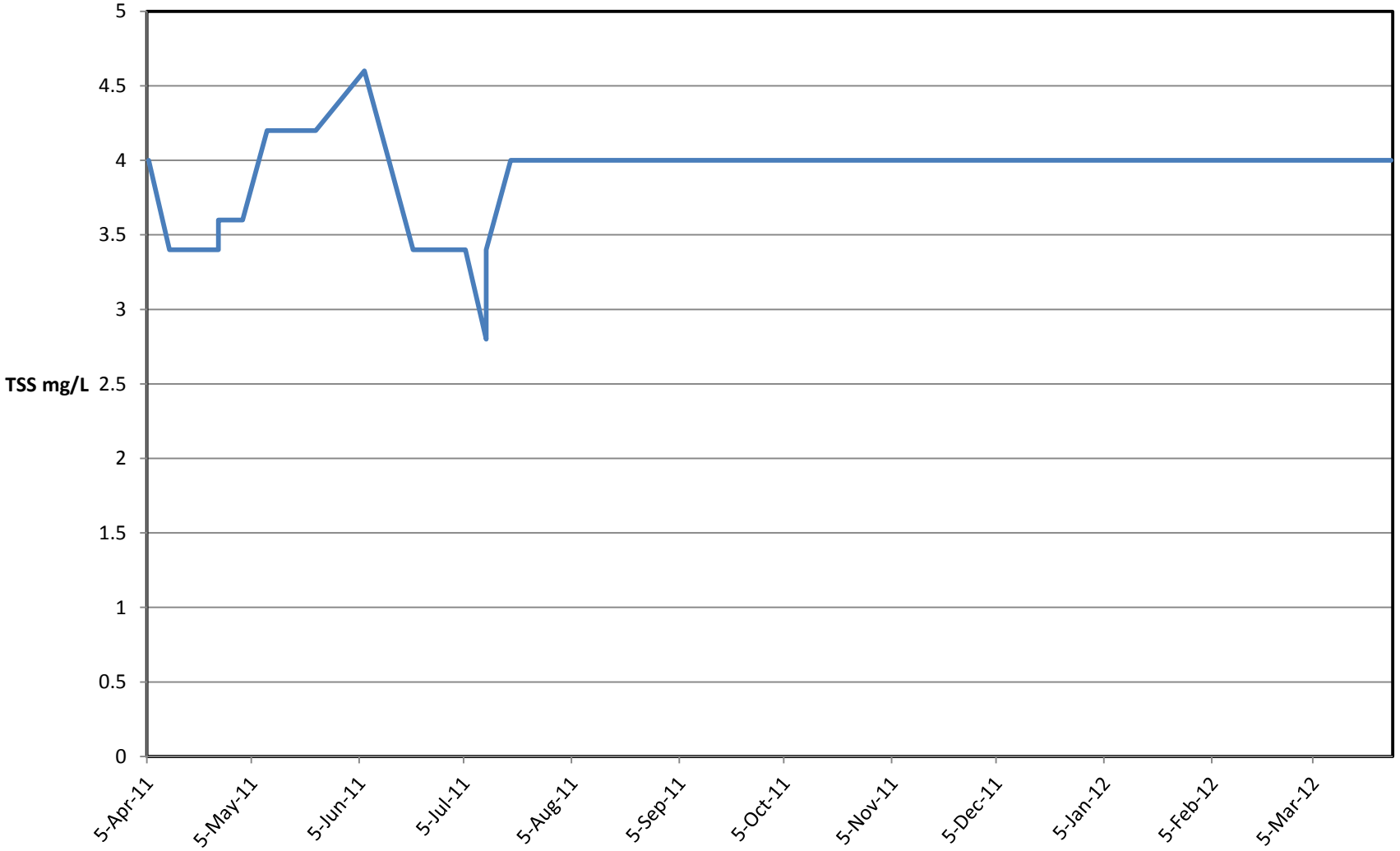
Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

GRAPH 61
LLO
TSS (mg/L)



Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

GRAPH 62
WB
TSS (mg/L)



Concentrations of TSS are averaged using a running average of 5 weekly samples compared to the objective for the 30 day mean.

QUINSAM COAL

Volume II

2011-2012 Annual Water Quality Monitoring Report

Covering Waste Management Permit-07008

2011/2012 ANNUAL WATER QUALITY MONITORING REPORT

COVERING WASTE MANAGEMENT PERMIT

PE-07008

REPORTING PERIOD FROM APRIL 1, 2011 TO MARCH 31, 2012

QUINSAM COAL CORPORATION

P.O. BOX 5000

CAMPBELL RIVER, B.C.

V9W 5C5

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APPENDIX I

BIOASSAYS

Quinsam Coal Corporation
Campbell River
WD-30Dec11-P

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : CL5074-01 / B200280 / 9239			Report # : 2-11-200-317-11-009
Sample Taken:	Dec. 30, 2011 12:00 PM	Sample pH:	7.7
Sample Collected By:	N/A	Sample Dissolved Oxygen:	11.1 mg/L
Sample Received:	Jan. 3, 2012	Sample Temperature:	14.2 °C
Start Date/Time:	Jan. 4, 2012 1:15 PM	Sample Conductance:	1774 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	55	14.7	15.1	7.8	7.5	10.2	10.2	0	0	0	0	0
100	1769	14.4	15.1	7.9	8.1	10.5	10.2	0	0	0	0	0

Comments:
All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	120 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.26 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.47 ± 0.12 g	Length (Mean + SD):	3.9 ± 0.3 cm
Weight (Range):	0.3– 0.74 g	Length (Range):	3.5– 4.5 cm

Reference Toxicant: Zinc
Test was conducted on: 21/12/2011
Test gave a 96-h LC50 of 0.26 (0.16, 0.64) mg/L
The historical mean LC50 and warning limits were 0.14 (0.05, 0.39) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 22 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012 Jan 09 JAN 09 2012

Quinsam Coal Corporation
Campbell River
SPD-30Dec11-P

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : CL5075-01 / B200280 / 9239 — Report # : 2-11-200-317-11-010

Sample Taken:	Dec. 30, 2011 10:00 AM	Sample pH:	7.2
Sample Collected By:	N/A	Sample Dissolved Oxygen:	10.5 mg/L
Sample Received:	Jan. 3, 2012	Sample Temperature:	14.4 °C
Start Date/Time:	Jan. 4, 2012 12:00 PM	Sample Conductance:	417 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	55	14.7	15.1	7.3	7.5	10.3	10.2	0	0	0	0	0
100	418	14.4	15.0	6.8	7.8	10.3	10.1	0	0	0	0	0

Comments:
All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	45 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.26 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.47 ± 0.12 g	Length (Mean + SD):	3.9 ± 0.3 cm
Weight (Range):	0.3– 0.74 g	Length (Range):	3.5– 4.5 cm

Reference Toxicant: Zinc
Test was conducted on: 21/12/2011
Test gave a 96-h LC50 of 0.26 (0.16, 0.64) mg/L
The historical mean LC50 and warning limits were 0.14 (0.05, 0.39) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 22 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012-Jan-09

JAN 0 9 2012

Quinsam Coal Corporation
Campbell River
SPD-30Jan12-P Grab

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : CP5862-01 / B207814 / 9239 — Report # : 2-11-200-317-12-002

Sample Taken:	Jan. 30, 2012 12:30 PM	Sample pH:	6.7
Sample Collected By:	N/A	Sample Dissolved Oxygen:	10.0 mg/L
Sample Received:	Jan. 31, 2012	Sample Temperature:	14.8 °C
Start Date/Time:	Feb. 1, 2012 3:30 PM	Sample Conductance:	244 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	52	14.5	15.1	7.3	7.0	10.1	9.7	0	0	0	0	0
100	244	14.8	15.0	6.7	7.5	10.1	9.9	0	0	0	0	0

Comments:
The final observations and measurements were accidentally taken 18 hours late. This did not affect the LC50 calculation. All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0.10%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	30 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.27 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.48 ± 0.14 g	Length (Mean + SD):	3.9 ± 0.3 cm
Weight (Range):	0.29– 0.81 g	Length (Range):	3.5– 4.6 cm

Reference Toxicant: Zinc
Test was conducted on: 24/01/2012
Test gave a 96-h LC50 of 0.16 (0.12, 0.22) mg/L
The historical mean LC50 and warning limits were 0.14 (0.05, 0.38) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 20 mg $CaCO_3$/L Other parameters available on request

Test Method:
Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012 Feb 08

J. Rickard
FEB 07 2012

Quinsam Coal Corporation
Campbell River
WD-30Jan12-P Grab

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : CP5806-01 / B207806 / 9239 — Report # : 2-11-200-317-12-001

Sample Taken:	Jan. 30, 2012 1:30 PM	Sample pH:	7.5
Sample Collected By:	N/A	Sample Dissolved Oxygen:	10.2 mg/L
Sample Received:	Jan. 31, 2012	Sample Temperature:	14.7 °C
Start Date/Time:	Feb. 1, 2012 3:30 PM	Sample Conductance:	1682 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	52	14.5	15.1	7.3	7.0	10.1	9.7	0	0	0	0	0
100	1677	14.7	15.0	7.6	8.2	10.2	10.0	0	0	0	0	0

Comments:
The final observations and measurements were accidentally taken 18 hours late. This did not affect the LC50 calculation. All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0.10%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	30 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.27 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.48 ± 0.14 g	Length (Mean + SD):	3.9 ± 0.3 cm
Weight (Range):	0.29– 0.81 g	Length (Range):	3.5– 4.6 cm

Reference Toxicant: Zinc
Test was conducted on: 24/01/2012
Test gave a 96-h LC50 of 0.16 (0.12, 0.22) mg/L
The historical mean LC50 and warning limits were 0.14 (0.05, 0.38) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 20 mg $CaCO_3$/L Other parameters available on request

Test Method:

Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst — 2012 Feb08

Verified By — J. Rickard — FEB 07 2012

Quinsam Coal Corporation
Campbell River
SPD-27Feb12-P Grab

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : CV0687-01 / B216542 / 9239			Report # : 2-11-200-317-12-003
Sample Taken:	Feb. 27, 2012 12:30 PM	Sample pH:	7.1
Sample Collected By:	N/A	Sample Dissolved Oxygen:	10.6 mg/L
Sample Received:	Feb. 28, 2012	Sample Temperature:	15.3 °C
Start Date/Time:	Mar. 1, 2012 4:30 PM	Sample Conductance:	421 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	48	15.0	15.0	7.4	7.4	10.2	9.6	0	0	0	0	0
100	439	15.1	14.9	7.2	7.8	10.4	9.7	0	0	0	0	0

Comments:
All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	30 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.45 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.81 ± 0.15 g	Length (Mean + SD):	4.5 ± 0.3 cm
Weight (Range):	0.6– 1.14 g	Length (Range):	4.1– 5.1 cm

Reference Toxicant: Zinc
Test was conducted on: 08/02/2012
Test gave a 96-h LC50 of 0.27 (0.2, 0.38) mg/L
The historical mean LC50 and warning limits were 0.14 (0.05, 0.39) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 24 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012 Mar 07 MAR 07 2012

Quinsam Coal Corporation
Campbell River
WD-27Feb12-P Grab

Rainbow Trout Bioassay
96-h LC50 %v/v: >100%

Maxxam Analytics
4606 Canada Way
Burnaby, BC
Canada V5G 1K5
tel: 604 734-7276
fax: 604 731-2386
web: http://maxxam.ca

Sample # : CV0694-01 / B216544 / 9239 — Report # : 2-11-200-317-12-004

Sample Taken:	Feb. 27, 2012 1:30 PM	Sample pH:	7.9
Sample Collected By:	N/A	Sample Dissolved Oxygen:	10.4 mg/L
Sample Received:	Feb. 28, 2012	Sample Temperature:	15.3 °C
Start Date/Time:	Mar. 1, 2012 4:30 PM	Sample Conductance:	1659 µmho/cm

Conc. (%v/v)	Cond. (µmho/cm)	Temp. Initial (°C)	Temp. Final (°C)	pH Initial	pH Final	D.O. Initial (mg/L)	D.O. Final (mg/L)	Percent Mortality 24 hr	48 hr	72 hr	96 hr	Number of Mortalities
0	50	15.1	15.0	7.5	7.5	10.3	9.7	0	0	0	0	0
100	1674	15.3	14.9	8.0	8.4	10.2	9.8	0	0	0	0	0

Comments:
All fish appeared and behaved normally during the test. The cumulative fish culture mortality in previous 7 days was 0%. The acceptability criteria for fish culture mortality is <2%.

Test Conditions:

Organisms per Replicate:	10	Preaeration Time:	30 min.
Test Volume:	18 L	Rate of aeration:	6.5 ml/min/L
Loading Density:	0.45 g/L		

Test Organism: Rainbow Trout (*Oncorhynchus mykiss*)

Weight (Mean + SD):	0.81 ± 0.15 g	Length (Mean + SD):	4.5 ± 0.3 cm
Weight (Range):	0.6– 1.14 g	Length (Range):	4.1– 5.1 cm

Reference Toxicant: Zinc
Test was conducted on: 08/02/2012
Test gave a 96-h LC50 of 0.27 (0.2, 0.38) mg/L
The historical mean LC50 and warning limits were 0.14 (0.05, 0.39) mg/L.

Dilution Water: Vancouver Tapwater hardened and dechlorinated
EDTA Hardness: 24 mg $CaCO_3$/L Other parameters available on request

Test Method: Biological Test Method: Reference Method for Determining Acute Lethality of Effluent to Rainbow Trout, EPS 1/RM/13, Second Edition, December 2000 and May 2007 Amendments. Results contained in this report refer only to the testing of samples as submitted.

Analyst **Verified By**

2012 Mar 07 MAR 07 2012

APPENDIX II

PHYTOPLANKTON & PERIPHYTON ANALYSIS PROTOCOLS & QA/QC

Jacques Whitford

Engineering,
Scientific,
Planning and
Management
Consultants

4370 Dominion Street
5th Floor
Burnaby BC
Canada V5G 4L7

Bus 604 436 3014
Fax 604 436 3752

www.jacqueswhitford.com

Phytoplankton & Periphyton Analysis

Protocols & QA/QC

Jacques Whitford

An Environment
of Exceptional
Solutions

Phytoplankton and Periphyton Protocols and QA/QC

Last revised April 21, 2005

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karen.munro@jacqueswhitford.com
Phone: 604-436-3014
Fax: 604-436-3752

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PHYTOPLANKTON AND PERIPHYTON ANALYSIS

1.0 QUALITY ASSURANCE/QUALITY CONTROL

Any supplied Chain of Custody forms are maintained. All samples are stored in the dark until they are prepared for examination. Standard protocols, listed below, are followed. Client requests for duplication are followed. Periodic checks of laboratory duplicates (two subsamples from the same container) are done. Taxonomic references are provided.

1.1 Equipment

Equipment includes a Zeiss IM inverted microscope with 10X oculars and 10X, 40X and 100X objectives and phase contrast optics. Field diameters, measured by a Zeiss technician, were used to calculate conversion factors.

1.2 Phytoplankton Samples

The method of phytoplankton analysis and guidelines for statistical reliability are discussed in Section 3. Glassware and sampling equipment are rinsed using sample water before settling the samples. Sample bottles are shaken well to distribute algae and 27 mL aliquots settled for a minimum of 16 hours. Subsamples are labeled or kept with the original sample bottles, to prevent confusion. Careful records of any dilutions are made. Any unusual or inconsistent results are checked by examining a new subsample. See Section 3.2 for additional comments on statistical reliability of the counts.

1.3 Periphyton Samples

The method of periphyton analysis and guidelines for statistical reliability are discussed in Section 4. Depending on the nature of the periphyton material, sample vials are shaken to distribute algae, or several subsamples of clumped material are removed. Material is examined on glass slides or in a 2 mL settling chamber. Subsamples are labeled or kept with the sample vials to prevent confusion.

1.4 Communicating Problems with the Client

The client is advised immediately if problems arise. This is seldom needed, but the most common reason is insufficient or no preservative in the sample.

2.0 SAMPLE PRESERVATION

Lugol's preservative is recommended. It can be ordered from a chemical supply house. Specify the concentrated form, not the dilute form used for gram staining of bacteria.

Lugol's is made by dissolving 5 g I_2 and 10 g KI in deionized water, then making it up to 200 mL including 20 mL glacial acetic acid. Store in a brown bottle away from light.

Use 1 mL per 100 mL Lugol's for phytoplankton samples. Use enough to turn the sample water the colour of tea for periphyton samples. Store preserved samples in the dark.

3.0 PHYTOPLANKTON ANALYSIS

3.1 Sampling Advice

Samples can be taken from the desired depth using a van Dorn or other type of discrete sampler. They also can be taken from just below the water surface, but these samples often do not reflect species composition in the lake. In thermally stratified lakes, samples should be taken at several depths (above, within and below the thermocline) to provide a good description of phytoplankton distribution.

Samples of 250 mL volume are adequate for analysis. They should be preserved immediately with Lugol's preservative (1 mL per 100 mL), and stored in the dark.

3.2 Counting Method

Samples are settled in 27 mL chambers then examined using a Zeiss inverted microscope. Very concentrated samples are settled in 2 mL chambers or diluted before analysis. Species are identified and enumerated at 100X, 400X, and 1000X magnifications. The use of three magnifications results in statistically reliable counts of both net plankton and nannoplankton. Results are presented as cells per mL or cells per L, as the client desires.

Samples from oligotrophic lakes usually require examination of the entire chamber bottom at 100X, two to four strips at 400X, and 50 to 200 fields at 1000X.

3.2.1 QA/QC Concerns

The reliability of the count depends on random distribution of organisms within the sample and a high enough count to be sure of the results. There are internal checks for accuracy of the analysis:

- Random distribution is checked when samples are examined at 100X magnification. Clumping is rarely a problem.
- Separate counts for individual strips and groups of fields are recorded. If numbers are inconsistent, more of the sample is counted or another subsample is examined.
- On the rare occasion when numbers seem inconsistent with other samples, another subsample is examined.

For a long series of samples, duplicate or blind samples can be submitted for analysis (10% replication recommended).

3.2.2 Statistical Reliability of Counts

At least 100 cells, filaments, or colonies of the predominant species are enumerated at each magnification. This provides an accuracy of $\pm$ 20% (0.95 confidence limits) for species counts (Lund *et al.*, 1958). Usually, at least 400 cells are counted at each magnification, providing $\pm$ 10% accuracy of total counts.

3.3 Cell Volume and Biomass Estimates

When requested, cell volumes are calculated for the most common species. This time-consuming step is recommended only for projects that involve several samples. A list of common species is established using two criteria: at least five observations in a sample to be considered common, and common in at least five samples. Subsamples of each sample are combined to create a composite sample. At least 20 cells per common species are measured. Cell volumes are calculated using geometric formulae, then mean values are calculated. Numerical abundance data are then converted to biovolume or biomass data (mg/m^3).

3.4 Biological Importance of the Counts

The method outlined in Section 3.2 ensures recognition of the very small phytoplankton, which often contribute much of the primary productivity of oligotrophic lakes. The numerical abundance data emphasize the importance of the nannoplankton, whereas the biomass data (Section 3.3) emphasize the importance of the netplankton.

4.0 PERIPHYTON ANALYSIS

4.1 Field Sampling Advice

4.1.1 Sampling Natural Substrates

In many cases, samples from natural substrates are preferable to those from artificial substrates (Aloi, 1990). This ensures that the algae collected reflect the natural community. Sampling natural substrates is quicker and requires little pre-planning, compared to sampling artificial substrates. However, when choosing individual rocks within a sampling location, natural patchiness of periphyton must be

considered. Several subsamples should be taken at each location, three to six depending on project needs and budget.
The RIC (1998) document *Freshwater Biological Sampling Manual* describes sampling procedures. Three or four rocks are selected randomly from the desired habitat (riffle, run, pool) at the site. Natural substrates are sampled quantitatively using a sampler with a known surface area (e.g., modified toilet plunger, template, a "Stockner sampler" - a modified wide barreled syringe fitted with a toothbrush). A known area (*ca.* 2.5 cm diameter) is sampled, removed to a vial, and preserved. Several "disks" can be composited in one sample (one or two disks per rock).

It is important to avoid contaminating the sample with river phytoplankton, so de-ionized water or filtered river water should be used to rinse a substrate surface or add liquid. When splitting the sample for both species identification and chlorophyll analysis, the samples are separated into two vials, as estimated by eye, and labeled. One sample is preserved for identification using Lugol's, then stored in the dark. The other sample is prepared for chlorophyll analysis following guidelines provided by the laboratory.

4.1.2 Sampling Artificial Substrates

Artificial substrates can be used to assess periphyton growth in streams and rivers. This avoids some of the problems associated with sampling natural substrates, such as heterogeneity of the natural environment, patchy periphyton distribution, and irregular sampling surfaces (Munro *et al.*, 1985). Various substrates have been used in the past, ranging in size from microscope slides to large plexiglass plates.

The substrates are removed after three or more weeks in the stream. The algae are removed with a scraper (e.g., plexiglass ice scraper for car windows) into a tray. The surface is rinsed with de-ionized water or filtered stream water, to prevent contamination of the sample by river phytoplankton. The contents are transferred to a labeled plastic vial using a wide mouth pipette or turkey baster.

When splitting the sample for both species identification and chlorophyll analysis, the samples are separated into two vials, as estimated by eye, and labeled. One sample is preserved for identification, using Lugol's, then stored in the dark. The sample for chlorophyll analysis is treated using guidelines provided by the laboratory (field filtration, stabilization with $MgCO_3$).

4.2 Periphyton Sample Analysis

Samples are examined qualitatively in the laboratory. Quantitative estimates are not made because they are not statistically reliable. The algae typically form mats, clumps, or are tangled among each other, rendering traditional counting techniques inaccurate.

Subsamples are examined in the microscope. Predominant and common organisms are identified to species or, occasionally, genus. Relative percent abundance of each non-diatom species (greens, blue-greens, reds, etc.) is estimated. The diatoms species are ranked as predominant, common, or present, as follows:

- predominant, more than 25% abundance;

- common, 5% to 25% abundance; and
- present, less than 5% abundance.

A quantitative estimate of diatom abundance can be obtained by boiling the sample in nitric acid to oxidize organic material. The clean silica shells of the diatoms are mounted permanently on microscope slides. Diatoms are identified and counted, then data are converted to numbers per cm^2. The procedure is time-consuming, expensive, and requires special laboratory arrangements to handle the chemicals and is not recommended in routine surveys.

4.2.1 Statistical Reliability

The greatest reliability is obtained through replicate sampling. The natural environment is highly variable, as are estimates of periphyton abundance. Using artificial substrates reduces the main source of variability. However, replication for species identification and especially for chlorophyll analysis is helpful.

For qualitative sample analysis, reliability is obtained by examining substantial portions of the sample. The samples are stored, so they can be re-examined at a later date. A species list, with scientific authorities, is included so that taxonomists can identify synonymous names for species.

Routine statistical analyses can be performed using data from the quantitative count of cleared diatoms described in section 4.2.

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CLOSING

This information is provided for general project guidance. It is recommended that interested scientists contact the undersigned for more specific guidance on program design, sample handling procedures and reporting requirements.

Respectfully submitted,

JACQUES WHITFORD LIMITED

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Biologist,
Environmental Planning and Permitting

[File Ref:P:\\BCV5047_\BCV50472 ALS\Methods and QAQC Manual – algae]

Jacques Whitford

APPENDIX III

PHYTOPLANKN ANALYTIAL RESULTS FOR MIDDLE QUINSAM LAKE AND LONG LAKE

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December 13, 2011

Project No: 1231-10406

Maxxam Analytics Laboratory
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Attention: Dave Langill and Amanda Hart

Dear Dave and Amanda:

Reference: Quinsam Lakes Phytoplankton, September 2011 (Sample reference B190361 and B191002)

1 INTRODUCTION

Quinsam Coal Ltd. collects six water samples from Long Lake and Middle Quinsam Lake monthly during the spring and summer growing season. Samples are submitted to Stantec Consulting Ltd. for phytoplankton taxonomic analysis, as part of ongoing monitoring requirements of the Ministry of Environment. Samples are taken at depths of 1 m, 4 m, and 9 m. Some months, an additional sample is taken as a field replicate for Quality Assurance/Quality Control (QA/QC). This brief report provides information about six samples and two duplicate samples collected on September 22 and 23, 2011.

2 METHODS

Sub-samples (27 mL) of preserved lake water were settled and examined at 100X, 400X and 1,000X magnifications using a Zeiss inverted microscope. Counting effort is defined as at least 100 organisms of the predominant species at 400X, up to 200 fields at 1,000X and a half or whole sub-sample at 100X.

3 RESULTS

3.1 Abundance

Abundance data for 1993 to 2010 are provided in Appendix A and detailed taxonomic results for September 2011 are presented in Appendix B.

Total abundance in the September 2011 samples for Long Lake ranged from 960 cells/mL (9 m sample depth) to 1,800 cells/mL (4 m sample depths), as summarized in Table 1, similar to results for previous years (Appendix A).

Table 1: Phytoplankton Abundance (cells/mL) in Long Lake, 2011

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2011	LL1	1,700	1,400	220	52
	LL4	3,900	3,260	540	80
	LL9	2,200	1,820	340	9
May 2011	LL1	3,600	2,880	720	6
	LL1 (rep)	3,500	2,790	690	6
	LL4	4,900	4,160	700	6
	LL9	1,300	900	350	5
June 2011	LL1	2,100	1,750	330	36
	LL4	2,300	2,050	290	3
	LL9	1,500	1,060	450	4
July 2011	LL1	1,400	1,150	270	3
	LL4	1,800	1,440	350	1
	LL4 (rep)	1,900	1,600	300	0.1
	LL9	1,900	1,550	320	2
August 2011	LL1	2,900	2,500	360	15
	LL4	1,800	1,400	320	27
	LL9	1,500	1,200	280	0.9
September 2011	LL1	1,300	940	380	2.2
	LL4	1,800	1,500	380	0.4
	LL9	960	770	190	0.3

Total abundance in the September 2011 samples for Middle Quinsam Lake is summarized in Table 2. Total abundance ranged from 1,600 cells/mL (9 m sample depth) to 2,600 cells/mL (4 m sample depth), similar to results for previous years (Appendix A).

Table 2: Phytoplankton Abundance (cells/mL) in Middle Quinsam Lake, 2011

Date	Sampling Site	Total Abundance	<5 µm (1000X)	5 to 25 µm (400X)	>25 µm (100X)
April 2011	MQ1	1,600	1,370	270	7
	MQ4	1,400	1,160	270	6
	MQ9	1,900	1,400	490	3
May 2011	MQ1	1,200	1,050	190	2
	MQ1 (rep)	1,200	1,040	170	3
	MQ4	1,800	1,370	410	4
	MQ9	1,600	670	920	4
June 2011	MQ1	2,000	1,840	150	1
	MQ4	1,500	1,300	200	1
	MQ9	1,700	1,200	520	10
July 2011	MQ1	2,200	2,100	110	0.4
	MQ4	1,600	1,330	230	3
	MQ9	1,000	770	200	1
	MQ9(rep)	1,100	860	200	1
August 2011	MQ1	1,400	1,200	210	4
	MQ4	3,300	3,000	280	0.6
	MQ9	1,200	1,000	200	0.1
September 2011	MQ1	2,300	2,100	190	17.2
	MQ4	2,600	2,400	190	0.2
	MQ9	1,600	1,400	240	9.6

3.2 Species Composition

Species composition data for September 2011 are contained in Appendix B. The most abundant phytoplankton in both Long Lake and Middle Quinsam Lake were the very small (<5 µm) chrysoflagellates *(Ochromonas* spp. and *Chromulina* spp.). Although these ultra-nanoplankton species were very abundant numerically, they usually contribute little to algal biomass.

In Long Lake, the most abundant larger species (>5 µm) at all depths sampled were the chrysophyte *Ochromonas* spp. and the cryptophyte *Rhodomonas minuta*.

In Middle Quinsam Lake, *Ochromonas* spp. and *Rhodomonas minuta* were abundant at all three depths. At 1 m and 4 m depth, the cryptophyte *Cryptomonas* spp. and the chrysophyte *Dinobryon cylindricum* were also abundant. At 9 m depth the diatom *Cyclotella bodanica* was also abundant.

4 SUMMARY

Temporal variations in phytoplankton abundance and composition are to be expected. These may result from changing lake conditions related to discharges from Quinsam Coal Ltd. (e.g., changes in sulphate or nutrient availability, shifts in pH) or to natural variation (e.g., timing of spring and autumn overturns).

Several features first observed in 2001 continue to be monitored: peak abundance in Long Lake samples in May and June of each year (a shift from pre-2001) and a second peak in abundance in Long Lake samples in September. Species composition and diversity continue to indicate oligotrophic conditions for both lakes, although some changes in recent years suggest shifts in nutrient dynamics of Long Lake, which would be useful to examine in greater detail.

5 CLOSURE

We trust this information meets your present requirements. Stantec would be pleased to organize a data review in support of the recent findings. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Biologist
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Appendix A: Historical Abundance Data: Quinsam Lakes System, 1993 – 2010
Appendix B: Species Composition Data, September 2011

SN/KM/pf

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APPENDIX A

Historical Abundance Data: Quinsam Lakes System, 1993 – 2010

Table A1-1 **Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1993 and 1994**

Date	Sampling Site	Total Abundance	< 5mm (1000X)	5 to 25 mm (400X)	>25 μm (100X)
1993 October	LLM1	2,300	1,800	530	
	LLM3	3,000	2,400	550	
	LLMB	610	420	190	
1994 May	LL1R	10,000	8,800	1,200	
	LL3R	5,000	3,800	1,200	
	LL9R	4,000	3,200	800	
1994 June	LL0	1,400	1,200	250	
	LL1	1,000	790	220	
	LL4	1,500	1,200	320	
	LL9	2,500	1,900	580	
	LLB	830	440	390	
1994 July	LL1	2,100	1,900	180	
	LL4	1900	1700	250	
	LL9	1,500	1,100	400	
1994 August	LL1	1,700	1,400	290	
	LL4	1,000	850	200	
	LL9	900	780	150	
1994 September	LL1	900	620	250	
	LL4	2,300	2,000	260	
	LL9	2,100	1,700	350	

Table A1-2: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1995

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
1995 April	LL1	3,100	2,700	340	
	LL4	3,300	2,900	350	
	LL9	1,300	1,100	280	
1995 May	LL1	5,400	4,900	570	
	LL4	4,800	4,100	700	
	LL9	1,500	1,000	500	
1995 June	LL1	2,100	1,800	300	
	LL4	2,600	2,100	500	
	LL9	7,400	6,600	850	
1995 July	LL1	2,000	1,700	300	
	LL4	1,900	1,650	350	
	LL9	1,500	1,200	300	
1995 August	LL1	1,100	960	180	
	LL4	1,300	1,100	240	
	LL9	1,900	1,700	210	
1995 September	LL1	2,900	2,800	170	
	LL4	3,400	3,100	330	
	LL9	1,900	1,600	280	

Table A1-3: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1996

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
1996 April	LL1	4,600	4,200	340	
	LL4	6,000	5,600	380	
	LL9	1,100	960	160	
1996 May	LL1	2,200	1,600	600	31
	LL4	2,200	1,700	540	16
	LL9	1,700	1,400	290	26
1996 June	LL1	2,100	1,600	440	4
	LL4	1,600	1,300	340	2
	LL9	1,600	1,100	500	9
1996 July	LL1	2,400	2,300	140	1
	LL4	3,200	3,000	200	3
	LL9	No sample			
1996 August	LL1	2,100	1,900	160	1
	LL4	2,200	1,800	390	37
	LL9	1,700	1,500	200	10
1996 September	LL1	1,900	1,600	230	82
	LL4	2,200	1,800	300	145
	LL9	2,100	1,800	220	38
1996 April	MQ1	No sample			
	MQ4	No sample			
	MQ9	No sample			
1996 May	MQ1	2,000	1,700	230	11
	MQ4	1,100	930	180	7
	MQ9	2,200	1,800	430	1
1996 June	MQ1	2,700	2,500	150	3
	MQ4	2,600	2,400	210	7
	MQ9	1,200	1,000	190	1
1996 July	MQ1	2,400	2,100	335	24
	MQ4	1,900	1,400	380	130
	MQ9	1,200	860	320	29
1996 August	MQ1	2,800	2,500	280	17
	MQ4	1,800	1,500	310	18
	MQ9	2,300	1,900	390	21
1996 September	MQ1	1,700	1,300	270	5
	MQ4	900	560	350	0.6
	MQ9	1,200	1,100	190	0.7

Table A1-4: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1997

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
1997 early May	LL1	3,200	2,800	340	12
	LL4	4,300	4,000	300	32
	LL9	1,700	1,600	140	5
1997 late May[1]	LL1	3,000	2,600	370	61
	LL4	4,900	4,200	620	100
	LL9	4,700	4,000	730	44
1997 June[2]	LL1	1,500	1,100	340	2
	LL4	1,200	1,000	240	1
	LL9	3,900	2,700	1,200	50
1997 July	LL1	2,400	2,300	110	0
	LL4	1,700	1,500	170	0.1
	LL9	480	390	80	2
1997 August	LL1	1,900	1,700	230	0.2
	LL4	880	740	140	0.6
	LL9	1,000	870	93	1.4
1997 September	LL1	1,000	870	140	0.6
	LL4	2,000	1,800	270	0.3
	LL9	700	490	210	0.8
1997 early May	MQ1	1,700	1,400	270	2
	MQ4	1,600	1,400	240	2
	MQ9	2,500	2,300	240	2
1997 late May	MQ1	1,200	1,000	150	0.4
	MQ4	1,600	1,300	280	1
	MQ9	1,200	1,000	190	0.2
1997 June	MQ1	1,900	1,700	140	1
	MQ4	2,500	2,400	130	1
	MQ9	1,400	1,200	200	1
1997 July	MQ1	2,400	2,300	130	0.3
	MQ4	1,500	1,400	110	0.1
	MQ9	890	640	260	0.6
1997 August	MQ1	2,100	1,900	220	0.8
	MQ4	1,500	1,300	190	1.4
	MQ9	1,000	760	240	1.6
1997 September	MQ1	800	640	170	1.3
	MQ4	900	620	280	6.4
	MQ9	650	370	280	1.5

1. recalculated counting *Synedra radians* at 400X rather than 100X
2. recalculated counting *Synedra radians* at 400X rather than 100X & *Cyclotella glomerata* at 1000X rather th

Table A1-5: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1998

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
1998 April	LL1	2,800	2,600	210	12
	LL4	4,100	3,700	390	12
	LL9	1,600	1,100	500	10
1998 May[1]	LL1	2000	1500	430	76
	LL4	1600	1100	480	85
	LL9	2100	1500	630	20
1998 June	LL1	5,700	5,600	140	0.3
	LL4	7,100	6,900	210	0.3
	LL9	3,300	1,700	1600	4
1998 July	LL1	1,200	1,100	130	10
	LL4	740	560	170	8
	LL9	760	130	630	5
1998 August	LL1	1,900	1,700	190	2
	LL4	2,200	2,000	230	2
	LL9	1,900	1,600	220	5
1998 September	LL1	5,000	4,900	130	2
	LL4	3,500	3,300	150	2
	LL9	2,200	2,000	220	5
1998 April	MQ1	2,200	1,900	250	3
	MQ4	1,900	1,600	260	3
	MQ9	3,100	2,700	460	2
1998 May	MQ1	2,500	2,300	210	1
	MQ4	2,600	2,400	180	2
	MQ9	2,100	1,700	480	0.4
1998 June	MQ1	1,900	1,700	180	1
	MQ4	1,600	1,400	200	1
	MQ9	1,300	1,000	310	0.4
1998 July	MQ1	1,500	1,400	120	19
	MQ4	1,800	1,600	150	35
	MQ9	1,300	1,100	190	25
1998 August	MQ1	1,900	1,700	250	12
	MQ4	1,300	950	350	10
	MQ9	1,400	890	490	12
1998 September	MQ1	2,000	1,800	200	11
	MQ4	2,700	2,500	220	7
	MQ9	2,100	1,900	230	10

1. recalculated for counting *Synedra radians* at 400X rather than 100X

Table A1-6: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 1999

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
1999	LL1	3,800	3,500	310	9
April	LL4	6,800	6,200	560	17
	LL9	3,000	2,600	410	10
1999	LL1	No sample			
May	LL4	No sample			
	LL9	No sample			
1999	LL1	1,100	910	150	2
early July	LL4	1,400	1,200	150	1
	LL9	1,300	1,200	100	1
1999	LL1	1,100	870	200	1
late July	LL4	2,000	1,800	280	1
	LL9	1,000	860	130	1
1999	LL1	2,700	2,500	180	2
August	LL4	2,800	2,600	170	6
	LL9	3,000	2,800	170	4
1999	LL1	3,700	3,500	230	12
September	LL4	5,000	4,700	290	17
	LL9	4,000	3,700	290	3
1999	MQ1	2,300	1,600	220	430
April	MQ4	2,200	1,800	200	230
	MQ9	2,700	1,900	600	190
1999	MQ1	No sample			
May	MQ4	No sample			
	MQ9	No sample			
1999	MQ1	790	700	90	0.4
early July	MQ4	770	620	150	0.5
	MQ9	1,100	1,000	130	0.3
1999	MQ1	2,700	2,600	110	0.2
late July	MQ4	2,100	1,900	220	0.8
	MQ9	620	420	190	0.3
1999	MQ1	2,100	2,000	140	6
August	MQ4	1,100	980	110	4
	MQ9	1,100	1,000	120	9
1999	MQ1	1,300	1,100	190	14
September	MQ4	1,500	1,300	190	9
	MQ9	760	540	210	10

Table A1-7: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2000

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2000 April	LL1	2,100	1,600	450	33
	LL4	2,500	1,800	700	68
	LL9	1,300	590	740	6.8
2000 May	LL1	3,300	2,800	530	17
	LL4	3,000	2,600	320	15
	LL9	2,000	1,500	490	15
2000 June	LL1	2,900	2,500	390	9.1
	LL4	2,900	2,400	400	19
	LL9	6,400	5,700	730	19
2000 July	LL1	1,600	1,400	130	2.1
	LL4	1,400	1,200	250	1.6
	LL9	1,200	990	250	3.6
2000 August	LL1	1,800	1,600	170	12
	LL4	1,100	940	190	8.2
	LL9	1,500	1,400	130	1.9
2000 September	LL1	2,200	1,900	360	11
	LL4	2,000	1,800	200	9.2
	LL9	1,300	1,100	200	7.2
2000 April	MQ1	1,800	1,300	450	5.9
	MQ4	1,700	1,300	420	1.6
	MQ9	1,500	1,200	280	1.7
2000 May	MQ1	1,800	1,500	290	3
	MQ4	1,600	1,300	290	4.4
	MQ9	1,900	1,600	270	7.6
2000 June	MQ1	2,100	1,900	250	1.4
	MQ4	2,400	2,200	200	2.1
	MQ9	1,800	1,500	380	1.1
2000 July	MQ1	1,300	1,100	210	7.4
	MQ4	2,100	1,800	250	9.6
	MQ9	2,100	1,300	800	22
2000 August	MQ1	1,500	1,200	290	5.8
	MQ4	2,200	1,900	310	7.2
	MQ9	2,400	1,900	500	7.5
2000 September	MQ1	1,800	1,600	200	14
	MQ4	2,100	1,900	250	14
	MQ9	2,000	1,700	220	28

Table A1-8: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2001

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2001 April	LL1	3,300	2,600	670	19
	LL4	4,400	3,900	830	13
	LL9	1,400	860	490	5
2001 May	LL1	7,700	6,200	1,100	310
	LL4	11,000	10,000	980	100
	LL9	4,600	3,600	670	22
2001 June	LL1	7,800	6,600	1,000	170
	LL4	6,800	5,100	1,500	210
	LL9	3,000	2,400	680	25
2001 July	LL1	3,300	3,100	170	1
	LL4	3,200	3,000	180	1
	LL9	1,600	1,400	160	2
2001 August	LL1	1,300	1,100	180	1
	LL4	1,700	1,500	200	2
	LL9	720	540	170	1
2001 September	LL1	8,200	8,000	270	13
	LL4	8,800	8,600	260	13
	LL9	4,800	4,600	190	1
2001 April	MQ1	3,600	3,200	400	10
	MQ4	3,500	3,200	310	11
	MQ9	5,700	4,900	830	24
2001 May	MQ1	1,900	1,500	360	17
	MQ4	1,800	1,400	370	14
	MQ9	3,800	3,200	600	13
2001 June	MQ1	2,200	1,900	240	2
	MQ4	3,700	3,400	310	2
	MQ9	4,000	3,600	390	4
2001 July	MQ1	2,500	2,300	230	8
	MQ4	2,700	2,400	260	6
	MQ9	1,500	1,200	240	8
2001 August	MQ1	1,800	1,600	190	17
	MQ4	1,900	1,700	180	15
	MQ9	1,800	1,600	160	16
2001 September	MQ1	1,900	1,700	180	24
	MQ4	3,200	2,900	230	37
	MQ9	1,800	1,600	190	43

Table A1-9: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2002

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2002 April	LL1	5600	5100	460	57
	LL4	5600	5100	490	40
	LL9	1300	1100	220	12
2002 May	LL1	2600	1900	710	29
	LL4	2700	2000	690	41
	LL9	1800	1300	460	37
2002 June	LL1	5800	5300	340	140
	LL4	9200	8600	450	96
	LL9	3700	3000	620	27
2002 July	LL1	2900	2700	180	0.3
	LL4	2400	2200	160	0.6
	LL9	3900	3300	560	41.2
2002 August	LL1	2900	2800	140	7.2
	LL4	2300	2200	150	3.2
	LL9	1500	1400	130	0.6
2002 September	LL1	3900	3700	220	27
	LL4	3500	3200	260	31
	LL9	2500	2300	210	2.2
2002 April	MQ1	2000	1700	360	8.2
	MQ4	1900	1600	300	3.6
	MQ9	1500	1200	260	4
2002 May	MQ1	1400	1100	270	1.1
	MQ4	1400	1200	230	1.7
	MQ9	1400	1100	330	1.4
2002 June	MQ1	1000	940	110	1
	MQ4	800	680	120	0.3
	MQ9	60	50	7	0
2002 July	MQ1	1700	1300	330	50
	MQ4	1500	1100	360	34
	MQ9	940	700	240	5.5
2002 August[1]	MQ1	1400	1200	140	42
	MQ4	1200	940	180	76
	MQ9	2600	200	300	275
2002 September	MQ1	1400	1200	160	33
	MQ4	2100	1900	220	28
	MQ9	1100	920	160	28

1. recalculated for counting *Cyclotella bodanica* at 400X rather than 100X

Table A1-10: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2003

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2003	LL1	4800	4200	560	36
April	LL4	3600	2900	640	8.6
	LL9	640	450	190	6.9
2003	LL1	4200	3500	620	25
May	LL4	4600	3800	800	23
	LL9	1400	1100	280	16
2003	LL1	2300	1600	630	37
June	LL4	6800	6100	600	43
	LL9	4500	3800	680	42
2003	LL1	1600	1400	240	1
July	LL4	2400	2100	270	0.5
	LL9	2900	2700	250	9.8
2003	LL1	2000	1800	240	0.8
August	LL4	2200	1900	250	0.5
	LL9	1900	1600	260	0.6
2003	LL1	2600	2400	290	0.2
September	LL4	3700	3400	340	1.8
	LL9	1900	1600	250	1.9
2003	MQ1	3500	2900	570	28
April	MQ4	3000	2400	510	17
	MQ9	2000	1600	310	17
2003	MQ1	2900	2400	350	99
May	MQ4	3000	2400	480	43
	MQ9	3000	2500	560	16
2003	MQ1	1300	1100	180	6
June	MQ4	1900	1500	420	21
	MQ9	3000	2700	350	16
2003	MQ1	2700	2600	170	0.5
July	MQ4	2000	1600	380	1.5
	MQ9	1400	1100	240	79
2003	MQ1	1300	1000	280	43
August	MQ4	1500	1200	240	44
	MQ9	3500	2500	620	338
2003	MQ1	2100	1900	260	6.5
September	MQ4	2300	2000	290	23
	MQ9	Not			

Table A1-11: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2004

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2004	LL1	5300	4100	1200	20
April	LL4	3500	2600	860	13
	LL9	3300	2600	730	9.1
2004	LL1	8000	7100	860	34
May	LL4	6600	5300	1200	36
	LL9	2800	2000	770	22
2004	LL1	2900	2600	270	3.1
June	LL4	2900	2600	310	5
	LL9	4900	4100	730	39
2004	LL1	1600	1300	280	2.7
July	LL4	1200	1100	170	2.2
	LL9	1700	1400	270	1
2004	LL1	1300	960	350	18
August	LL4	1400	1000	300	38
	LL9	1700	1600	110	27
2004	LL1	3800	3400	370	27
September	LL4	4300	3900	350	25
	LL4 - duplicate	3100	2800	320	19
	LL9	3000	2700	280	12
2004	MQ1	1500	1120	400	2.2
April	MQ4	1400	1030	370	5.2
	MQ9	1500	1200	340	4.2
2004	MQ1	2300	2000	310	2.4
May	MQ4	1500	1200	300	3.6
	MQ9	2600	2100	470	2.4
2004	MQ1	1900	1700	190	34
June	MQ4	3000	2700	250	48
	MQ9	2200	1900	210	123
2004	MQ1	1200	960	260	6.2
July[1]	MQ4	1700	1400	260	9.9
	MQ9	1300	840	340	82
2004	MQ1	2900	2600	260	53
August[2]	MQ4	3800	3500	250	51
	MQ4 -	2500	2200	210	53
	MQ9	3900	3600	260	44
2004	MQ1	2300	1700	550	25
September	MQ4	2100	1600	420	26
	MQ9	2500	2000	520	19

1. MQ9 recalculated for counting *Cyclotella bodanica* at 400X rather than 100X
2. MQ1, MQ4, MQ9 recalculated for counting *Elakatothrix gelatinosa* colonies at 400X rather than 100X

Table A1-12: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2005

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2005 April	LL1	2700	2100	550	24
	LL4	3500	2800	610	29
	LL9	670	460	200	8.5
2005 May	LL1	7200	6600	670	55
	LL4	5700	4900	850	20
	LL9	1300	850	440	20
2005 June	LL1	2700	2400	300	2.4*
	LL4	2800	2500	330	8.3*
	LL9	990	850	130	8.9
2005 July	LL1	1200	800	400	44*
	LL4	1700	1200	460	33*
	LL9	692	540	150	3.5*
2005 August	LL1	1400	1100	290	26
	LL4	1100	810	220	64
	LL9	2400	1900	360	73
2005 September	LL1	1400	1100	170	170
	LL4	2300	1900	220	170
	LL9	1800	1200	590	31*
2005 April	MQ1	1400	1100	370	8.8
	MQ4	1900	1500	400	3.6
	MQ9	1700	1300	400	6.6
2005 May	MQ1	1300	1000	300	3.4
	MQ4	1500	1200	330	3.2
	MQ9	1300	1000	340	3.7
2005 June	MQ1	1700	1600	150	4.6
	MQ4	1000	710	270	2.1
	MQ9	1100	900	200	1.1
2005 July[1]	MQ1	1100	860	220	14.6
	MQ4	1100	920	200	11.2
	MQ9	1400	700	170	489
2005 August[2]	MQ1	1100	950	170	0.5
	MQ4	1900	1600	250	7.1
	MQ9	2100	1700	330	89*
2005 September	MQ1	870	710	140	10.7
	MQ4	1200	1100	170	20.2
	MQ9	1400	1100	180	146

* = Cyclotella bodanica counted at 400X rather than 100X

Table A1-13: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2006

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)	>25 μm (100X)
2006 April	LL1	1800	1100	610	1.9*
	LL4	3200	2700	520	14.7
	LL9	690	550	135	2.2
2006 May	LL1	2600	2000	620	19.7
	LL4	4900	4200	640	12.9
	LL9	540	380	160	4.8
2006 June	LL1	860	610	200	39.5
	LL4	2000	1800	190	22.2
	LL4 (rep)	1100	940	190	23.2
	LL9	1700	1400	220	17.7
2006 July	LL1	1300	1100	160	54.8
	LL4	2700	2200	370	165
	LL9	1700	1300	350	19.1
2006 August	LL1	2700	2500	200	14.3
	LL4	2600	2300	220	34.6
	LL9	2800	2300	470	23.8
2006 September	LL1	3800	3600	160	0.4
	LL4	1300	1200	120	2
	LL9	1800	1700	130	3.6
2006 April	MQ1	2200	16,00	240	9.4
	MQ4	2400	1900	550	8.6
	MQ9	1600	1400	180	8.2
2006 May	MQ1	1700	1500	240	10.8
	MQ4	1700	1400	320	7.4
	MQ4 (rep)	2100	1800	310	11.8
	MQ9	1900	1600	280	4.1
2006 June	MQ1	1900	1800	130	0.9
	MQ4	1400	1200	200	4.4
	MQ9	950	840	110	0.6
2006 July	MQ1	1100	870	220	42.8
	MQ4	2000	1700	260	16.6
	MQ9	2300	2100	180	18.8*
2006 August	MQ1	1500	1200	280	6.5
	MQ4	2100	1800	290	13.3
	MQ9	1300	880	400	17.0*
2006 September	MQ1	2500	2300	200	1.9
	MQ4	2100	1800	260	11.8
	MQ9	3400	2400	970	1.8*

* *Cyclotella bodanica* (diatom) counted at 400X rather than 100X

Table A1-14: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2007

Date	Sampling Site	Total Abundance	< 5μm (1000X)	5 to 25 μm (400X)
2007 April	LL1	3100	2800	240
	LL4	3000	2200	620
	LL9	1200	910	240
2007 May	LL1	2600	2000	540
	LL4	3300	2600	670
	LL9	1300	890	430
2007 June	LL1	2100	1600	420
	LL4	2500	2000	520
	LL9	1100	750	300
2007 July	LL1	2300	2000	240
	LL4	2400	2100	270
	LL9	3100	3000	180
2007 August	LL1	1100	900	240
	LL4	2300	2100	150
	LL4 (rep)	2600	2400	150
	LL9	570	480	90
2007 September	LL1	2500	2200	280
	LL4	1700	1400	240
	LL9	420	350	68
2007 April	MQ1	1700	1500	230
	MQ4	1900	1602	300
	MQ9	1100	900	200
2007 May	MQ1	1500	1300	250
	MQ4	1800	1500	320
	MQ9	2600	2300	310
2007 June	MQ1	1500	1200	300
	MQ4	1800	1600	200
	MQ9	1500	1200	290
2007 July	MQ1	1500	1100	220
	MQ4	1900	1500	440*
	MQ9	1000	860	150
	MQ9 (rep)	1600	1400	150
2007 August	MQ1	2300	2100	200
	MQ4	1100	970	160
	MQ9	710	590	120
2007 September	MQ1	1400	1100	270
	MQ4	1500	1200	290
	MQ9	1000	690	300

Table A1-15: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2008

Date	Sampling Site	Total Abundance	< 5µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
2008 April	LL1	2,500	2,070	360	30
	LL4	3,100	2,500	540	50
	LL9	1,300	1,030	240	20
2008 May	LL1	3,100	2,840	220	20
	LL4	5,300	4,820	430	25
	LL9	1,300	1,030	260	20
2008 June	LL1	1,000	880	110	1
	LL4	960	730	220	8
	LL9 (rep)	1,500	1,060	380*	16*
	LL9	1,200	780	380*	7*
2008 July	LL1	1,000	970	80	1
	LL4	1,400	1,300	110	17
	LL9	2,000	1,500	370	110
2008 August	LL1	1,100	1,000	50	1
	LL4	1,400	1,300	50	11
	LL9	1,100	1,060	40	9
2008 September	LL1	2,100	1,730	420**	2**
	LL4	2,300	1,780	490**	3**
	LL9	2,900	2,250	690**	6**
2008 April	MQ1	2,100	1,850	200	1
	MQ4	1,700	1,530	200	3
	MQ9	2,800	2410	400	4
2008 May	MQ1	1,000	870	130	1
	MQ4	1,700	1460	230	2
	MQ9	1,200	1,000	180	2
2008 June	MQ1	840	700	140	0.4
	MQ4	1,300	1,040	240	1
	MQ9	870	580	280	0.5
2008 July	MQ1	620	520	90	8
	MQ4	500	370	130	8
	MQ9	870	680	180	0.5
	MQ9 (rep)	1,000	760	260	9
2008 August	MQ1	750	660	100	1
	MQ4	980	860	110	6
	MQ9	1,300	990	290	5
2008 September	MQ1	1,500	1,310	160	14
	MQ4	1,100	980	150	3
	MQ9	2,800	2,680	130	10

* *Synedra radians* (diatom) counted at 400X rather than 100X, due to high numbers

** *Asterionella formosa* (diatom) counted at 400X rather than 100X, due to high numbers

Table A1-16: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2008

Date	Sampling Site	Total Abundance	< 5 µm (1000X)	5 to 25 µm (400X)	> 25 µm (100X)
2008 April	LL1	780	480	300	6
	LL4	1,600	1,220	340	4
	LL9	90	60	30	1
2008 May	LL1	6,000	5,150	820	19
	LL4	4,900	4,100	760	10
	LL9	430	290	140	5
2008 June	LL1	1,700	1,370	370	5
	LL4	1,400	1,030	360	12
	LL9	680	340	330	6
2008 July	LL1	2,100	1,900	270	3
	LL4	2,700	2,400	330	4
	LL9	700	340	350	4
2008 August	LL1	3,100	2,900	170	3
	LL4	2,400	2,200	190	15
	LL9	1,700	1,300	370	10
2008 September	LL1	3,700	3,500	220	5
	LL4	2,300	2,100	180	3
	LL9	1,100	950	170	1
2008 April	MQ1	1,400	1,130	250	33
	MQ4	1,300	1,170	160	12
	MQ9	2,300	2,730	520	13
2008 May	MQ1	1,700	1,440	260	3
	MQ4	2,100	1,750	340	5
	MQ9	3,800	3,060	720	18
2008 June	MQ1	1,500	1,360	160	0.1
	MQ4	1,100	990	150	0.2
	MQ9	1,100	940	200	0.8
2008 July	MQ1	1,000	790	190	4
	MQ4	1,300	1,100	220	8
	MQ9	1,200	940	240	5
2008 August	MQ1	610	450	160	0.3
	MQ4	1,300	1,170	170	3
	MQ9	1,600	1,200	390	0.4
2008 September	MQ1	830	670	160	5
	MQ4	1,200	970	170	6
	MQ9	1,400	1,200	240	1

Table A1-17: Phytoplankton Abundance (cells/mL) in the Quinsam Lakes System, 2010

Date	Sampling Site	Total Abundance	<5 µm (1,000X)	5 to 25 µm (400X)	>25 µm (100X)
2010 April	LL1	630	490	140	1.6
	LL4	1,900	1,500	390	3
	LL9	170	100	70	0.4
2010 May	LL1	1200	940	270	13.4
	LL4	4,500	3,800	650	17
	LL9	530	390	140	0.9
2010 June	LL1	2400	1900	500	5.2
	LL4	3,600	3,000	610	11
	LL9	1500	1100	400	10.6
2010 July	LL1	2100	1900	170	8.7
	LL1 (rep)	1,900	1,700	180	5
	LL4	3,000	2,800	250	2
	LL9	1,900	1,700	210*	0
2010 August	LL1	1200	990	180	1.5
	LL4	1,600	1,400	190	1
	LL4 (rep)	1,600	1,400	180	2
	LL9	1,800	1,600	170	0
2011 September	LL1	2100	1800	260	15.1
	LL4	4,400	4,200	200	5
	LL9	1200	1100	130	0.4
2010 April	MQ1	1700	1600	100	0.4
	MQ4	1,200	1,100	120	1
	MQ9	800	710	90	2.4
2010 May	MQ1	1100	990	120	0.9
	MQ4	1,100	960	150	1
	MQ9	1600	1330	240	2.9
2010 June	MQ1	2000	1700	270	0.9
	MQ4	1,400	1,100	240	1
	MQ9	1000	850	200	1.1
2010 July	MQ1	1800	1500	250	8.7
	MQ1 (rep)	1,400	1,300	170	6
	MQ4	1,500	1,300	180	10
	MQ9	1,600	1,400	180	4
2010 August	MQ1	1400	1200	140	7.2
	MQ4	1,000	870	160	5
	MQ4 (rep)	1,100	900	150	5
	MQ9	1,200	1,000	150	8
2010 September	MQ1	1300	1000	260	1.3
	MQ4	1,300	1,040	220	3
	MQ9	1100	900	190	1.7

APPENDIX B

Species Composition Data, September 2011

QUINSAM LAKE PHYTOPLANKTON - 23 September 2011
Long Lake 1 m (BQ0225)
27 ml sample settled

TOTAL CELLS COUNTED	**385**
TOTAL CELLS PER ML	**1,300**

	number counted	cells per mL
1000X magnification - 100 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	58	522
Ochromonas/Chromulina spp. (4-5 um)	32	288
Ochromonas/Chromulina spp. (6-7 um)	7	63
Pseudokephyrion sp.	7	63
TOTAL	**104**	**936**
400X magnification - 1 strip		
CHRYSOPHYCEAE		
Diceras chodatii	2	3
Dinobryon sp. (cell)	1	2
Mallomonas spp.	2	3
Ochromonas spp. (8-10 um)	73	124
BACILLARIOPHYCEAE		
Cyclotella glomerata (cells + cols)	1	2
Cyclotella stelligera/ocellata	2	3
CHLOROPHYCEAE		
Crucigenia sp. (cols)	1	2
Gloeocystis sp. (cells + cols)	4	7
Nephrocytium limneticum (cells)	3	5
Oocystis sp. (cells + cols)	1	2
Schroederia setigera	1	2
CRYPTOPHYCEAE		
Chroomonas acuta	7	12
Cryptomonas spp.	3	5
Cryptomonas marssonii	2	3
Cryptomonas rostratiformis	1	2
Kathablepharis ovalis	5	9
Rhodomonas minuta	114	194
DINOPHYCEAE		
Gymnodinium sp.	1	2
CYANOPHYCEAE		
Chroococcus cf. Prescottii (cols)	1	2
TOTAL	**225**	**383**
100X magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon bavaricum (10 col, 22 cells)	22	0.9
Dinobryon cylindricum (12 col, 12 cells)	12	0.5
Dinobryon sociale (2 col, 4 cells)	4	0.2
BACILLARIOPHYCEAE		
Synedra radians	1	0.04
Synedra ulna	2	0.1
CHLOROPHYCEAE		
Botryococcus braunii (cols)	13	0.5
Elakatothrix gelatinosa (cols)	1	0.04
Nephrocytium limneticum (cols)	1	0.04
TOTAL	**56**	**2.2**

QUINSAM LAKE PHYTOPLANKTON - 23 September 2011
Long Lake 4 m (BQ0226)
27 ml sample settled

TOTAL CELLS COUNTED	**315**
TOTAL CELLS PER ML	**1,800**

	number counted	cells per mL
1000X magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	41	738
Ochromonas/Chromulina spp. (4-5 um)	26	468
Ochromonas/Chromulina spp. (6-7 um)	12	216
Pseduokephyrion sp.	2	36
TOTAL	**81**	**1458**
400X magnification - 1 strip		
CHRYSOPHYCEAE		
Diceras chodatii	1	2
Dinobryon sp.	1	2
Mallomonas sp.	7	12
Ochromonas spp. (8-10 um)	57	97
BACILLARIOPHYCEAE		
Cyclotella glomerata (cells + cols)	3	5
Cyclotella stelligera/ocellata	1	2
Melosira italica (fil)	1	2
CHLOROPHYCEAE		
Botryococcus braunii (cell)	1	2
Gloeocystis sp. (cells + cols)	5	9
Nephrocytium limneticum (cells)	7	12
Oocystis sp. (cells+cols)	3	5
CRYPTOPHYCEAE		
Cryptomonas spp.	8	14
Cryptomonas marssonii	4	7
Kathablepharis ovalis	2	3
Rhodomonas minuta	122	207
TOTAL	**223**	**379**
100X magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon bavaricum (8 col, 10 cells)	10	0.4
Dinobryon cylindricum (8 col, 8 cells)	8	0.3
BACILLARIOPHYCEAE		
Synedra ulna	1	0.04
CHLOROPHYCEAE		
Botryococcus braunii (cols)	2	0.1
TOTAL	**11**	**0.4**

QUINSAM LAKE PHYTOPLANKTON - 23 September 2011
Long Lake 9 m (BQ0227)
27 ml sample settled

TOTAL CELLS COUNTED	**321**
TOTAL CELLS PER ML	**960**

	number counted	cells per mL
1000X magnification - 100 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	44	396
Ochromonas/Chromulina spp. (4-5 um)	21	189
Ochromonas/Chromulina spp. (6-7 um)	6	54
Chrysochromulina parva	12	108
unidentified flagellate	2	18
TOTAL	**85**	**765**
400X magnification - 2 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols + cells)	2	2
Mallomonas sp.	2	2
Ochromonas spp. (8-10 um)	47	40
BACILLARIOPHYCEAE		
Cyclotella stelligera/ocellata	12	10
Melosira italica (fil)	28	24
CHLOROPHYCEAE		
Elakatothrix gelatinosa (cols)	5	4
CRYPTOPHYCEAE		
Cryptomonas spp.	6	5
Cryptomonas rostratiformis	1	1
Kathablepharis ovalis	1	1
Rhodomonas minuta	120	102
CYANOPHYCEAE		
Chroococcus cf. Prescottii (cols)	4	3
TOTAL	**228**	**194**
100X magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (3 col, 3 cells)	3	0.1
CHLOROPHYCEAE		
Botryococcus braunii (cols)	1	0.04
Quadrigula chodati (cols)	1	0.04
DINOPHYCEAE		
Gymnodinium helveticum	6	0.2
TOTAL	**8**	**0.3**

QUINSAM LAKE PHYTOPLANKTON - 22 September 2011
Middle Quinsam Lake 1 m (BP5478)
27 ml sample settled

TOTAL CELLS COUNTED	**881**
TOTAL CELLS PER ML	**2,300**

	number counted	cells per mL
1000X magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	53	954
Ochromonas/Chromulina spp. (4-5 um)	31	558
Ochromonas/Chromulina spp. (6-7 um)	8	144
unidentified flagellate	22	396
Chrysochromulina parva	3	54
Pseudokephyrion sp.	1	18
TOTAL	**118**	**2124**
400X magnification - 3 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols + cells)	3	2
Mallomonas sp.	3	2
Ochromonas spp. (8-10 um)	106	60
BACILLARIOPHYCEAE		
Melosira italica (fil)	1	1
Navicula sp.	1	1
CHLOROPHYCEAE		
Gloeocystis sp. (cells+cols)	7	4
Oocystis sp. (cells+cols)	4	2
Nephrocytium sp. (cells)	6	3
Schroederia setigera	1	1
CRYPTOPHYCEAE		
Cryptomonas sp.	48	27
Cryptomonas marssonii	15	9
Kathablepharis ovalis	11	6
Rhodomonas minuta	110	62
DINOPHYCEAE		
Gymnodinium sp.	2	1
CYANOPHYCEAE		
Aphanothece sp. (cols)	12	7
Chroococcus cf. Prescottii (cols)	3	2
TOTAL	**333**	**189**
100X magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (18 col, 415 cells)	415	16.6
BACILLARIOPHYCEAE		
Cyclotella bodanica	12	0.5
CHLOROPHYCEAE		
Botryococcus braunii (cols)	3	0.1
TOTAL	**430**	**17.2**

QUINSAM LAKE PHYTOPLANKTON - 22 September 2011
Middle Quinsam Lake 4 m (BP5478)
27 ml sample settled

TOTAL CELLS COUNTED	**493**
TOTAL CELLS PER ML	**2,600**

	number counted	cells per mL
1000X magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	77	1386
Ochromonas/Chromulina spp. (4-5 um)	34	612
Ochromonas/Chromulina spp. (6-7 um)	8	144
Chrysochromulina parva	2	36
unidentified flagellate	12	216
TOTAL	**133**	**2394**
400X magnification - 2 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols)	6	3
Dinobryon sp. (cells)	1	1
Mallomonas sp.	9	5
Ochromonas spp. (8-10 um)	73	41
BACILLARIOPHYCEAE		
Melosira italica (filaments)	3	2
CHLOROPHYCEAE		
Crucigenia sp. (cols)	1	1
Gloeocystis sp. (cols + cells)	12	7
Oocystis sp. (cols + cells)	2	1
Nephrocytium sp. (cells)	7	4
Schroederia setigera	3	2
CRYPTOPHYCEAE		
Cryptomonas spp.	68	39
Cryptomonas marssonii		
Cryptomonas rostratiformis	1	1
Kathablepharis ovalis	20	11
Rhodomonas minuta	110	62
DINOPHYCEAE		
Gymnodinium sp.	1	1
Peridinium sp.	1	1
CYANOPHYCEAE		
Aphanothece sp. (cols)	11	6
TOTAL	**329**	**186**
100X magnification - whole sample		
CHRYSOPHYCEAE		
Dinobryon cylindricum (11 col, 158 cells)	158	6.3
BACILLARIOPHYCEAE		0.0
Synedra radians	2	0.1
Synedra ulna	1	
Cyclotella bodanica	25	
CHLOROPHYCEAE		0.0
Botryococcus braunii (cols)	3	0.1
CYANOPHYCEAE		0.0
Chroococcus cf. prescotti (cols)		0.0
DINOPHYCEAE		0.0
Ceratium hirudinella	1	
TOTAL	**31**	**0.2**

QUINSAM LAKE PHYTOPLANKTON - 22 September 2011
Middle Quinsam Lake 9 m (BP5478)
27 ml sample settled

TOTAL CELLS COUNTED	**477**
TOTAL CELLS PER ML	**1,600**

	number counted	cells per mL
1000X magnification - 50 fields		
CHRYSOPHYCEAE		
Ochromonas/Chromulina spp. (2-3 um)	56	1008
Ochromonas/Chromulina spp. (4-5 um)	18	324
Ochromonas/Chromulina spp. (6-7 um)	4	72
TOTAL	**78**	**1404**
400X magnification - 2 strips		
CHRYSOPHYCEAE		
Chrysocapsa paludosa (cols+cells)	17	14
Chrysolikos sp.	1	1
Diceras chodatii	1	1
Mallomonas sp.	6	5
Ochromonas spp. (8-10 um)	63	54
BACILLARIOPHYCEAE		
Cyclotella stelligera/ocellata	1	1
Melosira italica (fil)	8	7
CHLOROPHYCEAE		
Gloeocystis sp. (cells + cols)	5	4
Schroederia setigera	1	1
CRYPTOPHYCEAE		
Chroomonas acuta	3	3
Cryptomonas spp.	17	14
Cryptomonas obovoidea	2	2
Kathablepharis ovalis	5	4
Rhodomonas minuta	135	115
Rhodomonas sp.	14	12
CYANOPHYCEAE		
Aphanothece sp. (cols)	7	6
Chroococcus cf. Prescottii (cols)	6	5
Dactylococcopsis acicularis (cols0	2	2
TOTAL	**279**	**237**
100X magnification - half sample		
BACILLARIOPHYCEAE		
Cyclotella bodanica	110	8.80
Synedra radians	1	0.08
CHLOROPHYCEAE		
Botryococcus braunii (cols0	1	0.08
Quadrigula sp. (cols)	8	0.64
TOTAL	**120**	**9.6**

APPENDIX IV

PERIPHYTON ANALYTICAL RESULTS FOR QUINSAM RIVER AND LONG LAKE OUTLET

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August 17, 2011

Project No: 1231-10406

Maxxam Analytics Laboratory
4606 Canada Way
Burnaby, BC
V5G 1K5

Attention: Dave Langill and VJ Oco

Dear Sirs:

Reference: Quinsam Lakes Periphyton, July 2011
(Sample reference AY6857)

Enclosed are results for analysis of two periphyton samples from two stream locations in the Quinsam Lakes system. Samples were collected in July 2011.

1 METHODS

Several subsamples (up to 5% of each sample) were examined in a Zeiss inverted microscope at 100x and 400x magnification to obtain a reliable semi-quantitative assessment of species abundance. Sufficient volume was examined to yield a consistent estimate of relative abundance of organisms that are distributed either randomly or in clumps.

Presence of silt and detritus was noted, and relative abundance (%) of non-diatom species (green, bluegreen, chrysophyte and red) was assessed, based on relative contribution to the biomass. Relative abundance of diatom species was ranked as predominant, common or present (corresponding approximately to >25%, 5 to 25% or <5%, respectively).

Abundance of non-diatom and diatom species was estimated based on “visual weight” (i.e., how much of a microscope field the organism covered), so is more closely related to biomass than cell number estimates. This approach accounts for large cells, filaments and colonies, which have more

biomass and 'visual weight', as well as small cells, which can be numerically predominant but contribute little to biomass. Species considered predominant were high in both number and overall biomass.

A semi-quantitative assessment avoids some problems associated with strictly numerical abundance estimates, which may emphasize predominance of very small cells such as *Achnanthes* spp. (common early colonizing species that contribute little to biomass) and de-emphasize larger cells, whose presence may reflect longer term environmental conditions. Given that many periphyton species do not display random distribution in the stream or in growth form (filaments, colonies, clumps or mats), this approach overcomes the requirement of quantitative methods for random distribution of organisms.

Organisms were identified to species wherever possible. Exceptions included uncommon species, green algae requiring sexual reproductive structures for identification and species of diatoms belonging to very large genera (e.g., *Nitzschia, Navicula*) or requiring clearing of organic matter from silica frustules to observe the distinctive marking patterns required for identification.

2 RESULTS

Samples were collected from sites WB and LLO, from artificial substrates. Samples from both locations contained visible amounts of fine sediment, with sample WB also containing several chironomids. The samples consisted mainly of diatoms (>99%) with some blue-green and green algae (Table 1). Both samples contained small amounts of detritus and silt.

In the WB sample, *Synedra ulna* and *Achnanthes minutissima* were predominant and *Achnanthes* spp., *Eunotia* spp., *Eunotia pectinalis* var. *minor, Synedra radians,* and *Tabellaria fenestrata* were common.

In the LL0 sample, there was no clearly predominant species. The distribution was spread among several common species, including *Achnanthes* spp., *Achnanthes minutissima, Cyclotella* sp., *Eunotia* spp., *Eunotia pectinalis* var. *minor, Gomphonema* spp., *Gomphonema subclavatum,* and *Gomphonema angustatum* common.

Community composition has varied over the years. All the species reported for 2010 have been observed in previous years for these samples, although relative proportions vary somewhat from year to year. These species are common in streams of coastal British Columbia and were found during the late 1970s in the lower section of the Quinsam River (Munro *et al.*, 1985)[1].

[1] Munro, K.A., S.C. Samis and M.D. Nassichuk. 1985. The effects of hatchery effluents on water chemistry, periphyton and benthic invertebrates of selected British Columbia streams. Can. MS. Rep. Fish. Aquat. Sci. 1830. 203 pp. plus appendices

Reference: Quinsam Lakes Periphyton, July 2011
(Sample reference AY6857)

Table 1: Periphyton Abundance in Samples from the Quinsam System, July 8, 2011

(+++ = predominant, ++ = common, + = present)

	WB	LLO
BACILLARIOPHYCEAE (diatoms)	**>99%**	**>99%**
Achnanthes spp.	+++	++
Achnanthes minutissima	+++	++
Cyclotella sp.	+	++
Cymbella spp.	+	+
Diatoma tenue	+	+
Epithemia turgida	+	+
Eunotia spp.	++	++
Eunotia pectinalis v. *minor*	++	++
Fragilaria sp.		+
Gomphonema spp.	+	++
Gomphonema acuminatum	+	+
Gomphonema angustatum	+	++
Gomphonema subclavatum	+	+
G. truncatum		+
Hannaea arcus	+	
Melosira italica	+	+
Navicula spp.		+
Nitzschia sp.	+	+
Pinnularia sp.		+
Rhopalodia gibba	+	
Synedra radians	++	+
Synedra ulna	+++	+
Tabellaria fenestrata	++	+
CHLOROPHYCEAE (green algae)		
Staurastrum sp.		+
CYANOPHYCEAE (blue-green algae)		
Anabaena sp.	+	

3 CLOSURE

We trust this information meets your present requirements. Should you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,

Stantec Consulting Ltd.

Original signed by:

Karen Munro, M.Sc., R.P.Bio.
Senior Aquatic Scientist
Environmental Management Group

KM/mp

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APPENDIX V

MINISTRY OF ENVIRONMENT
“COMPLIANCE REVIEW RECORD” & ETRC MEETING MINUTES

Meeting Minutes
2011/12 Public Meeting with the
Quinsam Coal Mine Environmental Technical Review Committee

March 5th, 2012
10:30am – 4:30pm
Campbell River Enterprise Centre, 900 Alder St, Campbell River

Attendees:	Andrea Miskelly	Ministry of Environment (MoE) (AM)
	Deb Epps	MoE, Nanaimo (DE)
	Hubert Bunce	MoE, Nanaimo (HB)
	Katherine Pearce	MoE, Nanaimo (KP)
	Ed Taje	Ministry of Energy and Mines (MEM) (ET)
	Denis Collins	Ministry of Forests, Lands and Natural Resource Operations (DC)
	Steve Gardner	Quinsam Coal Corporation (QCC) (SG)
	Gary Gould	QCC (GG)
	Kathleen Russell	QCC (KR)
	Norm Johnson	QCC (NJ)
	Sarah Shi	QCC (SS)
	Barbara Wernick	Golder Associates (BW)
	Alan Calder	Golder Associates (AC)
	Bruce Mattson	Lorax Environmental (BM)
	Laura Findlater	Lorax Environmental (LF)
	Terri Martin	City of Campbell River (TM)
	Larry Samson	City Councilor, City of Campbell River (LS)
	Lynne Stone	Office of Claire Travena, MLA (LS)
	Dr. Bill Cullen	UBC / Canadian Water Network (BC)
	Lynda Belter	Campbell River Environmental Committee (CREC) /Council of Canadians (LB)
	Leona Adams	CREC / Campbell River Estuary Protection Group (LA)
	Dietmar Setzer	CREC (DS)
	Don McIvor	CREC (DI)
	David Brown	Haig-Brown Institute (DB)
	Richard Hamilton	Greenways Land Trust (RH)
	Barry Ross	Greenways Land Trust (BR)
	Peter Winter	CREC / Greenways Land Trust (PW)
	Stan Goodrich	CREC / Greenways Land Trust (SGh)
	Paul Rudon	The Mirror Newspaper
Regrets:	Mark Van Doorn	Department of Fisheries and Oceans
	John Miller	Environment Canada
	Kim Bellefontaine	MEM
	Tania Demchuk	MEM

Purpose: To review the Quinsam Coal Corporation 2010/11 Annual Monitoring Report for completeness, review other environmental monitoring and protection measures taken since the report, identify issues and potential changes to the monitoring program and agree on possible recommendations to be made to the Regional Manager of Environmental Protection.

1. Overview of mine activity over the preceding year and plans for the coming year (QCC)

SG presented a PowerPoint presentation on the current status and future plans for the mine operations. Highlights from the presentation and discussion include:

- In 2011, 467,300 metric tonnes of clean coal was produced from a total of 685,600 tonnes of run of mine production, primarily from the 5 South Phase 2 mine operation.
- Fine tailings continue to be stored in the main tailings impoundment facility
- 7 South – submitted amended permit application June 7 2011, continue to address questions and provide additional information throughout 2011 (AM clarified this is referring to the Mines Act permit amendment)
- Submitted effluent permit amendment screening document to MoE in Oct 2011 and continue to provide supporting documentation
- Various studies and reports completed by QCC throughout the year were also discussed

Permitting and related activities:

- Tailings injection trial – mine permit amendment was obtained in March 2011 to conduct an underground tailings injection trial using non-PAG tailings. Tailings were pumped into previously mined 2 North area where solids will settle and decanted water was pumped from the underground dewatering system to SP4 water management facility. The injection well was installed behind the main tailing facility. The trial showed that tailings can successfully be injected into caved mine workings from surface wells and proved that the 2N historic mine waters were non-acidic and have low metals and predictable sulphate levels.
- 7 south mine - Presently clearing trees and prepping site to get ready for construction activities in the spring. The project timeline was described as: clearing of site and topsoil salvage, water management structures to be completed in first quarter of 2012. In the second quarter of 2012: materials excavation and mining in portal pit, extension of power line. Underground development to occur in later 2012.

2012 operational plan:

- Continue to produce coal from 5S and 2N mine, begin underground coal production from 7 south mine
- Continue to dispose of PAG-CCR waste in river barrier pillar through 2012
- Continuing to place tailings in the main tailings facility but plan to phase toward underground tailings injection in 2 north mine

LA had a question about seepage from the 2 North pit sump; stated that the updated hydrogeological assessment suggests the pit cannot be flooded to as was proposed as it could be a source of seepage to Middle Quinsam Lake (MQL). GG – water level is not high enough right now to allow seepage, the concern is at final flooding of the mine. We will be looking at moving some material out of the 2N pit sump so that the final flood elevation will keep all material in the pit submerged. SG – water seeping along old pit floor and collected at 2 North portal sump pumped into wetland behind pit and into settling pond. Therefore 2 North pit pond is not migrating underground directly to MQL – it goes through the water management facilities.

BC asked about further testing by Lorax regarding potential oxidation of 7S CCR and potential release of arsenic and how this affects the financial security deposit for the mine. HB – MEM has financial security from QCC. ET – security exists, some is earmarked for long term treatment, if necessary. BM – tests

ongoing – 5 South As levels increased to level of 90 – 100 ppb, compared to natural background levels in Dunsmuir sandstone groundwater of around 200-300 ppb typically. Study on 7S CCR is continuing. BC commented that there is a large risk if still continuing with tests. BM discussed the rate of transport, noting that transport is limited by the rate at which groundwater moves through bedrock (much lower rates of movement underground compared to surface). Natural levels of arsenic in groundwater have been measured at elevated levels in bedrock, with flows to the Quinsam River (discussed later).

DS asked where tests for arsenic in natural groundwater are taken. BM – discussed other studies on the island showing arsenic concentrations existing in natural conditions, such as in the Dunsmuir Sandstone present at the mine site. Monitoring wells were installed in the sandstone in 7S prior to any mining. This sandstone is also present in other areas of Vancouver Island and elevated arsenic in the groundwater is present.

2. Review of Annual Monitoring Report (MoE, QCC)

2.1 Report format

AM confirmed that public groups were able to access the report through the City of Campbell River, asked whether there were any issues with accessing the report.

LA noted that water quality exceedances were not always shown in the tables in bold font. SG – database issues are being addressed, SS to discuss work being done to improve presentation of data in the afternoon.

LA commented on an issue around one of the dates used in the introduction of the report. According to MEM report, mining began in 1985 on a test basis, with the Mine permit given 1986. Exploration of 3 South 77 pit which drains into Long Lake began in 1977. SG – noted that the section quoted from the introduction was referring to mining in the south mine area specifically and acknowledged that it is correct that bulk sampling began in 1985 and in a larger context in 1987. Noted that mining did not start in the south mine area until 1991. LA commented that should state south mine area in report. ***(Action item: edit text of Annual Report so that date that mining commenced references the location of the mine being referred to)***

AM acknowledged that highlighting/bolding of exceedances in the report was inconsistent, and indicated that MoE is working with QCC on addressing this issue for next year's report. MoE would like to see any exceedance of permit limits or water quality guidelines highlighted, and would like to see min and max concentrations as well as the frequency of exceedances (e.g. 1 of 5 samples exceeded) described in the text.

AM noted a change in how data was described in the text – comparison of annual averages was removed from the text after request from MoE because comparison of annual averages isn't a good indication of trends. MoE instead requested that QCC do a statistical analysis of data trends in a separate report, discussed later. The annual average data were still summarized in the report in tables (tables 66-67) because public groups indicated during last year's public ETRC that the annual average comparison is helpful. LA commented that the tables were difficult to read because they were too small when printed. ***(Action item: ensure table font size is appropriate for the printed tables in subsequent Annual Reports.)***

2.2 Adherence to monitoring schedule

AM – excellent adherence to monitoring schedule; QCC samples many more locations and parameters than required in the permit. A few fairly minor measurements were missed, which included TSS or flow measurements that are collected at high frequency.

2.3 Compliance with permit limits

Settling Pond 1:
AM indicated that there were some exceedances of iron at the discharge from settling pond 1, which occurred in the fall of 2010 and in January 2011 – the exceedance in January was relatively minor (minimal exceedance, not repeated); however, the fall exceedance was a more significant event (multiple exceedances in a row). The fall exceedance was related to dewatering at 4S.

SG presented a summary of the 4S dewatering event:

- The 4S mine is in the No. 3 seam, which is high sulphur (around 3%). The No. 3 seam was developed in 96-97, and allowed to flood in 2009.
- In 2010, it was decided to dewater 4 South and rehabilitate the underground infrastructure in order to investigate underground PAG-CCR storage opportunities.
- Pumping started on September 20, 2010 during day shifts only
- 2 samples per week were being taken during pumping at the discharge end
- On October 22, the iron exceedance was noted, in part due to severe discolouring at settling pond 1
- Pumping was immediately shut down and the water was diverted from the management system to the 3 South PAG pond.
- Charts were presented showing 4S discharge quality, Settling Pond 1 quality and daily discharge volumes for October.

BM provided an explanation of why iron levels were high in the 4 South mine:

- The 4 South mine water is reducing causing oxidation products on mine walls to be released to aqueous phase. Fe (III) is reduced to Fe(II), which increases pH.
- When water was pumped out it came in contact with the atmosphere and Fe(II) oxidized to Fe(III) which is an acid generating process; that is why we saw slightly acidic waters when pumping out the 4 South mine.

LA asked why only iron was high and not also high sulphate, manganese, etc. BM – other metals were probably diluted through physical mixing, bringing concentrations down. There are also other attenuation factors, generally related to pH. Manganese is pH sensitive so would be expected to come out of solution and settle out in the settling pond. When iron precipitates, it is very fine, so it requires sufficient time to settle out, otherwise the iron can stay suspended in solution. Sometimes iron can pass through filters because particles are very fine (even though it technically is a solid).

LA asked whether the water in the mine pool goes to groundwater. BM referred to the 4 South groundwater study – discusses how mine water from this area reports to Long Lake. Believe most groundwater from 4 south goes to Middle Quinsam Lake, though a small surficial portion goes to Long Lake.

LA asked about the discharge from 5 south. AM – 5 south water is pumped to settling pond 4.

DB requested clarification on BM's explanation of iron redox, specifically around precipitation and removal of iron from solution as iron sulphide. BM explained that in reducing conditions Fe(II) is in solution and a portion of the sulphate is reduced to sulphide. When sulphide and iron are present in reducing conditions, they reform into a iron sulphide precipitate; expects this process is happening in the 4 south mine pool to some degree.

DB asked what will happen in 50, 100 years in the 4 south mine. BM – condition probably will improve rather than get worse. Chemistry of flooded mine generally improves over time, depends on how quickly water is getting out of the mine to the environment. A few reasons for this – geochemical processes (previously discussed), no new sources of contamination, and new natural groundwater moving through the mine and replacing the old water. There is a chemical load in the mine pool, but if it is flooded and remains flooded, the water moves out slowly through relatively impermeable rock.

BC asked about monitoring of Middle Quinsam Lake (MQL). AM – some limited sediment work in MQ Lake, looking at revamping monitoring program which will include sediment monitoring on full site. There was discussion of the flow path from 4S to MQL. This groundwater flow was studied and reported by Lorax in QCC's 2011 Mines Act permit amendment application. The results showed the travel time for groundwater between the 4S mine and MQL is around 17 or 18 years (see report for specifics).

BC commented that seeing sulphide in the underground workings suggests a microbial process, rather than a chemical process dependant on oxygen, and indicated this is a serious problem in all mines and which creates acid mine drainage. He indicated that because of this, mine waste submerged in water can still generate acid. BM noted that the microbial process is what drives the chemical process. It was indicated that subaqueous disposal of mine wastes slows oxidation rates and is a proven and accepted practice. BC had additional questions around the chemical process resulting in the reduction of sulphate to sulphide; concerned that the same bacteria that are involved in conversion of sulphate to sulphide also produce acid mine drainage. BM – bacteria involved in sulphide reduction process are a different bacteria species than those that produce acid mine drainage.

AM – move to discussion of non-permit monitoring locations:

<u>Long lake seep</u> – elevated iron; LLS to be discussed later

<u>LLE (entry to Long Lake)</u>
AM noted elevated iron levels at LLE. LLE is not a permitted discharge point, therefore discharge iron limits are compared to LLE for screening purposes. AM overviewed the LLE sample location, which is a combination of water from Settling Pond 1 and ditch water that flows down the 2/4 South Haul Road, and from there into Long Lake. Evaluation of iron data at LLE is showing that iron is getting into the system between the SPD-SPC pathway and the final discharge to Long Lake (i.e. after flows from the Settling Pond 1 discharge meet flows from the 2/4 South Haul Rd ditch). AM indicated that QCC is investigating this issue and has made some mitigation efforts.

KR discussed QCC investigation into high iron concentrations at LLE. Refer to 2010/1 Annual Report Appendix IX for details. Overall:

- Results show that as water hits 4S inflow, the concentration of iron is really low; at the 4S upper site there was a little iron but not much; most sampling sites were really low except 4S under pad and 4 south lower (levels similar at both sites)

- Concentrations at LLE for this year showed some exceedances of iron. There is a seasonal trend – low iron when large amounts of precipitation. During dry months, iron concentration higher.
- Mitigation efforts were undertaken in 2011: a ditch was constructed so water that was flowing to 4S pad is now directed away from pad to the fire pond. Performed work in October – believe to be working so far, monitoring is continuing.

DB requested clarification of the trend of iron levels and precipitation. KR – clarified relationship of low precipitation (i.e. dry weather) corresponds to higher iron concentrations at LLE.

BC noted that there is a difference between concentration and total amount released. AM indicated that the concentration of iron is of interest to the exposed organisms. AM noted that iron levels in Long Lake were within water quality guidelines; however further investigation is warranted to find the source of the elevated iron levels at LLE. Another spring of monitoring data is needed to assess how the ditch is affecting the iron levels.

LA asked if iron from the 4S pad is seeping into groundwater. KR – would go into 4S mine. HB noted some would potentially go to ground, but is primarily directed through sump to mine.

2.4 Review of monitoring data

Review/Update on WQO and guidelines:

DE reviewed updating of water quality guidelines and objectives – current guidelines are from the 1980s. There have been recent updates to provincial guidelines for manganese and iron. Water quality objectives for Quinsam should be updated to align with new provincial values for manganese and iron as well as sulphate once available. Science since the 1980s has been updated so now provincial guidelines reflect different numbers than some of the objectives for the site. Iron guideline is now 1 mg/L total; 0.35 mg/L for dissolved. Objective for site is 0.3 mg/L for total (set in 1980s). More appropriate to use new number of 1 mg/L. MoE is working with QCC to determine what is appropriate in terms of updating water quality objectives.

SG noted the site wide monitoring program was being reformed to better align with sampling required for current MOE practices for water quality objective development, including weekly sampling at some times of the year in the lakes. He noted weekly sampling is already occurring at some of the other sites.

DS asked for clarification of the terms criteria vs. objectives, and asked for perspective on exceedances and missing results noted in compliance record. AM – exceedances/missed results are a few out of many parameters that are measured frequently – over 7000 analyses per year. If monitoring is a permit requirement, exceedance is required to be stated in report. DE – the term “criteria” refers to provincial guidelines. Water quality objectives (WQO) are site specific objectives for a specific water body. For clarity, the terms guideline or objective should be used rather than criteria.

LA questioned why the iron objective at the mine should be changed given issues of iron and arsenic in sediment. AM – sediment has different set of guidelines than water guidelines. The level at which a chemical is safe depends on the media it is in – different safe level in water than in sediment.

LA asked about the sulphate guideline. DE – guidelines are based on science. Draft sulphate guideline was sent out for review – proposed to change from just a maximum to a maximum and average to

reflect chronic effects versus acute/short term effects. Tests used to come up with numbers are being rerun, but doesn't think numbers will change much from draft. Draft guidelines = max 250 mg/L; average 65 mg/L (once/week, 60 weeks). Current guideline is a max of 100 mg/L, with no average.

SGh asked whether historical value of sulphate is looked at in developing guideline. It was answered that the provincial guideline is based on a safe exposure level (including safety factors); not background levels. Background data can be looked at for site specific objectives, but objectives are not usually lower than the provincial guidelines, since these represent conservative safe exposure levels.

LA asked why, if sulphate levels are over the guideline now, should sulphate objective be raised? AM – maximum is proposed to be raised from 100 mg/L to 250 mg/L, but a chronic guideline of 65 mg/L is also proposed, so that is a reduction from 100 mg/L.

SGh commented that salmon adjust to change over many years, and have adapted differently in different rivers – this raises questions around applying same provincial guideline to different areas.

BC commented that the regulations (guidelines) relate to sulphate in water but do not account for where it comes from. There might be rivers in BC with sulphate from natural sources.

LA had further questions about changing objectives at Quinsam. AM noted that proposed changes are to match with the most recent science. Usually the province-wide guidelines are the most conservative.

People asked why guidelines at the site would be increased when they are currently being exceeded. It was clarified that guidelines are based on scientific evidence of safe exposure levels. Not all updated guidelines go up in concentration. For example, the arsenic guideline is lower than the 1980's objective for the site. Though for manganese and iron, the guidelines have increased because evidence shows the higher levels are safe for aquatic life.

SGh was concerned that any proposed changes in objectives would result in erasing exceedances since the maximum in the guideline was raised. AM clarified the difference between maximum and average values, and which samples would be compared to which objective.

DB – who is the body doing the science? DE – CCME (Canadian Council of Ministers of the Environment) set guidelines federally. Provincially, MoE staff in Victoria research organisms applicable to BC.

DS had a question about the relationship between objectives and guidelines and determining exceedances under the permit. AM – the permit sets limits at the discharge point, which is different than objectives and guidelines which apply to the ambient environment. Objectives and guidelines are not legal limits, as opposed to permit limits. DS – what are the consequences of exceedances? HB/AM explained the difference between permit limits, which apply to discharge points vs. ambient levels in lake as per guidelines/objectives. Exceedances of objectives or guidelines prompt assessments into potential effects. They act as triggers for assessments and potentially for changes to site management.

LA noted that in Middle Quinsam Lake, cadmium, mercury and manganese are currently higher than water quality objectives, and asked whether these parameters will still be in exceedance when objectives change? AM – for manganese there were no exceedances using the provincial guideline. QCC is doing a detailed review of cadmium and mercury to determine background levels; we need to establish pre-mine or upstream levels of these parameters.

Annual Report

AM reviewed monitoring data from the annual report with respect to WQO and guidelines:

Sulphate – as discussed, guideline is being revised, but not yet approved. This year's annual report correctly applies the 100 mg/L SO_4 guideline. At MQL, SO_4 levels were all below the guideline (max of 37.7 mg/L), which demonstrated a sustained recovery from the elevated levels of the previous reporting year. At LL, SO_4 was over the guideline at depth in all sampling events, up to a max of 143 mg/L. LLO SO_4 was over the guideline in September and October sampling events, to a max of 120 mg/L. SO_4 remained below guideline in both MQL and WB.

Arsenic and Iron – comparing measured levels to provincial guidelines; no exceedances of the arsenic water quality guideline (0.005 mg/L) at any of the permitted receiving environment sites. Fe levels were below guidelines but one sample at LLO (December) was above the 1980's objective of 0.3mg/L (at 0.344mg/L) - guideline is 1 mg/L.

Manganese – no exceedances of the manganese provincial guideline, though there were some cases where the 1980's Mn objective was exceeded at LLM and LLO.

Mercury – continue to see some exceedances of the mercury objective (0.1 ug/L) on the surface of the lakes, and throughout at the water column of MQL July-Sept (max of 1.33 ug/L ,1m, Aug) and up to a depth of 9m in LL Apr-Sept (max of 1.89 ug/L, 1m, Aug).

Cadmium – it was brought to MoE's attention through the Mines Act permit amendment process that cadmium is regularly exceeding the WQG at some monitoring locations. In 2010/11 data show exceedances at upstream Quinsam River site WA (one exceedance at 26 ng/L, Oct, guideline of 10 ng/L); NNO (exceedances Aug - Dec, max 91 mg/L, Aug); and LLO (exceedances in Oct, Nov, Jan, max of 102 ng/L, Nov). We're not seeing exceedances in the lakes at this time, though may be a function of time of year of sampling and elevated detection limits. Historic (pre-mine) and upstream data also show Cd exceedances, which reflects the need to develop a site-specific Cd objective.

Trend Analysis

AM – MoE asked QCC to retain a qualified statistician to conduct trend analysis to obtain a fuller understanding of the last 5 years of data. MoE requested a **m**inimum of 5 years of data be included, as we're interested in the current trends, not so much the trends between prior to mining and now; but what is happening now. Monitoring locations and parameters for input into the trend analysis were determined in consultation with ETRC agency members. Locations included the outlets of SP's 1 and 4 and the outlets of their downstream wetlands, LLM, MQL and MQL outlet. Parameters: pH, alkalinity, SO_4, Fe, Mn, As, Hg, Cd analyzed for trends in concentration, also for the outlets of the settling ponds, loading rates were analyzed for the same parameters except pH.

The report was submitted by QCC in November; review at agency ETRC meeting raised significant questions, (eg: LL bottom was not included, some questions about the summary statistics). The consultants were contacted; currently awaiting the revised report.

Limitations/recommendations:

- Detection limits - sometimes too high; limited the ability of the analysis to be run for some metals parameters; detection limits were not always consistent, not always below the guideline QCC has now implemented low detection limits for metals
- Trend analysis was not run if more than half the values were below detection limits
- Recommended sampling schedule at more regular intervals to improve trend assessment
- 5 years is the minimum for trend analysis, 8 years would provide more robust data
- MoE recommends a redo in 3 years with low detection limits used consistently, support for a 3 year cycle was voiced at the agency meeting
- MoE will consider the trend analysis requirements in redrafting of the site-wide monitoring program

Results:

- Consultants are reviewing MoE comments and making revisions to the report
- Relatively few parameters were identified to have significant trends, those that did primarily had very low slopes. For most parameters – inconsistent trends, very low slopes on trend lines
- More significant trends were displayed in the north water management system than the south water management system
- A brief overview of the draft results was provided. UPDATE: the final report will be provided in the 2011/12 Annual Report; this should be referred to for details on the results.

3. Report out on actions taken as a result of the 2010 meetings (MoE)

AM – Section 7.1 of the Annual Report describes the recommendations and actions taken from the agency meeting. All recommendations were followed up on.

There were also 3 recommendations out of the public meeting:
1) Sediment sampling in the Quinsam River watershed, some additional sampling conducted through 7S application, including onsite (7S wetlands), Lower Wetland, LQL, and the Quinsam River sediment data were received by MoE Jan 2012 (not yet reviewed in detail)
2) Sediment sampling in the sediment ponds – QCC did this in 2009, presented later in the day
3) Environment Canada update on Quinsam River data – not posted to website because needs QA/QC before it can be posted. Can email Andrea Ryan at Environment Canada for the data

QCC has been asked to report out on action items from the public meeting in subsequent annual reports.

4. Long Lake (LL)

4.1 Previous Long Lake studies

AM – Numerous studies have been previously conducted on Long Lake; last year's public ETRC meeting saw presentations on the Golder 2011 study commissioned by QCC and the CWN 2010 study and interim report. Studies are continuing for LL, by QCC, CWN and MoE (discussed later). Baseline data for Long Lake and other water bodies from the 1980's have surfaced recently, due to efforts by MoE and QCC, including:

- 1983 Environment Canada report with sediment metals data for Q River, LL, MQL, No Name Lake, and Goose Neck Lake, including cores up to 30cm in LL
- 1982 International Environmental Consultants report with select sediment metals data for LL, MQL
- 1980 QCC report with data on percentage of coal fines in sediment in Quinsam River, LL, MQL

These reports were recovered within last couple weeks, have been distributed among MoE, QCC, Environment Canada, Dr Cullen, MoE consultants and MEM. It's too early to make conclusions as the data needs to be reviewed in detail. Early review shows elevated As in LL compared to other lakes or Quinsam River. Wanted to let people know that more baseline data does exist and will be evaluated in the context of the current LL monitoring studies. While studies and data reviews are ongoing, QCC is making headway into dealing with Long Lake Seep.

4.2 Long Lake Seep (LLS) mitigation update – GG presentation

- Goal of plan is to reduce sulphate levels and iron levels at the long lake seep
- Summary of objectives: collect and treat flow of effluent entering LL via seep, reduce iron to levels below permit limit for settling pond 1, reduce sulphate levels, and manage precipitate currently at seep
- Graph of sulphate levels at seep (April 2008 to Nov 2011) showed current levels are in the 400-500 mg/L range, which is a decrease from that which was previously seen in the 700-800mg/L range. Iron levels fluctuate, quite variable but mostly above 1 mg/L.
- Treatment facilities to be constructed south of extent of underground workings. Plan to draw water from mine pool through a dewatering well, and put through treatment system, with the intent to minimize flow of water at seep as the mine pool is drawn down
- 2S portal plug: minimize inflow of water into underground workings, also provide stability to wall as look at PAG-CCR storage in 2S pit later this year.
- Graph of series of GW monitoring wells in 3 south pit area showed seasonal fluctuation of levels and how it has changed since portal plugs installed – shows some success at controlling water levels
- Second step is treatment of water – design work by Golder. Bench scale testing has been conducted - the pilot testing showed the best combination of substrate (wood chips, hay, manure, etc.) to reduce sulphate to sulphide, and to capture sulphide by combining it with Fe.
- Demonstration module is the next phase after the bench scale work. Demonstration module will treat a 25% of the flow from the mine pool (to be constructed in late spring/early summer)
- Permitting: mine permit amendment application in October 2011, received Feb 2012 – to construct and use demonstration module to treat at a rate of 4.5 L/s (25% total mine pool flow). A MEM permit amendment is required for the demonstration module, an MoE permit

amendment will be required for the full scale system but is not required for the demonstration module.

- The design goals are: sulphate - from 800 mg/L to 300 mg/L, and iron – from 1.79 mg/L to 0.30 mg/L
- Layout of full system – 3 components:
    1. Biochemical reactor cells (4 cells) – microbial reduction of sulphate to sulphide
    2. Sulphide polishing system (2 cells) – sulphide sequestration
    3. Aerobic polish pond and settling basin – removal of excess organics, nutrients and metals
- Biochemical reactor cells: 80x60m, 2m thick substrate zone, residence time of water in cell is 14 days. Wood chips are sustaining carbon source for bacteria that kickstarts reaction

Question regarding size of demonstration module. GG – bench scale testing used 45 gallon drums; demonstration module will be thousands of times larger than bench scale. The demonstration module will include one biochemical reactor cell, which is roughly the size of a football field.

LA had a question about the lifespan of the cells – what happens at the end of the lifespan? GG– cells have 15-20 year life – substrate would then need to be removed and replaced. LA asked what would happen if the mine is no longer here at that time. GG – MEM bond in place. ET – Minister of Finance holds bond. GG – looking at longer term solution than operating and maintaining cells – if there is a way to seal the seep in the long term.

BC asked a series of questions related to removal of arsenic and specifics of design treatment. GG – need Golder to answer.

DI commented that QCC should have to ensure that the treatment system works before being allowed to go into 7S; $9-10 million bond may not be enough as it would get used up really quickly. Stated that we need to protect the fish in river – fish can't speak for themselves. Need to be cautious and prove that we can do things before going ahead.

DS requested the estimated cost of the full demonstration system. GG - $1.2 million –includes construction start up for demonstration only, not including operating costs or full system cost.

LA asked about the timeline of the treatment system – need 2 warm seasons. GG– if have good warm weather can get system running, will have 8-9 months of data before next construction season, could be there in 2013.

LA – asked about the specifics of the polishing pond – is it a settling pond? GG – looks like lagoon or settlement pond. LA requested clarification that the function of the polishing pond is to take out metals. GG– purpose of treatment is to take out sulphate. End polishing pond takes out some additional nutrients. LA asked whether the polishing pond has a liner and what stops the pond from seeping. GG– all ponds have a geomembrane liner. LA asked how long the liner would last. GG stated that there is a lifespan, but not sure of the exact number. ***(Action item: provide LA with information on the estimated lifespan of the liner).***

LA asked whether the water could overflow in a storm event. AM – clarified that there is no surface runoff entering the pond; they are to receive groundwater from the dewatering well. SG confirmed the ponds will be bermed to prevent surface water entering.

DB commented that during a PowerPoint presentation at the public meeting a year ago, the question came up regarding where else this is working at other coal mines around the world, noting that it feels as though QCC is starting from scratch even though systems must be in place elsewhere. GG – in US and South Africa they have similar systems.

DB commented that the system should be in place before mining in 7 south. GG – there isn't a sulphate concern with the effluent in 7S. DB asked why a treatment system can't be put in place more quickly rather than going through multiple stages of bench testing to demonstration to final system. DE/GG/AM – the purpose of the bench scale system was to determine the substrate mix and design specifics that will work for this specific effluent, climate, etc. The purpose of the demonstration module is to work out any operational or design issues prior to scale up to full system. Want to be sure the full scale system is built appropriately and may learn some lessons from the demo module.

SGh noted that sampling of the seep has been occurring several times per year, and it has been known that sulphate is high, bench scale testing had occurred previously – why was this not done a decade ago? GG– earlier testing looked at sulphate reduction but didn't address sequestering sulphide. The difference here is that bench testing took the next step. SGh read from an email he wrote to HB in 2000, in which he stated opposition to further expansions until QCC could successfully demonstrate sulphate can be dealt with. He indicated it's now 2012 and asked why this was not previously addressed. AM – MoE requested QCC embark on seep treatment in 2010 based on new information that year, including Dr. Cullen's 2010 report and the Golder report published in March. The Golder report showed porewater sulphate is correlated with benthic biodiversity. HB – we became aware of seep around 2000, sulphate standard was established in 2001, prior to that there was no benchmark. Requests for studies to evaluate the potential effects and requests for mitigation is an evolutionary process. Around 2000 we were looking at aqueous media, now we're aware of sediment coming from seep into LL, and we're still not sure of all mechanisms. As we learn more, we take step wise action. SGh commented that those evolutionary step-wise stages are not represented well in the annual report.

LA made the comment that treated water from seep will be used to cover CCR in the 2S pit and 7S underground. Commented that 7S waste permit and LL seep mitigation are very much tied together, therefore before 7S mine gets a waste permit, QCC have to show that it's working. If seeps are to be permitted, QCC has to have thorough mitigation included. LL seep mitigation is very much part of waste permit. AM – relates to Mines Act permit for PAG CCR storage, and MoE asked questions on this as part of the referral process. LA – isn't PAG-CCR storage a waste issue? HB – storage of that material is under mines permit. MoE authorization comes into play in relation to effluent from that. ET – water management within mine comes under MEM permit; geochemical aspects went through rigid review and the decision was made that it could be managed.

LA – how do we know treatment is enough for LL seep? Is there enough water to cover it all? We don't know until proven. ET – based on experience with many mines we have a comfort level that this mine will flood. LA commented that we're now told 2N won't flood because of too many seeps. GG – all workings will flood. HB – clarified 2N underground workings vs 2N pit sump. LA - need to reassess 2N sump – more seeps than thought, 5S has a lot of problems – how do we know those predictions are right? Shouldn't we reassess all? It was indicated that there is a difference in flooding underground workings, which rely on groundwater rebound and flooding above ground pits, which also rely on surface water inputs. MEM has reviewed the flooding information for the PAG storage areas.

4.3 Additional QCC sediment studies (QCC)

AM – noted that this section of agenda may need to be skipped in the interest of time. Noted QCC has done sediment sampling around the seep and upstream:

- Mine site sediment sampling (2009)
- Seep sediment sampling (2010)

KR – On page 107 annual report – 2009 sediment sampling.

AM – skipping change in agenda schedule to allow Dr. Cullen's presentation next.

4.4 Update on Canadian Water Network Studies (Dr Cullen)

- BC stated the interim sediment quality guideline for arsenic is 5.9 ug/g and the probable effects level is 17 ug/g
- BC reviewed the results of the 2010 CWN report titled "An environmental investigation of the Quinsam watershed" as well as the September 2010 interim report
- Since 2010 reports additional work has been done on mussels and sediment
- Sediment: conducted coring for sediment chemistry and dating in Long Lake, sampled on two occasions, first sampling not reliable (cores not big enough)
- Located underwater seep coming into lake – could be bringing compounds of interest into lake
- Took 5 cores in second coring event (A-E), results from dating received a few months ago
- Results showed:
    - All sampling points show similar profile with highest As in top 5 cm of sediment
    - Core E – As up to over 1200 ppm
    - Core D – over 1000 ppm
    - As is around 150-200 ppm in sediment lower than 5 cm; BC believes this to be baseline
- Graph showing As concentration in Core E – Core E showed dating information from 1907 to 2012. The increase in arsenic concentration found in the top 5 cm coincides with the beginning of mining operations, around 1977
- However, As can migrate up from under surface (diagenesis). Under oxic conditions the rate can be predicted but there's no way of predicting the rate under anoxic conditions. Therefore, we can't be sure if the increase in As concentration is partially due to diagenesis
- Two weeks ago, AM sent core data from 1983 for 3 sample locations in LL (west and east ends and mid lake. BC presented graphs showing these 1983 sediment core results for As, Mn and Fe (note there were some errors on the slides presented at the meeting – east and west sampling locations were interchanged – the following comments refer to the corrected slides):
    - Anomalous results from the east end of Long Lake could be indicative of iron arsenic mineral as opposed to sediments. We have previously noted that the sediments at the ends of the lake are different from those in the middle.
    - Graph comparing 1983 and 2011 cores showed similarities with arsenic up to 200 ppm in the mid lake sediments, which show little sign of diagenisis
- Seep not only source of compounds of interest – iron and arsenic are also coming down gully west of the seep
- Discussed bioavailability of As:
    - table showing As bioaccessibility in selected sediments and coal refuse samples
    - Bioaccessible As in sediments is substantial

- Discussed Golder report, BC stated opinion that conclusions are misleading, near shore invertebrate richness shows problems along south shore of lake, Hyalella Azteca (indicator species in report) shows decreased survival. CWN previously reported that a diver commented on the absence of life along the south shore.
- BC's work on biovailability using mud shrimp shows that Long lake sediment is toxic to this organism, although this organism does not live in the lake it is a good indicator as it seems to be the only indicator species specific for arsenic.

BW commented that BC's characterization of the Golder report is misleading. Noted that the test species (hyalella azteca) do not live in deep sediment so it is not ecologically relevant to conclude that the sediment is toxic. Commented that it is important to be careful in discussing lab test species because the lab result doesn't always transfer to real conditions in the environment. Contaminants like As are only one factor; other factors include carbon in sediment, and dissolved oxygen. Found variability of richness in organisms in lake but were not able to correlate with chemistry of lake. A naive test organism such as the mud shrimp may accumulate contaminants but that doesn't mean that will happen in the environment because organisms are adapted to their environment.

BC – discussion of freshwater mussels:

- Measured total As in Black mussels in the Quinsam River. Presented a graph of total As by year (1999 to Aug 2011) with comparison to Simms Creek and described a non-statistical upward trend in over time in As in mussels in the Quinsam River

BW – commented that it is important to be careful looking at data overtime as methods can change (e.g. how mussels are handled) – without background information, also be careful about implying that there is an upward trend. BC agreed that statistical analysis would probably not confirm a trend.

- BC presented graph showing mussel transfer from Lower Quinsam Lake to Long Lake, indicating an increase in As in mussels transported into Long Lake that were taken from Lower Quinsam Lake. BW commented that the findings are not surprising because the lakes have different chemistry.

- BC presented a graph of total As per mussel, showing increase of As. Presented table listing mortality of caged mussels in Long Lake:
    - 3 of 17 dead in east LL
    - 2 of 15 dead LL west
    - 8 of 16 dead in NNL east
    - 6 of 17 dead in NNL west

BW commented that mussel mortality could be due to lower oxygen content in LL. BC – there are no mussels in LL naturally – looked at life cycle of the mussels (*Anodonta kennerly*), which requires fish. In principle, one could expect to find mussels due to the presence of particular fish in LL MQL, NNL, but there are none there. There are mussels in LL outflow and Middle Quinsam inlet, but not in lake. Currently there is an experiment in progress involving mussel transfer at LQL 2011-2012 – no deaths to date.

AM asked about reporting out on the coring and mussel results. BC – core sediment paper is currently half written, can expect to see written version fairly soon. Mussel paper to wait until current experiment completed.

BM asked a question about mussels and water depths. BR – mussels were put into the lakes at standard depths; mussels grow naturally in lakes around 12 m depth. BM noted that it would be valuable to report information on depths of sampling locations. BW asked whether samples of growing mussels were collected for comparison, and whether oxygen and other parameters were measured. BR – yes, samples were taken but oxygen and other parameters not measured.

HB asked whether there is any evidence to suggest whether mussels ever existed in those lakes prior to 1970. BC/BR – no evidence, couldn't find any shells.

DB had a question about the relationship of mussels with fish. BC – the mussels travel on fish gills. Fish barriers in the lower reaches of the watershed, but DFO used to stock fish into the lakes. PW noted that Fisheries and Oceans Canada ceased to rear juvenile fish in those lakes; program not being continued due to lack of funding.

BM asked for clarification on why BC discounted the 1983 Environment Canada sediment sampling. BC - the samples at the ends of the lake do not correspond with recent LL results, but the middle sample does somewhat correspond. Also, the samples taken one month apart from the same location had very different concentrations. BM– how do you know that the samples are from the exact same spot? BC – we don't know, even with modern day GPS the sample locations are bound to be slightly different when returning at a different time.

BW clarified that bioavailability and uptake of As by organisms is different from effects. BC – looking at deaths is an effect. BW – not convinced that deaths are related to As in sediment.

LS asked if there are other organisms that live in the lake that can be used as an indicator. BC – mussels were used because they respond to As. BW discussed approach of looking at the overall benthic community to assess lake health, which was done in Golders work in the form of the biodiversity assessment. She also pointed out it is difficult to compare data among lakes – noted that Golder compared data from Long Lake to Gooseneck Lake not MQL, because LL and GNL have similar characteristics.

4.5 Long Lake hydrogeological study (Lorax) - BM

- Lorax conducted a LL groundwater study conducted fall 2011 to spring 2012 on behalf of QCC, at request of MoE
- Evaluated groundwater fluxes and chemistry, to establish groundwater loading rates to LL
- Groundwater flow and chemistry along 5 segments around the lake were used to calculate groundwater loading. These were compared to loading from Long Lake Seep.
- Well locations around LL:
    - in 2010, Lorax installed a number of wells in 4S mine area to look at groundwater chemistry and water levels
    - In the 2S and 3S area previously Golder installed a number of wells
    - Quinsam dewatering wells in 2S/3S mine area
    - Last year, Lorax installed 3 wells to look at groundwater conditions that are not directly impacted by mine activities– one on north shore of LL and two south of lake – to look at all possible groundwater influences to long lake

LA asked about where the groundwater from 4S goes and the timeline. BM – see the 4S report in the 2011 Mine Permit Amendment application. Most 4S mine water flows to Quinsam River (including the deep mine pool) – approximately 18 years to get there. A smaller portion of 4S groundwater flows to the east portion of LL, these are the surficial groundwater flows, which have a faster recharge and different chemistry that the deep mine pool.

LA asked if groundwater from the 3 south 77 pit would report to long lake. BM – yes.

DB had a question about seep flows compared to groundwater flux. BM clarified that groundwater flux measurements are independent of LL seep water. DB – is groundwater coming into LL insignificant compared to LL seep? BM – groundwater flow rates are lower than seep flow rates, but the other component is concentration.

BM – water chemistry:

- MoE asked QCC to identify loading of potential contaminants of concern such as SO_4, As, Fe, Mn, etc
- two distinct end members were identified – background waters from segment 4 (not mine-influenced) show strong sodium bicarbonate signature, whereas mine-influenced waters had strong calcium-sulphate signature
- waters from segment 4 (not mine-influenced) have highest As concentrations
- Graph of expected and maximum groundwater loads relative to LLS loads to Long Lake showed:
    - During peak flow period, LLS loads 2 to 6 times greater than total groundwater flow to LL (SO4, Cu, Fe, Mn, Ni)
    - During summer low flow period LLS loads are lower
    - As loading predominantly from Dunsmuir Sandstone on South shore of LL – segments 4 and 5
    - As loading from groundwater greater than that from LLS

AM asked when the report would be coming. GG – report was couriered last week. AM to check. UPDATE: MoE has received this report and it will be included as an appendix in the QCC 2011/12 Annual Report.

BC had a question around the relationship of the seep near middle of Long Lake detected in his study to data shown from cross section. BM – acknowledged this could be the same location.

RH and DB had questions about background As concentrations in Dunsmuir sandstone. BM – concentrations in Dunsmuir sandstone 2-3 times higher than what is being seen in mine impacted areas. Even with higher flows from LLS, natural groundwater flows are responsible for As loading and have been since before mine was in place.

AM to BC– with As entering LL in groundwater, would you expect the As to bind to sediment as groundwater enters the lake? BC – yes, this is likely a source of As in sediment.

LA commented that in the preliminary risk assessment it is stated that “results demonstrate one or more chemicals of interest are present in surface water that pose risk to organisms…” and that “results of preliminary risk assessment found one or more PCOC in sediment….” This again raises the question of why might we be raising objectives when this is already happening? LA read another quote from the preliminary risk assessment regarding metal toxicity, and asked how are metals stated as a risk to

aquatic organisms in risk assessment if they are below WQ objectives? AM – the preliminary risk assessment is the broadest screen to look for the most possible potential problems (discussed later).

5. Review of issues raised by local environmental organizations (MoE)

5.1 Long Lake EcoJustice letter, MoE Risk Assessment and follow up work

AM discussed the report, "Preliminary Risk Assessment of Long Lake", written by MacDonald Environmental Sciences Ltd for MoE, majority of work was completed in March 2011 and final version published Jan 2012.

Reason for report:

- EcoJustice submitted a letter to MoE Director of Waste Management Jan 18/11 on behalf of several of the local NGOs. The letter requested that Long Lake be designated a contaminated site or that a contaminated sites investigation be ordered for the Lake, based on elevated sediment As concentrations. The Director responded that he was not prepared to do so, given:
    1. The sediment investigation conducted by Golder on behalf of QCC was already underway
    2. MoE had already given QCC direction to mitigate the seep (mitigative action being taken)
    3. Evidence that baseline conditions appear to be above provincial guidelines and standards – not necessarily appropriate to compare against guidelines or standards if background levels higher than those
- Director indicated that MoE's Land Remediation staff would assist regional staff on review of Long Lake issues. Through partnership with them, Land Remediation staff came up with funding to support risk assessment study, for which MoE retained MacDonald Environmental Sciences Ltd.

Risk assessment is a science based process; looks at impacts of stressors on receptors. It is a multi-phased process that starts by looking at the broadest possible impacts and narrows down the issues as more information is obtained. It was noted that this study was done in March 2011 before the Golder study, so that information is not included in this assessment. LA asked whether the CWN study was used in the assessment. AM – yes, CWN study was included because it was from April 2010.

Assumptions used in the preliminary risk assessment make it a very conservative approach (i.e. an overestimate of potential impacts). This was done by comparing the maximum concentrations observed in LL from 1985 – 2010 to the no or negligible effects levels. Additional work conducted (e.g. Golder sediment study) would assist in narrowing down the scope to site-specific impacts.

AM discussed the sources of data and methods used for the study, refer to the report for details.

Overall results:

- Tabulated summary statistics for LL over period of 1985-2010 including a comparison to guidelines
- No parameters of concern were identified for human health
- Parameters were identified that may be concern for ecological health; this is not new information, but it shows that further investigation is warranted
- A major outcome of this study was a list of recommendations, many of which are currently being implemented.

Recommendations (and follow-up actions):

- Identify principle sources of PCOCs (Lorax hydrogeological study, seep sediment sampling, effluent sampling)
- Identify transport and exposure pathways (transport into lake is being evaluated as above, exposure pathways evaluated via bioavailability studies by Golder, Cullen, MoE - MoE hired SLR Consulting to look at all bioavailability and toxicity studies that have been done and put it all together, that work is just starting, report is expected later in 2012)
- Determine background levels of COPCs (background sediment concentrations are also being evaluated by SLR for MoE, QCC is doing work on background Cd and Hg levels in water)
- Conduct further sampling to determine full extent of sediment exceedances (Golder 2011 sediment study, Cullen's coring study)
- Assess contaminant availability and sediment toxicity (Golder's 2011 sediment study, Cullen's past and ongoing bioaccessibility studies, SLR's review of bioavailability and effects data)
- Evaluate cumulative effects (Golder's benthic community assessment, MoE's fish health study)
- Proceed to detailed risk assessment (MoE is not sure yet if that is end point we will pursue, currently trying to fill in pieces of puzzle)
- Refine detection levels (implemented by QCC)
- Update site-specific water quality objectives (MoE is working on this internally; QCC to look at Cd and Hg background levels)
- Review and update site wide monitoring program (MoE is working with QCC to build this into the permit amendment)

LA asked about access to sediment samples data. AM – that data is part of 7S effluent permit application, will release it during consultation on that application.

LA – pathway analysis – going back to what QCC has already identified – why were those not included in risk assessment? AM – assessment didn't identify any specific pathways – task was to put all the existing data together into a database and compare concentrations to guidelines. SG – SS is working on revamping QCC's database to create efficiencies in data manipulation and presentation.

DB asked whether the uncertainty principle drives a risk assessment, how the two are linked. AM – there are many of safety factors built into WQ guidelines and objectives. A site specific risk assessment aims to get past those to what is happening at that particular site. DE – uncertainty in this study built in by choosing maximum values over 20-30 years and assessing against the lowest value that would ever cause an impact. The next level would be more specific in assessing actual impacts.

LA commented that regarding the waste permit, two things stick out – is there going to be enough water to cover, is it going to work, and what is the mitigation? Once there is a problem, it will take a while to come up with a fix.

DB to ET – is there a dollar value to cost of closure? ET – many factors go into calculating closure costs. I In the last couple years, MEM have changed policy to require security to be upgraded to reflect changes.

LA commented that if all seeps had to be treated, $7.2 million sounds low; compared situation to Britannia mine. ET – comparing Britannia to Quinsam like comparing apples to oranges – totally different situations, especially since Britannia is a historic mine. At Quinsam, treatment is being looked at LLS; the problem should self-solve to the point where treatment is not as expensive as today. At 7S, totally different environment, won't have same problems. Have to look at issues on a site specific basis.

DS – question to ET about form of security deposit, and how security deposit is calculated. ET – calculated on what the cost would be to clean it up.

Presentation on revamping QCC's database, by SS:

- Purpose to present existing and new data in more representative, efficient, and user friendly way to achieve consistent and indexed statistics tables and charts
- Use existing data to identify which parameters may be extraneous based on trends
- More than 20 monitoring stations at the mine
- Example of stat table from LL: shows parameter, sampling frequency, current detection limit, number of data points, min-max, and WQG, and chart #
- Example of chart: shows WQG level and detection limits
- New system is more user-friendly and convenient for field tech to bring into field

AM – MoE has recommended more consistent highlighting of exceedances in annual report – will this work help address that recommendation? SS – can do that.

4:30 pm, meeting adjourned

Summary of recommended action items for QCC:

1. In subsequent Annual Reports, when writing about when mining commenced, ensure reference is given to the location of the mine being referred to.

2. In subsequent Annual Reports, ensure table font size is appropriate for the printed tables.

3. Provide LA with information on the estimated lifespan of the liner.

COMPLIANCE REVIEW RECORD

File number: PE-7008
Client name: Quinsam Coal Corporation
Address: PO Box 5000 Campbell River BC V9W 8A3
Client rep: Steve Gardner, Director of Exploration / Technical Services
Kathleen Russell, Environmental Technician
Contact info: 250 286-3224
Date of Inspection: September 27, 2011 completed by: Andrea Miskelly, Environmental Protection Officer

COMPLIANCE:	
IN or OUT:	OUT

AUTHORIZATION REQUIREMENTS: Review October 13, 2010 to September 27, 2011

	YES	NO	N/A	?
a) Does discharge have an authorization number?	X			
b) Is all discharge monitoring conducted as required?		X		
c) Is all discharge monitoring reported as required?	X			
d) Is all discharge monitoring data reviewed in compliance with the authorization?		X		
e) Is all environmental monitoring conducted as required?		X		
f) Is all environmental monitoring reported as required?	X			
g) Is all environmental monitoring data reviewed in compliance with authorization?			X	
h) Is environmental monitoring indicating achievement of receiving environment quality criteria?		X		

Activity:	On-site Inspection	NCD Matrix Level:	2	NCD Matrix category:	A
Comments:	QCC continues to implement MoE recommendations for improvement of environmental protection. This year non-compliance focused around discharge routing into the 4S ditch, discharge limit excursions due to 4S dewatering, and discharge of mine impacted water at Long Lake Seep. All of these issues are currently being investigated or addressed. A few minor non-compliances related to sampling/measurements were also noted.			Compliance tool initiated:	Advisory

AUTHORIZATION SUBSECTION	DETAILS	COMPLIANCE IN	COMPLIANCE OUT	COMPLIANCE ?
North Coal Mining Operation				
1.1.3 and 1.1.4 - **Auth'd works** must be complete and in operation and are made up of surface runoff collection and diversion ditches, plant site runoff collection box, flocc facilities, settling pond 4, 2N pit sump, tailings storage facility, 2N portal sump, surface and u/g pumping facilities and related appurtenances.	Authorized works observed during the inspection include settling pond 4, plant site collection box, plant site ditch, and other ditches and mine site containment structures in the north mine area.	X		
2.1.2 - The **maximum combined pump rate** for effluent pumped to settling pond 4 is 0.32 m^3/s unless auth'd by Regional Waste Manager (RWM). Pumping rates shall be decreased as necessary to accommodate flows from the gravity fed catchment	It was indicated that the pumping rate is currently sufficient and adjustments have not been needed to account for flows from gravity drained catchment. It was noted, however that the pumping rate may require an adjustment for underground tailings injection. **Consider whether a permit amendment will be required prior to initiation of underground tailings injection.**	X		

AUTHORIZATION SUBSECTION	DETAILS	COMPLIANCE		
		IN	OUT	?
2.1.4 - **Wash plant effluent** shall not be conveyed to the 2N pit sump without prior approval.	Wash plant effluent was being pumped to the tailings facility, as per the permit requirements, and was not being conveyed to the 2N pit sump. It was noted that the overflow for the collection box, which leads to the plant site ditch, is relatively close in elevation to the top of the water in the collection box. **Notify MOE when the collection box is close to overtopping and report overflows from the collection box to the plant site ditch.**	X		
2.1.5 - **Settled solids** from the pond shall be removed to maintain a **minimum water depth** below the pond decant of 1.0 m and a **minimum water storage volume** of 2300 m^3. Removed solids shall be disposed of in an approved manner.	Adequate freeboard was observed.	X		
2.1.6 - **Discharge routing** from settling pond 4 shall be via conveyance to Middle Quinsam Lake in an acceptable manner.	Discharge continues to be routed through the wetland between settling pond 4 and MQL.	X		
South Coal Mining Operation				
1.2.3 and 1.2.4 - **Auth'd works** must be complete and in operation and are made up of surface runoff collection and diversion ditches, flocc facilities, settling pond, 3 pit sumps (1s, 2s, 3s pits), an adit sump (4S adit), pumping facilities and related appurtenances.	Authorized works observed during the inspection include settling pond 1, the fire pond, the 4 South pad and various ditches and containment/diversion structures in the south mine area. It is currently unknown whether diversion and collection around the 4 South pad is adequate to capture all mine related runoff from this area. QCC is continuing with an investigation of water quality around the 4 South pad in attempt to clarify this issue. **Continue the water quality study around the 4 South pad. If this area is determined to be contributing runoff to the 2/4 South Haul Rd ditch the water must be rerouted to mine water management system.**			?
2.2.2 - The **catchment area** draining to settling pond 1 shall not exceed 68.4 ha, as defined by the South Pit Water Management plan (1990), unless auth'd by RWM.	No changes to the total catchment area had been made.	X		
2.2.3 - **Settled solids** from pond 1 shall be removed to maintain a **minimum water depth** below the pond decant of 1.0 m and a **minimum water storage volume** of 14,000 m^3. Removed solids shall be disposed of in an approved manner.	Adequate freeboard was observed.	X		
2.2.4 - **Discharge routing** from settling pond 1 shall be via conveyance to Long Lake through the adjacent wetlands, as defined by the South Pit Water Management plan (1990).	It was reported in 2011 that due to logging, a portion of the water leaving SP1 was draining toward the 4S pad and thus being routed through the 2/4 South Haul Road ditch. **This situation had been corrected by the time of the inspection** through the construction of a diversion ditch stretching from the output of the wetland below SP1 to the 4 South pad, directing water away from the pad to the fire pond, which discharges toward SPC through the permitted route.		**X**	

General Requirements		COMPLIANCE		
		IN	OUT	?
3.2 - **Environmental Procedures Manual** shall be maintained for mine construction and operation and shall be reviewed annually. Annual reviews and submissions are due on March 31 of each year.	The Environmental Procedures Manual was submitted in 2011.	X		
3.3 - **Acid Generation Control** PAG material shall be identified and handled specially. Sampling and analysis of PAG shall follow Reclamation Permit C-172. Corrective action may be required by RWM if ARD is suspected.	Acid generation was detected in November 2010 through dewatering of the 4 South mine. Corrective action was taken by QCC including halting of dewatering, neutralization of acidic water on surface, follow up sampling, a subsequent detailed hydrogeological review and submission of 4 South mining history. PAG rock and tailings continue to be analyzed for sulphur content and acid-base accounting.	X		
3.4 - **Water Quality Objectives and Criteria** Objectives contained in Campbell River Area, Middle Quinsam Lake Sub-Basin Water Quality Assessment and Objectives (1989) apply. The provincial sulphate criteria for receiving waters applies until an objective is established.	QCC compared receiving environment data to the Water Quality Objectives for a variety of parameters in the 2010/11 Annual Report. Objectives are not legal limits and therefore a comparison of the data with the objectives is not part of the compliance review. It is noted that the cadmium guideline was shown in the Annual Report in the wrong units, therefore the comparison to this guideline was not meaningful. **Ensure the cadmium water quality guideline is shown correctly and compared to relevant data in subsequent reports.**	X		
3.7 - **Spill Reporting** All spills shall be reported in accordance with the Spill Reporting Regulation.	Three spills were reported to the Provincial Emergency Program over the reporting year.	X		
3.8 - **Additional Works** Additional treatment works may be required based on results of monitoring program, etc.	Additional treatment was requested by MOE in December 2010 for water exiting the 2 South underground workings through Long Lake Seep, for reductions of iron and sulphate levels. In response, QCC retained a consultant to evaluate their treatment options, performed a bench scale test for sulphate reduction and sulphide sequestration, installed a dewatering well in a low point in the underground workings to extract water that could flow through the seep, installed plugs in the 2S pit, developed design plans for scaling up the treatment system from bench scale to a demonstration module to treat 25% of the flow through the underground workings, and presented progress to MOE. At the time of the inspection QCC was in the process of preparing a permit amendment application for the Ministry of Energy and Mines which is required prior to commissioning of the demonstration module. Note that an amendment to the waste discharge permit is not required for demonstration purposes, but will be required for the full scale system.	X		

General Requirements		COMPLIANCE		
		IN	OUT	?
3.9 - **Maintenance of Works and Emergency Procedures -** The permittee shall regularly inspect the auth'd works and maintain them in good working order. The RWM shall be notified of any condition preventing effective operation.	Pumps, ditches, and culverts were reported to be inspected and cleaned out where required on daily to weekly schedules. The settling ponds appeared in good working order. Settling pond 1 water levels were being managed to maintain water cover in the 3 South pit. Vegetation had grown up around the culvert to SP4 east of the haul road. **Vegetation around this (and other) culverts should be kept to a minimum to allow for visual inspections.** It is noted that the culvert at the LLE monitoring station had been cleaned out several times recently due to beaver activity, and a beaver trapper was going to be brought in. Ditches viewed appeared to be well maintained. Roadside ditches on the 2/4 South Haul Rd contained silt fences and settling ponds, some of which were well vegetated. The plant site ditch had been cleaned out to remove coal fines. The plant site collection box also appeared to be in good working order. It was indicated that this sump is cleaned out approximately once every two weeks. The 5 South portal breakout area was viewed. Surface water from the portal area is collected in a pond and pumped underground into the north water management system. The line taking water from the 5S portal area to the underground injection site was double lined to protect against breaks and leaks (4" pipe inside a 6" pipe). A small lined sump was observed at the injection site. There was a leak in the valve at the injection site and water was spraying into the sump. It was indicated that this would be corrected immediately.	X		
3.10 - **Bypasses** The permittee shall ensure no effluent is discharged without being processed through the auth'd works unless prior written approval is obtained from the RWM.	Mine impacted water continues to enter the receiving environment without passing through the authorized treatment works at the Long Lake Seep and potentially the 4 South pad. However, it is noted that releases of mine impacted water are improved from the previous year at all subsequently identified areas. Substantial efforts have been taken to reduce flows through the Long Lake Seep and treat this water, as described under section 3.8 above. Water inputs to the 4S pad have been reduced through construction of diversion ditch and study of this area continues, as described in sections 1.2.3, 1.2.4 and 2.2.4 above. In addition, effluent from the coal processing plant has been rerouted away from the plant site ditch, eliminating this effluent as a source of seepage to the environment.		**X**	
3.11 - **Environmental Review Procedure** the RWM may revise monitoring requirements based on recommendations of the ETRC.	QCC continues to refine their monitoring program based on the input of the ETRC.	X		
4.4.1 - **Composite Sampling** TSS samples for effluent shall be obtained via 24 hour composite samples. Each daily composite shall consist of eight samples collected at three hour intervals.	Composite TSS samples were collected as required for the most part, but less so in winter months. QCC has indicated that in the winter the automated sampler freezes, therefore composite samples cannot be collected. QCC has requested a permit amendment to allow for grab samples for TSS during freezing conditions. For the 2010/11 reporting year, 28/304 TSS samples were collected as grabs from WD (9% of WD TSS results). From SPD, 24/95 TSS samples were collected as grabs (25% of SPD TSS results). This is similar to the percentages of TSS grabs collected in the previous year (12% at WD and 25% at SPD).		**X**	
4.4.2 - **Continuous Flow Recording** The permittee shall provide and maintain suitable flow measuring devices and maintain a continuous record of the rate of effluent discharge.	There were eight missing data points for flow from WD and 4 SPD due to equipment failure. Maximum and average flow were reported for WD and SPD for all other days of the year. The missed results represent about 1 - 2 % of the discharge flow data for SPD and WD respectively.		**X**	

General Requirements		COMPLIANCE		
		IN	OUT	?
4.4.6 - **Monitoring of Drainage Ditches and Water Channels** - Visual inspection of these structures will be carried out by MOE staff and the permittee may be required to minimize soil erosion based on the results.	Drainage ditches viewed during the inspection appeared in good working order.	X		
4.6 - **Reporting** Monitoring results shall be submitted quarterly within 30 days following the pervious quarter. An annual review and interpretive report shall be prepared and submitted by May 31 of each year.	Quarterly reports were submitted in reasonable time. The annual report was submitted in September 2011. MOE approved this timeline due to requests for additions and changes to the report.	X		

MONITORING REQUIREMENTS:
Review Period: from **April 1, 2010** **to** **March 31, 2011**

DISCHARGE MONITORING	DETAILS	Reporting Frequency	COMPLIANCE		
			IN	OUT	?*
1.1.1 - **Discharge from the North** Coal Mining Operation and Coal Prep Plant shall not exceed a maximum of 0.32 m^3/s.	No flow exceedances were found in the 2010-11 Annual Report for the discharge from settling pond 4.	quarterly and annually	X		
1.1.2 - **Discharge from the North** Coal Mining Operation and Coal Prep Plant shall not exceed the permit limits.	No permit limit exceedances were found in the 2010-11 Annual Report for the discharge from settling pond 4.	quarterly and annually	X		
1.2.1 - **Discharge from the South** Coal Mining Operation and Coal Prep Plant shall not exceed a maximum of 0.46 m^3/s.	No flow exceedances were found in the 2010-11 Annual Report for the discharge from settling pond 1.	quarterly and annually	X		
1.2.2 - **Discharge from the South** Coal Mining Operation shall not exceed the permit limits.	Iron levels at SPD exceeded the discharge limit of 0.5 mg/L in five reported sample results, dated between Oct. 25 - Nov. 8 2010, and then again on Jan 31, 2011, at concentrations from 0.554 - 5.46 mg/L. The Oct/Nov exceedances resulted from dewatering the 4S mine. The cause of the January exceedance was not identified, and levels receded below permit limits during subsequent sampling. No other permit exceedances were reported for the 2010/11 year.	quarterly and annually		X	
2.1.6, 2.2.5 - **TSS variances** may be allowed for higher than auth'd discharge rates, and a TSS limit may be established in future for extreme storm events.	Discharge rates did not exceed authorized rates during the review period.	n.a.			n.a.

DISCHARGE MONITORING	DETAILS	Reporting Frequency	COMPLIANCE		
			IN	OUT	?*
4.1.2, 4.2.1, 4.4.1. 4.4.2 - **Effluent monitoring** frequencies and methods (specific to sample points and parameters)	Generally, QCC reports on more parameters, at more monitoring locations and at a greater monitoring frequency than is required in the permit, with over 7000 water quality analyses conducted over the year. However, QCC reports to have missed 12 discharge flow readings and 3 effluent TSS samples throughout the year. Reasons provided for the missed results include equipment failure and human error.	quarterly and annually		X	
4.4.4 - **Monitoring of Seeps** In-pit, out-of-pit, coal and waste rock seeps shall be monitored. Location and frequency will be determined by RWM. Analyses will be obtained for pH, dissolved sulphate and dissolved iron.	Long Lake seep and the wash plant ditch seep were monitored for the parameters listed in section 4.4.4 as well as the full suite of total and dissolved metals among other parameters. Long Lake seep was monitored monthly and the wash plant ditch seep was monitored April to June. During the inspection it was asked if monitoring of the plant ditch seep is still required, given that water from the coal prep plant no longer travels through the ditch, and as there are wells installed to monitor the quality of the seepage. **It is recommended that monitoring of the plant ditch seep water continue, and an assessment of water quality in the seep be conducted showing changes resulting from cessation of use of the ditch for wash plant water.**	quarterly and annually	X		
4.4.7 - **Precipitation monitoring** will be conducted daily using a rain gauge at a location approved by the RWM.	Precipitation records are included in the quarterly and annual reports.	quarterly and annually	X		
RECEIVING ENVIRONMENT MONITORING	**DETAILS**	**Reporting Frequency**	**IN**	**OUT**	?*
4.1.2, 4.2.2 - **Receiving water monitoring** frequencies (specific to sample points and parameters)	Generally, QCC reports on more parameters, at more monitoring locations and at a greater monitoring frequency than is required in the permit, with over 7000 water quality analyses conducted over the year. However, QCC reports to have missed flow readings from WB and LLO on two days due to staff gauges being washed out.	quarterly and annually		X	
4.4.5 - **Groundwater wells** will be constructed as required by the RWM.	Groundwater sampling was conducted and reported on quarterly and annually.	quarterly	X		
RECOMMENDED FOLLOW-UP FROM OCT 13/10 INSPECTION			COMPLIANCE		
			IN	OUT	?
1) Submit a contingency plan for potential clogging of the collection box pump and associated ditches and ponds, with the goal of eliminating seepage of wash plant water toward Middle Quinsam Lake. In the plan, provide a timeline for getting the contingency measures in place.	It's indicated in the Annual Report hat a 55 Hp pump was installed in the collection sump below the perimeter ditch. This was viewed during the inspection. It is also indicated in the annual report that the perimeter ditch was not used to convey wash plant water over the reporting year.		X		
2) Compile existing data for arsenic in water in Long Lake and sources feeding into the lake, including surface water and groundwater.	These data were presented during the 2010 ETRC and public meetings.		X		

RECOMMENDED FOLLOW-UP FROM OCT 13/10 INSPECTION		COMPLIANCE		
		IN	OUT	?
3) Convert weir-height measurements to flow for the Long Lake seep.	The 2010/11 Annual Report includes flow data for Long Lake Seep.	X		
4) Evaluate the sulphate levels in Middle Quinsam Lake and influencing factors since summer 2009. Suggest whether there is an increasing trend in sulphate levels in the lake, and if so why. If there does not appear to be an upward trend in sulphate levels in Middle Quinsam Lake, suggest why levels spiked in summer 2009.	This information was presented during the 2010 ETRC and public meetings. QCC credited the spike to low flows through the system.	X		
5) Investigate the source of iron at LLE including: -t+d metals and alkalinity -monthly sampling in three locations: ditch below the 4S pad input, ditch upgradient the 4S pad input and above the pad at the former "upper" sampling location.	A report summarizing the first 3 months of data was submitted April 2011. Recommendations were provided back to QCC, including a request to continue monthly sampling and report out after summer.	X		
6) Prepare a contingency plan for potential spills from the pipe that moves effluent from the collection box to the tailings facility, where it is located outside of mine-site containment.	It is indicated in the Annual Report that the pipeline was relocated into the mine site containment area. This was viewed during the inspection.	X		
7) Obtain sign-off by a qualified professional for the constructed wetland in the south mine area, to ensure the measures taken to reduce sulphate concentrations are appropriate and adequate.	Mitigation plans for Long Lake seep have progressed since last year's inspection, following a request from MOE dated December 1, 2010. See information under section 3.8 above.	X		
8) Submit a review of the Environmental Procedures Manual.	The EPM was updated and submitted to MOE.	X		
9) Evaluate whether there is a change in flow at the Long Lake seep with the plugging of the 2S portals. Submit this information to the ministry along with a plan to treat any remaining flows.	The 2 South portal plugs are in place and monitoring is continuing at Long Lake Seep. Data is needed over the winter season to evaluate changes from last year. Plans for treatment are underway as described in section 3.8 above.	X		

RECOMMENDED FOLLOW-UP FROM OCT 13/10 INSPECTION		COMPLIANCE		
		IN	OUT	?
10) Upon operation of the constructed wetland, conduct sampling of the influent and effluent of the wetland to quantify the sulphate and / or metals removal rates and quantities.	Treatment of the 2S mine water has not yet commenced.			n.a.
11) Conduct a visual inspection of the full length of the culvert connecting Brinco wetland to settling pond 4.	It is indicated in the Annual Report that Pipe-Eye Video was contracted to perform this work last April, but it could not be completed because flow through the culvert was too high. QCC reports that there are no apparent obstructions to flow. Water was flowing through the culvert during the Sept 2011 inspection.	X		
12) Continue to develop and implement an inspection and maintenance program for the plant site collection box and associated ditches and ponds to prevent clogging of the pump.	QCC reports that a solids-handling pump was installed in the collection box for better performance, and the area is inspected daily by the Plant Foreman and Surface Foreman.	X		
13) Remove coal fines from the plant-site ditch. Continue monitoring the plant ditch seep to evaluate whether the quantity and quality of this water changes with the changes to the north mine area water management system.	QCC reports to have removed coal fines from the plant site ditch and to be continuing regular monitoring of the plant ditch seep. The plant site ditch was viewed during the inspection and appeared in good condition. Monitoring of this area was reported for April - June 2011.	X		
14) Regularly inspect the bank behind the wash plant and ensure that CCR is not deposited outside of the mine catchment area.	It is indicated in the mine's Environmental Procedures Manual that frequent visual inspections of the coarse coal storage area is conducted. In the Annual Report it is specified that the bank is regularly inspected and maintenance cleanup is undertaken on a regular basis. The area was viewed during the inspection and appeared in good condition.	X		

Additional Comments and Recommended Follow-Up:

The inspection was conducted in cool dry weather. Photos are stored electronically by the Ministry of Environment at: I:\EnvProtection_Share\General\Pictures\INSPECTIONS\AM\2011-12. Detailed comments are provided above.

Recommended Follow-Up:

1) Confirm the leak at the 5S surface water injection site was corrected.

2) Clear vegetation from the culvert to SP4 (east side of main haul road), to allow for visual inspections.

3) Consider whether a permit amendment will be required for the pumping rate to Settling Pond 4 prior to initiation of underground tailings injection. Regardless of whether an amendment is required, submit an explanation of how flows through the settling pond will change due to input of water from underground tailings injection.

4) Notify MOE when the plant site collection box is close to overtopping and report overflows from the collection box to the plant site ditch, in accordance with permit section 2.1.4.

5) Continue sampling the seepage water collecting downgradient of the plant site ditch. In the 2011/12 Annual Report include an assessment of changes to water quality at this location since cessation of use of the ditch to convey water from the coal prep plant.

6) Continue the water quality study around the 4 South pad. If the pad is determined to be contributing runoff to the 2/4 South Haul Rd ditch the water must be rerouted to mine water management system, in accordance with permit section 3.10.

7) Continue with the plan for treatment of LLS and provide an update on the status of the demonstration trial in the 2011/12 Annual Report and Quarterly Reports.

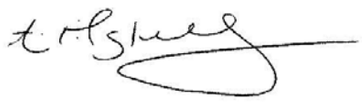
8) Report on flow rates at Long Lake Seep in the 2011/12 Annual Report and include a comparison of seep flow rates before and after installation of the 2 South portal plugs.

9) Review the cadmium water quality guideline and ensure it is shown in the correct units and compared to appropriate data in subsequent reports.

Please be aware that should non-compliance continue, escalating enforcement activities under the *Environmental Management Act* may be initiated.

For details on Non-Compliance Decision (NCD) Matrix levels and categories see
www.env.gov.bc.ca/main/prgs/docs/ce_policy_and_procedure.pdf

Please contact me with any questions or concerns.



Andrea Miskelly, Environmental Protection Officer andrea.miskelly@gov.bc.ca 250.751.3195

Ministry of Environment	West Coast Region Environmental Protection Division	Mailing Address: 2080A Labieux Rd Nanaimo BC V9T 6J9	Telephone: 250 751-3100 Facsimile: 250 751-3103 Website: http://www.gov.bc.ca/env/

COMPLIANCE REVIEW RECORD

File number: PR-15827

Client name: Quinsam Coal Corporation

Address: PO Box 5000 Campbell River BC V9W 8A3

Client rep: Steve Gardner, Director of Exploration / Technical Services
Kathleen Russell, Environmental Technician

Contact info: 250 286-3224

COMPLIANCE:	
IN or OUT:	IN

Date of Inspection: September 27, 2011 completed by: Andrea Miskelly, Senior Environmental Protection Officer

AUTHORIZATION REQUIREMENTS: Review October 13, 2010 **to** September 27, 2011

	YES	NO	N/A	?
a) Does discharge have an authorization number?	X			
b) Is all discharge monitoring conducted as required?			X	
c) Is all discharge monitoring reported as required?			X	
d) Is all discharge monitoring data reviewed in compliance with the authorization?			X	
e) Is all environmental monitoring conducted as required?			X	
f) Is all environmental monitoring reported as required?			X	
g) Is all environmental monitoring data reviewed in compliance with authorization?			X	
h) Is environmental monitoring indicating achievement of receiving environment quality criteria?			X	

Activity:	On-site Inspection	NCD Matrix Level:	I/C	NCD Matrix category:	A
Comments:	The facility was in compliance with the refuse permit.			Compliance tool initiated:	Notice

AUTHORIZATION SUBSECTION	DETAILS	COMPLIANCE IN	OUT	?
1.1 - Refuse from coal mining operation				
1.1.1 - The max auth'd rate of discharge is 300 m^3/a.	The authorized rate of discharge appears adequate.	X		
1.1.2 - Components of refuse which may be discharged are non-recyclable metal, wood waste, rubber, plastic, typical maintenance shop refuse, and residue from controlled open burning of wood waste. Putrescible and special wastes are excluded.	No putrescible or hazardous wastes were observed near the landfill. Rubber, plastics and wood were reported to be the main source of waste disposed of in the landfill.	X		

1.2 - Air contaminants from controlled open burning of wood waste		COMPLIANCE		
		IN	OUT	?
1.2.1 - The max auth'd rate at which wood waste may be burned is 60 m^3/a.	The wood waste pile in storage for burning was approximately 60 m^3 (prior to crushing).	X		
1.2.2 - Components of wood waste which may be burned are broken pallets, packing crates and failed or reject shoring timbers. Wood waste treated with preservatives or products registered under the Pest Control Products Act wastes are excluded.	The wood waste pile in storage for burning consisted approximately 99% of pallets. It was reported that non-treated mine timbers were also included.	X		
2 - General requirements				
2.1 - Landfill Operation Refuse shall be compacted and cover material applied once every 20 operating days or at least once per month. Metallic components shall be segregated, placed in a separate area from wood waste and covered every 20 days and at least every month. The frequency may be reduced by the RWM based on circumstances affecting normal operation.	The landfill was reported to be compacted and covered at least once per month. Metal was stored for recycling.	X		
2.2 - Site Preparation and Restoration Fencing, site access, vehicle safety barriers, surface water works, firebreaks and site restoration as required shall be carried out to the satisfaction of the RWM.	The refuse area and wood waste pile are within the mine's footprint and are therefore secured by the same means as the mine.	X		
2.3 - Waste Reduction and Alternate Disposal The permittee is encouraged to segregate for recycling and reuse, where possible, materials destined for disposal at this site. Alternate disposal for specific wastes may be required if problems arise that are attributable to specific wastes.	Metal is stockpiled and hauled off site by Steel Pacific. Waste oil containers, used oil and antifreeze are collected by Newalta. Paper and cardboard are recycled. Rubber conveyor belts are removed from the site approximately once per year.	X		

2.6 - Operational requirements for controlled open burning		COMPLIANCE		
		IN	OUT	?
Location of Burning Area - The burning operation shall be restricted to a site designated as a burning area by the RWM.	QCC provided information on a proposed burn location via email date April 27, 2011. The location is adjacent to the 2-4 South Haul Road, just south of the South Dyke Pond. This site is within the area designated in permit PR-15827 under section 1.2.3 and in the permit's site plan. Therefore, no additional designation is needed in order to burn there.	X		
Waste Segregation - Burnable wastes shall be segregated from non-combustible materials and only readily burnable wood waste originating from the mine operations shall be open-burned. No waste shall be burned which is unacceptable to the RWM.	A small amount of plastic was observed to be present in the burn pile. Mine staff indicated the plastics should not be there. **Plastics should be removed prior to burning.**	X		
Frequency - The max burning frequency is 2 times per year. Each burn shall comprise one continuous period necessary to reduce the wood waste to ashes, but shall not exceed two days in duration.	It was reported that no burning had occurred this year.			n.a.
Timing - Burning shall only take place when an attendant is on duty and when conditions promote rapid combustion and dispersion. No burning shall take place during period of fire hazard or when burning is prohibited by other govn't agencies.	It was reported that no burning had occurred this year.			n.a.
Fire Control - Suitable approved devices shall be available for extinguishing fires to prevent spreading; these may include pressurized water supply, chemical fire extinguishers, or an earth stockpile. Earth moving equipment must be kept on-site for the latter. A fireguard shall be cleared and maintained free of combustibles.	It was reported that no burning had occurred this year.			n.a.

MONITORING REQUIREMENTS:
Review Period: from **October 13, 2010** **to** **September 27, 2011**

DISCHARGE MONITORING	DETAILS	Reporting Frequency	COMPLIANCE		
			IN	OUT	?
n.a.	n.a.				n.a.
RECEIVING ENVIRONMENT MONITORING	**DETAILS**	**Reporting Frequency**	**IN**	**OUT**	n.a.
n.a.	n.a.				

RECOMMENDED FOLLOW-UP FROM OCT 13/10 INSPECTION		COMPLIANCE		
		IN	OUT	?
1) Submit a request in writing to have the burn location designated by the Regional Waste Manager, as required by permit section 2.6.	The 2S pit was not used as a burn location this year. A request was submitted for a new burn location, however this was determined to be within the area designated for burning in the permit.	X		
2) Remove plastics from the burn pile prior to initiating the next burn.	It was reported that this was completed prior to last year's burn.	X		

Additional Comments and Recommended Follow-Up:

The inspection was conducted in cool, dry weather. Photos are stored electronically at I:\EnvProtection Share\General\Pictures\INSPECTIONS\AM\2011-12\Quinsam 11Sep27.

The landfill area was observed. Waste was adequately covered. A wood waste pile was present at the landfill, and it was indicated the material would be moved across the street prior to burning. A small amount of plastic pipe was observed in the wood waste pile, which needs to be removed prior to burning.

Recommended Follow-Up:

1) Plastic and any other non-permitted materials must be removed from the wood waste pile prior to burning.

For details on Non-Compliance Decision (NCD) Matrix levels and categories see www.env.gov.bc.ca/main/prgs/docs/ce_policy_and_procedure.pdf

Please contact me with any questions or concerns.

Andrea Miskelly, Senior Environmental Protection Officer
andrea.miskelly@gov.bc.ca 250.751.3195

Ministry of Environment	West Coast Region Environmental Protection Division	Mailing Address: 2080A Labieux Rd Nanaimo BC V9T 6J9	Telephone: 250 751-3100 Facsimile: 250 751-3103 Website: http://www.gov.bc.ca/env/

APPENDIX VI

2011/2012 ANNUAL GROUNDWATER MONITORING SUMMARY, 2 NORTH, 3 SOUTH AREAS QUINSAM COAL

June 13, 2012

REPORT

2011/2012 Annual Groundwater Monitoring Summary, 2 North, 3 South Areas Quinsam Mine

Submitted to:

Quinsam Coal Corporation
P.O. Box 5000
Campbell River, BC
V9W 5C5

REPORT

A world of capabilities delivered locally

Report Number: 1214760001-006-R-Rev0

Distribution:

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2 copies - Golder Associates Ltd.

Golder Associates

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) is pleased to provide Quinsam Coal Corporation (QCC) with the 2011/2012 Annual Groundwater Monitoring Summary report for the 2 North and 3 South areas of the Quinsam Mine (the Site) located west of Campbell River, BC, Figure 1. Golder understands that this report will be included in QCC's Annual Water Quality Monitoring and Reclamation Report. The monitoring period for QCC's annual report extends from April 2011 through January 2012. The schedule for Golder's annual monitoring summary report coincides with QCC's annual reporting schedule. During the 2011/2012 monitoring period, Golder submitted three quarterly groundwater quality monitoring letter reports (spring, summer, and fall 2011) to QCC and the British Columbia Ministry of Environment (BC MoE). The 2011/2012 annual summary report includes the January 2012 (winter) quarterly groundwater monitoring results, summarizes the data from the previous three monitoring events in 2011, and discusses observed data trends from the 2011/2012 monitoring period including historical data since monitoring began in 2001.

This report should be interpreted and used in accordance with the limitations and considerations set out in the Golder Associates Ltd. *Limitations and use of this Report*, provided in Section 10.0.

2.0 BACKGROUND

Golder was retained by QCC to conduct a preliminary groundwater assessment in 2000 to assess groundwater conditions downgradient of the 2 North wash plant ditch, and in the 2 South, 3 South pit area (Golder, 2000)[1]. The scope of work for the 2 North, 3 South quarterly groundwater monitoring program, which began in September 2001[2], was developed by Golder and QCC, with input from the Environmental Technical Review Committee (ETRC), comprising representatives from the British Columbia Ministry of Environment (BC MoE), British Columbia Ministry of Energy and Mines (BC MEM), Fisheries and Oceans Canada (F&OC), City of Campbell River, Environment Canada, and Quinsam Coal Corporation (QCC).

2.1.1 2 North Wash Plant Ditch Area Monitoring Wells

In 2000, two boreholes were advanced in the 2 North area, in an area downgradient of the coal preparation plant (CPP) drainage ditch ("Wash Plant ditch"). Each borehole was completed as a multi-level installation with shallow (MW00-1S, MW00-6S) and deep (MW00-1D, MW00-6D) monitoring wells constructed with 51 mm (2 inch) diameter PVC pipe. Groundwater monitoring wells MW00-1D and MW00-6D are installed in glacial till (i.e., silty sand to sandy silt). Groundwater monitoring wells MW00-1S and MW00-6S are installed in unconsolidated sediments (i.e., sand and gravel) and sandy silt fill, respectively. The lateral and vertical extent of the surficial aquifer materials is unknown. Borehole logs and well completion details are provided in Appendix I. The approximate locations of the monitoring wells are indicated on Figure 2.

[1] Golder Associates Ltd. 2000. *Preliminary Groundwater Assessment, Quinsam Mine, Campbell River, BC*.
[2] Golder Associates Ltd. 2001. *Phase II Groundwater Assessment, Quinsam Mine, Campbell River, BC*.

2.1.2 2 South, 3 South Area Monitoring Wells

Four bedrock groundwater monitoring wells are located in the 2 South, 3 South area. Monitoring well MW00-2 is installed in shallow bedrock located approximately 15 m from the northeast corner of the 3 South pit. Monitoring wells MW00-3, MW00-4, and MW00-5 are installed in the "gobbed" underground workings of the former No. 1 coal seam located on the side of the access road to the 3 South pit. Borehole logs and well completion details are provided in Appendix I. The approximate locations of the 2 South, 3 South area monitoring wells are indicated on Figure 2.

In 2011, QCC advanced a borehole (QU11-11) within the 2 South underground workings to be utilized as a dewatering well for the proposed sulphate mitigation cell (Figure 2). QCC indicated that the total drilled depth of this borehole was approximately 68 m below ground surface; the drill hole record for this location was not developed. Groundwater level monitoring for this location was included in the current monitoring program to provide additional information on groundwater elevations within the former 2 South underground workings.

3.0 REGULATORY CONSIDERATIONS

Golder understands that QCC is authorized to discharge effluent under permit PE-07008 (December 23, 1987, amended July 7, 2004) issued by the former British Columbia Ministry of Water, Land and Air Protection (now British Columbia Ministry of Environment (BC MoE)) under provisions of the former *Waste Management Act* (now the *Environmental Management Act*). The permit identifies three locations where discharge of effluent is authorised; the North Coal Mining Operation and Coal Preparation Plant, the South Coal Mining Operation, and the Block 242 Coal Mining Operation. Permit PE-07008 provides criteria for chemical parameters of interest (i.e., dissolved aluminum, copper, iron, lead, phosphorous, zinc, and pH) to assess effluent quality at the designated discharge locations.

The criteria outlined in permit PE-07008 are not directly applicable to groundwater. However as a screening benchmark, the laboratory analytical results from the quarterly groundwater monitoring program were compared to the water quality criteria provided in the permit. The permit criteria for zinc and iron in the North Coal Mining Operation are different from those in the South Coal Mining Operation.

In addition to the criteria listed in permit PE-07008, and also as a screening benchmark, water quality results from the quarterly groundwater monitoring program were compared to the BC Contaminated Sites Regulation (CSR) [BC Reg. 375/96; includes amendments up to BC Reg. 97/2011, May 31, 2011] water quality standards for freshwater aquatic life (AW) as it is assumed that groundwater may discharge to surface water at the Site. The aquatic life standards assume that a minimum 1:10 dilution is available if groundwater were to be discharged to a freshwater body that contains aquatic life.

4.0 METHODS

The January 2012 quarterly groundwater monitoring event included the following activities:

- Record groundwater levels with a water level meter in eight monitoring wells (MW00-1S, MW00-1D, MW00-2, MW00-3, MW00-4, MW00-5, MW00-6S, and MW00-6D) and two drillholes (94-009 and QU11-11);
- Purge wells, measure field water quality parameters (pH, conductivity, temperature, and redox), collect groundwater samples and submit for laboratory analysis of selected chemical parameters: dissolved metals, dissolved anions (including sulphate), total alkalinity, and hardness; and
- Compile factual results of the groundwater assessment with previous monitoring information in the comprehensive 2011/2012 Annual Report.

The January 2012 field monitoring event was carried out on January 11 and 12, 2012 by Ms. Paige Maddock, C. Tech., of Golder.

ALS Laboratory Group, Environmental Division (ALS) of Burnaby, BC analyzed the groundwater samples that were collected during the 2011/2012 groundwater monitoring program. ALS is certified by the Canadian Association for Laboratory Accreditation Inc. (CALA) for the analytical methods used for this program.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

Standard field and laboratory procedures were used throughout the field monitoring program, including Quality Assurance/Quality Control (QA/QC) methods to assess the reproducibility of laboratory analysis results. The QA/QC target for the monitoring program was approximately one replicate sample for every ten samples analyzed for a particular compound (i.e., 10% replicates) per sampling event; one replicate groundwater sample was submitted with seven groundwater samples.

The relative percent difference (RPD - the absolute difference between the two values, divided by their mean) of replicate analyses was used to evaluate the sample result variability. A RPD value of less than 20 percent for groundwater is generally considered an indication of acceptable analytical precision. Higher RPD values are evaluated on a case by case basis and may reflect compositional variability inherent to the sample, or variability related to sample collection, handling and analysis. Where the concentration of a given parameter is less than five times the laboratory method detection limit, the results are less precise and the RPD is not calculated. For parameters with concentrations below five times the laboratory detection limit, the acceptable analytical precision is determined by calculating the absolute difference between replicate samples. The absolute difference should then be less than two times the laboratory detection limit (USEPA, 2004)[3].

[3] USEPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review Final*. EPA-540-R-04-004.

6.0 RESULTS

6.1 January 2012 Groundwater Quality

Between approximately 19 Litres (L) and 124 L of groundwater was purged from each of the wells prior to sampling. Based on groundwater levels in MW00-3 it was determined that there was insufficient groundwater for sampling. Groundwater sampled from monitoring wells MW00-1S, MW00-2, MW00-4, MW00-6S, and MW00-6D was observed to be generally clear with no odours detected. Groundwater sampled from monitoring well MW00-5 was observed to be clear with slight hydrogen sulphide-like odours detected. Groundwater sampled from monitoring well MW00-1D was observed to be cloudy with no odours detected. A compilation of groundwater analytical data is presented in Table II-1, Appendix II. The laboratory certificate of analysis is provided in Appendix V. General observations on the compiled groundwater quality analytical results include:

- pH values ranged from approximately 6.8 to 9.3 and were within the permit criterion (6.0 to 8.5) except for groundwater sampled from MW00-1D and MW00-6D, which had pH values of approximately 9.3 and 8.6, respectively; and
- Concentrations of sulphate at MW00-2 and MW00-5, were 1,190 mg/L and 1,840 mg/L, respectively, and exceeded the CSR freshwater aquatic life standard of 1,000 mg/L.

6.2 Quality Assurance and Quality Control

Seven groundwater samples and one field replicate collected from groundwater monitoring well MW00-1D during the January 2012 monitoring event were submitted for laboratory analysis. The RPD results for the field replicate sample were within the acceptable RPD limit of 20% for parameters to which the RPD was applicable. The absolute value results were within the acceptable absolute value limits of two times the laboratory detection for parameters to which the absolute value limit was applicable. The RPD and absolute value results are provided in Table II-2 in Appendix II.

A review of the laboratory data determined that the laboratory appeared to have met their own standards and internal QA/QC targets the parameters analyzed. The laboratory RPD results are provided in the ALS Certificate of Analysis attached in Appendix V.

6.3 January 2012 Groundwater Levels

Groundwater levels measured on January 11, 2012 are summarized in Table 1. A compilation of groundwater levels from previous monitoring events is provided in Table IV-1, Appendix IV. Historical groundwater level and elevation data for the 2 North, 3 South area monitoring wells are provided in Graphs IV-1 through IV-6, Appendix IV.

Table 1: Summary of January 11, 2012 Groundwater Levels and Elevations

Well ID	Depth to Groundwater (m below ground surface) (before purging)	Surveyed Ground Surface Elevation (m geodetic)	Groundwater Elevation (m geodetic)
MW00-1S	1.39	308.028	306.64
MW00-1D	14.51	308.028	293.52
MW00-2	0.80	326.080	325.28
MW00-3	39.43	345.620	306.19
MW00-4	41.70	347.813	306.11
MW00-5	34.74	342.773	308.03
MW00-6S	0.97	307.957	306.99
MW00-6D	0.27	307.957	307.69
Drillhole 94-009	1.60	353.47	351.87
QU11-11	48.36	354.032	305.67

Note: Ground surface elevations are based on survey information provided by Quinsam Coal Corporation on October 12, 2011.

Information on ground survey elevations for the monitoring well locations were provided by QCC in October 12, 2011. Based on this information, the groundwater level and elevation data set was updated accordingly.

Groundwater levels were monitored in QU11-11 by Golder twice during in 2011/2012.

7.0 DISCUSSION

7.1 2 North 2011/2012 Groundwater Quality

Sulphate

The laboratory analytical results for sulphate for the 2011/2012 monitoring period had a seasonal patterns consistent with that observed since 2001. A slight downward trend in sulphate concentrations was observed in 2011/2012 and was likely due to cessation of the Wash Plant ditch flows after September 12, 2010. However, periodic flow was observed in the Wash Plant ditch during 2011/2012 and was inferred to be sourced from the coal stockpiles located next to the coal preparation plant. This source of runoff likely contributed sulphate to the shallow groundwater aquifer in the area of the Wash Plant ditch. Surface water flow from the stockpiles was inferred to be seasonal with most of the flow in the winter months with little contribution of flow in the summer months. However, overall sulphate concentrations in shallow monitoring wells MW00-1S and MW00-6S have exhibited a slight downward trend and have reported the lowest concentrations since 2000 and 2001, respectively (Graph III-1, Appendix III).

Sulphate concentrations in groundwater at MW00-6D appear to be more seasonally affected than in MW00-1 and have been approximately 40 mg/L higher on average than sulphate concentrations at MW00-1D since approximately 2002. This may be due to MW00-1D being approximately 10 m deeper than MW00-6D and being less influenced from the Wash Plant ditch seepage.

pH

An apparent pH gradient with depth continued to be observed during the 2011/2012 monitoring period (Graph III-2, Appendix III). The apparent gradient ranged from circum-neutral (approximately 6.7 to 7.4) at MW00-1S and MW00-6S to generally more alkaline values (approximately 8.5 to 9.3) at MW00-1D and MW00-6D. The groundwater pH appears to have stabilized during the 2011/2012 monitoring period.

Chloride

Chloride concentrations in MW00-6S were observed to have a slight downward trend in 2011/2012 compared with the 2010/2011 results. Chloride concentrations at MW00-1S increased in 2011 then decreased in January 2012 to similar concentration as MW00-6S. Chloride concentrations in deep monitoring wells MW00-1D and MW00-6D were low and stable in 2011/2012.

Metals

Concentrations of dissolved metals (i.e., calcium, magnesium, manganese, and sodium) in shallow groundwater were generally higher than those in samples collected from the deeper groundwater during the 2010/2011 monitoring period. This trend has been generally consistent since monitoring began in 2000. However, concentrations of dissolved aluminum, arsenic, molybdenum (at MW00-1D), and vanadium were higher in the deep monitoring wells compared with the shallow monitoring wells.

7.2 2 South, 3 South 2011/2012 Groundwater Quality

Sulphate

The laboratory analytical results for sulphate for the 2011/2012 monitoring program were generally consistent with the sulphate concentration trends and patterns observed since 2004 (Graph III-4, Appendix III). Concentrations of sulphate ranged from 1,510 to 1,840 mg/L and 206 to 273 mg/L in groundwater sampled from monitoring well MW00-5 and MW00-4, respectively that were installed in the former underground workings south of the 3 South pit. Concentrations of sulphate in groundwater ranged from 1,190 to 1,320 mg/L at MW00-2 installed in bedrock (i.e., shale and coal) located adjacent to the 3 South pit. Monitoring well MW00-3 had insufficient water available for sampling during the 2011/2012 period; therefore groundwater chemistry information for this location is not available.

Sulphate concentrations at MW00-2 were relatively consistent in 2011/2012 compared with monitoring results since approximately 2004. However, two noticeable downward spikes in sulphate concentration that occurred in February 2007 and November 2010 may be due to periods of increased precipitation and runoff into 3 South pit. Sulphate concentrations at MW00-4 declined in 2011/2012 compared with previous monitoring periods and continued to have a slight downward trend in concentration since approximately 2010. Sulphate concentrations reported for MW00-5 continued to have a strong seasonal response in the 2011/2012 monitoring period, with an overall slight upward trend in concentrations since approximately 2004.

pH

Field measured pH values in the 2 South, 3 South area monitoring wells were circum-neutral (6.7 to 7.3) during the 2011/2012 monitoring period (Graph III-5, Appendix III). Field pH values observed in 2011/2012 were generally within the pH range observed since 2001.

Chloride

Chloride concentrations observed in 2011/2012 at MW00-2 and MW00-5 have declined since March 2010 and are relatively low (<4 mg/L). An apparent chloride concentration gradient from MW00-2 and MW00-5 (<4 mg/L) toward MW00-4 ($\leq$0.60 mg/L) has been observed since March 2010 (Graph III-6, Appendix III). Chloride concentrations in monitoring well MW00-4 were low and stable in 2011/2012.

Metals

Concentrations of dissolved metals were generally low or below laboratory detection limits during the 2011/2012 monitoring period except for dissolved iron MW00-5. Dissolved iron exceeded the permit criteria limit (0.5 mg/L) at MW00-5 (one event) during the 2011/2012 period (Graph III-7, Appendix III).

7.2.1 Groundwater Levels

Groundwater levels in the 2 North wash plant ditch area monitoring wells MW00-1S, MW00-6S, and MW00-6D continued to show seasonal variations. Groundwater levels in monitoring well MW00-1D have declined slightly and have exhibited less seasonal variation since approximately February 2009. Estimated groundwater elevations in MW00-1D compared with MW00-1S continued to be 13 m lower in elevation from February 2009 to January 2012. Based on a review of the updated survey information provided by QCC in 2011, an apparent decline in groundwater elevation in MW00-6S was observed in mid 2008. Estimated groundwater elevations at MW00-6S compared with MW00-6D were lower from September 2008 to January 2012.

Groundwater elevations in monitoring well MW00-2 were higher on average by approximately 0.20 m in 2011/2012 compared with 2010/2011 and on average by approximately 0.77 m higher in elevation compared with monitoring events prior to 2010.

In 2011/2012 groundwater elevations in MW00-3 and MW00-4 increased but did not return to previous seasonal levels observed from 2006 to early 2011. This may be attributed to the closing of the three portal entrances with concrete bulkheads in 2 South Pit in the summer of 2011. The closed entrances likely redirected surface flow to the 2 South sump area. Groundwater elevations in borehole QU11-11 were slightly lower compared with elevations in MW00-3 and MW00-4 in December 2011 and January 2012. Groundwater levels in MW00-5 during the 2011/2012 period exhibited slight seasonal patterns consistent with those measured since the landslide occurred in 2005 and may have not been affected by the closing of the 2 South Pit portal entrances.

The seasonal variation in groundwater levels in monitoring wells MW00-2, MW00-3, MW00-4, MW00-5, and inferred subsurface relationship to the No. 1 and No. 2 coal seams is illustrated in Conceptual Cross-section A-A', Figure 3. The information suggests that the abandoned underground workings in the former No. 1 coal seam (assumed thickness of 2.5 m) continue to be flooded in the areas of monitoring wells MW00-3 and MW00-4 throughout the year and flooded in the area of MW00-5 during the wet winter months. The groundwater flow direction in the vicinity of the 3 South area was inferred to be generally towards Long Lake.

8.0 RECOMMENDATIONS

The following recommendations are provided for QCC's consideration, based on long term groundwater quality trends observed in the 2 North, 3 South areas:

- Continue to conduct quarterly groundwater monitoring of 2 North monitoring wells (MW00-1S, MW00-1D, MW00-6S, and MW00-6D) to assess groundwater quality in the area of the Wash Plant ditch.
- Continue to conduct quarterly monitoring in the 3 South area to assess groundwater quality trends in the former underground workings and 3 South pit area.

9.0 CLOSURE

We trust this report provides you with the information you require at this time. Should you have any questions regarding the contents of this report, or require any further information, please do not hesitate to contact Dwayne Smith at Golder's Victoria office at 250-419-4947.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Dwayne Smith, B.Sc., P.Geo.
Geologist, Project Manager

Reviewed by:

ORIGINAL SIGNED

Jeff Fillipone, Ph.D., P.Geo.
Principal, Project Director

DS/JF/kar

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10.0 LIMITATIONS AND USE OF THIS REPORT

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Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use by any party of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs, techniques and equipment choice, scheduling and sequence of operations would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves

judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect certain conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between sampling points may differ from those that actually exist.

Groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their measurement. Groundwater conditions may vary between reported locations and can be affected by annual, seasonal and special meteorological conditions or tidal fluctuations. Groundwater conditions may also be altered by construction activity on or in the vicinity of the project site.

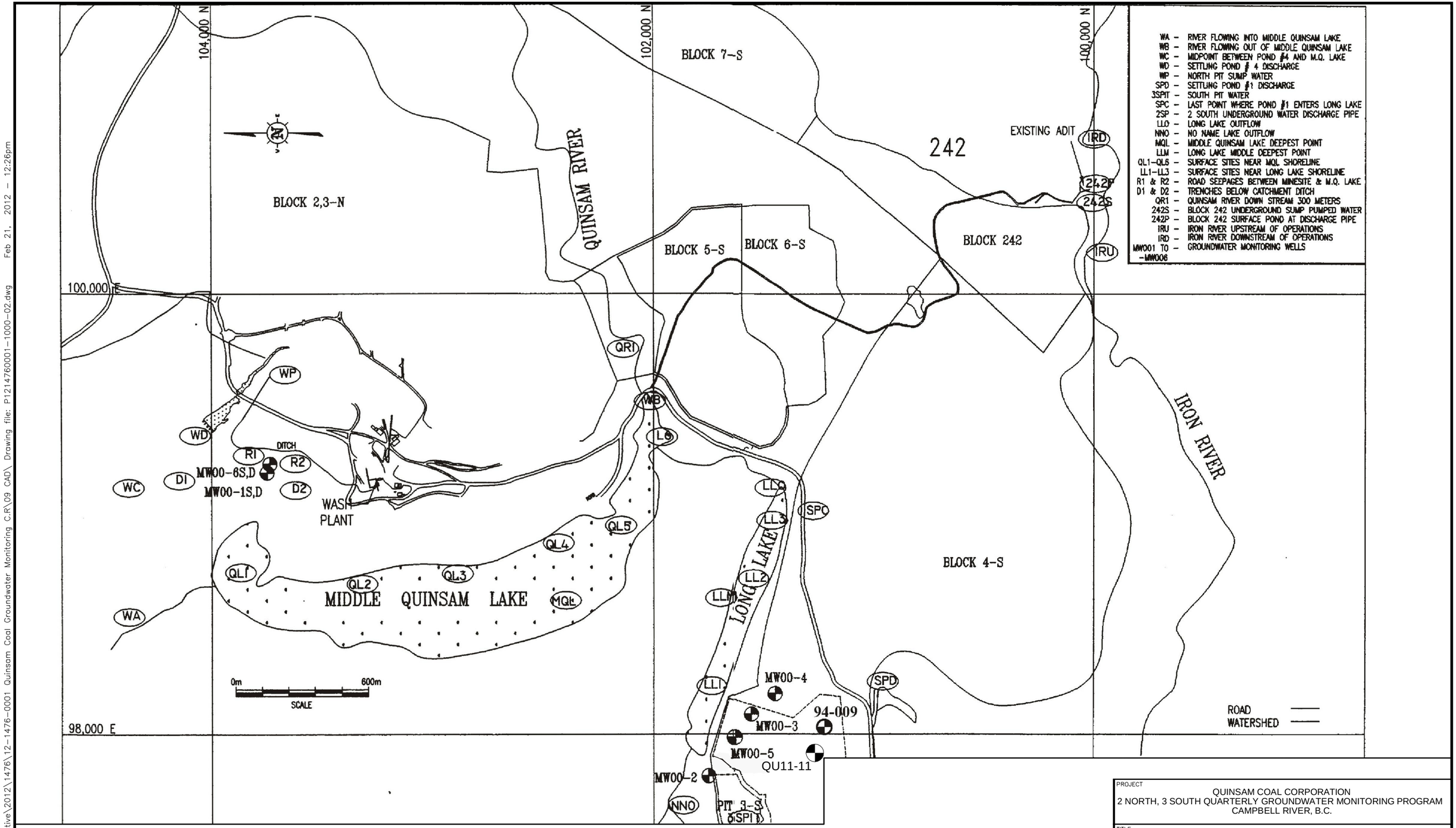
Sample Disposal: All contaminated samples and materials shall remain the property and responsibility of the Client for proper disposal. Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense.

Follow-Up and Construction Services: All details of the design and proposed construction may not be known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

FIGURES

SITE
N
S
E
W
Campbell River
Cape Mudge
Willow Pt
Shelter Pt
Shelter Point
Campbell River District Mun Limits
Oyster Bay
Oyster River
Kuhushan Pt
Saratoga Beach
Miracle Beach Prov Pk
Black Creek
Williams Beach
Merville
Headquarters
Grantham
Courtenay
Puntledge
Bevan
Cumberland
Comox Lake
Constitution Hill
Mount Washington
Forbidden Plateau
Mount Adrian
Alexandra Peak
Lupin Mountain
Mount Phillips
Strathcona Prov Pk
Mount Myra
Mount Harmston
Mount Argus
The Red Pillar
Kookjat Mtn
Alone Mountain
Old Camp Point
Mount Hennessy
Mount Clifton
Jap Mtn
Indianhead Mtn
Mt Becher
Wood Mountain Provincial Ski Park
Courtenay Airpark
Buttle Lake
Quinsam Lake
Middle Quinsam L
Upper Quinsam Lake
Gosseneck
Snakehead L
Lukwa L
Mirror L
Gilson L
Gentian L
Camp L
Wokas L
Wowo L
Regan L
Beadnell L
Harris L
Pearl L
Norm L
Sunrise L
Circlet L
Mariwood L
Moat L
Faith L
Ralph L
Delight L
Ink L
Carey Lk
Memory L
Milla L
Tzela L
Cruickshank Canyon
Comox Glacier
Mount Washington Alpine Resort
Vancouver Island
Strata Mtn
Mt Brooks
Mt Elma
Mt Mitchell
Mt Regan
Mt Albert Edward
Augerpoint Mtn
Castlecrag Mtn
Mount George V
Iutland Mtn
Rees Ridge
Flower Ridge
Tsolum River
Puntledge River
Comox Lake
Courtenay River
Black Creek
Oyster River
Woodhus Ck
Chute Ck
Iron Ck
Adrian Ck
Beadnell Ck
Haskins Ck
Balsam Ck
Mine Ck
Stuart Ck
Oyster River
Tsolum River
Wolf Lake
Headquarters Ck
Portuguese Ck
Dave Ck
Jackpot Ck
Anderson L
Paradise Ck
Battleship Ck
Lake Helen Mackenzie
Rosseter L
Diversion L
Harris L
Norm L
Pearl L
Sunrise L
Circlet L
Mariwood L
Moat L
Faith L
Ralph L
Delight L
Ink L
Carey Lk
Memory L
Milla L
Tzela L
Cruickshank Canyon
Aldermen Ls
Eric Ck
Stokem Ck
Rees Ck
Henshaw Ck
Price Ck
Tsable River
Trent River
Bloedel L
Tsable L
Bradley L
Poum L
Idle Ck
Trent Ck
Tremain Ck
Maple L
Roy L
Allen L
Hamilton L
Cumberland Ck
Perseverance Ck
Boston Ck
Supply Ck
Wolfaway Ck
Fire
Rough and Tumble Mtn
Forbush L
Willemar L
Beaufort Ck
Beaufort Range
Nanaimo Lakes Land Dist
Comox Land Dist
Nelson Land Dist
Discovery Passage
Sayward Land Dist
Elma Bay
Miracle Beach Prov Pk
Kitty Coleman
Pentledge IR 2
Com 120
Communication
Com 140
Aband
Fire
Woods
Com
Willow
Campbell River
Shelter Pt
Shelter Point
Campbell River District Mun Limits
Oyster Bay
Kuhushan Pt
Oyster River
Saratoga Beach
Elma Bay
Miracle Beach Prov Pk
Black Creek
Williams Beach
Nanaimo Lakes Land Dist
Comox Land Dist
Merville
Constitution Hill
Headquarters
Grantham
Portuguese Ck
Com 120
Communication
Courtenay
Courtenay Airpark
Puntledge
Bevan
Cumberland
Nelson Land Dist
Comox Lake
Mount Washington
Mount Washington Alpine Resort
Forbidden Plateau
Mount Adrian
Alexandra Peak
Lupin Mountain
Mount Phillips
Strathcona Prov Pk
Mount Myra
Mount Harmston
Mount Argus
The Red Pillar
Kookjat Mtn
Alone Mountain
Old Camp Point
Mount Hennessy
Mount Clifton
Jap Mtn
Indianhead Mtn
Mt Becher
Wood Mountain Provincial Ski Park
Buttle Lake
Quinsam Lake
Middle Quinsam L
Upper Quinsam Lake
Gosseneck
Snakehead L
Lukwa L
Mirror L
Gilson L
Gentian L
Camp L
Wokas L
Wowo L
Regan L
Beadnell L
Harris L
Pearl L
Norm



WA – RIVER FLOWING INTO MIDDLE QUINSAM LAKE
WB – RIVER FLOWING OUT OF MIDDLE QUINSAM LAKE
WC – MIDPOINT BETWEEN POND #4 AND M.Q. LAKE
WD – SETTLING POND # 4 DISCHARGE
WP – NORTH PIT SUMP WATER
SPD – SETTLING POND #1 DISCHARGE
3SPIT – SOUTH PIT WATER
SPC – LAST POINT WHERE POND #1 ENTERS LONG LAKE
2SP – 2 SOUTH UNDERGROUND WATER DISCHARGE PIPE
LLO – LONG LAKE OUTFLOW
NNO – NO NAME LAKE OUTFLOW
MQL – MIDDLE QUINSAM LAKE DEEPEST POINT
LLM – LONG LAKE MIDDLE DEEPEST POINT
QL1–QL5 – SURFACE SITES NEAR MQL SHORELINE
LL1–LL3 – SURFACE SITES NEAR LONG LAKE SHORELINE
R1 & R2 – ROAD SEEPAGES BETWEEN MINESITE & M.Q. LAKE
D1 & D2 – TRENCHES BELOW CATCHMENT DITCH
QR1 – QUINSAM RIVER DOWN STREAM 300 METERS
242S – BLOCK 242 UNDERGROUND SUMP PUMPED WATER
242P – BLOCK 242 SURFACE POND AT DISCHARGE PIPE
IRU – IRON RIVER UPSTREAM OF OPERATIONS
IRD – IRON RIVER DOWNSTREAM OF OPERATIONS
MW001 TO –MW006 – GROUNDWATER MONITORING WELLS

LEGEND

Approximate Location of Monitoring Wells and Drill Holes

REFERENCE

Base plan provided by Quinsam Coal Corporation.

PROJECT

QUINSAM COAL CORPORATION
2 NORTH, 3 SOUTH QUARTERLY GROUNDWATER MONITORING PROGRAM
CAMPBELL RIVER, B.C.

TITLE

SITE AND MONITORING WELL LOCATION PLAN

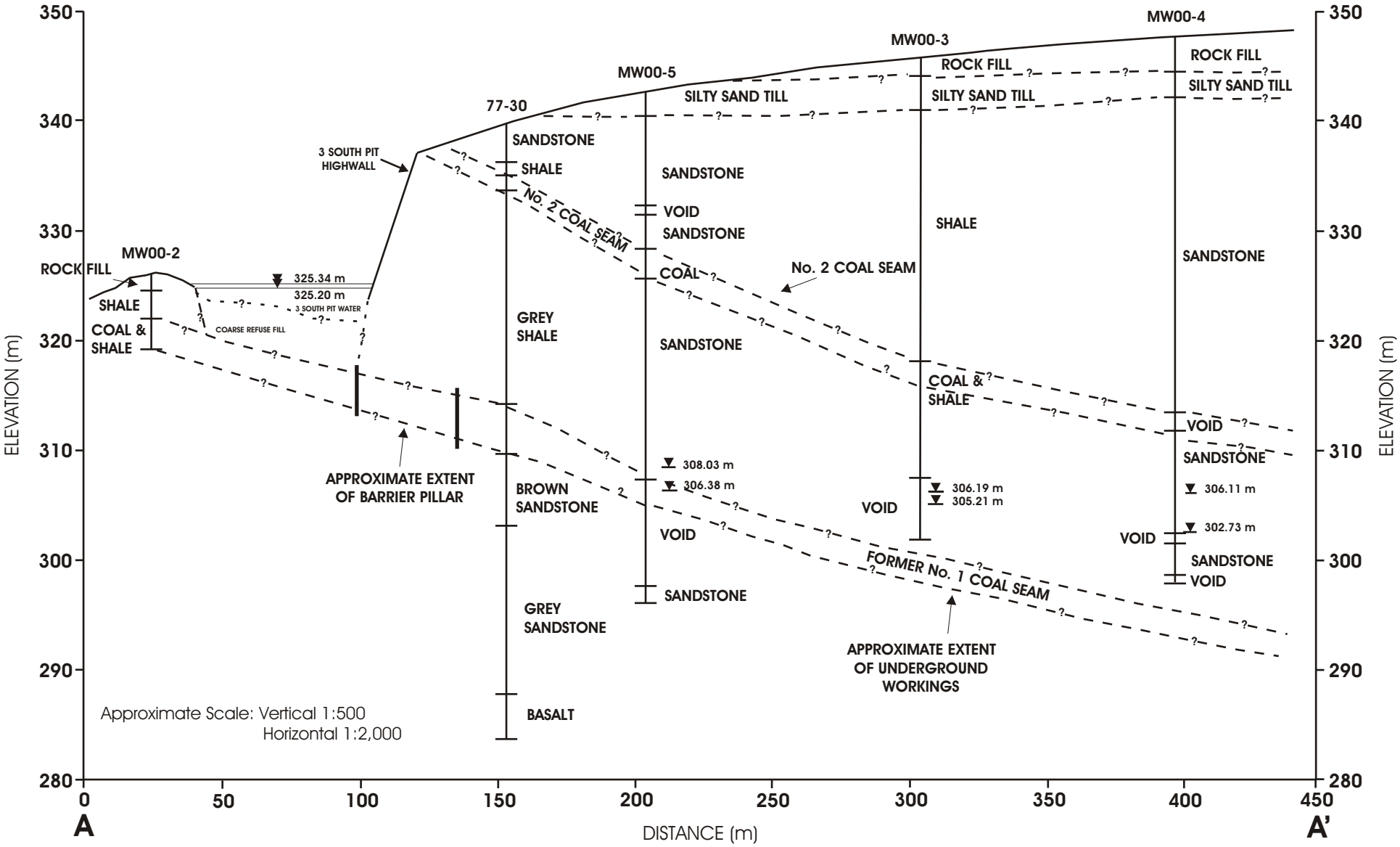
Golder Associates
Victoria, BC

PROJECT No. 12–1476–0001			FILE No. P1214760001–1000–02		
DESIGN	DS	8 FEB 12	SCALE	NTS	REV. 0
CADD	AW	8 FEB 12			
CHECK	DS	8 FEB 12			
REVIEW	JF	8 FEB 12			

FIGURE 2

\\Vic1-s-filesrv1\data\Active\2012\1476\12-1476-0001 Quinsam Coal Groundwater Monitoring C.R\09 CAD\ Drawing file: P1214760001-1000-02.dwg Feb 21, 2012 - 12:26pm

COREL FILE: N:\Active\2012\1476\12-1476-0001 Quinsam Coal Groundwater Monitoring\07 Deliverables\Figures\Figure3_Feb 9-12.cdr



LEGEND

–?– –	Inferred lithologic contact
▼ 308 m	Approximate groundwater elevation

NOTES

1. Groundwater level survey conducted Quarterly by Golder.
2. Groundwater elevations presented represent seasonal ranges for 2011/2012 monitoring period.
3. Drillhole information for 77-30 was provided by Brown et al., 1982.
4. Cross section constructed from base plan from QCC drawing No. 91-BC-270A, 91-BC-336 and 97-E-025.

PROJECT
QUINSAM COAL CORPORATION
2011/2012 GROUNDWATER MONITORING PROGRAM
QUINSAM MINE

TITLE
CONCEPTUAL CROSS SECTION A-A' 3 SOUTH PIT

Golder Associates

PROJECT No. 12-1476-0001			PHASE No. 1000	
DESIGN	DS	9 Feb. 2012	SCALE See scale	REV.
CD	DS	9 Feb. 2012		
CHECK	DS	9 Feb. 2012		
REVIEW	JF	19 Feb. 2012		

FIGURE 3

APPENDIX I

Record of Drillholes and Monitoring Wells

QUINSAM COAL CORPORATION – DRILLER'S LITHOLOGY LOG

Drillwell Enterprises Ltd.

HOLE NUMBER : QU – 94 – 09

CO–ORDINATES : 101228.280 N – 97992.465 E
ELEVATION : 353.47 m.

DATE DRILLED : Nov.10, 1994

DEPTH (m) From	To	DESCRIPTION
0.0	0.9	Road fill
0.9	2.4	gravel & sand brown
2.4	4.3	Sandstone, brown
4.3	23.2	Sandstone, light green
23.2	31.4	Sandstone, dark green
31.4	39.6	Sandstone, greenish brown
39.6	47.6	Sandstone, light green
47.6	54.3	Sandstone, light grey
54.3	55.5	Siltstone, grey
55.5	56.1	COAL
56.1	68.3	Siltstone, grey
68.3	74.4	COAL
74.4	76.8	Coal layered siltstone
76.8	80.8	Siltstone, grey; END OF HOLE

Remarks: Hole makes 2 GPM of water

↑ While drilling with air.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-1(S&D)

SHEET 1 OF 2

LOCATION: 2 North Washplant Ditch Area, Quinsam Mine

BORING DATE: April 17-18, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Loose, moist, brown SAND and GRAVEL, trace silt.		0.00	1	CS					Cement; Pea Gravel
2		Dense, dry to moist, grey, coarse GRAVEL and SAND with cobbles (granite), trace to some silt.		1.83	2	CS					MW00-1S; Bentonite
4					3	CS					Filter Sand
6					4	CS					Slotted PVC Pipe
8		Dense, moist to dry, grey, gravelly SAND, trace silt, trace to some clay (TILL).		7.32	5	CS					
10					6	CS					
12		Dense, moist, dark grey, silty SAND, trace to some gravel, trace clay (TILL).		10.36	7	CS					
14					8	CS					Pea Gravel; MW00-1D
16					9	CS					
18											
20				19.81							

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: M.D.

CHECKED: J.A.F.

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-1(S&D)

SHEET 2 OF 2

LOCATION: 2 North Washplant Ditch Area, Quinsam Mine

BORING DATE: April 17-18, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Dense, dry, grey, gravelly SAND and GRAVEL, trace to some silt (TILL). *(continued)*									Bentonite
22											
24				24.38							
26		Dense, dry, gravelly SAND, some clay, trace silt (TILL).			10	CS					Slotted PVC Pipe Filter Sand
28											
30											Drill Cuttings
32		End of MONITORING WELL.		30.48							
34											
36											
38											
40											

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: M.D.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-2

SHEET 1 OF 1

LOCATION: 3 South Pit, Quinsam Mine

BORING DATE: April 17-18, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa — nat V. + Q - ● / rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT — Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface											
0	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Dry, grey SAND and GRAVEL (shale rock fragments) (Rock Fill).		0.00									Cement; Bentonite
2		SHALE (bedrock).		1.52									Filter Sand
4		Coal and Shale.		3.96	1	CS							
		SHALE		4.88	2	CS							Slotted PVC Pipe
		Coal Seam.		5.49	3	CS							
6		SHALE		6.10									
		End of MONITORING WELL.		6.81									
8													
10													
12													
14													
16													
18													
20													

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: M.D.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-3

SHEET 1 OF 3

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: April 17-18, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface											
0	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Dry, grey Shale fragments ROCKFILL.		0.00									Cement
2		Dense, dry, brown-grey, silty SAND, some gravel, trace to some clay (TILL).		1.68	1 2	CS CS							
4		Dry, brown, clayey TILL, some sand and silt, trace gravel.		4.27 4.57	3	CS							
6													
8													
10													
12		Grey SHALE (bedrock).											
14													
16		-slight colour change, shale darker.											
18													
20					4	CS							
		CONTINUED NEXT PAGE											

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: M.D.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-3

SHEET 2 OF 3

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: April 17-18, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Grey SHALE (bedrock). *(continued)*			5	CS					
22											
24											
26											
28				27.13	6	CS					
30											
32		Dark grey/brown COAL and SHALE.			7	CS					
34											
36											Slotted PVC Pipe
38				38.70							
40		Air circulation lost - probable mine workings borehole caved to 40.2m.									
		CONTINUED NEXT PAGE									

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: M.D.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-3

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: April 17-18, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
40	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Air circulation lost - probable mine workings borehole caved to 40.2m. *(continued)*									
42											
44		End of MONITORING WELL.		43.60							Piezometer installed with screen from 34.1-40.2m depth, no backfill, no sand pack. Air circulation lost-probable mine workings, borehole caved to 40.2m depth.
46											
48											
50											
52											
54											
56											
58											
60											

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: M.D.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-4

SHEET 1 OF 3

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: Nov. 20,22&23, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Loose, moist, grey and brown ROCK FILL, some sand and silt.		0.00							Bentonite and Concrete
2											
4		Dense, moist, light brown, silty SAND, some gravel (sub-angular). (Till).		3.35	1	CS					
6				5.79							
8					2	CS					
10											
12		Medium strong, grey SANDSTONE. - grades to lighter grey @ 15.24m - trace black coal @ 24.38m									
14											
16					3	CS					
18											
20					4	CS					

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-4

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: Nov. 20,22&23, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Medium strong, grey SANDSTONE. - grades to lighter grey @ 15.24m - trace black coal @ 24.38m *(continued)*			4	CS							
22													
24													
26					5	CS							
28													
30													
32					6	CS							
34		VOID - likely old mine workings, broken and caved in bedrock.		34.14									
36		SANDSTONE.		35.66									
38													
40		*CONTINUED NEXT PAGE*											

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-4

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: Nov. 20,22&23, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
40	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	SANDSTONE. *(continued)*									
42											
44											
		VOID - likely old mine workings, broken and caved in bedrock.		44.81							
46		SANDSTONE.		45.72							
48											Slotted PVC Pipe
		VOID - likely old mine workings, broken and caved in bedrock.		48.77							
50		End of MONITORING WELL.		49.68							
52											
54											
56											
58											
60											

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-5

SHEET 1 OF 3

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: Nov. 21-22, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		Ground Surface									
0	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Loose to compact, moist, light brown, silty SAND, some gravel (sub-angular). (Till).		0.00	1	CS					Bentonite and Concrete
2				2.13	2	CS					
4											
6		Medium strong, grey SANDSTONE. - trace black coal			3	CS					
8											
10		VOID - Caved in bedrock.		10.06							
12		Grey, medium strong SANDSTONE.		10.52	4	CS					
14		Friable, black COAL.		14.02							
16											
18		Grey SANDSTONE.		16.76	5	CS					
20		*CONTINUED NEXT PAGE*									

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-5

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: Nov. 21-22, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary										
22											
24											
26					6	CS					
28		Grey SANDSTONE. *(continued)*									
30											
32											
34											
36				36.58							
38		VOID space and/or broken bedrock - likely old mine workings and caved in bedrock.									
40		*CONTINUED NEXT PAGE*									

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-5

LOCATION: 2 South/3 South Area, Quinsam Mine

BORING DATE: Nov. 21-22, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
40	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	VOID space and/or broken bedrock - likely old mine workings and caved in bedrock. *(continued)*									Slotted PVC Pipe
42											
44											
46		SANDSTONE.		45.72							
		End of MONITORING WELL.		46.63							
48											
50											
52											
54											
56											
58											
60											

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

DEPTH SCALE

1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

PROJECT No.: 002-1065

RECORD OF MONITORING WELL: MW00-6(S&D)

SHEET 1 OF 1

LOCATION: 2 North Washplant Ditch Area, Quinsam Mine

BORING DATE: Nov. 21-22, 2000

DATUM: Local

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		Ground Surface									
	Drillwell Enterprises Ltd. Tamrock DK-25 KW Air Rotary	Compact, moist, light brown TILL (FILL) (boulders, cobbles, sandy silt).		0.00	1	CS					MW00-6D MW00-6S Slough Bentonite Seal Silica Sand
					2	CS					
				5.79	3	CS					Slotted PVC Pipe
		Dense, moist to wet, dark grey, sandy SILT (Native), some gravel, cobbles and boulders. (TILL).									Bentonite Seal Slotted PVC Pipe Silica Sand Slough
		End of MONITORING WELL.		18.59							

DEPTH SCALE
1 : 100

Golder Associates

LOGGED: W.H.

CHECKED: J.A.F.

BOREHOLE 2000 BHL.GPJ GLDR_CAN.GDT 10/22/07

APPENDIX II

January 2012 Monitoring Event Groundwater Quality Data

Table II-1: January 2012 Groundwater Chemical Analyses - 2 North, 3 South Area, Quinsam Mine

Location	**BC MoE Permit PE-07008**[1]	CSR Standards Freshwater Aquatic Life (AW) [2]	CSR Notes	MW00-1S	MW00-1D	MW00-1D	MW00-2	MW00-3	MW00-4	MW00-5	MW00-6S	MW00-6D
Date Sampled				12-Jan-2012	12-Jan-2012	12-Jan-2012	12-Jan-2012	12-Jan-2012	12-Jan-2012	12-Jan-2012	12-Jan-2012	12-Jan-2012
Sample Control Number				0341-03	0341-01	0341-02	0341-04	-	0341-06	0341-05	0341-07	0341-08
QA/QC						field replicate						
Physical Tests								Insufficient Water for Sampling				
Hardness $CaCO_3$				875	22.1	22.2	1170	-	258	966	655	79.0
Field pH	**6.0-8.5**			6.75	**9.33**	**9.33**	6.89	-	7.32	7.07	7.33	**8.60**
Field Temperature (^oC)				7.67	7.50	7.50	9.49	-	6.09	8.55	8.62	7.66
Field Conductivity (us/cm)				1855	235	235	2171	-	566	3425	1803	262
Field Alkalinity - Total $CaCO_3$				411	60	60	267	-	152.7	376.8	282.3	175.5
Dissolved Anions												
Bromide				<1.0	<0.050	<0.050	<1.0	-	<0.050	<1.0	<1.0	<0.050
Chloride		1,500		6.8	0.67	0.67	2.9	-	0.28	2.0	6.3	0.68
Fluoride		2-3	H	<0.40	0.141	0.138	<0.40	-	0.072	<0.40	<0.40	0.106
Sulphate		1,000		781	27.5	27.3	1,190	-	206	1,830	817	42.6
Dissolved Metals												
Aluminum	**0.5**			<0.025	0.0315	0.0324	<0.025	-	0.0052	<0.050	<0.025	0.0147
Antimony		0.2		<0.0025	<0.00050	<0.00050	<0.0025	-	<0.00050	<0.0050	<0.0025	<0.00050
Arsenic		0.05		<0.0025	0.0196	0.0198	<0.0025	-	<0.00050	<0.0050	<0.0025	0.0245
Barium		10		<0.020	<0.020	<0.020	<0.020	-	0.025	<0.020	0.037	<0.020
Beryllium		0.053		<0.0050	<0.0010	<0.0010	<0.0050	-	<0.0010	<0.010	<0.0050	<0.0010
Bismuth				<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20
Boron		50		0.49	<0.10	<0.10	0.41	-	0.15	2.19	0.30	<0.10
Cadmium		0.0001-0.0013	P,H	<0.000085	<0.000017	<0.000017	<0.000085	-	<0.000017	<0.00017	<0.000085	<0.000017
Calcium				272	8.65	8.69	402	-	87.3	333	223	29.7
Chromium		0.01^{VI}, 0.09^{III}	V	<0.0050	<0.0010	<0.0010	<0.0050	-	<0.0010	<0.010	<0.0050	<0.0010
Cobalt		0.04		<0.0015	<0.00030	<0.00030	0.0058	-	<0.00030	<0.0030	<0.0015	<0.00030
Copper	**0.02**	0.02-0.09	H	<0.0050	0.0030	0.0030	<0.0050	-	<0.0010	<0.010	<0.0050	0.0010
Iron	**0.3 / 0.5**			<0.030	<0.030	<0.030	0.337	-	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0025	<0.00050	<0.00050	<0.0025	-	<0.00050	<0.0050	<0.0025	<0.00050
Lithium				<0.025	<0.0050	<0.0050	<0.025	-	0.0062	<0.050	<0.025	<0.0050
Magnesium				47.3	0.12	0.12	40.2	-	9.64	32.7	24.1	1.17
Manganese				0.155	<0.00030	<0.00030	2.24	-	0.00977	0.0144	0.192	<0.00030
Mercury		0.001		<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		<0.0050	0.0110	0.0111	<0.0050	-	<0.0010	<0.010	0.0265	0.0052
Nickel		0.25-1.5	H	<0.0050	<0.0010	<0.0010	<0.0050	-	<0.0010	<0.010	<0.0050	<0.0010
Phosphorous	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	-	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				2.3	<2.0	<2.0	3.6	-	<2.0	4.1	2.8	<2.0
Selenium		0.01		<0.0050	<0.0010	<0.0010	<0.0050	-	<0.0010	<0.010	<0.0050	<0.0010
Silicon				7.19	2.52	2.57	2.50	-	3.14	2.33	5.16	3.40
Silver		0.0005-0.015	H	<0.00010	<0.000020	<0.000020	<0.00010	-	<0.000020	<0.00020	<0.00010	<0.000020
Sodium				132	42.8	44.1	96.2	-	23.5	472	192	27.8
Strontium				1.49	0.0299	0.0306	2.47	-	0.673	3.81	1.19	0.136
Thallium		0.003		<0.0010	<0.00020	<0.00020	<0.0010	-	<0.00020	<0.0020	<0.0010	<0.00020
Tin				<0.0025	<0.00050	<0.00050	<0.0025	-	<0.00050	<0.0050	<0.0025	<0.00050
Titanium		1		<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010
Uranium		3		0.0030	0.00078	0.00078	<0.0010	-	<0.00020	<0.0020	0.0089	0.00096
Vanadium				<0.0050	0.0110	0.0111	<0.0050	-	<0.0010	<0.010	<0.0050	0.0050
Zinc	**0.1 / 0.2**	0.075-2.4	P,H	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients								-				
Nitrate Nitrogen		400		0.11	0.0268	0.0282	<0.10	-	0.0496	0.18	0.39	0.0171
Nitrite Nitrogen		0.2-2	Cl	0.025	<0.0010	<0.0010	<0.020	-	<0.0010	0.033	0.026	0.0012

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004. * denotes dissolved parameter.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011).

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.
Permit criterion for total iron and zinc is 0.3 mg/L and 0.1 mg/L in the North coal mining operation and 0.5 mg/L and 0.2 mg/L, respectively in the South coal mining operation.
Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2011).
Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.
H = standard is hardness dependant.
V = standard is valence dependant.
Cl = guideline is chloride dependant
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.

Table II-2: January 2012 Groundwater QA/QC Results - 2 North, 3 South Area, Quinsam Mine

Location **Date Sampled** **Sample Control Number** **QA/QC**	**BC MoE Permit PE-07008**[1]	CSR Standards Freshwater Aquatic Life (AW) [2]	CSR Notes	MW00-1D 12-Jan-2012 0341-01	MW00-1D 12-Jan-2012 0341-02 field replicate	RPD% [Absolute Difference]
Physical Tests						
Hardness (mg/L as $CaCO_3$)				22.1	22.2	0.5%
Dissolved Anions						
Bromide				<0.050	<0.050	NC
Chloride		1500		0.67	0.67	[0]
Fluoride		2-3	H	0.141	0.138	2.2%
Sulphate		1000		27.5	27.3	0.7%
Dissolved Metals						
Aluminum	**0.5**			0.0315	0.0324	2.8%
Antimony		0.2		<0.00050	<0.00050	NC
Arsenic		0.05		0.0196	0.0198	[0.0002]
Barium		10		<0.020	<0.020	NC
Beryllium		0.053		<0.0010	<0.0010	NC
Bismuth				<0.20	<0.20	NC
Boron		50		<0.10	<0.10	NC
Cadmium		0.0001-0.0013	P,H	<0.000017	<0.000017	NC
Calcium				8.65	8.69	0.5%
Chromium		0.01^{VI}, 0.09^{III}	V	<0.0010	<0.0010	NC
Cobalt		0.04		<0.00030	<0.00030	NC
Copper	**0.02**	0.02-0.09	H	0.0030	0.0030	[0]
Iron	**0.3 / 0.5**			<0.030	<0.030	NC
Lead	**0.05**	0.04-0.16	H	<0.00050	<0.00050	NC
Lithium				<0.0050	<0.0050	NC
Magnesium				0.12	0.12	0.0%
Manganese				<0.00030	<0.00030	NC
Mercury		0.001		<0.000010	<0.000010	NC
Molybdenum		10		0.0110	0.0111	0.9%
Nickel		0.25-1.5	H	<0.0010	<0.0010	NC
Phosphorous	**0.03**			*<0.30*	*<0.30*	NC
Potassium				<2.0	<2.0	NC
Selenium		0.01		<0.0010	<0.0010	NC
Silicon				2.52	2.57	2.0%
Silver		0.0005-0.015	H	<0.000020	<0.000020	NC
Sodium				42.8	44.1	3.0%
Strontium				0.0299	0.0306	2.3%
Thallium		0.003		<0.00020	<0.00020	NC
Tin				<0.00050	<0.00050	NC
Titanium		1		<0.010	<0.010	NC
Uranium		3		0.00078	0.00078	[0]
Vanadium				0.0110	0.0111	0.9%
Zinc	**0.1 / 0.2**	0.075-2.4	P,H	<0.0050	<0.0050	NC
Nutrients						
Nitrate Nitrogen		400		0.0268	0.0282	5.1%
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)		<0.0010	<0.0010	NC

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004. * denotes dissolved parameter.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011)

Notes:

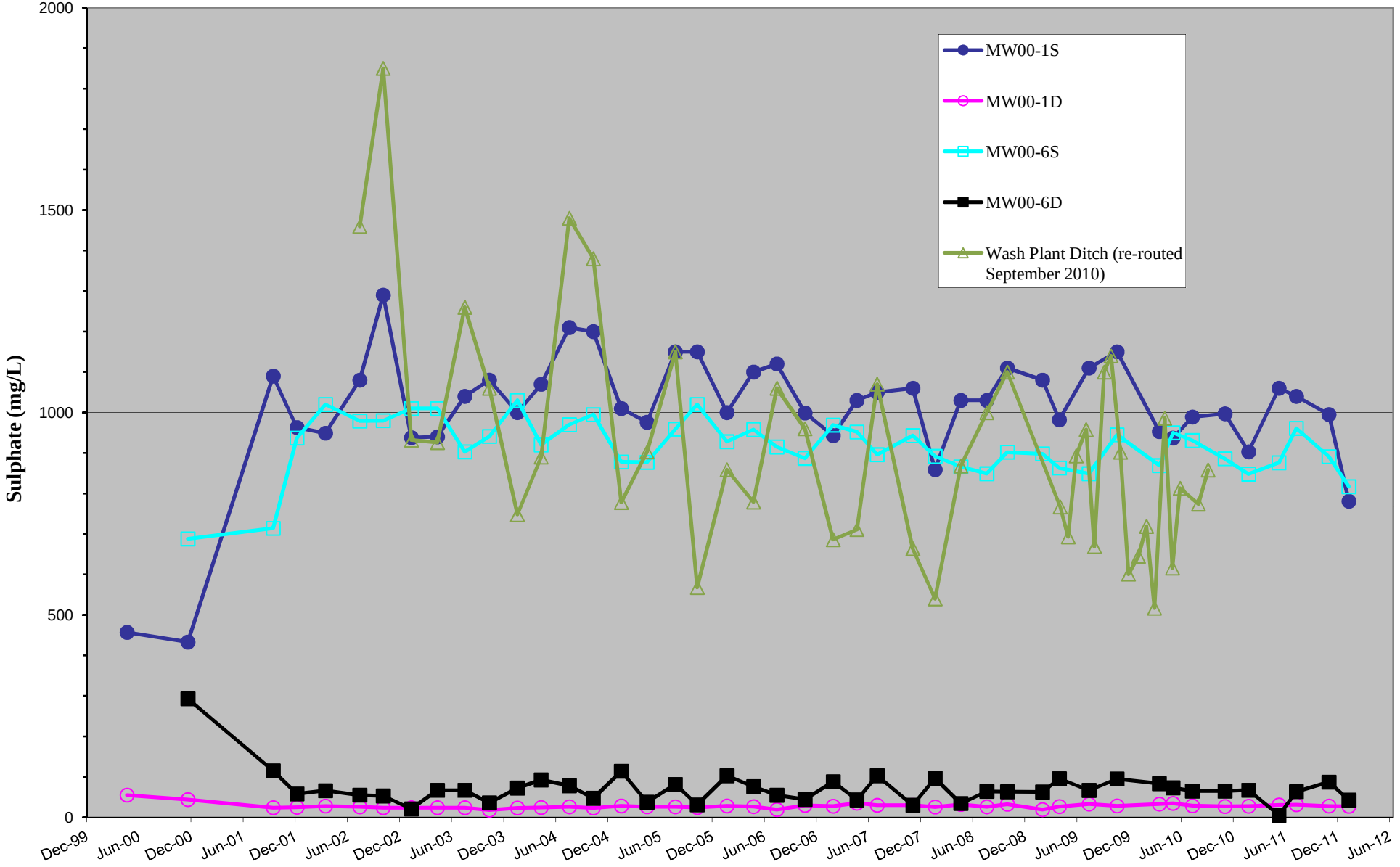
All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Bold and boxed numbers exceed the most stringent permit (PE-07008) criteria for the North and South Coal mining operations.
Permit criterion for total iron and zinc is 0.3 mg/L and 0.1 mg/L in the North coal mining operation and
0.5 mg/L and 0.2 mg/L, respectively in the South coal mining operation.
Shaded and boxed numbers exceed the CSR Freshwater Aquatic Life (AW) Standard (2011).
Italics indicate the laboratory detection limit is set higher than the MoE permit requirement.
H = standard is hardness dependant.
V = standard is valence dependant.
P = Refers to Protocol 10; Contaminated Sites, Hardness Dependant Site Specific Water Quality Standards for Cadmium and Zinc.
Bold relative percent difference (RPD) or [Absolute Difference] results indicate QA/QC limits were exceeded.
NC = Results are below the laboratory detection limit and the RPD value is therefore not calculated.
[ ] = For concentrations below five times the laboratory detection limit, the absolute difference calculation between duplicate samples should

APPENDIX III

Compilation of Historical Monitoring Well Groundwater Quality Data and Graphs

6/16/2011

Graph III-1: Compilation of Groundwater Sulphate Concentrations in the 2 North Area



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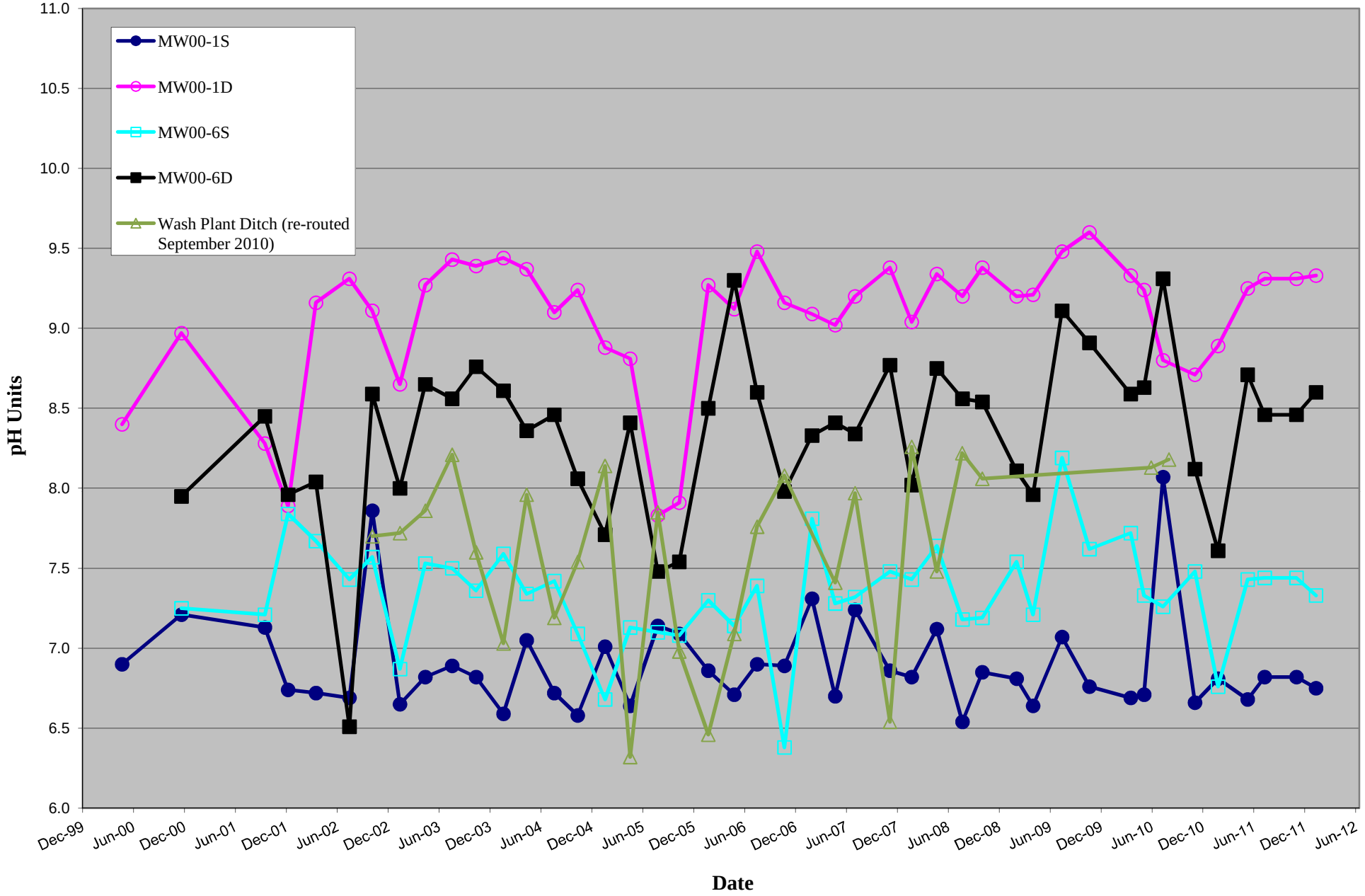
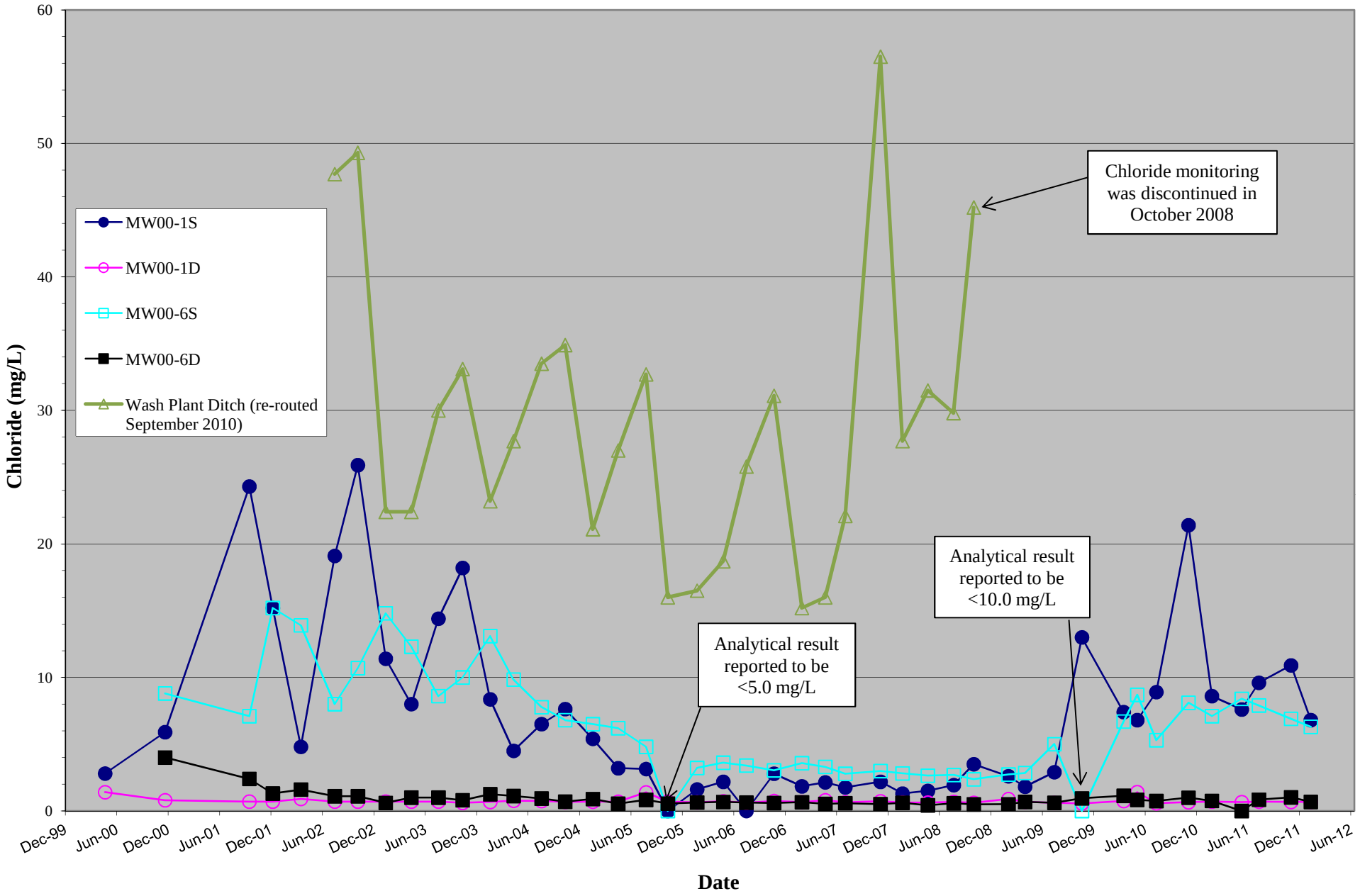
Tables III-1 to III-10,Graphs III-1 to III-6 24Apr2012.xls

Golder Associates

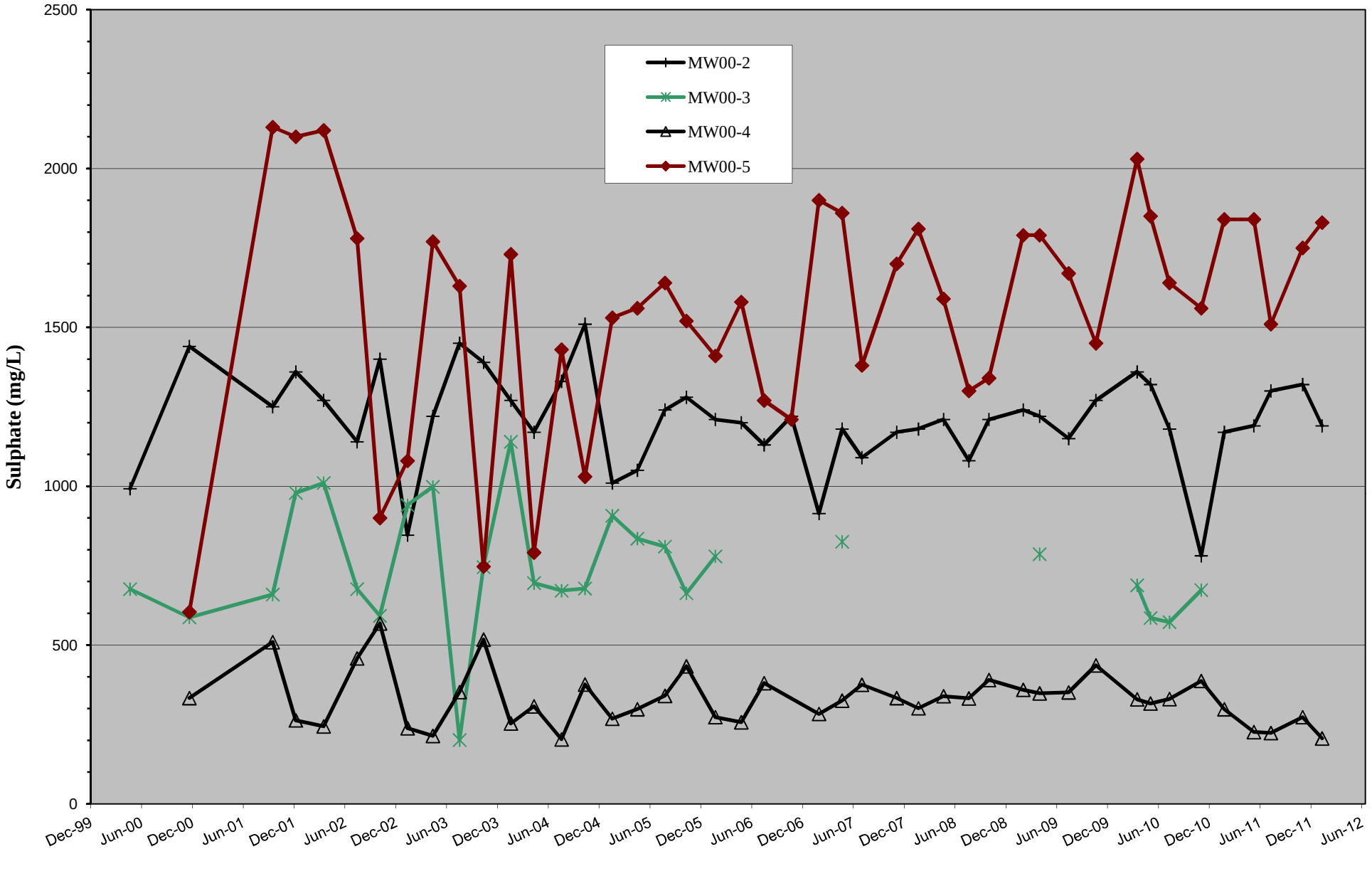
Graph III-2: Compilation of Field Measured pH in Groundwater in the 2 North Area



Graph III-3: Compilation of Groundwater Chloride Concentrations in the 2 North Area



Graph III-4: Compilation of Groundwater Sulphate Concentrations in the 3 South Pit Area



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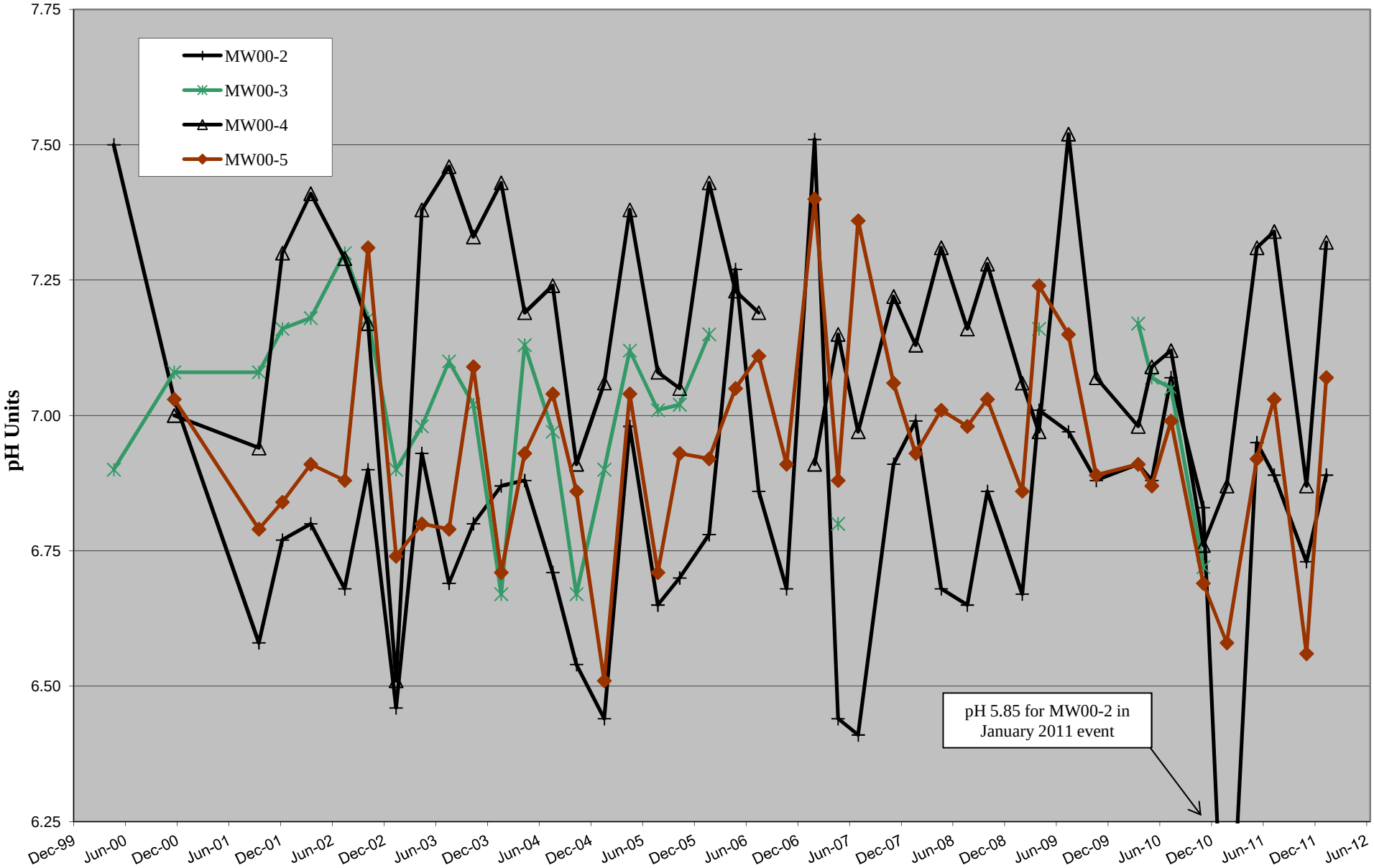
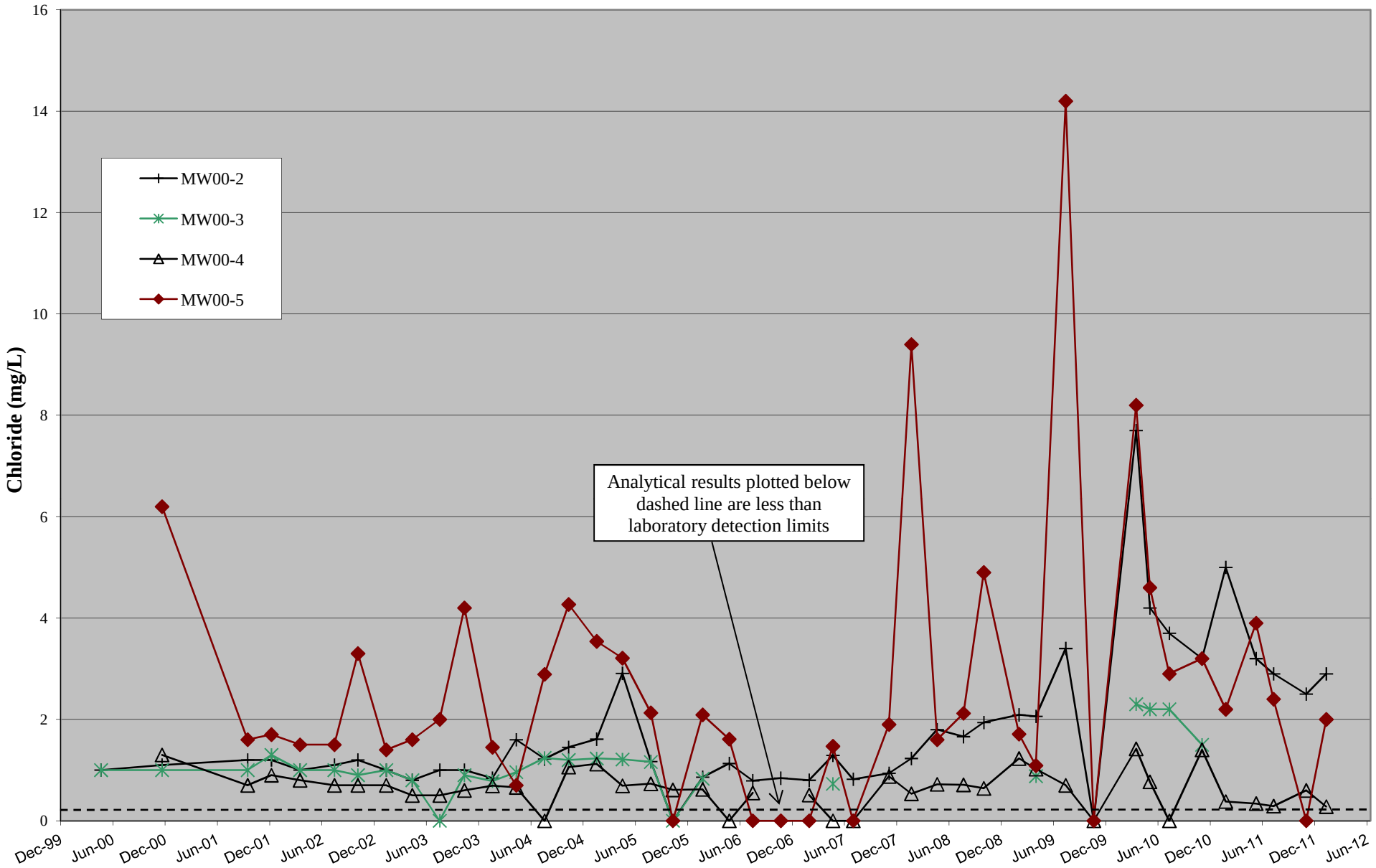
Tables III-1 to III-10,Graphs III-1 to III-6 24Apr2012.xls

Golder Associates

Graph III-5: Compilation of Field Measured pH in Groundwater in the 3 South Area



Graph III-6: Compilation of Groundwater Chloride Concentrations in the 3 South Area



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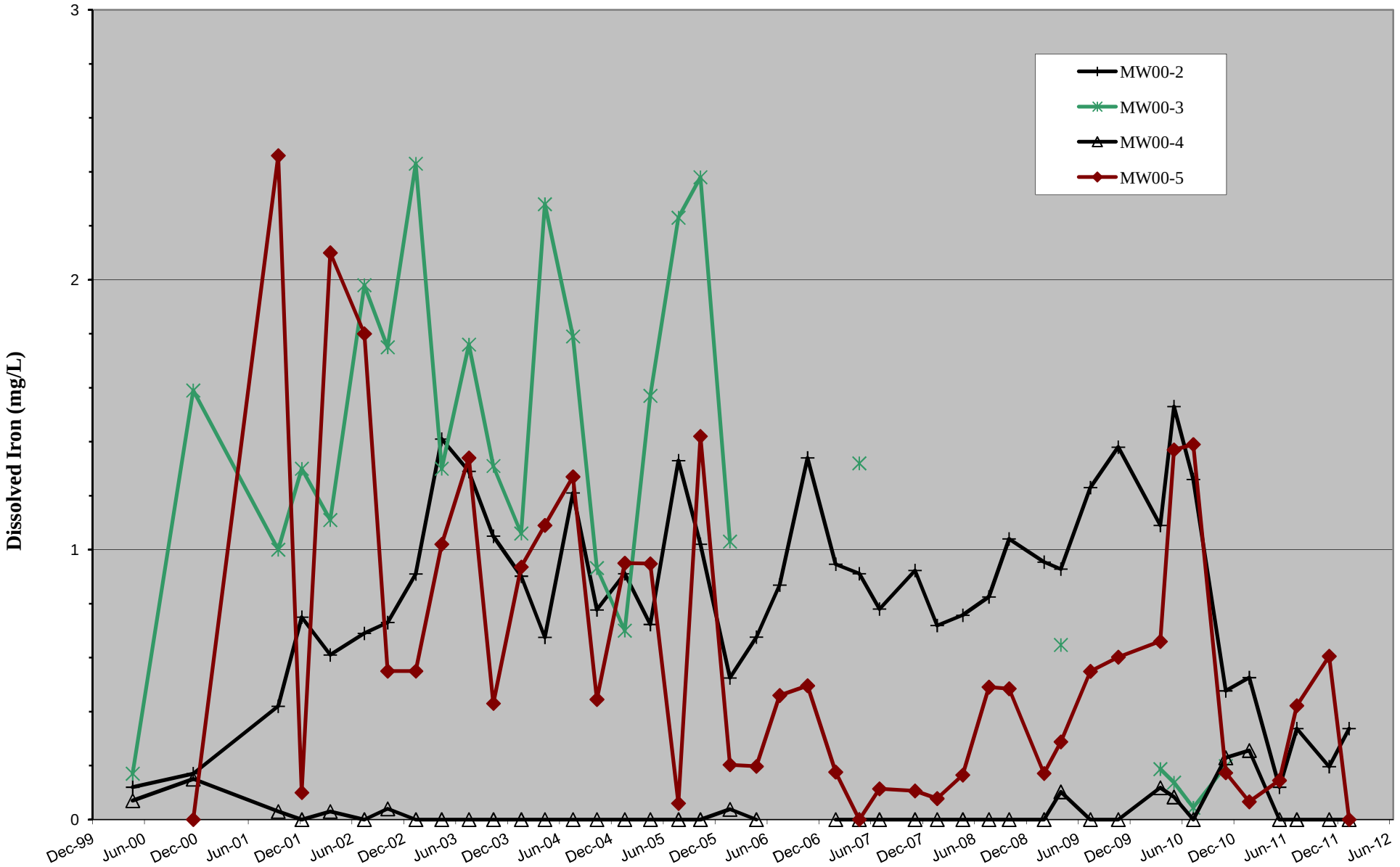
Tables III-1 to III-10,Graphs III-1 to III-6 24Apr2012.xls

Golder Associates

Graph III-7: Compilation of Groundwater Dissolved Iron Concentrations in the 3 South Pit Area



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Tables III-1 to III-10,Graphs III-1 to III-6 24Apr2012.xls

Golder Associates

Table III-1: MW00-1S Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Standards Freshwater Aquatic Life[2]	CSR Notes	25-Apr-00	24-Nov-00	19-Sep-01	11-Dec-01	21-Mar-02	19-Jul-02	9-Oct-02	16-Jan-03	16-Jan-03	17-Apr-03	22-Jul-03	16-Oct-03	22-Jan-04	14-Apr-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Apr-05	20-Apr-05	28-Jul-05	13-Oct-05	25-Jan-06	28-Apr-06
Sample Control Number				4487-02	6227-04	5143-06	6719-08	6739-05	6767-09	6798-14	7252-09	7252-10	7286-10	9301-08	9309-10	9327-08	8688-08	8708-09	8932-08	0008-08	0040-06	0040-07	0120-08	1037-10	1163-06	1068-07
QA-QC												field replicate									field replicate				
Physical Tests																									
Hardness $CaCO_3$				687	1,100	1,040	786	857	1,040	1,170	880	840	969	1,050	1,100	963	1,080	1,150	1,080	1,090	882	930	1,180	1,230	1,020	1,120
Field pH	**6.0-8.5**			6.9	7.21	7.13	6.74	6.72	6.69	7.86	6.65	6.65	6.82	6.89	6.82	6.59	7.05	6.72	6.58	7.01	6.64	6.64	7.14	7.09	6.86	6.71
Field Temperature (^oC)				8	11	11.7	-	7.4	11.5	11.7	-	-	-	11.2	9.6	8.8	-	10.6	11.2	9.2	8.7	8.7	11	10.4	9.1	8.7
Field Conductivity (µS/cm)				1,395	1,985	2,630	2,650	2,170	2,680	2,250	1,900	1,900	1,920	2,310	2,310	2,040	-	2,390	2,370	2,310	2,330	2,330	2,160	2,470	1,970	2,190
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	363	345	255	276	363	283	333	333	335	337	271	291
Dissolved Anions																										
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				418	380	347	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	380	347	373	315	321	327	346	335	330	372	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.5	<0.5	<0.5	<0.5	<0.05	0.07	0.06	<0.05	<0.05	<0.05	<0.05	0.05	<0.050	<0.10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.25
Chloride		1500		2.8	5.9	24.3	15.2	4.8	19.1	25.9	11.4	10.8	8	14.4	18.2	8.36	4.5	6.5	7.6	5.4	3.2	3.53	3.14	<5.0	1.61	2.18
Fluoride		2-3	H	0.05	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	0.05	<0.02	0.044	<0.040	0.029	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.10
Sulphate		1000		457	433	1,090	963	949	1,080	1,290	938	923	940	1,040	1,080	1,000	1,070	1,210	1,200	1,010	976	1,090	1,150	1,150	1,000	1,100
Dissolved Metals																										
Aluminum	**0.5**			<0.03	0.09	0.2	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.089	<0.050	<0.058	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Antimony		0.2		<0.2	<0.2	<0.1	<0.1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic		0.05		<0.2	<0.2	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Barium		10		0.32	0.2	0.09	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.06	0.04	0.043	0.032	0.04	0.037	0.027	0.024	0.026	0.029	0.038	0.024	0.021
Beryllium		0.053		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				-	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.3	0.4	0.5	0.4	0.3	0.4	0.5	0.3	0.3	0.4	0.5	0.5	0.37	0.37	0.58	0.46	0.43	0.35	0.36	0.50	0.49	0.34	0.37
Cadmium		0.0001-0.0006	H	*<0.001*	*<0.002*	*<0.002*	*<0.002*	0.0003	0.0004	0.0004	<0.0003	<0.0003	<0.0003	0.0004	<0.0003	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Calcium				202	338	314	236	257	314	354	262	250	286	311	332	292	328	350	326	338	268	275	357	381	308	343
Chromium		0.01[VI], 0.09[III]	V	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Cobalt		0.04		<0.01	<0.01	0.02	0.01	0.013	0.014	0.008	0.006	0.006	0.005	0.006	0.004	0.0047	0.0167	0.0113	0.0109	<0.0025	<0.0025	0.0028	0.0031	0.0031	0.0090	0.0034
Copper	**0.02**	0.02-0.09	H	<0.01	<0.01	<0.01	<0.01	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Iron	**0.3**			<0.03	0.1	0.14	0.08	**2.02**	**0.66**	0.23	0.05	0.05	0.08	<0.03	<0.03	0.058	**0.701**	0.035	<0.030	0.045	<0.030	<0.030	0.058	<0.030	0.268	0.076
Lead	**0.05**	0.04-0.16	H	<0.005	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Lithium				-	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium				44.4	62.6	62.6	48.2	52.1	61.9	69.8	54.6	52.5	62.2	66.4	65.6	56.6	64.4	67.2	64.6	59.9	51.9	58.7	69.9	67.3	60.5	64.4
Manganese				0.148	1.46	6.59	5.19	6.69	7.13	6.18	4.96	4.76	4.14	4.57	3.32	1.3	4.14	3.11	1.47	0.645	0.795	0.841	2.34	0.216	2.70	1.82
Mercury		0.001		<0.00005	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum		10		<0.03	<0.03	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel		0.25-1.5	H	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Phosphorus	**0.03**			-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				-	3	4	2	3	3	3	3	3	3	3	3	2.3	3.2	3.4	3.0	3.0	<2.0	2.2	2.1	2.2	2.6	2.5
Selenium		0.01		<0.005	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silicon				-	8.69	9.64	9.36	8.76	8.24	9.6	8.77	8.47	9.08	8.79	8.75	8.52	8.05	8.44	8.00	7.01	6.45	6.60	7.73	8.36	7.36	6.48
Silver		0.0005-0.015	H	<0.0005	*<0.001*	0.0001	*<0.001*	<0.0003	<0.0003	*<0.01*	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Sodium				92	173	216	153	144	170	194	168	160	170	174	189	168	163	176	176	165	106	114	133	146	123	137
Strontium				-	1.34	1.78	1.29	1.52	1.76	1.88	1.48	1.41	1.55	1.65	1.81	1.48	1.81	1.98	1.80	1.63	1.38	1.49	1.50	1.71	1.58	1.73
Thallium		0.003		<0.0005	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin				-	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	0.035	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium		1		-	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		0.006	0.0061	0.003	0.003	0.002	0.004	0.004	0.003	0.003	0.003	0.004	0.005	0.0034	0.0027	0.0039	0.0046	0.0035	0.0037	0.0039	0.0038	0.0047	0.0023	0.0033
Vanadium				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.035	<0.030	<0.030	<0.030
Zinc	**0.1**	0.075-2.4	H	0.008	<0.005	<0.05	<0.05	0.006	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.0050	<0.0050	0.0051	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																										
Nitrate Nitrogen		400		0.038	0.014	<0.1	0.014	0.016	0.014	0.008	0.008	0.006	0.005	<0.1	<0.1	<0.1	<0.2	<0.1	<1.0	<1.0	<1.0	<1.0	<1.0	<0.050	<0.050	<0.025
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	0.019	0.002	<0.1	<0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.1	<0.1	<0.1	<0.2	<0.1	<1.0	<1.0	<1.0	<1.0	<1.0	0.011	<0.010	0.0076
Nitrite/Nitrate Nitrogen		400		-	-	0.008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	0.003	0.002	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	0.131	0.328	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	4.2	6.7	5.8	5.3	4.6	5.6	5.7	4.3	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 286/2010, October 4, 2010)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Date Sampled	BC MoE Permit PE-07008[1]	CSR Standards Freshwater Aquatic Life[2]	CSR Notes	19-Jul-06	25-Oct-06	25-Oct-06	1-Feb-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	24-Jul-08	3-Oct-08	3-Feb-09	3-Apr-09	16-Jul-09	22-Oct-09	19-Mar-10	6-May-10	13-Jul-10	4-Nov-10	26-Jan-11	26-Jan-11	12-May-11	12-Jul-11	3-Nov-11	12-Jan-2012
Sample Control Number				1500-05	0571-01	0571-02	0615-06	1330-07	1326-07	17225-05	17284-05	0955-06	0919-07	0850-05	0788-06	0796-07	0853-04	2N-00-1S	21455-08	21436-10	21952-09	21760-07	0101-06	0101-07	0552-04	0154-05	0188-05	0341-03
QA-QC						field replicate												(QCC)						field replicate				
Physical Tests																												
Hardness $CaCO_3$				1,100	1,140	1,110	940	1,120	1,300	1,220	1,050	1,190	1,200	1,160	1,150	1,100	1,230	1,290	1,020	984	1,110	1,020	932	925	1,020	1,050	1,050	875
Field pH	**6.0-8.5**			6.9	6.89	6.89	7.31	6.70	7.24	6.86	6.82	7.12	6.54	6.85	6.81	6.64	7.07	6.76	6.69	6.71	8.07	6.66	6.81	6.81	6.68	6.82	6.80	6.75
Field Temperature (^oC)				9.9	9.1	9.1	7.3	7.7	10.6	9.2	7.6	7.6	9.38	10	7.41	6.68	9	9.69	7.99	8.94	10.79	10.51	7.99	7.99	8.25	8.97	9.12	7.67
Field Conductivity (µS/cm)				2,330	1,529	1,529	1,516	2,190	2,280	2,190	1,373	2,120	2,403	2,330	2,204	1,951	2,270	3,194	2,033	1,436	1,479	1,647	1,278	1,278	1,481	1,334	1,529	1,855
Field Alkalinity - Total $CaCO_3$				318	363	363	291	306	-	-	276	269	328	288	300	-	390	-	-	249	-	-	-	-	372	378	399	411
Dissolved Anions																												
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	65.7	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	-	-	337	351	-	-	-	-	-	295	-	370	323	-	339	355	349	346	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	-	-		-	337	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.25	<0.050	<0.050	<0.050	<0.25	<0.050	<0.50	<0.050	<0.50	<0.050	<0.50	<5.0	<1.0	<1.0	<1.0	<4.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloride		1500		<2.5	2.79	2.90	1.84	2.14	1.76	2.18	1.3	1.5	1.93	3.5	2.6	1.81	2.9	13	7.4	6.8	8.9	21.4	8.6	7.0	7.6	9.6	10.9	6.8
Fluoride		2-3	H	<0.10	<0.020	<0.020	<0.020	0.26	<0.020	<0.20	<0.020	<0.20	<0.020	<0.20	<0.030	<0.40	<0.40	<0.40	<0.20	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Sulphate		1000		1,120	999	1,090	943	1,030	1,050	1,060	859	1,030	1,030	1,110	1,080	982	1,110	1,150	953	937	989	997	903	869	1,060	1,040	995	781
Dissolved Metals																												
Aluminum	**0.5**			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050	<0.050	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Antimony		0.2		<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic		0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Barium		10		0.025	0.020	0.020	<0.020	0.022	0.022	<0.020	<0.020	0.025	<0.020	0.025	0.043	0.035	0.022	0.030	0.030	0.037	0.034	<0.020	<0.020	<0.020	0.021	0.027	<0.020	<0.020
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.42	0.45	0.43	0.35	0.37	0.42	0.47	0.37	0.38	0.42	0.41	0.39	0.36	0.41	0.47	0.35	0.39	0.47	0.59	0.49	0.49	0.44	0.52	0.53	0.49
Cadmium		0.0001-0.0006	H	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025	<0.00025	<0.000085	<0.000085	<0.000085	<0.000085	<0.00025	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085
Calcium				335	344	337	293	343	399	374	320	367	366	353	343	336	374	390	301	302	341	314	288	286	316	320	323	272
Chromium		0.01[VI], 0.09[III]	V	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt		0.04		<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0029	<0.0050	<0.0025	<0.0025	<0.0015	<0.0015	<0.0015	<0.0015	<0.0025	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015
Copper	**0.02**	0.02-0.09	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Iron	**0.3**			<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Magnesium				63.2	67.8	65.7	50.9	63.6	72.6	68.7	61.2	67.1	69.1	68.9	70.9	62.7	72.6	76.8	66.5	55.8	62.3	57.7	51.5	51.2	57.3	60.1	58.8	47.3
Manganese				0.568	0.063	0.069	0.530	0.697	0.542	0.223	0.626	0.191	0.361	0.0681	0.0126	0.269	0.129	0.561	0.0513	0.295	0.270	0.219	0.0602	0.0610	0.0778	0.158	0.143	0.155
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel		0.25-1.5	H	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.030*	*<0.030*	*<0.30*	*<0.30*	*<0.050*	*<0.30*
Potassium				2.1	2.3	2.3	2.0	2.4	2.6	2.6	2.4	2.4	2.5	2.6	2.5	2.1	2.3	2.7	2.3	2.1	2.4	2.9	2.6	2.7	2.3	2.7	2.6	2.3
Selenium		0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silicon				6.85	7.47	7.31	6.73	6.85	7.05	8	7.56	7.2	7.4	7.88	7.5	7.13	7.58	8.05	8.16	6.83	7.67	7.92	7.48	7.45	6.83	7.40	7.79	7.19
Silver		0.0005-0.015	H	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium				134	140	142	109	126	145	134	126	125	128	133	135	107	123	128	129	116	135	168	149	149	141	160	155	132
Strontium				1.57	1.62	1.63	1.12	1.67	1.84	1.79	1.6	1.74	1.86	1.8	1.67	1.62	1.80	2.02	1.37	1.56	1.75	1.76	1.57	1.57	1.75	1.86	1.81	1.49
Thallium		0.003		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	0.014	<0.050	<0.010	<0.010	<0.010	0.015	0.015	0.015	<0.010	<0.010	<0.010	<0.010
Uranium		3		0.0044	0.0055	0.0056	0.0035	0.0033	0.0043	0.0046	0.003	0.0041	0.0046	0.0054	0.0056	0.0033	0.0046	0.0047	0.0045	0.0028	0.0032	0.0036	0.0029	0.0030	0.0031	0.0035	0.0036	0.0030
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	**0.1**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0053	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																												
Nitrate Nitrogen		400		0.025	0.0054	0.0077	0.0409	0.096	0.0379	0.054	0.0328	<0.050	0.0211	0.075	<0.50	<0.10	<0.10	-	<0.050	<0.10	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	0.13	0.11
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	<0.0050	0.0015	0.0012	<0.0010	<0.0050	<0.0010	<0.010	<0.0010	0.015	<0.0010	<0.010	<0.10	<0.020	0.026	-	<0.010	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.025
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 286/2010, October 4, 2010)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-2: MW00-1D Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	CSR Notes	25-Apr-00	24-Nov-00	19-Sep-01	11-Dec-01	21-Mar-02	21-Mar-02	19-Jul-02	9-Oct-02	16-Jan-03	17-Apr-03	22-Jul-03	16-Oct-03	22-Jan-04	22-Jan-04	14-Apr-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Apr-05	28-Jul-05	13-Oct-05	25-Jan-06	28-Apr-06	19-Jul-06
Sample Control Number				4487-01	6227-05	5143-07	6719-09	6739-06	6739-07	6767-10	6798-15	7252-11	7286-11	9301-09	9309-11	9327-09	9327-10	8688-09	8708-11	8932-09	0008-09	0040-09	0120-09	1037-12	1163-09	1068-08	1500-08
QA-QC									field replicate								field replicate										
Physical Tests																											
Hardness $CaCO_3$				70.4	81.2	47.7	23.4	21.2	21.5	32.1	24.1	22	23.6	26	21	25.3	25.5	22.7	23	32.2	22.4	21.5	24.3	27.2	23.4	23.8	26.6
Field pH	**6.0-8.5**			8.4	**8.97**	8.28	7.89	**9.16**	**9.16**	**9.31**	**9.11**	**8.65**	**9.27**	**9.43**	**9.39**	**9.44**	**9.44**	**9.37**	**9.10**	**9.24**	**8.88**	**8.81**	7.83	7.91	**9.27**	**9.12**	**9.48**
Field Temperature (^oC)				7.9	9	8.8		8.3	8.3	10.1	9.4	-	-	10.6	8.4	7.5	7.5	-	10.5	9.1	8.3	9.8	10.6	9.1	8.5	8.9	9.3
Field Conductivity (µS/cm)				332	297	222	245	260	260	310	233	230	263	227	237	234	234	-	227	258	251	230	236	236	251	325	231
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	75	89	89	84	74	78	84	90	110	94	87	81	93
Dissolved Anions																											
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				108	332	114	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	332	104	157	90	81	85	78	72	80	79	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride		1500		1.4	0.8	0.7	0.7	0.9	0.9	0.7	0.7	0.7	0.7	0.7	0.6	0.67	0.67	0.76	0.74	0.67	0.69	0.69	1.39	0.70	0.64	0.72	0.61
Fluoride		2-3	H	0.19	0.15	0.17	0.15	0.12	0.13	0.15	0.12	0.14	0.15	0.14	0.14	0.143	0.144	0.146	0.136	0.137	0.114	0.144	0.120	0.141	0.130	0.144	0.132
Sulphate		1000		55	44	24	25	28	27	26	24	24	24	24	18	23.3	23.2	24.5	26.2	23.3	28.2	26.3	26.1	24.3	28.2	26.6	19.4
Dissolved Metals																											
Aluminum	**0.5**			0.025	**18.9**	**13.0**	**1.3**	0.2	0.26	**4.28**	**0.92**	**1.68**	**1.1**	**1.0**	0.04	**1.58**	**2.09**	0.412	0.257	**4.21**	0.405	**0.501**	**0.653**	**2.24**	0.490	0.488	**3.16**
Antimony		0.2		<0.2	<0.2	<0.1	<0.1	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic		0.05		<0.2	<0.2	0.01	0.01	0.016	0.016	0.015	0.018	0.017	0.018	0.019	0.017	0.0174	0.0169	0.0192	0.019	0.0150	0.0176	0.0179	0.0170	0.0171	0.0179	0.0184	0.0162
Barium		10		0.03	0.39	0.14	<0.02	<0.02	<0.02	0.06	<0.02	<0.02	0.02	0.02	<0.02	0.023	0.03	<0.020	<0.020	0.060	<0.020	<0.020	<0.020	0.031	<0.020	<0.020	0.035
Beryllium		0.053		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				-				<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.10	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium		0.0001-0.0006	H	*<0.002*	*0.0004*	*<0.002*	*<0.002*	<0.00005	<0.00005	0.00008	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	0.000052	<0.000050	<0.000050	0.000094	*<0.00010*	<0.000050	<0.000050	0.000053	<0.000050	<0.000050	<0.000050
Calcium				23.7	22.9	13.5	8.1	7.8	7.8	10.6	8.7	7.7	8.6	9.1	7.9	8.78	8.63	8.57	8.77	11.1	8.50	7.92	9.04	9.48	8.78	9.05	9.09
Chromium		0.01[VI], 0.09[III]	V	<0.01	<0.01	<0.01	<0.01	<0.0005	<0.0005	<0.003	<0.0005	0.0009	0.0006	<0.0005	<0.0005	0.00099	0.0012	<0.00050	<0.00050	0.00171	<0.0010	<0.00050	0.00053	0.00112	<0.00050	<0.00050	0.00215
Cobalt		0.04		<0.01	0.02	<0.01	<0.01	<0.0005	<0.0005	0.0033	0.0013	0.0015	0.0011	0.0014	<0.0005	0.00231	0.00154	0.00698	0.00744	0.0108	0.0035	0.00147	0.00134	0.00668	0.00170	0.00175	0.00272
Copper	**0.02**	0.02-0.09	H	**0.02**	**0.11**	**0.06**	<0.01	0.005	0.006	**0.025**	0.009	0.014	0.009	0.009	0.003	0.0102	0.0124	0.0056	0.0045	**0.0249**	0.0048	0.0060	0.0063	0.0162	0.0052	0.0052	0.0144
Iron	**0.3**			0.03	**14.1**	**8.32**	1.11	0.12	0.23	**2.51**	**0.64**	**1.05**	**0.6**	**1.29**	<0.03	**1.48**	**1.85**	0.259	0.189	**2.34**	0.266	**0.686**	**0.668**	**1.82**	**0.364**	0.294	**1.97**
Lead	**0.05**	0.04-0.16	H	<0.001	0.009	<0.01	<0.01	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	0.0015	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium				-	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium				2.7	5.9	3.4	0.8	0.4	0.5	1.3	0.6	0.7	0.5	0.8	0.3	0.82	0.96	0.31	0.27	1.12	0.29	0.41	0.43	0.85	0.36	0.28	0.94
Manganese				0.015	0.71	0.30	0.03	<0.01	0.01	0.1	0.02	0.03	0.02	0.04	<0.01	0.039	0.049	0.018	0.019	0.132	0.011	0.016	0.020	0.062	0.013	0.012	0.068
Mercury		0.001		<0.00005	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum		10		0.04	<0.03	0.01	0.01	0.013	0.013	0.007	0.011	0.009	0.011	0.01	0.013	0.0095	0.0088	0.0117	0.0114	0.0067	0.0112	0.0106	0.0098	0.0075	0.0112	0.0106	0.0086
Nickel		0.25-1.5	H	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus	**0.03**			-	**0.6**	**0.3**	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	**0.34**	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium		0.01		<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon				-	26.2	15	4.65	2.66	2.78	6.92	3.49	4.16	3.6	4.91	2.66	5.05	5.62	3.09	2.95	7.51	2.69	3.52	3.08	4.90	2.98	2.71	5.07
Silver		0.0005-0.015	H	<0.0001	<0.0001	<0.0001	<0.0001	<0.00005	<0.00005	<0.00005	<0.01	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium				58	48	46	42	41	41	44	44	44	47	46	45	43.8	43.2	47.6	48.1	40.7	48.3	45.9	46.4	42.8	45.1	50.0	44.0
Strontium				-	0.135	0.071	0.034	0.029	0.029	0.045	0.032	0.039	0.034	0.034	0.031	0.0425	0.0425	0.0297	0.0318	0.0474	0.0362	0.0324	0.0312	0.0387	0.0324	0.0336	0.0369
Thallium		0.003		<0.0001	0.0001	<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium		1		-	0.17	0.19	0.07	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	0.07	<0.05	0.069	0.08	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		0.00142	0.00183	<0.002	<0.002	0.001	0.001	0.0011	0.001	0.001	0.0011	0.0011	0.0007	0.00088	0.00088	0.00086	0.00084	0.00091	0.00079	0.00082	0.00081	0.00084	0.00080	0.00081	0.00081
Vanadium				-	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.033	<0.030
Zinc	**0.1**	0.075-2.4	H	**0.121**	0.051	<0.05	<0.05	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	0.0093	<0.0050	<0.0050	<0.0050	0.0079	<0.0050	<0.0050	0.0067
Nutrients and Organic Parameters																											
Nitrate Nitrogen		400		0.011	<0.005	<0.1	0.034	0.04	0.039	0.028	0.045	0.036	0.031	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	0.0143	0.0057	0.0214	0.0205
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl > 10 mg/L)	Cl	0.015	0.004	<0.1	0.002	0.004	0.004	<0.001	<0.001	0.003	0.001	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.0010	<0.0010	<0.0010	<0.0010
Nitrite/Nitrate Nitrogen		400		-	-	0.037	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	0.147	0.144	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	0.953	0.615	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	6.4	3.2	3.2	3.2	3.2	3.2	3.0	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-2: MW00-1D Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	CSR Notes	25-Oct-06	1-Feb-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	23-Jul-08	3-Oct-08	3-Feb-09	3-Apr-09	16-Jul-09	16-Jul-09	22-Oct-09	19-Mar-10	6-May-10	13-Jul-10	4-Nov-10	26-Jan-11	12-May-11	12-Jul-11	12-Jul-11	12-Jan-2012	12-Jan-2012
Sample Control Number				0571-07	0615-08	1330-09	1326-08	17225-04	17284-06	0955-07	0919-05	0850-07	0788-05	0796-06	0853-05	0853-06	2N-00-1D	21455-09	21436-11	21952-08	21760-06	0101-05	0552-05	0154-06	0188-06	0341-01	0341-02
QA-QC																field replicate	(QCC)									field replicate
Physical Tests																										
Hardness $CaCO_3$				23.1	26.8	22.4	27.2	26.1	26	26.9	22.3	23.3	44.6	22.4	24	22.9	22.3	23.2	28.5	22.3	22.5	22.7	22.0	24.0	22.6	22.1	22.2
Field pH	**6.0-8.5**			**9.16**	**9.09**	**9.02**	**9.2**	**9.38**	**9.04**	**9.34**	**9.2**	**9.38**	**9.2**	**9.21**	**9.48**	**9.48**	**9.60**	**9.33**	**9.24**	**8.80**	**8.71**	**8.89**	**9.25**	**9.31**	**8.69**	**9.33**	**9.33**
Field Temperature (°C)				8.3	6.9	8.5	10.3	8.2	7.1	9.1	8.89	9.5	7.39	7.99	10.4	10.4	8.2	8.25	8.61	9.93	8.56	8.01	8.24	9.49	8.05	7.5	7.5
Field Conductivity (µS/cm)				153	178	247	246	241	162	254	247	234	225	223	245	245	320	246	169	173	163	149	171	150	162	235	235
Field Alkalinity - Total $CaCO_3$				87	91	87	-	-	84	83	89	68	-	-	101	101	-	-	108	-	-	-	108	96	97.5	60	60
Dissolved Anions																										
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	<1.0	-	-	-	-	-	-		-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	90.8	89.1	-	-	-	-	82.8	93.8	-	-	87.2	90.6	-	92.6	93.4	91.9	-		-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-		-	79.5	-	-	-	-	-	73.4	-	-	-	-	-	-				-		-	-	-
Bromide				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.17	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride		1500		0.74	0.65	0.80	0.64	0.722	0.632	0.63	0.68	0.61	0.89	0.68	0.60	0.62	0.56	0.74	1.41	0.57	0.65	0.70	0.66	0.69	0.67	0.67	0.67
Fluoride		2-3	H	0.139	0.123	0.133	0.085	0.126	0.118	0.112	0.128	0.127	0.129	0.121	0.102	0.102	0.113	0.130	0.119	0.112	0.131	0.101	0.120	0.140	0.142	0.141	0.138
Sulphate		1000		29.8	27.6	35.2	30.0	29.9	25.7	32.1	26.2	32.6	19.2	26.8	33	33.8	28.3	32.9	34.8	28.7	27.0	27.6	30.8	31.5	28.0	27.5	27.3
Dissolved Metals																										
Aluminum	**0.5**			0.238	**1.12**	0.150	**1.84**	**2.14**	**1.11**	**5.98**	0.043	0.0382	**6.68**	0.0408	0.0338	0.0406	0.032	0.0387	0.079	0.0316	0.0317	0.0325	0.0354	0.0317	0.0317	0.0315	0.0324
Antimony		0.2		<0.00050	<0.00050	<0.00050	<0.0025	<0.0025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic		0.05		0.0197	0.0176	0.0173	0.0182	0.0183	0.02	0.0203	0.0192	0.0187	0.0222	0.0203	0.0202	0.0209	0.0190	0.0194	0.0188	0.0190	0.0215	0.0197	0.0190	0.0215	0.0200	0.0196	0.0198
Barium		10		<0.020	<0.020	<0.020	0.025	<0.020	<0.020	0.029	<0.020	<0.020	0.079	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium		0.0001-0.0006	H	<0.000050	<0.000050	<0.000050	*<0.00025*	*<0.00025*	<0.000050	0.000226	<0.000050	<0.000017	0.00015	<0.000017	<0.000017	<0.000017	<0.000050	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
Calcium				8.81	9.96	8.63	9.76	9.66	9.52	9.68	8.64	9.02	12.1	8.72	9.25	8.92	8.70	9.01	11.10	8.73	8.76	8.87	8.63	9.34	8.84	8.65	8.69
Chromium		0.01[VI], 0.09[III]	V	<0.00050	0.00091	<0.00050	<0.0025	<0.0025	0.00106	0.00473	<0.00050	<0.0010	0.005	<0.0010	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt		0.04		0.00129	0.00235	0.00124	<0.0025	<0.0025	0.00411	0.00351	<0.00050	<0.00030	0.00356	<0.00030	<0.00030	<0.00030	<0.00050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper	**0.02**	0.02-0.09	H	0.0040	0.0107	0.0036	0.0157	0.0121	0.0107	0.0176	0.0043	0.0037	0.0187	0.0039	0.0035	0.0038	0.0032	0.0041	0.0031	0.0028	0.0032	0.0034	0.0026	0.0029	0.0031	0.0030	0.0030
Iron	**0.3**			0.198	**0.794**	0.101	**1.36**	**0.926**	**0.979**	**1.38**	<0.030	<0.030	**8.13**	<0.030	<0.030	<0.030	<0.030	<0.030	0.048	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.00050	0.00091	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.052	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium				0.26	0.46	0.20	0.69	0.49	0.54	0.67	0.17	0.19	3.49	0.14	0.22	0.14	0.13	0.17	0.20	0.11	0.14	0.14	0.12	0.17	0.12	0.12	0.12
Manganese				<0.010	0.030	<0.010	0.043	0.031	0.034	0.042	<0.010	0.00067	0.123	0.00041	0.00044	0.00060	<0.010	0.00058	0.00113	0.00050	0.00038	0.00031	0.00071	0.00037	0.00056	<0.00030	<0.00030
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		0.0112	0.0091	0.0104	0.0103	0.0102	0.009	0.0138	0.0112	0.0118	0.0113	0.0114	0.0117	0.0121	0.0111	0.0106	0.0109	0.0103	0.0108	0.0110	0.0104	0.0110	0.0113	0.0110	0.0111
Nickel		0.25-1.5	H	<0.0050	<0.0050	<0.0050	<025	<0.025	<0.0050	<0.0050	<0.0050	<0.0010	0.0051	<0.0010	<0.0010	<0.0010	<0.0050	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	**0.145**	*<0.30*	*<0.30*	**0.146**	*<0.30*	*<0.30*
Potassium				<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium		0.01		<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon				2.52	3.42	2.54	4.18	4.12	4.32	4.82	2.58	2.5	26.7	2.48	2.44	2.45	2.45	2.51	2.73	2.56	2.57	2.51	2.42	2.53	2.52	2.52	2.57
Silver		0.0005-0.015	H	<0.000050	<0.000050	<0.000050	<0.00025	<0.00025	<0.000050	<0.000050	<0.000050	<0.000020	0.000029	<0.000020	<0.000020	<0.000020	<0.000050	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium				48.5	47.7	45.1	46.4	46.4	45.7	43.7	45.1	42.3	46.7	44.7	46.7	46.6	43.4	46.5	44.2	45.6	46.1	44.9	45.1	49.7	45.4	42.8	44.1
Strontium				0.0346	0.0343	0.0341	0.0395	0.0378	0.0381	0.0412	0.0309	0.0338	0.0613	0.0322	0.0334	0.0315	0.0312	0.0305	0.0354	0.0333	0.0330	0.0315	0.0317	0.0347	0.0327	0.0299	0.0306
Thallium		0.003		<0.00020	<0.00020	<0.00020	<0.0010	<0.0010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<010	0.614	<0.010	<0.010	<0.010	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium		3		0.00079	0.00079	0.00071	<0.0010	<0.0010	0.0008	0.00089	0.00088	0.00091	0.00086	0.00085	0.00091	0.00095	0.00084	0.00074	0.00079	0.00071	0.00077	0.00078	0.00067	0.00077	0.00080	0.00078	0.00078
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.0111	0.02	0.0124	0.0127	0.0137	<0.030	0.0114	0.0114	0.0087	0.0108	0.0106	0.0104	0.0116	0.0112	0.0110	0.0111
Zinc	**0.1**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	0.0054	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0169	<0.0050	<0.0050	<0.0050	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																										
Nitrate Nitrogen		400		0.0094	0.0117	0.0114	0.0162	0.0267	0.0146	0.0418	0.0135	0.0302	0.0212	0.0293	0.0240	0.0259	-	0.0431	0.0380	0.0247	0.0591	0.0453	0.0252	0.0220	0.0296	0.0268	0.0282
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl > 10 mg/L)	Cl	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	0.0373	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amend B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Working Table III-3: MW00-2 Compilation of Groundwater Chemical Analyses - 2 South, 3 South Area

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	25-Apr-00	25-Apr-00	25-Nov-00	25-Nov-00	19-Sep-01	11-Dec-01	21-Mar-02	19-Jul-02	9-Oct-02	9-Oct-02	16-Jan-03	17-Apr-03	22-Jul-03	16-Oct-03	22-Jan-04	14-Apr-04	22-Jul-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Apr-05	28-Jul-05	13-Oct-05	13-Oct-05	25-Jan-06	28-Apr-06	28-Apr-06
Sample Control Number				4487-04	4487-05	6227-08	6227-09	5143-01	6719-01	6739-01	6767-03	6798-07	6798-08	7252-03	7286-03	9301-01	9309-03	9327-03	8688-01	8708-03	8708-04	8932-01	0008-01	0040-01	0120-01	1037-04	1037-05	1163-01	1068-01	1068-02
QA-QC					field replicate		field replicate						field replicate								field replicate						field replicate			field replicate
Physical Tests																														
Hardness $CaCO_3$				1,120	1,240	1,560	1,480	1,370	1,290	1,210	1,380	1,360	1,400	1,230	1,180	1,280	1,480	1,330	1,340	1,480	1,420	1,450	1,220	1,090	1,360	1,420	1,390	1,300	1,370	1,320
Field pH	**6.0-8.5**			7.5	7.5	7.03	7.03	6.58	6.77	6.80	6.68	6.90	6.90	6.46	6.93	6.69	6.80	6.87	6.88	6.71	6.71	6.54	6.44	6.98	6.65	6.70	6.70	6.78	7.27	7.27
Field Temperature (°C)				8.5	8.5	10.6	10.6	15.7	11.9	7.4	13.3	15.6	15.6	10.4	8.6	14	15.1	8.5	-	15.7	15.7	16.3	10.4	9.2	13.7	13.9	13.9	11	9.3	9.3
Field Conductivity (µS/cm)				1,737	1,737	2,600	2,600	2,550	2,670	2,220	2,460	2,180	2,180	2,120	1,970	2,200	2,320	2,080	-	2,180	2,180	2,510	1,960	2,190	2,050	2,270	2,270	2,070	2,160	2,160
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	-	-	249	144	116	136	136	168	129	134	151	134	134	138	139	139
Dissolved Anions																														
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				142	-	172	173	184	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$						172	173	184	163	161	158	181	177	165	152	168	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.25
Chloride		1500		1	-	1.1	1.1	1.2	1.2	1	1.1	1.2	1.2	1	0.8	1	1	0.84	1.6	1.22	1.31	1.45	1.61	2.91	1.17	<5.0	<5.0	0.86	1.13	0.96
Fluoride		2-3	H	0.12	-	0.13	0.14	<0.02	0.07	<0.02	0.1	<0.02	<0.02	0.1	0.11	0.15	0.14	0.123	0.222	0.123	0.117	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.13	0.11	
Sulphate		1000		992	1,020	1,410	638	1,250	1,360	1,270	1,140	1,400	1,570	846	1,220	1,450	1,390	1,270	1,170	1,330	1,330	1,510	1,010	1,050	1,240	1,280	1,270	1,210	1,200	1,200
Dissolved Metals																														
Aluminum	**0.5**			<0.03	<0.03	<0.05	<0.05	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050	<0.050
Antimony		0.2		<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025
Arsenic		0.05		<0.2	<0.2	<0.2	<0.2	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Barium		10		0.02	0.02	0.02	0.02	0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.022	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	0.022	0.021	<0.020	0.021	0.020
Beryllium		0.053		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				-	-	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.4	0.4	0.5	0.5	0.6	0.4	0.4	0.4	0.5	0.5	0.3	0.4	0.4	0.6	0.38	0.37	0.57	0.54	0.49	0.39	0.36	0.48	0.51	0.48	0.37	0.37	0.34
Cadmium		0.0001-0.0006	H	*<0.001*	*<0.001*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025	<0.00025
Calcium				379	417	548	521	472	444	415	475	470	482	417	398	434	505	457	459	506	485	496	424	363	462	491	481	439	466	448
Chromium		0.01[VI], 0.09[III]	V	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025
Cobalt		0.04		<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.014	0.012	0.014	0.014	0.013	0.019	0.014	0.012	0.0189	0.0118	0.0103	0.0147	0.0115	0.0107	0.0091	0.0097	0.0113	0.0091	0.0130	0.0073	0.0086
Copper	**0.02**	0.02-0.09	H	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0063	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Iron	**0.5**			0.12	0.12	0.17	0.15	0.42	**0.75**	**0.61**	**0.69**	**0.73**	**0.74**	**0.91**	**1.41**	**1.29**	**1.05**	**0.902**	**0.675**	**1.21**	**1.21**	**0.777**	**0.911**	**0.723**	**1.33**	**1.02**	**0.994**	**0.525**	**0.676**	**0.671**
Lead	**0.05**	0.04-0.16	H	<0.005	<0.005	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Lithium				-	-	0.02	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium				43	49.4	47.7	43	45.9	44.8	41.8	48.3	46.3	47.4	45.2	43.8	47	52.8	47.1	46.6	53	51.1	51.1	39.5	45.8	50.5	48.1	46.0	49.5	50.4	48.9
Manganese				1.04	1.13	2.23	2.12	1.43	3.06	2.42	2.47	2.79	2.87	2.76	2.64	2.24	2.75	2.32	2.15	2.49	2.43	2.32	2.13	1.88	2.53	2.34	2.24	2.17	2.14	2.08
Mercury		0.001		<0.00005	<0.00005	<0.00005	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum		10		<0.03	<0.03	<0.03	<0.03	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Nickel		0.25-1.5	H	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<0.03	<0.03	<0.03	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025
Phosphorus	**0.03**			-	-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				-	-	4	4	5	4	4	3	4	4	3	4	3	5	3.1	2.9	4.2	4.3	4.2	3.4	2.7	3.0	3.1	2.9	3.7	3.7	3.6
Selenium		0.01		<0.005	<0.005	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050
Silicon				-	-	2.35	2.23	2.56	2.67	2.14	2.61	2.79	2.83	2.48	2.31	2.63	3.08	2.41	2.33	2.96	2.84	2.95	2.25	2.12	2.58	2.86	2.78	2.34	2.26	2.19
Silver		0.0005-0.015	H	<0.0005	<0.0005	*<0.001*	*<0.001*	0.0002	*<0.001*	<0.0003	<0.0003	*<0.01*	*<0.01*	<0.0003	<0.0003	<0.0003	<0.0003	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025	<0.00025
Sodium				48	59	56	51	54	45	42	48	47	48	42	35	38	47	39.8	35.1	42.4	40.6	42.5	37.0	37.2	38.7	36.4	34.8	36.3	36.3	35.2
Strontium				-	-	3.26	2.95	3.33	3.02	2.94	3.25	3.1	3.18	2.9	2.7	2.85	3.54	2.96	3.11	3.37	3.23	3.24	2.52	2.70	3.09	3.07	2.98	2.72	2.94	2.90
Thallium		0.003		<0.0005	<0.0005	<0.001	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010
Tin				-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	0.031	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium		1		-	-	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		0.00026	0.00026	0.0003	0.0004	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010
Vanadium				-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc	**0.2**	0.075-2.4	H	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	0.01	0.0071	<0.0050	<0.0050	0.0052	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																														
Nitrate Nitrogen		400		0.02	-	0.018	0.016	<0.1	0.014	0.017	<0.005	0.006	<0.005	0.006	0.01	<0.1	<0.1	<0.1	<0.2	<0.10	<0.10	<1.0	<1.0	<1.0	<1.0	<0.050	<0.050	<0.050	<0.025	<0.025
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	0.001	-	0.001	<0.001	<0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<1.0	<1.0	<1.0	<1.0	0.020	0.022	<0.010	0.0076	0.0063
Nitrite/Nitrate Nitrogen		400		-	-	-	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-		-	-	-	0.002	0.002	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-		-	-	-	0.004	0.007	0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	1	0.8	0.9	2.4	0.9	0.9	1.1	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				0.9																										

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Working Table III-3: MW00-2 Compilation of Groundwater Chemical Analyses - 2 South, 3 South Area

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	19-Jul-06	25-Oct-06	1-Feb-07	25-Apr-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	23-Apr-08	23-Jul-08	3-Oct-08	3-Feb-09	2-Apr-09	16-Jul-09	20-Oct-09	19-Mar-10	6-May-10	12-Jul-11	13-Jul-10	4-Nov-10	4-Nov-10	26-Jan-11	12-May-11	12-Jul-11	3-Nov-11	3-Nov-11	12-Jan-2012
Sample Control Number				1500-01	0571-03	0615-03	1330-01	1330-02	1326-01	17225-01	17284-01	0955-01	0955-02	0919-01	0850-01	0788-01	0796-01	0853-01	3S-MW00-2	21455-01	21436-05	21952-01	21952-02	21760-01	21760-02	0101-01	0552-01	0154-01	0188-01	0188-02	0341-04
QA-QC								field replicate					field replicate						(QCC)				field replicate		field replicate					field replicate	
Physical Tests																														
Hardness $CaCO_3$				1,140	1,300	946	1,220	1,270	1,420	1,390	1,320	1,330	1,370	1,320	1,270	1,330	1,230	1,230	1,340	1,360	1,320	1,210	1,180	899	871	1,160	1,120	1,240	1,250	1,270	1,170
Field pH	**6.0-8.5**			6.86	6.68	7.51	6.44	6.44	6.41	6.91	6.99	6.68	6.68	6.65	6.86	6.67	7.01	6.97	6.88	6.91	6.88	7.07	7.07	6.83	6.83	**5.85**	6.95	6.89	6.73	6.73	6.89
Field Temperature (°C)				13	14.2	8.2	8.2	8.2	11.8	12.5	8.6	8.8	8.8	11.4	14.4	9.46	8.93	12.7	14.08	7.57	10.99	11.02	11.02	13.69	13.69	9.32	9.42	11.29	11.74	11.74	9.49
Field Conductivity (µS/cm)				2,010	1,660	1,303	2,040	2,040	2,000	2,110	1,493	2,090	2,090	2,239	2,160	2,276	2,166	2,080	2,267	2,362	1,701	1,581	1,581	1,246	1,246	1,427	1,477	1,473	1,683	1,683	2,171
Field Alkalinity - Total $CaCO_3$				148	177	149	155	155	-	-	147	160	160	161	132	192	-	180	-	-	189	-	-	-	-	-	1210	228	187.5	187.5	267
Dissolved Anions																														
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.1	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	-	-	160	172	-	-	-	-	-	163	178	-	202	192	-	183	178	128	134	199	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	-	-	-	-	160	-	-	-	-	-	-	163	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.050	<0.050	<0.050	<0.25	<0.25	<0.050	<0.050	<0.050	<0.50	<0.50		<0.50	<5.0	<1.0	<0.50	<1.0	<6.8	<1.0	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloride		1500		0.79	0.84	0.80	1.29	1.27	0.82	0.937	1.23	1.8	1.8	1.66	1.94	2.09	2.06	3.4	<10	7.7	4.2	3.7	3.3	3.2	2.4	5.0	3.2	2.9	2.5	2.5	2.9
Fluoride		2-3	H	0.112	0.113	0.101	0.21	0.20	0.097	0.112	0.111	0.22	<0.20	0.105	<0.20	6.7	<0.40	<0.20	<0.40	<0.40	<0.40	<0.20	<0.20	<0.20	<0.20	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Sulphate		1000		1,130	1,220	914	1,180	1,140	1,090	1,170	1,180	1,210	1,200	1,080	1,210	1,240	1,220	1,150	1,270	1,360	1,320	1,180	1,170	781	779	1,170	1,190	1,300	1,320	1,340	1,190
Dissolved Metals																														
Aluminum	**0.5**			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Antimony		0.2		<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic		0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Barium		10		<0.020	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020	<0.020	<0.020	0.022	0.023	<0.020	0.024	0.021	0.023	0.022	0.021	0.022	0.021	0.021	0.026	0.023	0.024	0.025	<0.020
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.35	0.48	0.28	0.28	0.30	0.32	0.4	0.35	0.35	0.36	0.37	0.41	0.36	0.39	0.38	0.44	0.39	0.40	0.40	0.41	0.32	0.32	0.38	0.35	0.43	0.42	0.42	0.41
Cadmium		0.0001-0.0006	H	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.000085	<0.000085	<0.000085	0.000089	<0.00025	<0.000085	<0.00017	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	0.000108	<0.000085	<0.000085	<0.000085	<0.000085
Calcium				381	444	327	420	439	488	475	451	457	469	452	436	458	424	420	463	466	453	414	404	307	297	399	383	422	430	435	402
Chromium		0.01[V1], 0.09[III]	V	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt		0.04		0.0099	0.0101	0.0086	0.0085	0.0095	0.0079	0.0085	0.0074	0.0087	0.0089	0.0083	0.0078	0.0088	0.0083	0.0082	0.0081	0.0076	0.0094	0.0069	0.0070	0.0036	0.0032	0.0062	0.0057	0.0063	0.0057	0.0056	0.0058
Copper	**0.02**	0.02-0.09	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Iron	**0.5**			**0.869**	**1.34**	**0.946**	**0.911**	**1.01**	**0.780**	**0.923**	**0.719**	**0.757**	**0.766**	**0.825**	**1.04**	**0.954**	**0.928**	**1.23**	**1.38**	**1.09**	**1.53**	**1.26**	**1.22**	0.477	0.423	**0.526**	0.120	0.337	0.196	0.200	0.337
Lead	**0.05**	0.04-0.16	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Magnesium				44.7	47.1	31.4	41.8	42.9	48.2	48.9	46.5	46.4	47.2	45.4	43.8	46	42.6	43.4	44.6	46.8	46.9	41.9	42.0	32.2	31.6	40.4	39.0	44.0	43.6	44.3	40.2
Manganese				2.07	3.12	2.06	2.58	2.76	2.45	2.49	2.39	2.64	2.68	2.81	2.47	2.63	2.37	2.85	3.06	2.60	3.22	2.26	2.25	1.11	0.988	2.23	1.62	2.40	2.13	2.07	2.24
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nickel		0.25-1.5	H	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.0087	0.0054	<0.0050	0.0084	<0.025	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	<0.0050	<0.0050	<0.0050
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	<0.030	*<0.30*	*<0.30*	*<0.050*	*<0.050*	*<0.30*
Potassium				2.8	3.6	2.2	2.9	3.0	3.3	3.5	3.5	3.4	3.5	3.6	3.9	3.5	3.5	3.5	4.0	3.7	4.1	3.8	3.8	3.2	3.2	3.6	3.2	3.9	3.7	3.8	3.6
Selenium		0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silicon				2.30	2.93	1.98	2.23	2.37	2.36	2.78	2.61	2.48	2.51	2.76	3	2.67	2.45	2.75	3.06	2.68	2.81	2.74	2.67	2.52	2.45	2.59	2.44	2.63	2.65	2.71	2.50
Silver		0.0005-0.015	H	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00025	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium				30.9	36.8	22.0	24.3	26.2	27.8	26.9	37.1	40.8	41	44.7	49.1	67.1	93.3	67.2	69.3	80.0	85.7	119	116	58.9	57.3	105	103	118	94.9	97.1	96.2
Strontium				2.58	2.85	1.64	2.33	2.52	2.60	2.66	2.74	2.84	2.92	2.69	2.8	2.65	2.54	2.47	2.52	2.71	2.95	2.38	2.33	1.87	1.81	2.37	2.34	2.77	2.67	2.74	2.47
Thallium		0.003		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.030	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	0.014	<0.050	<0.010	<0.010	<0.010	<0.010	0.015	0.015	0.015	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium		3		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.030	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	**0.2**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0093	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0054	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																														
Nitrate Nitrogen		400		<0.0050	<0.0050	0.0143	0.046	0.063	<0.0050	<0.0050	<0.0050	<0.050	<0.050	<0.0050	<0.050	<0.50	<0.10	<0.050	-	<0.10	<0.10	<0.050	<0.050	<0.050	<0.050	<0.10	<0.10	<0.10	0.16	0.15	<0.10
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	<0.0010	<0.0010	<0.0010	0.0057	0.0075	<0.0010	<0.0010	<0.0010	0.057	0.058	<0.0010	<0.010	<0.10	<0.020	<0.010	-	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C																	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendme Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwa

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	25-Apr-00	24-Nov-00	19-Sep-01	11-Dec-01	21-Mar-02	19-Jul-02	19-Jul-02	9-Oct-02	16-Jan-03	17-Apr-03	22-Jul-03	16-Oct-03	22-Jan-04	14-Apr-04	14-Apr-04	22-Jul-04	14-Oct-04	14-Oct-04	20-Jan-05	20-Apr-05	28-Jul-05	13-Oct-05	25-Jan-06	28-Apr-06
Sample Control Number				4487-03	6227-06	5143-09	6719-04	6739-09	6767-05	6767-06	6798-10	7252-05	7286-05	9301-03	9309-05	9327-05	8688-03	8688-04	8708-06	8932-03	8932-04	0008-03	0040-03	0120-03	1037-07	1163-03	-
QA-QC										field replicate								field replicate			field replicate						
																											Insufficient Water for Sampling
Physical Tests																											
Hardness $CaCO_3$				505	584	509	692	827	551	533	499	665	946	502	603	991	630	629	539	580	530	999	564	729	634	704	-
Field pH	**6.0-8.5**			6.9	7.08	7.08	7.16	7.18	7.30	7.30	7.18	6.90	6.98	7.10	7.02	6.67	7.13	7.13	6.97	6.67	6.67	6.90	7.12	7.01	7.02	7.15	-
Field Temperature (^oC)				8.6	8.4	9.2	8.4	8.4	12	12	12.9	8.8	-	10.2	9.1	7.7	-	-	10.1	10.1	10.1	8.6	9.4	11.6	9.4	9	-
Field Conductivity (µS/cm)				1,615	1,712	1,950	2,400	2,350	1,628	1,628	1,618	1,870	2,100	1,650	1,821	2,040	-	-	1,650	1,750	1,750	1,800	1,850	1,810	1,610	1,720	-
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	249	174	229	229	179	262	262	183	241	266	258	211	-
Dissolved Anions								*					*														
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				288	330	381	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	330	381	270	256	325	313	346	261	228	287	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.5	<0.5	<0.5	<0.5	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-
Chloride		1500		1	1	1	1.3	1	1	1	0.9	1	0.8	<0.5	0.9	0.78	0.96	0.94	1.24	1.20	1.07	1.23	1.21	1.16	<5.0	0.83	-
Fluoride		2-3	H	0.21	0.21	0.18	0.15	<0.02	0.18	0.21	<0.02	0.19	0.18	0.06	0.2	0.148	0.198	0.197	0.342	0.24	0.31	<0.20	<0.20	<0.20	<0.20	0.24	-
Sulphate		1000		676	587	659	979	1,010	676	680	592	940	998	201	745	1,140	695	694	671	678	688	907	835	810	663	779	-
Dissolved Metals																											-
Aluminum	**0.5**			<0.03	<0.05	<0.1	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.020	<0.050	<0.020	<0.050	-
Antimony		0.2		<0.2	<0.2	<0.1	<0.1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0010	<0.0025	<0.0010	<0.0025	-
Arsenic		0.05		<0.2	<0.2	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	0.005	0.006	<0.005	<0.005	0.0071	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	0.0065	<0.0050	<0.0050	0.0027	<0.0050	-
Barium		10		0.04	0.02	0.02	<0.02	<0.02	0.02	0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.020	<0.020	0.023	0.021	0.021	<0.020	<0.020	<0.020	0.021	0.021	<0.020	-
Beryllium		0.053		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Bismuth				-	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-
Boron		50		1.2	1.1	1.1	1.0	0.8	1.1	1	1.1	0.9	0.8	0.9	0.9	0.63	0.88	0.88	0.96	0.85	0.80	0.60	0.66	0.92	0.90	0.67	-
Cadmium		0.0001-0.0006	H	*<0.001*	*<0.002*	*<0.002*	*<0.002*	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.00025	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00010	<0.00025	<0.00010	<0.00025	-
Calcium				183	210	182	243	283	198	192	179	231	318	179	212	334	224	223	192	204	186	342	193	255	226	242	-
Chromium		0.01[V1], 0.09[III]	V	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0010	<0.0025	<0.0010	<0.0025	-
Cobalt		0.04		0.02	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0034	<0.0050	0.0028	0.0074	0.0055	<0.0025	0.0026	0.0015	0.0081	0.0037	<0.0025	-
Copper	**0.02**	0.02-0.09	H	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0020	<0.0050	<0.0040	<0.0050	-
Iron	**0.5**			0.17	**1.59**	**1**	**1.30**	**1.11**	**1.98**	**1.95**	**1.75**	**2.43**	**1.3**	**1.76**	**1.31**	**1.06**	**2.28**	**2.27**	**1.79**	**0.932**	**0.885**	**0.700**	**1.57**	**2.23**	**2.38**	**1.03**	-
Lead	**0.05**	0.04-0.16	H	<0.005	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0020	<0.0050	<0.0020	<0.0050	-
Lithium				-	0.03	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Magnesium				12	14.6	13.2	20.7	29.3	13.8	13.2	12.3	21.3	36.8	13.5	17.9	38	17.2	17.2	14.7	17.0	15.7	35.2	20.2	22.6	16.8	24.2	-
Manganese				0.309	0.363	0.29	0.79	0.94	0.35	0.33	0.29	0.62	0.82	0.36	0.38	0.905	0.45	0.452	0.361	0.256	0.234	0.907	0.412	0.405	0.344	0.466	-
Mercury		0.001		<0.00005	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-
Molybdenum		10		<0.03	<0.03	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0020	<0.0050	<0.0020	<0.0050	-
Nickel		0.25-1.5	H	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<0.03	<0.03	<0.03	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.010	<0.025	<0.010	<0.025	-
Phosphorus	**0.03**			-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	-
Potassium				-	3	3	3	4	3	3	3	3	3	<2	<2	3.3	2.3	2.8	2.5	2.6	2.9	3.0	<2.0	2.0	<2.0	2.5	-
Selenium		0.01		<0.005	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0020	<0.0050	<0.0020	<0.0050	-
Silicon				-	2.75	2.75	3.27	3.34	3.03	2.91	3.09	3.08	3.63	2.69	2.84	3.66	3.22	3.2	2.92	2.64	2.46	3.94	2.65	2.89	2.89	3.09	-
Silver		0.0005-0.015	H	<0.0005	*<0.001*	<0.0001	<0.0001	<0.0003	<0.0003	<0.0003	*<0.01*	<0.0003	<0.0003	<0.0003	<0.0003	<0.00025	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00010	<0.00025	<0.00010	<0.00025	-
Sodium				224	224	219	203	177	226	217	207	192	148	176	166	141	189	188	185	173	163	114	102	147	155	130	-
Strontium				-	1.98	2.03	2.58	2.91	2.26	2.2	1.97	2.46	3.03	1.99	2.25	2.85	2.42	2.4	2.16	2.15	1.97	2.65	1.74	2.05	2.04	2.12	-
Thallium		0.003		<0.005	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00040	<0.0010	<0.00040	<0.0010	-
Tin				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-
Titanium		1		-	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-
Uranium		3		0.00027	0.0002	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00040	<0.0010	<0.00040	<0.0010	-
Vanadium				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-
Zinc	**0.2**	0.075-2.4	H	<0.005	<0.005	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-
Nutrients and Organic Parameters																											
Nitrate Nitrogen		400		<0.005	<0.005	<0.1	0.018	<0.005	0.008	0.007	<0.005	<0.005	<0.005	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<1.0	<1.0	<1.0	<1.0	<1.0	<0.050	<0.050	-
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	0.001	0.001	<0.1	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<1.0	<1.0	<1.0	<1.0	<1.0	0.023	<0.010	-
Nitrite/Nitrate Nitrogen		400		-	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	0.002	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	0.004	0.007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	1.1	2.1	1.4	1.1	1.3	1.0	1.3	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
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* laboratory pH measurement.
H = standard is hardness dependant
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(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	19-Jul-06	25-Oct-06	1-Feb-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	22-Jul-08	3-Oct-08	3-Feb-09	2-Apr-09	16-Jul-09	20-Oct-09	19-Mar-10	6-May-10	6-May-10	13-Jul-10	4-Nov-10	26-Jan-11	12-May-11	12-Jul-11	3-Nov-11	12-Jan-12
Sample Control Number				-	-	-	1330-04	-	-	-	-	-	-	-	0796-03	-	-	21455-04	21436-07	21436-08	21952-04	21760-04	-	-	-	-	-
QA-QC																	(QCC)			Field Replicate							
Physical Tests				Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling		Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling		Insufficient Water for Sampling	Insufficient Water for Sampling						Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling	Insufficient Water for Sampling
Hardness $CaCO_3$				-	-	-	906	-	-	-	-	-	-	-	761	-	-	648	590	609	574	704	-	-	-	-	-
Field pH	**6.0-8.5**			-	-	-	6.80	-	-	-	-	-	-	-	7.16	-	-	7.17	7.07	7.07	7.05	6.72	-	-	-	-	-
Field Temperature (^oC)				-	-	-	9.7	-	-	-	-	-	-	-	8.63	-	-	8.61	8.87	8.87	9.26	9.02	-	-	-	-	-
Field Conductivity (µS/cm)				-	-	-	1,816	-	-	-	-	-	-	-	1,782	-	-	1,603	992	992	959	1,117	-	-	-	-	-
Field Alkalinity - Total $CaCO_3$				-	-	-	210	-	-	-	-	-	-	-	-	-	-	-	240	240	-	-	-	-	-	-	-
Dissolved Anions																											
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	277		-	224	-	-	233	246					
Alkalinity - Bicarbonate $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-
Bromide				-	-	-	<0.050	-	-	-	-	-	-	-	<0.50	-	-	<3.3	<0.50	<0.50	<0.50	<0.50	-	-	-	-	-
Chloride		1500		-	-	-	0.73	-	-	-	-	-	-	-	0.88	-	-	2.3	2.2	3.3	2.2	1.5	-	-	-	-	-
Fluoride		2-3	H	-	-	-	0.162	-	-	-	-	-	-	-	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	-	-	-
Sulphate		1000		-	-	-	825	-	-	-	-	-	-	-	786	-	-	668	585	584	572	673	-	-	-	-	-
Dissolved Metals				-	-	-		-	-																		
Aluminum	**0.5**			-	-	-	<0.050	-	-	-	-	-	-	-	<0.025	-	-	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-	-	-
Antimony		0.2		-	-	-	<0.0025	-	-	-	-	-	-	-	<0.0025	-	-	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	-	-	-	-	-
Arsenic		0.05		-	-	-	0.0078	-	-	-	-	-	-	-	<0.0025	-	-	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	-	-	-	-	-
Barium		10		-	-	-	<0.020	-	-	-	-	-	-	-	0.029	-	-	0.025	0.029	0.029	0.027	<0.020	-	-	-	-	-
Beryllium		0.053		-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Bismuth				-	-	-	<0.20	-	-	-	-	-	-	-	<0.20	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	-	-	-
Boron		50		-	-	-	0.65	-	-	-	-	-	-	-	0.83	-	-	0.61	0.6	0.61	0.63	0.64	-	-	-	-	-
Cadmium		0.0001-0.0006	H	-	-	-	<0.00025	-	-	-	-	-	-	-	<0.000085	-	-	<0.000085	<0.000085	<0.000085	<0.000085	<0.000085	-	-	-	-	-
Calcium				-	-	-	315	-	-	-	-	-	-	-	269	-	-	227	208	216	205	246	-	-	-	-	-
Chromium		0.01[VI], 0.09[III]	V	-	-	-	<0.0025	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Cobalt		0.04		-	-	-	0.0030	-	-	-	-	-	-	-	0.0022	-	-	0.0018	<0.0015	<0.0015	<0.0015	0.0019	-	-	-	-	-
Copper	**0.02**	0.02-0.09	H	-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Iron	**0.5**			-	-	-	**1.32**	-	-	-	-	-	-	-	**0.647**	-	-	0.187	0.137	0.144	0.044	0.198	-	-	-	-	-
Lead	**0.05**	0.04-0.16	H	-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0025	-	-	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	-	-	-	-	-
Lithium				-	-	-	<0.050	-	-	-	-	-	-	-	0.026	-	-	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-	-	-
Magnesium				-	-	-	29.2	-	-	-	-	-	-	-	21.9	-	-	19.6	16.9	16.7	15.1	21.7	-	-	-	-	-
Manganese				-	-	-	0.573	-	-	-	-	-	-	-	0.414	-	-	0.296	0.261	0.260	0.226	0.355	-	-	-	-	-
Mercury		0.001		-	-	-	<0.00020	-	-	-	-	-	-	-	<0.000020	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-	-	-	-
Molybdenum		10		-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Nickel		0.25-1.5	H	-	-	-	<0.025	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Phosphorus	**0.03**			-	-	-	*<0.30*	-	-	-	-	-	-	-	*<0.30*	-	-	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	-	-	-	-	-
Potassium				-	-	-	2.6	-	-	-	-	-	-	-	2.5	-	-	2.5	2.4	2.3	2.1	2.4	-	-	-	-	-
Selenium		0.01		-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Silicon				-	-	-	3.29	-	-	-	-	-	-	-	2.84	-	-	2.67	2.52	2.55	2.48	2.94	-	-	-	-	-
Silver		0.0005-0.015	H	-	-	-	<0.00025	-	-	-	-	-	-	-	<0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-	-	-	-
Sodium				-	-	-	120	-	-	-	-	-	-	-	154	-	-	114	120	119	121	108	-	-	-	-	-
Strontium				-	-	-	2.50	-	-	-	-	-	-	-	2.42	-	-	1.93	1.77	1.81	1.83	2.14	-	-	-	-	-
Thallium		0.003		-	-	-	<0.0010	-	-	-	-	-	-	-	<0.0010	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Tin				-	-	-	<0.030	-	-	-	-	-	-	-	<0.0025	-	-	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	-	-	-	-	-
Titanium		1		-	-	-	<0.050	-	-	-	-	-	-	-	<0.010	-	-	<0.010	<0.010	<0.010	<0.010	0.014	-	-	-	-	-
Uranium		3		-	-	-	<0.0010	-	-	-	-	-	-	-	<0.0010	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	-	-	-	-
Vanadium				-	-	-	<0.030	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Zinc	**0.2**	0.075-2.4	H	-	-	-	<0.0050	-	-	-	-	-	-	-	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-	-	-	-
Nutrients and Organic Parameters																											
Nitrate Nitrogen		400		-	-	-	<0.0050	-	-	-	-	-	-	-	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	-	-	-
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	-	-	-	<0.0010	-	-	-	-	-	-	-	<0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	-	-	-	-	-
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendmen 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-5: MW00-4 Compilation of Groundwater Chemical Analyses - 2 South, 3 South Area

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	25-Apr-00	24-Nov-00	19-Sep-01	19-Sep-01	11-Dec-01	21-Mar-02	19-Jul-02	9-Oct-02	16-Jan-03	17-Apr-03	22-Jul-03	16-Oct-03	16-Oct-03	22-Jan-04	14-Apr-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Apr-05	28-Jul-05	13-Oct-05	25-Jan-06	28-Apr-06	19-Jul-06	25-Oct-06	30-Jan-07	30-Jan-07
Sample Control Number				-	6227-01	5143-02	5143-03	6719-05	6739-02	6767-07	6798-11	7252-06	7286-06	9301-04	9309-06	9309-07	9327-06	8688-05	8708-07	8932-05	0008-04	0040-04	0120-04	1037-08	1163-04	1068-04	1500-04	-	0615-01	0615-02
QA-QC				no data			field replicate									field replicate														field replicate
																												Insufficient Water for Sampling		
Physical Tests																														
Hardness $CaCO_3$				-	296	1310	490	232	249	488	549	233	227	340	489	496	284	362	351	320	252	305	401	447	327	303	380	-	332	321
Field pH	**6.0-8.5**			-	7	6.94	6.94	7.30	7.41	7.29	7.17	6.51	7.38	7.46	7.33	7.33	7.43	7.19	7.24	6.91	7.06	7.38	7.08	7.05	7.43	7.23	7.19	-	6.91	6.91
Field Temperature (^{0}C)				-	8.4	6.2	6.2	6.9	9	7.7	7	-	8.3	6.7	7	7	8	-	7.6	6.7	6.6	9.6	7.3	64	5.4	9.5	-	-	6.9	6.9
Field Conductivity (µS/cm)				-	1186	675	675	640	1061	1265	605	563	924	1210	627	627	989	-	926	686	770	860	1150	649	715	991	-	-	836	836
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	155	155	60	83	131	136	68	96	124	147	55	88	142	-	76	76
Dissolved Anions																														
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	134	201	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	135	201	209	77	92	170	186	75	74	154	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bromide				-	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.25	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050
Chloride		1500		-	1.3	0.7	0.7	0.9	0.8	0.7	0.7	0.7	0.5	0.5	0.6	0.6	0.69	0.66	<0.50	1.06	1.12	0.69	0.73	0.61	0.62	<0.50	0.55	-	0.51	0.51
Fluoride		2-3	H	-	0.11	0.12	0.11	0.07	0.03	0.09	<0.02	0.07	0.07	0.1	0.11	0.11	0.062	0.068	0.061	0.126	0.059	0.085	0.091	0.126	0.052	0.075	0.085	-	0.063	0.062
Sulphate		1000		-	333	509	532	263	244	458	568	238	214	352	517	518	253	307	203	376	268	298	340	433	273	257	380	-	283	283
Dissolved Metals																														
Aluminum	**0.5**			-	0.03	<0.1	<0.1	<0.1	<0.01	<0.02	<0.05	<0.01	<0.01	<0.02	<0.05	<0.05	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-	<0.020	<0.020
Antimony		0.2		-	<0.2	<0.1	<0.1	<0.1	<0.0005	<0.001	<0.003	<0.0005	<0.0005	<0.001	<0.003	<0.003	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010
Arsenic		0.05		-	<0.2	<0.01	<0.01	<0.01	<0.001	<0.002	<0.005	<0.001	<0.001	<0.002	<0.005	<0.005	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020
Barium		10		-	0.06	0.02	0.05	0.02	0.03	0.06	0.05	0.02	0.03	0.04	0.05	0.05	0.03	0.035	0.049	0.041	0.020	0.032	0.046	0.057	0.023	0.028	0.031	-	0.022	0.022
Beryllium		0.053		-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050
Bismuth				-	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	<0.20
Boron		50		-	0.4	0.5	0.4	0.2	0.2	0.3	0.4	0.2	0.2	0.3	0.5	0.5	0.18	0.22	0.35	0.48	0.33	0.30	0.38	0.56	0.18	0.19	0.29	-	0.20	0.19
Cadmium		0.0001-0.0006	H	-	*<0.001*	*<0.002*	*<0.002*	*<0.002*	<0.00005	<0.0001	<0.0003	<0.00005	<0.00005	<0.0001	<0.0003	<0.0003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010
Calcium				-	103	451	169	78.6	84.4	166	188	78.4	75.6	115	165	168	95.1	122	119	109	83.7	99.8	135	155	108	101	129	-	112	108
Chromium		0.01[VI], 0.09[III]	V	-	<0.01	<0.01	<0.01	<0.01	<0.0005	<0.001	<0.003	<0.0005	<0.0005	<0.001	<0.003	<0.003	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010
Cobalt		0.04		-	<0.01	<0.01	<0.01	<0.01	<0.0005	<0.001	<0.003	<0.0005	0.0011	<0.001	<0.003	<0.003	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<0.0010	0.0062	0.0022	-	<0.0010	<0.0010
Copper	**0.02**	0.02-0.09	H	-	<0.01	<0.01	<0.01	<0.01	0.002	<0.002	<0.005	0.001	0.002	<0.002	<0.005	<0.005	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0040	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020
Iron	**0.5**			-	0.07	0.15	0.12	0.03	<0.03	0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.038	<0.030	-	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	-	<0.005	<0.01	<0.01	<0.01	<0.001	<0.002	<0.005	<0.001	<0.001	<0.002	<0.005	<0.005	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020
Lithium				-	0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050
Magnesium				-	9.2	43.9	16.5	8.6	9.2	17.7	19	9.1	9.2	12.9	18.4	18.6	11.4	13.8	13.3	11.4	10.4	13.5	15.5	14.6	13.8	12.5	14.0	-	12.6	12.3
Manganese				-	0.094	1.21	0.37	0.02	<0.01	0.25	0.38	<0.01	<0.01	0.07	0.5	0.51	<0.010	0.022	0.141	0.157	0.025	<0.010	0.049	0.220	<0.010	0.018	0.093	-	0.022	0.021
Mercury		0.001		-	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020	<0.00020
Molybdenum		10		-	<0.03	<0.01	<0.01	<0.01	<0.001	<0.002	<0.005	<0.001	<0.001	<0.002	<0.005	<0.005	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020
Nickel		0.25-1.5	H	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.005	<0.005	<0.01	<0.03	<0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010
Phosphorus	**0.03**			-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	-	*<0.30*	*<0.30*
Potassium				-	<2	4	2	<2	<2	2	3	<2	<2	<2	2	2	<2.0	2.5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0
Selenium		0.01		-	<0.005	<0.01	<0.01	<0.01	<0.001	<0.002	<0.005	<0.001	<0.001	<0.002	<0.005	<0.005	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020
Silicon				-	2.80	2.42	3.04	2.99	2.84	2.92	2.91	2.64	2.72	2.42	2.89	2.95	2.92	3.06	2.46	2.37	3.00	3.03	2.78	2.72	2.90	2.64	2.28	-	2.74	2.64
Silver		0.0005-0.015	H	-	<0.0005	0.0002	0.0001	*<0.001*	<0.00005	<0.0001	*<0.01*	<0.00005	<0.00005	<0.0001	<0.0003	<0.0003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	<0.00010	<0.00010
Sodium				-	86	51	115	37	38	79	102	35	29	67	110	109	31.9	47.3	84.7	93.8	41.3	47.3	55.8	96.1	22.3	33.0	43.2	-	32.5	31.7
Strontium				-	0.915	3.15	1.74	0.675	0.76	1.56	1.78	0.7	0.643	1.05	1.64	1.65	0.701	1.02	1.12	1.06	0.658	0.816	0.917	1.19	0.712	0.755	0.825	-	0.697	0.683
Thallium		0.003		-	<0.0005	<0.002	<0.002	<0.002	<0.0002	<0.0004	<0.001	<0.0002	<0.0002	<0.0004	<0.001	<0.001	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	-	<0.00040	<0.00040
Tin				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-	<0.030	<0.030
Titanium		1		-	<0.01	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050
Uranium		3		-	0.00007	<0.002	<0.002	<0.002	<0.0002	<0.0004	<0.001	<0.0002	<0.0002	<0.0004	<0.001	<0.001	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	-	<0.00040	<0.00040
Vanadium				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-	<0.030	<0.030
Zinc	**0.2**	0.075-2.4	H	-	<0.005	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050
Nutrients and Organic Parameters																														
Nitrate Nitrogen		400		-	0.013	<0.1	<0.1	0.087	0.106	<0.005	<0.005	0.048	0.046	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.0050	0.0552	0.0618	<0.0050	-	0.0693	0.0685
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	-	0.009	<0.1	<0.1	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010
Nitrite/Nitrate Nitrogen		400		-	-	<0.005	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	0.002	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	0.003	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	2.2	2.3	2.8	2.1	2.5	2.3	2.5	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-5: MW00-4 Compilation of Groundwater Chemical Analyses - 2 South, 3 South Area

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	25-Apr-07	5-Jul-07	5-Jul-07	7-Nov-07	24-Jan-08	24-Jan-08	23-Apr-08	23-Jul-08	23-Jul-08	3-Oct-08	3-Oct-08	3-Feb-09	3-Apr-09	3-Apr-09	16-Jul-09	20-Oct-09	19-Mar-10	6-May-10	12-Jul-11	4-Nov-10	26-Jan-11	12-May-11	12-Jul-11	12-Jul-11	3-Nov-11	12-Jan-12
Sample Control Number				1330-05	1326-03	1326-04	17225-03	17284-03	17284-04	0955-04	0919-03	0919-04	0850-03	0850-04	0788-04	0796-04	0796-05	0853-03	3S-MW00-4	21455-05	21436-09	21952-05	21760-05	0101-03	0552-03	0154-03	0154-04	0188-04	0341-06
QA-QC						field replicate			field replicate			field replicate		field replicate			field replicate		(QCC)								field replicate		
Physical Tests																												
Hardness $CaCO_3$				384	491	479	386	361	357	386	406	398	432	442	440	412	411	427	491	379	419	415	426	353	294	295	294	355	258
Field pH	**6.0-8.5**			7.15	6.97	6.97	7.22	7.13	7.13	7.31	7.16	7.16	7.28	7.28	7.06	6.97	6.97	7.52	7.07	6.98	7.09	7.12	6.76	6.87	7.31	7.34	7.34	6.87	7.32
Field Temperature (^{0}C)				9.4	6.9	6.9	5.7	6.9	6.9	-	7.65	7.65	8.9	8.9	6.41	6.80	6.80	8.5	7.44	7.03	7.41	8.82	7.11	6.52	7.28	8.20	8.20	6.35	6.09
Field Conductivity (µS/cm)				981	850	850	500	859	859	.	975	975	1,040	1,040	947	829	829	931	1,097	794	541	609	624	475	450	387	387	480	566
Field Alkalinity - Total $CaCO_3$				110	-	-	-	93	93	106	143	143	141	141	135	-	-	150	-	-	132	-	-	-	126	141	141	127.5	152.7
Dissolved Anions																												
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.3	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	157	157	108	-	-	-	-	-	-	-	-	113	112	-	193	99.5	-	154	115	120	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	157	157	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.50	<1.6	<0.25	<0.50	<0.50	<0.050	<0.050	<0.050	<0.050	<0.25	<0.050
Chloride		1500		<0.50	<0.50	<0.50	0.875	0.533	0.506	0.72	0.71	0.7	0.64	0.64	1.23	1.02	1.01	0.70	<5.0	1.42	0.77	<1.0	1.4	0.38	0.34	0.29	0.29	0.60	0.28
Fluoride		2-3	H	0.079	0.069	0.070	0.073	0.073	0.074	0.073	0.093	0.093	0.102	0.099	0.078	0.068	0.068	0.073	<0.20	<0.10	<0.10	<0.20	<0.20	0.060	0.080	0.095	0.091	<0.10	0.072
Sulphate		1000		325	375	375	333	301	289	339	332	332	390	391	359	348	348	351	436	329	316	330	387	298	226	223	223	273	206
Dissolved Metals																												
Aluminum	**0.5**			<0.020	<0.050	<0.050	<0.050	<0.020	<0.020	<0.020	<0.020	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.0052
Antimony		0.2		<0.0010	<0.0025	<0.0025	<0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050
Arsenic		0.05		<0.0020	<0.0050	<0.0050	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	0.0012	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050
Barium		10		0.029	0.039	0.040	0.023	0.025	0.025	0.026	0.031	0.031	0.037	0.037	0.037	0.026	0.026	0.032	0.046	0.023	0.027	0.037	0.026	0.023	0.025	0.033	0.032	0.033	0.025
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.22	0.32	0.32	0.25	0.2	0.2	0.21	0.31	0.31	0.39	0.39	0.26	0.21	0.21	0.29	0.43	0.16	0.19	0.25	0.28	0.22	0.19	0.20	0.20	0.22	0.15
Cadmium		0.0001-0.0006	H	<0.00010	<0.00025	<0.00025	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.00010	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.000034	<0.000017
Calcium				131	168	164	132	122	121	131	138	135	146	150	150	139	139	146	167	126	143	142	144	119	99.9	100	100	121	87.3
Chromium		0.01[VI], 0.09[III]	V	<0.0010	<0.0025	<0.0025	<0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010
Cobalt		0.04		<0.0010	<0.0025	<0.0025	<0.0025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00060	<0.00060	<0.00060	0.00071	0.00067	<0.00060	<0.0010	0.00073	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00030
Copper	**0.02**	0.02-0.09	H	<0.0020	<0.0050	<0.0050	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.003	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0035	<0.0020	<0.0020	<0.0020	<0.0010
Iron	**0.5**			<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.103	0.098	<0.030	<0.030	0.118	0.084	<0.030	0.229	0.256	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0020	<0.0050	<0.0050	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.012	0.012	0.016	<0.010	0.011	<0.010	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.0062
Magnesium				14.1	17.2	17.1	13.5	13.5	13.3	14.1	14.9	14.7	16.2	16.3	15.8	15.7	15.5	15.3	18.1	15.5	14.9	15.0	16.2	13.4	10.8	10.9	10.8	12.9	9.64
Manganese				0.015	0.032	0.033	0.013	<0.010	<0.010	<0.010	0.039	0.039	0.151	0.153	0.00545	0.0731	0.0708	0.0189	0.103	0.0553	0.036	0.0192	0.113	0.0686	0.00351	0.00997	0.00968	0.0345	0.00977
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		<0.0020	<0.0050	<0.0050	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010
Nickel		0.25-1.5	H	<0.010	<0.025	<0.025	<0.025	<0.010	<0.010	<0.010	<0.010	<0.010	0.0028	0.0029	<0.0020	0.0026	0.0022	<0.0020	<0.010	0.0024	<0.0020	<0.0020	<0.0020	0.0022	<0.0020	0.0266	<0.0020	<0.0020	<0.0020	<0.0010
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	<0.030	<0.30	*<0.30*	*<0.30*	*<0.050*	*<0.30*
Potassium				<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium		0.01		<0.0020	<0.0050	<0.0050	<0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010
Silicon				2.88	2.55	2.52	3.21	3.13	3.09	2.66	2.85	2.8	2.71	2.73	3.15	3.27	3.25	2.79	2.78	3.55	3.48	2.93	3.90	3.12	2.60	2.76	2.73	3.24	3.14
Silver		0.0005-0.015	H	<0.00010	<0.00025	<0.00025	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.00010	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000040	<0.000020
Sodium				38.6	60.2	60.5	43	38.2	37.6	35.9	55.7	52.4	69.5	69.5	47.8	36.8	36.0	50.8	73.7	29.5	31.3	44.4	47.2	35.5	30.8	35.3	34.9	37.2	23.5
Strontium				0.961	1.19	1.20	1.01	0.953	0.936	0.963	1.11	1.1	1.23	1.24	1.22	1.05	1.03	1.16	1.40	0.878	0.95	1.10	1.16	0.936	0.773	0.795	0.787	0.962	0.673
Thallium		0.003		<0.00040	<0.0010	<0.0010	<0.0010	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00020
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.030	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.050	<0.010	<0.010	<0.010	0.011	0.011	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium		3		<0.00040	<0.0010	<0.0010	<0.0010	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00020
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.030	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010
Zinc	**0.2**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0063	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																												
Nitrate Nitrogen		400		0.0542	<0.0050	<0.0050	0.0479	0.0605	0.0591	0.0619	<0.0050	<0.0050	<0.0050	<0.0050	0.0998	0.0891	0.0889	<0.0050	-	0.074	0.092	<0.050	0.127	0.0358	0.0056	<0.0050	<0.0050	0.033	0.0496
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0018	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0050	<0.0050	<0.010	<0.010	<0.0010	0.0013	<0.0010	<0.0010	0.0051	<0.0010
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.050	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amend 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwate

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-6: MW00-5 Compilation of Groundwater Chemical Analyses - 2 South, 3 South Area

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	-	25-Nov-00	19-Sep-01	11-Dec-01	11-Dec-01	21-Mar-02	21-Mar-02	19-Jul-02	9-Oct-02	16-Jan-03	17-Apr-03	22-Jul-03	16-Oct-03	22-Jan-04	14-Apr-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Apr-05	28-Jul-05	13-Oct-05	25-Jan-06	28-Apr-06	19-Jul-06	19-Jul-06
Sample Control Number				-	6227-07	5143-08	6719-02	6719-03	6739-08	6739-10	6767-04	6798-09	7252-04	7286-04	9301-02	9309-04	9327-04	8688-02	8708-05	8932-02	0008-02	0040-02	0120-02	1037-06	1163-02	1068-03	1500-02	1500-03
QA-QC				no data				field replicate		field replicate																		field replicate
Physical Tests																												
Hardness $CaCO_3$				-	678	987	1,170	1,200	1,210	-	1,140	414	1,170	1,110	948	325	1,190	1,180	1,030	574	1,250	969	1,200	1,030	1,050	1,140	591	541
Field pH	**6.0-8.5**			-	7.03	6.79	6.84	6.84	6.91	6.91	6.88	7.31	6.74	6.80	6.79	7.09	6.71	6.93	7.04	6.86	6.51	7.04	6.71	6.93	6.92	7.05	7.11	7.11
Field Temperature (°C)				-	4	9.2	8.7	8.7	8.5	8.5	10.7	12.8	10.8	-	10.4	8.8	8.1	-	11.3	10	9.1	9	10.6	9.1	9	8.8	10.8	10.8
Field Conductivity (µS/cm)				-	2,700	4,240	4,360	4,360	4,180	4,180	4,000	2,280	3,070	2,690	2,830	1,910	3,130	-	2,620	2,370	3,110	3,110	3,000	3,020	2,790	3,110	2,710	2,710
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	-	338	312	303	194	305	327	327	328	322	324	297	254	254
Dissolved Anions				-					*	*				*														
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	435	404	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	435	404	376	379	382	-	361	312	350	340	315	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				-	<0.5	<0.5	<5	<5	0.14	0.13	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.050	<0.050	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.25	<0.25	<0.25
Chloride		1500		-	6.2	1.6	1.7	1.8	1.5	1.6	1.5	3.3	1.4	1.6	2	4.2	1.45	0.7	2.89	4.27	3.54	3.21	2.13	<5.0	2.09	1.61	<2.5	<2.5
Fluoride		2-3	H	-	0.15	<0.2	0.2	<0.2	<0.02	<0.02	0.08	<0.02	0.14	0.17	0.2	0.24	0.17	0.08	0.173	0.25	<0.20	0.20	<0.20	<0.20	0.25	0.24	0.23	0.22
Sulphate		1000		-	604	2,130	2,100	2,060	2,120	2,080	1,780	900	1,080	1,770	1,630	747	1,730	791	1,430	1,030	1,530	1,560	1,640	1,520	1,410	1,580	1,270	1,260
Dissolved Metals																												
Aluminum	**0.5**			-	<0.05	0.2	<0.1	<0.1	<0.1	-	<0.1	<0.05	<0.1	<0.1	<0.1	<0.05	<0.10	<0.10	<0.10	<0.050	<0.10	<0.050	<0.10	<0.050	<0.10	<0.10	<0.050	<0.050
Antimony		0.2		-	<0.2	<0.1	<0.1	<0.1	<0.005	-	<0.005	<0.003	<0.005	<0.005	<0.005	<0.003	<0.0050	<0.0050	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0050	<0.0025	<0.0025
Arsenic		0.05		-	<0.2	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.005	<0.01	<0.01	<0.01	<0.005	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.0050
Barium		10		-	0.04	0.02	<0.02	<0.02	0.02	-	0.02	<0.02	<0.02	0.02	<0.02	0.02	<0.020	<0.020	<0.020	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium		0.053		-	<0.005	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	0.0067	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				-	<0.1	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		-	3.4	2.3	2.0	2.0	2.3	-	2.1	2.9	1.8	1.8	1.9	3	1.63	1.49	2.37	2.78	1.90	1.45	1.92	1.87	1.85	1.50	2.31	2.08
Cadmium		0.0001-0.0006	H	-	*<0.002*	*<0.002*	*<0.002*	*<0.002*	<0.0005	-	<0.0005	<0.0003	<0.0005	<0.0005	<0.0005	<0.0003	<0.00050	<0.00050	<0.00050	<0.00025	<0.00050	<0.00025	<0.00050	<0.00025	<0.00050	<0.00050	<0.00025	<0.00025
Calcium				-	244	346	407	416	419	-	396	146	403	382	329	114	412	413	357	200	443	333	415	365	360	392	205	186
Chromium		0.01^{VI}, 0.09^{III}	V	-	<0.01	<0.01	<0.01	<0.01	<0.005	-	<0.005	<0.003	<0.005	<0.005	<0.005	<0.003	<0.0050	<0.0050	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0050	<0.0025	<0.0025
Cobalt		0.04		-	<0.01	<0.01	<0.01	<0.01	<0.005	-	<0.005	<0.003	<0.005	0.005	<0.005	<0.003	<0.0050	0.0057	<0.0050	0.0063	<0.0050	0.0070	<0.0050	0.0076	<0.0050	<0.0050	<0.0025	<0.0025
Copper	**0.02**	0.02-0.09	H	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.005	<0.01	<0.01	<0.01	<0.005	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.0050
Iron	**0.5**			-	<0.03	**2.46**	0.10	<0.03	**2.1**	-	**1.8**	**0.55**	**0.55**	**1.02**	**1.34**	**0.43**	**0.936**	**1.09**	**1.27**	0.445	**0.950**	**0.948**	0.060	**1.42**	0.203	0.197	0.460	0.416
Lead	**0.05**	0.04-0.16	H	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.005	<0.01	<0.01	<0.01	<0.005	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.0050
Lithium				-	0.01	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	0.051	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium				-	16.9	29.9	38.2	39.0	39.3	-	37.1	12.2	39.3	37.6	31	9.6	38.6	37.1	32.9	18.2	34.9	33.1	40.6	29.7	35.5	39.5	19.2	18.3
Manganese				-	0.345	0.23	0.29	0.31	0.34	-	0.26	0.14	0.26	0.23	0.19	0.1	0.186	0.306	0.273	0.160	0.259	0.317	0.382	0.291	0.172	0.052	0.132	0.119
Mercury		0.001		-	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum		10		-	0.05	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.005	<0.01	<0.01	<0.01	<0.005	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.0050
Nickel		0.25-1.5	H	-	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<0.050	<0.050	<0.050	<0.025	<0.050	<0.025	<0.050	<0.025	<0.050	<0.050	<0.025	<0.025
Phosphorus	**0.03**			-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				-	5	5	5	6	7	-	6	4	6	5	4	2	4.9	4.1	6.6	4.1	5.1	3.8	4.3	3.1	4.8	5.4	2.8	2.7
Selenium		0.01		-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.005	<0.01	<0.01	<0.01	<0.005	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.0050
Silicon				-	5.25	3.98	3.11	3.19	3.74	-	3.53	3.22	3.01	2.93	2.96	3.09	2.83	2.8	3.44	2.99	2.73	2.50	2.59	2.62	2.69	2.16	2.30	2.09
Silver		0.0005-0.015	H	-	*<0.001*	0.0002	*<0.001*	*<0.001*	<0.0005	-	<0.0005	*<0.01*	<0.0005	<0.0005	<0.0005	<0.0003	<0.00050	<0.00050	<0.00050	<0.00025	<0.00050	<0.00025	<0.00050	<0.00025	<0.00050	<0.00050	<0.00025	<0.00025
Sodium				-	516	609	445	453	530	-	492	368	383	345	330	323	351	302	380	362	335	263	369	341	320	341	355	344
Strontium				-	2.63	4.67	5.22	5.33	5.79	-	5.12	1.75	4.84	4.58	3.8	1.39	4.51	4.68	4.16	2.36	4.43	3.90	4.84	3.90	3.87	4.70	2.12	2.01
Thallium		0.003		-	<0.001	<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.001	<0.002	<0.002	<0.002	<0.001	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020	<0.0010	<0.0020	<0.0010	<0.0020	<0.0020	<0.0010	<0.0010
Tin				-	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium		1		-	<0.01	<0.01	<0.01	<0.01	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		-	0.0013	<0.002	<0.002	<0.002	<0.002	-	<0.002	<0.001	<0.002	<0.002	<0.002	<0.001	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020	<0.0010	<0.0020	<0.0010	<0.0020	<0.0020	<0.0010	<0.0010
Vanadium				-	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc	**0.2**	0.075-2.4	H	-	<0.005	<0.05	<0.05	<0.05	<0.005	-	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.0050	<0.0050	0.0074	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0065	<0.0050	<0.0050
Nutrients and Organic Parameters																												
Nitrate Nitrogen		400		-	0.147	<0.1	0.07	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.2	<0.1	<0.1	<0.1	<0.10	<1.0	<1.0	<1.0	<1.0	<0.050	<0.050	0.065	<0.025	<0.025
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	-	0.011	<0.1	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.2	<0.1	<0.1	<0.1	<0.1	<1.0	<1.0	<1.0	<1.0	0.021	<0.010	0.0071	<0.0050	<0.0050
Nitrite/Nitrate Nitrogen		400		-	-	<0.005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	0.003	<0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	0.009	0.006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	1.2	1.2	2.1	1.0	-	1.7	1.0	1.1	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-6: MW00-5 Compilation of Groundwater Chemical Analyses - 2 South, 3 South Area

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	25-Oct-06	1-Feb-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	23-Jul-08	3-Oct-08	3-Feb-09	3-Feb-09	2-Apr-09	16-Jul-09	20-Oct-09	19-Mar-10	19-Mar-10	6-May-10	13-Jul-10	4-Nov-10	26-Jan-11	12-Jul-11	12-Jul-11	3-Nov-11	12-Jan-12
Sample Control Number				0571-05	0615-04	1330-03	1326-02	17225-02	17284-02	0955-03	0919-02	0850-02	0788-02	0788-03	0796-02	0853-02	3S-MW00-5	21455-02	21455-03	21436-06	21952-03	21760-03	0101-02	0552-02	0154-02	0188-03	0341-05
QA-QC														field replicate			(QCC)		field replicate								
Physical Tests																											
Hardness $CaCO_3$				440	1,100	1,310	713	1,050	1,230	889	582	464	965	968	1,110	959	591	1,100	1,100	969	883	707	1,080	991	602	749	966
Field pH	**6.0-8.5**			6.91	7.40	6.88	7.36	7.06	6.93	7.01	6.98	7.03	6.86	6.86	7.24	7.15	6.89	6.91	6.91	6.87	6.99	6.69	6.58	6.92	7.03	6.56	7.07
Field Temperature (^oC)				8.8	8.9	9.1	11.3	8.9	7.8	10.4	9.89	11.1		8.54	9.76	10.5	9.21	8.43	8.43	399	10.09	9.47	8.47	8.93	9.93	8.76	8.55
Field Conductivity (µS/cm)				1,818	2,690	3,550	2,950	3,390	2,420	3,280	3,160	3,000		3,674	3,408	3,350	3,162	3,823	3,823	2,604	2,329	2,303	2,253	2,421	1,971	2,355	3,425
Field Alkalinity - Total $CaCO_3$				256	278	291	-	-	315	257	287	249	405	405	-	327	-	-	-	949	-	-	-	300	309	265.5	376.8
Dissolved Anions																											
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	24.0	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	293	317	-	-	-	-	293	-	310	-	331	363	360	-	339	337	348	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	-	-	293	-	-	-	-	-	293	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.25	<0.25	<0.25	<0.25	<1.0	<2.5	<0.50	<0.050	<0.50	<5.0	<5.0	<1.3	<2.5	<1.0	<10	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloride		1500		<2.5	<2.5	1.47	<2.5	1.9	9.4	1.6	2.12	4.9	1.71	1.73	1.09	14.2	<10	8.2	7.9	4.6	2.9	3.2	2.2	3.9	2.4	<2.0	2.0
Fluoride		2-3	H	0.33	0.22	0.32	0.15	<0.40	<1.0	0.27	0.267	<0.20	0.210	0.233	<0.50	0.231	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Sulphate		1000		1,210	1,900	1,860	1,380	1,700	1,810	1,590	1,300	1,340	1,790	1,830	1,790	1,670	1,450	2,030	2,030	1,850	1,640	1,560	1,840	1,840	1,510	1,750	1,830
Dissolved Metals																											
Aluminum	**0.5**			<0.10	<0.050	<0.050	0.063	<0.050	<0.050	<0.050	<0.10	<0.050	<0.050	<0.050	<0.025	<0.025	<0.10	<0.050	<0.050	<0.025	<0.050	<0.050	<0.025	<0.050	<0.025	<0.050	<0.050
Antimony		0.2		<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0050	<0.0050	<0.0050	<0.0025	<0.0050	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0050
Arsenic		0.05		<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.010	<0.0050	<0.0050	<0.0025	<0.0050	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0050
Barium		10		<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.029	0.028	0.027	<0.020	0.020	0.024	0.020	0.033	0.029	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		3.10	1.50	1.70	2.67	2.25	1.89	2.17	2.91	3.22	2.37	2.45	2.00	2.17	3.01	2.23	2.25	2.17	2.30	2.79	2.14	1.95	2.99	2.84	2.19
Cadmium		0.0001-0.0006	H	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00017	<0.00017	<0.00017	<0.000085	<0.000085	<0.00050	<0.00017	<0.00017	<0.000085	<0.00017	<0.00017	<0.000085	<0.00017	<0.000085	<0.00017	<0.00017
Calcium				155	380	451	249	360	421	306	203	162	332	332	379	328	205	378	378	331	304	246	373	342	209	261	333
Chromium		0.01^{VI}, 0.09^{III}	V	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010
Cobalt		0.04		<0.0050	0.0054	<0.0025	0.0028	0.0033	0.0041	<0.0025	<0.0050	<0.0030	<0.0030	<0.0030	<0.0015	0.0028	<0.0050	<0.0030	<0.0030	0.0023	<0.0030	<0.0030	<0.0015	<0.0030	0.0017	<0.0030	<0.0030
Copper	**0.02**	0.02-0.09	H	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	0.0064	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.0060	<0.0050	<0.010	<0.010	<0.010	<0.0060	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010
Iron	**0.5**			0.496	0.176	<030	0.114	0.106	0.078	0.165	0.491	0.485	0.171	0.17	0.288	**0.549**	**0.602**	**0.660**	**0.658**	**1.37**	**1.39**	0.173	0.066	0.145	0.422	**0.605**	<0.030
Lead	**0.05**	0.04-0.16	H	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.010	<0.0050	<0.0050	<0.0025	<0.0050	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0050
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.035	<0.025	<0.050	<0.050	<0.050	<0.025	<0.050	<0.050	<0.025	<0.050	<0.025	<0.050	<0.050
Magnesium				13.0	37.3	45.3	22.0	36.2	44.3	30	18.4	14.3	32.8	33.9	41.0	34.0	19.1	37.4	38.0	34.4	30.0	22.4	36.9	33.1	19.1	24.0	32.7
Manganese				0.149	0.288	0.044	0.175	0.192	0.152	0.102	0.144	0.17	0.219	0.21	0.039	0.177	0.136	0.258	0.252	0.212	0.188	0.0934	0.0267	0.158	0.179	0.212	0.0144
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010
Nickel		0.25-1.5	H	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.050	<0.010	<0.010	<0.010	0.0086	0.0065	<0.050	<0.010	<0.010	0.0056	<0.010	<0.010	0.0054	<0.010	<0.0050	<0.010	<0.010
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	<0.030	<0.30	*<0.30*	*<0.050*	*<0.30*
Potassium				2.8	4.1	6.0	4.2	4.8	5.9	4.6	3.7	3.2	4.5	4.5	5.0	4.3	3.9	4.7	4.8	4.5	4.3	3.9	4.8	4.5	3.8	4.1	4.1
Selenium		0.01		<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.010	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010
Silicon				2.64	2.00	2.53	2.62	2.76	2.68	2.49	2.87	2.94	2.67	2.69	2.42	2.66	2.91	2.75	2.75	2.82	2.83	2.97	2.72	2.45	2.77	2.75	2.33
Silver		0.0005-0.015	H	<0.00050	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00050	<0.00020	<0.00020	<0.00010	<0.00020	<0.00020	<0.00010	<0.00020	<0.00010	<0.00020	<0.00020
Sodium				447	414	459	507	476	497	458	518	538	558	563	445	501	548	538	544	536	508	519	469	488	587	589	472
Strontium				1.65	4.48	5.36	2.76	4.23	5.21	3.85	2.46	2.02	3.97	4.01	4.61	3.93	2.57	4.28	4.31	4.54	3.32	2.83	4.13	3.93	2.60	3.14	3.81
Thallium		0.003		<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020	<0.0020	<0.0010	<0.0020	<0.0010	<0.0020	<0.0020
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.030	<0.0050	<0.0050	<0.0025	<0.0050	<0.0050	<0.0025	<0.0050	<0.0025	<0.0050	<0.0050
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010	0.014	<0.050	<0.010	<0.010	<0.010	<0.010	0.014	0.015	<0.010	<0.010	<0.010	<0.010
Uranium		3		<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	<0.0010	<0.0020	<0.0020	<0.0020	<0.0010	<0.0020	<0.0020	<0.0010	<0.0020	<0.0010	<0.0020	<0.0020
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.010	<0.010	<0.010	<0.0050	<0.0050	<0.030	<0.010	<0.010	<0.0050	<0.010	<0.010	<0.0050	<0.010	<0.0050	<0.010	<0.010
Zinc	**0.2**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0062	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																											
Nitrate Nitrogen		400		<0.0050	<0.025	0.132	<0.025	<0.10	<0.25	<0.050	<0.0050	<0.050	<0.50	<0.50	0.16	<0.25	-	<0.10	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	0.18
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	<0.0050	<0.0050	<0.0050	0.0108	0.02	<0.050	0.028	<0.0010	<0.010	<0.10	<0.10	<0.025	0.104	-	<0.020	<0.020	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.033
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	<0.10	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.
2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments u 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-7: MW00-6S Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	-	24-Nov-00	19-Sep-01	11-Dec-01	21-Mar-02	19-Jul-02	9-Oct-02	16-Jan-03	17-Apr-03	17-Apr-03	22-Jul-03	16-Oct-03	22-Jan-04	14-Apr-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Jan-05	20-Apr-05	28-Jul-05	13-Oct-05	25-Jan-06	28-Apr-06	19-Jul-06
Sample Control Number				-	6227-03	5143-04	6719-06	6739-03	6767-08	6798-12	7252-07	7286-07	7286-08	9301-05	9309-08	9327-07	8688-06	8708-08	8932-06	0008-05	0008-06	0040-05	0120-05	1037-09	1163-05	1068-05	1500-07
QA-QC				no data									field replicate								field replicate							
Physical Tests																											
Hardness $CaCO_3$				-	694	357	522	660	715	711	729	686	762	663	704	738	716	624	700	746	760	611	719	832	742	762	665
Field pH	**6.0-8.5**			-	7.25	7.21	7.84	7.67	7.43	7.57	6.87	7.53	7.53	7.50	7.36	7.59	7.34	7.42	7.09	6.68	6.68	7.13	7.10	7.08	7.3	7.14	7.39
Field Temperature (^oC)				-	11	11.4	9.1	8.7	12.2	10.9	9	-	-	12.6	9.6	8.8	-	10.2	11.7	9.9	9.9	10	7.1	10.1	9.8	10	11.6
Field Conductivity (µS/cm)				-	2,300	1,540	1,877	2,250	1,917	2,040	1,990	2,140	2,140	2,030	2,400	2,040	-	1,890	2,290	2,230	2,230	2,210	2,080	2,370	2,090	2,110	2,060
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	249	244	259	268	278	260	260	276	291	273	293	277	258
Dissolved Anions																											
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	209	131	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	209	131	164	220	247	243	270	256	259	241	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				-	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.25	<0.25
Chloride		1500		-	8.8	7.1	15.2	13.9	8	10.7	14.8	12.3	12	8.6	10	13.1	9.84	7.77	6.8	6.5	6.6	6.2	4.80	<5.0	3.22	3.61	3.4
Fluoride		2-3	H	-	0.15	<0.02	0.03	<0.02	0.06	<0.02	0.08	0.08	0.08	0.12	0.07	0.08	0.054	0.052	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.10	<0.10
Sulphate		1000		-	688	714	937	1,020	979	980	1,010	1,010	973	903	941	1,030	920	970	995	878	997	877	959	1,020	928	958	915
Dissolved Metals																											
Aluminum	**0.5**			-	<0.05	0.1	<0.1	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	0.075	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050
Antimony		0.2		-	<0.2	<0.1	<0.1	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025
Arsenic		0.05		-	<0.2	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Barium		10		-	0.15	0.05	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.046	0.046	0.038	0.042	0.043	0.039	0.038	0.040	0.043	0.037	0.042	0.033
Beryllium		0.053		-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				-	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		-	0.4	0.2	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.4	0.39	0.38	0.35	0.29	0.41	0.43	0.34	0.36	0.39	0.37	0.37	0.32
Cadmium		0.0001-0.0006	H	-	*<0.002*	*<0.002*	*<0.002*	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00050	<0.00025
Calcium				-	227	124	182	229	246	245	246	233	259	224	241	251	243	210	236	256	265	203	242	283	248	255	221
Chromium		0.01^{VI}, 0.09^{III}	V	-	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025
Cobalt		0.04		-	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0089	0.0146	0.0087	0.0130	<0.0025	0.0032	0.0094	<0.0025	0.0068	0.0071	<0.0050	<0.0025
Copper	**0.02**	0.02-0.09	H	-	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Iron	**0.3**			-	<0.03	0.09	<0.03	0.08	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	0.035	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.042	<0.030
Lead	**0.05**	0.04-0.16	H	-	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Lithium				-	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium				-	31	11.8	16.1	21.3	24.2	24.1	27.8	25.4	27.9	24.8	24.8	26.8	26.4	23.9	26.7	25.9	23.8	25.2	27.9	30.5	29.8	30.5	27.2
Manganese				-	0.571	0.16	0.29	0.48	0.38	0.25	0.63	0.18	0.22	0.32	0.12	0.405	0.45	0.173	0.405	0.135	0.167	0.211	0.297	0.480	0.238	0.339	0.530
Mercury		0.001		-	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum		10		-	0.03	0.04	0.04	0.039	0.036	0.041	0.051	0.041	0.042	0.049	0.052	0.0555	0.0511	0.041	0.0481	0.0367	0.0363	0.0378	0.0363	0.0397	0.0359	0.033	0.0369
Nickel		0.25-1.5	H	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025
Phosphorus	**0.03**			-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				-	7	3	3	4	3	3	4	4	4	3	3	3	2.6	3.1	2.8	3.6	3.3	2.7	2.5	2.6	3.5	3.6	2.3
Selenium		0.01		-	<0.01	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050
Silicon				-	4.20	4.43	4.43	4.98	4.98	4.96	5.37	5.07	5.55	4.92	5.39	5.67	5.79	5.17	5.23	5.17	5.35	5.19	4.98	5.77	5.48	5.42	4.93
Silver		0.0005-0.015	H	-	*<0.001*	0.0001	*<0.001*	*<0.0003*	*<0.0003*	*<0.01*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.0003*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00050*	*<0.00025*
Sodium				-	321	243	232	250	249	242	282	244	264	223	246	272	253	226	254	254	227	174	191	217	215	229	191
Strontium				-	1.24	0.798	1.15	1.48	1.49	1.41	1.57	1.44	1.59	1.33	1.49	1.42	1.45	1.28	1.40	1.39	1.27	1.18	1.12	1.38	1.31	1.45	1.09
Thallium		0.003		-	<0.001	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010
Tin				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium		1		-	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		-	0.0156	0.007	0.010	0.012	0.012	0.01	0.01	0.009	0.009	0.009	0.009	0.0083	0.0078	0.0076	0.0086	0.0091	0.0087	0.0086	0.0079	0.0090	0.0093	0.0093	0.0078
Vanadium				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc	**0.1**	0.075-2.4	H	-	<0.005	<0.05	<0.05	<0.005	0.033	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																											
Nitrate Nitrogen		400		-	0.213	<0.1	0.494	0.236	0.215	0.488	0.241	0.216	0.286	0.3	0.2	0.23	0.13	0.17	<1.0	<1.0	<1.0	<1.0	<1.0	0.130	0.235	0.127	0.070
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	-	0.007	<0.1	0.011	0.02	0.011	0.007	0.018	0.006	0.002	<0.1	<0.1	<0.1	<0.10	<0.10	<1.0	<1.0	<1.0	<1.0	<1.0	0.013	<0.010	0.0091	0.0119
Nitrite/Nitrate Nitrogen		400		-	-	0.035	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	0.056	0.045	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	0.196	0.096	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	7.4	6.6	4.3	4.5	3.8	3.8	3.4	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-7: MW00-6S Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	25-Oct-06	1-Feb-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	24-Jul-08	3-Oct-08	3-Feb-09	3-Apr-09	16-Jul-09	22-Oct-09	19-Mar-10	6-May-10	13-Jul-10	4-Nov-10	26-Jan-11	12-May-11	12-May-11	12-Jul-11	12-Jul-11	12-Jan-12
Sample Control Number				0571-06	0615-05	1330-06	1326-05	17225-06	17284-07	0955-05	0919-08	0850-06	0788-08	0796-08	0853-07	2N-00-6S	21455-07	21437-01	21952-06	21760-09	0101-04	0552-06	0552-07	0154-07	0188-07	0341-07
QA-QC																(QCC)						field replicate			
Physical Tests																										
Hardness $CaCO_3$				756	776	829	842	746	810	768	736	676	761	741	702	744	754	740	765	712	703	674	675	708	695	655
Field pH	**6.0-8.5**			6.38	7.81	7.28	7.32	7.48	7.43	7.64	7.18	7.19	7.54	7.21	8.19	7.62	7.72	7.33	7.26	7.48	6.76	7.43	7.43	7.44	6.36	7.33
Field Temperature (^oC)				9.9	6.6	8.8	11.7	9.9	8.1	9	10.21	12.2	7.29	7.73	9.8	9.09	9.64	9.11	11.61	10.39	9.01	8.80	8.80	12.09	8.99	8.62
Field Conductivity (µS/cm)				1,449	1,693	2,110	2,010	2,070	1,403	1,921	2,057	1,955	1,743	1,898	1,869	2,580	1,907	1,481	1,411	1,461	1,254	1,291	1,291	1,318	1,336	1,803
Field Alkalinity - Total $CaCO_3$				297	290	309	-	-	253	242	241	212	333	-	297	-	-	237	-	-	-	237	237	291	300	282.3
Dissolved Anions																										
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	14.3	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	272	269	-	-	-	-	-	262	-	261	244	-	272	274	264	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	-	-	272	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.050	<0.050	<0.25	<0.050	<0.50	<0.050	<0.050	<0.050	<0.50	<5.0	<0.50	<0.50	<1.0	<4.3	<1.0	<0.50	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloride		1500		3.04	3.58	3.3	2.78	2.99	2.81	2.64	2.69	2.37	2.73	2.84	5.0	<10	6.7	8.7	5.3	8.1	7.1	9.0	8.40	7.9	6.9	6.3
Fluoride		2-3	H	0.041	0.036	0.31	0.033	<0.20	0.034	0.033	0.04	<0.20	3.6	<0.20	<0.20	<0.40	<0.20	<0.40	<0.20	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Sulphate		1000		887	969	952	896	943	892	866	849	902	898	863	849	945	869	950	931	886	848	911	876	961	891	817
Dissolved Metals																										
Aluminum	**0.5**			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Antimony		0.2		<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Arsenic		0.05		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Barium		10		0.041	0.041	0.038	0.039	0.025	0.04	0.037	0.035	0.033	0.043	0.047	0.031	0.040	0.043	0.047	0.045	0.033	0.034	0.032	0.032	0.037	0.033	0.037
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		0.38	0.38	0.38	0.35	0.32	0.37	0.34	0.34	0.31	0.33	0.31	0.31	0.34	0.33	0.36	0.34	0.34	0.35	0.31	0.32	0.34	0.34	0.30
Cadmium		0.0001-0.0006	H	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.000128	0.000122	0.000132	0.000259	<0.00025	0.000088	0.000135	0.000085	0.000096	0.000113	0.000117	0.000131	0.000179	0.000089	<0.000085
Calcium				251	259	277	282	251	271	258	245	226	252	249	234	244	251	242	254	237	234	227	227	237	234	223
Chromium		0.01^{VI}, 0.09^{III}	V	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cobalt		0.04		0.0032	<0.0025	<0.0025	0.0111	<0.0025	<0.0025	0.0059	<0.0025	<0.0015	<0.0015	<0.0015	<0.0015	<0.0025	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015
Copper	**0.02**	0.02-0.09	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Iron	**0.3**			<0.030	<0.030	<0.030	<0.030	<0.030	0.047	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.050	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0050	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.096	<0.025	<0.025	<0.025	<0.025	<0.050	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Magnesium				31.3	31.7	33.4	33.6	29.3	32.5	30.1	30.5	27.1	31.7	28.9	28.5	32.9	31.0	33.0	31.7	28.9	28.8	26.1	26.2	28.2	26.8	24.1
Manganese				0.551	0.623	0.398	0.363	0.182	0.117	0.165	0.33	0.235	0.476	0.216	0.269	0.606	0.479	0.693	0.158	0.278	0.377	0.148	0.113	0.329	0.219	0.192
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		0.0339	0.0335	0.0282	0.0310	0.0307	0.0296	0.0294	0.0331	0.0343	0.033	0.0304	0.0288	0.0303	0.0255	0.0269	0.0208	0.0248	0.0255	0.0270	0.0261	0.0260	0.0270	0.0265
Nickel		0.25-1.5	H	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	**0.047**	*<0.30*	*<0.30*	*<0.30*	**0.051**	*<0.30*
Potassium				2.9	3.1	3.4	3.5	3.2	3.6	3.3	3.3	3.1	3.2	3.0	2.9	3.5	3.3	3.5	3.1	3.1	3.2	2.9	2.9	3.2	3.1	2.8
Selenium		0.01		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silicon				5.65	5.27	5.99	5.53	5.77	6.15	5.92	5.89	5.7	5.78	5.60	5.61	5.79	5.93	6.18	6.12	6.17	5.94	5.72	5.65	5.80	5.75	5.16
Silver		0.0005-0.015	H	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	*<0.00025*	<0.00025	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00025	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium				215	203	220	237	205	238	216	218	206	215	207	205	218	212	241	214	195	200	209	205	229	213	192
Strontium				1.30	1.25	1.41	1.43	1.29	1.45	1.35	1.37	1.27	1.38	1.32	1.27	1.40	1.35	1.38	1.40	1.34	1.32	1.26	1.27	1.37	1.30	1.19
Thallium		0.003		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.030	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	0.013	<0.050	<0.010	<0.010	<0.010	0.014	0.014	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium		3		0.0087	0.0090	0.0076	0.0080	0.008	0.0074	0.0072	0.0067	0.0077	0.0075	0.0084	0.0081	0.0074	0.0075	0.0076	0.0073	0.0074	0.0071	0.0071	0.0069	0.0076	0.0079	0.0089
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Zinc	**0.1**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	0.0095	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																										
Nitrate Nitrogen		400		0.0959	0.0996	0.183	0.178	0.13	0.0876	0.0659	0.0701	0.119	<0.50	0.226	0.151	-	0.249	<0.10	0.237	0.19	0.20	<0.10	<0.10	<0.10	0.35	0.39
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	0.0084	0.0050	0.0083	<0.0010	0.018	<0.0010	0.0012	0.003	<0.010	<0.10	<0.010	<0.010	-	<0.010	<0.020	<0.010	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.026
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	<0.10	-	-	-	-	-	-	-	-		-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendment Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwat

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-8: MW00-6D Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	-	24-Nov-00	19-Sep-01	11-Dec-01	21-Mar-02	19-Jul-02	9-Oct-02	16-Jan-03	17-Apr-03	22-Jul-03	22-Jul-03	16-Oct-03	22-Jan-04	14-Apr-04	22-Jul-04	14-Oct-04	20-Jan-05	20-Apr-05	28-Jul-05	28-Jul-05	13-Oct-05	25-Jan-06	25-Jan-06	28-Apr-06
Sample Control Number				-	6227-02	5143-05	6719-07	6739-04	6767-11	6798-13	7252-08	7286-09	9301-06	9301-07	9309-09	9327-11	8688-07	8708-10	8932-07	0008-07	0040-08	0120-06	0120-07	1037-11	1163-07	1163-08	1068-06
QA-QC				no data										field replicate									field replicate			field replicate	
Physical Tests																											
Hardness $CaCO_3$				-	253	102	81.7	81.5	68.8	76.7	46.7	92.1	86	81	64	94	113	110	68	125	64.3	101	108	63.6	95.9	103	105
Field pH	**6.0-8.5**			-	7.95	8.45	7.96	8.04	6.51	**8.59**	8.00	**8.65***	**8.56**	**8.56**	**8.76**	**8.61**	8.36	8.46	8.06	7.71	8.41	7.48	7.48	7.54	8.5	8.5	**9.3**
Field Temperature (^oC)				-	10.2	11.5		9.1	10.5	10.4	9.5	-	11.5	11.5	9	8.6	-	11.3	10.2	9.3	9.8	11.1	11.1	10	9.3	9.3	9.3
Field Conductivity (µS/cm)				-	703	309	300	262	313	282	262	382	338	338	266	351	-	327	330	459	257	317	317	265	376	376	369
Field Alkalinity - Total $CaCO_3$				-	-	-	-	-	-	-	-	-	-	-	81	68	83	91	93	95	99	89	89	87	97	97	86
Dissolved Anions																											
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	88	89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	88	89	80	83	82	84	78	88	92	89	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				-	<0.5	<0.5	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride		1500		-	4	2.4	1.3	1.6	1.1	1.1	0.6	1	1	0.8	0.8	1.25	1.12	0.93	0.69	0.89	0.54	0.83	0.81	0.55	0.63	0.61	0.67
Fluoride		2-3	H	-	0	0.15	0.16	0.1	0.12	0.11	0.12	0.12	0.12	0.12	0.12	0.116	0.103	0.103	0.109	0.080	0.114	0.085	0.085	0.112	0.080	0.084	0.106
Sulphate		1000		-	293	115	58	66	55	53	21	67	67	49	36	72.7	92.7	78.2	47.4	114	37.6	81.5	83.9	31.0	103	96.0	76.1
Dissolved Metals																											
Aluminum	**0.5**			-	**8.7**	**0.7**	0.2	0.07	0.06	0.08	0.09	0.13	0.04	0.06	0.02	0.057	0.221	<0.065	0.048	0.052	0.075	0.035	0.078	0.291	0.431	0.461	0.072
Antimony		0.2		-	<0.2	<0.1	<0.1	0.0006	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	0.00085	<0.00050	<0.00050	<0.0010	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic		0.05		-	<0.2	<0.01	<0.01	0.015	0.018	0.018	0.023	0.02	0.02	0.021	0.024	0.0203	0.0208	0.0226	0.0241	0.0191	0.0235	0.0199	0.0196	0.0262	0.0240	0.0235	0.0201
Barium		10		-	0.14	0.04	0.02	0.02	0.02	<0.02	<0.02	0.02	0.02	<0.02	<0.02	0.021	0.032	0.024	<0.020	0.032	<0.020	0.024	0.026	<0.020	0.024	0.026	0.023
Beryllium		0.053		-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth				-	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium		0.0001-0.0006	H	-	*<0.001*	*<0.002*	*<0.002*	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Calcium				-	89.1	37.5	30.4	30.5	25.9	28.9	17.6	34.5	32.3	30.3	24.1	35.2	42.4	41.1	25.7	46.6	24.0	37.8	40.3	23.9	35.7	38.5	39.4
Chromium		0.01[VI], 0.09[III]	V	-	<0.01	<0.01	<0.01	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt		0.04		-	<0.01	<0.01	<0.01	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00367	0.00624	0.0044	0.00431	<0.0010	0.0105	<0.00050	0.00828	0.00718	<0.00050	0.00180	0.00322
Copper	**0.02**	0.02-0.09	H	-	**0.02**	<0.01	<0.01	0.003	0.002	0.002	0.002	0.002	<0.001	0.001	0.001	0.0011	0.0027	0.0012	0.0012	<0.0020	0.0011	<0.0010	0.0012	0.0021	0.0023	0.0023	0.0011
Iron	**0.3**			-	**5.2**	**0.6**	0.11	0.05	0.04	0.06	0.07	0.09	<0.03	<0.03	<0.03	<0.030	0.189	0.034	<0.030	0.032	0.061	<0.030	0.059	0.269	**0.322**	**0.306**	0.079
Lead	**0.05**	0.04-0.16	H	-	<0.005	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium				-	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium				-	7.5	1.9	1.4	1.3	1	1.1	0.7	1.4	1.3	1.2	0.9	1.44	1.8	1.74	0.99	2.16	1.08	1.61	1.77	0.98	1.66	1.78	1.70
Manganese				-	0.229	0.04	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	0.015	<0.010	<0.010	<0.010	0.017	<0.010	0.014	0.018	<0.010	0.011	<0.010
Mercury		0.001		-	<0.00005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum		10		-	<0.03	0.07	0.05	0.043	0.028	0.023	0.008	0.019	0.016	0.016	0.01	0.014	0.0152	0.0121	0.0072	0.0134	0.0062	0.0094	0.0096	0.0054	0.0082	0.0089	0.0100
Nickel		0.25-1.5	H	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus	**0.03**			-	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*
Potassium				-	3	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium		0.01		-	<0.005	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon				-	9.75	4.07	3.52	3.66	3.36	3.67	3.25	3.69	3.26	3.25	3.34	3.44	3.81	3.87	3.18	3.07	3.30	3.01	3.18	3.70	3.85	3.87	3.27
Silver		0.0005-0.015	H	-	<0.0005	<0.0001	*<0.001*	<0.00005	<0.00005	*<0.01*	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium				-	74	49	41	42	33	35	24	38	34	33	27	36.6	38.9	38.6	26.5	41.9	26.8	33.1	35.0	24.2	31.3	32.9	37.1
Strontium				-	0.388	0.185	0.150	0.156	0.12	0.131	0.091	0.168	0.155	0.148	0.119	0.164	0.209	0.204	0.126	0.270	0.126	0.168	0.179	0.114	0.170	0.184	0.194
Thallium		0.003		-	<0.0005	<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium		1		-	0.21	0.03	0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium		3		-	0.00302	0.003	<0.002	0.0015	0.0014	0.0013	0.0012	0.0014	0.0014	0.0014	0.001	0.0013	0.0014	0.00131	0.00110	0.00150	0.00110	0.00131	0.00136	0.00101	0.00121	0.00126	0.00128
Vanadium				-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc	**0.1**	0.075-2.4	H	-	0.013	<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																											
Nitrate Nitrogen		400		-	0.103	<0.1	0.026	0.066	0.049	0.063	0.07	0.062	<0.1	<0.1	<0.1	<0.1	<0.1	0.17	<0.1	<0.10	<0.10	<0.10	<0.10	0.0719	0.0702	0.0736	0.0349
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	-	0.003	<0.1	0.002	0.004	0.005	0.004	0.004	0.002	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.1	<0.10	<0.10	<0.10	<0.10	0.0031	0.0032	0.0030	0.0030
Nitrite/Nitrate Nitrogen		400		-	-	0.028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	0.153	0.162	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	0.27	0.465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	2.3	1.7	1.4	1.8	1.3	1.2	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwater)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Table III-8: MW00-6D Compilation of Groundwater Chemical Analyses - Quinsam Mine

Date Sampled	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	19-Jul-06	25-Oct-06	1-Feb-07	25-Apr-07	5-Jul-07	7-Nov-07	24-Jan-08	23-Apr-08	23-Jul-08	3-Oct-08	3-Feb-09	3-Apr-09	16-Jul-09	22-Oct-09	22-Oct-09	19-Mar-10	6-May-10	13-Jul-10	4-Nov-10	26-Jan-11	12-May-11	12-Jul-11	3-Nov-11	12-Jan-12
Sample Control Number				1500-06	0571-04	0615-07	1330-08	1326-06	17225-07	17284-08	0955-08	0919-06	0850-08	0788-07	0796-09	0853-08	2N-00-6D	GW221009	21455-06	21437-02	21952-07	21760-08	0101-08	0552-08	0154-08	0188-08	0341-08
QA-QC																	(QCC)	field replicate								
Physical Tests																										
Hardness $CaCO_3$				73.1	75.2	108	67.9	121	66.9	137	67.2	101	94.2	98	129	102	124	126	120	116	102	99.6	102	58.6	90.4	131	79.0
Field pH	**6.0-8.5**			**8.6**	7.98	8.33	8.41	8.34	**8.77**	8.02	**8.75**	**8.56**	**8.54**	8.11	7.96	**9.11**	**8.91**	**8.91**	**8.59**	**8.63**	**9.31**	8.12	7.61	**8.71**	8.46	7.72	**8.60**
Field Temperature (^{o}C)				14	8.9	8.2	9.3	11.4	8.6	7.1	8.7	9.4	9.4	6.52	8.19	10.1	8.73	8.73	9.04	9.47	10.68	9.45	8.37	9.41	9.89	7.96	7.66
Field Conductivity (µS/cm)				287	176	280	268	263	232	282	244	340	345	241	394	301	334	334	379	226	217	236	213	217	186	254	262
Field Alkalinity - Total $CaCO_3$				79	94	-	85	-	-	103	78	95	-	123	-	108	-	-	-	87	-	-	-	90	102	120	175.5
Dissolved Anions																										
Acidity (mg/L as $CaCO_3$)				-	-	-	-	-	-	-	-	-	-	-	-	-	<1.0	<1.0	-	-	-	-	-	-	-	-
Alkalinity - Total $CaCO_3$				-	-	-	-	109	84.3	-	-	-	100	-	108	-	108	104	107	-	102	104	98.1	-	-	-	-
Alkalinity - Bicarbonate $CaCO_3$				-	-	-	-	106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromide				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride		1500		0.62	0.59	0.65	0.53	0.58	0.504	0.607	0.42	0.57	0.49	0.5	0.68	0.61	0.94	0.95	1.13	0.83	0.74	0.99	0.75	<0.10	0.84	1.02	0.68
Fluoride		2-3	H	0.104	0.111	0.082	0.101	0.064	0.102	0.082	0.09	0.095	0.097	0.089	0.083	0.072	0.072	0.071	0.093	0.084	0.070	0.095	0.073	<0.020	0.101	0.094	0.106
Sulphate		1000		54.8	44.4	88.2	43.4	103	30	96.7	34.4	64.2	63.5	62.8	95.4	66.9	95.1	95.9	83.5	73.1	64.9	65.0	67.1	5.38	63.6	87.2	42.6
Dissolved Metals																										
Aluminum	**0.5**			0.102	0.056	0.036	0.075	<0.050	0.077	0.154	0.169	0.014	0.0126	0.0147	0.0133	0.0125	0.012	0.012	0.0108	0.012	0.0117	0.0157	0.0137	0.0173	0.0132	0.0118	0.0147
Antimony		0.2		<0.00050	<0.00050	<0.00050	<0.00050	<0.0025	<0.0025	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic		0.05		0.0192	0.0241	0.0220	0.0243	0.0220	0.0229	0.0219	0.0237	0.0229	0.0234	0.0218	0.023	0.0252	0.0197	0.0201	0.0215	0.0227	0.0233	0.0257	0.0259	0.0220	0.0272	0.0190	0.0245
Barium		10		<0.020	<0.020	0.025	<0.020	0.024	<0.020	0.03	<0.020	0.02	<0.020	0.024	0.031	0.020	0.030	0.030	0.028	0.027	0.024	0.021	0.021	<0.020	0.020	0.027	<0.020
Beryllium		0.053		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth				<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron		50		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium		0.0001-0.0006	H	<0.000050	<0.000050	<0.000050	<0.000050	<0.00025	<0.00025	<0.000050	<0.000050	<0.000050	0.000021	0.000020	0.000025	0.000053	<0.000050	<0.000050	0.000018	0.000018	0.000023	0.000036	0.000047	0.000022	0.000020	<0.000017	<0.000017
Calcium				27.3	28.1	40.3	25.5	45.3	25.1	50.7	25	37.8	35.2	36.8	48.2	38.4	46.0	46.8	44.7	43.4	38.2	37.2	38.3	21.9	33.9	48.7	29.7
Chromium		0.01^{VI}, 0.09^{III}	V	<0.00050	<0.00050	<0.00050	<0.00050	<0.0025	<0.0025	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt		0.04		0.00389	0.00448	<0.00050	<0.00050	<0.0025	<0.0025	0.00243	<0.00050	<0.00050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00050	<0.00050	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper	**0.02**	0.02-0.09	H	0.0016	0.0012	0.0013	0.0011	<0.0050	<0.0050	0.0012	0.0014	0.0023	0.0014	0.0040	0.0015	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	0.0010
Iron	**0.3**			0.087	0.057	<0.030	0.055	<0.030	0.048	0.148	0.108	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	**0.05**	0.04-0.16	H	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium				<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.050	<0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium				1.18	1.21	1.82	1.03	1.87	1.05	2.43	1.17	1.64	1.55	1.52	2.18	1.60	2.22	2.26	2.06	1.91	1.64	1.64	1.69	0.94	1.39	2.18	1.17
Manganese				<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.00030	<0.00030	<0.00030	<0.00030	<0.010	<0.010	<0.00030	0.00079	<0.00030	0.00041	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Mercury		0.001		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.000020	<0.000020	<0.000020	<0.000020	<0.00020	<0.00020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum		10		0.0120	0.0088	0.0121	0.0062	0.0092	0.0064	0.0098	0.0049	0.0082	0.0078	0.0082	0.0096	0.0077	0.0086	0.0088	0.0073	0.0066	0.0071	0.0071	0.0067	0.0051	0.0050	0.0102	0.0052
Nickel		0.25-1.5	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.025	<0.025	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus	**0.03**			*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	*<0.30*	**0.162**	*<0.30*	*<0.30*	**0.116**	*<0.30*
Potassium				<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium		0.01		<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon				3.33	3.32	3.14	3.42	3.33	3.53	4.04	3.54	3.54	3.52	3.52	3.56	3.47	3.53	3.51	3.56	3.65	3.56	3.61	3.54	3.24	3.59	3.73	3.40
Silver		0.0005-0.015	H	<0.000050	<0.000050	<0.000050	<0.000050	<0.00025	<0.00025	<0.000050	<0.000050	<0.000050	<0.000020	<0.000020	<0.000020	<0.000020	<0.000050	<0.000050	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium				30.3	31.0	40.8	26.1	36.3	25.9	41.2	24.7	32.2	31.6	32.2	38.2	33.5	39.0	39.1	36.0	36.9	32.0	34.0	33.4	26.6	32.1	42.1	27.8
Strontium				0.128	0.144	0.188	0.130	0.202	0.118	0.245	0.126	0.175	0.169	0.172	0.225	0.176	0.236	0.237	0.209	0.195	0.177	0.180	0.182	0.105	0.165	0.237	0.136
Thallium		0.003		<0.00020	<0.00020	<0.00020	<0.00020	<0.0010	<0.0010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.030	<0.030	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium		1		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010	<0.050	<0.050	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium		3		0.00110	0.00108	0.00136	0.00103	0.0014	0.0012	0.00144	0.00095	0.00128	0.00114	0.00112	0.00144	0.00131	0.00129	0.00128	0.00129	0.00119	0.00110	0.00111	0.00115	0.00105	0.00100	0.00129	0.00096
Vanadium				<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.005	0.0048	0.0052	0.0052	<0.030	<0.030	0.0047	0.0047	0.0046	0.0050	0.0051	0.0052	0.0043	0.0049	0.0050
Zinc	**0.1**	0.075-2.4	H	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0062	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nutrients and Organic Parameters																										
Nitrate Nitrogen		400		0.0358	0.0323	0.0418	0.0514	0.0527	0.0506	0.044	0.0769	0.0325	0.0481	0.0409	0.0374	0.0465	-	-	0.0451	0.0528	<0.0050	0.0455	0.0307	0.0075	0.0739	0.0542	0.0171
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	<0.0010	0.0046	0.0031	0.0108	<0.0010	0.0036	0.001	0.0035	<0.0010	<0.0010	0.0012	<0.0010	0.0039	-	-	0.0014	0.0018	<0.0010	<0.0010	0.0022	<0.0010	0.0013	0.0024	0.0012
Nitrite/Nitrate Nitrogen		400		-	-	-	-	-	-	-	-	-	-	-	-	-	0.0363	0.0379	-	-	-	-	-	-	-	-	-
Total Dissolved Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phosphate				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon C				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendmen Reg. 97/2011, May 31, 2011). Standards used are from Schedule 6 for Aquatic Life (Freshwate

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2009)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant
(QCC) indictaes that Quinsam personnel collected the groundwater sample.

Date Sampled **Sample Control Number**	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	17-Oct-03 9310-12	23-Jan-04 9329-02
Physical Tests					
Hardness $CaCO_3$				340	161
Field pH	**6.0-8.5**			7.02	8.18
Field Alkalinity - Total $CaCO_3$				-	90
Dissolved Anions					
Alkalinity - Total $CaCO_3$				-	-
Alkalinity - Bicarbonate $CaCO_3$				-	-
Bromide				<0.05	<0.050
Chloride		1500		0.5	0.52
Fluoride		2-3	H	0.02	0.028
Sulphate		1000		111	102
Dissolved Metals					
Aluminum	**0.5**			<0.02	<0.010
Antimony		0.2		<0.001	<0.00050
Arsenic		0.05		0.005	<0.0010
Barium		10		0.08	0.036
Beryllium		0.053		<0.005	<0.0050
Bismuth				<0.2	<0.20
Boron		50		0.1	<0.10
Cadmium		0.0001-0.0006	H	<0.0001	<0.000050
Calcium				122	56.1
Chromium		0.01^{VI}, 0.09^{III}	V	<0.001	<0.00050
Cobalt		0.04		<0.001	0.0105
Copper	**0.02**	0.02-0.09	H	<0.002	<0.0010
Iron	**0.3**			0.16	<0.030
Lead	**0.05**	0.04-0.16	H	<0.002	<0.0010
Lithium				<0.05	<0.050
Magnesium				8.3	5.03
Manganese				0.1	0.109
Mercury		0.001		<0.0002	<0.00020
Molybdenum		10		<0.002	<0.0010
Nickel		0.25-1.5	H	<0.01	<0.0050
Phosphorus	**0.03**			*<0.3*	*<0.30*
Potassium				<2	<2.0
Selenium		0.01		<0.002	<0.0010
Silicon				6.45	4.37
Silver		0.0005-0.015	H	<0.0001	<0.000050
Sodium				29	16.6
Strontium				1.15	0.489
Thallium		0.003		<0.0004	<0.00020
Tin				<0.03	<0.030
Titanium		1		<0.05	<0.050
Uranium		3		<0.0004	<0.00020
Vanadium	**0.1**			<0.03	<0.030
Zinc		0.075-2.4	H	<0.005	<0.0050
Nutrients					
Nitrate Nitrogen		400		<0.1	0.27
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	<0.1	<0.1

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 286/2010, October 4, 2010)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2007)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant

Table III-10
Baseline Groundwater Chemical Analyses, Drillholes 77-30 and 78-198C, Quinsam Mine

Date Sampled **Sample Control Number**	BC MoE Permit PE-07008[1]	CSR Freshwater Aquatic Life[2]	Notes	10-Jun-82 77-30	10-Jun-82 78-198C
Physical Tests					
pH	**6.0-8.5**			8.4	8.1
Field Conductivity (µS/cm)				446	307
Color				10	40
Turbidity				30	36
Hardness				16.8	146
Solids					
Total Suspended				111	47
Total Dissolved				356	260
Dissolved Anions					
Alkalinity - Bicarbonate ($CaCO_3$)				230	177
Alkalinity - Carbonate ($CaCO_3$)				6.09	nil
Alkalinity - Hydroxide (OH)				nil	nil
Acidity to pH 8.5				<5	<5
Chloride		1500		9.35	<0.5
Sulphate		1000		2.5	10
Nitrate Nitrogen		400		<0.010	0.019
Nitrite Nitrogen		0.2 (Cl < 2 mg/L) 2 (Cl ≥ 10 mg/L)	Cl	0.002	0.001
Ortho-Phosphate				0.03	0.01
Fluoride		2-3	H	1.4	0.13
Dissolved Metals					
Aluminum	**0.5**			0.024	<0.005
Arsenic		0.05		0.009	0.014
Barium		10		0.034	0.033
Cadmium		0.0001-0.0006	H	*<0.001*	0.001
Calcium				6.17	51.2
Chromium		0.01^{VI}, 0.09^{III}	V	<0.03	<0.03
Cobalt		0.04		<0.005	<0.005
Copper	**0.02**	0.02-0.09	H	<0.001	0.02
Iron	**0.3**			0.034	0.035
Lead	**0.05**	0.04-0.16	H	<0.001	<0.001
Magnesium				0.33	4.42
Manganese				0.008	0.2
Mercury		0.001		<0.00005	<0.00005
Molybdenum		10		<0.005	<0.005
Nickel		0.25-1.5	H	<0.005	<0.005
Potassium				0.52	0.4
Silicon				3.76	11.1
Sodium				97.9	4.19
Titanium		1		0.008	0.01
Uranium		3		-	-
Zinc	**0.1**	0.075-2.4	H	<0.010	0.017
Pollutant Tests					
Ammonia Nitrogen				0.35	0.27

Reference:

1. BC Ministry of Environment permit PE-07008. Date issued: December 23, 1987, amended July 7, 2004.

2. British Columbia Contaminated Sites Regulation (CSR)(BC Reg 375/96 includes amendments up to B.C. Reg. 286/2010, October 4, 2010)

Notes:

All concentrations are in milligrams per litre (mg/L) unless otherwise noted.
< = Less than the detection limit indicated.
Shaded numbers exceed the CSR Aquatic Life Standard (2007)
Italics indicate the laboratory detection limit is set higher than the CSR standard.
* laboratory pH measurement.
H = standard is hardness dependant
V = standard is valence dependant
Cl = standard is chloride dependant

APPENDIX IV

Compilation of Historical Monitoring Well Groundwater Levels, Elevations, and Graphs

Date/Well No.	MW00-1S	MW00-1D	MW00-2	MW00-3	MW00-4	MW00-5	MW00-6S	MW00-6D	94-009	QU11-11
19-Apr-00	3.27	-	1.53	-	-	-	-	-	-	**Dewatering well**
25-Apr-00	1.61	17.04	1.58	38.67	-	-	-	-	-	-
24-Nov-00	1.82	14.16	-	38.79	41.00	45.12	5.73	2.26	-	-
25-Nov-00	-	-	2.03	-	-	-	-	-	-	-
18-Sep-01	1.90	14.36	1.90	39.47	41.66	35.64	0.91	0.83	-	-
10-Dec-01	1.42	14.11	1.28	37.27	39.38	34.36	0.69	0.33	-	-
11-Dec-01	1.43	14.12	1.33	37.24	39.37	34.34	6.55	3.36	-	-
20-Mar-02	1.44	13.82	1.42	37.29	39.45	34.38	0.72	0.37	-	-
21-Mar-02	1.51	16.02	1.42	37.33	39.49	34.44	6.55	3.13	-	-
18-Jul-02	1.93	14.09	1.75	39.03	41.06	35.49	1.00	0.65	-	-
19-Jul-02	1.92	16.21	1.75	39.03	41.04	38.23	6.74	4.05	-	-
8-Oct-02	2.03	14.35	1.16	39.78	41.82	35.77	1.09	0.87	-	-
9-Oct-02	2.05	16.44	2.13	39.79	41.83	38.19	6.57	3.86	-	-
15-Jan-03	1.34	13.97	1.48	37.27	39.52	34.36	0.63	0.29	-	-
16-Jan-03	1.48	15.91	1.48	37.31	39.57	34.37	7.03	2.58	-	-
16-Apr-03	1.46	13.77	1.50	36.70	38.97	33.80	0.66	0.29	3.93	-
17-Apr-03	1.48	16.20	1.49	36.79	39.06	33.88	6.67	3.01	3.79	-
21-Jul-03	2.01	13.95	1.68	38.65	40.92	35.28	1.18	0.77	12.75	-
22-Jul-03	2.05	16.01	1.68	38.66	40.93	37.20	6.74	2.89	13.27	-
15-Oct-03	1.59	14.12	1.84	39.17	41.45	35.59	0.83	0.49	12.07	-
16-Oct-03	1.54	16.12	1.79	39.13	41.38	38.22	6.55	2.45	11.12	-
21-Jan-04	1.37	13.77	1.79	36.52	38.80	33.62	0.77	0.24	3.67	-
22-Jan-04	1.49	15.41	1.77	36.58	38.84	33.68	6.77	2.27	3.94	-
13-Apr-04	1.57	13.71	1.69	37.08	39.32	34.16	0.55	0.38	7.13	-
14-Apr-04	1.61	15.60	1.69	37.12	39.37	34.20	6.83	2.15	-	-
21-Jul-04	1.85	14.05	1.77	38.49	40.77	35.29	0.91	0.66	12.20	-
22-Jul-04	1.86	16.21	1.78	38.49	40.77	37.34	6.57	2.47	-	-
13-Oct-04	1.78	13.97	1.78	38.39	40.66	35.14	0.90	0.60	11.11	-
14-Oct-04	1.82	15.80	1.78	38.39	40.65	37.63	6.99	2.18	-	-
19-Jan-05	1.21	13.87	1.65	36.54	38.79	33.62	0.50	0.10	2.15	-
20-Jan-05	1.19	15.22	1.53	35.95	38.21	33.02	6.45	1.46	-	-
19-Apr-05	1.42	13.71	1.56	36.58	38.85	33.67	0.76	0.40	2.84	-
20-Apr-05	1.42	15.49	1.56	36.54	38.82	33.63	6.45	1.94	-	-
27-Jul-05	1.93	13.87	1.52	37.67	39.94	34.71	0.97	0.73	8.13	-
28-Jul-05	1.95	15.33	1.54	37.71	39.96	34.74	6.47	1.87	-	-
12-Oct-05	1.84	13.99	1.68	38.56	40.82	35.35	0.98	0.67	11.16	-
13-Oct-05	1.88	15.60	1.66	38.55	40.82	37.29	6.61	1.97	-	-
24-Jan-06	1.15	13.51	1.62	38.75	41.03	34.76	0.19	-0.04	3.27	-
25-Jan-06	1.35	15.21	1.59	38.97	41.23	36.21	6.37	1.15	-	-
27-Apr-06	1.34	13.60	1.49	40.37	43.53	34.85	0.50	0.32	4.24	-
28-Apr-06	1.37	15.09	-	40.36	43.57	37.94	5.89	1.86	-	-
18-Jul-06	2.08	13.93	1.68	40.40	45.33	35.99	1.13	0.82	11.77	-
19-Jul-06	2.10	15.22	1.66	40.38	45.31	38.94	6.20	1.80	-	-
24-Oct-06	2.15	14.29	2.02	40.39	45.94	36.35	1.32	0.90	12.27	-
25-Oct-06	2.21	15.00	2.04	40.39	45.92	39.32	6.66	2.18	-	-
31-Jan-07	1.20	13.74	1.55	38.56	40.78	34.76	0.17	0.03	3.16	-
1-Feb-07	1.32	14.58	1.55	-	-	34.74	6.48	0.90	-	-
24-Apr-07	1.28	13.78	1.59	39.43	41.71	34.80	0.50	0.18	3.11	-
25-Apr-07	1.32	14.51	1.57	39.44	41.69	37.37	6.45	1.00	-	-
4-Jul-07	1.93	13.99	1.64	40.39	44.29	36.08	1.01	0.71	10.92	-
5-Jul-07	1.94	15.09	1.65	-	44.30	38.95	6.44	1.59	-	-
6-Nov-07	1.35	14.03	1.47	40.34	43.01	34.78	0.43	0.22	4.07	-
7-Nov-07	1.37	15.04	1.51	40.37	43.00	36.98	6.39	1.00	-	-
23-Jan-08	1.39	13.72	1.36	38.33	40.61	34.80	0.40	0.05	-	-
24-Jan-08	1.40	14.89	1.36	38.42	40.69	36.32	5.20	0.84	3.32	-
22-Apr-08	1.56	13.85	1.19	39.46	41.73	35.48	0.63	0.46	4.48	-
23-Apr-08	1.58	14.96	1.26	39.50	41.76	37.70	5.73	1.33	-	-
22-Jul-08	2.05	14.17	1.38	40.37	43.52	35.91	1.09	0.78	7.26	-
23-Jul-08	-	15.15	1.40	-	43.54	38.58	-	1.57	-	-
24-Jul-08	2.05	-	-	-	-	-	5.57	-	-	-
30-Sep-08	2.07	14.36	1.54	40.39	44.95	36.24	1.16	0.85	8.71	-
2-Feb-09	1.55	14.34	0.98	38.95	41.23	35.06	0.49	0.24	-	-
3-Feb-09	1.36	15.49	0.97	38.97	41.22	37.29	6.23	1.33	-	-
31-Mar-09	-	-	1.49	37.54	39.82	34.57	-	-	-	-
2-Apr-09	1.53	14.41	-	-	-	-	0.85	0.22	2.66	-
15-Jul-09	1.83	14.79	1.67	40.29	42.55	35.96	1.01	0.63	5.44	-
19-Oct-09	-	-	1.76	-	-	-	-	-	-	-
20-Oct-09	-	-	-	40.50	45.01	36.38	-	-	-	-
21-Oct-09	1.63	14.94	-	-	-	-	0.77	0.52	-	-
18-Mar-10	1.35	14.54	0.99	37.83	40.10	35.56	0.39	0.25	1.67	-
5-May-10	1.39	14.56	0.86	37.93	40.22	34.89	0.84	0.27	1.86	-
12-Jul-10	1.73	14.79	1.33	38.97	41.24	35.41	1.11	0.56	6.99	-
1-Nov-10	1.36	14.77	0.71	39.20	41.47	35.53	0.75	0.37	1.52	-
24-Jan-11	1.38	14.52	1.10	40.38	43.85	34.79	0.58	0.20	-	-
11-May-11	1.61	14.61	0.74	40.37	45.08	35.95	0.76	0.49	3.28	-
24-Jul-11	1.90	14.76	0.89	40.41	44.98	35.80	1.16	0.74	6.99	-
2-Nov-11	1.58	14.76	0.80	40.41	44.26	36.39	0.83	0.47	3.52	-
6-Dec-11	-	-	0.75	40.11	42.49	34.88	-	-	-	48.91
11-Jan-12	1.39	14.51	0.80	39.43	41.70	34.74	0.97	0.27	1.60	48.36
Ground elev. (m)	308.028	308.028	326.080	345.620	347.813	342.773	307.957	307.957	353.47	354.032
PVC Stickup (m)	0.775	0.775	0.95	0.98	0.58	1.1	1.057	1.057	0.1	0.3

Notes:

Ground water levels are reported in metres below existing ground surface (mbgs).

QCC personnel assessed groundwater levels on October 19, 20, and 21, 2009, and December 6, 2011.

QCC provided updated survey information on October 12, 2011.

Dewatering well QU11-11 stick-up estimated from site photograph.

Dewatering well QU11-11 elevation estimated from Quinsam site plan.

Date/Well No.	MW00-1S	MW00-1D	MW00-2	MW00-3	MW00-4	MW00-5	MW00-6S	MW00-6D	94-009	QU11-11
19-Apr-00	304.76	-	324.55	-	-	-	-	-	-	**Dewatering well**
25-Apr-00	306.42	290.99	324.50	306.96	-	-	-	-	-	-
24-Nov-00	306.21	293.87	-	306.83	306.81	297.65	303.13	305.70	-	-
25-Nov-00	-	-	324.05	-	-	-	-	-	-	-
18-Sep-01	306.13	293.67	324.18	306.15	306.15	307.13	307.95	307.13	-	-
10-Dec-01	306.61	293.92	324.80	308.35	308.43	308.41	308.17	307.63	-	-
11-Dec-01	306.60	293.91	324.75	308.38	308.44	308.43	302.31	304.60	-	-
20-Mar-02	306.59	294.21	324.66	308.33	308.36	308.39	308.14	307.59	-	-
21-Mar-02	306.52	292.01	324.67	308.29	308.32	308.33	302.31	304.83	-	-
18-Jul-02	306.10	293.94	324.33	306.59	306.76	307.28	307.86	307.31	-	-
19-Jul-02	306.10	291.82	324.33	306.59	306.77	304.54	302.12	303.91	-	-
8-Oct-02	306.00	293.68	324.92	305.84	305.99	307.01	307.77	307.08	-	-
9-Oct-02	305.98	291.59	323.95	305.83	305.99	304.59	302.29	304.10	-	-
15-Jan-03	306.69	294.06	324.60	308.35	308.29	308.42	308.23	307.67	-	-
16-Jan-03	306.55	292.12	324.60	308.31	308.24	308.40	301.82	305.38	-	-
16-Apr-03	306.57	294.26	324.58	308.92	308.84	308.98	308.20	307.67	349.54	-
17-Apr-03	306.55	291.83	324.59	308.83	308.75	308.89	302.19	304.95	349.68	-
21-Jul-03	306.01	294.08	324.40	306.97	306.89	307.49	307.68	307.18	340.73	-
22-Jul-03	305.98	292.02	324.40	306.96	306.88	305.57	302.11	305.07	340.20	-
15-Oct-03	306.44	293.91	324.24	306.46	306.36	307.18	308.02	307.47	341.41	-
16-Oct-03	306.49	291.91	324.29	306.49	306.43	304.56	302.31	305.50	342.36	-
21-Jan-04	306.66	294.26	324.29	309.10	309.02	309.16	308.09	307.72	349.80	-
22-Jan-04	306.54	292.62	324.31	309.04	308.97	309.09	302.09	305.69	349.53	-
13-Apr-04	306.46	294.32	324.39	308.54	308.49	308.61	308.31	307.57	346.35	-
14-Apr-04	306.42	292.43	324.39	308.50	308.45	308.58	302.03	305.80	-	-
21-Jul-04	306.18	293.98	324.31	307.13	307.04	307.48	307.95	307.30	341.27	-
22-Jul-04	306.17	291.82	324.30	307.13	307.05	305.44	302.29	305.49	-	-
13-Oct-04	306.25	294.06	324.30	307.23	307.16	307.63	307.95	307.35	342.36	-
14-Oct-04	306.21	292.23	324.30	307.24	307.16	305.14	301.87	305.78	-	-
19-Jan-05	306.82	294.16	324.43	309.08	309.02	309.15	308.36	307.86	351.32	-
20-Jan-05	306.84	292.81	324.55	309.67	309.61	309.75	302.40	306.50	-	-
19-Apr-05	306.61	294.32	324.52	309.04	308.97	309.10	308.10	307.56	350.63	-
20-Apr-05	306.61	292.54	324.52	309.08	309.00	309.14	302.40	306.02	-	-
27-Jul-05	306.10	294.16	324.56	307.95	307.88	308.06	307.89	307.22	345.35	-
28-Jul-05	306.08	292.70	324.54	307.91	307.85	308.03	302.39	306.09	-	-
12-Oct-05	306.19	294.04	324.40	307.07	306.99	307.42	307.88	307.29	342.31	-
13-Oct-05	306.15	292.43	324.42	307.07	307.00	305.49	302.25	305.99	-	-
24-Jan-06	306.88	294.52	324.46	306.87	306.78	308.01	308.66	308.00	350.20	-
25-Jan-06	306.68	292.82	324.49	306.65	306.58	306.57	302.49	306.81	-	-
27-Apr-06	306.69	294.43	324.59	305.25	304.28	307.93	308.36	307.63	349.23	-
28-Apr-06	306.66	292.94	-	305.26	304.25	304.83	302.96	306.10	-	-
18-Jul-06	305.95	294.10	324.40	305.22	302.49	306.78	307.72	307.14	341.71	-
19-Jul-06	305.93	292.81	324.42	305.24	302.50	303.84	302.65	306.16	-	-
24-Oct-06	305.88	293.74	324.06	305.23	301.87	306.42	307.53	307.05	341.21	-
25-Oct-06	305.82	293.03	324.05	305.23	301.89	303.45	302.19	305.77	-	-
31-Jan-07	306.83	294.29	324.53	307.06	307.04	308.01	308.69	307.93	350.32	-
1-Feb-07	306.71	293.45	324.53	-	-	308.03	302.37	307.06	-	-
24-Apr-07	306.75	294.25	324.49	306.19	306.11	307.98	308.36	307.77	350.37	-
25-Apr-07	306.71	293.52	324.51	306.18	306.13	305.41	302.41	306.96	-	-
4-Jul-07	306.10	294.04	324.44	305.23	303.52	306.70	307.85	307.24	342.55	-
5-Jul-07	306.09	292.94	324.44	-	303.52	303.82	302.41	306.36	-	-
6-Nov-07	306.68	294.00	324.61	305.29	304.80	307.99	308.43	307.74	349.40	-
7-Nov-07	306.66	292.99	324.57	305.25	304.82	305.79	302.47	306.96	-	-
23-Jan-08	306.64	294.31	324.73	307.29	307.20	307.97	308.46	307.90	-	-
24-Jan-08	306.63	293.14	324.73	307.21	307.12	306.45	303.66	307.12	350.05	-
22-Apr-08	306.47	294.18	324.89	306.16	306.08	307.30	308.22	307.49	348.99	-
23-Apr-08	306.45	293.07	324.82	306.13	306.06	305.08	303.12	306.63	-	-
22-Jul-08	305.98	293.86	324.70	305.25	304.29	306.86	307.77	307.18	346.21	-
23-Jul-08	-	292.88	324.68	-	304.27	304.19	-	306.39	-	-
24-Jul-08	304.60	-	-	-	-	-	303.29	-	-	-
30-Sep-08	305.95	293.67	324.54	305.24	302.86	306.53	306.79	307.10	344.76	-
2-Feb-09	306.48	293.69	325.10	306.67	306.59	307.72	307.47	307.71	-	-
31-Mar-09	-	-	324.59	308.08	308.00	308.20	-	-	-	-
2-Apr-09	306.50	293.62	-	-	-	-	307.10	307.73	350.81	-
15-Jul-09	306.20	293.24	324.41	305.34	305.27	306.82	306.95	307.33	348.03	-
19-Oct-09	-	-	324.32	-	-	-	-	-	-	-
20-Oct-09	-	-	-	305.12	302.80	306.39	-	-	-	-
21-Oct-09	306.40	293.09	-	-	-	-	307.18	307.43	-	-
18-Mar-10	306.67	293.49	325.09	307.79	307.71	307.21	307.57	307.71	351.81	-
5-May-10	306.64	293.47	325.22	307.69	307.60	307.88	307.12	307.69	351.61	-
12-Jul-10	306.30	293.24	324.75	306.65	306.57	307.36	306.85	307.40	346.48	-
1-Nov-10	306.67	293.26	325.37	306.42	306.34	307.24	307.21	307.59	351.95	-
24-Jan-11	306.65	293.50	324.98	305.25	303.96	307.98	307.38	307.76	-	-
11-May-11	306.42	293.42	325.34	305.25	302.73	306.82	307.20	307.46	350.19	-
24-Jul-11	306.13	293.26	325.20	305.21	302.83	306.97	306.80	307.22	346.49	-
2-Nov-11	306.45	293.27	325.28	305.21	303.55	306.38	307.13	307.48	349.96	-
6-Dec-11	-	-	325.33	305.51	305.32	307.89	-	-	-	305.12
11-Jan-12	306.64	293.52	325.28	306.19	306.11	308.03	306.99	307.69	351.87	305.67
Ground elev. (m)	308.028	308.028	326.080	345.620	347.813	342.773	307.957	307.957	353.47	354.032

Notes:

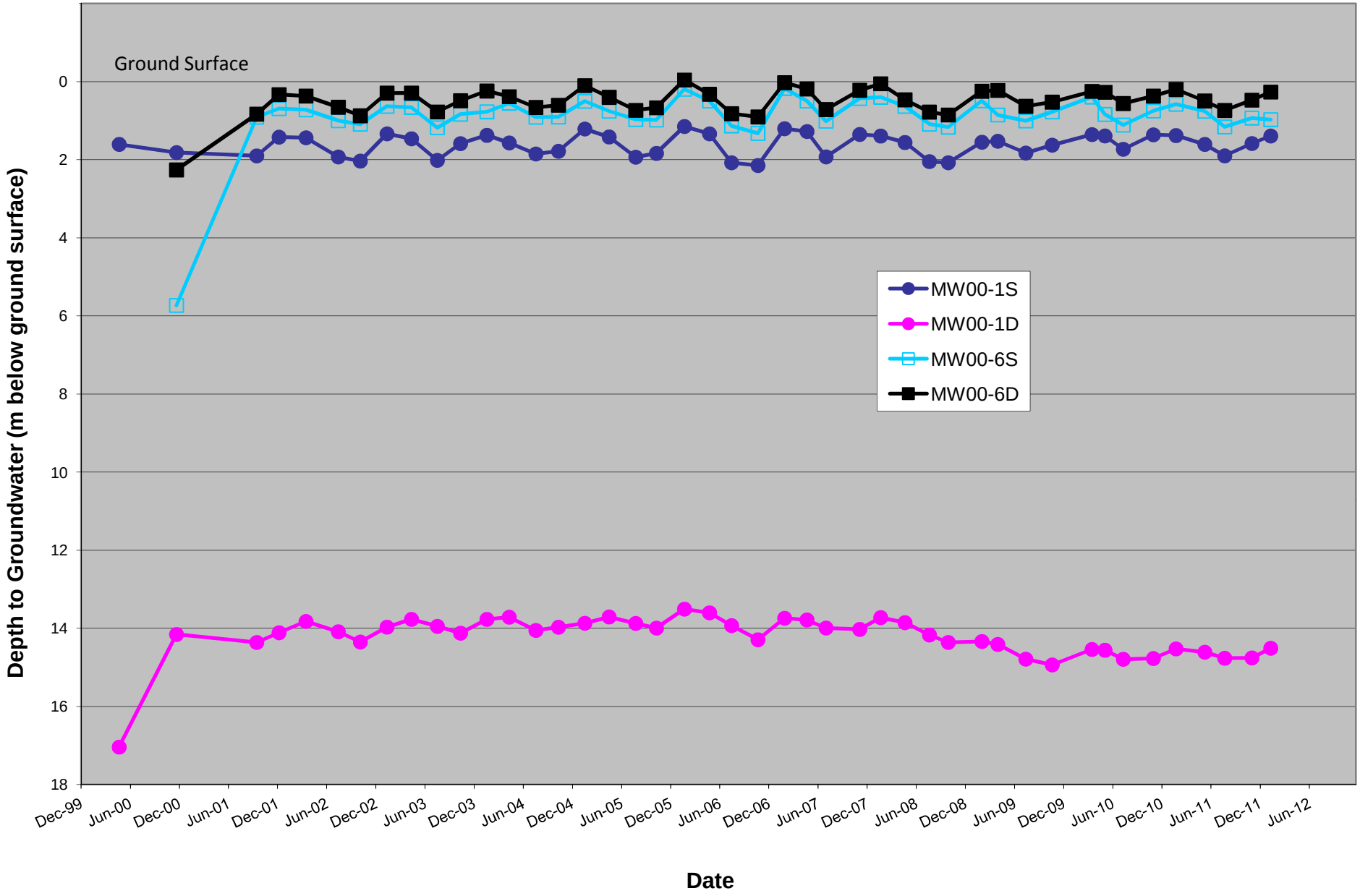
QCC personnel assessed groundwater levels on October 19, 20, and 21, 2009, and December 6, 2011.

QCC provided updated survey information on October 12, 2011.

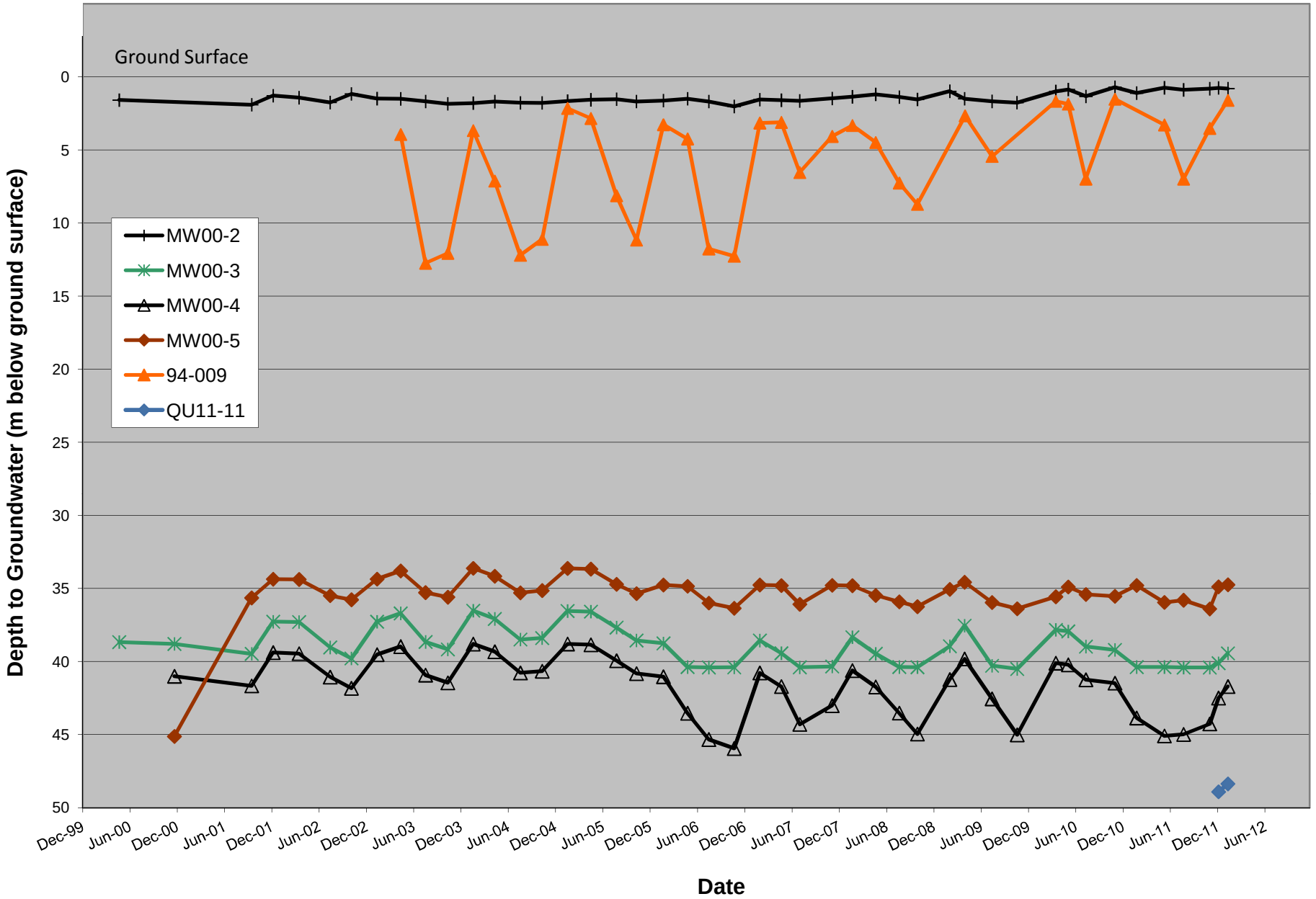
Dewatering well QU11-11 stick-up estimated from site photograph.

Dewatering well QU11-11 elevation estimated from Quinsam site plan.

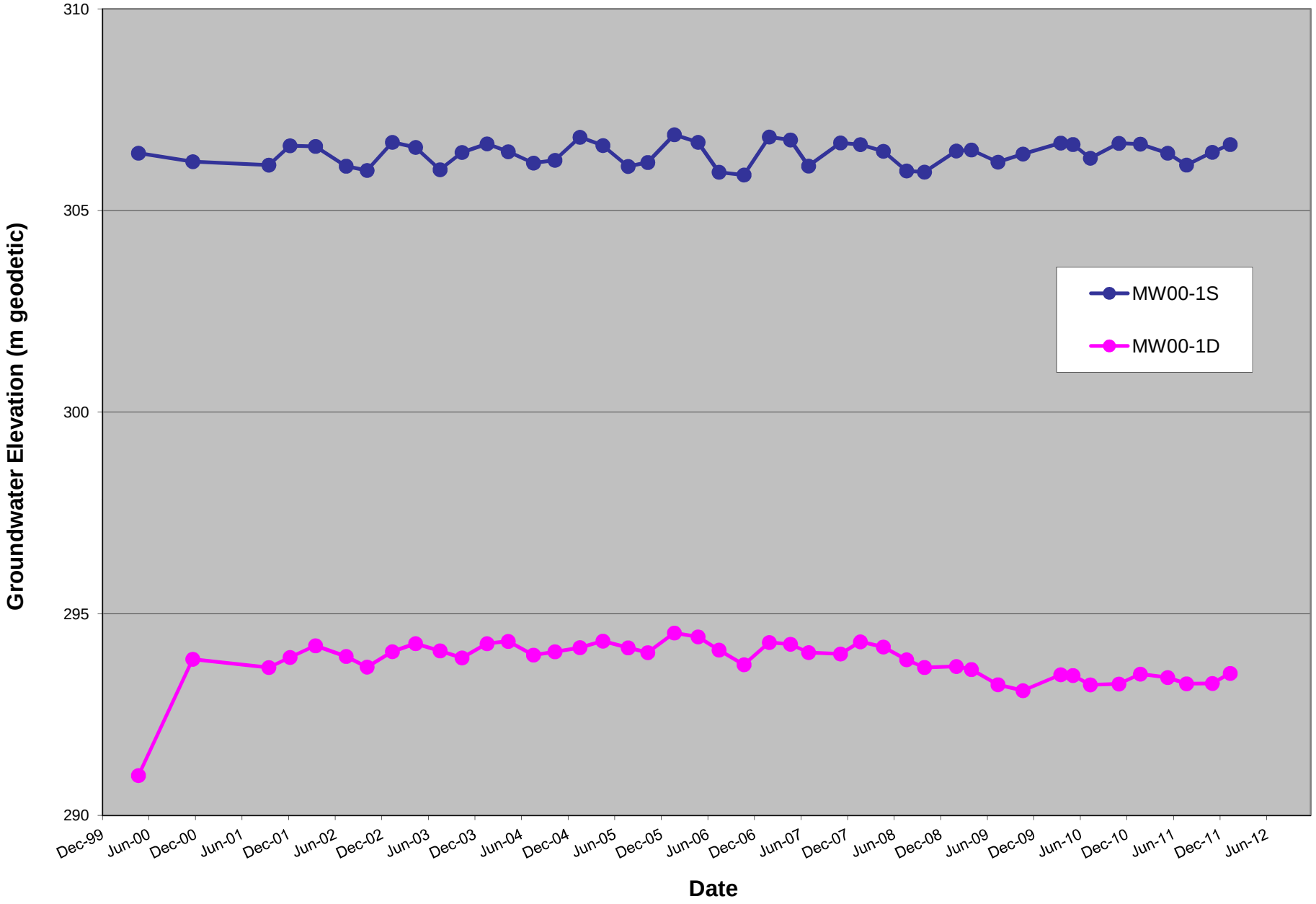
Graph IV-1: Compilation of Groundwater Levels in the 2 North Area



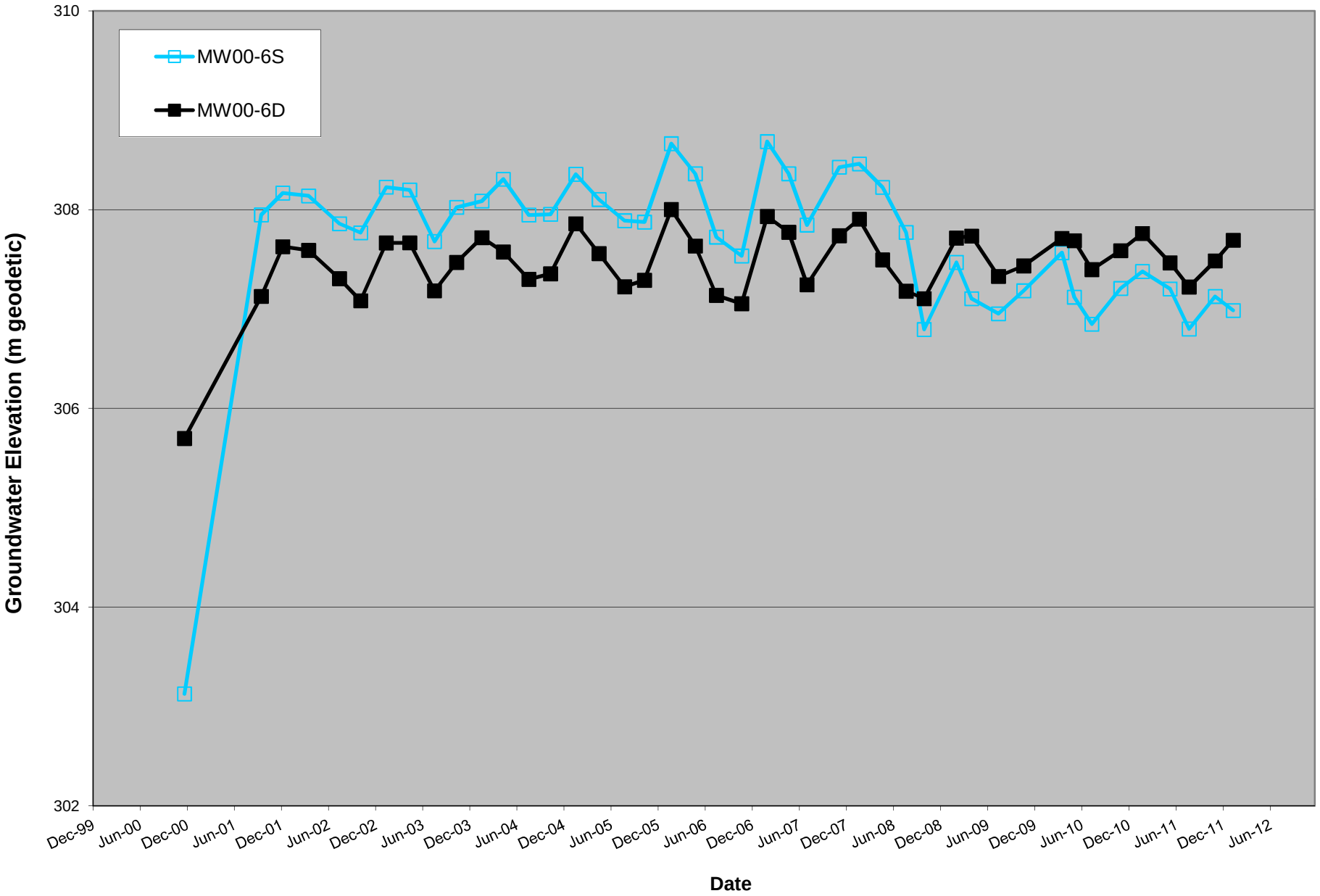
Graph IV-2: Compilation of Groundwater Levels in the 3 South Pit Area



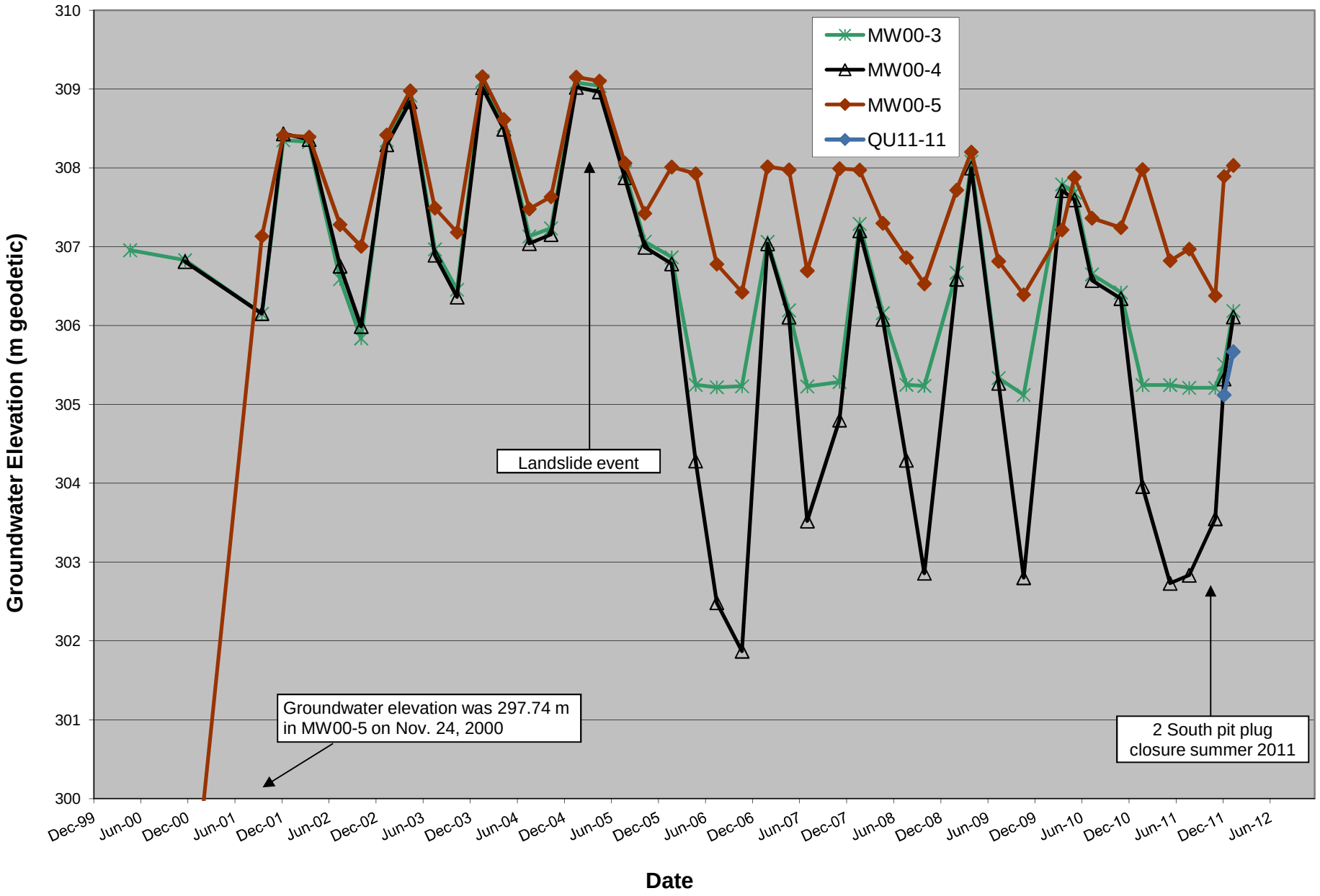
Graph IV-3: Groundwater Elevations of MW00-1 in the 2 North Area



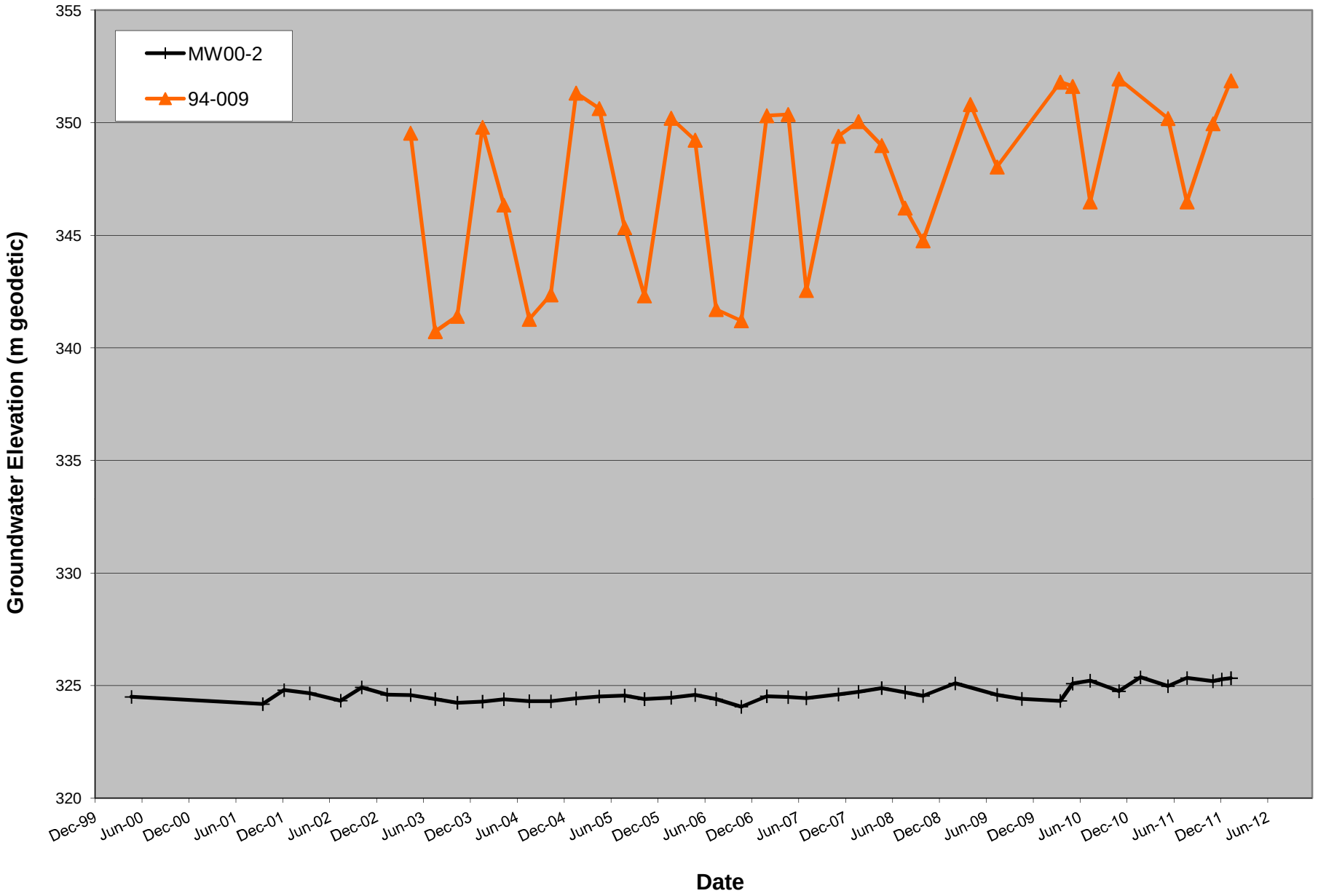
Graph IV-4: Groundwater Elevations of MW00-6 in the 2 North Area



Graph IV-5: Groundwater Elevations of MW00-3, MW00-4, and MW00-5 in the 3 South Pit Area



Graph IV-6: Groundwater Elevations of MW00-2 and 94-009 in the 3 South Pit Area



APPENDIX V

January 2012 ALS Laboratory Certificate of Analysis

GOLDER ASSOCIATES LTD.
ATTN: Dwayne Smith
3795 Carey Road
Victoria BC V8Z 6T8

Date Received: 14-JAN-12
Report Date: 18-JAN-12 15:17 (MT)
Version: FINAL

Client Phone: 250-881-7372

Certificate of Analysis

Lab Work Order #: L1104243

Project P.O. #: NOT SUBMITTED
Job Reference: 12-1476-0001/1000
C of C Numbers: 0341
Legal Site Desc:

Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1104243-1	L1104243-2	L1104243-3	L1104243-4	L1104243-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	12-JAN-12	12-JAN-12	12-JAN-12	12-JAN-12	12-JAN-12
	Sampled Time	11:50	11:50	12:35	13:33	14:31
	Client ID	0341-01	0341-02	0341-03	0341-04	0341-05
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	22.1	22.2	875	1170	966
Anions and Nutrients	Bromide (Br) (mg/L)	<0.050	<0.050	<1.0 DLM	<1.0 DLM	<1.0 DLM
	Chloride (Cl) (mg/L)	0.67	0.67	6.8	2.9	2.0
	Fluoride (F) (mg/L)	0.141	0.138	<0.40 DLM	<0.40 DLM	<0.40 DLM
	Nitrate (as N) (mg/L)	0.0268	0.0282	0.11	<0.10 DLM	0.18
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.025	<0.020 DLM	0.033
	Sulfate (SO4) (mg/L)	27.5	27.3	781	1190	1830
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0315	0.0324	<0.025 DLA	<0.025 DLA	<0.050 DLA
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0025 DLA	<0.0025 DLA	<0.0050 DLA
	Arsenic (As)-Dissolved (mg/L)	0.0196	0.0198	<0.0025 DLA	<0.0025 DLA	<0.0050 DLA
	Barium (Ba)-Dissolved (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0050 DLA	<0.0050 DLA	<0.010 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10	0.49	0.41	2.19
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017	<0.000017	<0.000085 DLA	<0.000085 DLA	<0.00017 DLA
	Calcium (Ca)-Dissolved (mg/L)	8.65	8.69	272	402	333
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0050 DLA	<0.0050 DLA	<0.010 DLA
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.00030	<0.0015 DLA	0.0058 DLA	<0.0030 DLA
	Copper (Cu)-Dissolved (mg/L)	0.0030	0.0030	<0.0050 DLA	<0.0050 DLA	<0.010 DLA
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	0.337	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0025 DLA	<0.0025 DLA	<0.0050 DLA
	Lithium (Li)-Dissolved (mg/L)	<0.0050	<0.0050	<0.025 DLA	<0.025 DLA	<0.050 DLA
	Magnesium (Mg)-Dissolved (mg/L)	0.12	0.12	47.3	40.2	32.7
	Manganese (Mn)-Dissolved (mg/L)	<0.00030	<0.00030	0.155	2.24	0.0144
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.0110	0.0111	<0.0050 DLA	<0.0050 DLA	<0.010 DLA
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0050 DLA	<0.0050 DLA	<0.010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0	<2.0	2.3	3.6	4.1
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0050 DLA	<0.0050 DLA	<0.010 DLA
	Silicon (Si)-Dissolved (mg/L)	2.52	2.57	7.19	2.50	2.33
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.000020	<0.00010 DLA	<0.00010 DLA	<0.00020 DLA
	Sodium (Na)-Dissolved (mg/L)	42.8	44.1	132	96.2	472
	Strontium (Sr)-Dissolved (mg/L)	0.0299	0.0306	1.49	2.47	3.81
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.00050	<0.0025 DLA	<0.0025 DLA	<0.0050 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1104243-6	L1104243-7	L1104243-8		
	Description	GW	GW	GW		
	Sampled Date	12-JAN-12	12-JAN-12	12-JAN-12		
	Sampled Time	15:24	16:04	16:35		
	Client ID	0341-06	0341-07	0341-08		
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	258	655	79.0		
Anions and Nutrients	Bromide (Br) (mg/L)	<0.050	<1.0 DLM	<0.050		
	Chloride (Cl) (mg/L)	0.28	6.3	0.68		
	Fluoride (F) (mg/L)	0.072	<0.40 DLM	0.106		
	Nitrate (as N) (mg/L)	0.0496	0.39	0.0171		
	Nitrite (as N) (mg/L)	<0.0010	0.026	0.0012		
	Sulfate (SO4) (mg/L)	206	817	42.6		
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0052	<0.025 DLA	0.0147		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.0025 DLA	<0.00050		
	Arsenic (As)-Dissolved (mg/L)	<0.00050	<0.0025 DLA	0.0245		
	Barium (Ba)-Dissolved (mg/L)	0.025	0.037	<0.020		
	Beryllium (Be)-Dissolved (mg/L)	<0.0010	<0.0050 DLA	<0.0010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Dissolved (mg/L)	0.15	0.30	<0.10		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017	<0.000085 DLA	<0.000017		
	Calcium (Ca)-Dissolved (mg/L)	87.3	223	29.7		
	Chromium (Cr)-Dissolved (mg/L)	<0.0010	<0.0050 DLA	<0.0010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00030	<0.0015 DLA	<0.00030		
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0050 DLA	0.0010		
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030		
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.0025 DLA	<0.00050		
	Lithium (Li)-Dissolved (mg/L)	0.0062	<0.025 DLA	<0.0050		
	Magnesium (Mg)-Dissolved (mg/L)	9.64	24.1	1.17		
	Manganese (Mn)-Dissolved (mg/L)	0.00977	0.192	<0.00030		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	0.0265	0.0052		
	Nickel (Ni)-Dissolved (mg/L)	<0.0010	<0.0050 DLA	<0.0010		
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	<2.0	2.8	<2.0		
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0050 DLA	<0.0010		
	Silicon (Si)-Dissolved (mg/L)	3.14	5.16	3.40		
	Silver (Ag)-Dissolved (mg/L)	<0.000020	<0.00010 DLA	<0.000020		
	Sodium (Na)-Dissolved (mg/L)	23.5	192	27.8		
	Strontium (Sr)-Dissolved (mg/L)	0.673	1.19	0.136		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.0010 DLA	<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.00050	<0.0025 DLA	<0.00050		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1104243-1 GW 12-JAN-12 11:50 0341-01	L1104243-2 GW 12-JAN-12 11:50 0341-02	L1104243-3 GW 12-JAN-12 12:35 0341-03	L1104243-4 GW 12-JAN-12 13:33 0341-04	L1104243-5 GW 12-JAN-12 14:31 0341-05
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
WATER						
Dissolved Metals	Uranium (U)-Dissolved (mg/L)	0.00078	0.00078	0.0030	DLA <0.0010	DLA <0.0020
	Vanadium (V)-Dissolved (mg/L)	0.0110	0.0111	DLA <0.0050	DLA <0.0050	DLA <0.010
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1104243-6	L1104243-7	L1104243-8		
	Description	GW	GW	GW		
	Sampled Date	12-JAN-12	12-JAN-12	12-JAN-12		
	Sampled Time	15:24	16:04	16:35		
	Client ID	0341-06	0341-07	0341-08		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Uranium (U)-Dissolved (mg/L)	<0.00020	0.0089	0.00096		
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0050 DLA	0.0050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulfate (SO4)	MS-B	L1104243-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-LOW-IC-VA	Water	Low level Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-DIS-CCME-MS-VA	Water	Diss. Metals in Water by ICPMS (CCME)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

0341

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: GOLDER ASSOCIATES LTD.
3795 Carey Road
Victoria BC V8Z 6T8
Contact: Dwayne Smith

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-BR-IC-VA	**Water**							
Batch R2312677								
WG1416326-9 DUP		**L1104243-8**						
Bromide (Br)		<0.050	<0.050	RPD-NA	mg/L	N/A	20	15-JAN-12
WG1416326-12 LCS								
Bromide (Br)			92.3		%		85-115	15-JAN-12
WG1416326-2 LCS								
Bromide (Br)			90.3		%		85-115	15-JAN-12
WG1416326-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	15-JAN-12
WG1416326-10 MB								
Bromide (Br)			<0.050		mg/L		0.05	15-JAN-12
WG1416326-4 MB								
Bromide (Br)			<0.050		mg/L		0.05	15-JAN-12
WG1416326-7 MB								
Bromide (Br)			<0.050		mg/L		0.05	15-JAN-12
WG1416326-11 MS		**L1104243-8**						
Bromide (Br)			86.6		%		75-125	15-JAN-12
ANIONS-CL-LOW-IC-VA	**Water**							
Batch R2312677								
WG1416326-9 DUP		**L1104243-8**						
Chloride (Cl)		0.68	0.68		mg/L	0.12	25	15-JAN-12
WG1416326-12 LCS								
Chloride (Cl)			99.5		%		85-115	15-JAN-12
WG1416326-2 LCS								
Chloride (Cl)			99.2		%		85-115	15-JAN-12
WG1416326-1 MB								
Chloride (Cl)			<0.10		mg/L		0.1	15-JAN-12
WG1416326-10 MB								
Chloride (Cl)			<0.10		mg/L		0.1	15-JAN-12
WG1416326-4 MB								
Chloride (Cl)			<0.10		mg/L		0.1	15-JAN-12
WG1416326-7 MB								
Chloride (Cl)			<0.10		mg/L		0.1	15-JAN-12
WG1416326-11 MS		**L1104243-8**						
Chloride (Cl)			102.0		%		75-125	15-JAN-12
ANIONS-F-IC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-F-IC-VA	**Water**							
Batch R2312677								
WG1416326-9 DUP		**L1104243-8**						
Fluoride (F)		0.106	0.105		mg/L	0.24	20	15-JAN-12
WG1416326-12 LCS								
Fluoride (F)			108.0		%		85-115	15-JAN-12
WG1416326-2 LCS								
Fluoride (F)			107.9		%		85-115	15-JAN-12
WG1416326-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	15-JAN-12
WG1416326-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	15-JAN-12
WG1416326-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	15-JAN-12
WG1416326-7 MB								
Fluoride (F)			<0.020		mg/L		0.02	15-JAN-12
WG1416326-11 MS		**L1104243-8**						
Fluoride (F)			113.4		%		75-125	15-JAN-12
ANIONS-NO2-IC-VA	**Water**							
Batch R2312677								
WG1416326-9 DUP		**L1104243-8**						
Nitrite (as N)		0.0012	0.0012		mg/L	2.2	20	15-JAN-12
WG1416326-12 LCS								
Nitrite (as N)			102.2		%		85-115	15-JAN-12
WG1416326-2 LCS								
Nitrite (as N)			101.9		%		85-115	15-JAN-12
WG1416326-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	15-JAN-12
WG1416326-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	15-JAN-12
WG1416326-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	15-JAN-12
WG1416326-7 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	15-JAN-12
WG1416326-11 MS		**L1104243-8**						
Nitrite (as N)			104.6		%		75-125	15-JAN-12
ANIONS-NO3-IC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO3-IC-VA	**Water**							
Batch R2312677								
WG1416326-9 DUP		**L1104243-8**						
Nitrate (as N)		0.0171	0.0170		mg/L	0.52	20	15-JAN-12
WG1416326-12 LCS								
Nitrate (as N)			100.9		%		85-115	15-JAN-12
WG1416326-2 LCS								
Nitrate (as N)			100.4		%		85-115	15-JAN-12
WG1416326-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	15-JAN-12
WG1416326-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	15-JAN-12
WG1416326-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	15-JAN-12
WG1416326-7 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	15-JAN-12
WG1416326-11 MS		**L1104243-8**						
Nitrate (as N)			103.5		%		75-125	15-JAN-12
ANIONS-SO4-IC-VA	**Water**							
Batch R2312677								
WG1416326-9 DUP		**L1104243-8**						
Sulfate (SO4)		42.6	42.6		mg/L	0.15	20	15-JAN-12
WG1416326-12 LCS								
Sulfate (SO4)			101.9		%		85-115	15-JAN-12
WG1416326-2 LCS								
Sulfate (SO4)			101.5		%		85-115	15-JAN-12
WG1416326-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	15-JAN-12
WG1416326-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	15-JAN-12
WG1416326-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	15-JAN-12
WG1416326-7 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	15-JAN-12
WG1416326-11 MS		**L1104243-8**						
Sulfate (SO4)			98.8		%		75-125	15-JAN-12
WG1416326-5 MS		**L1104106-3**						
Sulfate (SO4)			99.3		%		75-125	15-JAN-12
WG1416326-8 MS		**L1104109-9**						
Sulfate (SO4)			N/A	MS-B	%		-	15-JAN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2312959								
WG1416563-3 DUP		**L1104243-1**						
Mercury (Hg)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	16-JAN-12
WG1416770-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	16-JAN-12
WG1416770-5 MS		**L1103975-13**						
Mercury (Hg)-Dissolved			90.2		%		70-130	16-JAN-12
WG1416770-6 MS		**L1104112-4**						
Mercury (Hg)-Dissolved			90.7		%		70-130	16-JAN-12
WG1416770-8 MS		**L1103516-8**						
Mercury (Hg)-Dissolved			91.4		%		70-130	16-JAN-12
WG1416770-9 MS		**L1104243-2**						
Mercury (Hg)-Dissolved			87.2		%		70-130	16-JAN-12
MET-DIS-CCME-MS-VA	**Water**							
Batch R2313411								
WG1416563-2 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			102.7		%		80-120	16-JAN-12
Antimony (Sb)-Dissolved			98.9		%		80-120	16-JAN-12
Arsenic (As)-Dissolved			98.0		%		80-120	16-JAN-12
Beryllium (Be)-Dissolved			99.9		%		80-120	16-JAN-12
Cadmium (Cd)-Dissolved			99.8		%		80-120	16-JAN-12
Chromium (Cr)-Dissolved			97.1		%		80-120	16-JAN-12
Cobalt (Co)-Dissolved			96.8		%		80-120	16-JAN-12
Copper (Cu)-Dissolved			93.7		%		80-120	16-JAN-12
Lead (Pb)-Dissolved			98.4		%		80-120	16-JAN-12
Lithium (Li)-Dissolved			99.4		%		80-120	16-JAN-12
Manganese (Mn)-Dissolved			100.2		%		80-120	16-JAN-12
Molybdenum (Mo)-Dissolved			98.0		%		80-120	16-JAN-12
Nickel (Ni)-Dissolved			96.7		%		80-120	16-JAN-12
Selenium (Se)-Dissolved			95.7		%		80-120	16-JAN-12
Silver (Ag)-Dissolved			96.0		%		80-120	16-JAN-12
Thallium (Tl)-Dissolved			97.7		%		80-120	16-JAN-12
Tin (Sn)-Dissolved			96.9		%		80-120	16-JAN-12
Vanadium (V)-Dissolved			98.8		%		80-120	16-JAN-12
Uranium (U)-Dissolved			99.0		%		80-120	16-JAN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2313922								
WG1416563-3 DUP		**L1104243-1**						
Aluminum (Al)-Dissolved		0.0315	0.0322		mg/L	1.9	20	17-JAN-12
Antimony (Sb)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	17-JAN-12
Arsenic (As)-Dissolved		0.0196	0.0197		mg/L	0.42	20	17-JAN-12
Beryllium (Be)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	17-JAN-12
Cadmium (Cd)-Dissolved		<0.000017	<0.000010	RPD-NA	mg/L	N/A	20	17-JAN-12
Chromium (Cr)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	17-JAN-12
Cobalt (Co)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	17-JAN-12
Copper (Cu)-Dissolved		0.0030	0.0030		mg/L	1.4	20	17-JAN-12
Lead (Pb)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	17-JAN-12
Lithium (Li)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	17-JAN-12
Manganese (Mn)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	17-JAN-12
Molybdenum (Mo)-Dissolved		0.0110	0.0111		mg/L	0.72	20	17-JAN-12
Nickel (Ni)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	17-JAN-12
Selenium (Se)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	17-JAN-12
Silver (Ag)-Dissolved		<0.000020	<0.000020	RPD-NA	mg/L	N/A	20	17-JAN-12
Thallium (Tl)-Dissolved		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	17-JAN-12
Tin (Sn)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	17-JAN-12
Vanadium (V)-Dissolved		0.0110	0.0111		mg/L	1.2	20	17-JAN-12
Uranium (U)-Dissolved		0.00078	0.00078		mg/L	0.82	20	17-JAN-12
MET-DIS-ICP-VA	**Water**							
Batch R2313503								
WG1416563-2 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			98.3		%		80-120	16-JAN-12
Bismuth (Bi)-Dissolved			97.1		%		80-120	16-JAN-12
Boron (B)-Dissolved			100.0		%		80-120	16-JAN-12
Calcium (Ca)-Dissolved			102.2		%		80-120	16-JAN-12
Iron (Fe)-Dissolved			99.3		%		80-120	16-JAN-12
Magnesium (Mg)-Dissolved			100.3		%		80-120	16-JAN-12
Phosphorus (P)-Dissolved			101.7		%		80-120	16-JAN-12
Potassium (K)-Dissolved			100.0		%		80-120	16-JAN-12
Silicon (Si)-Dissolved			104.3		%		80-120	16-JAN-12
Sodium (Na)-Dissolved			98.5		%		80-120	16-JAN-12
Strontium (Sr)-Dissolved			102.5		%		80-120	16-JAN-12
Titanium (Ti)-Dissolved			100.8		%		80-120	16-JAN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2313503								
WG1416563-2 CRM		**VA-HIGH-WATRM**						
Zinc (Zn)-Dissolved			97.5		%		80-120	16-JAN-12
WG1416563-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	16-JAN-12
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	16-JAN-12
Boron (B)-Dissolved			<0.10		mg/L		0.1	16-JAN-12
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	16-JAN-12
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	16-JAN-12
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	16-JAN-12
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	16-JAN-12
Potassium (K)-Dissolved			<2.0		mg/L		2	16-JAN-12
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	16-JAN-12
Sodium (Na)-Dissolved			<2.0		mg/L		2	16-JAN-12
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	16-JAN-12
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	16-JAN-12
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	16-JAN-12
Batch R2313781								
WG1416563-3 DUP		**L1104243-1**						
Barium (Ba)-Dissolved		<0.020	<0.010	RPD-NA	mg/L	N/A	20	17-JAN-12
Bismuth (Bi)-Dissolved		<0.20	<0.20	RPD-NA	mg/L	N/A	20	17-JAN-12
Boron (B)-Dissolved		<0.10	<0.10	RPD-NA	mg/L	N/A	20	17-JAN-12
Calcium (Ca)-Dissolved		8.65	8.70		mg/L	0.54	20	17-JAN-12
Iron (Fe)-Dissolved		<0.030	<0.030	RPD-NA	mg/L	N/A	20	17-JAN-12
Magnesium (Mg)-Dissolved		0.12	0.12		mg/L	1.9	20	17-JAN-12
Phosphorus (P)-Dissolved		<0.30	<0.30	RPD-NA	mg/L	N/A	20	17-JAN-12
Potassium (K)-Dissolved		<2.0	<2.0	RPD-NA	mg/L	N/A	20	17-JAN-12
Silicon (Si)-Dissolved		2.52	2.55		mg/L	1.2	20	17-JAN-12
Sodium (Na)-Dissolved		42.8	43.7		mg/L	2.1	20	17-JAN-12
Strontium (Sr)-Dissolved		0.0299	0.0306		mg/L	2.3	20	17-JAN-12
Titanium (Ti)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	17-JAN-12
Zinc (Zn)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	17-JAN-12

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

L110 42-43

CHAIN OF CUSTODY RECORD/ANALYSIS REQUEST

№ 0341 page 1 of 1

Golder Associates
500-4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone 604-298-6623 Fax 604-298-5253

Project Number: 12-1476-0001/1000		Laboratory Name: ALS	
[redacted]		Address: 8081 Lougheed Hwy, Burnaby, BC	
Golder Contact: Dwayne Smith	Golder E-mail Address: dsmith @golder.com	Telephone/Fax: 604 253-4188	Contact: Amber Saringer

Office the final reports should be sent to: L110474 Paige Haddock phaddock@golder.com

- ☐ 500 – 4260 Still Creek Dr. Burnaby, B.C. V5C 6C6 Tel: 604-298-6623 Fax: 604-298-5253
- ☐ 202 – 2790 Gladwin Road Abbotsford, B.C. V2T 4S8 Tel: 604-850-8786 Fax: 604-850-8756
- ☒ 3795 Carey Road, 2nd floor Victoria, B.C. V8Z 6T8 Tel: 250-881-7372 Fax: 250-881-7470

Sample Control Number (SCN)	[redacted]	Sample Matrix (over)	Date Sampled (D / M / Y)	[redacted]	Number of Containers	Anion Scan	Dissolved metals	Hardness						RUSH	Remarks (over)
									Analyses Required						
0341-01		gw	12/1/12		2	X	X	X	sampled @ 11:50 hrs						
0341 -02		gw	12/1/12		2	X	X	X	sampled @ 12:30 hrs						Please
0341 -03		gw	12/1/12		2	X	X	X	sampled @ 12:35 hrs						show full
0341 -04		gw	12/1/12		2	X	X	X	sampled @ 13:33 hrs.						metal scan.
0341 -05		gw	12/1/12		2	X	X	X	sampled @ 14:31 hrs.						(ICPOES) + low
0341 -06		gw	12/1/12		2	X	X	X	sampled @ 15:24 hrs.						level chloride
0341 -07		gw	12/1/12		2	X	X	X	sampled @ 16:04 hrs.						
0341 -08		gw	12/1/12		2	X	X	X	sampled @ 16:35 hrs						
-09															*Dissolved
-10															metal samples
-11															were field
-12															filtered + preserved.

Sampler's Signature: P. Haddock	Relinquished by: Signature: P. Haddock	Company: Golder	Date: Jan 12/12	Time: 1730	Received by: Signature	Company
Sample Storage (°C): 6N ICE	Relinquished by: Signature	Company	Date	Time	Received by: Signature	Company

Comments: CSR DW1 BCWQG detection limits	Method of Shipment: DHL/1.00 m/s	Waybill No.: D0216557256	Received for Lab by: Walt	Date	Time
	Shipped by:	Shipment Condition: Seal Intact:	Temp (°C): 12	Cooler opened by:	Date: Jan 14 12 / Time: 10:30

WHITE: Golder Copy YELLOW: Lab Copy PINK: Lab Returns with Final Report

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Golder Associates

APPENDIX VII

PHOTOGRAPHS

PHOTO 1
Settling Pond # 4

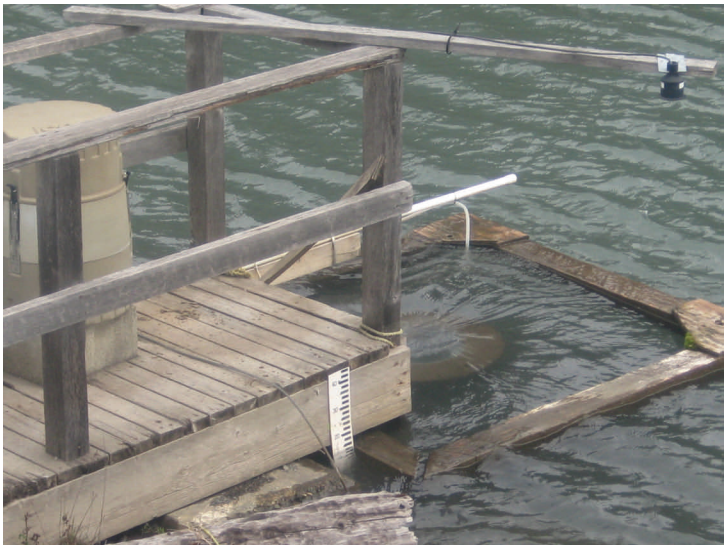

PHOTO 2
Settling Pond # 4
Decant Riser Monitoring Station (WD)

PHOTO 3
2 North Pit Sump (WP) - June 2009

PHOTO 4
North Pit Culvert (WC)

PHOTO 5
North Underground Portal

PHOTO 6
2 North Portal Sump

PHOTO 7
Wash Plant Ditch

PHOTO 8
North Sulphate Remediation Test Cell

PHOTO 9
Middle Quinsam Lake

PHOTO 10
Middle Quinsam Lake Outflow (WB)

PHOTO 11
South Dyke Pond

PHOTO 12
Culvert into Long Lake (LLE)

PHOTO 13
Settling Pond #1 (SPD)
June 2009

PHOTO 14
Settling Pond #1 (SPD)
Decant Riser Monitoring Station

PHOTO 15
Long Lake Outlet (LLO)

PHOTO 16
3S77 Audit Pit

PHOTO 17
3 South Pit—June 2009

PHOTO 18
No name Lake outlet (NNO)

PHOTO 19
4 South Lower

PHOTO 20
Long Lake Seep Weir I

PHOTO 21
7 south iron River Upper

PHOTO 22
7 south Iron River Lower

PHOTO 23
7 South Quinsam River Lower

PHOTO 24
Roadside Settling Sump at Quinsam Bridge Approach

APPENDIX VIII

SPILLS

Spill Report Record

Spill Reporter: Kathleen Russell

Spill Location: 3 South Pit

Date and Time of Spill: May 15th, 2011 approximately 5:00 pm

Duration of Spill: Approximately 5 minutes for the hydraulic fluid to spill out of two pole top transformers.

Material Spilled (concentration): Univis Bio 40 Hydraulic Fluid

Amount Spilled: 200-243 L

Cause: Power pole severed near the base. Two of the three transformers attached to the pole spilled onto the ramp leading down to the 3 South Pit Pump Station.

Effect of the Spill: Spill was contained within the 3 South pit pond. The soil and the water where the spill occurred at the 3 South pit pond have been contaminated with the hydraulic fluid.

Steps taken to contain and control the spill: Absorbent pads and booms were used to contain and clean up the spilled hydraulic fluid. The pads were replaced repeatedly until they remained white and no oil slick was observed on the water. The soil will be removed and remediated.

Spilled on What? Disturbed mine area.

Proximity to sensitive environment or property lines? Approximately 175 m to No Name Lake.

Corrective actions taken: Power pole was replaced without the three transformers.

Agencies on scene: Vancouver Island Power Lines Inc.
Quinsam Coal: Environmental Technician, Surface Foreman, Electrician and maintenance crew.

Persons or agencies advised: Provincial Emergency Program, Ministry of Environment.

Incident:

At approximately 5:00 PM on May 15th, 2011 a power pole supporting three pole - top transformers broke in half, spilling approximately 200-243 L of UNIVIS BIO 40 hydraulic fluid onto the ground, and then drained into the 3 South pit pond. The Environmental Technician was notified on Monday at 11:00 am and immediately responded to the cleanup of the spill. The spill was reported to PEP at approximately 2:30 pm on Monday May 16th, 2011. The hydraulic fluid was tested for PCB's. The results produced PCB free material. Vancouver Island Power Lines Inc. were at the scene when the Environmental Technician arrived. The old pole was taken out and a new pole was installed.

Corrective Actions

The pumps were shut off immediately with no water leaving the 3 South pit pond. An absorbent floating boom was deployed trapping the majority of the spilled oil into a confined area. Approximately eight bags containing 200 absorbent pads were applied to the water surface in the 3 South pit pond. The saturated absorbent pads were removed and placed in drums. Fresh pads were applied until no further hydraulic fluid was observed on the surface of the water and the absorbent pads remained white. This was performed over a period of one week. The contaminated soils will be relocated to an area for further remediation.

Environmental Risks

As the spill was contained within the disturbed area near the 3 South pit pond, with no effluent escaping or entering the water management system, the risk may be deemed as low. Pumping at the 3 South Pit will not be initiated until October when the heavy rains start. The water will be sampled for Oil and Grease prior to and during the commencement of pumping as recommended by the MOE.

Actions

As this represent a spill in excess of the reportable limit of 100L a report has been filed with PEP (1-800 663-3456) Report Number DGIR # 110468.

Prevention

The Power pole should have been inspected before installation. More than one anchor line should have been used to support the pole at the terminus of the line.

Contact Information

Quinsam Coal Corporation

Hwy 28, KM 12, Argonaut Main,

PO Box 5000

Campbell River, B.C.

V9W 8A3

Phone 250-286-3224

Spill Report Record

Spill Reporter: Kathleen Russell

Spill Location: Quinsam Coal Mine, behind the warehouse at the maintenance shop/fuel up station.

Date and Time of Spill: May 17th, 2011 approximately 7:00 am

Duration of Spill: Approximately 10 minutes for the hydraulic fluid to spill out of the container.

Material Spilled (concentration): Titan MP Transmission fluid, (hydraulic oil).

Amount Spilled: Approximately 190 L

Cause: Man carrier pulled in to fuel up and hit the drain spigot on the lube cube, breaking it off. The lube cube contained approximately 800 L of hydraulic fluid.

Effect of the Spill: Spill was contained upon the concrete pad and curbs.

Steps taken to contain and control the spill: Rags were used to create a temporary plug, preventing additional fluid from draining out of the lube cube. The oil water separator valve was closed to prevent the spilled fluid from draining into the water management system. The hydraulic fluid that was spilled was pumped back into a spill container. Newalta pumped the waste oil that was spilled from the containers and

removed all of the used spill control pads and rags from the spill site. Walco Industries supplied a vacuum truck to remove the large volume of contaminated mud from the concrete pad and the oil-water separator. All of the contaminated mud from the concrete pad and the oil water separator was removed from site and taken to an approved waste management facility in Nanaimo.

Spilled on What?

Concrete Pad within disturbed Mine Land, inside the water management area of the mine.

Proximity to sensitive environment or property lines? Approximately 600 m to Middle Quinsam Lake.

Corrective actions taken: Workers have been informed to take caution when fueling up equipment. Straw Bales have been put in front of the oil water separator to aid in the absorption of mud and prevent any mud from entering the oil-water separator. Maintenance staff repositioned the lube cubes to prevent a similar recurrence.

Agencies on scene: Walco Industries, Newalta and QCC staff.

Persons or agencies advised: Provincial Emergency Program, Ministry of Environment.

Incident:

At approximately 7:00 AM on May 17th, 2011 a Man Carrier was entering the warehouse to fuel up. The man carrier bumped into the drain spigot at the bottom of a bulk hydraulic lube-cube containing 800 L of hydraulic fluid, spilling approximately 190 L of hydraulic fluid onto the contained concrete pad. The Environmental Technician was notified on Tuesday Morning at 7:30 am and immediately responded to the cleanup of the spill. The spill was reported to PEP at approximately 2:30 pm on Tuesday May 17th, 2011. The spilled hydraulic oil was pumped out of the concrete pad into the containment drum. Due to the amount of mud within the concrete pad that had been contaminated, Walco Industries was called out with a vacuum truck. The vacuum truck removed the contaminated mud from the concrete pad and the oil-water separator and transported the material off-site to an approved waste management facility in Nanaimo. Newalta was called to pump out the container of waste hydraulic fluid that had been spilled.

Corrective Actions

The oil-water separator valve was closed and the spilled hydraulic fluid was pumped back into a container. Newalta Inc. and Walco Industries Inc. were called to assist with the cleanup of the spill.

Environmental Risks

As the spill was contained upon the concrete pad with no spilled fluid escaping or entering the water management system, the risk may be deemed as low.

Actions

As this represent a spill in excess of the reportable limit of 100L a report has been filed with PEP (1-800 663-3456) Report Number DGIR # 110474.

Prevention

The shop foreman will host a meeting with all employees to remind them to be aware of their surroundings, while operating equipment. Once a new fueling station is operational, it will prevent the frequency of spills behind the warehouse.

Contact Information

Quinsam Coal Corporation

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Phone 250-286-3224

APPENDIX IX

BENCH SCALE PASSIVE TREATEMENT TESTING RESULTS

TECHNICAL MEMORANDUM

Date:	September 21, 2011	**Project No.:**	113-81501
To:	Gary Gould	**Company:**	Hillsborough Resources Limited
From:	Eric Blumenstein		
cc:	Jim Gusek, Ryan Schipper	**Email:**	eblumenstein@golder.com
RE:	**BENCH SCALE PASSIVE TREATMENT TESTING RESULTS**		

1.0 BACKGROUND AND PURPOSE OF BENCH SCALE TESTING

A bench scale passive treatment system was constructed by Golder Associates Inc. (GAI) at the Hillsborough Resources Limited (HRL) Quinsam Mine Site (Quinsam) west of Campbell River, British Columbia from 28 – 31 March 2011. The bench scale passive treatment system consisted of a feed tank, influent distribution piping, five biochemical reactor (BCR) cells, and eventually, three sulphide polishing cells. The BCR cells were constructed for the purpose of testing different substrate mixtures to optimize sulfate reduction to sulphide. The sulphide polishing cells were included to test for sequestration of sulphide produced in the BCR effluent. Each of the BCR cells was constructed using 55-gallon (approximately 200 liters) plastic drums, and each of the sulphide polishing cells was constructed using 5-gallon (approximately 20 liters) plastic buckets.

This technical memorandum provides an assessment of the test data. It includes sections on experimental setup, field and analytical results, and a substrate mixture recommendation. This specific mixture should be used in the construction of a demonstration or full scale system in the future. A recommended process flow, with appropriate unit operations, is also given.

2.0 BENCH SCALE CONSTRUCTION

The bench setup was constructed by Eric Blumenstein (GAI) and Kathleen Russell (Quinsam) with substrate materials collected by HRL and Quinsam personnel. A plastic feed tank, feed pump, and float level controls were used from a test system that had been previously constructed and operated. The influent distribution piping was installed, followed by the construction of the BCR cells. The feed tank, influent distribution piping, and 55-gallon drums are shown in Figure 1.

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Figure 1: Bench Feed Tank, Influent Distribution Piping, and 55 gallon Plastic Drums

The substrate materials were combined in five mixtures which were formulated to be most likely to reduce sulphate to the desired effluent concentration. A summary of the substrate mixtures is provided in Table 1. Iron substrate was added to BCR3 and BCR4 to provide a sacrificial iron source which would sequester the sulphide produced in the cell (via biological sulphate reduction) and precipitate out as an iron sulfide particulate. BCR1, BCR2, and BCR5 were constructed with a more typical substrate mixture that is designed to biologically reduce sulphate, but not sequester it in the cell. A sixth drum, seen on the far right in Figure 1, was prepared as a spare but not used during testing.

Table 1: Bench BCR Cell Mixtures on an As-Received Weight Basis

Substrate	BCR1	BCR2	BCR3	BCR4	BCR5
Wood Chips	74.7%	59.7%	53.7%	50.7%	74.7%
Sawdust	0%	15%	0%	0%	0%
Hay	10%	10%	10%	10%	10%
Limestone Chips	15%	15%	10%	7%	15%
Iron Mine Slag	0%	0%	0%	32%	0%
Hedin Iron	0%	0%	26%	0%	0%
Animal Manure (Inoculum)	0.3%	0.3%	0.3%	0.3%	0.3%
Total	100%	100%	100%	100%	100%
Logic	Baseline 1 Woodchips	Baseline 2 Wdchp+Swdst	Hedin Iron $Fe(OH)_3$	Iron Mine Slag 40% Iron	Baseline 1 Woodchips

Substrates were mixed in their respective ratios for each BCR cell and placed in the 55-gallon plastic drums in 15-cm lifts. After each 15-cm lift was placed, the substrate was compacted to eliminate any empty pockets and prevent short-circuiting particularly along the cell wall. The substrates are shown pre and post mixing in Figure 2. Mixed substrate shown being placed in the 55-gallon BCR cell in lifts, and after compaction, is shown in Figure 3.

Figure 2: Substrate Before (left) and after (right) Mixing

Figure 3: Substrate Placed in BCR Cell in Lift and After Compaction

Once the mixed substrate was placed in the BCR cells, influent piping (including a flow control valve) and effluent tubing was installed on each of the cells (Figure 4). The effluent tubing was connected to a hose that conveys the BCR effluent to a common header pipe that is buried. The effluent from each of the BCR cells combines in the buried header and is carried to a drainage ditch nearby.

After the piping/tubing was installed, water was added to each of the BCR cells to a level of approximately 5 cm above the top of the substrate. The volume of water added to each BCR cell was recorded. The porosity of the substrate was estimates by dividing the volume of water added by the in-place volume of the substrate. This calculation included an adjustment for the 5 cm of substrate submergence. The BCR

cells were then insulated with hay and wood chips to protect against the cold spring conditions. The final bench test site is shown in Figure 5.

Figure 4: Influent Piping, Flow Control Valve, and Effluent Tubing Flowing to Buried Discharge Header

Figure 5: Completed Bench Test Site with Insulation around BCR Cells

After the BCR cells had been flushed and had reached a steady state with respect to sulphate reduction (near the beginning of July), a sulphide polishing cell was added to the effluent of BCR1, BCR2, and BCR5 in an attempt to sequester the excess sulphide leaving the respective BCR cells as an iron sulphide particulate. Since BCR3 and BCR4 contained a sacrificial iron source internal to the substrate in the cell, they did not need sulphide polishing and the BCR effluent from those cells was sent directly to the buried effluent header and was discharged.

3.0 BENCH FLOW RATE

After a seven day incubation period, the test began on 7 April with the initiation of flow to the BCR cells from the feed tank at approximately 4 mL/min to each cell. This flow rate was selected because it resulted in a 14-day hydraulic retention time (HRT), which was found to be the appropriate HRT by previous studies. The first analytical data was received near the end of April, and it showed that sulphate reduction was not occurring in the BCR cells. Flow was suspended from 18 May through 9 June to further incubate the BCR cells for the purpose of developing a healthy microbial consortium capable of reducing sulphate levels to the concentration desired (approximately 50% reduction).

Upon restarting flow on 9 June, the BCR cells BCR1, BCR2, BCR4, and BCR5 began reducing sulphate immediately. BCR3 began reducing sulphate approximately three weeks later. Flow remained unchanged to the BCR cells from 9 June until 18 August, when the flow delivered to BCR3 and BCR4 was doubled to approximately 8 mL/min. Cells BCR3 and BCR4 were selected for an increased flow rate because they had exhibited nearly complete sulphate reduction and their effluents were not subject to further sulphide polishing. Flow has remained at this rate (4 mL/min for BCR1, BCR2, BCR5 and 8 mL/min for BCR3, BCR4) to the present day.

4.0 DATA ANALYSIS

Once a week, field parameters were monitored and samples were collected and sent to Maxxam Analytics (4606 Canada Way; Burnaby, British Columbia V5G 1K5) for analytical testing.

Figure 6 through Figure 17 graphically compare the data/results of the five bench BCR cells with respect to the following parameters:

- pH (Figure 6)
- Temperature (Figure 7)
- Conductivity (Figure 8)
- Oxidation Reduction Potential (Figure 9)
- Flow Rate (Figure 10)
- Sulphate Concentration (Figure 11 and Figure 12)
- Sulphate Removal (Figure 13 and Figure 14)
- Sulphide Concentration (Figure 15)

- Biochemical Oxygen Demand (Figure 16)
- Pore Volumes Treated (Figure 17)
- Arsenic Concentration (Figure 18)
- Iron Concentration (Figure 19)
- Manganese Concentration (Figure 20)

Graphs were developed using the field data collected by Quinsam personnel during the weekly sampling events and the Maxxam Analytics analytical results.

4.1 Field Measurements

Field sampling reports are provided in Appendix A.

4.1.1 pH (Figure 6)

The influent pH to the bench cells averaged 8.3 standard units. The pH in the BCR1 effluent averaged 7.0 s.u., BCR2 effluent averaged 6.5 s.u., BCR3 effluent averaged 7.0 s.u., BCR4 effluent averaged 6.9 s.u., and BCR5 effluent averaged 6.9 s.u. Influent and BCR effluent average pH values are presented in Table 2. BCR2 pH values were consistently lower than that of the other cells, but all BCR effluent pH values were above 6.0 s.u. after flow was restarted on 9 June.

Table 2: Average pH Values During Bench Testing (standard units)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	8.3	7.0	6.5	7.0	6.9	6.9

On the 28 July sampling event, the pH observed in most of the BCR cells was very high (8.4 – 11.8 s.u.); there were also unusually high ORP values and unusually low sulphide values exhibited in that sampling event. It is believed that the pH values observed during this sampling event are erroneous, as there were acceptable sulfate reduction values in that sampling event as well as the sampling events prior to and after it.

4.1.2 Temperature (Figure 7)

The influent temperature to the bench cells averaged 13.6° C. The temperature in the BCR1 effluent averaged 13.1° C, BCR2 effluent averaged 12.6° C, BCR3 effluent averaged 12.3° C, BCR4 effluent averaged 12.3° C, and BCR5 effluent averaged 12.2. Influent and BCR effluent average temperatures are presented in Table 3.

Table 3: Average Temperature During Bench Testing (degrees Celsius)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	13.6	13.1	12.6	12.3	12.3	12.2

Temperatures during the first month after the initial start-up were below 10° C. This is believed to have played a role in the lack of biological activity that prompted the second incubation period. During the second incubation period the temperature was above 10° C the entire time. This temperature observation should influence start-up activities of a demonstration or full-scale system, as Golder believes it is very difficult to develop a healthy microbial consortium with water temperatures much below 10° C. After system maturity is reached, however, BCRs have been found to acceptably tolerate temperatures less than this threshold.

4.1.3 Conductivity (Figure 8)

The influent electric conductivity to the bench cells averaged 2.1 mS/cm. The conductivity in the BCR1 effluent averaged 2.4 mS/cm, BCR2 effluent averaged 2.4 mS/cm, BCR3 effluent averaged 3.5 mS/cm, BCR4 effluent averaged 2.5 mS/cm, and BCR5 effluent averaged 2.5 mS/cm. Influent and BCR effluent average conductivity are presented in Table 4.

Table 4: Average Conductivity During Bench Testing (mS/cm)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	2.1	2.4	2.4	3.5	2.5	2.5

Conductivity at the initial and second start-up was elevated for all cells. Once small particles and labile organics had been flushed from the BCRs and they reached steady-state conditions, the conductivity in all of the cell effluents was virtually equal to the conductivity of the influent.

4.1.4 Oxidation Reduction Potential (Figure 9)

The influent oxidation reduction potential (ORP) to the bench cells averaged -35 mV. The ORP in the BCR1 effluent averaged -130 mV, BCR2 effluent averaged -118 mV, BCR3 effluent averaged -86 mV, BCR4 effluent averaged -89 mV, and BCR5 effluent averaged -113 mV. Influent and BCR effluent average ORP are presented in Table 5. In general, BCR1, BCR2, and BCR5 exhibited lower ORP readings than BCR3 and BCR4, which may be due to the sacrificial iron sources that were present in the substrate mixtures of BCR3 and BCR4.

Table 5: Average ORP During Bench Testing (mV)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	-35	-130	-118	-86	-89	-113

On the 28 July sampling event, the ORP of most of the BCR cells was uncharacteristically high (124-222 mV); there were also unusually high pH values and an unusually low sulphide values associated with that sampling event. It is believed that the ORP values observed during this sampling event are erroneous, as there were acceptable sulfate reduction values in that sampling event as well as the sampling events prior to and after it.

4.1.5 Flow Rate (Figure 10)

The flow rate to BCR1 averaged 3.9 mL/min, BCR2 flow rate averaged 3.9 mL/min, BCR3 flow rate averaged 4.5 mL/min, BCR4 flow rate averaged 4.5 mL/min, and BCR5 flow rate averaged 3.8 mL/min. Average flow rates to each of the BCR cells are presented in Table 6. The BCR3 and BCR4 average flow rates were higher than the other cells due to the increased flows delivered to those cells during the last three weeks of testing, as discussed in section 3.0 – Bench Flow Rate.

Table 6: Average Flow Rate During Bench Testing (L/min)

	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	3.9	3.9	4.5	4.5	3.8

4.2 Analytical Results

Analytical data reports are provided in Appendix B.

4.2.1 Sulphate (Figure 11 and Figure 12)

The influent sulphate concentration of the water delivered to the bench cells averaged 513 mg/L. The sulphate concentration in the BCR1 effluent averaged 209 mg/L, BCR2 effluent averaged 209 mg/L, BCR3 effluent averaged 682 mg/L, BCR4 effluent averaged 220 mg/L, and BCR5 effluent averaged 256 mg/L (Table 7 and Figure 11).

The average sulphate concentrations are misleading due to the lack of sulphate reduction during the first month of testing. When those values are removed from the analysis, and only sulphate concentrations from 9 June through 1 September are considered, the sulphate reduction is much improved. During this period, the influent sulphate concentration of the water sent to the bench cells averaged 533 mg/L; the sulphate concentration of BCR1 effluent averaged 106 mg/L, BCR2 effluent averaged 106 mg/L, BCR3

effluent averaged 245 mg/L, BCR4 effluent averaged 140 mg/L, and BCR5 effluent averaged 175 mg/L (Figure 12).

Table 7: Average Sulphate Concentrations During Bench Testing (mg/L)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	513	209	209	682	220	256
9 June – 1 September	533	106	106	245	140	175

Compared to the other cells, BCR3 took about two to three weeks longer to begin reducing sulphate. If the 9 June and 16 June values are removed from the analysis, the 23 June through 1 September sulphate concentration for BCR3 effluent averaged 120 mg/L.

4.2.2 Sulphate Removal (Figure 13 and Figure 14)

The sulphate removal rate for BCR1 averaged 0.116 mol/m^3/day, BCR2 averaged 0.116 mol/m^3/day, BCR3 averaged -0.025 mol/m^3/day, BCR4 averaged 0.129 mol/m^3/day, and BCR5 averaged 0.097 mol/m^3/day. (Figure 13). Average sulphate removal rates for each of the BCR cells are presented in Table 8.

The average sulphate removal rates are misleading due to the lack of sulphate reduction during the first month of testing. When those values are removed from the analysis, and only sulphate removal rates from 9 June through present are included, the rates are much improved. During this period, the sulphate removal rate of BCR1 averaged 0.162 mol/m^3/day, BCR2 averaged 0.163 mol/m^3/day, BCR3 averaged 0.145 mol/m^3/day, BCR4 averaged 0.174 mol/m^3/day, and BCR5 averaged 0.136 mol/m^3/day (Figure 14).

Table 8: Average Sulphate Removal Rate During Bench Testing (mol/m^3/day)

	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	0.116	0.116	-0.025	0.129	0.097
9 June – 1 September	0.162	0.163	0.145	0.174	0.136

BCR3 required about two to three weeks longer than the other cells to begin reducing sulphate. If the 9 June and 16 June values are removed from the analysis, the 23 June through 1 September sulphate removal rate for BCR3 averaged 0.205 mol/m^3/day, which is the best value of all five cells.

Due to the HRT constraints at 4 mL/min (the flow rate sent to the cells for the majority of bench testing), 0.20 mol/m^3/day was the resulting removal rate if all the sulphate was reduced/removed. When the flow rates in BCR3 and BCR4 were doubled, the sulphate removal rates gradually increased to

0.40 mol/m^3/day. The benchmark sulphate reduction rate used for a typical substrate mixture is 0.30 mol/m^3/day. Due to the results seen BCR3 and BCR4 once the flow rate was increased, it is reasonable to expect that all of the bench BCR cells would achieve the 0.30 mol/m^3/day benchmark removal rate if their flows were to increase.

4.2.3 Sulphide (Figure 15)

The influent sulphide concentration of the water sent to the bench cells averaged 0.01 mg/L. The sulphide concentration in the BCR1 effluent averaged 24.2 mg/L, BCR2 effluent averaged 18.0 mg/L, BCR3 effluent averaged 0.05 mg/L, BCR4 effluent averaged 0.28 mg/L, and BCR5 effluent averaged 11.8 mg/L. Influent and BCR effluent average sulphide concentrations are presented in Table 9.

Table 9: Average Sulphide Concentration During Bench Testing (mg/L)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	0.01	24.2	18.0	0.05	0.28	11.8

BCR1, BCR2, and BCR5 effluents exhibit elevated sulphide levels as was expected, since their substrate mixtures did not include sacrificial iron. Conversely, BCR3 and BCR4 maintained near non-detect sulphide levels, likely due to the sacrificial iron source present in those cells.

On the 28 July sampling event, the sulfide of all of the BCR cells approached non-detect levels (0.01 mg/L); there were also unusually high pH values and unusually high ORP values in that sampling event. It is believed that the sulphide values observed during this sampling event are erroneous, as there were acceptable sulfate reduction values in that sampling event as well as the sampling events prior to and after it.

4.2.4 Biochemical Oxygen Demand (Figure 16)

The influent biochemical oxygen demand (BOD) concentration of the water sent to the bench cells averaged 106 mg/L; however, this value is significantly skewed by one data point (1,820 mg/L on 9 June). If the 9 June data point is removed as an outlier, the average influent BOD drops to 5 mg/L. It is believed that the 9 June sample was erroneously high due to contamination or sample mislabeling. The BOD concentration of BCR1 effluent averaged 672 mg/L, BCR2 effluent averaged 1,155 mg/L, BCR3 effluent averaged 864 mg/L, BCR4 effluent averaged 1,141 mg/L, and BCR5 effluent averaged 1,033 mg/L. Influent and BCR effluent average BOD concentrations are presented in Table 10.

Table 10: Average BOD Concentration During Bench Testing (mg/L)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	106 (5)	672	1,155	864	1,141	1,033
7 July – 1 September	5	313	934	279	256	397

The average BOD concentrations are misleading due to the elevated amount of particulates and labile organic materials being flushed from the cells during the two start-up periods. Considering the data in Figure 16, it is evident that the BOD concentrations dropped steadily through the course of the bench testing. All BCR cells exhibited effluent BOD concentrations under 300 mg/L (and most under 100 mg/L) during the final few weeks of bench testing considered in this report. The more water the BCR cells received, the lower the effluent BOD concentrations became. This will be an important consideration during start-up of a demonstration or full-scale system as the initial high BOD effluent should not be sent to a sulphide polishing cell until the majority of particulates are flushed from the cell and BOD levels drop. In the interim, the BCR effluent flow should be sent directly to the aerobic polishing system for polishing prior to discharge.

4.2.5 Pore Volumes Treated (Figure 17)

Figure 17 displays the amount of pore volumes treated during bench testing. Pore volumes treated for each BCR cell are calculated using Equation 1:

$$Pore\ Volumes\ Treated = T \div \left[\frac{V_S \times \eta}{Q}\right] \qquad \text{Equation 1}$$

where T = duration of flow sent to cell (days), Vs = volume of substrate in the BCR cell (liters), η = porosity of the substrate, and Q = flow rate sent to the BCR cell (liters/day).

Establishing the relationship between pore volumes treated and a decrease in BOD concentrations to manageable levels is an important start-up consideration of a future demonstration or full-scale system.

Comparing the BOD concentration plot (Figure 16) against the pore volumes treated chart (Figure 17), it appears that BOD concentrations typically dropped to relatively low levels once four to five pore volumes had been treated in each of the cells. It should be noted that BCR2 BOD regression was behind the pace exhibited for all other BCR cells. The repair of a slow leak found in BCR2 at the beginning of the bench testing is responsible for the discrepancy, as the repair delayed flow delivery to BCR2 by about two to three weeks.

4.2.6 Arsenic (Figure 18)

The influent arsenic concentration of the water the bench cells received averaged 0.003 mg/L. The arsenic concentration in the BCR1 effluent averaged 0.281 mg/L, BCR2 effluent averaged 0.079 mg/L, BCR3 effluent averaged 0.075 mg/L, BCR4 effluent averaged 0.066 mg/L, and BCR5 effluent averaged 0.023 mg/L. Influent and BCR effluent average arsenic concentrations are presented in Table 11.

Table 11: Average Arsenic Concentration During Bench Testing (mg/L)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	0.003	0.281	0.079	0.075	0.066	0.023

Arsenic concentrations were analyzed for and included in this report because some arsenic is suspected to be present in the substrate used for all bench BCR cells. A total metals analysis was conducted on each of the substrates used in bench testing. Results showed that there were small amounts of arsenic present in most all of the substrates used (Appendix C). The phenomenon of arsenic leaching from the substrate is one of the reasons that an aerobic polishing system should be included in a demonstration or full-scale system.

The arsenic leached from a BCR cell can be easily co-precipitated as an iron-arsenic hydroxide particulate in aerobic conditions so long as there is at least five times as much iron as arsenic present in the BCR effluent (Langmuir et al., 1999). This will need to be considered in the design of a demonstration or full-scale system.

4.2.7 Iron (Figure 19)

The influent iron concentration of the water sent to the bench cells averaged 0.13 mg/L; the iron concentration in the BCR1 effluent averaged 6.48 mg/L, BCR2 effluent averaged 6.06 mg/L, BCR3 effluent averaged 102 mg/L, BCR4 effluent averaged 91 mg/L, and BCR5 effluent averaged 6.91 mg/L. Influent and BCR effluent average iron concentrations are presented in Table 12.

The average iron concentrations are misleading due to the excess iron leached from the BCR cell during the start-up periods when small particulate matter and labile organics were being flushed from the cells. If the post start-up data alone is used (from 7 July through 1 September), the iron concentrations are closer to those expected under steady state operations. During this period, the influent iron concentration of the water the bench cells received averaged 0.12 mg/L; the iron concentration in the BCR1 effluent averaged 2.02 mg/L, BCR2 effluent averaged 3.91 mg/L, BCR3 effluent averaged 96 mg/L, BCR4 effluent averaged 59 mg/L, and BCR5 effluent averaged 2.66 mg/L.

Table 12: Average Iron Concentration During Bench Testing (mg/L)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	0.13	6.48	6.06	102	91	6.91
7 July – 1 September	0.12	2.02	3.91	96	59	2.66

The elevated iron levels produced by the sacrificial iron source, whether mixed in with the substrate in the BCR cell (as is the case for BCR3 and BCR4) or in a post BCR sulphide polishing cell (as is the case with BCR1, BCR2, and BCR5), will require removal in an aerobic polishing system prior to discharge to the environment for a demonstration or full-scale system.

The iron concentrations present in the BCR3 and BCR4 effluent continually decreased throughout bench testing. This is a concern because those cells were designed with the sacrificial iron source mixed in with the BCR substrate; making it difficult to access the cell for the addition of extra iron should iron levels decrease to a point that they would not be able to sequester all of the sulfide produced in the cell or to co-precipitate with the arsenic in the aerobic polishing portion of the system. Golder also has previous experience at other sites where a sacrificial metal has been mixed with the BCR substrate and decreased to levels to the point that the sacrificial metal was not fulfilling its intended function.

4.2.8 Manganese (Figure 20)

The influent manganese concentration of the water sent to the bench cells averaged 0.026 mg/L; the manganese concentration in the BCR1 effluent averaged 3.08 mg/L, BCR2 effluent averaged 2.67 mg/L, BCR3 effluent averaged 6.13 mg/L, BCR4 effluent averaged 50.1 mg/L, and BCR5 effluent averaged 4.36 mg/L. Influent and BCR effluent average manganese concentrations are presented in Table 13.

The average manganese concentrations are misleading due to the excess manganese leached from the BCR cell during the start-up periods when small particulate matter and labile organics were being flushed from the cells. If the post start-up data alone is used (from 7 July through 1 September), the manganese concentrations are closer to those expected under steady state operations. During this period, the influent manganese concentration of the water the bench cells received averaged 0.006 mg/L; the iron concentration in the BCR1 effluent averaged 1.08 mg/L, BCR2 effluent averaged 1.15 mg/L, BCR3 effluent averaged 2.09 mg/L, BCR4 effluent averaged 8.77 mg/L, and BCR5 effluent averaged 1.19 mg/L.

Table 13: Average Manganese Concentration During Bench Testing (mg/L)

	BCR INF	BCR1 EFF	BCR2 EFF	BCR3 EFF	BCR4 EFF	BCR5 EFF
7 April – 1 September	0.026	3.08	2.67	6.13	50.1	4.36
7 July – 1 September	0.006	1.08	1.15	2.09	8.77	1.19

Manganese concentrations were analyzed for and included in this report because it is apparent that there is some manganese present in the substrate used for all bench BCR cells. A total metals analysis was conducted on each of the substrates used in bench testing which showed that there were small amounts of manganese present in most all of the substrates used (Appendix C). This phenomenon of manganese leaching from the substrate is one of the reasons that there will need to be an aerobic polishing system included in a demonstration or full-scale system.

The manganese leached from the BCR cell will likely be mitigated in part as a manganese dioxide (MnO_2) coating on surfaces in aerobic conditions (Gusek et al., 2011). Manganese may also provide a site for arsenic hydroxide co-precipitation in an aerobic polishing system. This will need to be considered in the design of a demonstration or full-scale system.

4.3 Sulphide Polishing Cell Data

The sulphide polishing cells were not commissioned at the beginning of bench testing to prevent fouling the cells with the small particulate material and labile organics that flushed out of the BCR cells during the first four to five pore volumes of bench testing (discussed in section 4.2.4 – Biochemical Oxygen Demand). The sulphide polishing cells were initially commissioned on approximately 26 July, with adjustments made to the trial set-up in mid-August. Because of the limited amount of representative data, the data from the sulphide polishing cells has not been included in this report and has not been analyzed.

5.0 BENCH TEST PERFORMANCE SUMMARY

The primary focus of the bench BCR testing was to determine if the BCR cells could effectively remove 50% of the sulphate present in water representing the water that will be collected from the Long Lake Seep, to determine the appropriate substrate mixture, and to determine the recommended process flow and unit operations to be used for a demonstration or full-scale passive treatment system. The Quinsam bench testing can be characterized by five distinct phases:

- Initial Incubation Period (31 March – 6 April)
- Primary Start-up Period (7 April – 12 May)
- Second Incubation Period (13 May – 8 June)
- Second Start-up Period (9 June – approximately 7 July)
- Steady-State Operations (approximately 7 July – 1 September)

The Steady-State Operations period of bench testing provided data that is most representative of what would be expected during the operation of a demonstration or full-scale BCR cell. During this period, each of the substrate mixtures successfully removed, on average, over 50% of the influent sulphate concentration. Based on the results collected from the Steady State Operations portion of the bench test, combined with Golder's previous experience with scaling small-scale BCR bench systems up to demonstration size systems, Golder is confident that these bench test results provide the necessary information for selecting a substrate mixture that will achieve the desired sulphate reduction.

While the sulphide polishing cell testing did not provide any usable data for the purposes of sulphide sequestration, BCR3 and BCR4 results suggest that the sacrificial iron sources selected are capable of sequestering sulphide if the BCR effluent is exposed to the iron media before it is exposed to oxidizing conditions.

The aerobic polishing system was not tested during bench testing because it is very difficult to acquire representative data for polishing cells in the small-scale and the short-duration of a bench test. This is one of the main reasons that Golder recommends designing a demonstration system that can handle a portion of the flow of a full-scale system, for the purpose of piloting the sulphide polishing and aerobic polishing systems prior to full-scale construction. This approach will afford HRL and Golder the opportunity to operate a larger system for a longer period of time to observe the results, allowing design of a full-scale system to be modified prior to construction.

6.0 DESIGN OBSERVATIONS FROM BENCH TESTING

Several conditions observed during the course of bench testing influenced the selection of the preferred substrate mixture for a demonstration and/or full-scale system:

- Each of the five BCR cells demonstrated that sulphate can be removed to the levels desired (at least 50% removal);
- Each of the five BCR cells provided sulphate removal rates at the highest levels possible, (approximately 0.20 mol/m^3/day) given the HRT in the cells ;
- When the flow rate sent to the BCR3 and BCR4 cells was doubled, sulphate removal rates increased and eventually doubled as well (approximately 0.40 mol/m^3/day);
- Based on the above observations, the standard benchmark for sulphate removal of 0.30 mol/m^3/day will be used for design of the demonstration and/or full-scale systems;
- While BCR3 and BCR4 provided acceptable sulphide sequestration in situ, the iron levels in their effluent dropped throughout the bench testing. This led to concerns about iron longevity in the BCR as previous sites utilizing sacrificial metal in situ only provided a short period of effective treatment (6 months – 3 years) before additional metal needed to be added to the cell;
- Because of a concern that sacrificial iron mixed with the BCR substrate may not provide sufficient iron for sulphide sequestration beyond the first six months to three years of

operation, a sacrificial iron source will be provided in a separate sulphide polishing cell and not be mixed in the BCR substrate in the demonstration and/or full-scale systems;

- Separation of the BCR (sulphate reduction) and the sulphide polishing cell (sulphide sequestration) portions of the demonstration and/or full-scale systems will allow for maximum flexibility, O&M, and modification of the sulphide polishing step without disturbing the BCR cell;
- Because of a variety of nuisance parameters present in the BCR cell effluent (BOD, TOC, arsenic, manganese, etc.), it is necessary to include an aerobic polishing step in a demonstration and/or full-scale system;
- Due to elevated levels of small particles and labile organic material flushing out of the system during start-up of a BCR, the BCR effluent should not be sent to the sulphide polishing cell or aerobic polishing system until approximately four to five pore volumes of water has been sent through the cell. Interim treatment of the BCR effluent should be diverted directly to the aerobic polishing system;
- Arsenic levels may increase through the BCR cell due to presence in the solid substrate, this is another reason that it is important to have an aerobic polishing system to treat the BCR effluent prior to discharge to the environment;
- Because of the arsenic leached from the BCR substrate, it will be important to have iron and/or manganese in the water sent to the aerobic polishing system, as these materials can help sequester arsenic;
- Because of a need for flexibility in the amount of iron sent to the aerobic polishing system, a bypass will be provided in the demonstration and/or full-scale systems;
- Manganese levels may increase through the BCR cell due to presence in the substrate (this can be turned into a positive, as mentioned above, as manganese can help sequester arsenic in an aerobic system), this is another reason that it is important to have an aerobic polishing system to treat the BCR effluent prior to discharge to the environment.

7.0 PREFERRED SUBSTRATE MIXTURE SELECTION

Based on the observations made during bench testing, presented in section 6.0 – Design Observations from Bench Testing, the substrate mixture used in BCR1 and BCR5 was selected as the preferred substrate mixture. This mixture exhibited the ability to remove sulphate to acceptable concentrations in both cells. Because this mixture does not contain a sacrificial iron source, it will be combined with a sulphide polishing cell. The separation of the sulphate reduction (BCR) and sulphide sequestration (sulphide polishing cell) will provide a maximum amount of flexibility during demonstration of full-scale operations.

8.0 RECOMMENDED DEMONSTRATION SYSTEM PROCESS FLOW

The recommended demonstration system contains three treatment components: a BCR followed by a sulphide polishing cell and an aerobic polishing system. The BCR will be sized to accommodate 25% of the flow of a full-scale system while the sulphide polishing cell and aerobic polishing system will be sized to accommodate 50% of the flow of a full-scale system. The three components were sized in a way that will enable additional cells to be constructed to augment the demonstration system and create a full-scale system in the future. The demonstration system will include piping and valving that will allow for

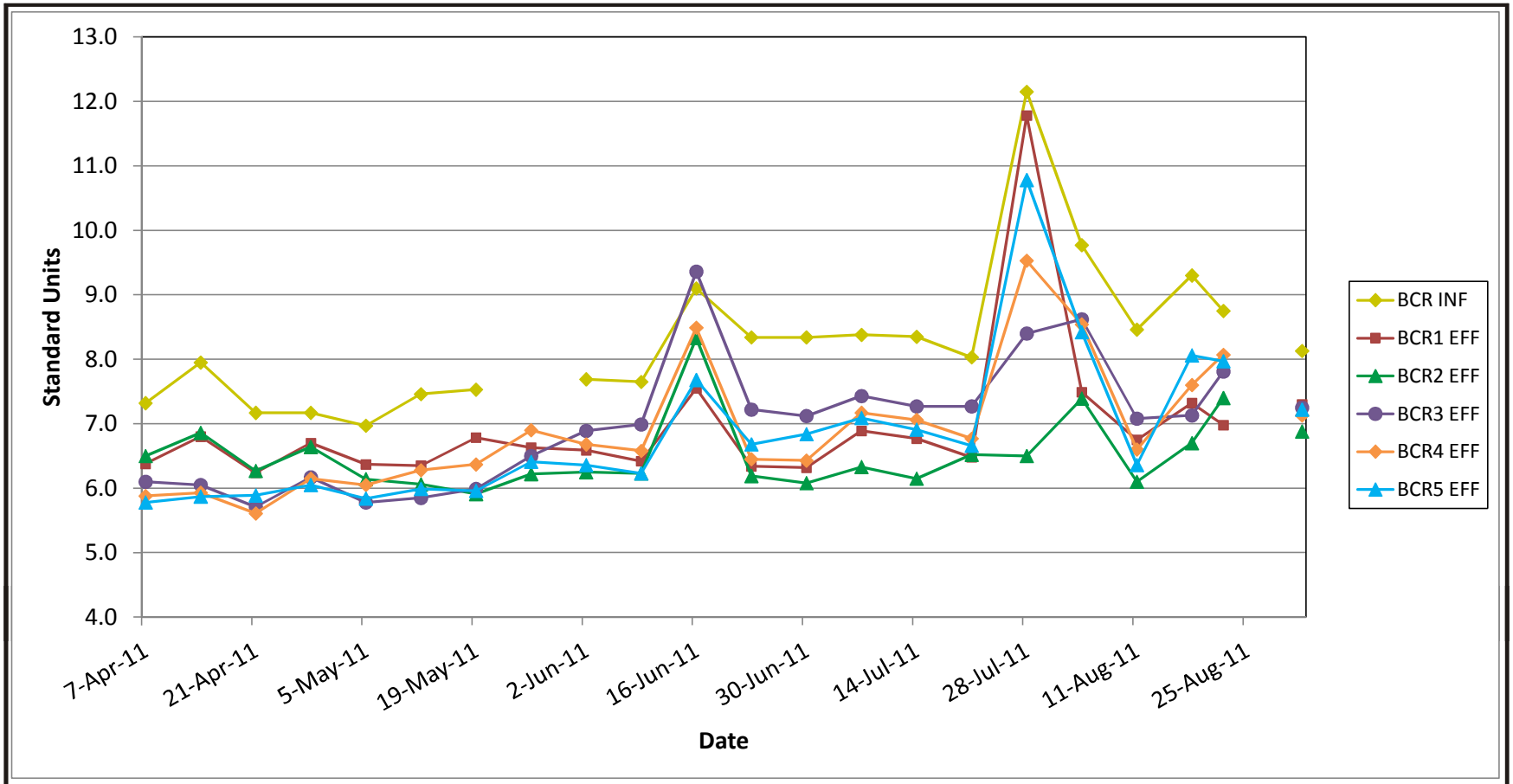
maximum flexibility in flow control of the system. Any individual component may be bypassed, and all cells in a future full-scale system will be able to operate in parallel or in series.

9.0 REFERENCES

Gusek et al., 2011. J. Gusek, L. Josselyn, W. Agster, S. Lofholm, and D. Millsap. "Process Selection & Design of a Passive Treatment System for the Empire Mine State Historic Park, California." 2011 National Meeting of the American Society of Mining and Reclamation, Bismarck, ND **Reclamation: Sciences Leading to Success** June 11 – 16, 2011. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

Langmuir et al., 1999. D. Langmuir, J. Mahoney, A. MacDonald, J. Rowson. "Predicting the Arsenic Source-Term from Buried Uranium Mill Tailings." Proceedings of the Sixth International Conference on Tailings and Mine Waste '99, Fort Collins, CO. January 24-27, 1999. Published by Balkema, Brookfield, VT.

FIGURES



Golder Associates

Denver, Colorado

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

TITLE

Bench BCR Field Data - pH

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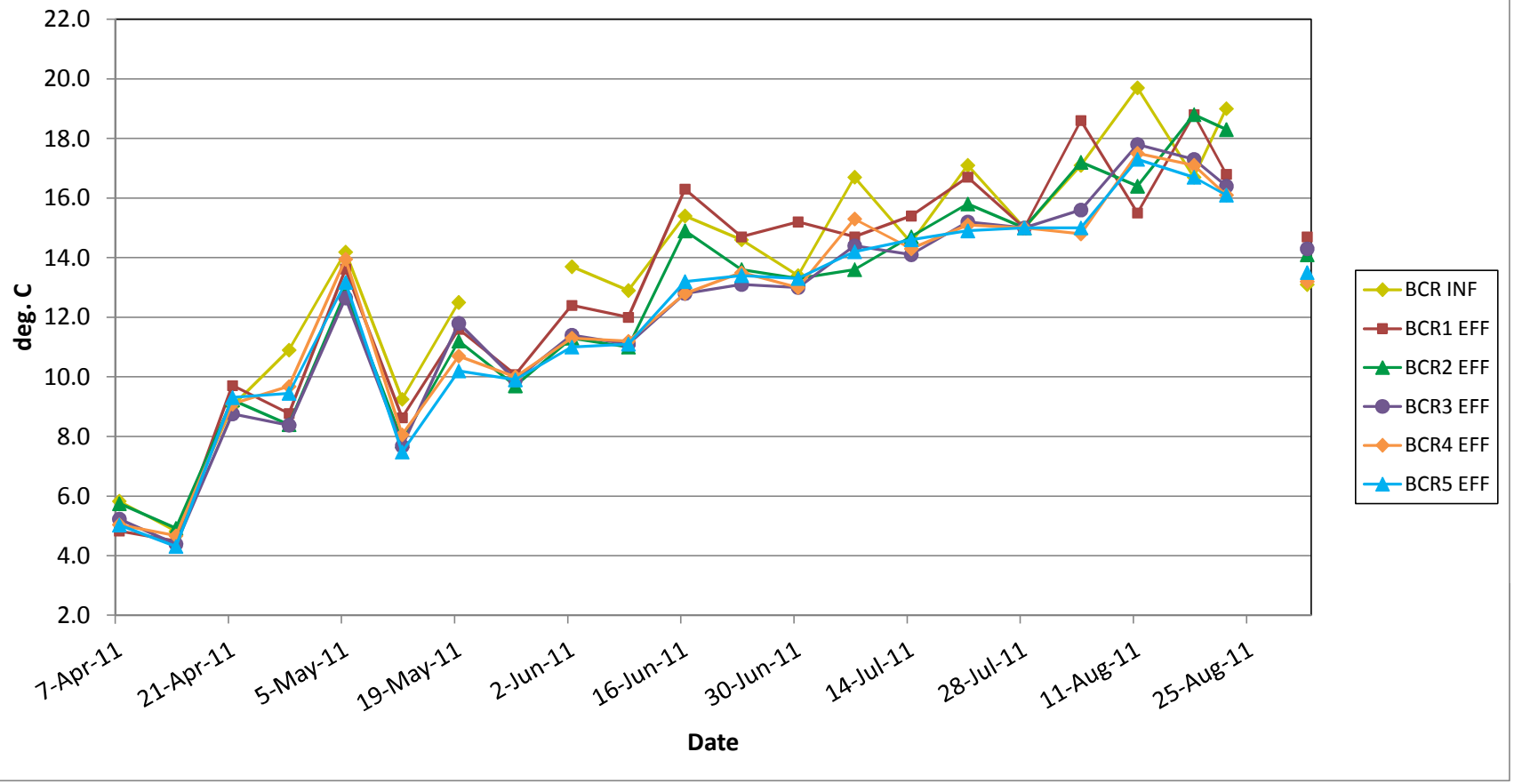

Golder Associates

Denver, Colorado

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

TITLE

Bench BCR Field Data - Temperature

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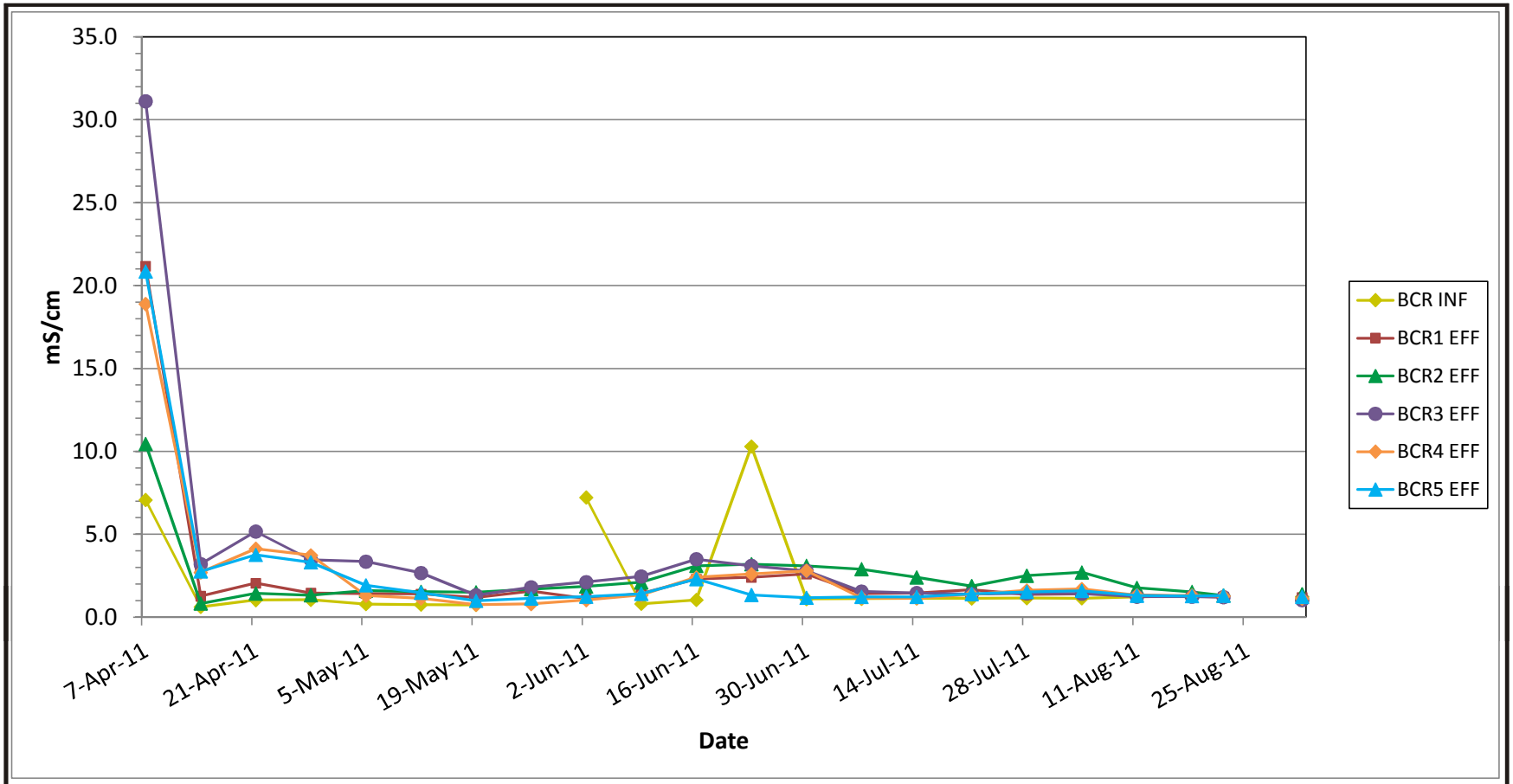

Golder Associates

Denver, Colorado

TITLE

Bench BCR Field Data - Conductivity

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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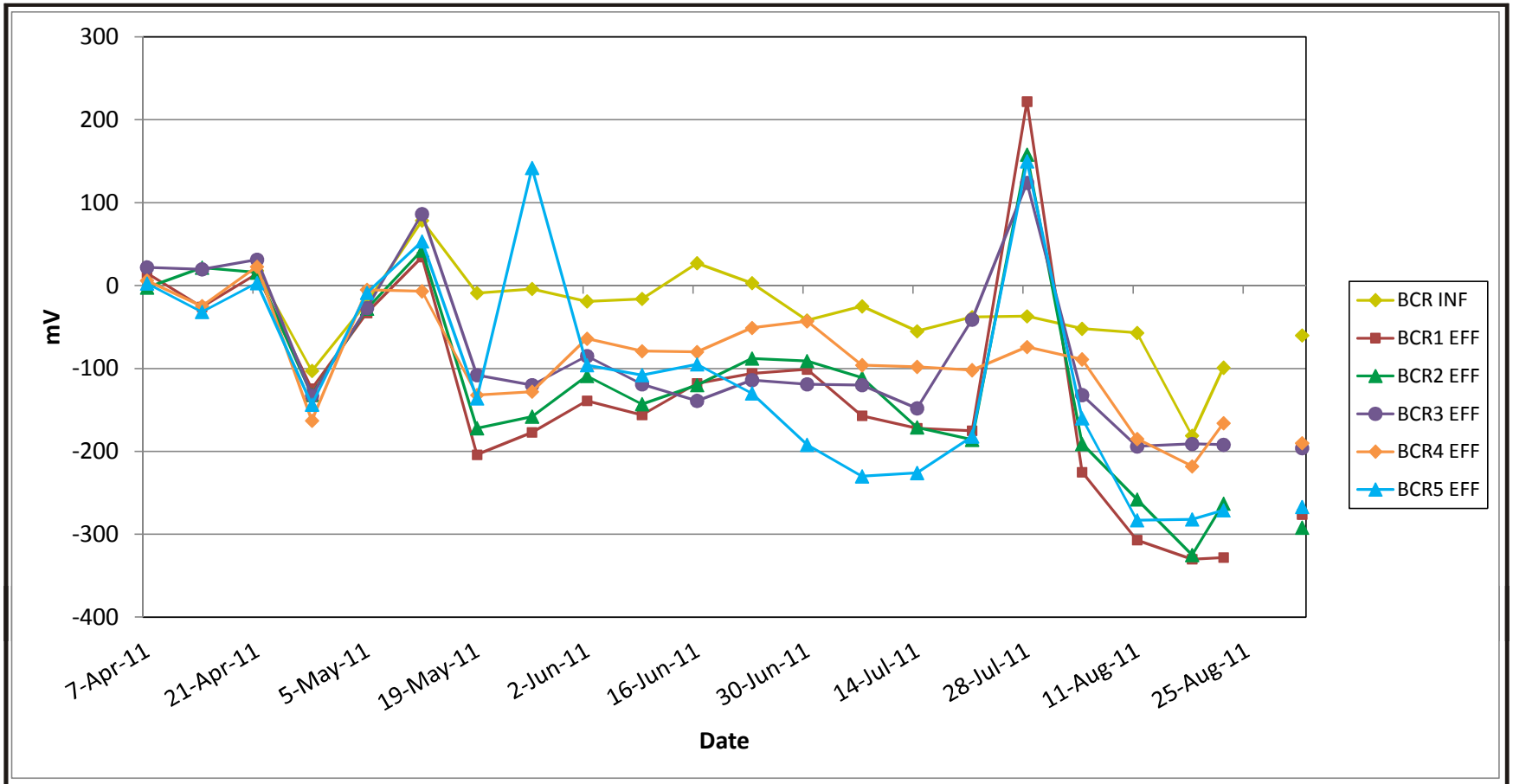

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Denver, Colorado

TITLE

Bench BCR Field Data - ORP

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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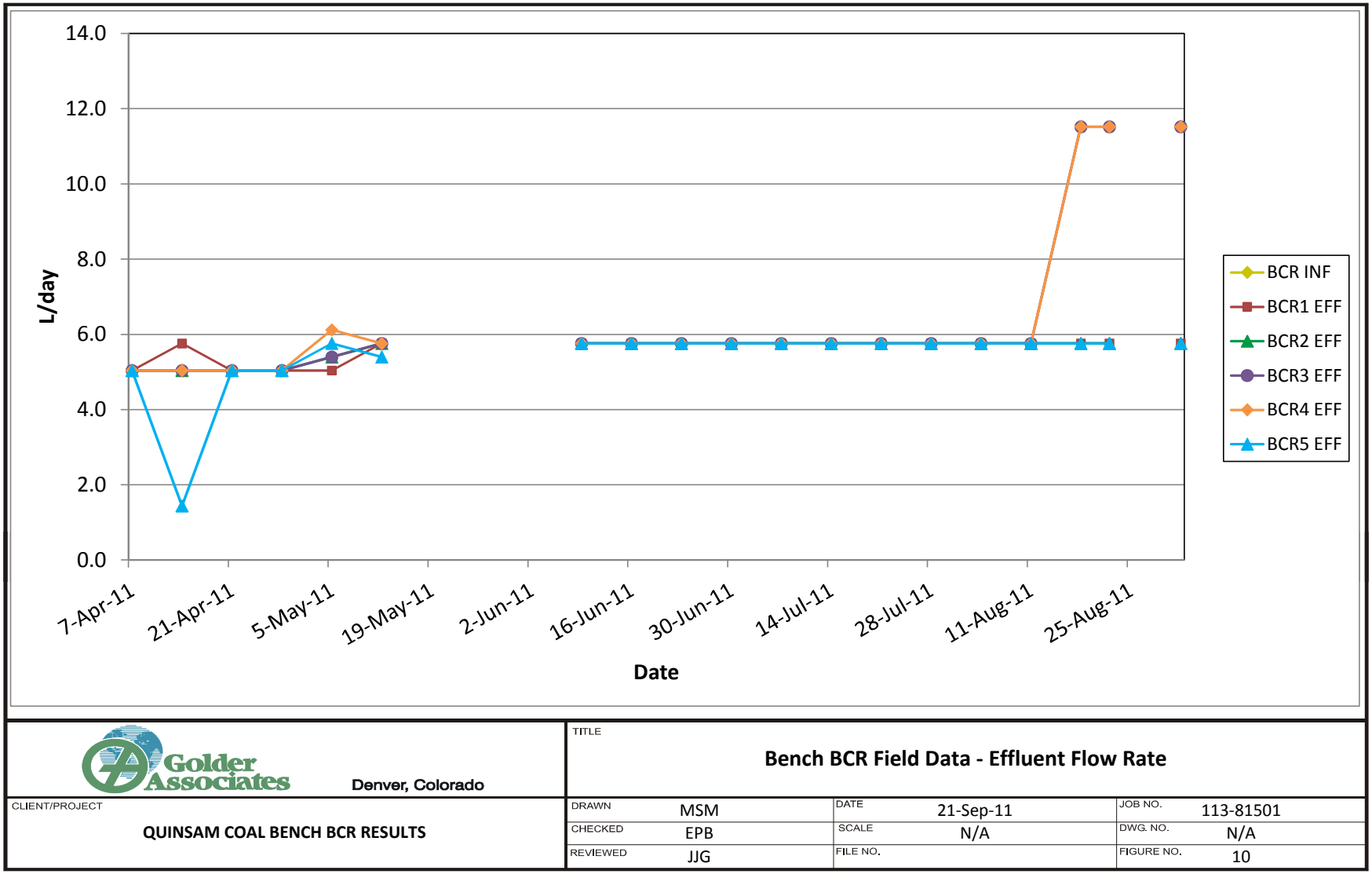

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Denver, Colorado

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

TITLE

Bench BCR Field Data - Effluent Flow Rate

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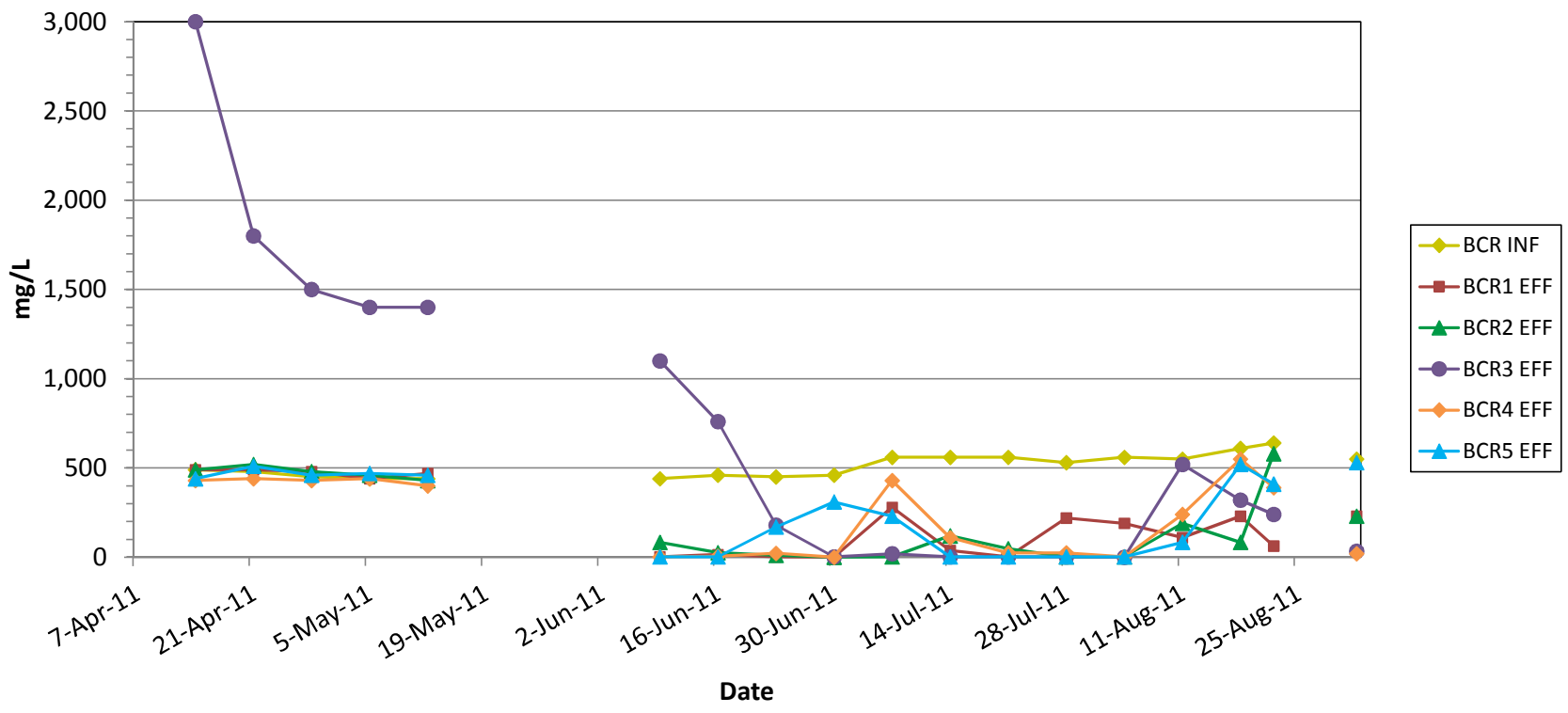

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TITLE

Bench BCR Field Data - Sulfate

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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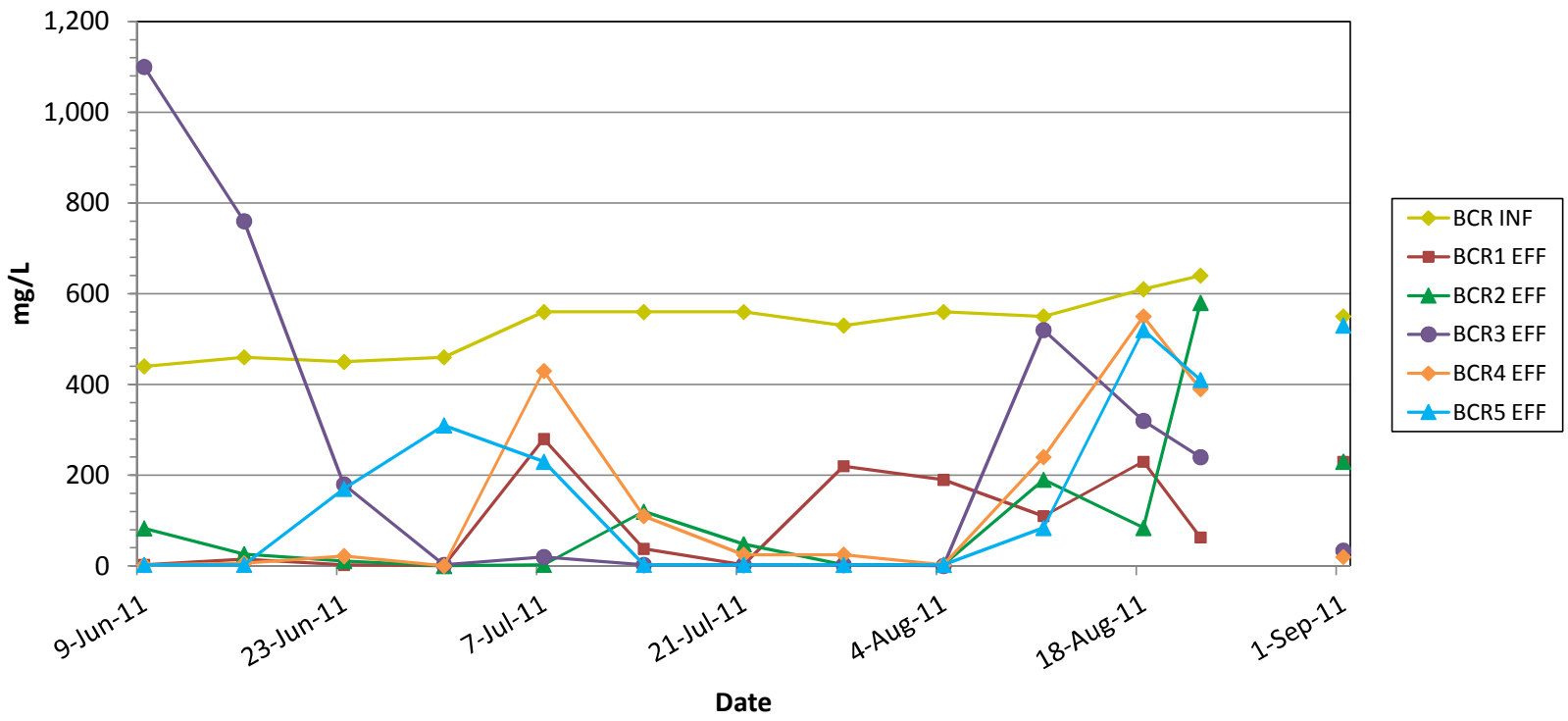

Golder Associates

Denver, Colorado

TITLE

Bench BCR Field Data - Sulfate (Post 9 June 2011)

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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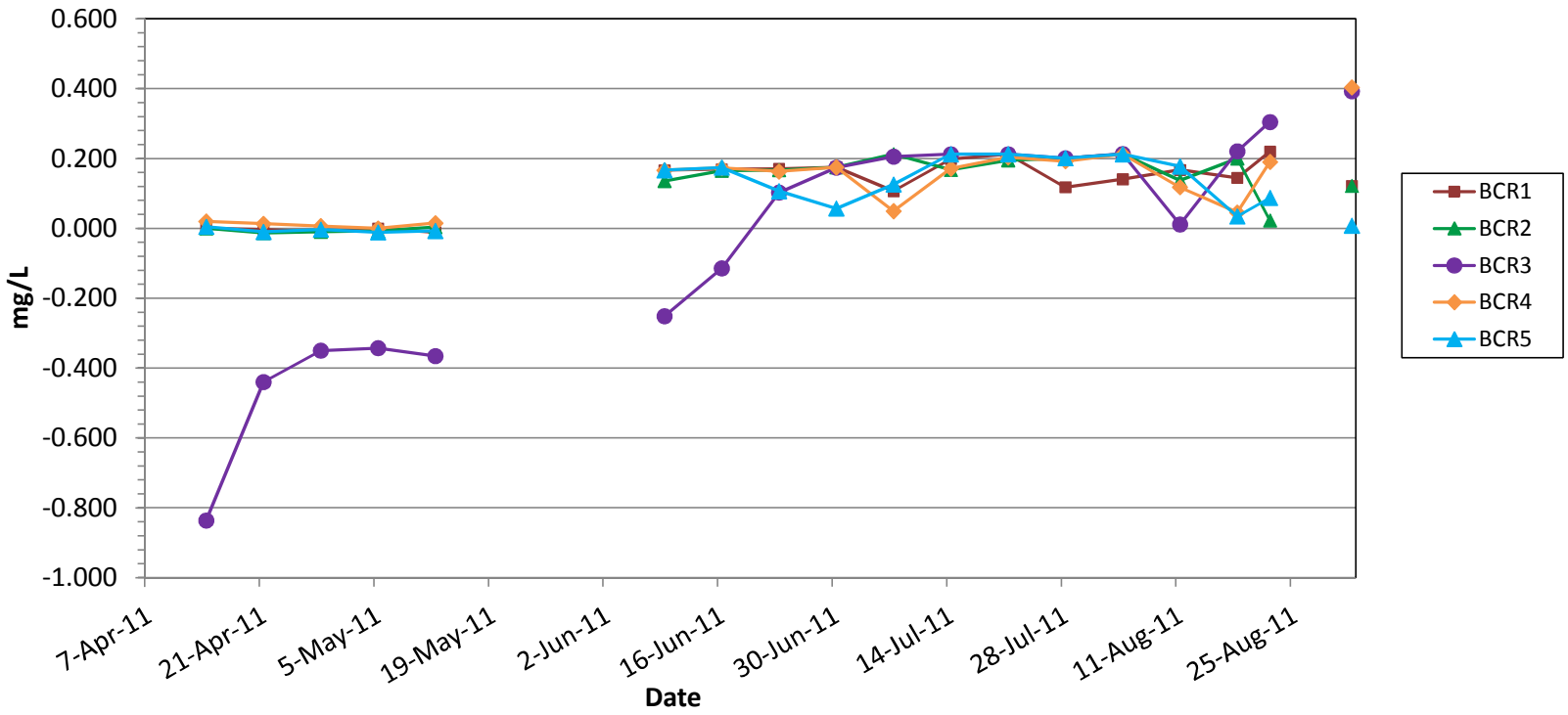

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TITLE

Bench BCR Field Data - Sulfate Reduction

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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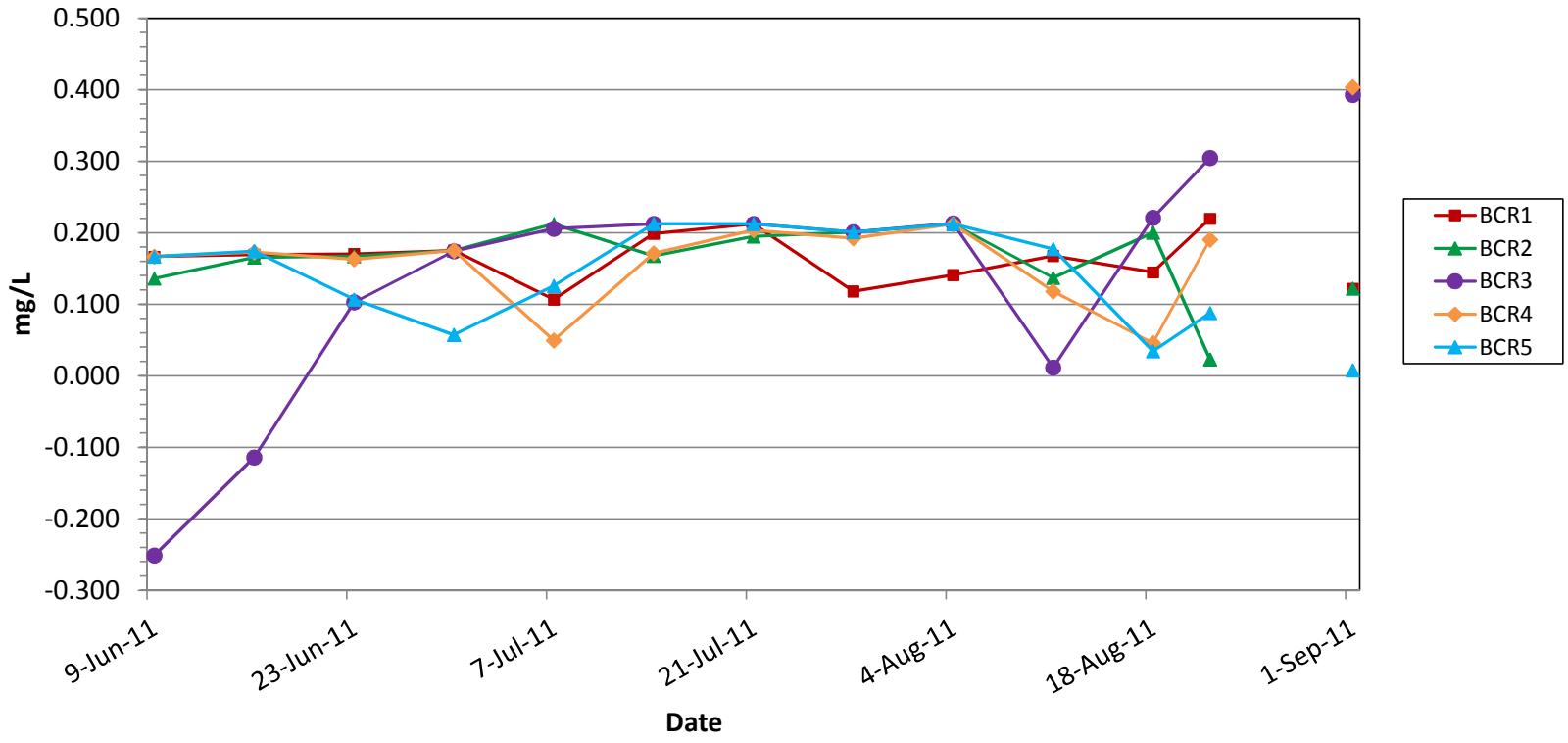

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CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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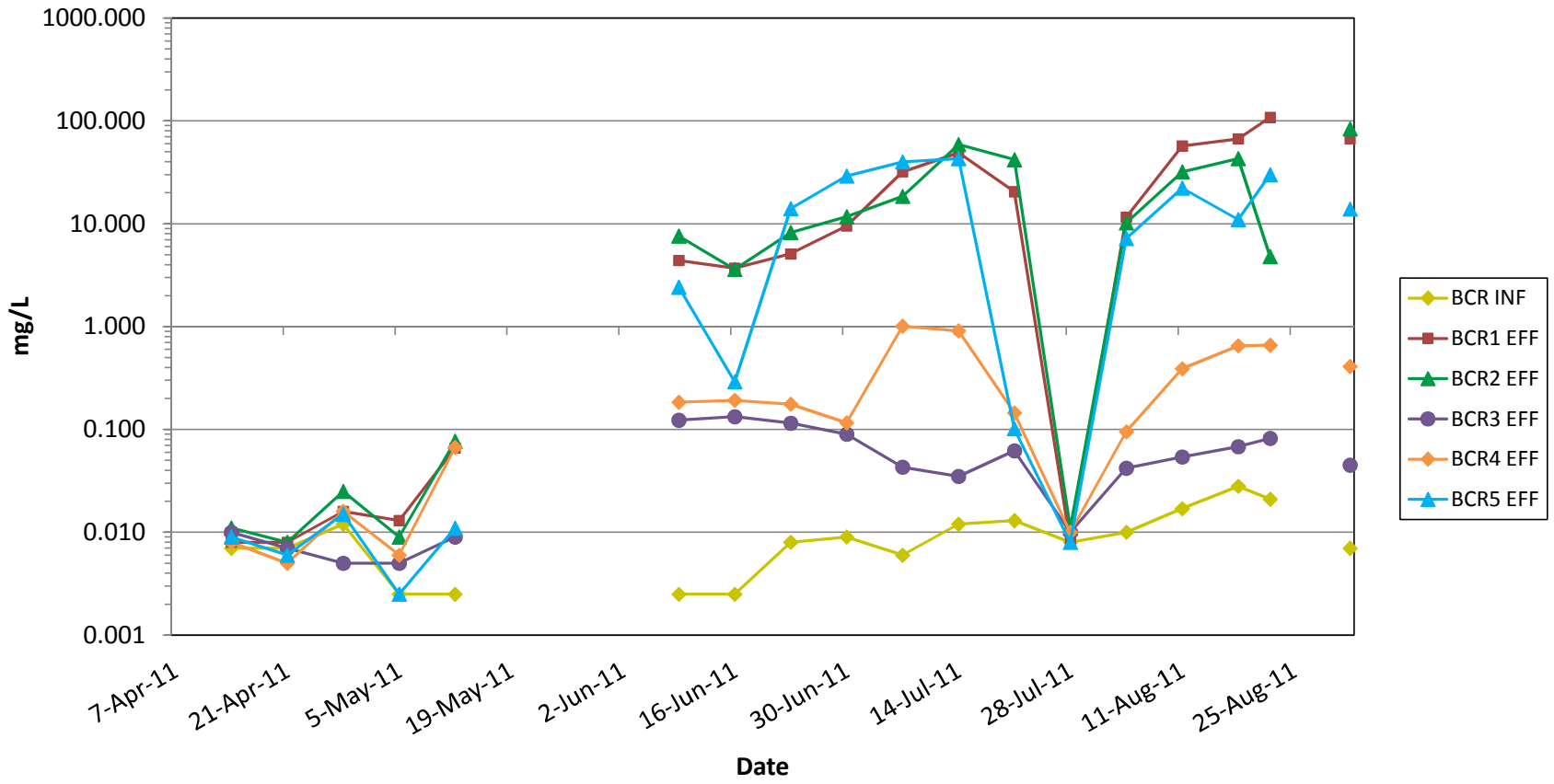

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TITLE

Bench BCR Field Data - Sulfide

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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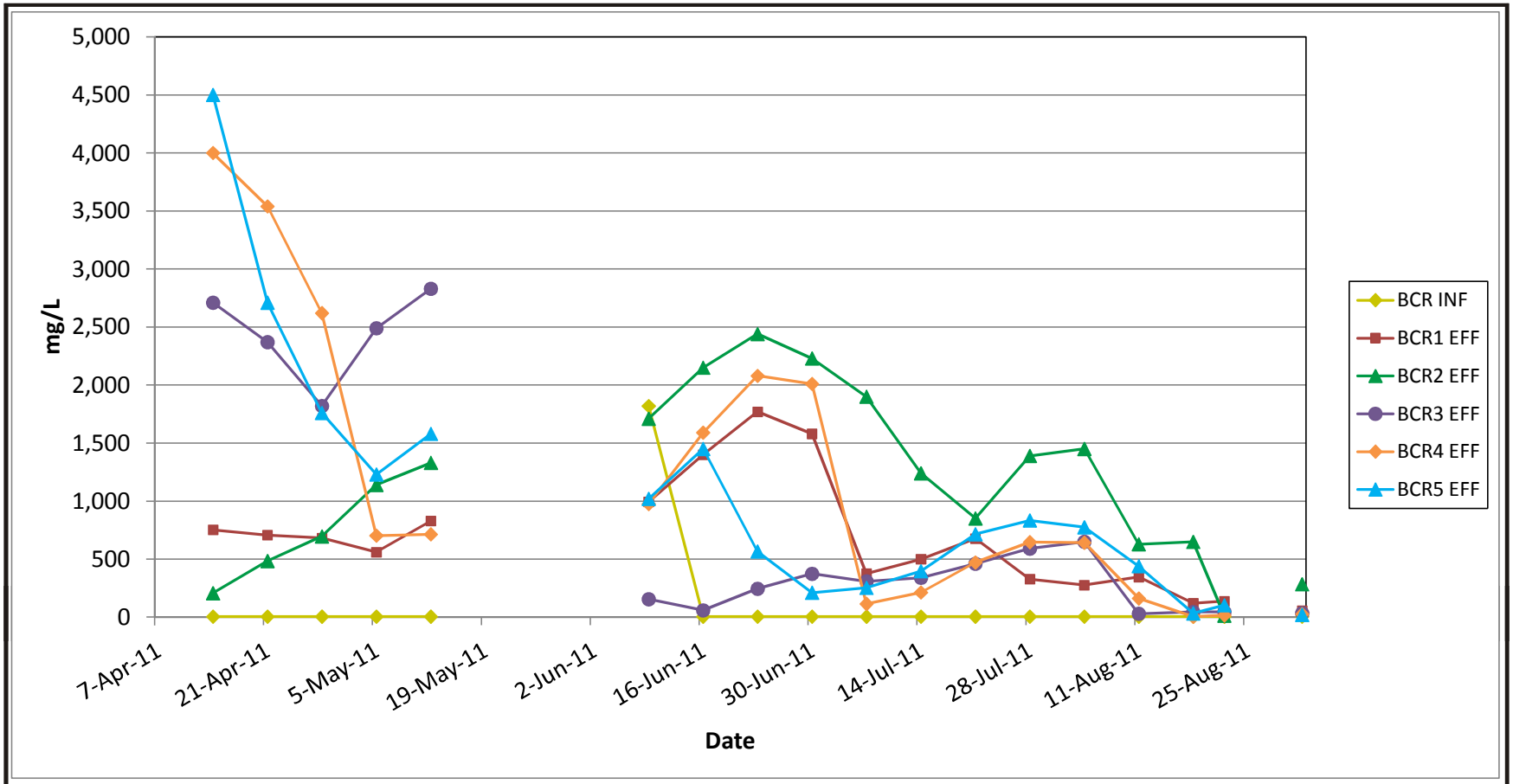

Golder Associates

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TITLE

Bench BCR Field Data - Biochemical Oxygen Demand

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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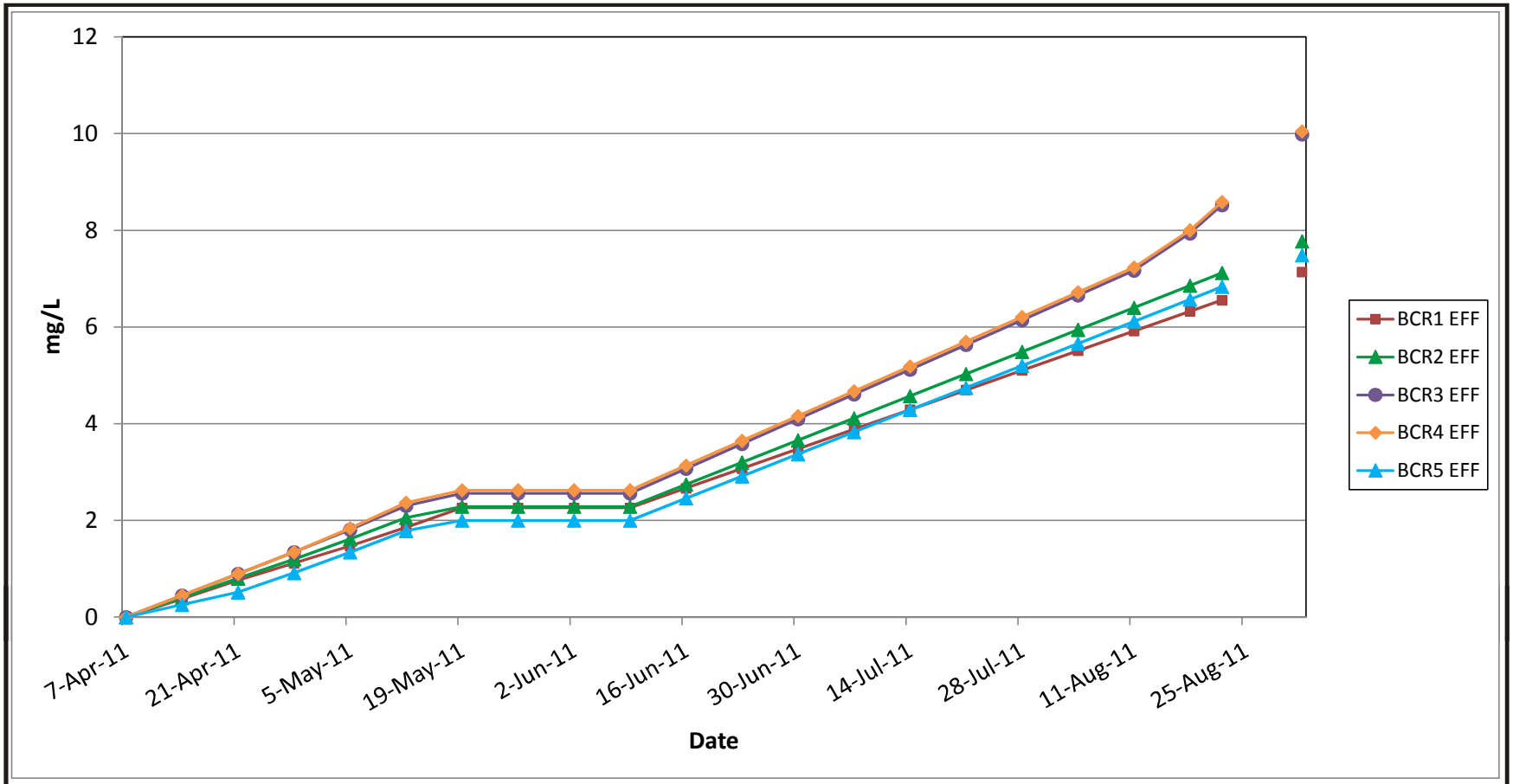

Golder Associates — Denver, Colorado

TITLE: **Bench BCR Field Data - Pore Volumes Treated**

CLIENT/PROJECT: **QUINSAM COAL BENCH BCR RESULTS**

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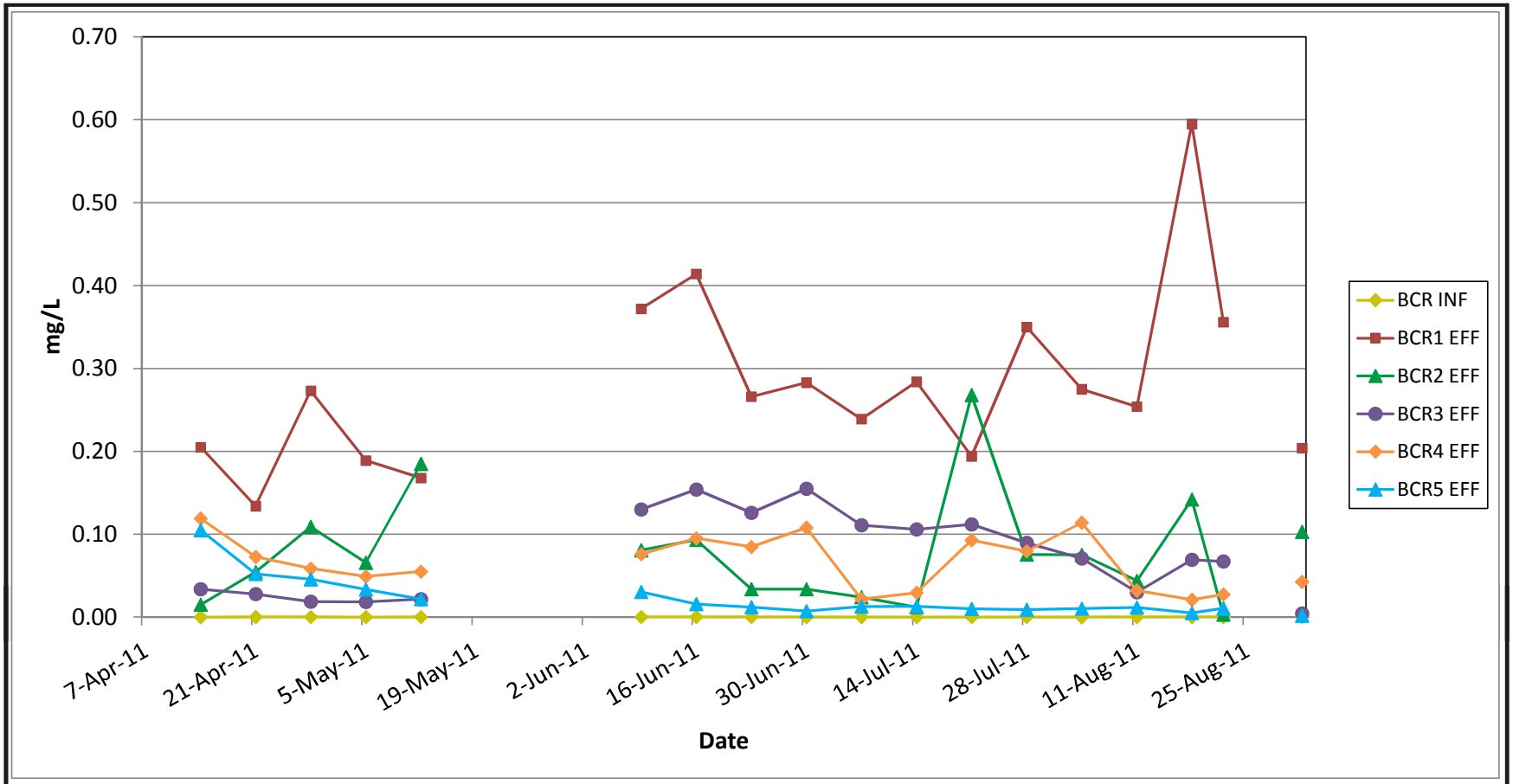

Golder Associates

Denver, Colorado

TITLE

Bench BCR Field Data - Arsenic

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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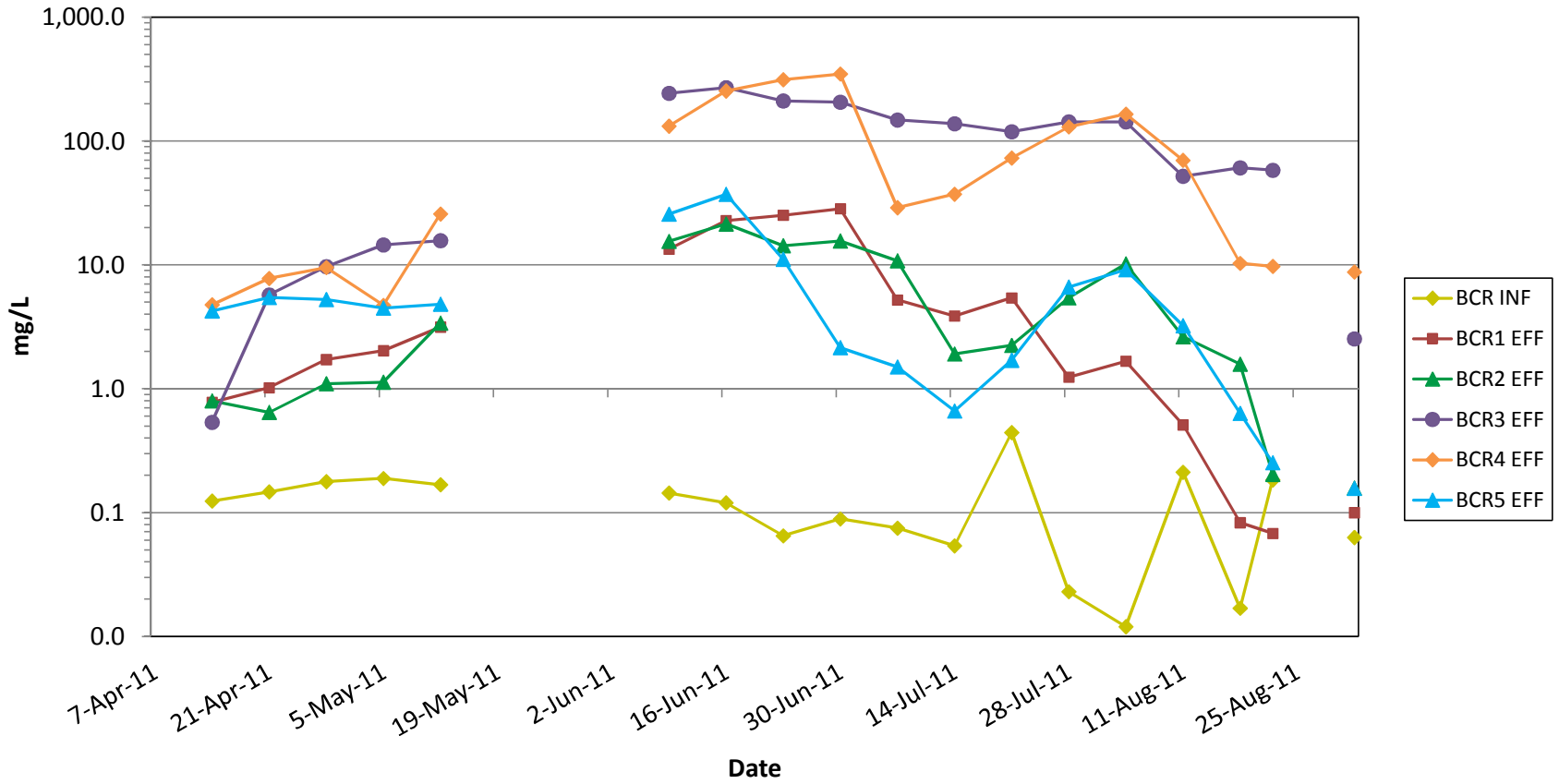

Golder Associates

Denver, Colorado

TITLE

Bench BCR Field Data - Iron

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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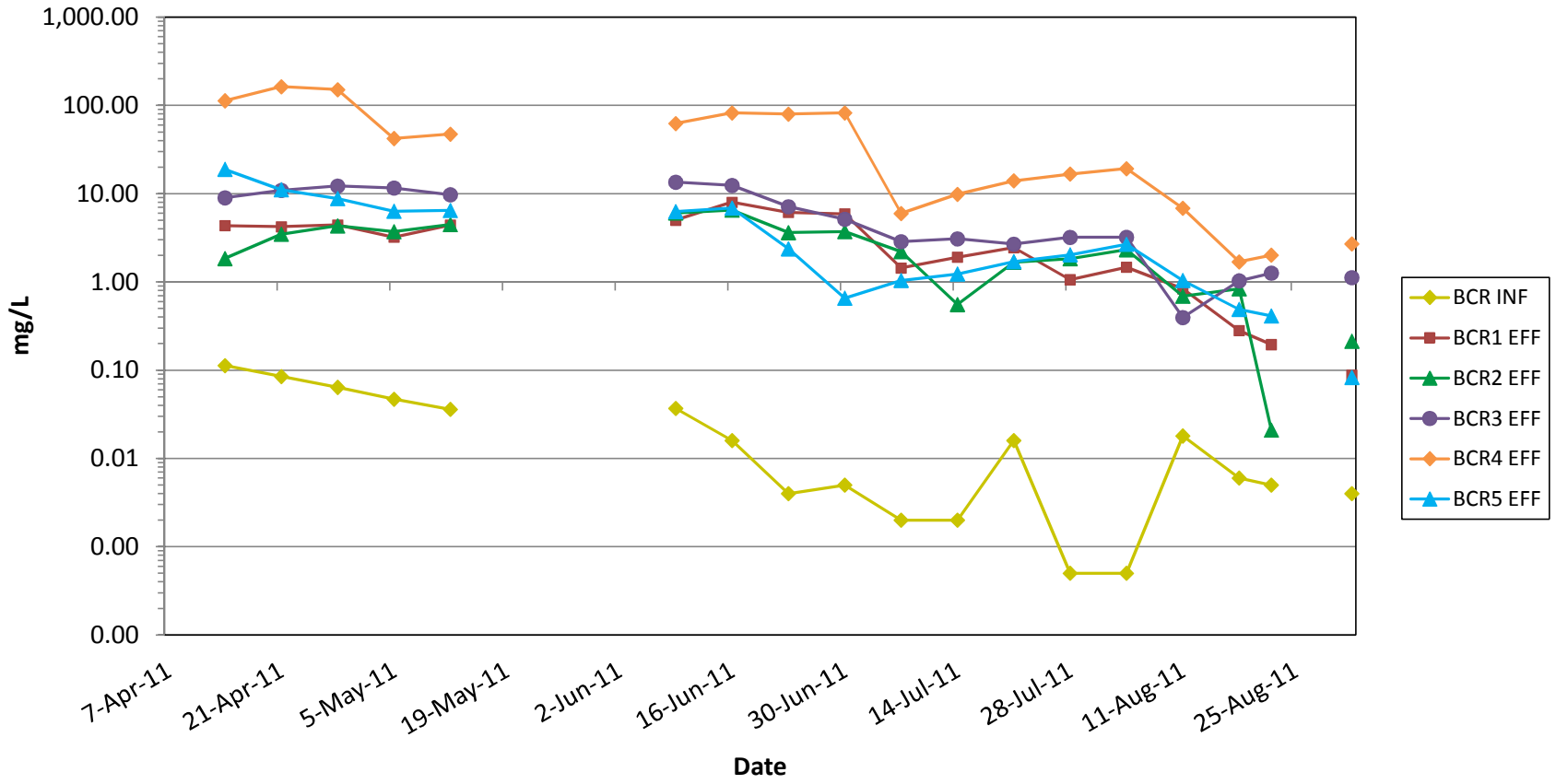

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TITLE

Bench BCR Field Data - Manganese

CLIENT/PROJECT

QUINSAM COAL BENCH BCR RESULTS

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APPENDIX X

WATER QUALITY TREND ANALYSIS

SUMMIT
ENVIRONMENTAL CONSULTANTS INC.
A Member of the Associated Engineering Group of Companies

Report

Quinsam Coal Corporation

WATER QUALITY TREND ASSESSMENT

Project: 2011-8169.000

Version 2: April 2012

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April 10, 2011

File: 2011-8169.000

Mr. Gary Gould
Hillsborough Resources Ltd.
950-1090 West Georgia Street
Vancouver, BC
V6E 3V7

Re: FINAL REPORT - QUINSAM COAL WATER QUALITY TREND ANALYSIS 2006-2011 (Version 2)

Dear Mr. Gould:

Summit Environmental Consultants Inc. is pleased to provide this report that presents the trend analyses of water quality monitoring data collected at the Quinsam Coal Corporation's (QCC) operations from 2006 to 2011. The report addresses the comments on the draft report that were received from the Ministry of Environment in February 2012.

The results indicate the presence of statistically significant trends for some parameters at some locations – notable sulphate, total mercury, and dissolved mercury. However, caution should be taken when interpreting the results given the time frame that was assessed and the uneven monitoring schedule. Trend analyses are more robust when the samples are evenly spaced in time, and it is recommended that QCC adopt a regular sampling schedule if trend assessments are considered important for the monitoring program in the future.

We trust this completes our current assignment to your satisfaction. Please call if you have any questions or wish to discuss any aspect of the findings.

Yours truly,

Hugh Hamilton, Ph.D., P.Ag.
Senior Environmental Scientist

Reviewed by:

Brenda Miskimmin, Ph.D., R.P.Bio.
Senior Biologist

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Appendix A - GRAPHS PLOTTING CONCENTRATION AGAINST TIME

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List of Abbreviations

As – Arsenic
Cd – Cadmium
DL – Detection limit
Fe – Iron
Hg – Mercury
LLM - Long Lake Middle sampling site
LOWESS – Locally weighted scatterplot smoothing
Mn – Manganese
MOE – B.C. Ministry of Environment
MQL - Middle Quinsam Lake sampling site
QCC – Quinsam Coal Corporation
SDP1 - Settling Pond 1 sampling site
SO_4 - Sulphate
SPC - Wetland below SPD sampling site
WB - Outlet of Middle Quinsam Lake sampling site
WC - Wetland below WD sampling site
WD - Settling Pond 4 sampling site

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Quinsam Coal Corporation (QCC) operates an underground coal mine at a site located 28 km by road southwest of Campbell River, B.C. As part of the terms of its operating permit (MOE File PE-7008), QCC has been collecting surface water samples for analyses at a number of locations, including the following seven (7) key locations:

- two at settling pond outlets
  - Settling Pond 1 (SDP);
  - Settling Pond 4 (WD);
- two at the outlets of wetlands downstream from the settling ponds
  - Wetland below SPD (SPC);
  - Wetland below WD (WC);
- three receiving environment (lake) sites
  - Long Lake (LLM) - samples obtained at 2 depths;
  - Middle Quinsam Lake (MQL) - samples obtained at 3 depths; and
  - Outlet of Middle Quinsam Lake (WB).

The results of the monitoring are reported to the B.C. Ministry of Environment (MOE) on an annual basis. The most recent report was submitted in September 2011 (Quinsam Coal Corporation 2011). In August 2011 MOE requested that QCC complete trend analysis of the monitoring data to supplement QCC's annual report. This request was communicated in a letter from Hubert Bunce of the Ministry of Environment (MOE) to Mr. Gary Gould of QCC dated August 4, 2011. MOE has requested that the trend analyses be completed for eight (8) parameters – pH, alkalinity, sulphate, iron, manganese, arsenic, mercury, and cadmium ("the study parameters"). At the three lake and two wetland sites the analyses are to be for concentrations of the study parameters while at the settling pond outlet sites (WD and SDP) the analyses are also to be for loading rate of those parameters where the load has been calculated. The load (units are mass per unit of time – kg/day) is calculated as the product of the concentration (mg/L converted to kg/m^3) and the average discharge (m^3/day) on the date of sampling. For the metals, the data sets include both the dissolved and total fractions for iron and mercury; for the other metals there are totals only.

In September 2011 QCC retained Summit Environmental Consultants Inc. (Summit) to complete the trend analyses of the above monitoring data. This report presents the results of the analyses and provides recommendations for changes in the monitoring program to enhance QCC's ability to assess trends in the future. A draft version of this report was submitted to MOE in November 2011. In March 2012 MOE requested some additional analyses and changes to the way some data are presented. This report addresses those requests by incorporating the requested information.

1.2 PROJECT OBJECTIVES

The goals of the trend analyses are to:

- determine if there is a statistically significant change (increase or decrease) in the concentrations of the study parameters at all seven sites and lake depths;
- determine if there is a statistically significant change in the loading rate of the study parameters at the pond outlets;
- develop recommendations, if needed, for changes in the monitoring program to better facilitate trend detection; and
- Present the findings in a report suitable for submission to MOE.

The graphs and tables in this report are presented at the end of each section. In this report the results of statistical analyses are considered significant at the 95% probability level (i.e. when $p \leq 0.05$).

2 METHODS

2.1 DATA ASSEMBLY AND SCREENING

The data for the monitoring locations was provided to Summit in MS Excel format by Kathleen Russell of QCC. Ms. Russell had previously screened the data to ensure it was complete and that the coincident discharge and water chemistry data were included for the sites where loadings are needed. The data for each site were copied to individual working files.

Trend monitoring refers to a survey of temporal patterns. Water quality trend-monitoring programs are typically implemented when changes in water quality (either improvement or degradation) are expected to be subtle or where natural variation makes simple "before and after" comparisons challenging. The trend analysis is basically a regression of the water quality variable of interest against time, following appropriate data transformations. Trend analysis can be applied to most standard physical/chemical variables (e.g. turbidity, true colour, total P) and to indicators derived from such data (e.g. number of days per year exceeding water quality guidelines).

Water quality data typically presents a number of challenges for trend detection. The first is that the data are often not normally distributed, which means that parametric statistical methods cannot be employed (e.g. linear regression). Non-parametric tests are then used. Non-parametric tests make no assumptions about data distribution and are generally based on the rank order of observations. The results with non-parametric tests of trend are the same whether the data have been transformed or not.

The second challenge is that "censored" data are common. Censored data are data that fall below the laboratory detection limit (DL), which are typically recorded as < [DL]. These data cannot be discarded because they represent a real observation, and therefore need to be substituted for in order to complete statistical analyses (Helsel and Hirsch 1991). The substituted value can either be the detection limit or some consistent fraction of DL. For the current assessment a value of 50% of the DL was used (where the DL varied the highest DL was used for all substitutions). This further constrains the use of parametric tests, but not non-parametric tests which are based on the rank order of observations rather than their value. Within each Excel working file an adjusted data set was created with the 50% of DL values replacing the <DL observations.

The normality of the data was assessed using the Shapiro-Wilk test (see Section 2.2 for software details). The results confirmed that the majority of data sets were not normally distributed, and further analyses of trend were based on non-parametric methods. The data sets provided by QCC included the sampling date and time. To facilitate trend analysis the date must be converted to a continuous data value. The data sets generally span the 2006 to mid-2011 period. Therefore January 1, 2005 was arbitrarily set as Day 0 and the sampling dates were converted to days since that date. Appendix A includes graphs of the study variables plotted against time. A visual review of the plots was used to assess data variable (general

scatter and seasonal variations), the potential presence of a trend, and the number of values below the detection limit.

2.2 STATISTICAL ANALYSES

The statistical analyses were completed with the SYSTAT 13 software (Systat Software Inc. 2009) based on procedures outlined in Helsel and Hirsch (1991) and Paine (1998). As noted above, the data were initially tested for normality with the Shapiro-Wilk test. Most results indicate non-normal distributions and the non-parametric tests were judged to be the most appropriate for trend detection.

The statistical time series tests that were run on each data set are:

- Autocorrelation (ACF function in SYSTAT) – to assess whether consecutive samples are independent of one another, which is an underlying assumption of trend analysis. The resulting graphs also provide an indication of seasonality.
- Data smoothing using the LOWESS (locally weighted scatterplot smoothing) function – provides a graphical indication of trend in order to determine whether the hypothesis that will be tested is for a downward or upward trend. This is an exploratory technique and produces no equation describing the line or a test of significance (Helsel and Hirsch 1991).
- The Mann-Kendall test, which is a simple, non-parametric, rank-based test for assessing the significance of a trend in a time series. The user specifies either an upward, downward, or two-sided hypothesis. For the QCC data both the downward and upward trend hypothesis were tested.
- Three tests are available in SYSTAT to detect seasonal trends in the data:
  - *Kendall.* Performs a nonparametric trend test for seasonal data by assuming independence among seasons.
  - *Modified Kendall.* Performs a nonparametric trend test for seasonal data by considering the covariance among seasons.
  - *Homogeneity*. Performs a nonparametric test for checking the homogeneity of trend direction in different seasons.

For the seasonal assessment the specified season was initially the month (January, February, etc.), but several runs were also completed with winter (December-February), spring (March-May), summer (June-August), and fall (September-November) defined as seasons. The Modified Kendall test cannot be run if there are any missing data (making the seasons unbalanced) and could not therefore be used since most of the QCC data sets do not have data distributed evenly throughout the year. This is discussed in Section 3.3.4 below.

2.3 DISCUSSIONS WITH MINISTRY OF ENVIRONMENT

As noted in the report introduction, Quinsam Coal submitted a draft version of this report to MOE in November 2011. MOE provided written comments on February 20, 2012. The consultant then met with

MOE representatives Andrea Miskelly and Deb Epps by teleconference on February 29 to review their comments and clarify MOE's needs for the final report. The comments that were received have been addressed in this report.

3 RESULTS

3.1 DESCRIPTIVE STATISTICS

Table 3-1 provides the following descriptive statistics for the study parameters at each site – median, sample size (n), mean, minimum and maximum. Table 3-1 also includes the permit limits under which QCC operates, the B.C. Water Quality Guideline for the protection of aquatic life (Ministry of Environment 2011), and site-specific water quality objectives (Ministry of Environment 1989). Exceedances from the permit limits, where they exist, are highlighted in bold on Table 3-1. Exceedances from water quality guidelines or objectives are highlighted by underlining.

The data sets that were analyzed for this report cover the period from January 2006 until about April 2011. At a little over five years of monitoring this just meets the rule-of-thumb minimum amount of data to assess whether a trend is present. However, it is not uncommon for surface water quality trends to not become apparent (i.e. statistically significant) until there are about 10 years of data because of variability unrelated to time (Paine 1998). In the settling pond and downstream wetland sites there are frequent data for pH and sulphate (220-250 samples) and alkalinity (>100); while the metals samples sizes are in the 50-65 range (Table 3-1). Sample sizes in the lakes are smaller (about n = 25-30); although at the Middle Quinsam Lake outlet there 250-260 samples for pH and sulphate and 55-65 for metals.

For some sites more than half of the analytical data for particular metals were below the detection limit, which has implications for trend analysis. Of the data for Settling Pond #1, approximately 80% of the total cadmium values and over 90% of the total mercury values were below the detection limit. Of the data collected at Settling Pond #4, approximately 90% of total arsenic, total cadmium, and dissolved iron values and almost all the total mercury values were below detection. At both the South Pit Culvert and the North Pit Culvert all total and dissolved mercury data and nearly all total cadmium data was below detection. This also occurred at the South Pit Culvert for roughly 80% of the values for total arsenic and at the North Pit Culvert for nearly all total arsenic and dissolved iron values.

Of the data from Middle Quinsam Lake at 1m depth, 4m depth, and 1m from bottom, all total arsenic values and almost all total cadmium values were below the detection limit. This was also the case for all dissolved iron values at 1m depth, as well as nearly all dissolved iron values and just over 50% of total iron values at 1m from bottom. At Mid Quinsam Lake Outlet, almost all total cadmium, total mercury, and dissolved mercury and approximately 80% of total arsenic were below detection, while just over 50% of dissolved iron values were below detection. For Long Lake Middle at 1m depth, nearly all cadmium values and slightly over 50% of dissolved iron values were less than the detection limit. Roughly 60% of the dissolved iron values were also below detection at Long Lake Middle, both 1 m from surface and 1m from bottom. As noted in the methods section, the below DL values were replaced with 50% of the highest DL, but statistical tests for trend did not proceed if more than half of the values were <DL (see Section 3.3.2).

3.2 COMPARISONS TO WATER QUALITY GUIDELINES

The data that exceed the specific permit limits for QCC are highlighted in bold in Table 3-1, while values that exceed the Middle Quinsam Water Quality Objectives or the B.C. guidelines for freshwater aquatic life protection (Ministry of Environment 2011) are underlined. They are provided here to support the discussion of trends in Sections 3.0 and 4.0. The following points outline the observations:

- The pH permit range for SPD, SPC, WD and WC is 6.0-8.8, and all pH measurements at those sites fell within this range. All pH measurements at all other sites fell within the guideline range of pH 6.5 to 9.0.
- Dissolved sulphate concentrations routinely exceeded the 100 mg/L guideline in Settling Pond #1 and #4, where the median concentrations were 295 and 293 mg/L, respectively. At the SPC site more than half of the values met the guideline and the median and maximum values were 84.4 mg/L and 268 mg/L, respectively. In contrast, all of the samples at the WD site exceeded the guideline (median 673 mg/L, minimum 103 mg/L, maximum 1,110 mg/L).
- At the Quinsam Lake sites most dissolved sulphate values fell within the guideline. The only exceedances were recorded in the samples obtained 1 m above the bottom in Middle Quinsam Lake (max. 248 mg/L). In Long Lake the guideline was exceeded in all the samples obtained near the lake bottom (range 113-158 mg/L), whereas near the surface (1 m depth) 19 out of 28 samples were within the guideline and the average was 79.4 mg/L (max. 137 mg/L).
- The only exceedances of the total and dissolved iron guidelines were at SPD, but both the median and average values were within the guideline. There was a similar result for total manganese; it was only exceeded at SPD but the mean and median values at this site met the guideline.
- The total arsenic guideline was exceeded at the two wetland sites downstream from the settling ponds – SPC and WC. All other observations were below the 0.005 mg/L guideline.
- Data are available for both dissolved and total mercury at most sites. The benchmark for total mercury shown in Table 3-1 is the Water Quality Objective set in the 1980s for the Middle Quinsam Lake watershed of 0.0001 mg/L.[1] There were no exceedances of this objective in the settling pond (SPD, WD) or downstream wetland (SPC, WC) sites, and most observations were below the detection limit. However, the Objective was exceeded in about half of all samples at the Middle Quinsam Lake site. At the Long Lake surface site the median total Hg concentration was about three times higher than the Objective (0.00034 vs. 0.0001 mg/L), while the median and mean values for samples taken at the bottom met the Objective.
- At the sites with total mercury exceedances, the dissolved fraction made up about 50-75% of the total mercury concentration. This suggests potential groundwater, atmospheric, and/or local runoff influences on mercury concentrations in the lakes. The other potential source of mercury in Middle Quinsam Lake is from the upstream hydro-electrical system reservoir. Fluctuation in reservoir water levels is a factor in the release of mercury from bottom sediments.

[1] The CCME guideline for total mercury is 0.000026 mg/L (0.026 µg/L). See MOE (1989) for background to the Objective.

- Exceedences of the total cadmium guideline occurred at WC, Middle Quinsam Lake at 1 m and 4 m depths, the Middle Quinsam Lake outlet (WB), and Long Lake Middle at 1 m depth.

The 2011 annual monitoring report includes additional detail on water quality guideline exceedances (QCC 2011).

3.3 TREND ANALYSES

3.3.1 Autocorrelation and LOWESS Plots

The autocorrelation analysis was run to assess whether consecutive measurements are independent, an assumption in trend analyses. This step is most applicable where automated sampling systems are used and water data are collected frequently (e.g. hourly). Not surprisingly, the correlation coefficients in the lag (time interval) are significant (i.e. serially correlated) for some time in the data sets were the sampling interval was less than a month (i.e. pH and sulphate in the settling ponds and wetlands). For the metals at those sites and all parameters at the lake sites, the consecutive data points were either not correlated or only weakly correlated at lag = 1 (usually one month) and can therefore be treated as independent in the trend analyses. For consistency, the trend analyses discussed in Sections 3.3.2 to 3.34 used all the available data. The implications of the observed serial correlation are discussed in Section 4.0.

Figure 3-1 shows the autocorrelation plots for sulphate at SDP (indicating that samples are not independent until about 7 weeks) and for total mercury at Middle Quinsam Lake outlet (WB) where there is no serial correlation. The bars are the correlation coefficients and the solid line is approximately the 95% confidence limit (i.e. correlation bars within the lines are not significant at $p<0.05$).

LOWESS plots were generated for each site-parameter combination to evaluate whether a trend was potentially present and to guide whether the test hypothesis was an upward or downward trend. In general, if the smoothed line suggested a trend then the Mann-Kendall result often confirmed it. Figure 3-2 shows three examples of the LOWESS plots: Sulphate at MQL-1, total mercury at MQL-1, and pH at SPD.

3.3.2 Concentration Trend Results – Mann-Kendall and Sen's Slope

Table 3-2 provides the results of the Mann-Kendall test for each of the study sites and parameters. It includes the Mann-Kendall statistic, Kendall's Tau (a non-parametric correlation coefficient), and the p values for both the downward and upward trend hypothesis. Trends are considered significant where $p \leq 0.05$. Table 3-2 also includes the Sen's slope estimate and the upper 95% confidence limit for that estimate.

The Mann-Kendall results indicate that there are relatively few parameters where there is a significant trend, either downward or upward. For the metals a downward trend in concentration would be interpreted as “improving” and an upward trend would be interpreted as “worsening”. Table 3-3 is a summary of the results. In cases where more than half of the results were below the laboratory detection limit the trend analyses did not proceed, as indicated by a * symbol.

The most notable upward trends are in Middle Quinsam Lake where:

- Dissolved mercury is trending up at all four locations - the 1 m depth samples, the 4 m depth samples, the samples obtained 1 m from the bottom, and at the lake outlet.
- Total mercury is also trending up in the 1 m depth and 4 m depth samples, as are alkalinity, pH, and dissolved sulphate.
- Total manganese is trending up at the 4 m depth and down at the lake outlet, but the trend is not significant at the other two sites.
- Total iron is trending down at 1 m depth and the outlet, but is not significant at the other two sites.

The upward trend in total and dissolved mercury was also observed in the Long Lake 1 m deep site (Table 3-3), while both total iron and total manganese are trending down. At 1 m from the bottom in Long Lake only sulphate exhibited a statistically significant trend, which was downward.

There were no significant trends in Settling Pond #1. In settling Pond #4 alkalinity had an upward trend while pH and manganese were downward. Downstream of Pond #1 (SPC) pH, alkalinity, and sulphate are trending down while total manganese and total and dissolved iron were trending up. Below Pond #4 only alkalinity, total iron, and total manganese exhibited trends; all upward.

Although there are a number of statistically significant trends, in most cases the trend is not particularly pronounced. Table 3-2 includes the slope estimate – the larger the number the greater the magnitude of the trend. A negative slope indicates downward trend; positive an upward trend. Note that the slope estimates in Table 3-2 have been rounded to three decimal places and some of the statistically significant trends have a slope that appears as 0.000. The most pronounced slopes in the concentration data are only in the order of ±0.04.

It is important to note that the Mann-Kendall test is a test for the presence of a monotonic trend – which is a steady trend rather than a “jump” or other major change over a short period in response to some change in water treatment or management practice (Helsel and Hirsch 1991). The finding that the slopes of these trends tend to be low may be partly influenced by the variations that are related to seasonal effects, which can also mask a long term trend in data sets that are relatively short like QCC. Section 3.3.4 below explores seasonality in the data.

3.3.3 Sulphate Loading Trends

QCC calculated daily sulphate loads (unit kg/day) at the two settling pond outlet sites. The trend analyses were completed only for the dates when there were both concentration and discharge (flow) data, which gives samples sizes of 243 at WD and 255 at SPD. The median sulphate load at WD was 3,469 kg/day whereas at SPD it was 110 kg/day.

The results indicate that there are significant upward trends in sulphate loads at both sites. At SPD the Sen's slope value is 0.035, indicating a slight upward trend, while at WD the slope is 1.34, which is more pronounced. Note that although the load trends were significant the concentration trends were not when seasonality is not considered. The influence of season on the loading trends is discussed in the next section.

3.3.4 Trend Assessment with Seasonality

If the results of the Mann Kendall indicate that a trend is not statistically significant, it may only mean that it is not detectable with the available data. There are a number of influences that are sources of variation in the study parameters, some related to operations and management and others related to seasonal variation. Where a trend is not apparent using the Mann Kendall test, the next step is to compensate or "remove" seasonal variation to better assess the probability of a trend in the study parameters over time (Helsel and Hirsch 1991).

The statistical tests for seasonal trend rely more on consistency in the data set than the non-seasonal tests. Specifically they are more sensitive to having a regular sampling interval, equal sample sizes in the seasons of interest (with "seasons" meaning any relevant period), and a reasonable sample size in each season (e.g. n>10). For this study we initially looked for evidence of a trend defining "season" as month and by quarter. The sample sizes for the months in the QCC data were too uneven to proceed, which is not a concern since calendar month is not a consistent indicator of hydrologic or limnological processes. Seasonal tests were then completed with winter (December-February), spring (March-May), summer (June-August), and fall (September-November) defined as seasons. As noted in Section 2.0, only Seasonal Mann-Kendall and Homogeneity tests in SYSTAT could be run because the Modified Seasonal Kendall test cannot be run unless the sample size in each season is the same.

The seasonal analyses were completed for the parameters with larger sample sizes – sulphate, pH and alkalinity. Initial screening on the metals data indicated the sample sizes are too small (e.g. <10/year), too uneven between seasons, and have too many data points below the detection limit to yield results for a trend to be interpreted from 5-6 years of data. Tables 3-4 and 3-5 summarize the results from the Seasonal Mann-Kendall and Homogeneity tests respectively.

From Table 3-4, a trend was detected in two cases where the standard test did not detect a trend – sulphate at WC (downward, slope -0.042) and pH at WB (upward, slope <0.0001). In the other four cases the outcome was the same as in the standard Mann-Kendall test. Note, however, that the slope values are low in both significant cases.

The homogeneity test (Table 3-5) evaluates whether trends are similar in the different seasons. The results from both of the statistically significant cases, sulphate at WC and pH at WB, indicate that there is a significant monotonic trend across all the seasons.

Although there were few cases of the seasonal tests being able to detect a trend that was otherwise not apparent, the visual review of the plotted data indicates that seasonality likely plays a role in the variation of most of the study parameters. Again, the absence of a statistically significant trend in a significant portion of the current 2006-2011 data sets may not mean that a trend isn't occurring, only that the it could not be detected in the data that are available. It is likely that collecting at least three years of additional data will help to better assess trends. Additional recommendations for changes to the monitoring protocol are outlined in Section 5.0.

The sulphate load data at the two settling pond outlet sites were also assessed for seasonal trends. At SPD, where there was an overall upward but slight trend (Section 3.3.3), the trend was not present in every season. For the summer data, Kendall's Tau was -0.28 indicating a weak downward trend, although the summer sample size is just 17 compared to 38, 61, and 51 in the fall, winter and spring, respectively (the upward trend was present in these seasons, contributing to the overall slight upward trend). At WD there was also a significant upward trend in sulphate load based on the Mann-Kendall test, and the slope was 1.34. This is the highest slope value in any of the site/parameter combinations that were assessed. A significant seasonal trend is present and the homogeneity test indicates that the upward trend was present in all seasons.

Table 3-1
Descriptive Statistics summary

Site	Statistic	pH	Alkalinity (mg/L)	Sulphate – Dissolved (mg/L)	Iron – Dissolved (mg/L)	Iron – Total (mg/L)	Mangan-ese Total* (mg/L)	Arsenic – Total (mg/L)	Mercury – Dissolved (mg/L)	Mercury* – Total (mg/L)	Cadmium* – Total (mg/L)
	Permit Limits	6.0 – 8.5	n/a	n/a	0.3 WD & WC; 0.5 SPD & SPC	n/a	n/a	n/a	n/a	n/a	n/a
	BC Aquatic Life Guideline or Objective	6.5 – 9.0	10 min.	100	0.350	1.0	0.87 max.	0.005	ng	0.0001	0.00001
Settling Pond 1 (SPD)	Median (n)	7.77 (248)	57.0 (77)	295 (248)	0.095 (60)	0.311 (60)	0.092 (60)	0.00069 (60)	nd	0.000010 (60)	<0.000017 (60)
	Mean	7.67	53.9	269	0.266	0.646	0.257	0.00105	nd	0.000013	0.000023
	Min. – Max.	6.34-8.26	6.40-121	3.20-628	<0.030 - **5.46**	0.044-10.6	0.008-3.66	<0.001 - 0.00450	nd	<0.000010-0.000090	<0.000010 - 0.000193
Settling Pond 4 (WD)	Median (n)	8.13	321.5	293	0.015	0.158 (61)	0.064(62)	<0.0025	nd	<0.000010 (62)	<0.000085
	Mean	8.12	332.7	268	0.016	0.178	0.066	<0.0025	nd	<0.000010	<0.000085
	Min. – Max.	7.51-**8.67**	229-1,300	3.20-628	<0.005-0.043	<0.030-0.480	0.018-0.167	<0.0025 - 0.0016	nd	<0.000010-0.000020	<0.00002-0.000330

Bold – Exceeds permit limit. Underline – Exceeds objective or guideline. *See notes at bottom of table. < - indicates less than detection limit as shown. n/a – no applicable permit limit

Table 3-1 (cont.)

Site	Statistic	pH	Alkalinity	Sulphate - Dissolved	Iron - Dissolved	Iron – Total	Mangan-ese - Total	Arsenic - Total	Mercury - Dissolved	Mercury – Total	Cadmium – Total
	Permit Limits	6.0 – 8.5	n/a	n/a	0.3 WD & WC; 0.5 SPD & SPC	n/a	n/a	n/a	n/a	n/a	n/a
	BC Aquatic Life Guideline or Objective	6.5 – 9.0	10	100	0.350	1.0	0.87 max	0.005	Ng	0.0001	0.00001
South Pit Culvert (SPC)	Median (n)	7.59 (181)	23.0 (59)	84.4 (181)	0.054 (44)	0.083 (43)	0.003 (43)	<0.02 (43)	<0.00001 (44)	Nd	<0.010 (43)
	Mean	7.57	25.4	95.3	0.056	0.146	0.008	<0.02	<0.00001	Nd	<0.010
	Min. – Max.	6.68-8.15	13.0-58.6	22.4-268	<0.030-0.118	<0.030-0.896	0.001-0.057	0.0002-0.00067	<0.000010 - <0.000020	nd	<0.00001-0.004
North Pit Culvert (WC)	Median (n)	8.27 (245)	274 (141)	673 (245)	0.015 (55)	0.059 (55)	0.023 (55)	<0.2 (55)	<0.000020 (55)	<0.000020 (11)	<0.010 (55)
	Mean	8.263	279	705	0.016	0.090	0.032	<0.2	<0.000020	<0.000020	<0.010
	Min. – Max.	7.74-8.50	23.4 - 370	103-1,110	0.008-0.034	<0.030-1.02	0.009-0.202	0.0005-0.0009	<0.000010-<0.000020	<0.000010-<0.000020	<0.00001-0.00021
Mid Quinsam Lake 1m (MQL)	Median (n)	7.71(26)	27.1 (26)	19.0 (27)	<0.030	0.035 (25)	0.006 (25)	<0.0005	0.000160 (25)	0.000275 (25)	<0.000017 (25)
	Mean	7.71	27.4	21.4	<0.030	0.034	0.007	<0.0005	0.000306	0.000479	<0.000017
	Min. – Max.	6.92-8.18	20.6 - 38.8	6.31-51.0	<0.030 - <0.030	<0.030-0.055	0.004-0.012	<0.0005-<0.0005	0.000027-0.001310	0.000045-0.001680	<0.000017 - 0.000155

Bold – Exceeds permit limit. Underline – Exceeds objective or guideline. *See notes at bottom of table. < - indicates less than detection limit as shown. n/a – no applicable permit limit

Table 3-1 (cont.)

Site	Statistic	pH	Alkalinity	Sulphate - Dissolved	Iron - Dissolved	Iron – Total	Mangan-ese - Total	Arsenic - Total	Mercury - Dissolved	Mercury – Total	Cadmium – Total
	Permit Limits	6.0 – 8.5	n/a	n/a	0.3 WD & WC; 0.5 SPD & SPC	n/a	n/a	n/a	n/a	n/a	n/a
	BC Aquatic Life Guideline or Objective	6.5 – 9.0	ng	100	0.350	1.0	0.87 max	0.005	ng	0.0001	0.00001
Mid Quinsam Lake 4m (MQL)	Median (n)	7.72 (26)	27.8 (26)	19.6 (26)	nd	0.034 (25)	0.006 (25)	<0.0005	0.000106 (25)	0.000180 (25)	<0.000017 (25)
	Mean	7.71	27.8	22.1	nd	0.032	0.006	<0.0005	0.000178	0.000284	<0.000017
	Min. – Max.	7.19-8.13	20.2-38.3	7.17-55.4	nd	<0.030-0.052	0.003-0.014	<0.0005-<0.0005	0.000019-0.000715	<0.00002-0.001090	<0.000017 - 0.000049
Mid Quinsam Lake 1m off bottom (MQL)	Median (n)	7.67	33.2	57.8	<0.030	<0.030	0.011	<0.0005	0.000036	0.000056	<0.000017
	Mean	7.65	36.2	73.4	<0.030	0.039	0.047	<0.0005	0.000058	0.000117	<0.000017
	Min. – Max.	7.30-7.96	30.0-48.2	19.6-248	<0.030 - 0.033	<0.030-0.137	0.004-0.604	<0.0005 - <0.0005	0.000019-0.000361	<0.00002-0.000569	<0.000017 - <0.000017
Mid Quinsam Lake Outlet (WB)	Median (n)	7.65 (267)	27.0 (70)	24.6 (263)	<0.030 (55)	0.044 (55)	0.008 (63)	<0.0005 (63)	<0.000010 (55)	<0.000010 (62)	<0.000017 (63)
	Mean	7.62	28.6	25.9	<0.030	0.047	0.009	<0.0005	<0.000010	<0.000010	<0.000017
	Min. – Max.	6.70-8.23	16.9-110	6.04-74.2	<0.030-0.112	<0.030 -0.098	0.003-0.019	<0.0001-0.0003	<0.000002-0.000028	<0.000010-0.000040	<0.000010 0.000042

Bold – Exceeds permit limit. Underline – Exceeds objective or guideline. *See notes at bottom of table. < - indicates less than detection limit as shown. n/a – no applicable permit limit

Table 3-1 (cont.)

Site	Statistic	pH	Alkalinity	Sulphate – Dissolved	Iron - Dissolved	Iron – Total	Mangan-ese - Total	Arsenic - Total	Mercury - Dissolved	Mercury – Total	Cadmium – Total
	Permit Limits	6.0 – 8.5	n/a	n/a	0.3 WD & WC; 0.5 SPD & SPC	n/a	n/a	n/a	n/a	n/a	n/a
	BC Aquatic Life Guideline	6.5 – 9.0	ng	100	0.350	1.0	0.87 max	0.005	ng	0.0001	0.00001
Long Lake Middle 1m (LLM)	Median (n)	7.76 (28)	38.3 (28)	80.3 (28)	<0.030 (26)	0.056 (27)	0.011 (26)	0.0006 (26)	0.000161 (26)	0.00034 (25)	<0.000017 (26)
	Mean	7.78	37.5	79.4	<0.030	0.058	0.014	0.0005	0.000342	0.00059	<0.000017
	Min. – Max.	7.09-8.04	13.8-62.9	18.4-137	<0.030 - 0.048	<0.030-0.094	0.001-0.061	<0.0005-0.000810	0.000027-0.00159	0.000060-0.00269	<0.00001-0.000021
Long Lake Middle 1m from bottom (LLM-B)	Median (n)	7.6 (29)	58.8 (29)	146 (29)	<0.030 (25)	0.075 (26)	0.560 (26)	<0.005 (26)	0.000022 (25)	0.000057 (26)	<0.000017 (26)
	Mean	7.6	58.3	146	<0.030	0.099	0.753	<0.005	0.000024	0.000056	<0.000017
	Min. – Max.	6.8 - 7.9	46.4 – 67.0	113 – 158	<0.030 – 0.033	<0.030 – 0.284	0.185 – 2.17	<0.0005 – 0.00063	<0.000020 – 0.000067	<0.000020 – 0.000151	<0.000017 - <0.000017

Bold – Exceeds permit limit. Underline – Exceeds objective or guideline. *See notes at bottom of table. < - indicates less than detection limit as shown. n/a – no applicable permit limit

*Notes

- Manganese guideline depends on water hardness. The 1.0 mg/L guideline is the chronic guideline for hardness of 30 mg/L (the most restrictive is 0.7 mg/L). See text.
- Total mercury guideline is the CCME guideline. BC guideline requires methyl-mercury data to determine but is similar (e.g. 0.00002 where MeHg = 0.5% of THg).
- Total cadmium guideline is a working guideline (i.e. not finalized by MOE). Varies with hardness. Guideline shown is for hardness 30 mg/L.
- Detection limits (DL) varied through the monitoring period for some parameters. In some case the DL was initially higher than the applicable guideline (e.g. As & Cd).

Table 3-2
Trend analysis results

Variable	Mann-Kendall statistic	Mann-Kendall p-value (downward trend)	Kendall Tau statistic	Slope Estimate	95% Upper Limit	Is there a Trend?	Mann-Kendall p-value (upward trend)
Settling Pond #1 (SPD)							
Alkalinity (total)	-221	0.157	-0.080	-0.006	0.005	No trend	0.843
Arsenic (total)	-90	0.282	-0.051	0.000	0.000	No trend	0.718
Cadmium (total)	48	*	0.027	0.000	0.000	*	0.376
Iron (dissolved)	90	0.716	0.051	0.000	0.000	No trend	0.284
Iron (total)	62	0.651	0.035	0.000	0.000	No trend	0.349
Mercury (total)	-107	*	-0.060	0.000	0.000	*	0.843
Manganese (total)	26	0.563	0.015	0.000	0.000	No trend	0.437
pH	-339	0.391	-0.012	0.000	0.000	No trend	0.609
Sulphate (dissolved)	-1203	0.162	-0.043	-0.014	0.010	No trend	0.838
Settling Pond #4 (WD)							
Alkalinity (total)	703	0.999	0.260	0.034	0.053	**Upward**	0.001
Arsenic (total)	192	*	0.134	0.000	0.000	*	*
Cadmium (total)	-116	*	-0.081	0.000	0.000	*	*
Iron (dissolved)	-61	*	-0.043	0.000	0.000	*	*
Iron (total)	139	0.848	0.097	0.000	0.000	No trend	0.152
Mercury (total)	-209	0.006	-0.146	0.000	0.000	*	0.994
Manganese (total)	-231	0.043	-0.161	0.000	0.000	**Downward**	0.957
pH	-2018	0.049	-0.072	0.000	0.000	**Downward**	0.951
Sulphate (dissolved)	-1781	0.083	-0.060	-0.019	0.004	No trend	0.917

* More than half of results below laboratory detection limit

Table 3-2 (cont.)

Variable	Mann-Kendall statistic	Mann-Kendall p-value (downward trend)	Kendall Tau statistic	Slope Estimate	95% Upper Limit	Is there a Trend?	Mann-Kendall p-value (upward trend)
South Pit Culvert (SPC)							
Alkalinity (total)	-593	0.000	-0.372	-0.010	-0.006	**Downward**	1.000
Arsenic (total)	-421	*	-0.466	0.000	0.000	*	1.000
Cadmium (total)	-482	*	-0.534	0.000	0.000	*	1.000
Iron (dissolved)	315	1.000	0.349	0.000	0.000	**Upward**	0.000
Iron (total)	384	1.000	0.425	0.000	0.000	**Upward**	0.000
Mercury (dissolved)		*				*	*
Mercury (total)		*				*	*
Manganese (total)	163	0.962	0.181	0.000	0.000	**Upward**	0.038
pH	-4027	0.000	-0.268	0.000	0.000	**Downward**	1.000
Sulphate (dissolved)	-3946	0.000	-0.262	-0.034	-0.023	**Downward**	1.000
North Pit Culvert (WC)							
Alkalinity (total)	1188	0.985	0.124	0.017	0.031	**Upward**	0.015
Arsenic (total)	-396	*	-0.277	0.000	0.000	*	1.000
Cadmium (total)	-391	*	-0.273	0.000	0.000	*	1.000
Iron (dissolved)	175	*	0.122	0.000	0.000	*	0.013
Iron (total)	264	0.975	0.184	0.000	0.000	**Upward**	0.025
Mercury (dissolved)		*				*	*
Mercury (total)		*				*	*
Manganese (total)	465	1.000	0.325	0.000	0.000	**Upward**	0.000
pH	671	0.709	0.024	0.000	0.000	No trend	0.291
Sulphate (dissolved)	-1828	0.067	-0.065	-0.039	0.003	No trend	0.933

* More than half of results below laboratory detection limit

Table 3-2 (cont.)

Variable	Mann-Kendall statistic	Mann-Kendall p-value (downward trend)	Kendall Tau statistic	Slope Estimate	95% Upper Limit	Is there a Trend?	Mann-Kendall p-value (upward trend)
Mid Quinsam Lake 1m (MQL_1m)							
Alkalinity (total)	131	0.998	0.403	0.006	0.009	**Upward**	0.002
Arsenic (total)		*				*	*
Cadmium (total)	34	*	0.105	0.000	0.000	*	*
Iron (dissolved)		*				*	*
Iron (total)	-91	0.030	-0.259	0.000	0.000	**Downward**	0.970
Mercury (dissolved)	146	0.999	0.449	0.000	0.000	**Upward**	0.001
Mercury (total)	135	0.998	0.415	0.000	0.000	**Upward**	0.002
Manganese (total)	40	0.805	0.123	0.000	0.000	No trend	0.195
pH	106	0.990	0.326	0.000	0.000	**Upward**	0.010
Sulphate (dissolved)	79	0.957	0.243	0.008	0.016	**Upward**	0.043
Mid Quinsam Lake 4m (MQL_4m)							
Alkalinity (total)	128	0.997	0.394	0.006	0.009	**Upward**	0.003
Arsenic (total)		*				*	*
Cadmium (total)	36	*	0.111	0.000	0.000	*	*
Iron (total)	14	0.615	0.043	0.000	0.000	No trend	0.385
Mercury (dissolved)	123	0.996	0.378	0.000	0.000	**Upward**	0.004
Mercury (total)	124	0.997	0.382	0.000	0.000	**Upward**	0.003
Manganese (total)	78	0.955	0.240	0.000	0.000	**Upward**	0.045
pH	129	0.998	0.397	0.000	0.000	**Upward**	0.002
Sulphate (dissolved)	86	0.970	0.265	0.008	0.016	**Upward**	0.030
Mid Quinsam Lake 1m from bottom (MQL_1mB)							
Alkalinity (total)	-37	0.200	-0.123	-0.001	0.003	No trend	0.800
Arsenic (total)		*				*	*

* More than half of results below laboratory detection limit

Table 3-2 (cont.)

Variable	Mann-Kendall statistic	Mann-Kendall p-value (downward trend)	Kendall Tau statistic	Slope Estimate	95% Upper Limit	Is there a Trend?	Mann-Kendall p-value (upward trend)
Cadmium (total)		*				*	*
Iron (dissolved)	24	0.945	0.080	0.000	0.000	*	*
Iron (total)	25	0.728	0.083	0.000	0.000	*	*
Mercury (dissolved)	128	0.999	0.427	0.000	0.000	**Upward**	0.001
Mercury (total)	113	0.996	0.377	0.000	0.000	**Upward**	0.004
Manganese (total)	15	0.628	0.050	0.000	0.000	No trend	0.372
pH	110	0.995	0.367	0.000	0.000	**Upward**	0.005
Sulphate (dissolved)	-70	0.053	-0.233	-0.028	0.000	No trend	0.947
Mid Quinsam Lake Outlet (WB)							
Alkalinity (total)	206	0.861	0.090	0.001	0.003	No trend	0.139
Arsenic (total)	-738	*	-0.390	0.000	0.000	*	*
Cadmium (total)	-172	*	-0.091	0.000	0.000	*	*
Iron (dissolved)	23	*	0.015	0.000	0.000	*	*
Iron (total)	118	0.802	0.079	0.000	0.000	No trend	0.198
Mercury (dissolved)	-518	*	-0.283	0.000	0.000	*	*
Mercury (total)	-478	*	-0.261	0.000	0.000	*	*
Manganese (total)	275	0.952	0.145	0.000	0.000	**Upward**	0.048
pH	254	0.580	0.009	0.000	0.000	No trend	0.420
Sulphate (dissolved)	2953	0.991	0.102	0.003	0.005	Upward	0.009
Long Lake Middle, 1m depth (LLM_1m)							
Alkalinity (total)	27	0.706	0.077	0.003	0.015	No trend	0.294
Arsenic (total)	-25	0.303	-0.071	0.000	0.000	No trend	0.697
Cadmium (total)	32	*	0.091	0.000	0.000	*	*
Iron (dissolved)	23	*	0.066	0.000	0.000	*	*

* More than half of results below laboratory detection limit

Table 3-2 (cont.)

Variable	Mann-Kendall statistic	Mann-Kendall p-value (downward trend)	Kendall Tau statistic	Slope Estimate	95% Upper Limit	Is there a Trend?	Mann-Kendall p-value (upward trend)
Iron (total)	-91	0.030	-0.259	0.000	0.000	**Downward**	0.970
Mercury (dissolved)	174	1.000	0.535	0.000	0.000	**Upward**	0.000
Mercury (total)	141	0.998	0.402	0.000	0.000	**Upward**	0.002
Manganese (total)	-105	0.015	-0.299	0.000	0.000	**Downward**	0.985
pH	51	0.852	0.145	0.000	0.000	No trend	0.148
Sulphate (dissolved)	9	0.566	0.026	0.001	0.030	No trend	0.434
Long Lake Middle 1m from bottom (LLM_B)							
Alkalinity (total)	39	0.786	0.111	0.002	0.006	No trend	0.214
Arsenic (total)		*				*	*
Cadmium (total)		*				*	*
Iron (dissolved)	-69	*	-0.212	0.000	0.000	*	*
Iron (total)	-54	0.134	-0.154	0.000	0.000	No trend	0.866
Mercury (dissolved)	55	0.893	0.169	0.000	0.000	No trend	0.107
Mercury (total)	29	0.721	0.083	0.000	0.000	No trend	0.279
Manganese (total)	33	0.748	0.094	0.000	0.001	No trend	0.252
pH	-13	0.401	-0.037	0.000	0.000	No trend	0.599
Sulphate (dissolved)	-89	0.038	-0.245	-0.006	0.000	**Downward**	0.962

* More than half of results below laboratory detection limit

Table 3-3
Trend analysis summary

	Settling Ponds		Downstream of Settling Ponds		Middle Quinsam Lake				Long Lake	
Variable	**SP1 (#1)**	**WD (#4)**	**SPC**	**WC**	**MQL (1 m)**	**MQL (4 m)**	**MQL (bottom)**	**WB (Outlet)**	**LL (1 m)**	**LL (bottom)**
pH	-	Down	Down	-	Up	Up	Up	-	-	-
Alkalinity	-	Up	Down	Up	Up	Up	-	-	-	-
Arsenic – total	-	-	-*	-*	-*	-*	-*	-*	-	-*
Cadmium – total	-*	-*	-*	-*	-*	-*	-*	-*	-*	-*
Iron - dissolved	-	-*	Up	-*	-*	n/a	-*	-*	-*	_*
Iron – total	-	-	Up	Up	Down	-	-*	Down	Down	-
Mercury – dissolved	n/a	n/a	-*	-*	Up	Up	Up	Up	Up	-
Mercury – total	-*	-*	-*	-*	Up	Up	-*	-*	Up	-
Manganese – total	-	Down	Up	Up	-	Up	-	Down	Down	-
Sulphate - dissolved	-	-	Down	-	Up	Up	-	-	-	Down

n/a – no data

Up – Upward trend significant at $p<0.05$; **Down** – Downward trend significant at $p \leq 0.05$

- No trend (not significant at $p \leq 0.05$); * More than half results below laboratory detection limit

Table 3-4
Seasonal Kendall test results examples

Site	Variable	Seasonal Mann-Kendall statistic	Mann-Kendall p-value (downward trend)	Kendall Tau statistic	Slope Estimate	95% Upper Limit	Is there a Detectable Trend?	Mann-Kendall p-value (upward trend)
SPD	Sulphate	-142	0.32	-0.029	-0.005	0.000	No*	0.58
SPD	pH	-258	0.20	-0.018	-0.00003	0.000	No*	0.71
WD	Sulphate	-227	0.24	-0.037	-0.0077	0.000	No*	0.74
WC	Sulphate	-829	0.004	-0.120	-0.0414	-0.015	Down**	0.99
WC	pH	114	0.643	0.018	0.0000	0.000	No*	0.357
WB	pH	587	0.967	0.092	0.0000	0.000	Up**	0.031
LL_B	Sulphate	-26	0.124	-0.235	-0.004	0.000	No	0.876

* Same outcome as Mann-Kendall test
** Detected a trend that was not apparent with the Mann-Kendall test.

Table 3-5
Homogeneity Test Results

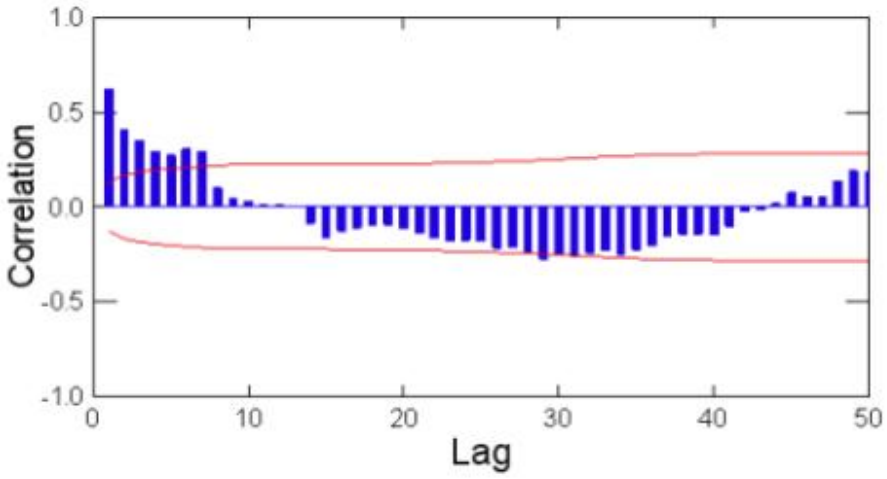
Site	Variable	Homogeneity		Trend	
		Statistic	p	Statistic	p
SPD	Sulphate	5.20	0.16	0.229	0.63
SPD	pH	25.4	<0.001	0.004	0.94
WD	Sulphate	5.52	0.137	0.801	0.37
WC	Sulphate	0.041	0.99	7.11	**0.01**
WC	pH	11.7	0.008	0.304	0.58
WB	pH	8.21	0.042	4.91	**0.03**

Bold – Indicates that trend is present in the seasonal as well as annual data.

Figure 3-1
Autocorrelation plot examples

Sulphate at Settling Pond #1 outlet (SPD).

- Serial correlation present for Lag = 7 (about 7 weeks); evidence of seasonality



Total Mercury at Middle Quinsam Lake Outlet (WB)

- No serial correlation; no obvious seasonality

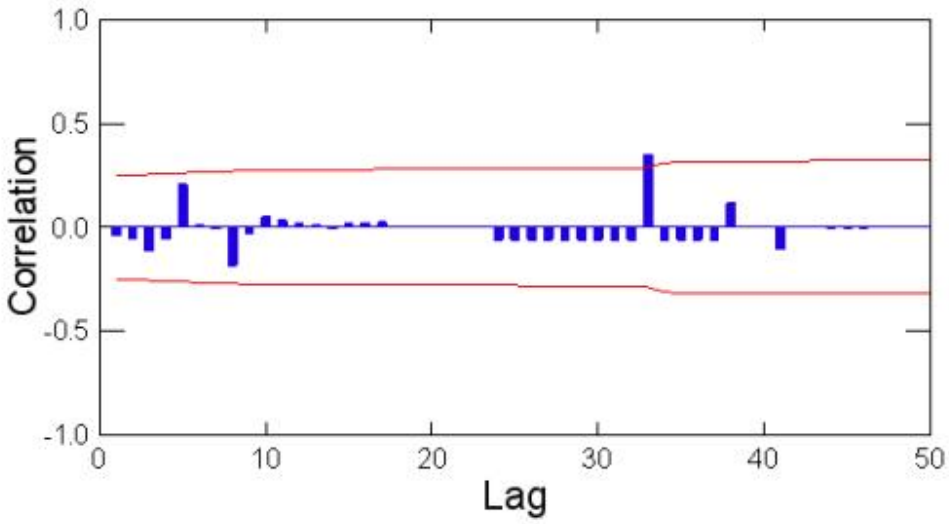


Figure 3-2
LOWESS Plot Examples – Sulphate (MQL-1), total mercury (MQL-1), and pH (SPD)

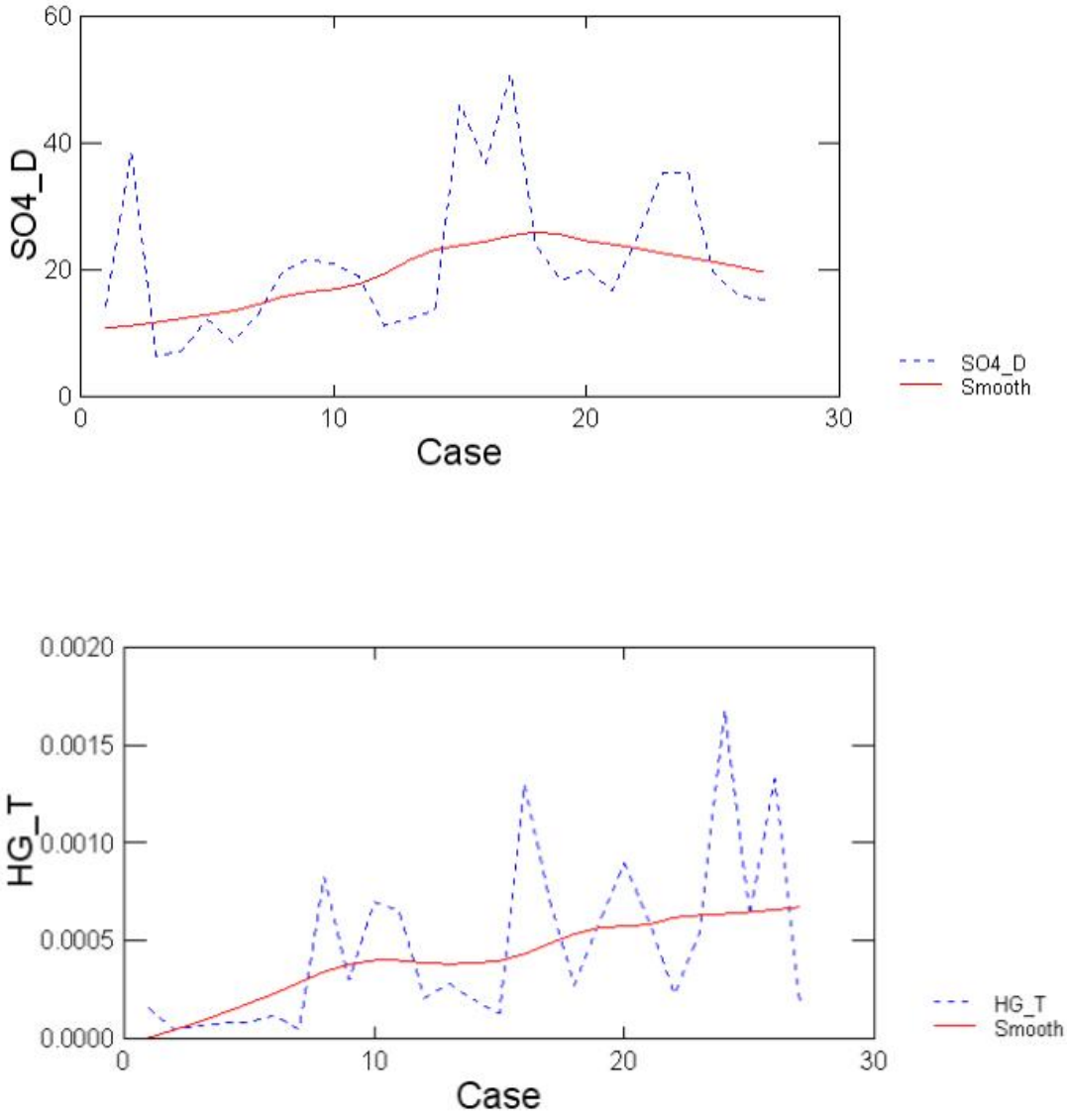
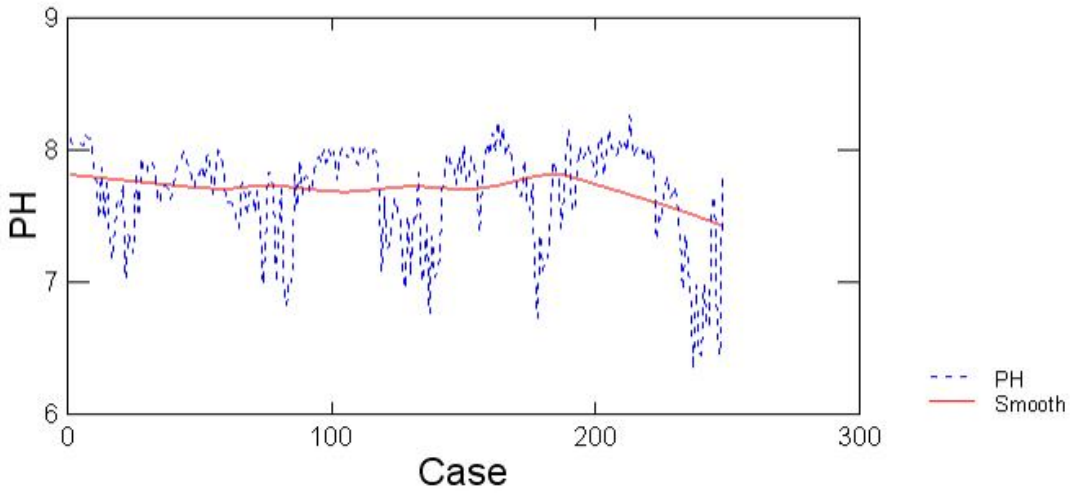


Figure 3-2 continued



4 DISCUSSION

4.1 STUDY PARAMETER TRENDS

This section briefly discusses the trend observations for each of the study parameters.

Sulphate concentration was measured relatively frequently over the 2006-2011 period; approximately weekly at the settling pond (SP1 and WD), wetland (SPC and WC), and Middle Quinsam Lake outlet (WB). At the other sites the sample size for sulphate is the same as for the other parameters. The only statistically significant trends were at SPC (downward), the 1 m and 4 m depths in Middle Quinsam Lake (both upward), and Long Lake near the bottom (downward). Given the sample sizes and schedule, both 1) the observed trend at SPC, and 2) the lack of trend at SP1, WD, WC and WB are results with a reasonable level of confidence. The apparent upward trend in sulphate at the Middle Quinsam Lake site should be treated with caution since the data are not evenly spaced in time (see Section 4.2).

The upward trends in sulphate loads in the settling ponds (SPD and WD) were significant despite no significant trends being present in the concentration data. This suggests an increase in flow over the monitoring period. A review of the flow data for SPD and WD and at two Water Survey of Canada hydrometric stations on the Quinsam River does not indicate a clear trend in flow over the monitoring period, so the presence of an upward trend in the loads appears to involve a somewhat complex interaction between concentration and flow in the higher flow months. This interaction should be explored further when additional data are available (e.g. at the end of 2012).

Mercury is the parameter with the most consistent trend direction where the results are statistically significant (Table 3-3). Not only are the trends at the lake sites upward, the values routinely exceed the water quality objective. However, it is important to note that the slope values are very low, indicating that the magnitude of the trend is slight, and the data only marginally meet the criteria for trend analyses. Nevertheless, the trends in mercury should be investigated further by sampling at more regular time intervals and by consistently using a low laboratory detection limit.

Neither arsenic nor cadmium exhibited any significant trends. This is in part because so many of the samples were below the detection limits. The detection limits were less than the guideline values, and so the inability to detect a trend is not an immediate concern. The use of consistent detection limits and a regular sampling schedule will help to assess trends, or lack thereof, in the future.

There was no consistent pattern in the iron and manganese trends – the numbers of sites showing upward and downward trends was about the same, and no trend was noted in many of the site/parameter combinations. Again, even where a trend was detected the slope was small. The trends in pH and

alkalinity were similarly mixed, with low slope values, indicating that the upward or downward trend, if any, was slight over the monitoring period.

4.2 DATA CONSTRAINTS ON TREND ANALYSIS

The results of the trend analyses presented in this report should be considered as an initial review that indicates where trends are apparent or potentially apparent, subject to confirmation. At about five to five and a half years, the current data set[2] is close to the minimum size that is needed to detect a trend in water quality. However, now that the data transformations have been completed to facilitate trend analyses, it will be relatively straightforward to repeat the basic assessment of trends as part of the annual water quality monitoring and reporting program. A detailed assessment should be considered for the end of 2013 when there are three more years of all-season data.

In addition to sample size, consistency of sampling interval limited the ability to complete trend analyses. The SYSTAT versions of the Mann-Kendall and seasonal tests include a software routine that prevents analyses from proceeding if the sampling intervals are too uneven. It also issues a caution for interpretation if the intervals are judged not evenly spaced. In the majority of the trend runs this warning was generated, which indicates that the specific statistics (e.g. the Mann-Kendall statistic and slope estimate) should not be too heavily relied upon. Steps to reduce this are outlined in Section 5.0 (conclusions and recommendations).

The assessment of autocorrelation found that there was evidence of serial correlation in the sulphate and, to a lesser extent, the pH data at the pond and wetland sites where samples are collected at weekly intervals. This means that consecutive samples may not be considered independent samples (see Section 3.3.1). The lake sites did not show significant serial correlation at the sampling intervals that were used. For future trend analyses it would be appropriate to first calculate monthly means or median and complete the statistical analyses on those monthly values to minimize serial correlation effects. In this initial analysis of trend the data were used as they are in order to assess this effect, given the other limitations outlined above.

[2] Water quality data has been collected annually by QCC from well before 2006. It is understood that the pre-2006 data varies in terms of sampling and laboratory methods, and may not be suitable for the quantitative assessment of trend.

5 CONCLUSION AND RECOMMENDATIONS

Trend analyses were completed on the 2006-2011 data sets provided by QCC for seven locations. At one of those locations, Middle Quinsam Lake, there are data at three depths. At the Long Lake site there are data for near surface (1 m deep) and near the bottom (1 m from the bottom). The key findings are as follows:

- Although it is *theoretically* feasible to carry out trend analyses of a five-year data set, care needs to be taken in interpreting the results, especially if the sampling interval was not consistent or there is a high proportion of samples below the laboratory detection limit, as is the situation with the 2006-2011 metals data from QCC.
- For pH, alkalinity and sulphate, the combination of sample size and a reasonably regular sampling schedule makes analyses of trend more reliable at some sites. These parameters were sampled approximately weekly at five sites (the 2 settling ponds, 2 downstream wetlands, and Middle Quinsam Lake outlet).
- The only statistically significant trends for sulphate were at SPC (downward), Long Lake near the bottom (downward), and the 1 m and 4 m depths in Middle Quinsam Lake (both upward). Given the sample sizes and schedule, both 1) the observed trend at SPC, and 2) the lack of trend at SP1, WD, WC, WC and WB are results with a reasonable level of confidence. The apparent upward SO_4 trend at the Middle Quinsam Lake site should be treated with caution since the data are not evenly spaced in time.
- Dissolved mercury was trending upward at both locations sampled in Middle Quinsam Lake - the lake centre (at 1 m, 4 m, and 1 m from the bottom) and the lake outlet. Total mercury also exhibits an upward trend at Middle Quinsam (1 m and 4 m depth) and Long Lake (1 m depth). However the slope (magnitude of trend) was small and future monitoring should be adjusted to help assess whether these trends continue.
- Neither arsenic nor cadmium exhibited any significant trends.
- Some trends were observed in pH, alkalinity, iron and manganese; but there was little consistency between sites and the slope (magnitude) was slight.
- Seasonal trend tests, the Seasonal Mann-Kendall and Homogeneity test, were applied to assess the presence of trend in data sets where visual examination of graphs indicated seasonal variation. A trend was detected in two cases where the standard test did not detect a trend – sulphate at WC (downward) and pH at WB (upward).
- Sulphate loading rates (kg/day) were calculated for the two settling pond outlet sites. Significant upward trends are present at both, based on the Mann-Kendall and Seasonal Mann-Kendall tests. Trends were not present in all seasons at SPD, but were present each season at WD.

If additional trend detection is desirable in the future, the following recommendations will enhance QCC's ability to evaluate trends.

1. Sampling should take place at consistent regular intervals. Ideally sampling would occur on the same date within the week for weekly samples or within the month (e.g. January 15, February 15, etc.) for monthly samples, although a one-day adjustment (plus or minus) is likely acceptable if the standard date falls on a weekend.
2. Consistent laboratory detection limits should be utilized. The detection limit should be less than the applicable water quality guideline so that all actual values exceeding the guideline are utilized in the trend analysis (rather than the substituted 50% DL values). Based on previous observations of above-guideline/objective total mercury concentrations, QCC has adopted a low detection limit for mercury (QCC 2011), which should be continued.
3. For the settling pond outlet sites, the flow should be measured at the time of sampling assess variations in loading rates. To date, the loading has been calculated using the daily flow rate and the concentration of a single sample obtained on that date. This is reasonable if the flow is relatively consistent throughout the day, but may influence the loading estimates if it varies.

MOE has asked QCC to consider sampling at the lake sites on a five samples within 30 days schedule since some water quality guidelines are based on this schedule. The “5 in 30” sampling would occur three times per year – 1) spring freshet/lake turnover, 2) summer low flow/lake stratification, and 3) fall flush/lake turnover (i.e. total of 15 samples/year). Trend assessment for this sampling regime is possible by defining the time variable as the number of “lake seasons” since the start of monitoring, where the “lake seasons” are the three periods noted in the previous sentence plus winter. Each parameter would therefore have only four data points per year, and it would likely take at least six years of monitoring according to this schedule to assess whether or not a statistically significant trend is present.

6 REFERENCES

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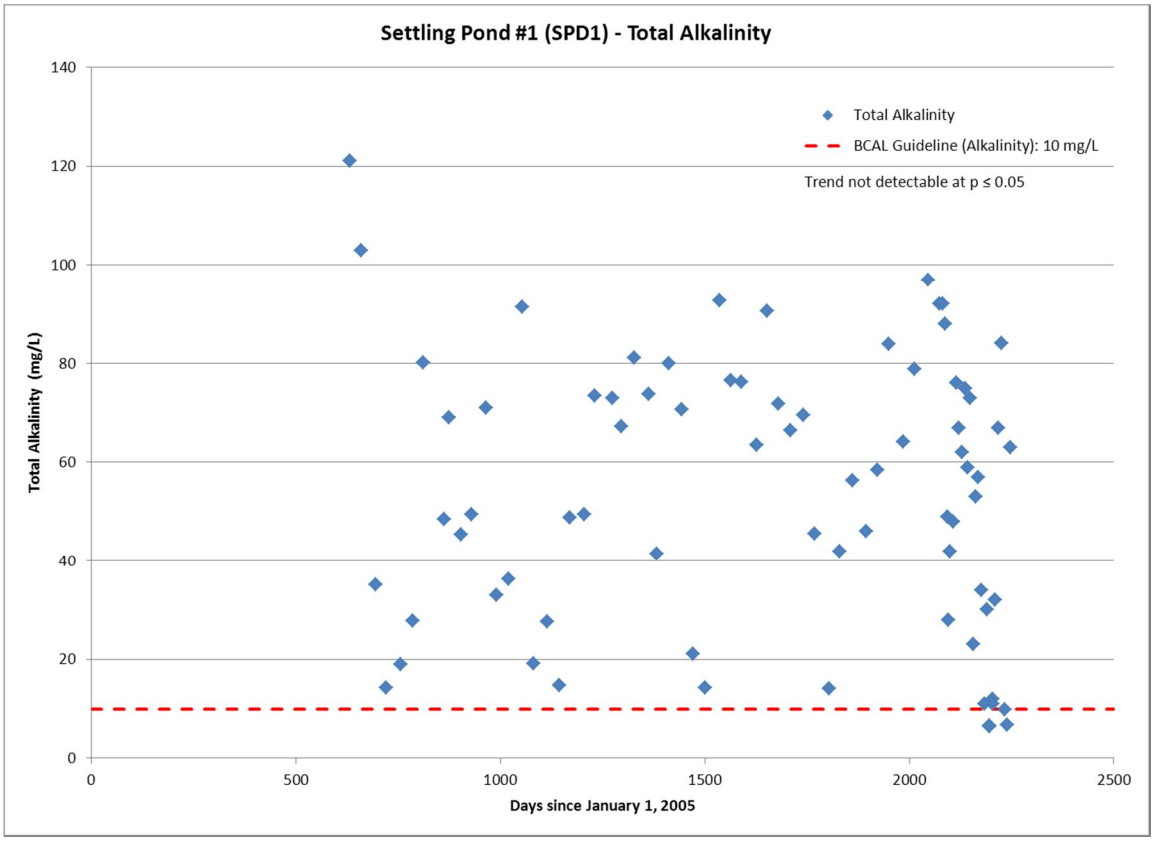
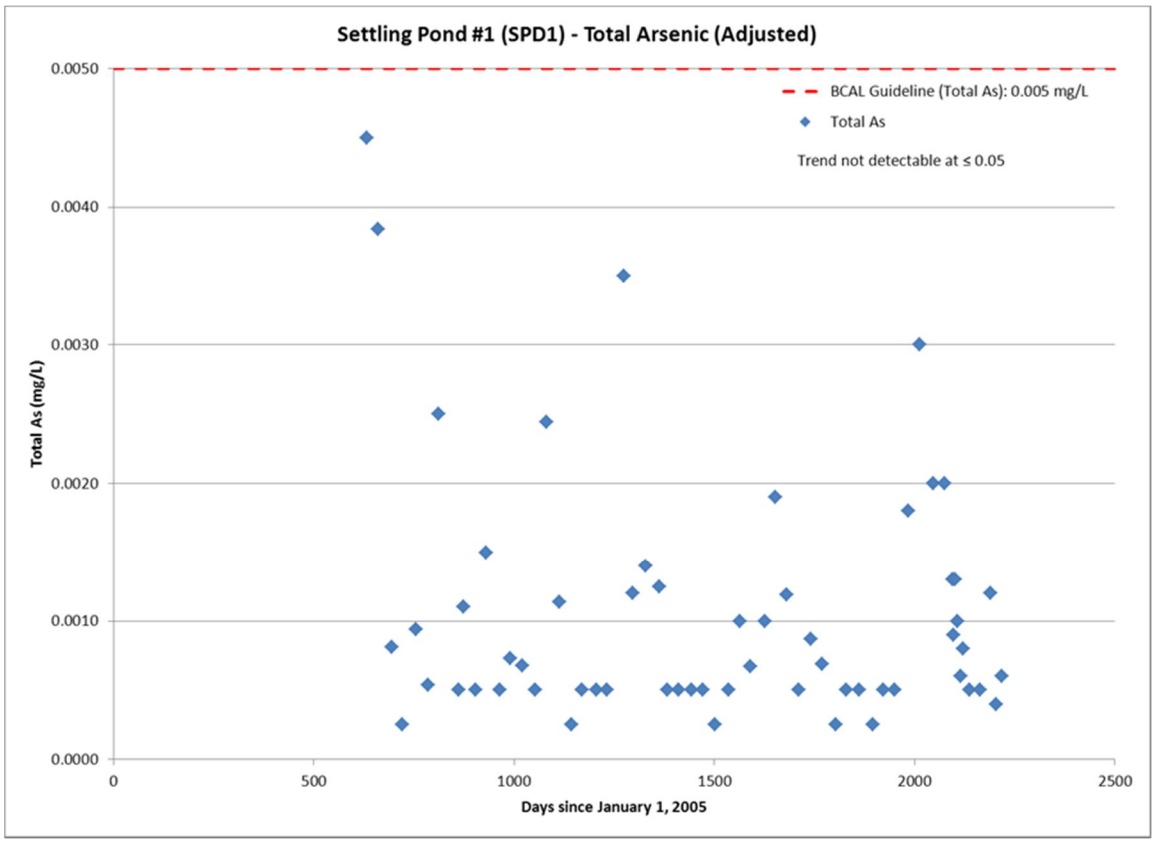
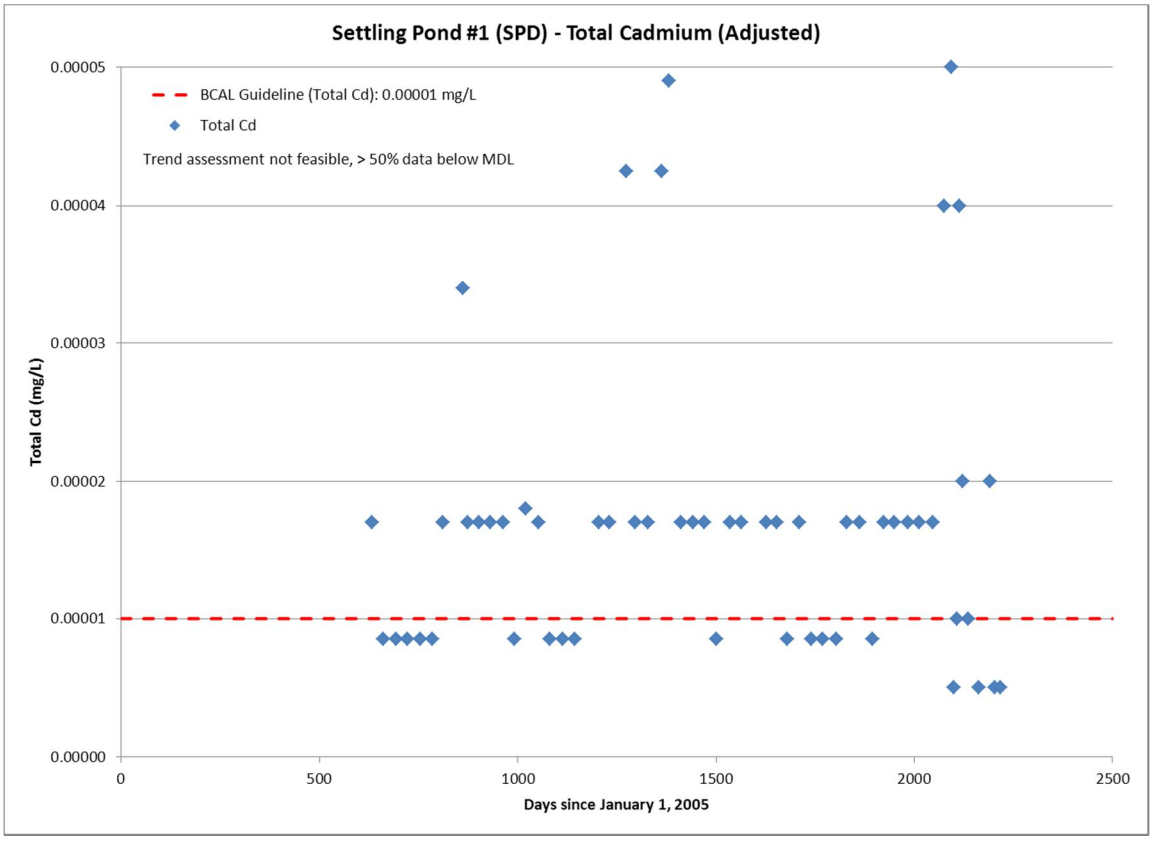
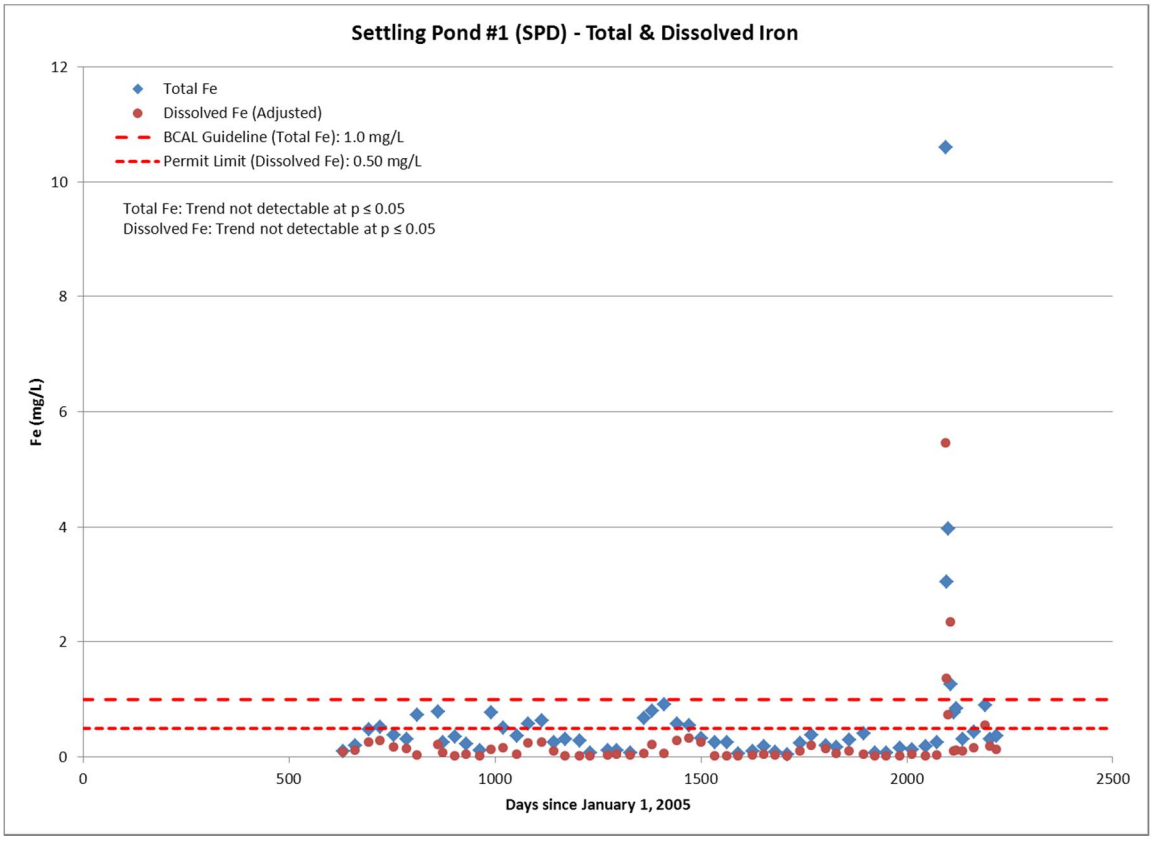
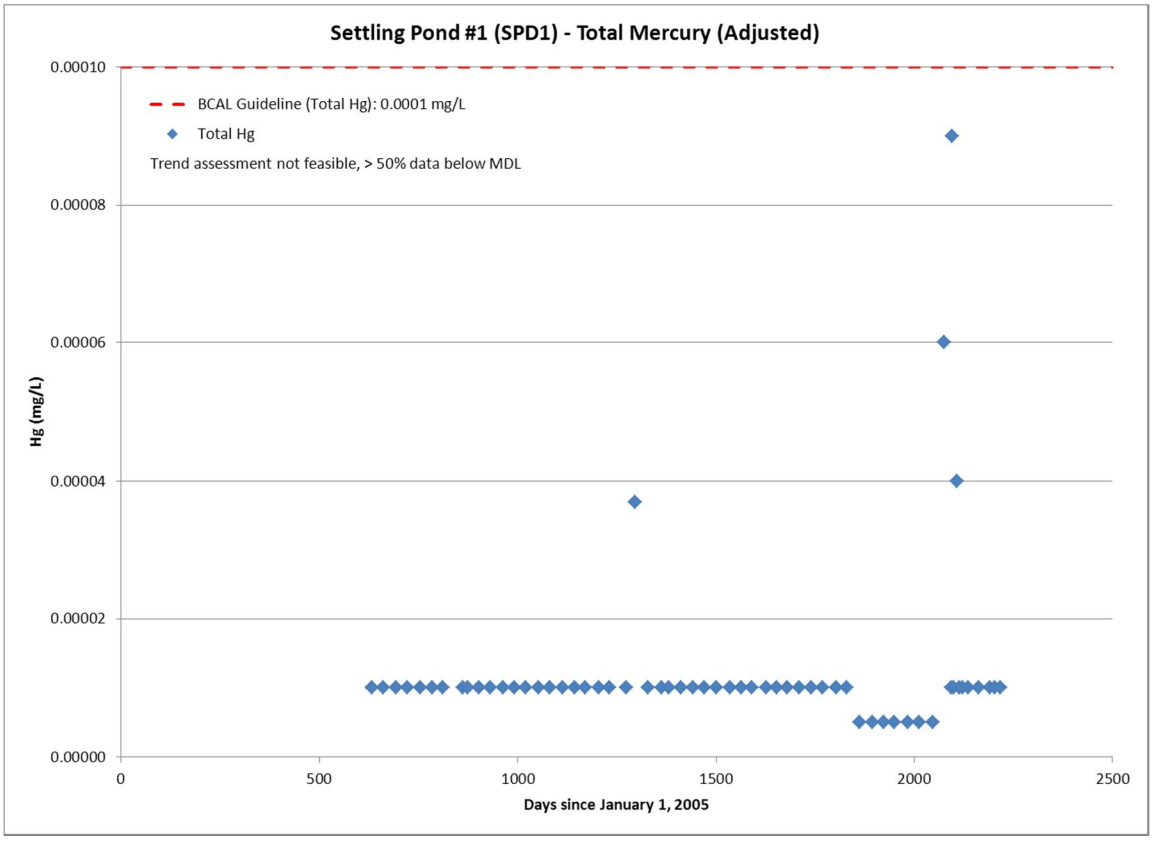
A Appendix A - GRAPHS PLOTTING CONCENTRATION AGAINST TIME

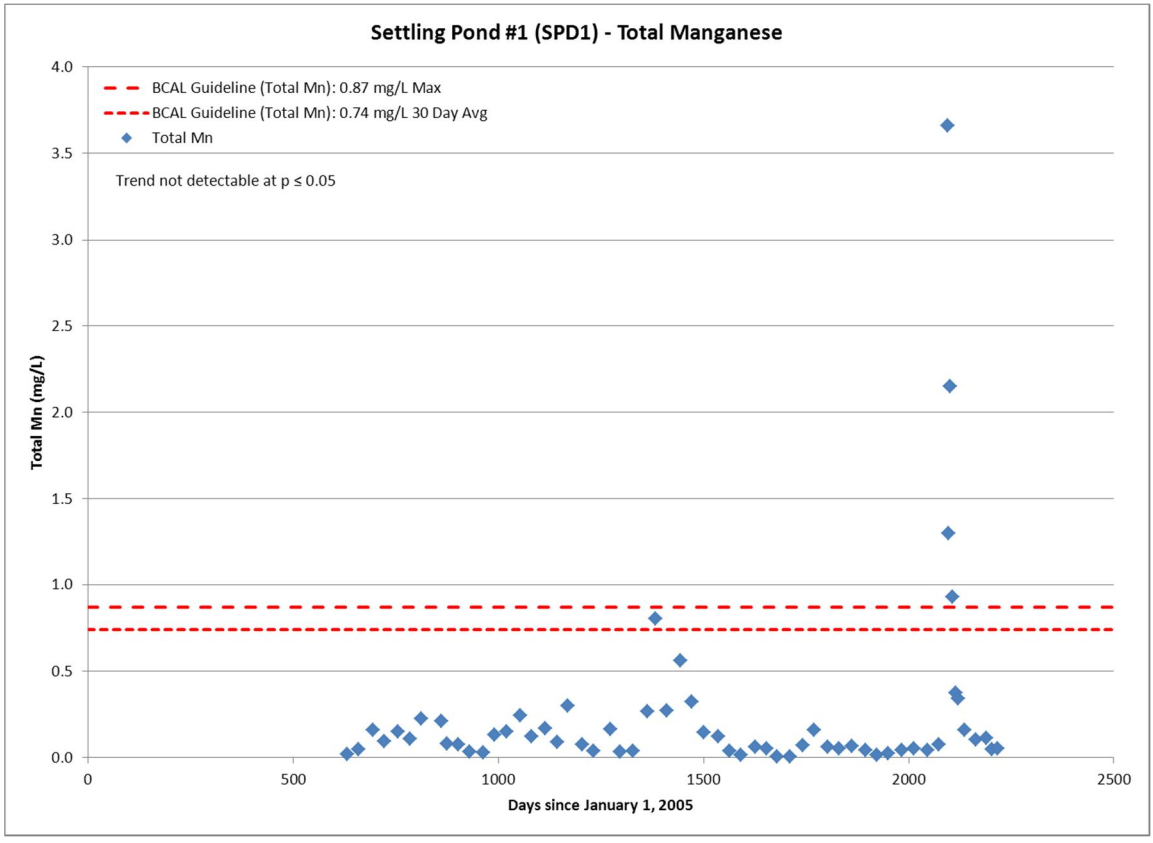

Settling Pond #1 (SPD1) - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Trend not detectable at p ≤ 0.05
Total Alkalinity (mg/L)
Days since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

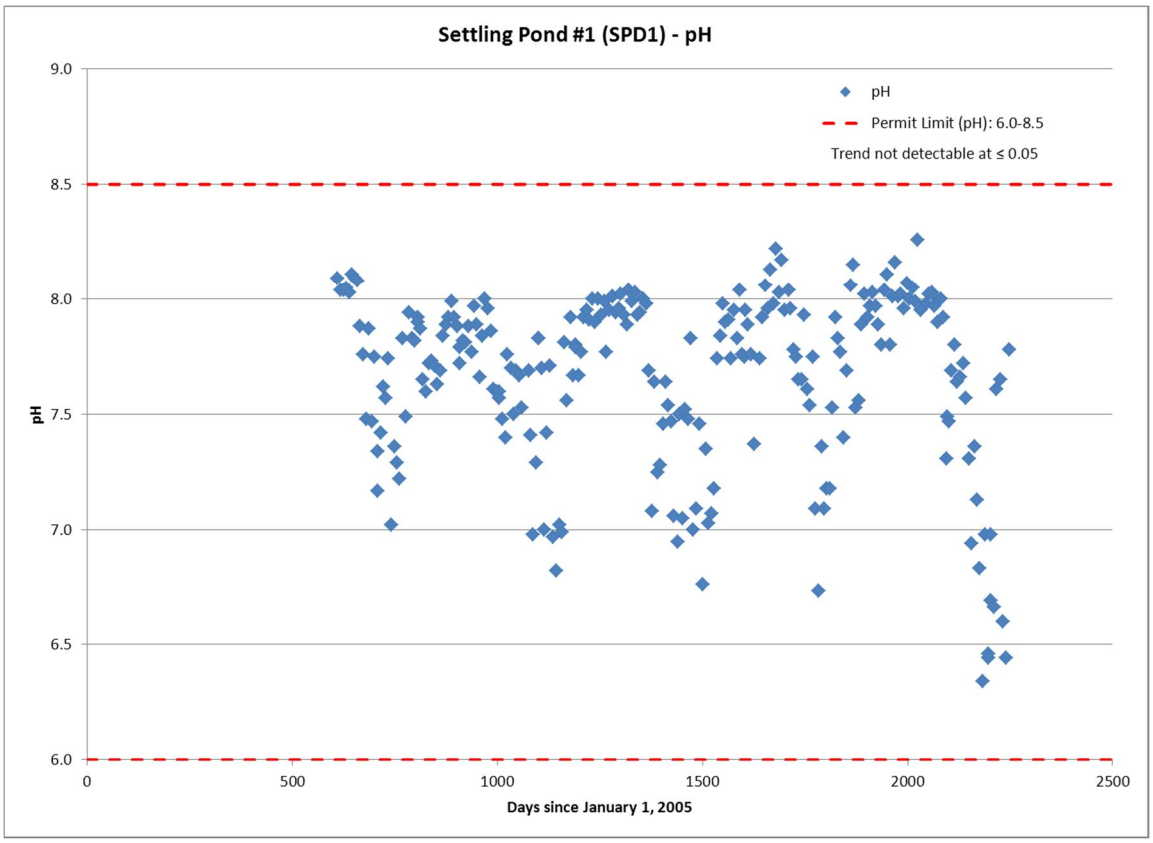

Settling Pond #1 (SPD1) - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend not detectable at ≤ 0.05
Total As (mg/L)
Days since January 1, 2005
0.0000
0.0010
0.0020
0.0030
0.0040
0.0050
0
500
1000
1500
2000
2500

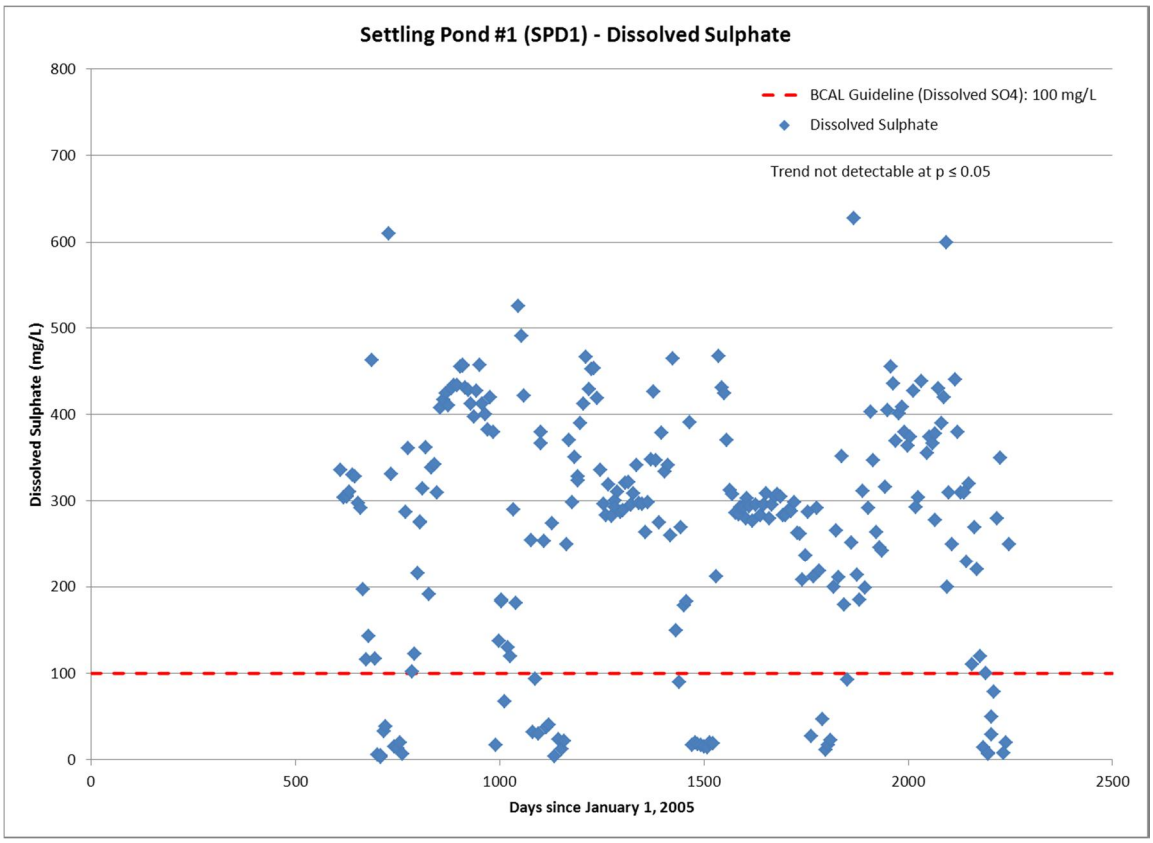

Settling Pond #1 (SPD) - Total Cadmium (Adjusted)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL
Total Cd (mg/L)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0
500
1000
1500
2000
2500
Days since January 1, 2005

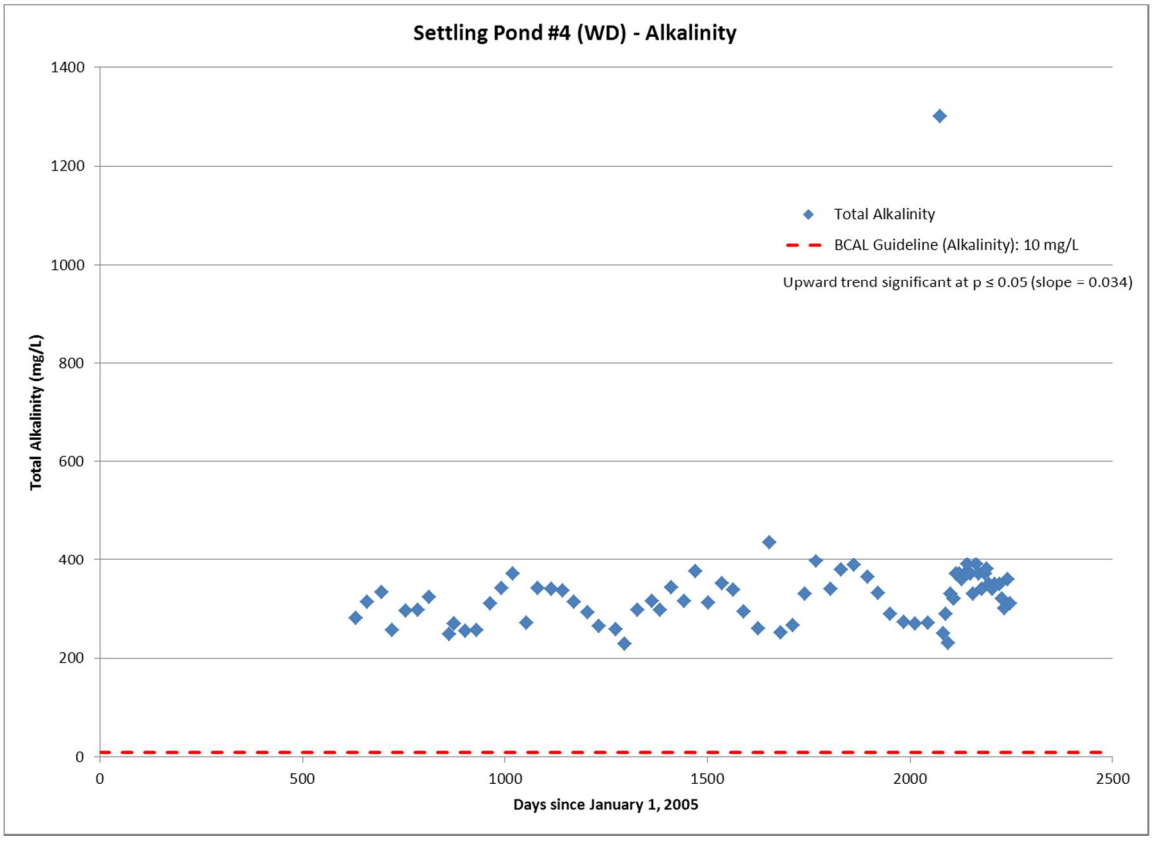

Settling Pond #1 (SPD) - Total & Dissolved Iron
Total Fe
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
Permit Limit (Dissolved Fe): 0.50 mg/L
Total Fe: Trend not detectable at p ≤ 0.05
Dissolved Fe: Trend not detectable at p ≤ 0.05
Fe (mg/L)
12
10
8
6
4
2
0
0
500
1000
1500
2000
2500
Days since January 1, 2005

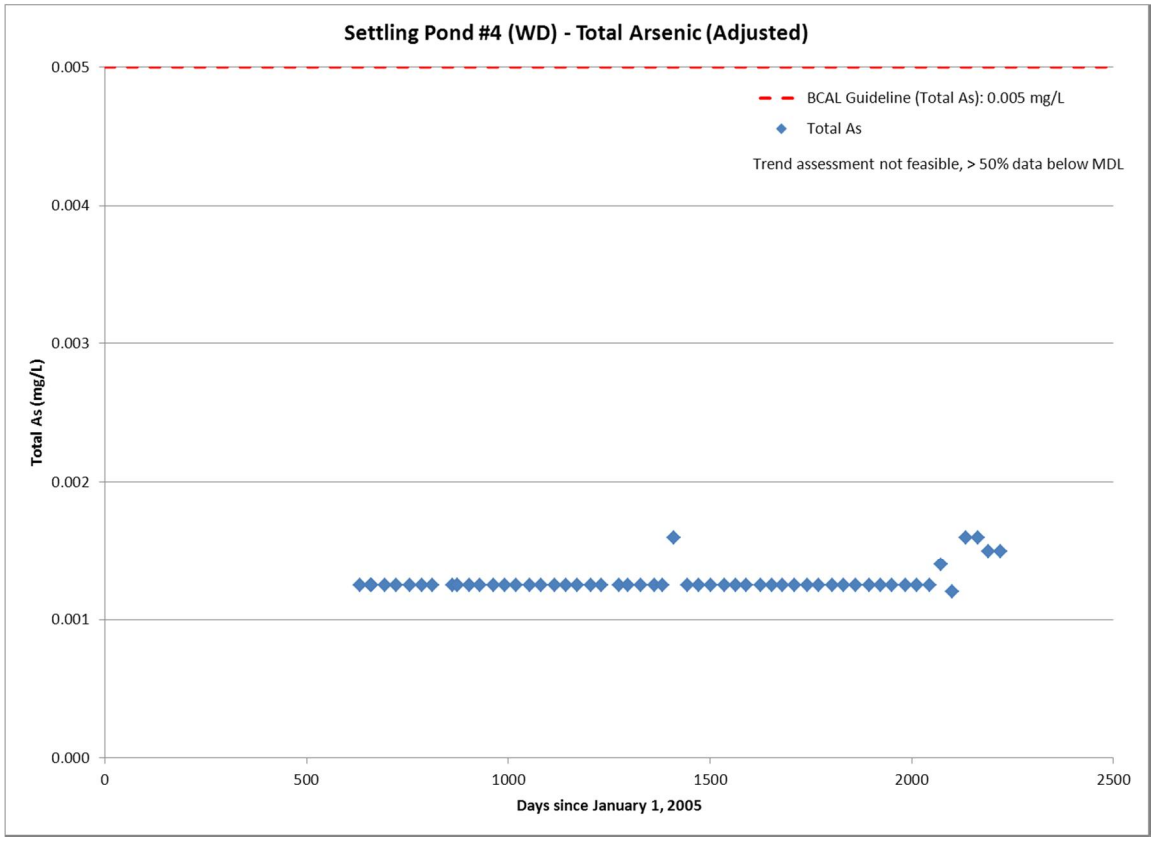

Settling Pond #1 (SPD1) - Total Mercury (Adjusted)
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg
Trend assessment not feasible, > 50% data below MDL
Hg (mg/L)
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
0
500
1000
1500
2000
2500
Days since January 1, 2005

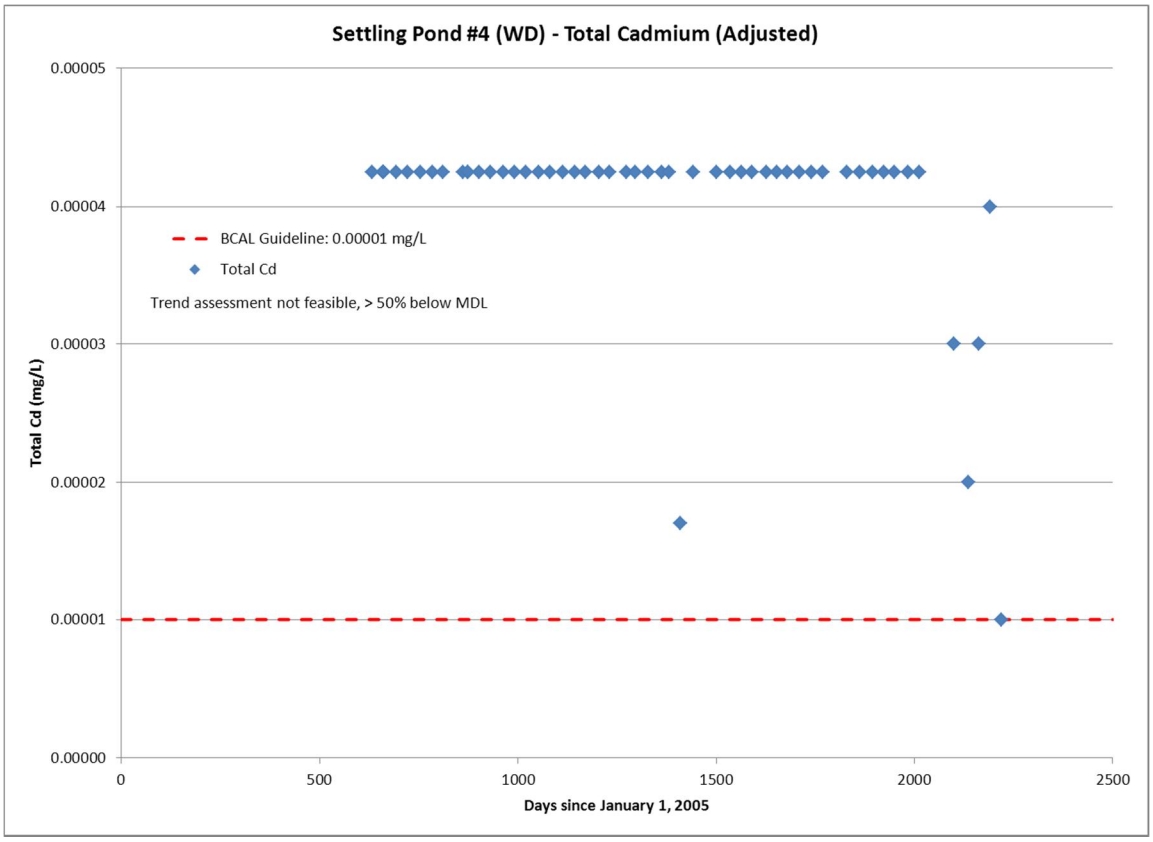

Settling Pond #1 (SPD1) - Total Manganese
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg
Total Mn
Trend not detectable at p ≤ 0.05
Total Mn (mg/L)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

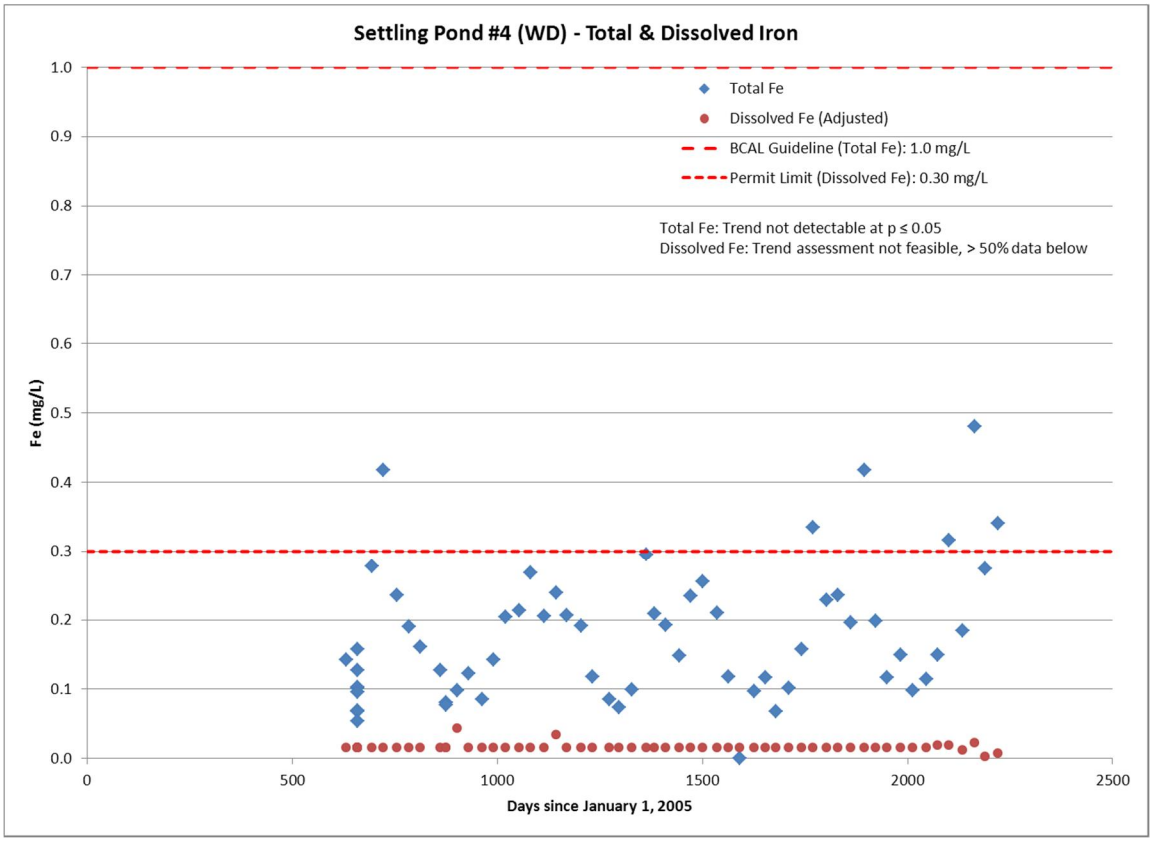

Settling Pond #1 (SPD1) - pH
pH
Permit Limit (pH): 6.0-8.5
Trend not detectable at ≤ 0.05
pH
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

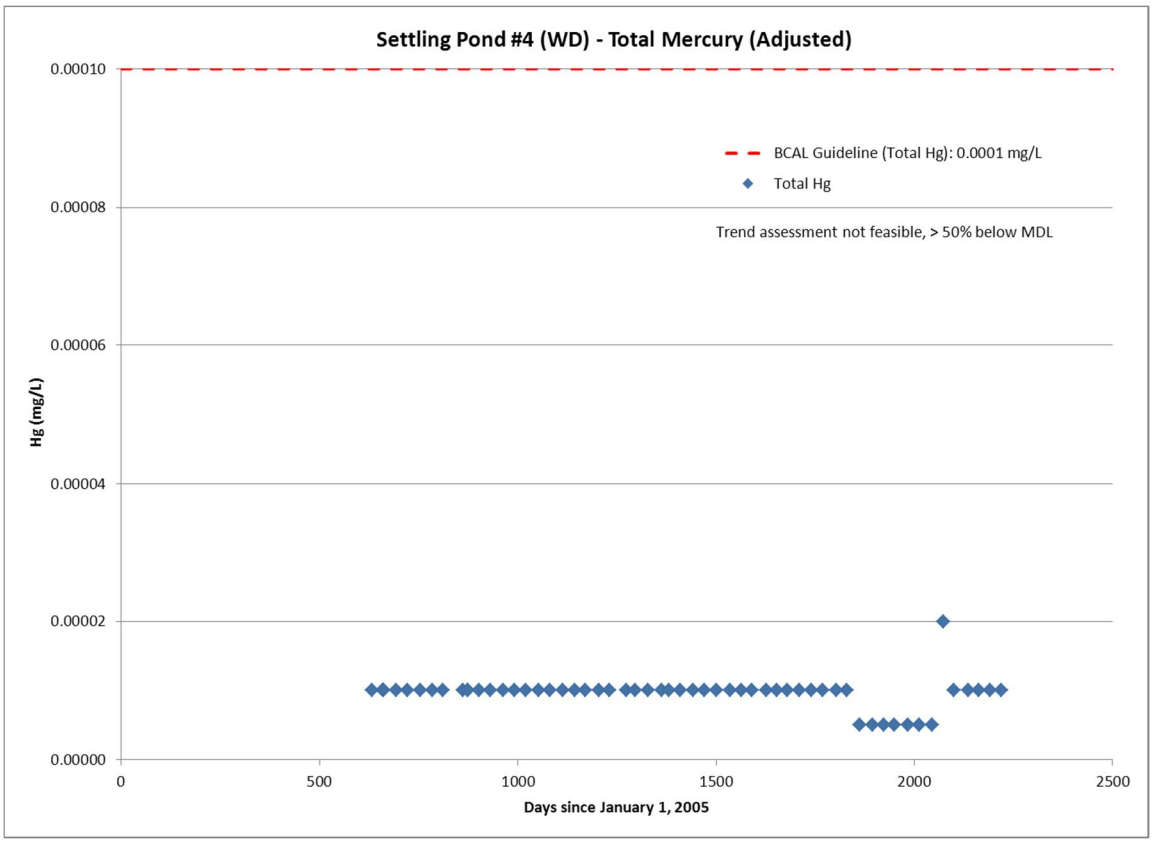

Settling Pond #1 (SPD1) - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Trend not detectable at p ≤ 0.05
Dissolved Sulphate (mg/L)
800
700
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500
Days since January 1, 2005

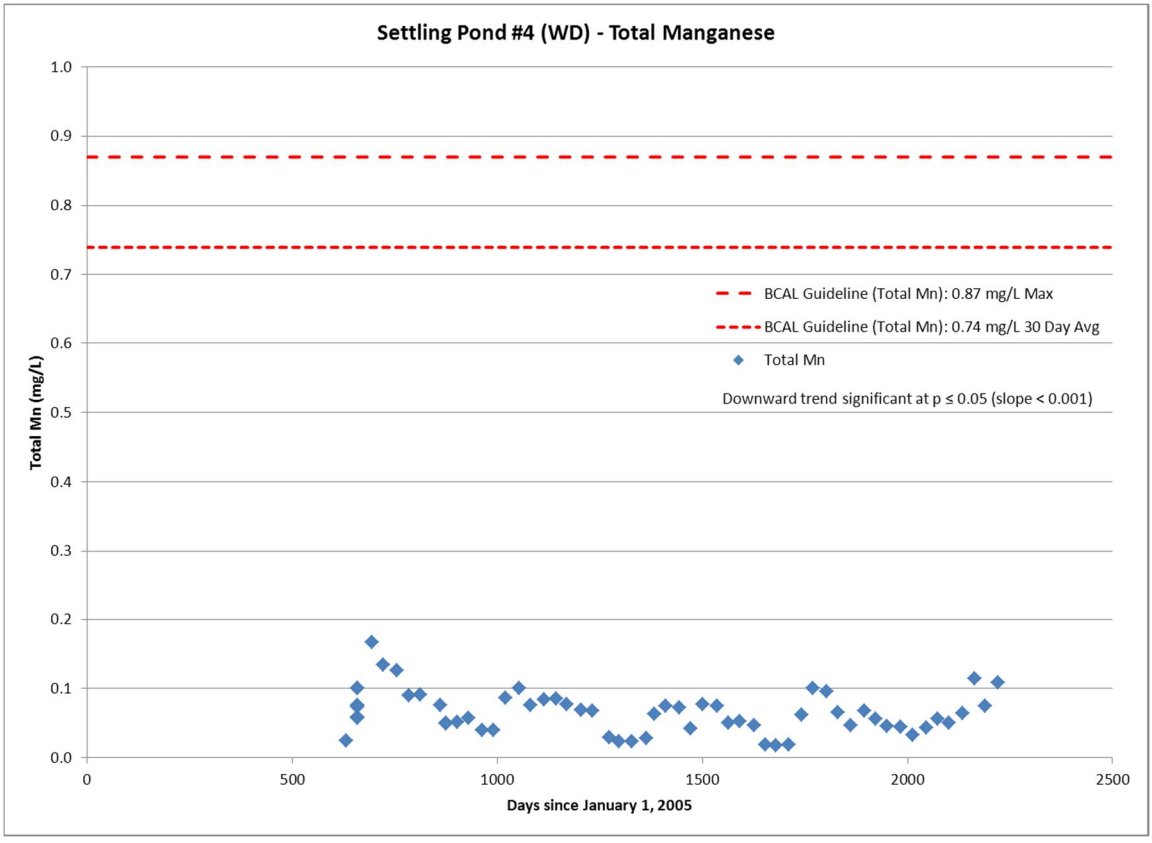

Settling Pond #4 (WD) - Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Upward trend significant at p ≤ 0.05 (slope = 0.034)
Total Alkalinity (mg/L)
Days since January 1, 2005
0
200
400
600
800
1000
1200
1400
0
500
1000
1500
2000
2500

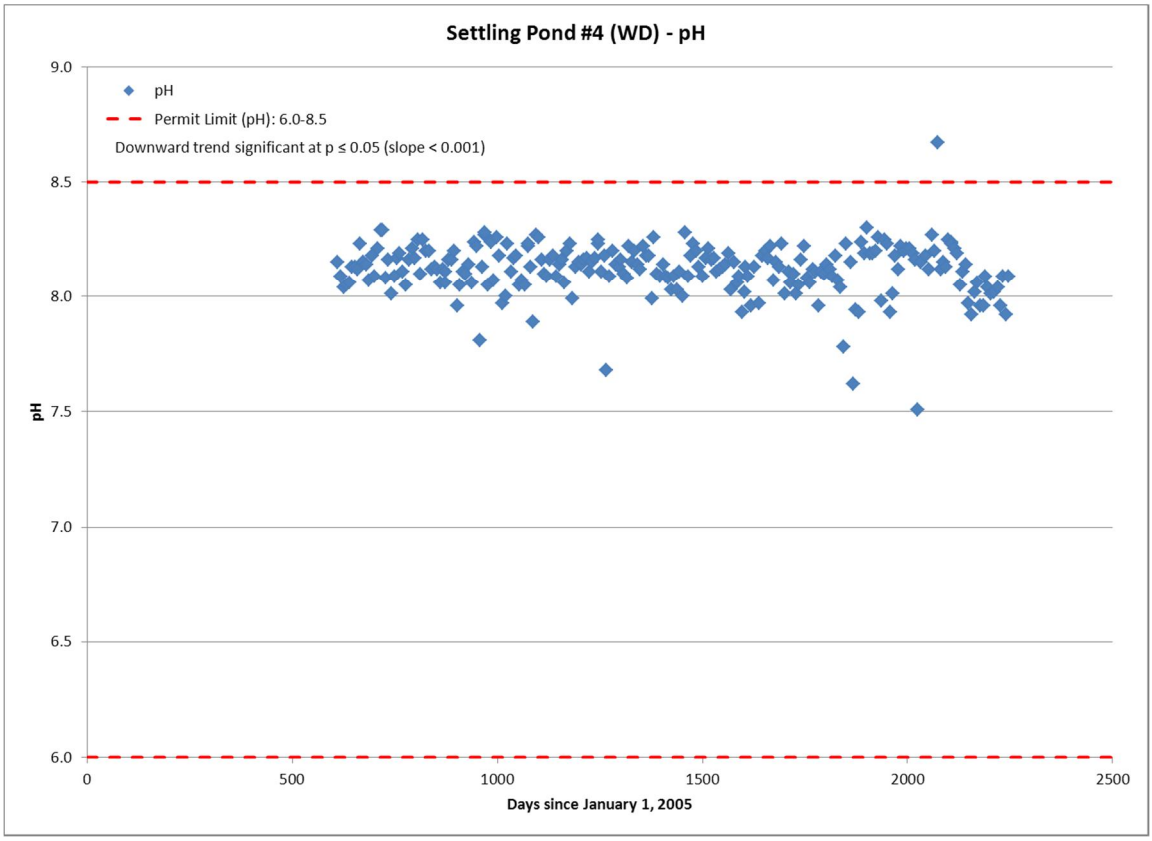

Settling Pond #4 (WD) - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0.000
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500

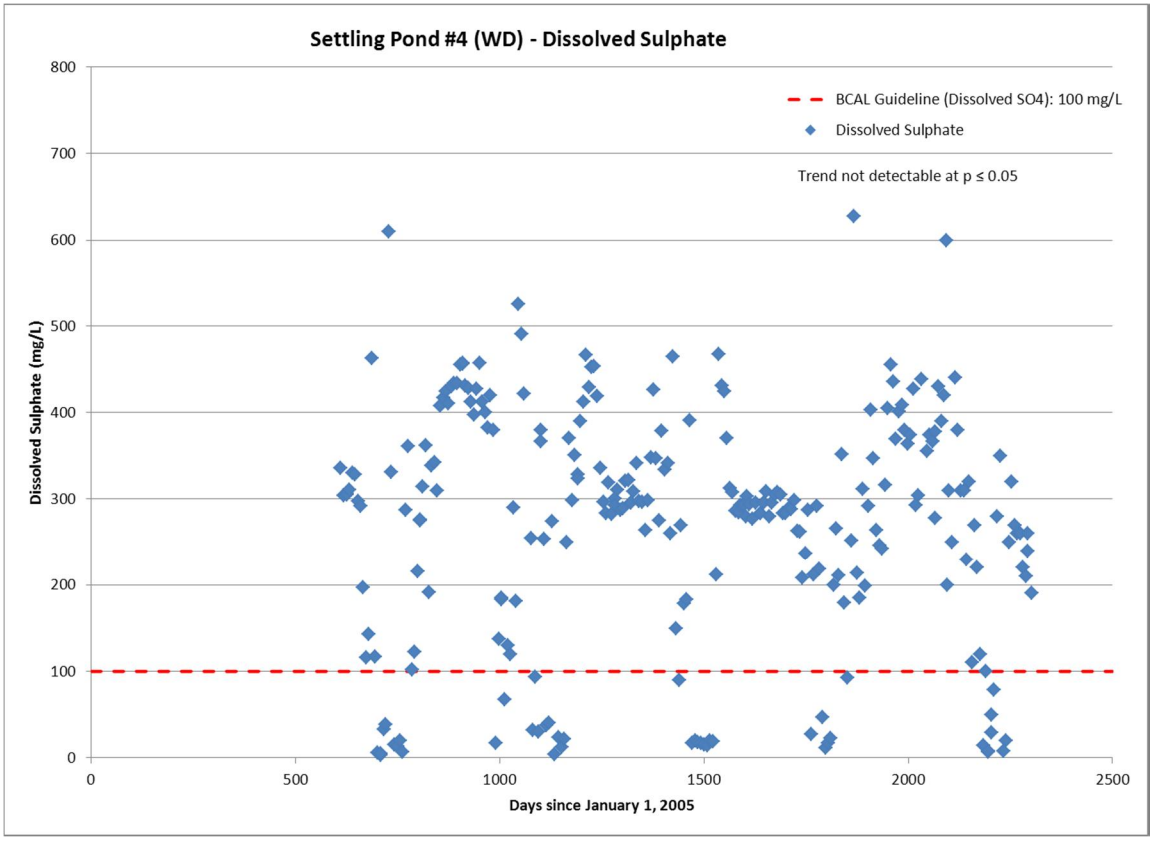

Settling Pond #4 (WD) - Total Cadmium (Adjusted)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
Total Cd (mg/L)
BCAL Guideline: 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

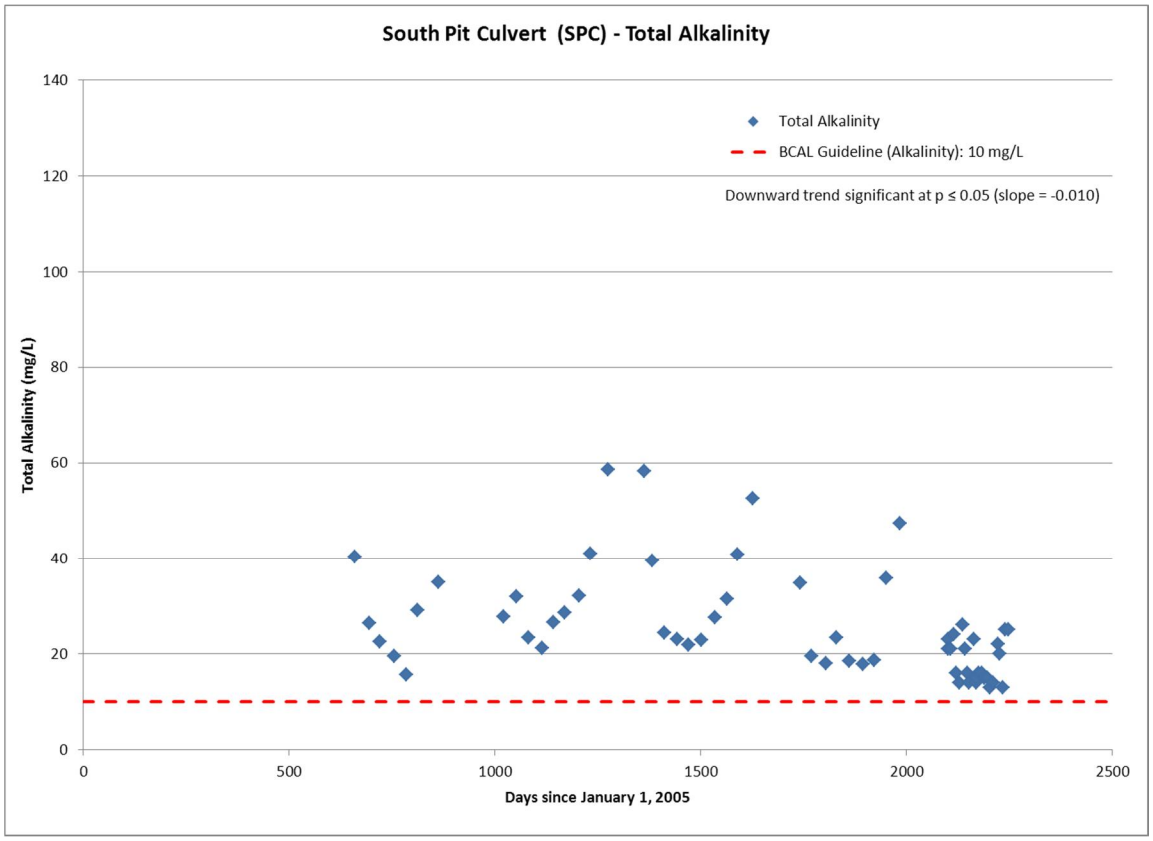

Settling Pond #4 (WD) - Total & Dissolved Iron
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Fe (mg/L)
Total Fe
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
Permit Limit (Dissolved Fe): 0.30 mg/L
Total Fe: Trend not detectable at p ≤ 0.05
Dissolved Fe: Trend assessment not feasible, > 50% data below
0
500
1000
1500
2000
2500
Days since January 1, 2005

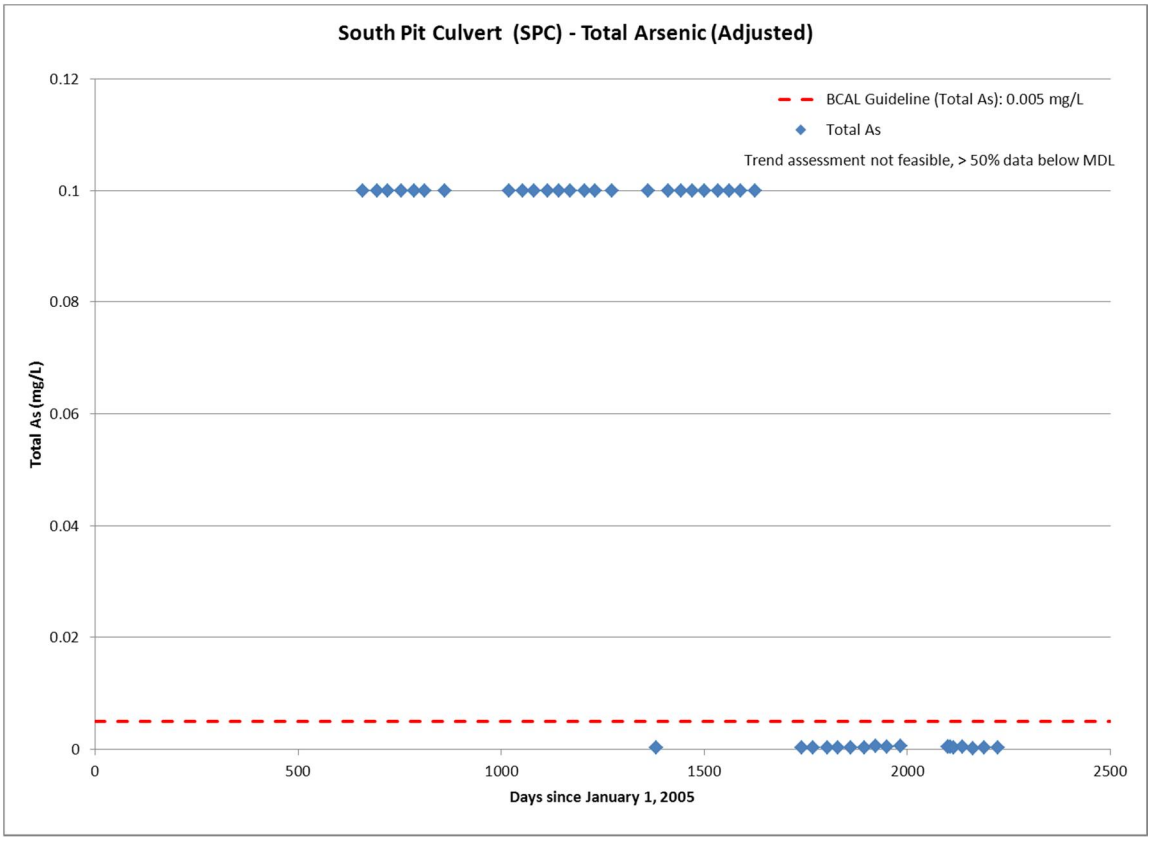

Settling Pond #4 (WD) - Total Mercury (Adjusted)
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Hg (mg/L)
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg
Trend assessment not feasible, > 50% below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

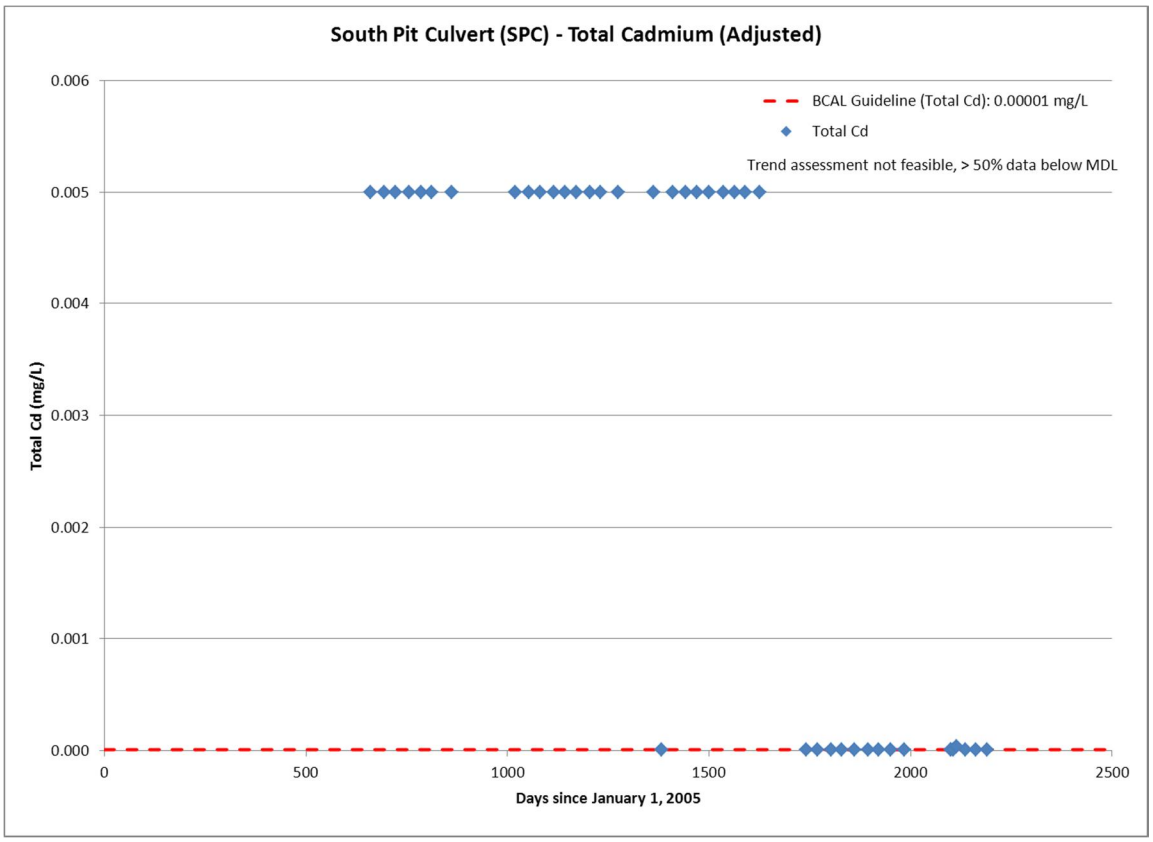

Settling Pond #4 (WD) - Total Manganese
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Mn (mg/L)
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg
Total Mn
Downward trend significant at p ≤ 0.05 (slope < 0.001)
0
500
1000
1500
2000
2500
Days since January 1, 2005

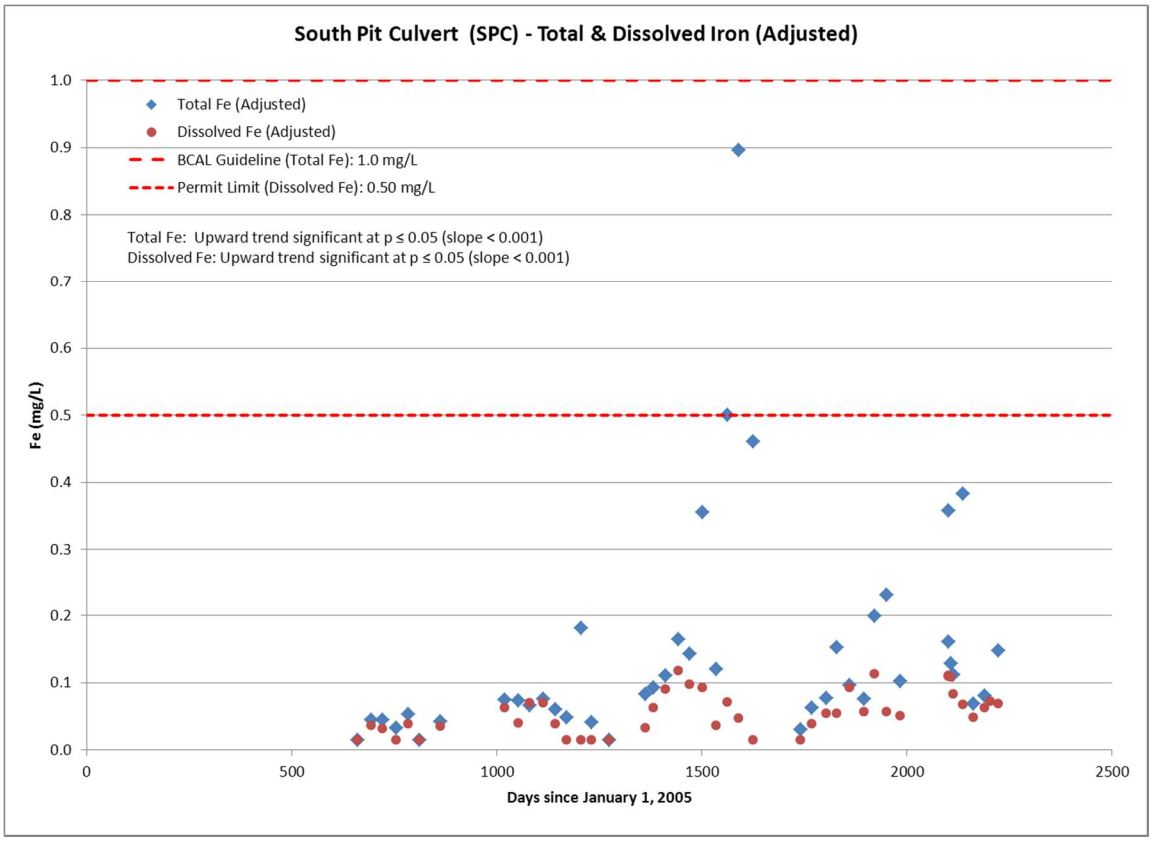

Settling Pond #4 (WD) - pH
pH
Permit Limit (pH): 6.0-8.5
Downward trend significant at p ≤ 0.05 (slope < 0.001)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
pH
0
500
1000
1500
2000
2500
Days since January 1, 2005

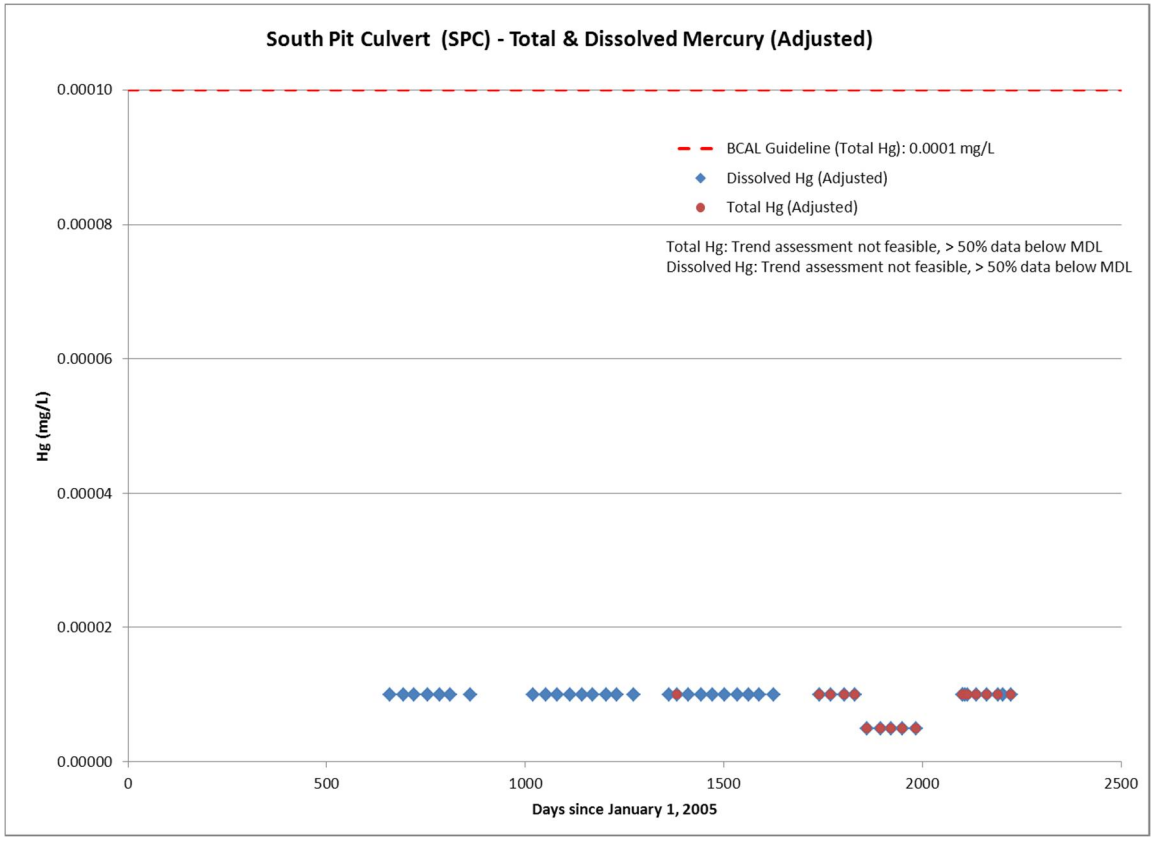

Settling Pond #4 (WD) - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Trend not detectable at p ≤ 0.05
800
700
600
500
400
300
200
100
0
Dissolved Sulphate (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005

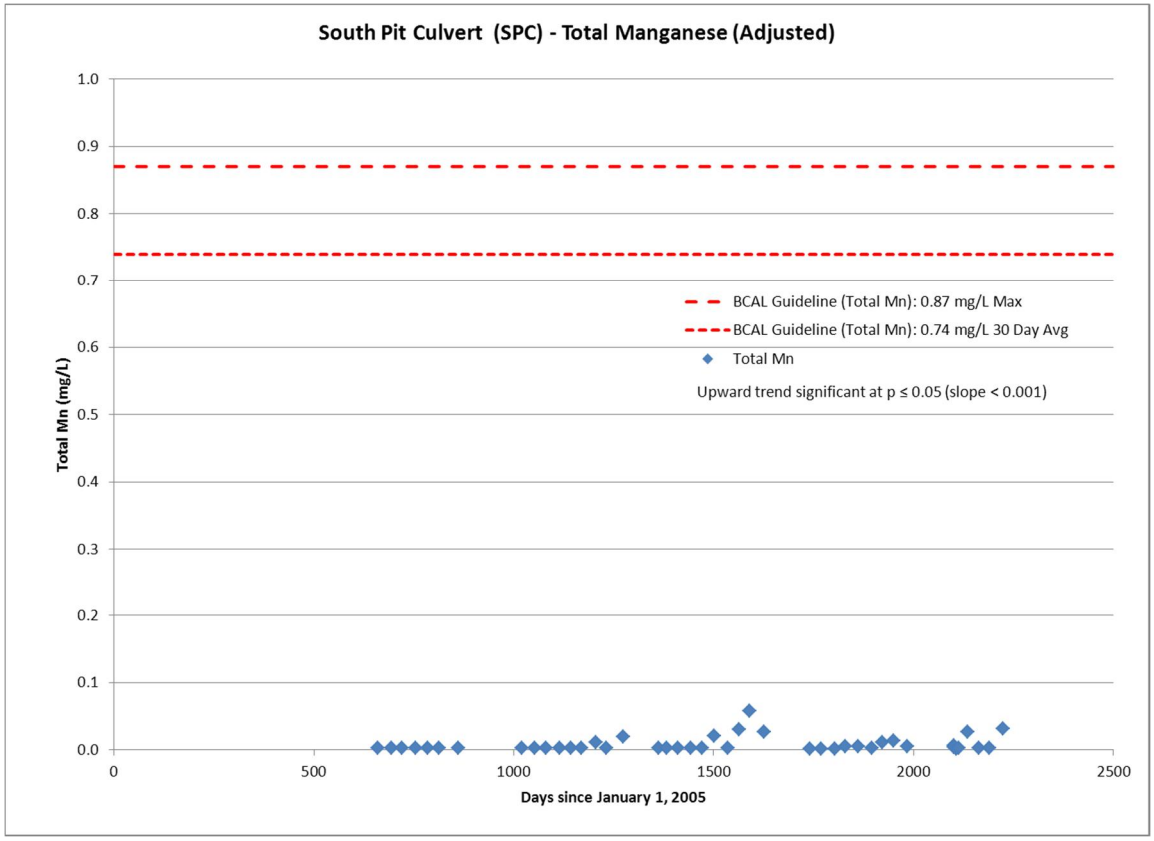

South Pit Culvert (SPC) - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Downward trend significant at p ≤ 0.05 (slope = -0.010)
Total Alkalinity (mg/L)
Days since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

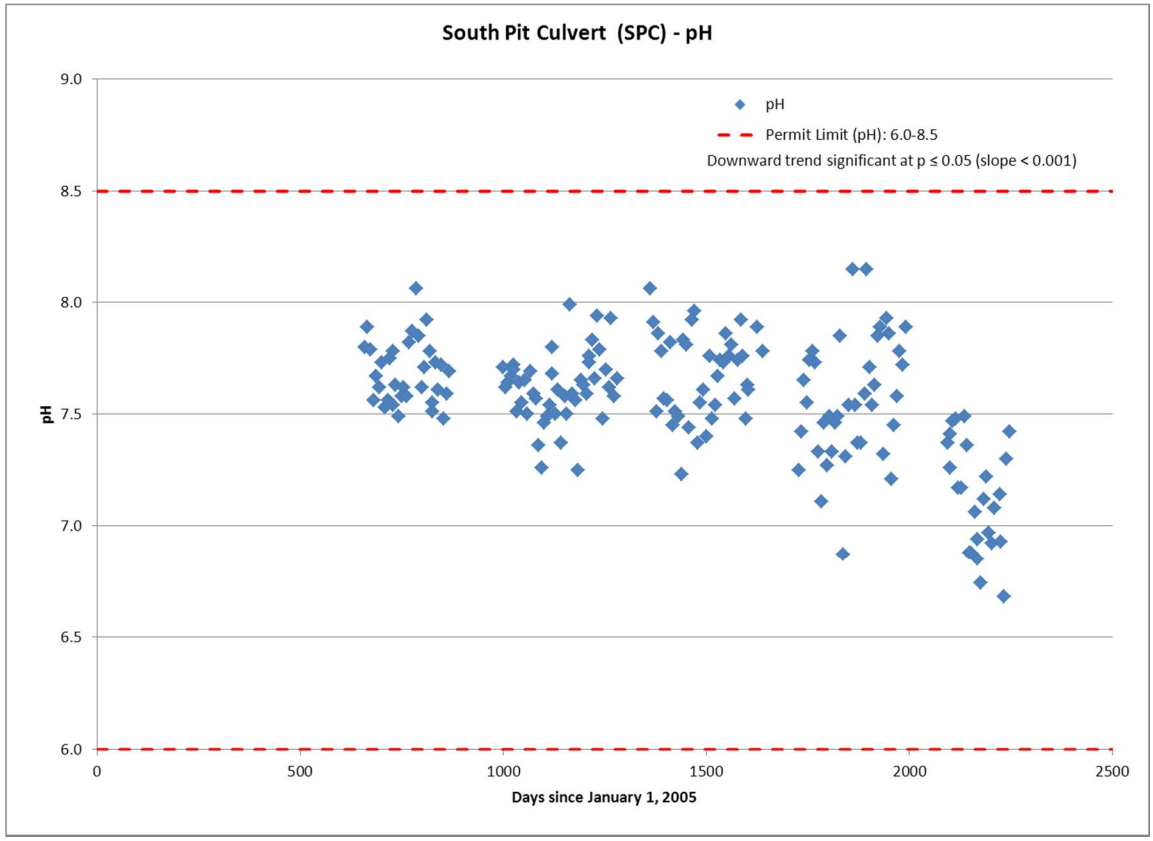

South Pit Culvert (SPC) - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0
0.02
0.04
0.06
0.08
0.1
0.12
0
500
1000
1500
2000
2500

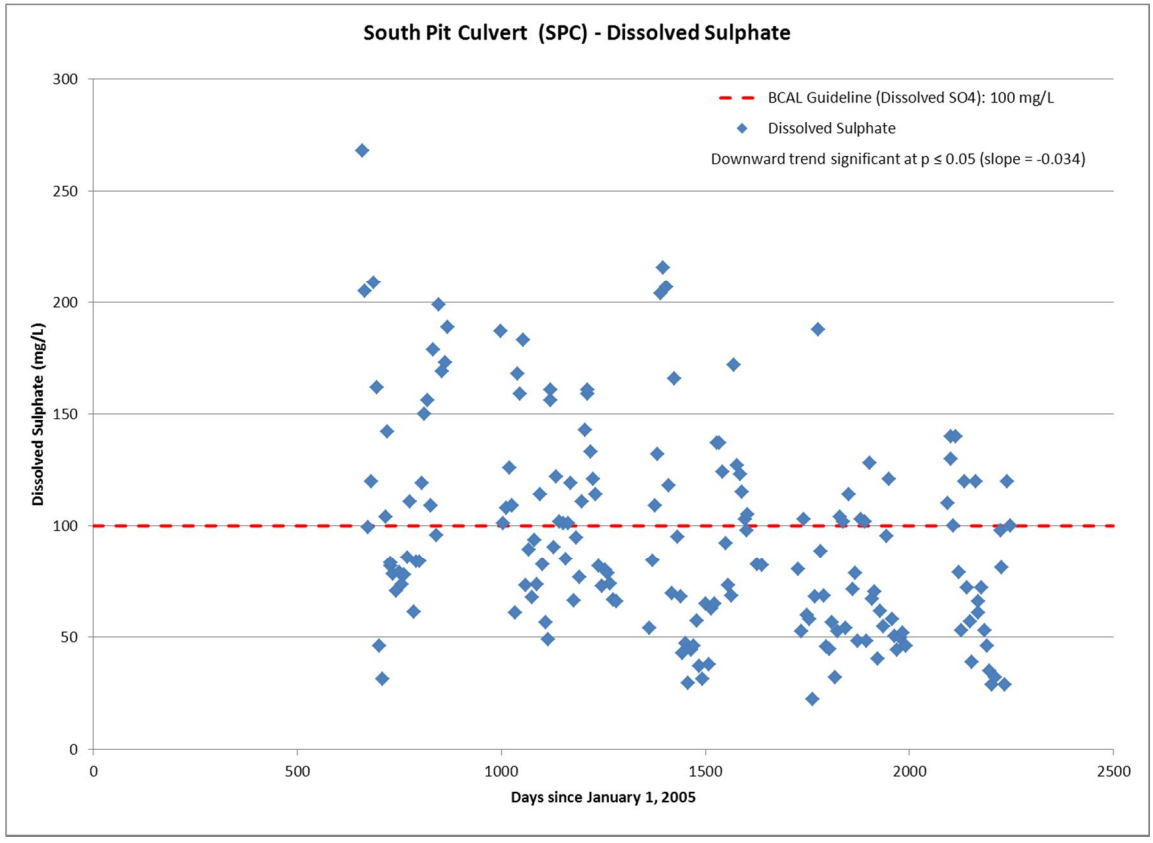

South Pit Culvert (SPC) - Total Cadmium (Adjusted)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL
Total Cd (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0
500
1000
1500
2000
2500
Days since January 1, 2005

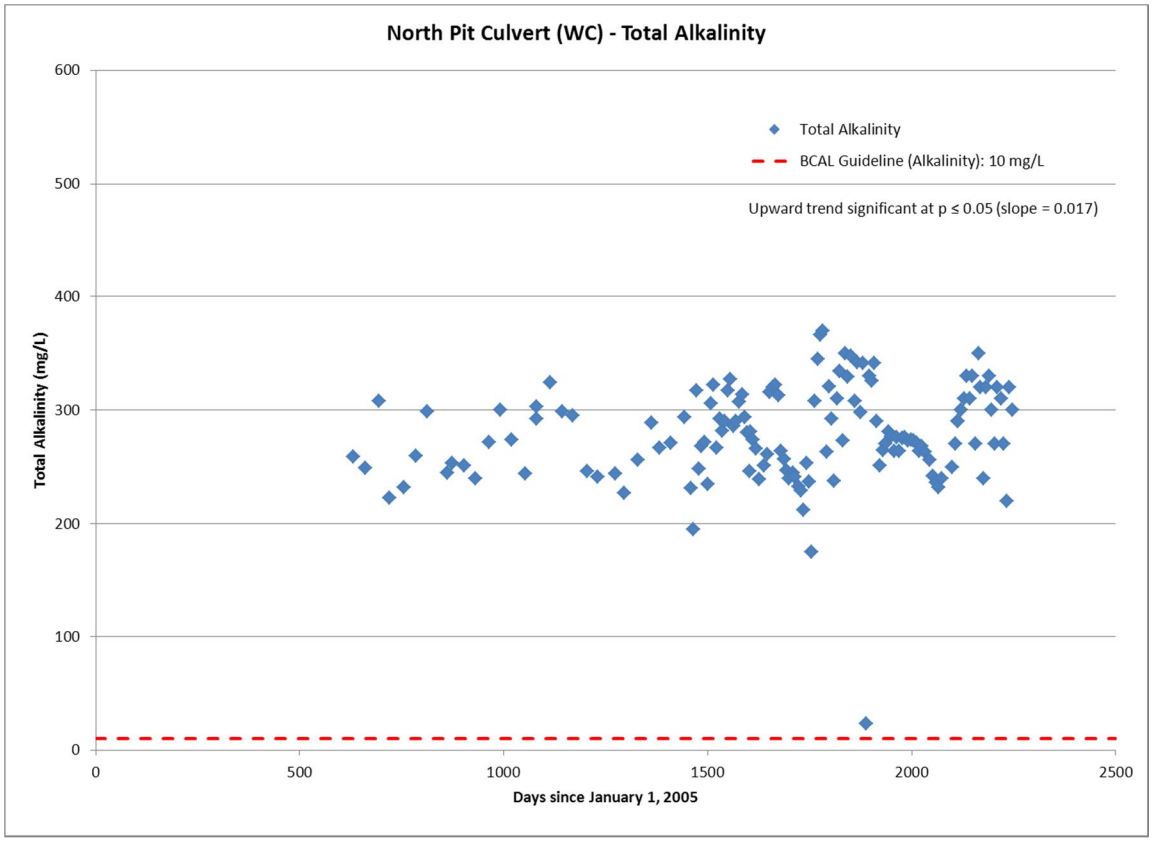

South Pit Culvert (SPC) - Total & Dissolved Iron (Adjusted)
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
Permit Limit (Dissolved Fe): 0.50 mg/L
Total Fe: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Fe: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Fe (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

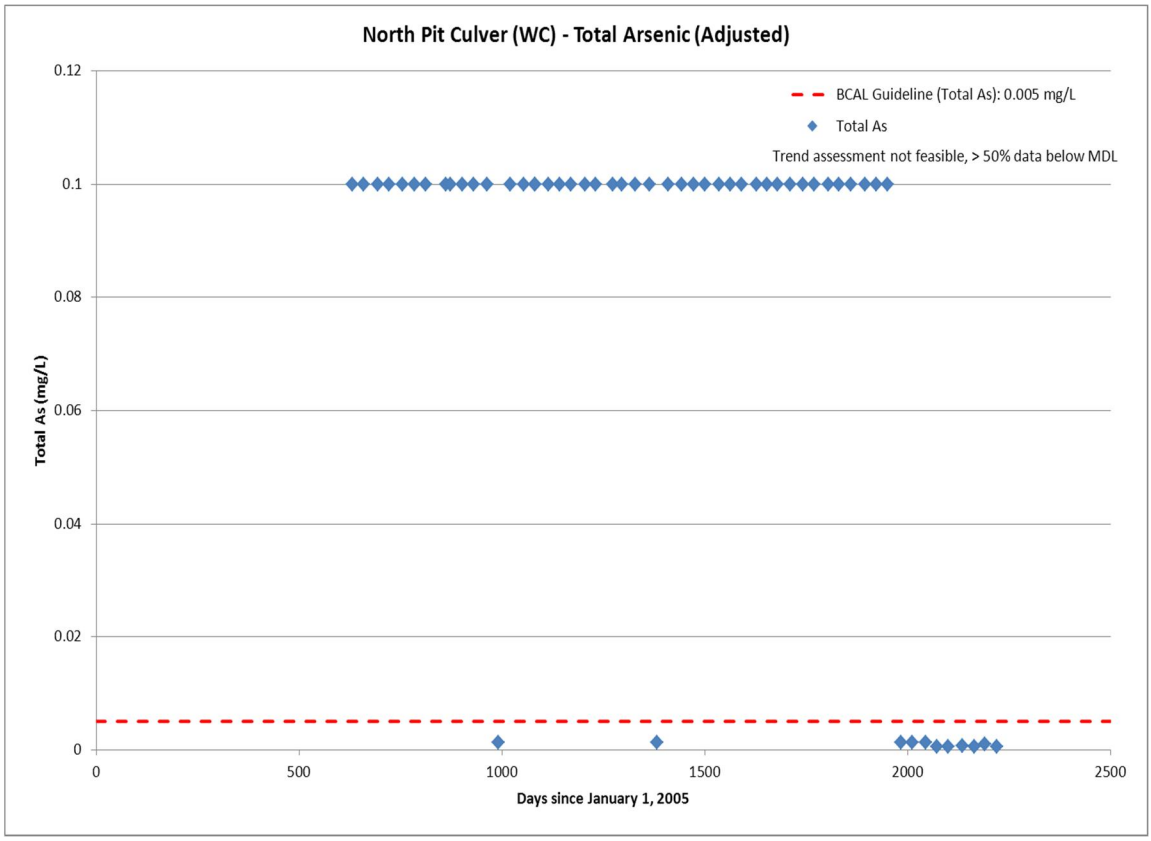

South Pit Culvert (SPC) - Total & Dissolved Mercury (Adjusted)
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Hg (mg/L)
BCAL Guideline (Total Hg): 0.0001 mg/L
Dissolved Hg (Adjusted)
Total Hg (Adjusted)
Total Hg: Trend assessment not feasible, > 50% data below MDL
Dissolved Hg: Trend assessment not feasible, > 50% data below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

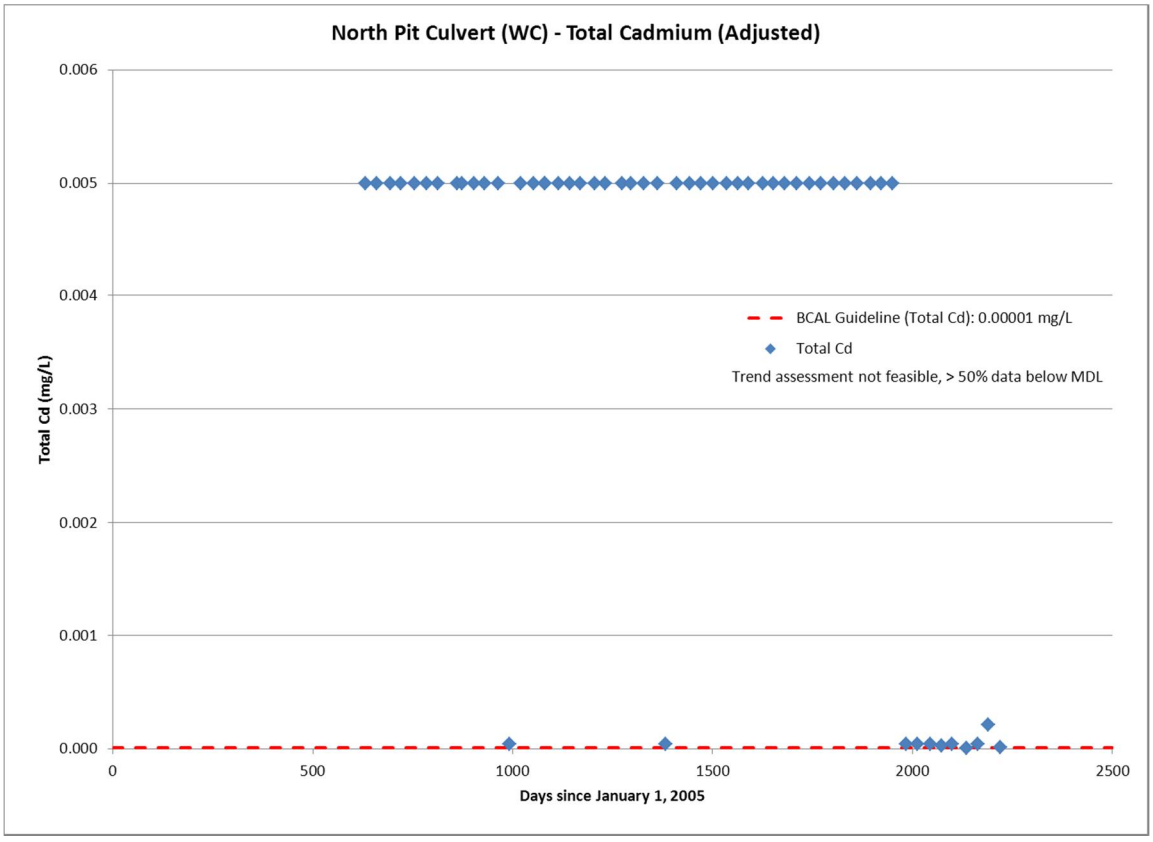

South Pit Culvert (SPC) - Total Manganese (Adjusted)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Mn (mg/L)
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg
Total Mn
Upward trend significant at p ≤ 0.05 (slope < 0.001)
0
500
1000
1500
2000
2500
Days since January 1, 2005

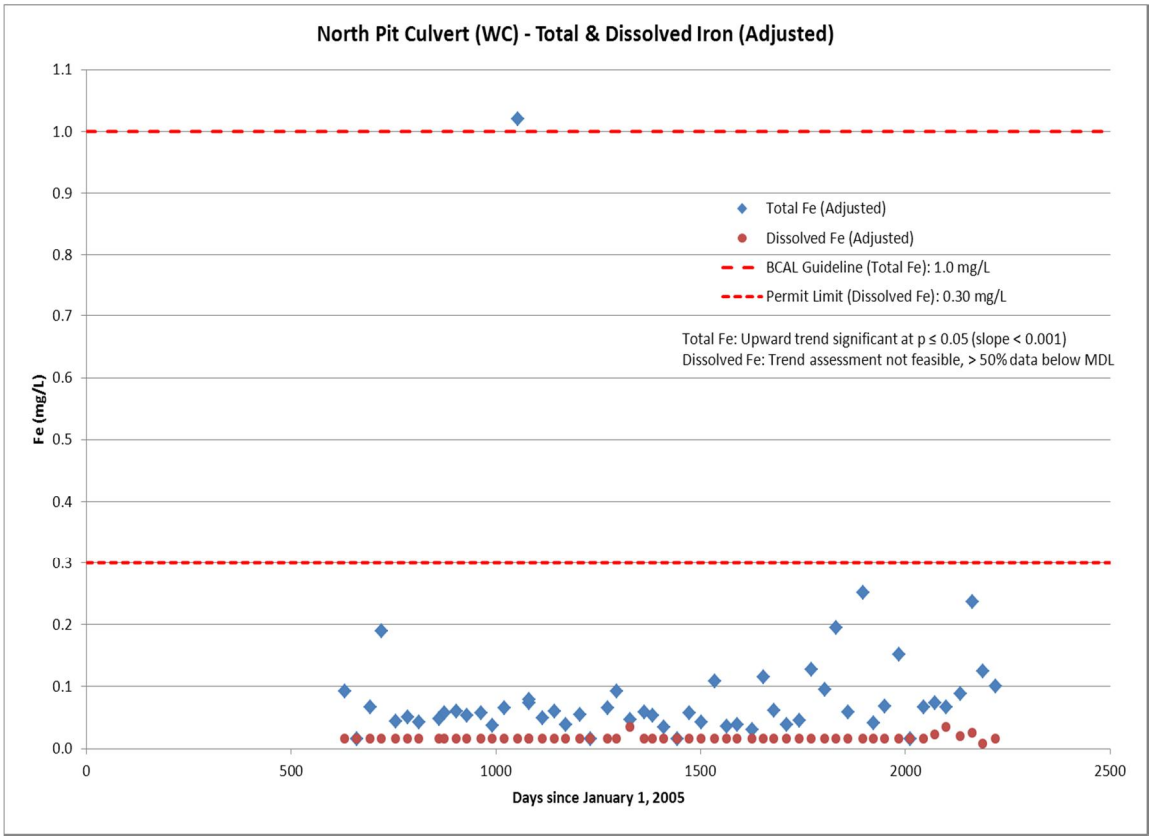

South Pit Culvert (SPC) - pH
pH
Permit Limit (pH): 6.0-8.5
Downward trend significant at p ≤ 0.05 (slope < 0.001)
pH
Days since January 1, 2005
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
500
1000
1500
2000
2500

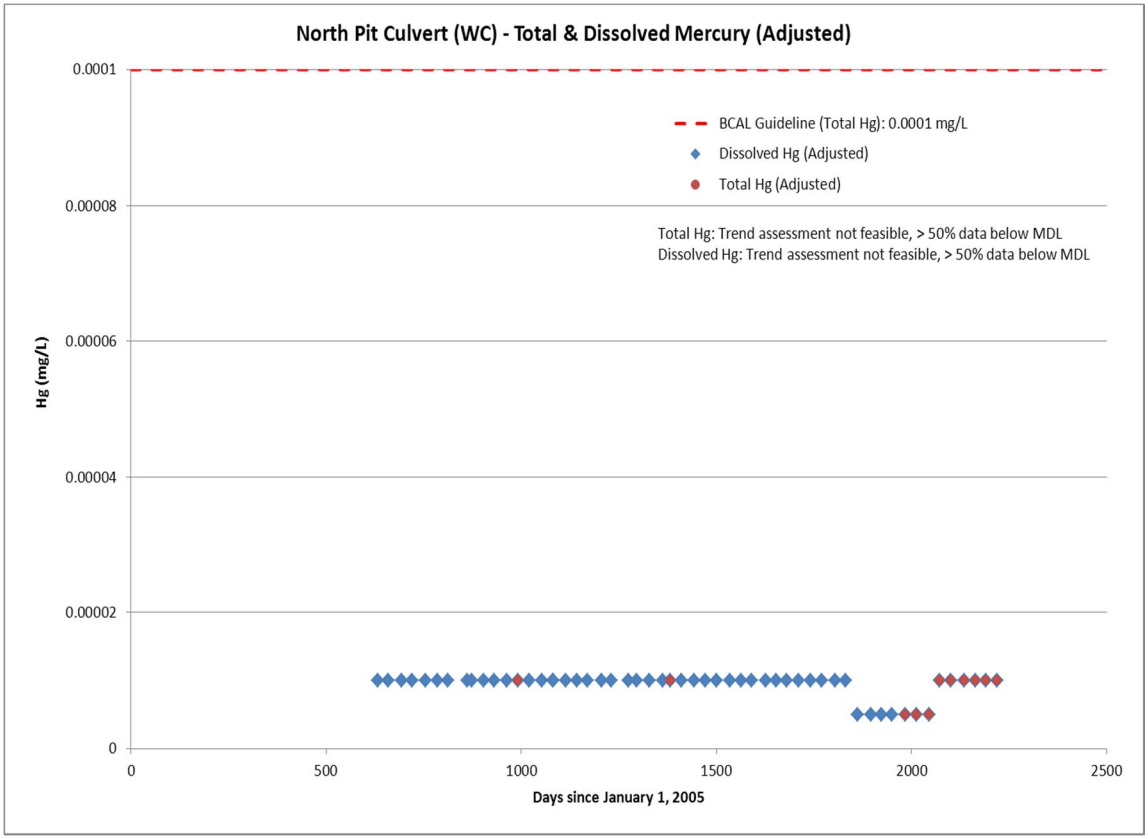

South Pit Culvert (SPC) - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Downward trend significant at p ≤ 0.05 (slope = -0.034)
Dissolved Sulphate (mg/L)
Days since January 1, 2005
300
250
200
150
100
50
0
0
500
1000
1500
2000
2500

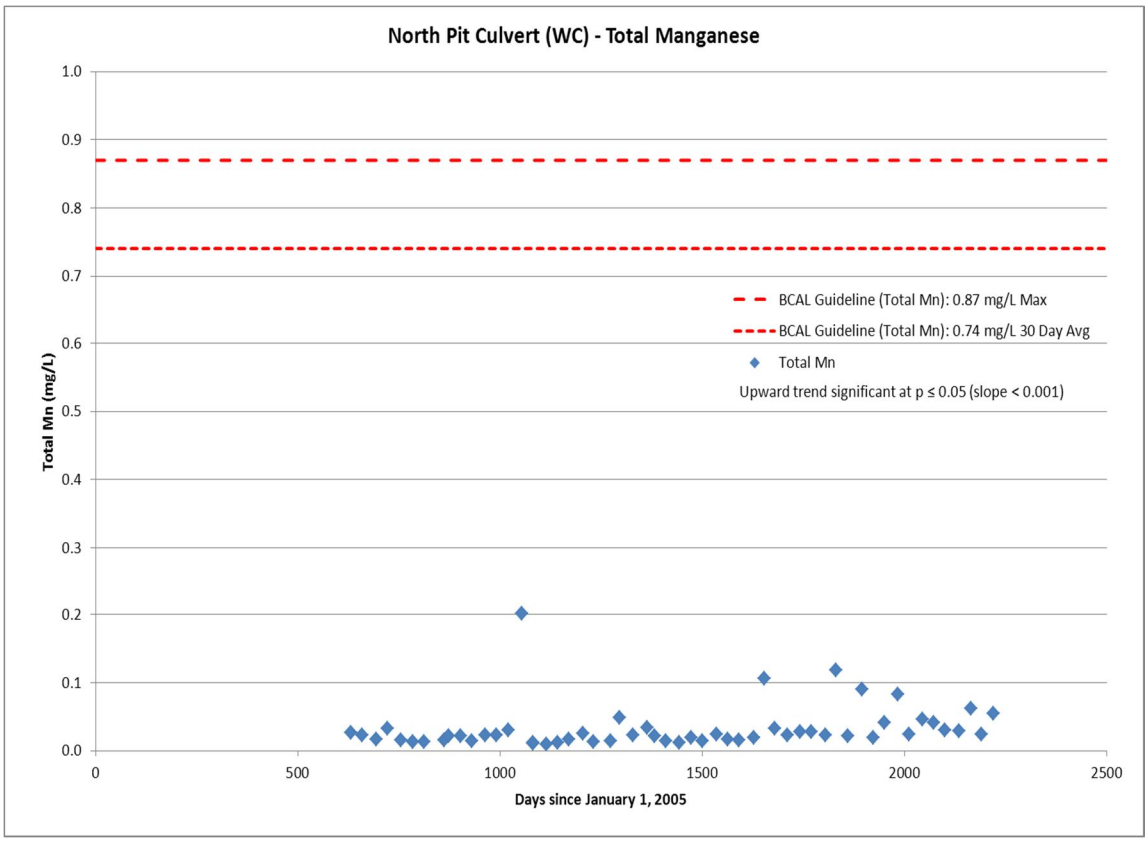

North Pit Culvert (WC) - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Upward trend significant at p ≤ 0.05 (slope = 0.017)
Total Alkalinity (mg/L)
Days since January 1, 2005
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500

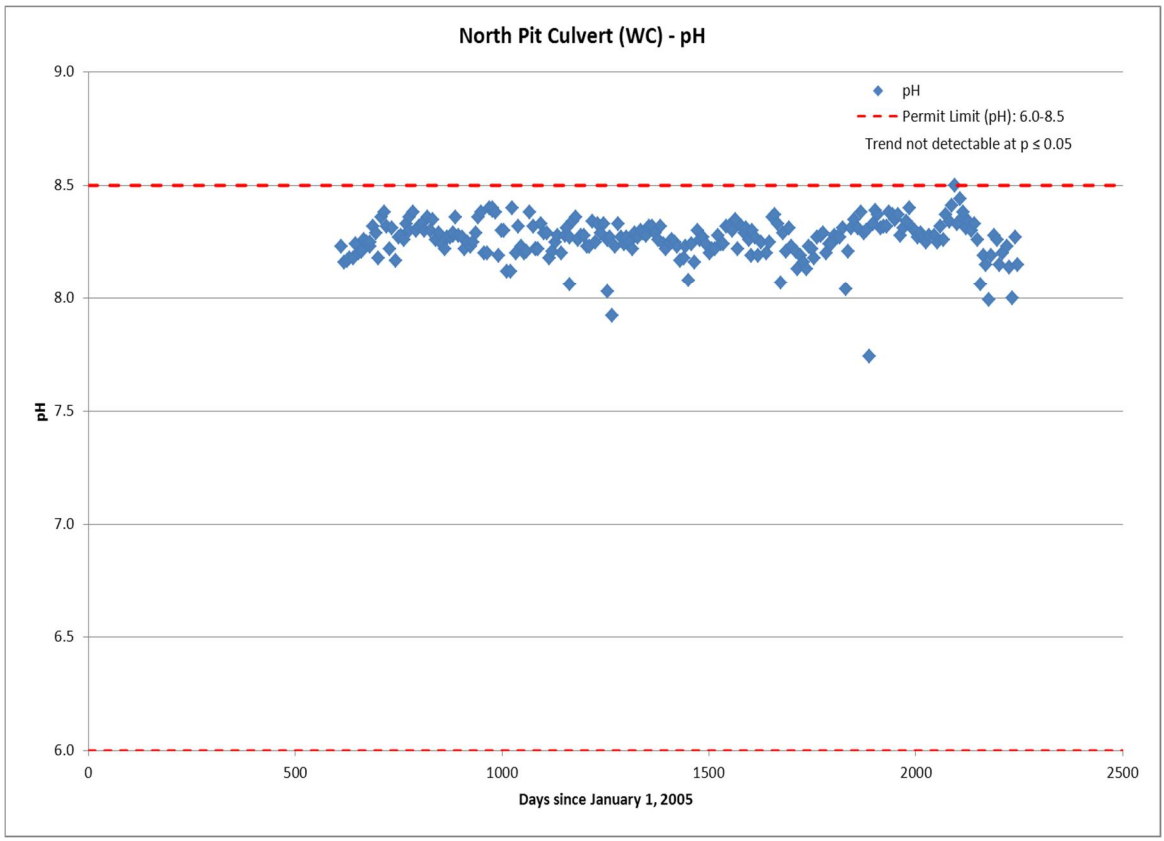

North Pit Culver (WC) - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0.12
0.1
0.08
0.06
0.04
0.02
0
0
500
1000
1500
2000
2500

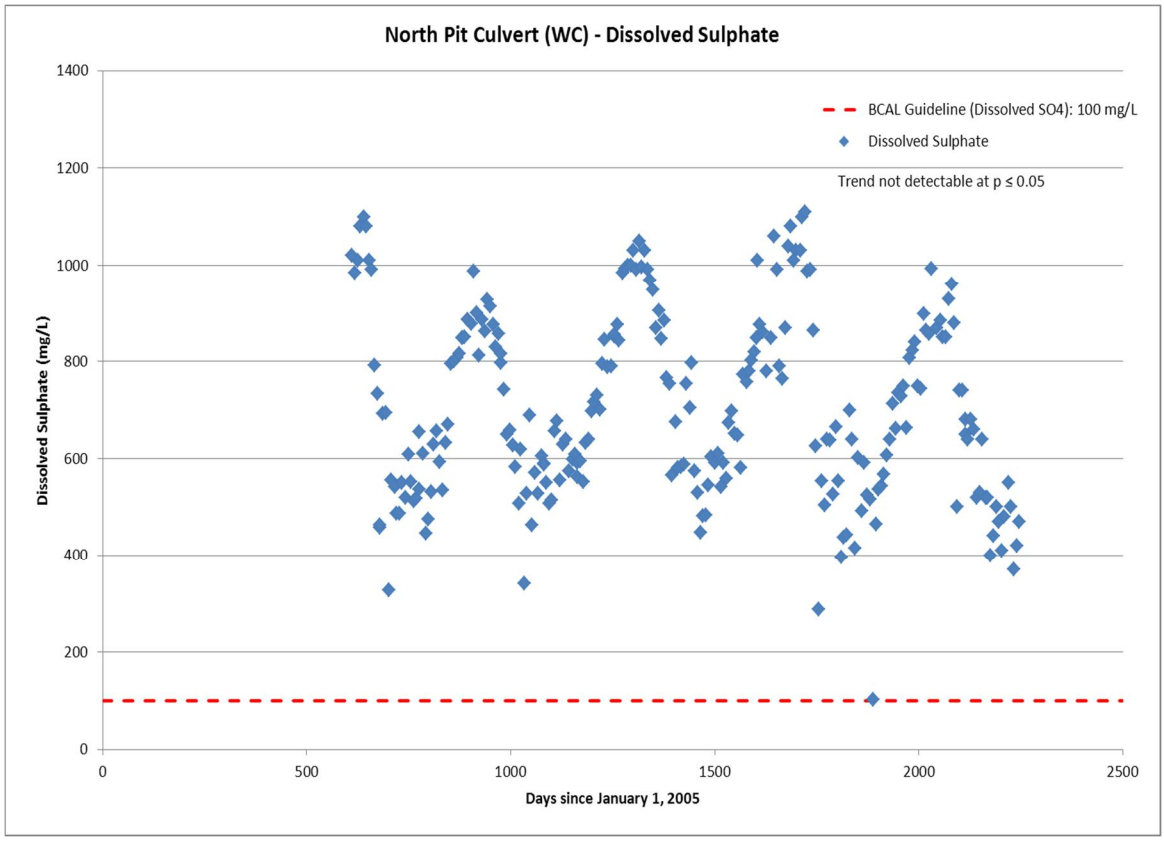

North Pit Culvert (WC) - Total Cadmium (Adjusted)
Total Cd (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL

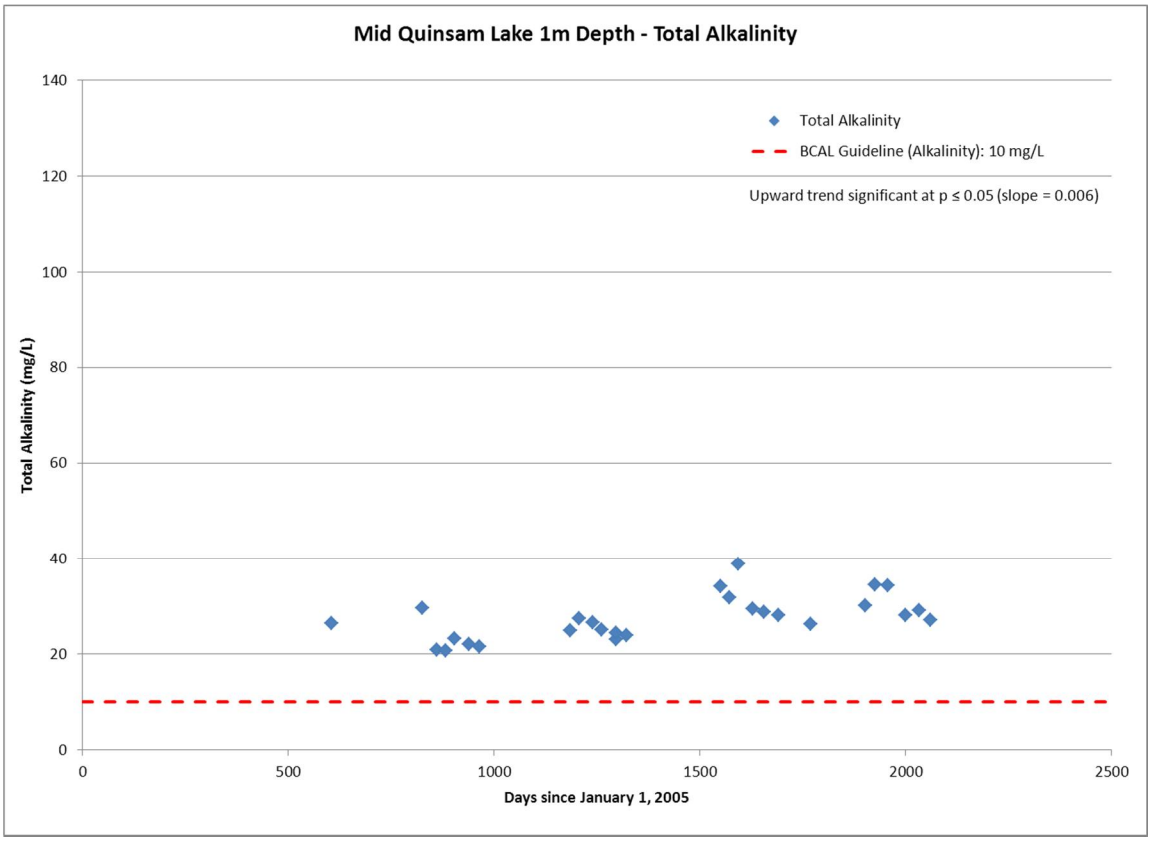

North Pit Culvert (WC) - Total & Dissolved Iron (Adjusted)
Fe (mg/L)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
Permit Limit (Dissolved Fe): 0.30 mg/L
Total Fe: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Fe: Trend assessment not feasible, > 50% data below MDL

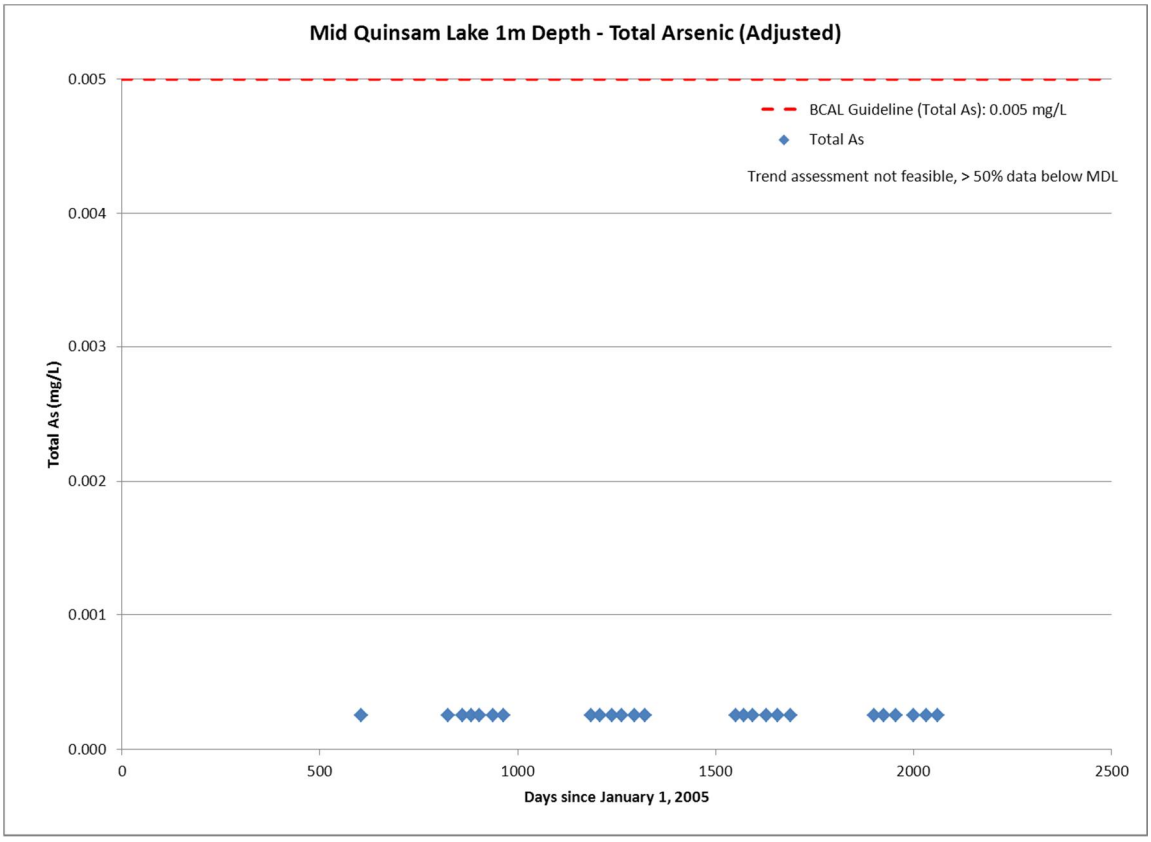

North Pit Culvert (WC) - Total & Dissolved Mercury (Adjusted)
0.0001
0.00008
0.00006
0.00004
0.00002
0
Hg (mg/L)
BCAL Guideline (Total Hg): 0.0001 mg/L
Dissolved Hg (Adjusted)
Total Hg (Adjusted)
Total Hg: Trend assessment not feasible, > 50% data below MDL
Dissolved Hg: Trend assessment not feasible, > 50% data below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

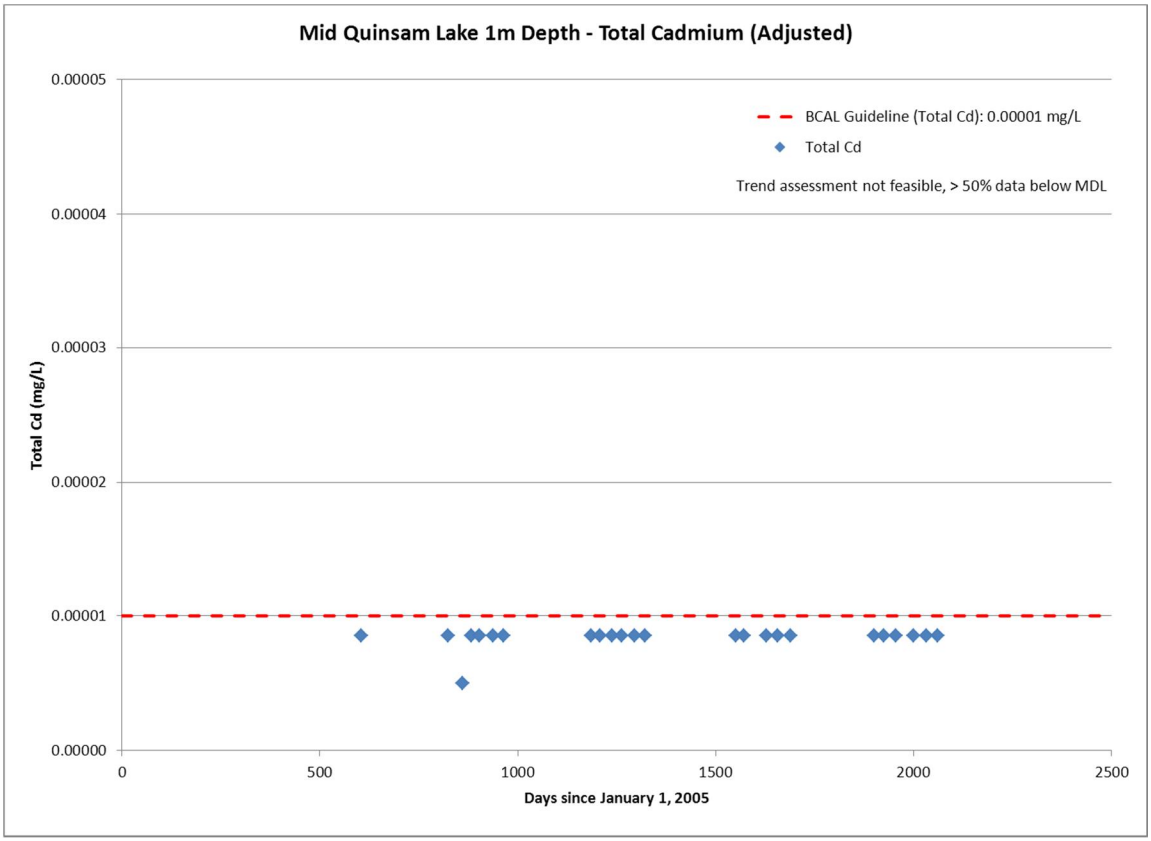

North Pit Culvert (WC) - Total Manganese
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Mn (mg/L)
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg
Total Mn
Upward trend significant at p ≤ 0.05 (slope < 0.001)
0
500
1000
1500
2000
2500
Days since January 1, 2005

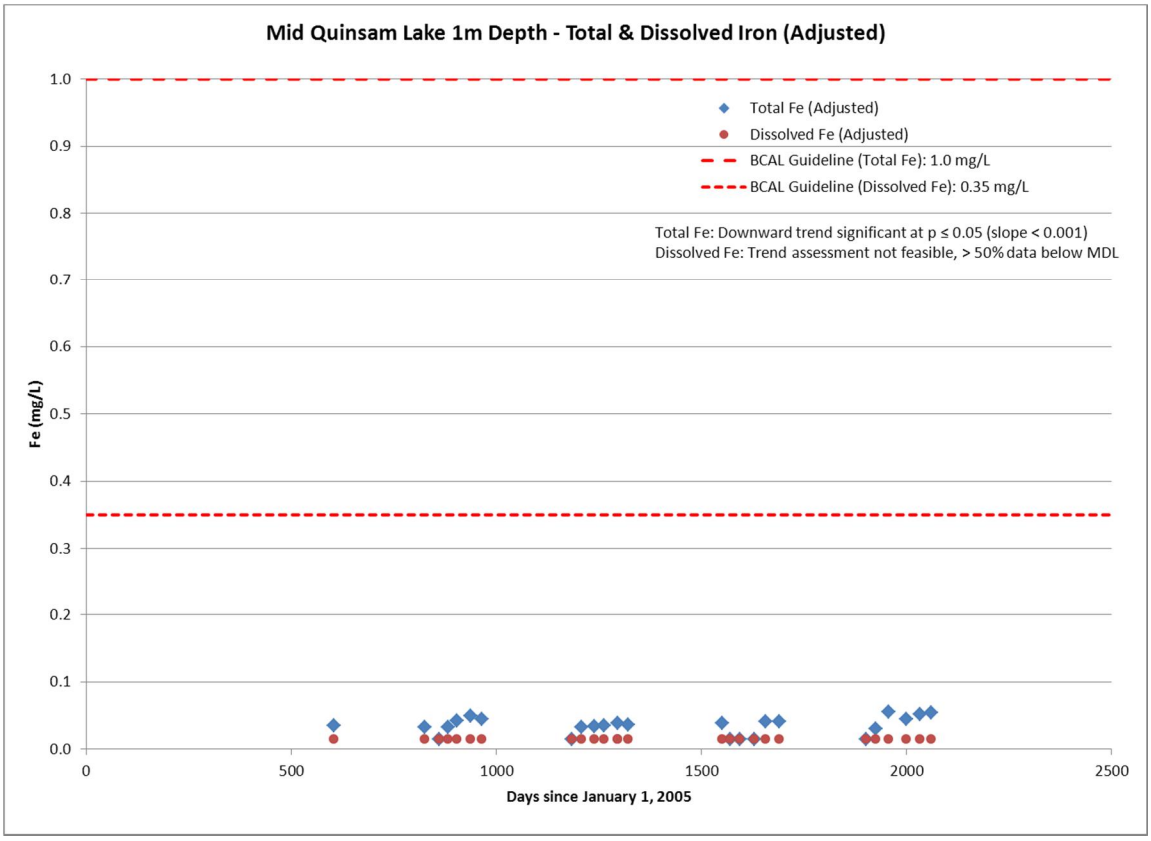

North Pit Culvert (WC) - pH
pH
Permit Limit (pH): 6.0-8.5
Trend not detectable at p ≤ 0.05
9.0
8.5
8.0
7.5
7.0
6.5
6.0
pH
0
500
1000
1500
2000
2500
Days since January 1, 2005

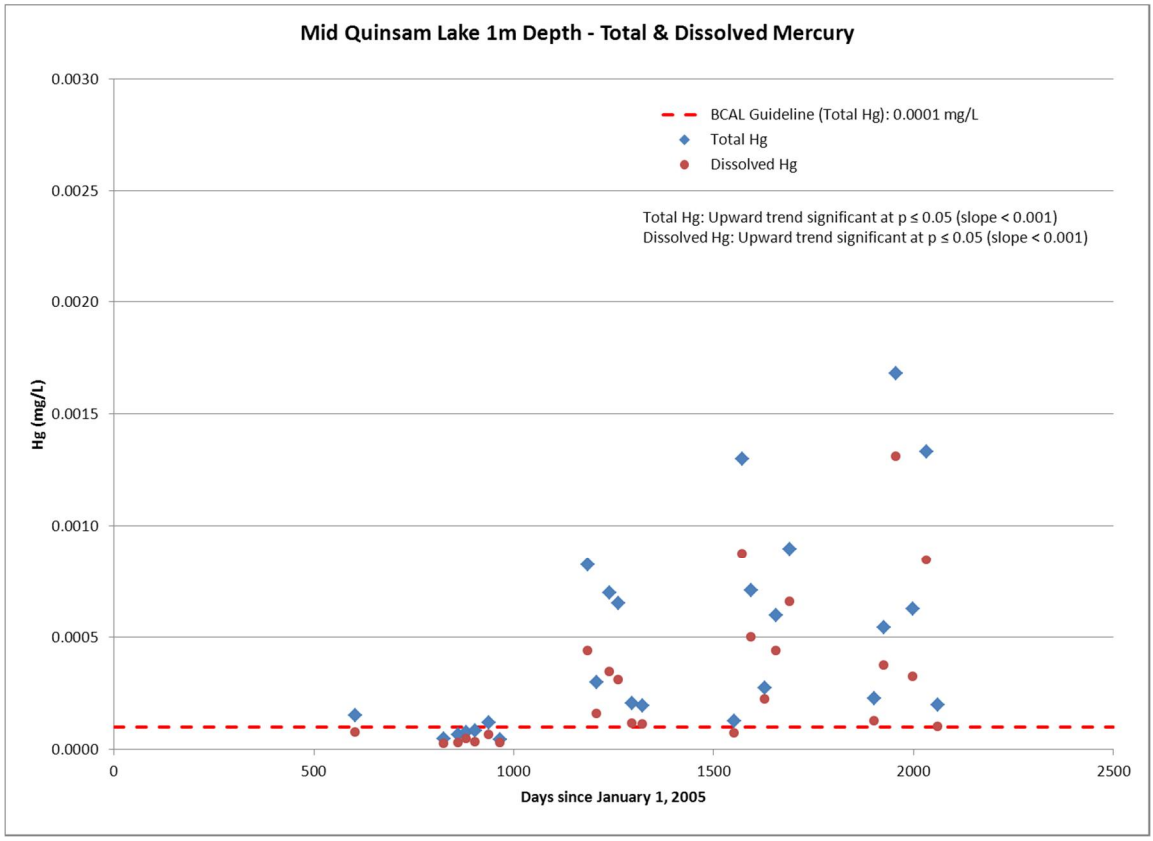

North Pit Culvert (WC) - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Trend not detectable at p ≤ 0.05
1400
1200
1000
800
600
400
200
0
Dissolved Sulphate (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005

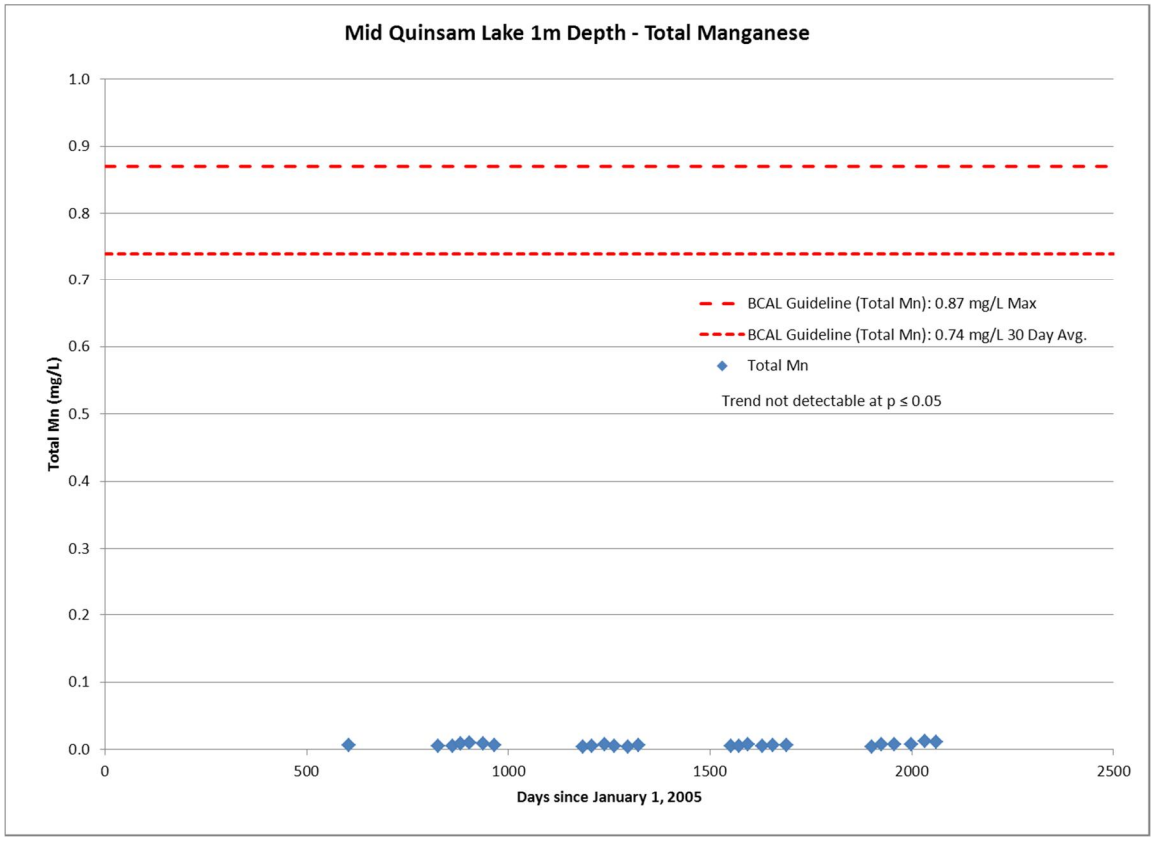

Mid Quinsam Lake 1m Depth - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Upward trend significant at p ≤ 0.05 (slope = 0.006)
Total Alkalinity (mg/L)
Days since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

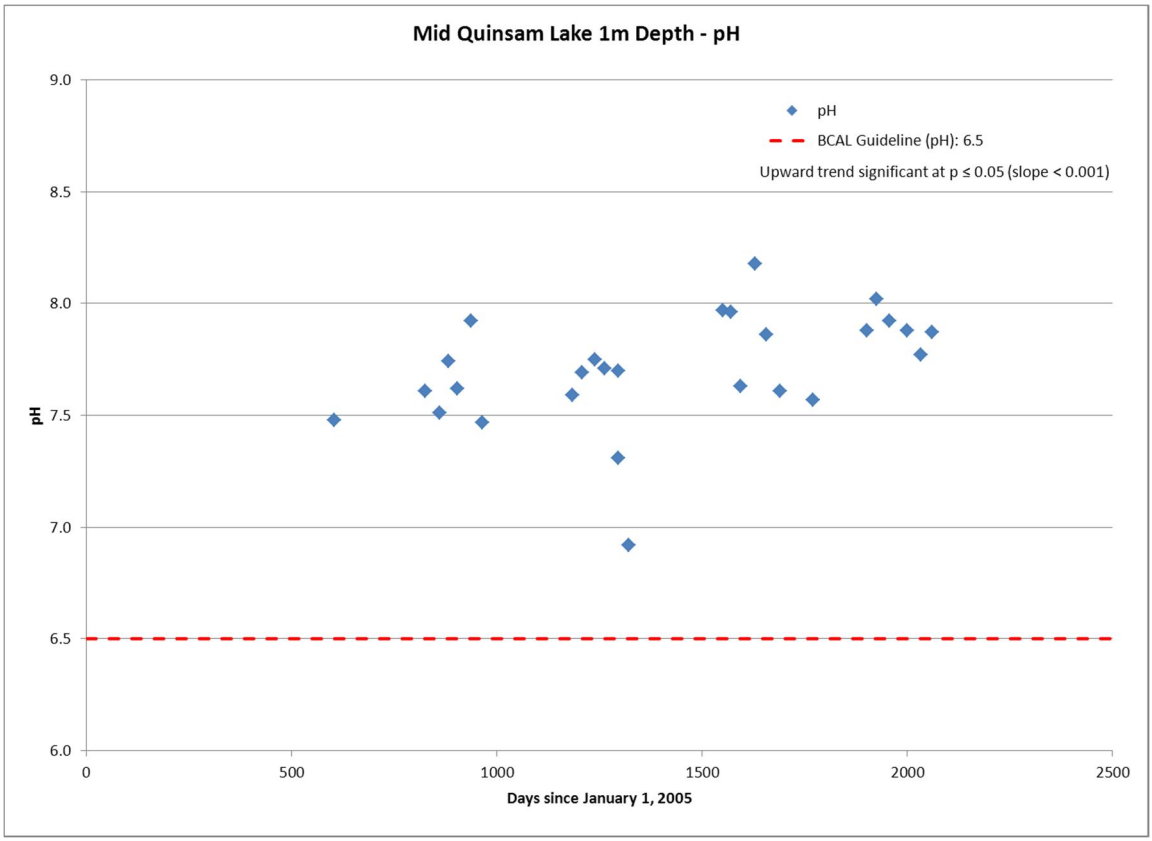

Mid Quinsam Lake 1m Depth - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0.000
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500

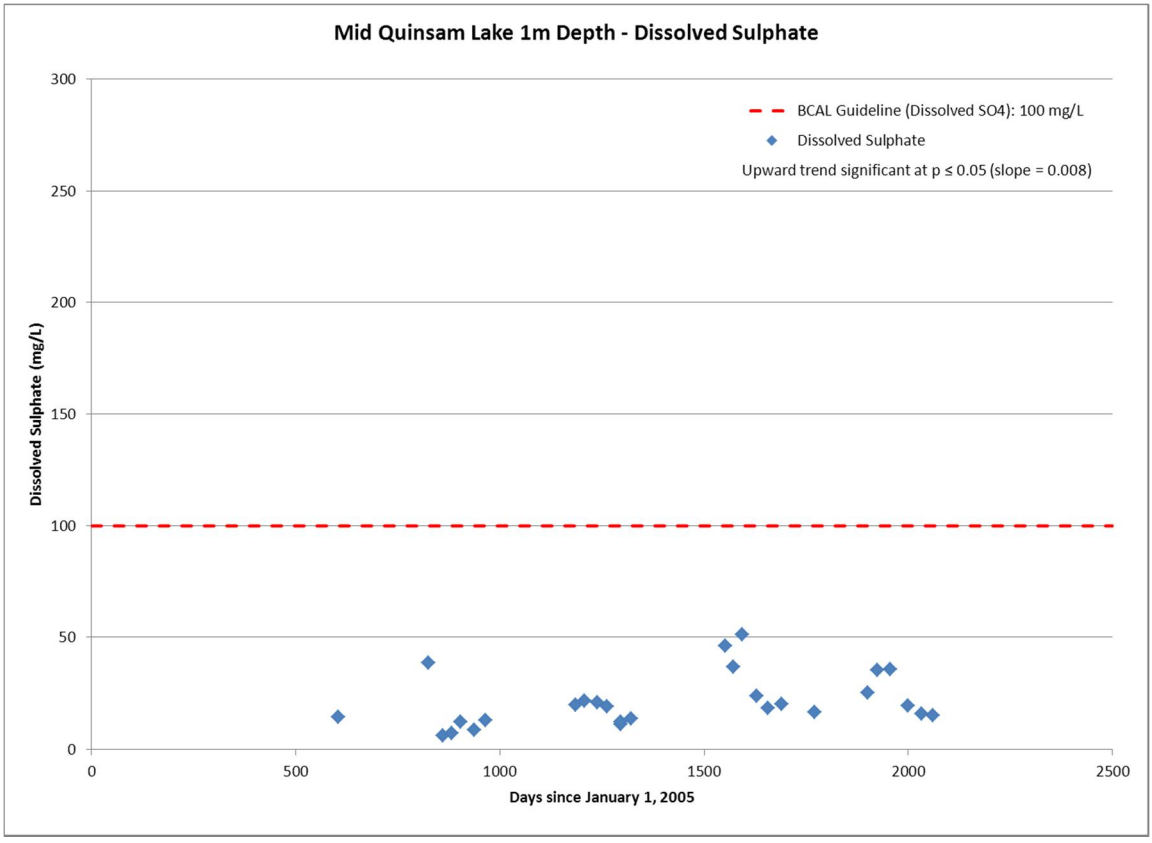

Mid Quinsam Lake 1m Depth - Total Cadmium (Adjusted)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
Total Cd (mg/L)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

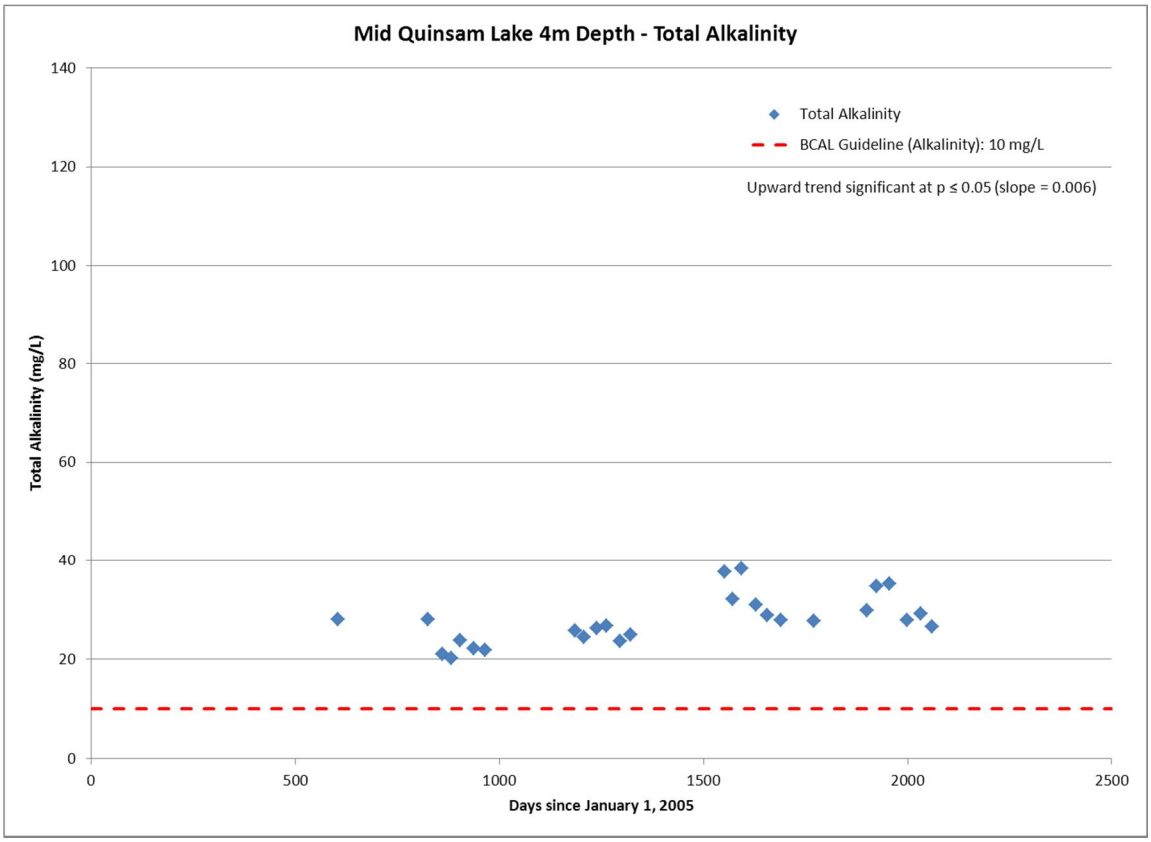

Mid Quinsam Lake 1m Depth - Total & Dissolved Iron (Adjusted)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Fe (mg/L)
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
BCAL Guideline (Dissolved Fe): 0.35 mg/L
Total Fe: Downward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Fe: Trend assessment not feasible, > 50% data below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

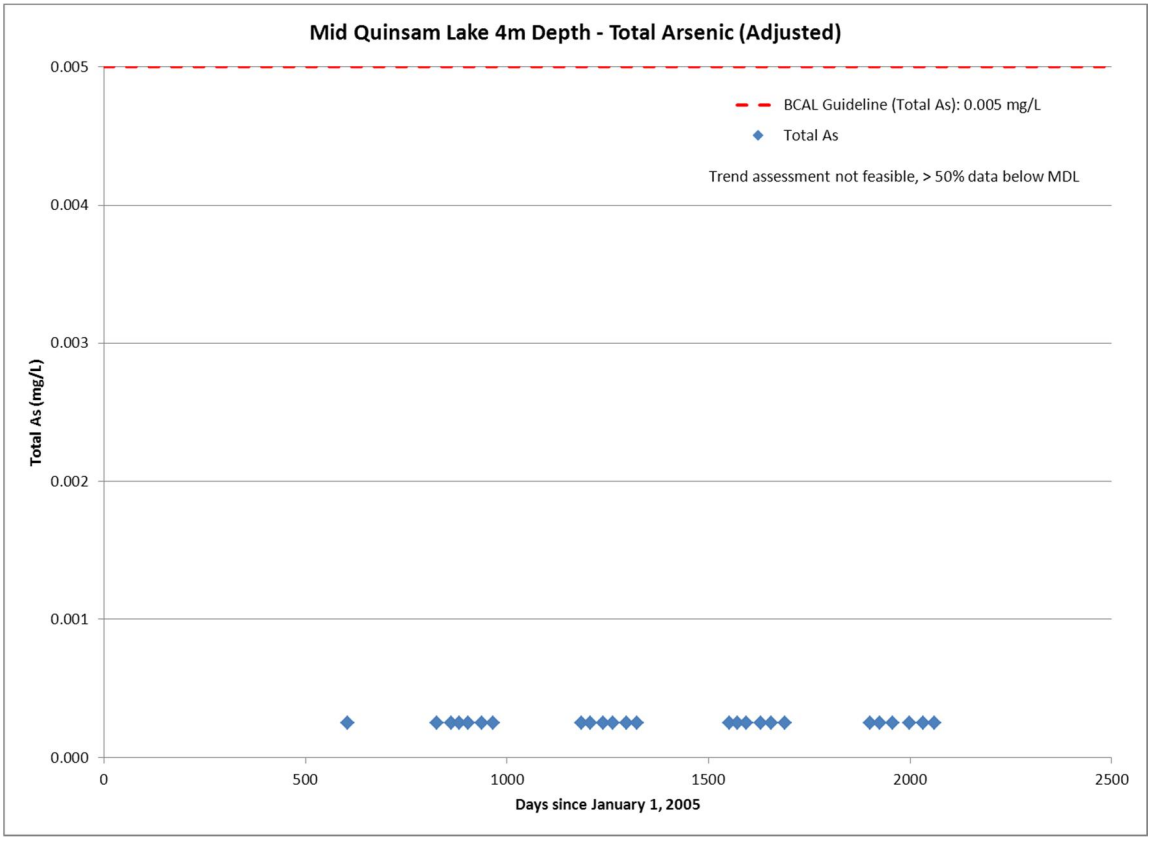

Mid Quinsam Lake 1m Depth - Total & Dissolved Mercury
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Hg (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg
Dissolved Hg
Total Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)

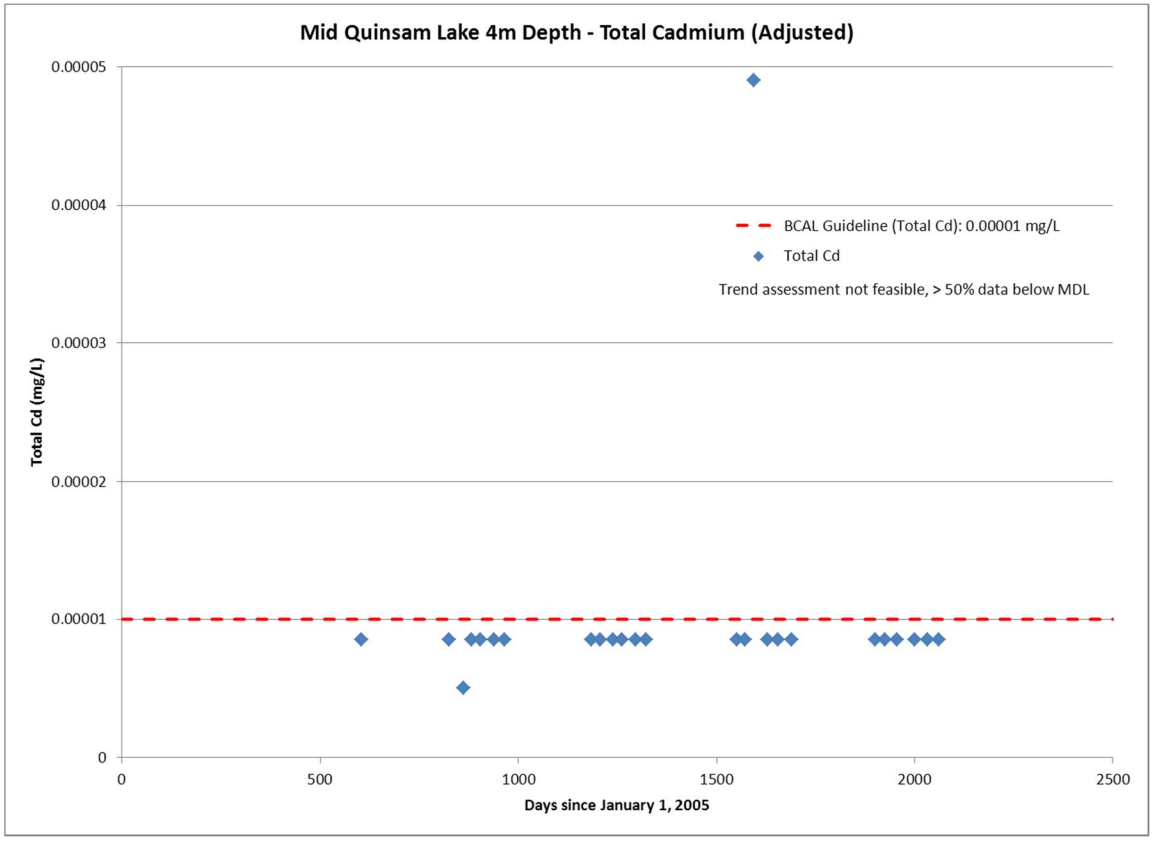

Mid Quinsam Lake 1m Depth - Total Manganese
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Mn (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg.
Total Mn
Trend not detectable at p ≤ 0.05

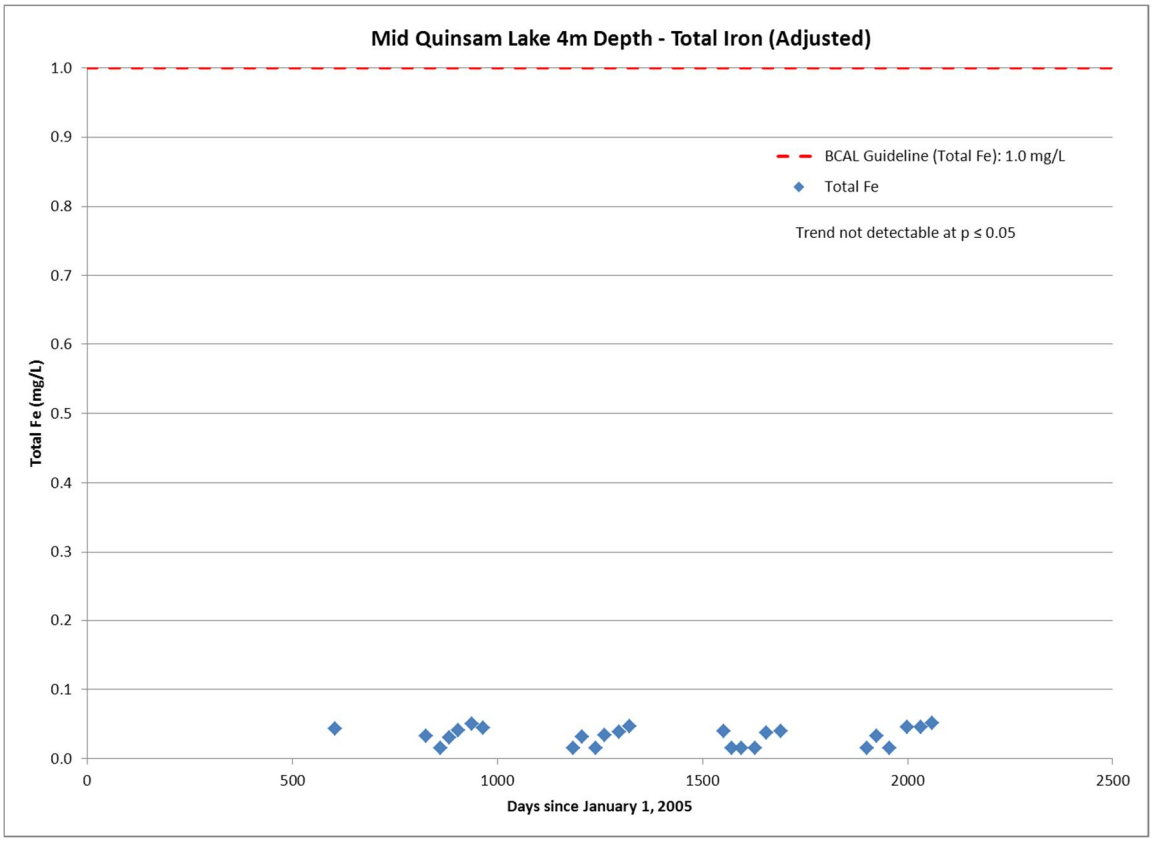

Mid Quinsam Lake 1m Depth - pH
pH
BCAL Guideline (pH): 6.5
Upward trend significant at p ≤ 0.05 (slope < 0.001)
pH
Days since January 1, 2005
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
500
1000
1500
2000
2500

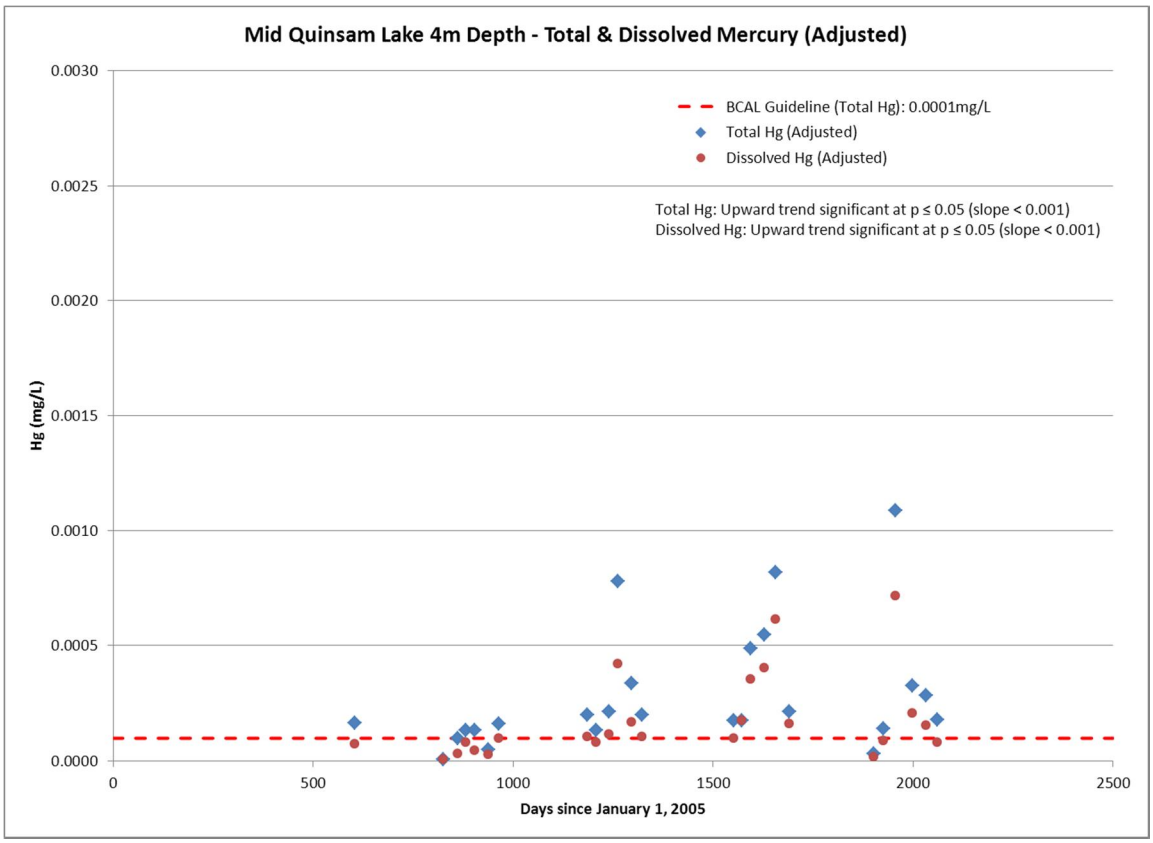

Mid Quinsam Lake 1m Depth - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Upward trend significant at p ≤ 0.05 (slope = 0.008)
Dissolved Sulphate (mg/L)
Days since January 1, 2005
300
250
200
150
100
50
0
0
500
1000
1500
2000
2500

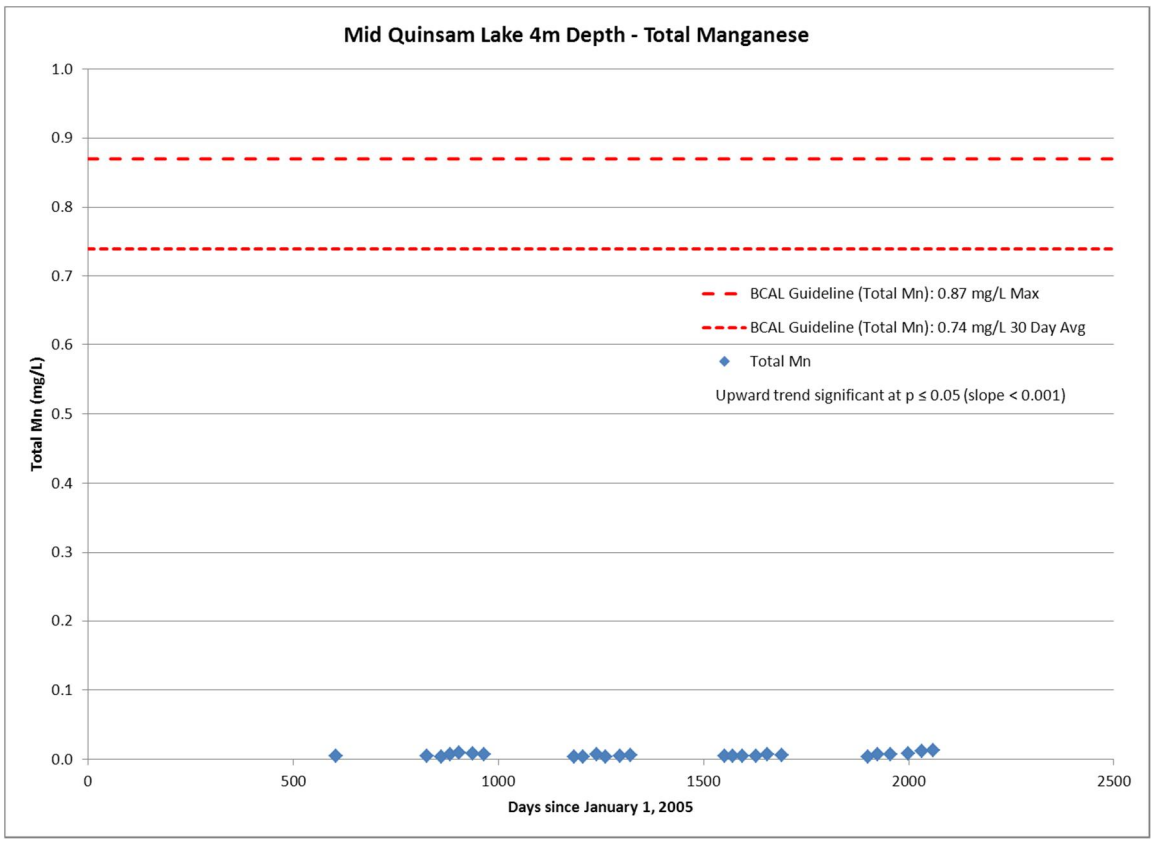

Mid Quinsam Lake 4m Depth - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Upward trend significant at p ≤ 0.05 (slope = 0.006)
Total Alkalinity (mg/L)
Days since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

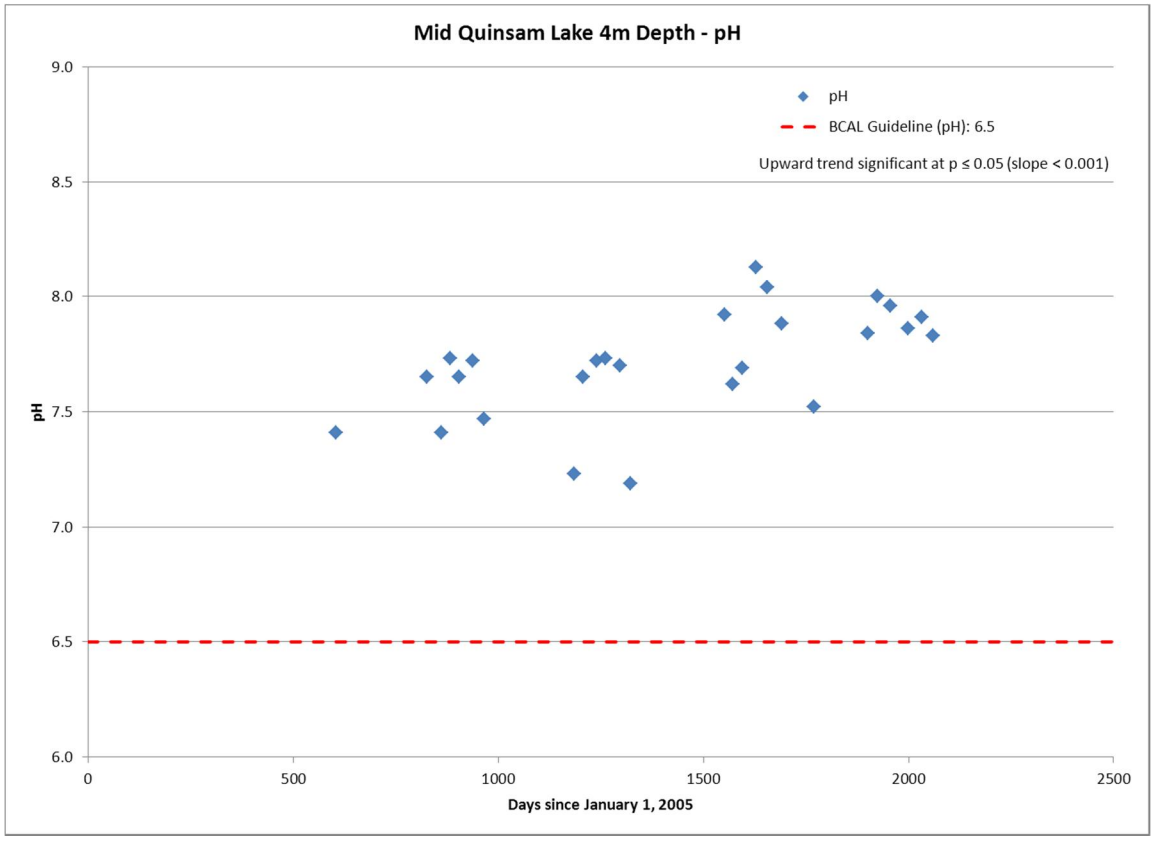

Mid Quinsam Lake 4m Depth - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0.000
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500

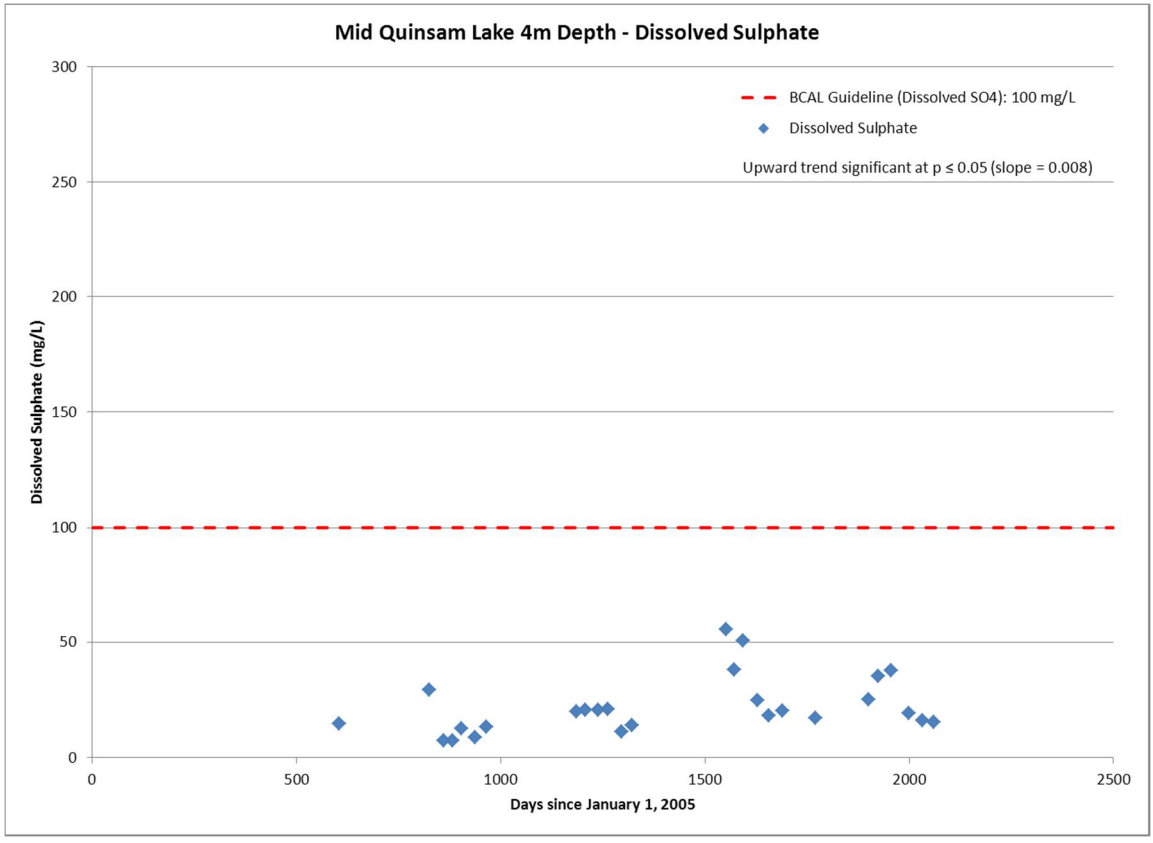

Mid Quinsam Lake 4m Depth - Total Cadmium (Adjusted)
0.00005
0.00004
0.00003
0.00002
0.00001
0
Total Cd (mg/L)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL
0
500
1000
1500
2000
2500
Days since January 1, 2005

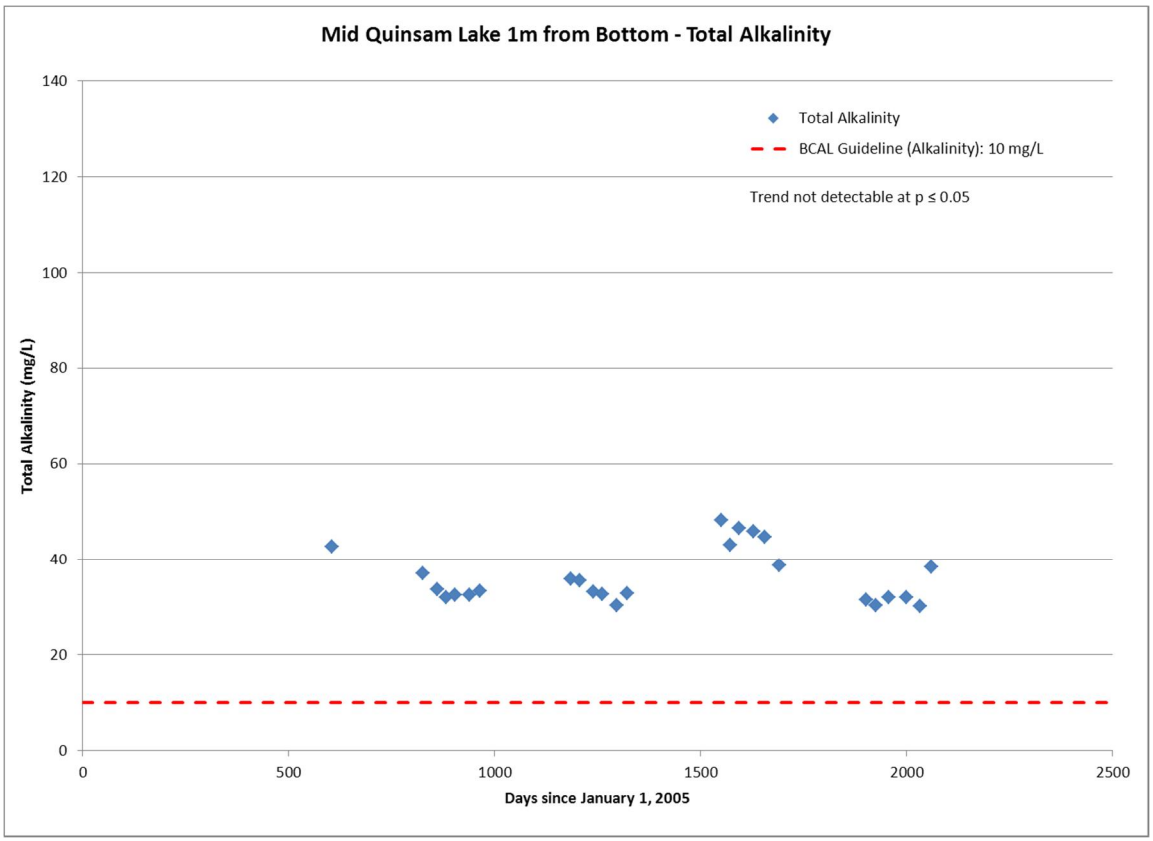

Mid Quinsam Lake 4m Depth - Total Iron (Adjusted)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Fe (mg/L)
BCAL Guideline (Total Fe): 1.0 mg/L
Total Fe
Trend not detectable at p ≤ 0.05
0
500
1000
1500
2000
2500
Days since January 1, 2005

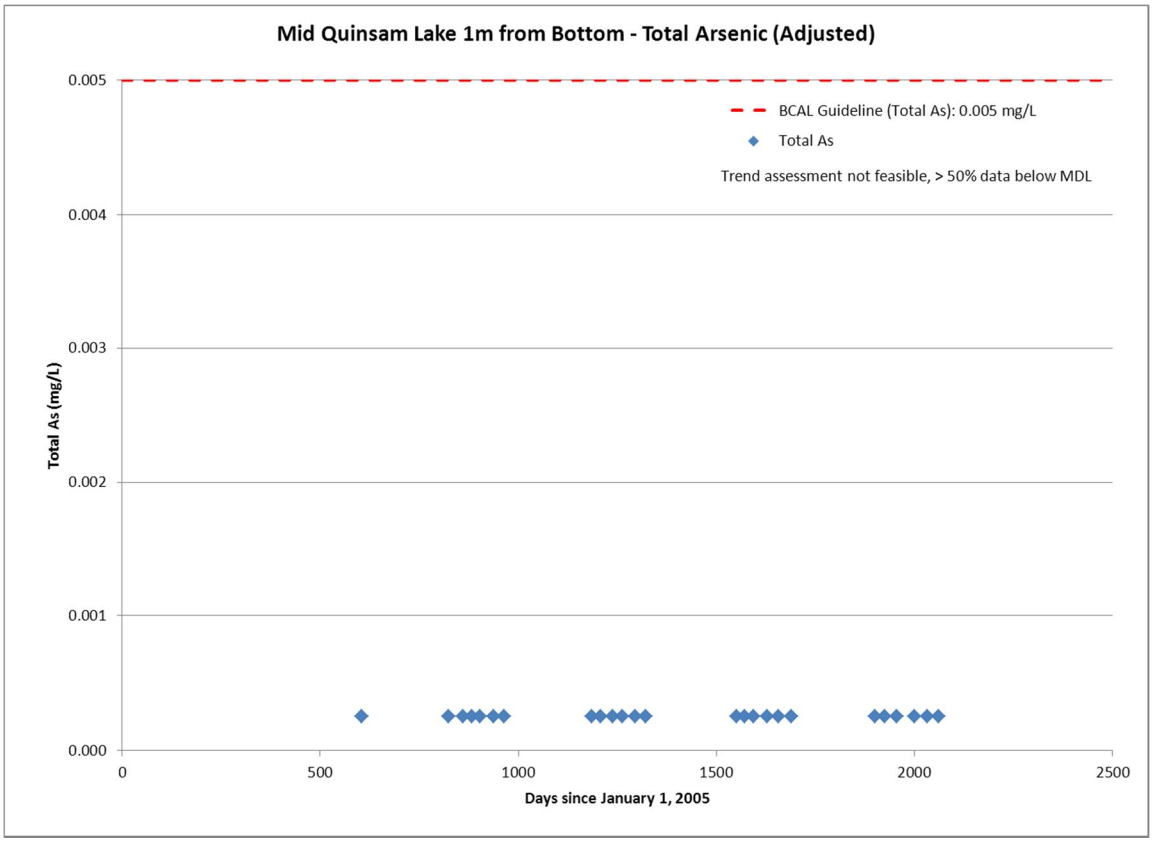

Mid Quinsam Lake 4m Depth - Total & Dissolved Mercury (Adjusted)
BCAL Guideline (Total Hg): 0.0001mg/L
Total Hg (Adjusted)
Dissolved Hg (Adjusted)
Total Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Hg (mg/L)
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
0
500
1000
1500
2000
2500
Days since January 1, 2005

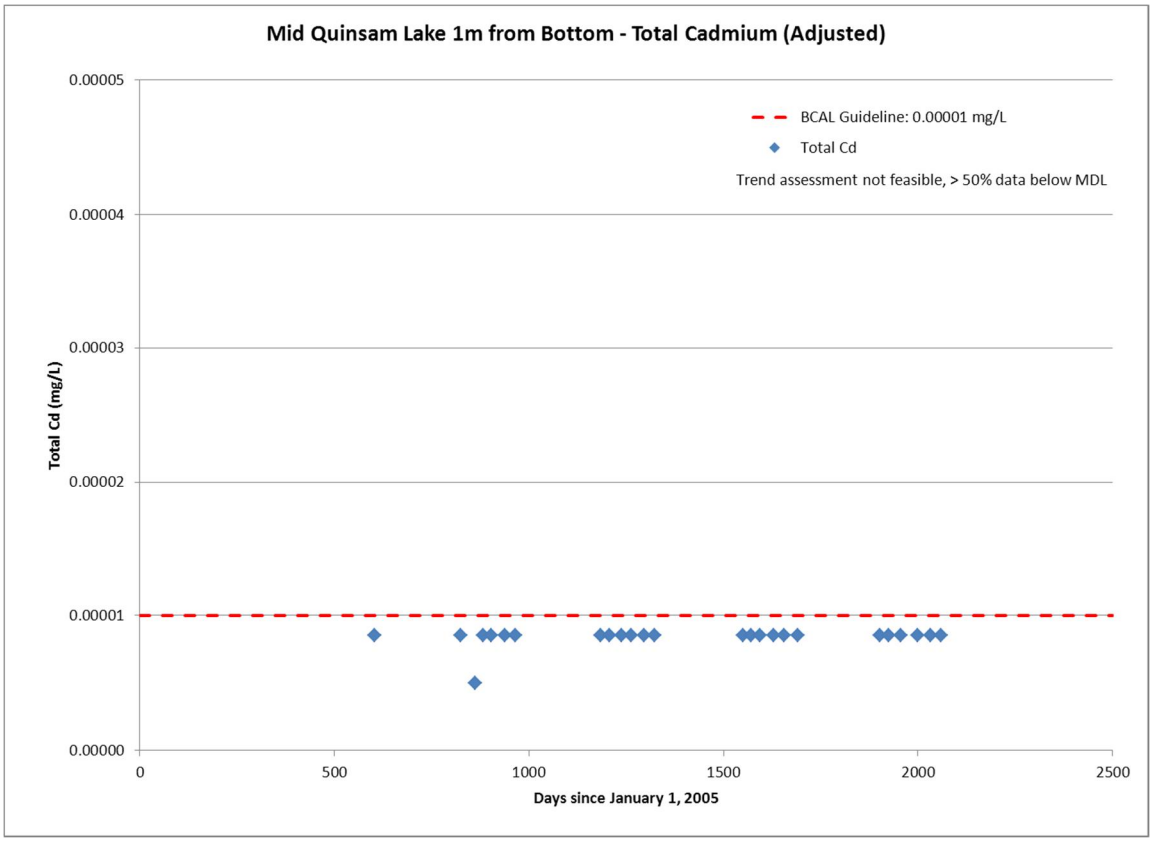

Mid Quinsam Lake 4m Depth - Total Manganese
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg
Total Mn
Upward trend significant at p ≤ 0.05 (slope < 0.001)
Total Mn (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

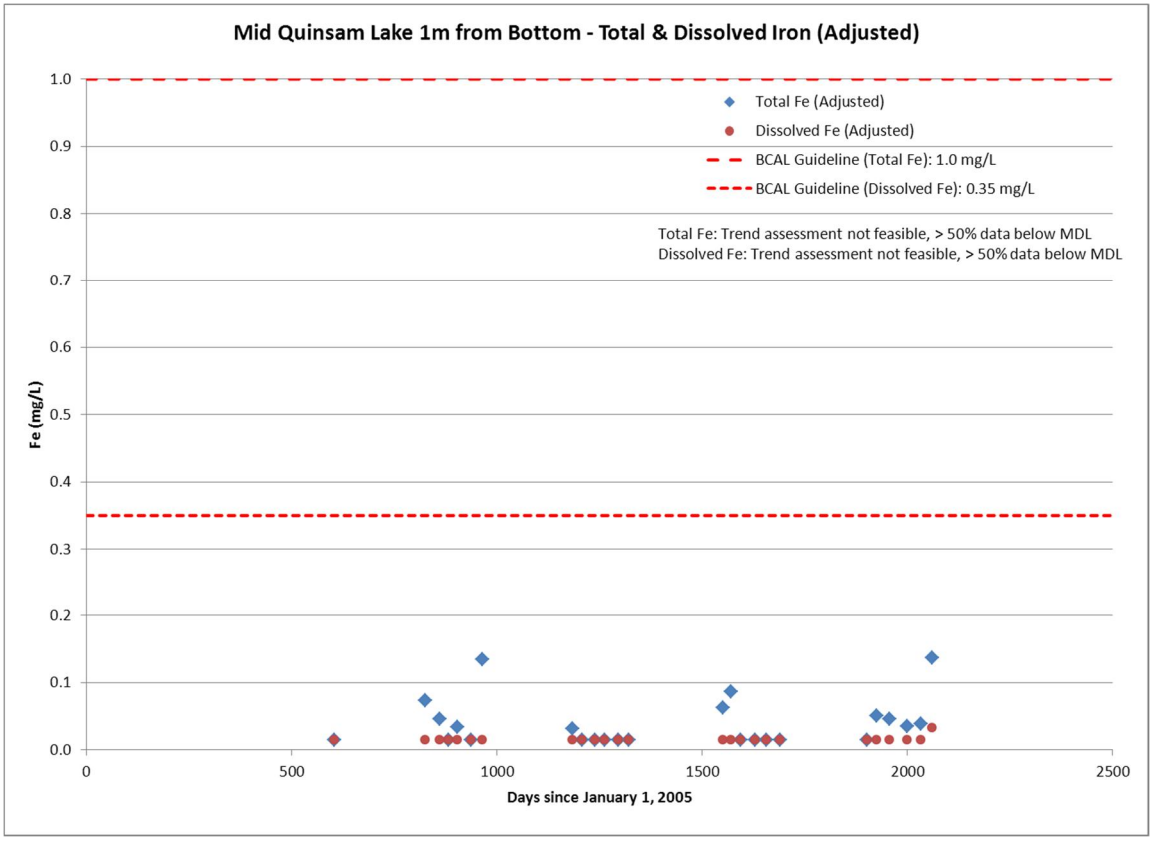

Mid Quinsam Lake 4m Depth - pH
pH
BCAL Guideline (pH): 6.5
Upward trend significant at p ≤ 0.05 (slope < 0.001)
pH
Days since January 1, 2005
9.0
8.5
8.0
7.5
7.0
6.5
6.0
0
500
1000
1500
2000
2500

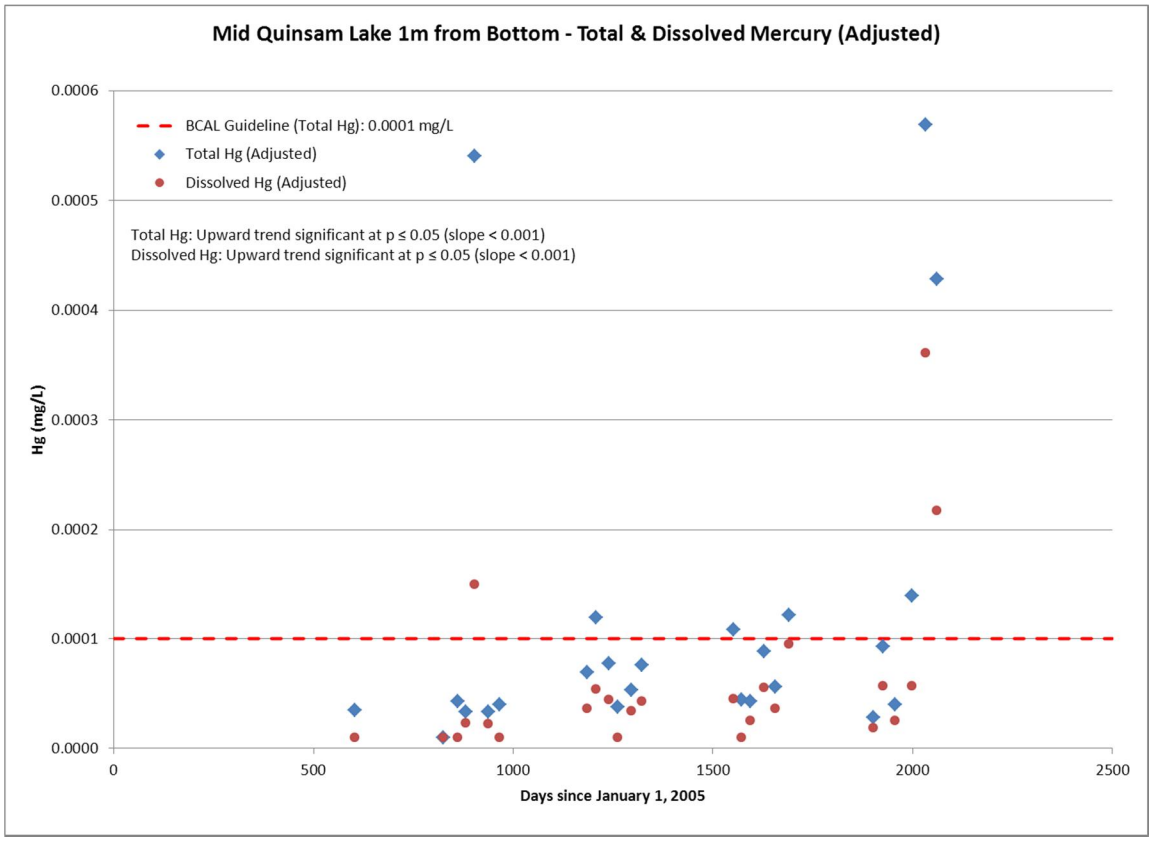

Mid Quinsam Lake 4m Depth - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Upward trend significant at p ≤ 0.05 (slope = 0.008)
Dissolved Sulphate (mg/L)
Days since January 1, 2005
300
250
200
150
100
50
0
0
500
1000
1500
2000
2500

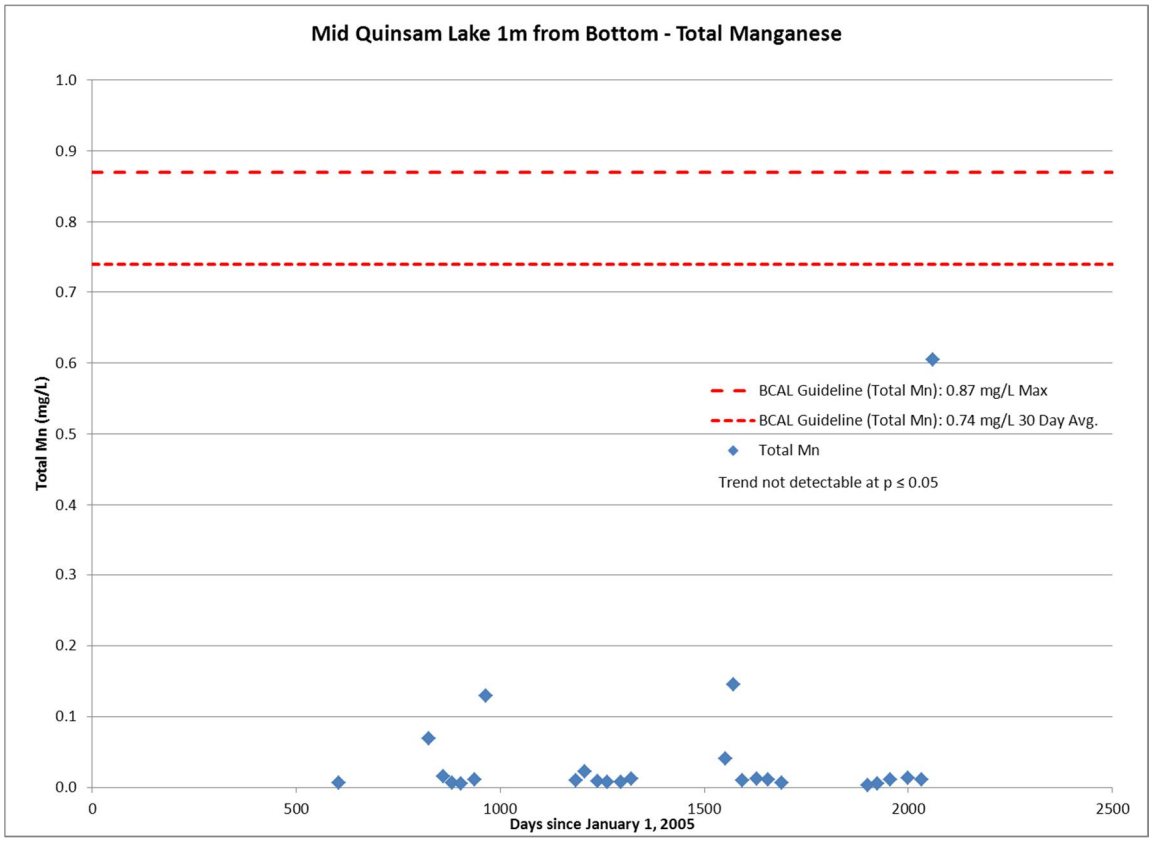

Mid Quinsam Lake 1m from Bottom - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Trend not detectable at p ≤ 0.05
Total Alkalinity (mg/L)
Days since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

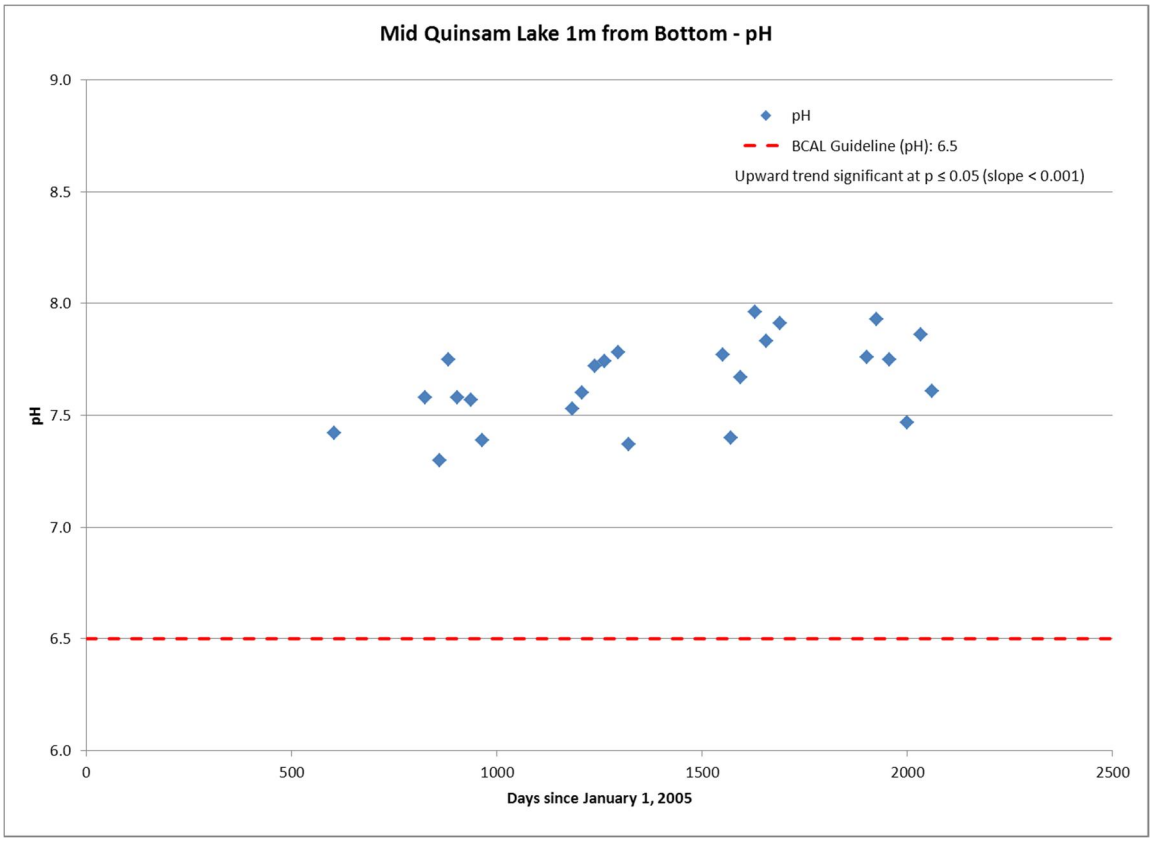

Mid Quinsam Lake 1m from Bottom - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0.000
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500

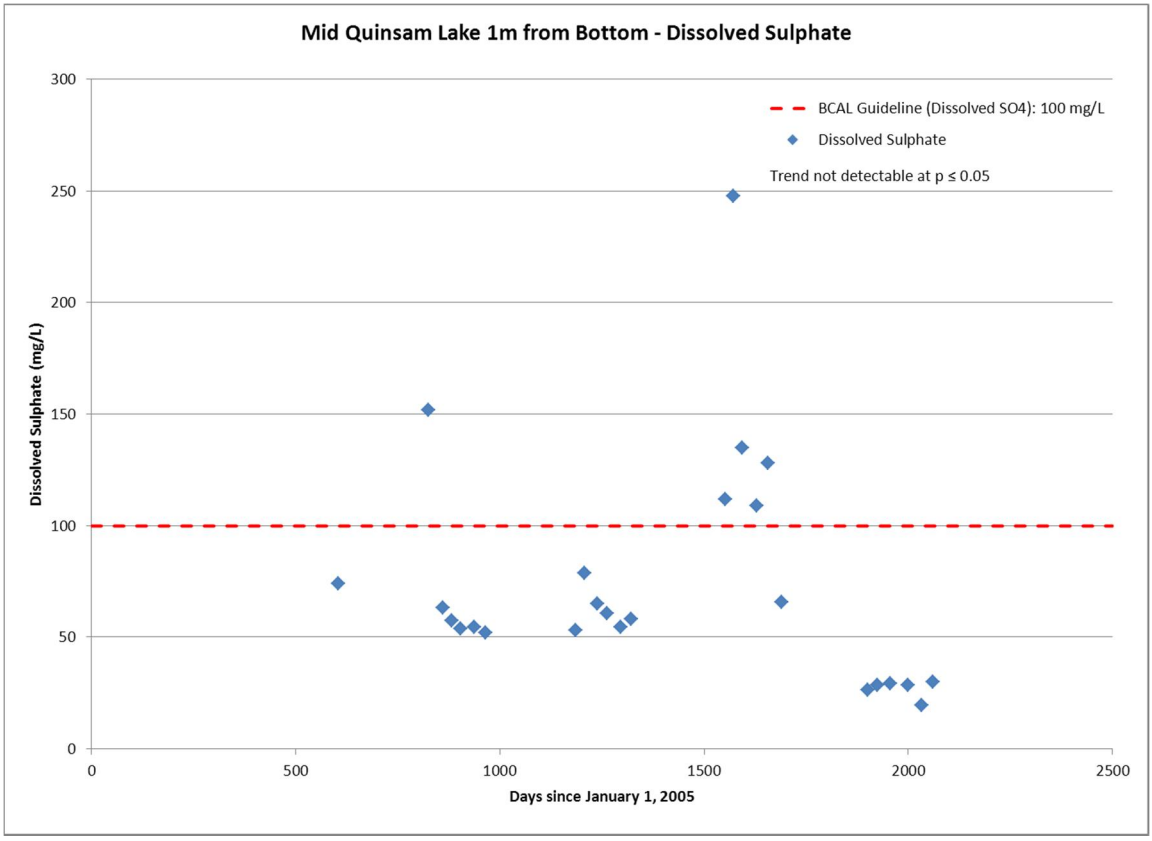

Mid Quinsam Lake 1m from Bottom - Total Cadmium (Adjusted)
BCAL Guideline: 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL
Total Cd (mg/L)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0
500
1000
1500
2000
2500
Days since January 1, 2005

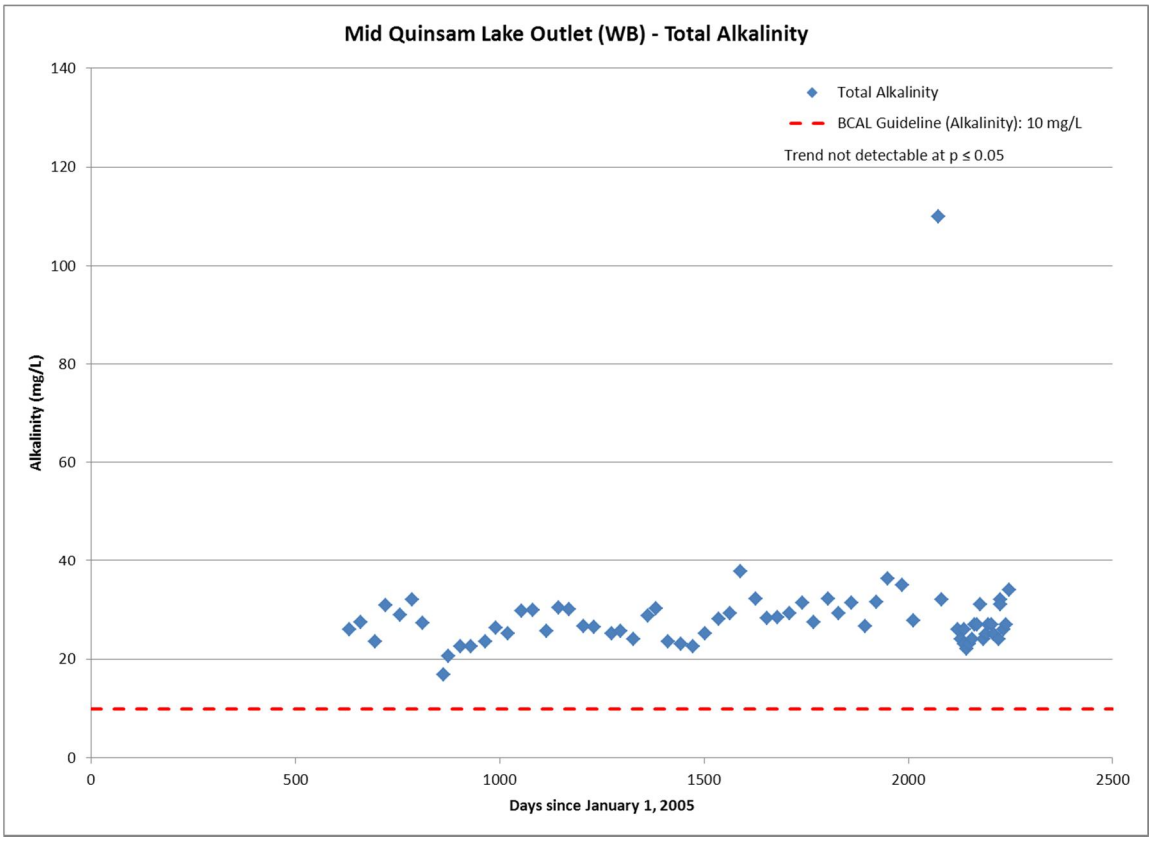

Mid Quinsam Lake 1m from Bottom - Total & Dissolved Iron (Adjusted)
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
BCAL Guideline (Dissolved Fe): 0.35 mg/L
Total Fe: Trend assessment not feasible, > 50% data below MDL
Dissolved Fe: Trend assessment not feasible, > 50% data below MDL
Fe (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

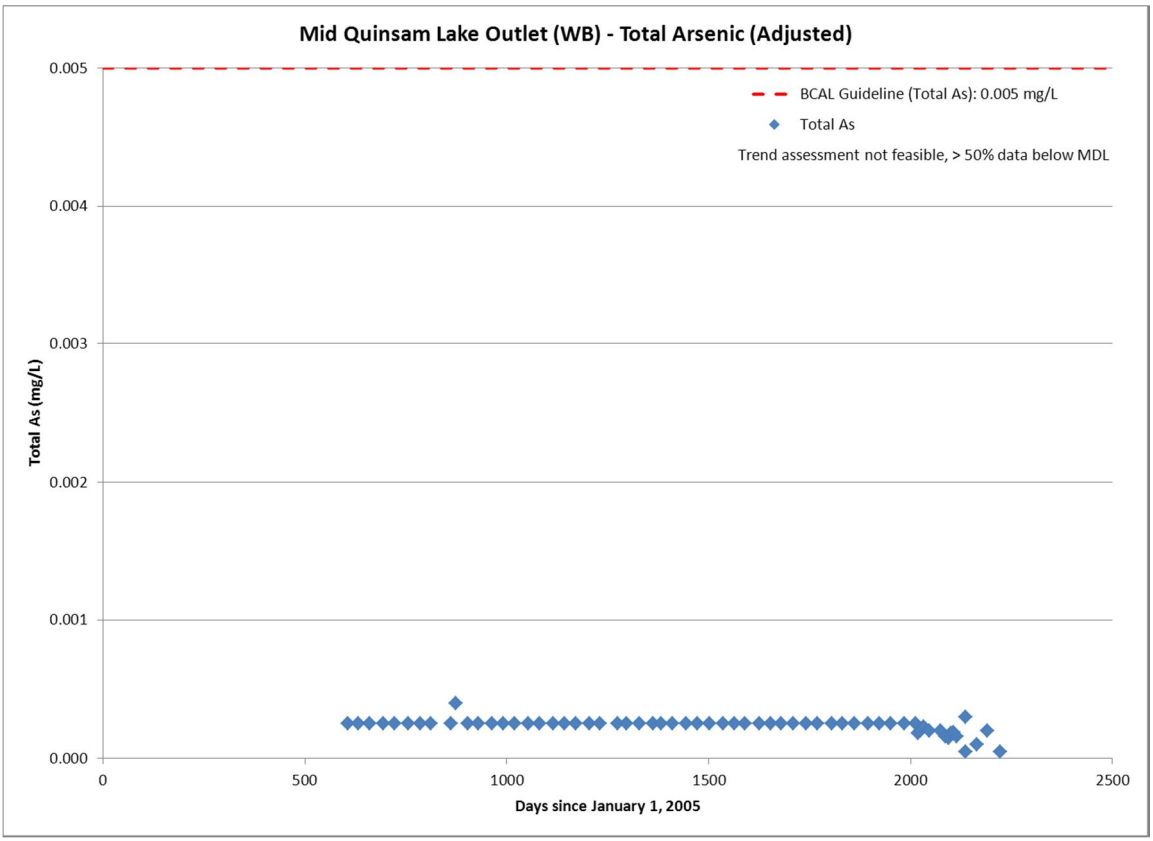

Mid Quinsam Lake 1m from Bottom - Total & Dissolved Mercury (Adjusted)
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg (Adjusted)
Dissolved Hg (Adjusted)
Total Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Hg (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
500
1000
1500
2000
2500
Days since January 1, 2005

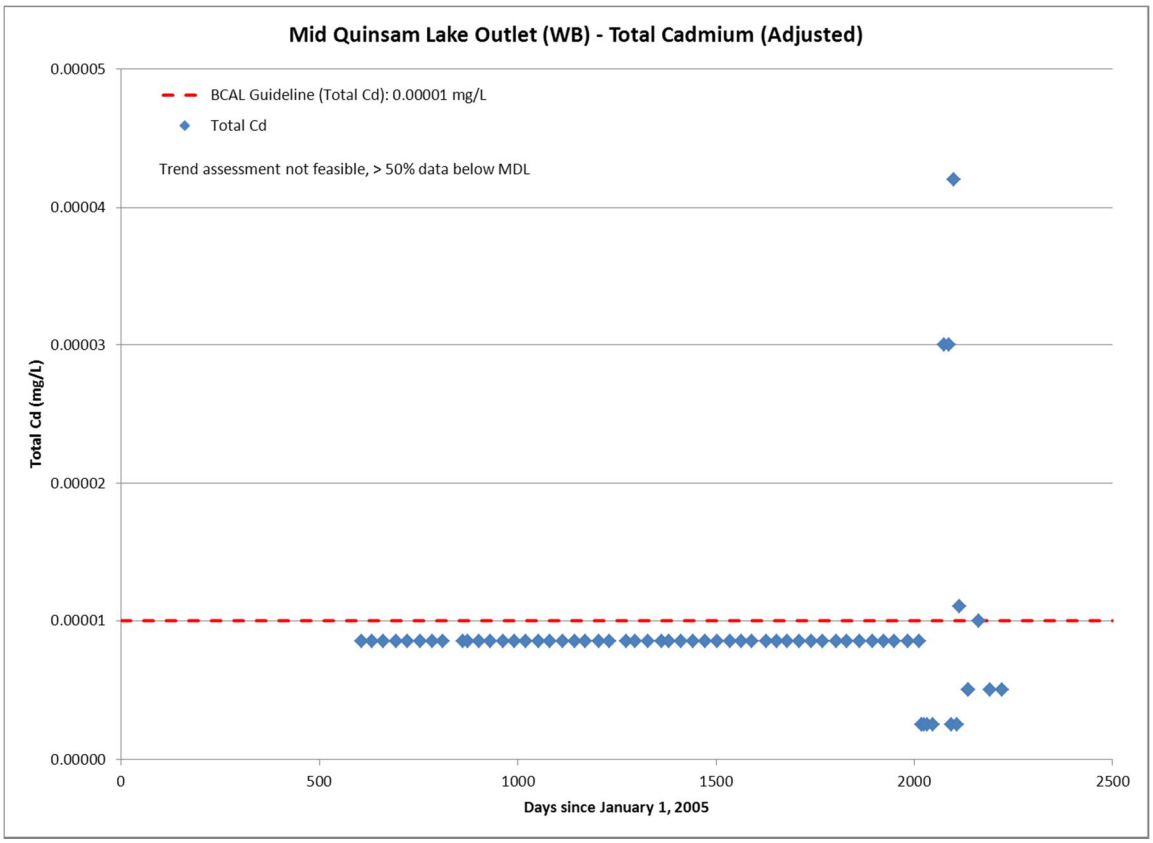

Mid Quinsam Lake 1m from Bottom - Total Manganese
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg.
Total Mn
Trend not detectable at p ≤ 0.05
Total Mn (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

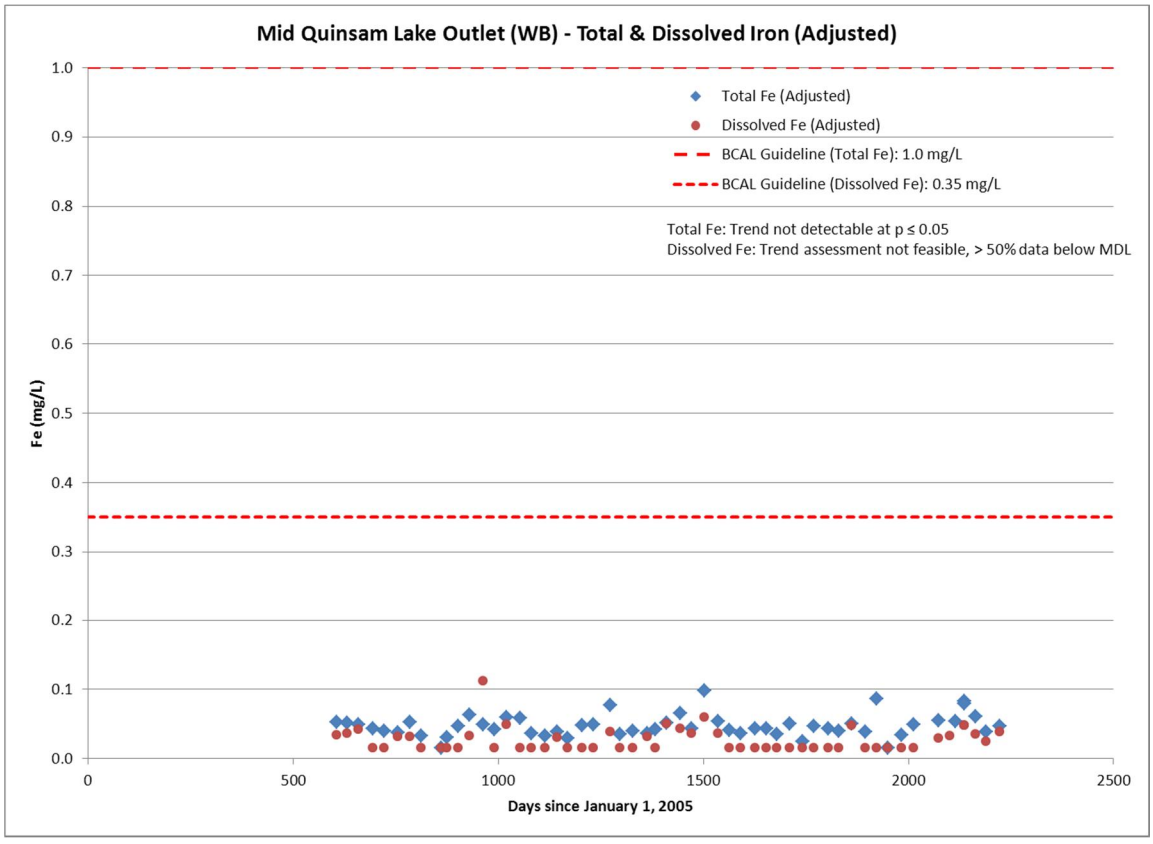

Mid Quinsam Lake 1m from Bottom - pH
pH
BCAL Guideline (pH): 6.5
Upward trend significant at p ≤ 0.05 (slope < 0.001)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
pH
0
500
1000
1500
2000
2500
Days since January 1, 2005

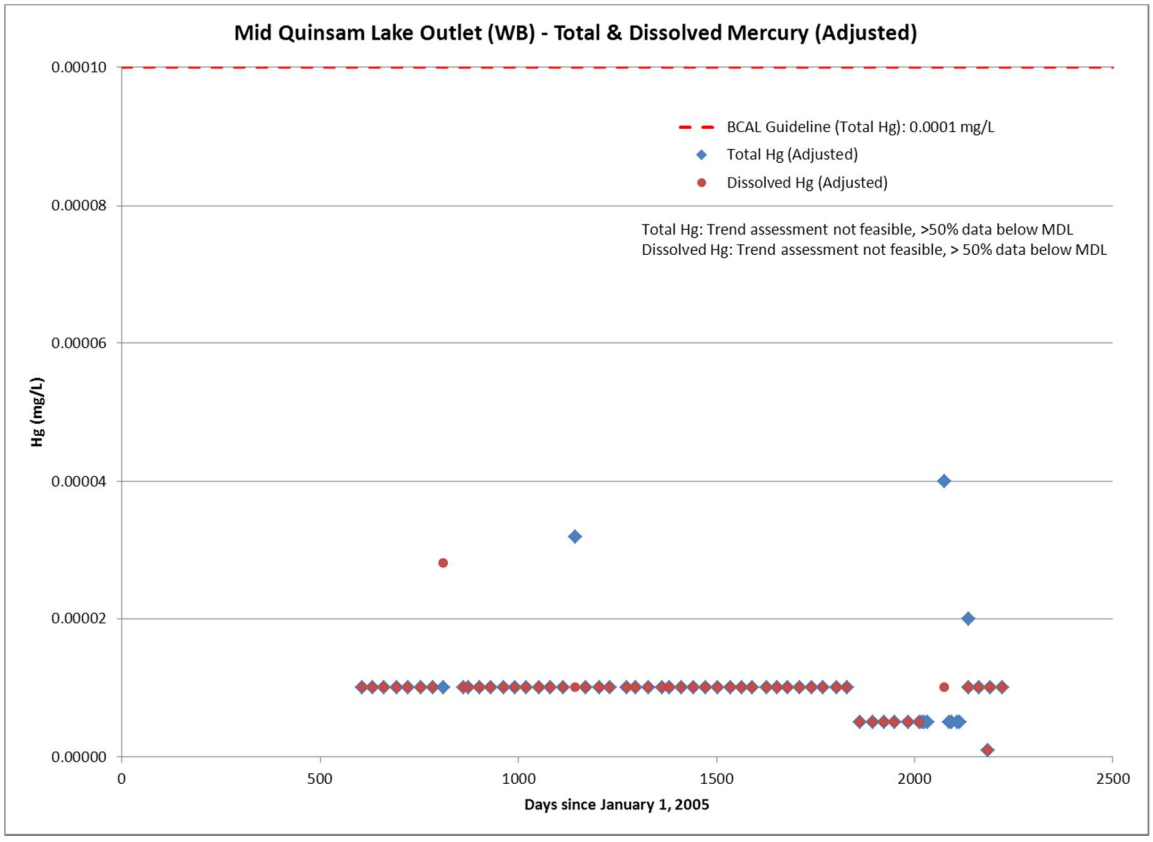

Mid Quinsam Lake 1m from Bottom - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Trend not detectable at p ≤ 0.05
300
250
200
150
100
50
0
Dissolved Sulphate (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005

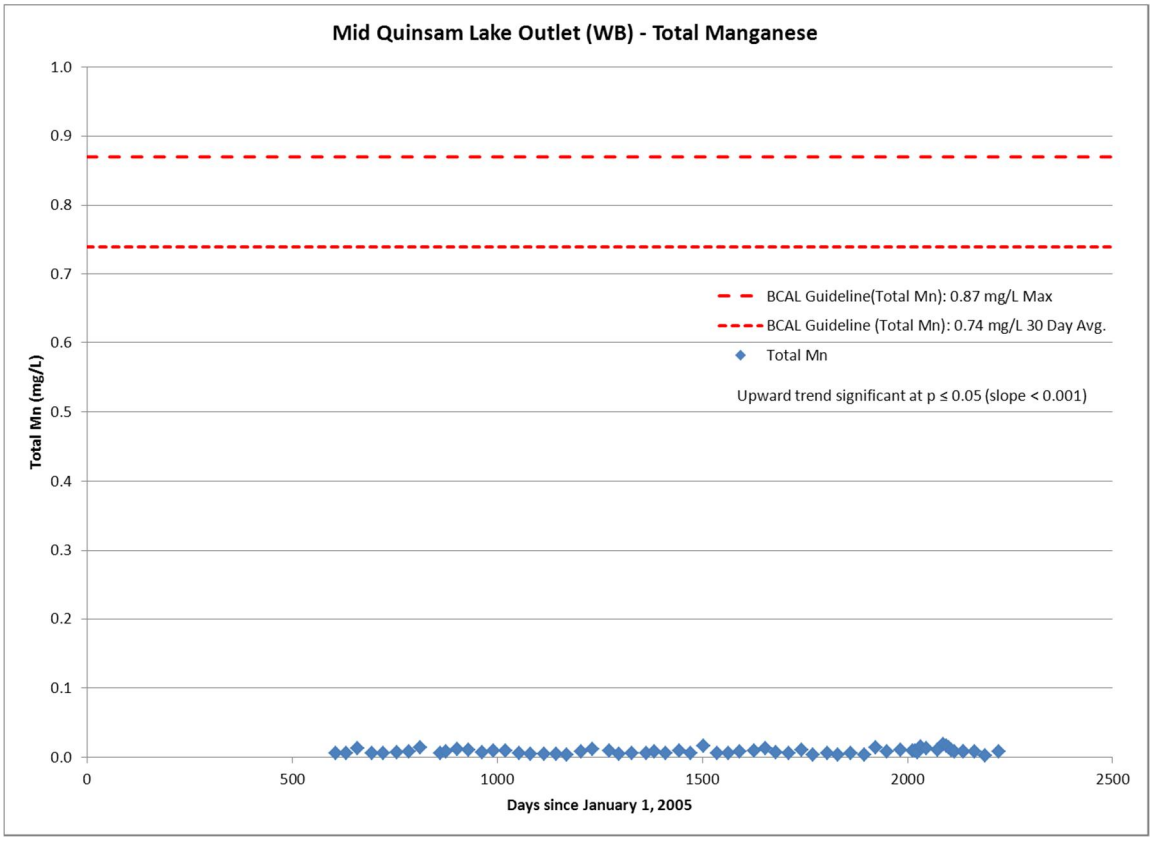

Mid Quinsam Lake Outlet (WB) - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Trend not detectable at p ≤ 0.05
Alkalinity (mg/L)
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
Days since January 1, 2005

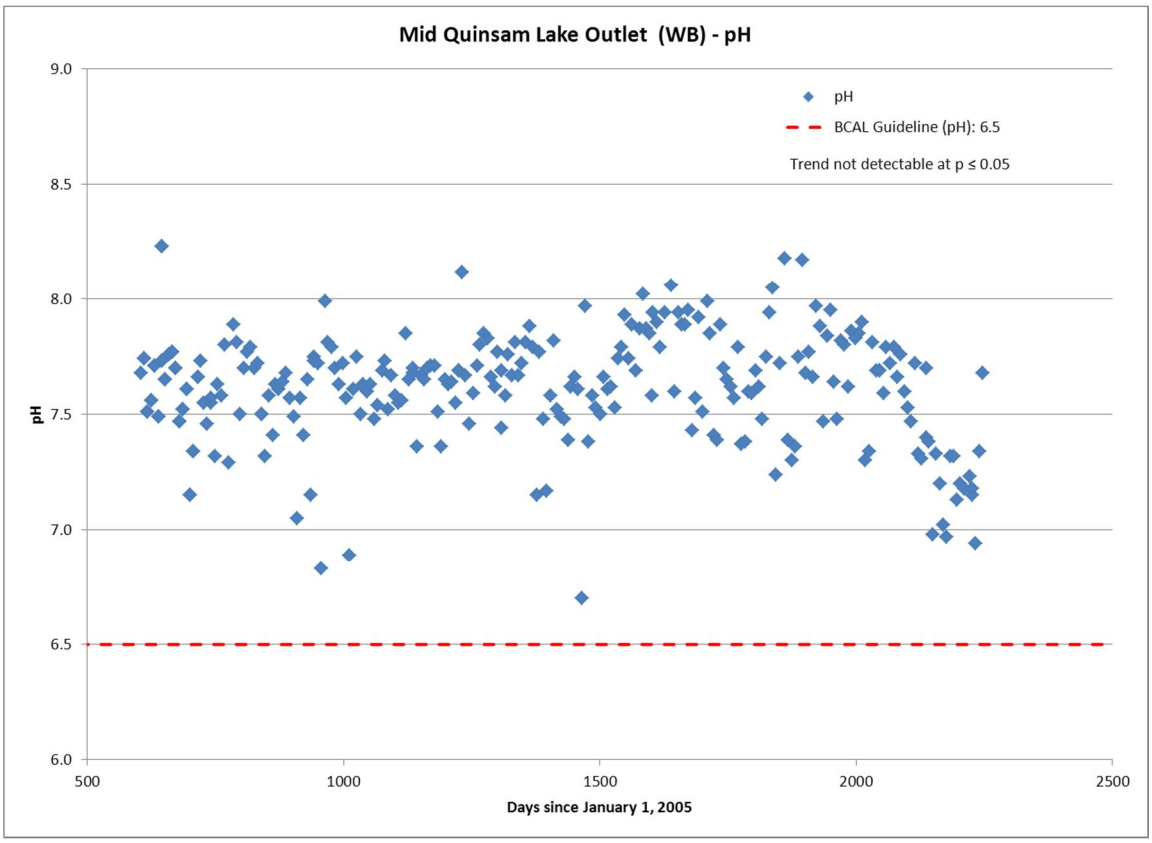

Mid Quinsam Lake Outlet (WB) - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
0.000
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500
Days since January 1, 2005

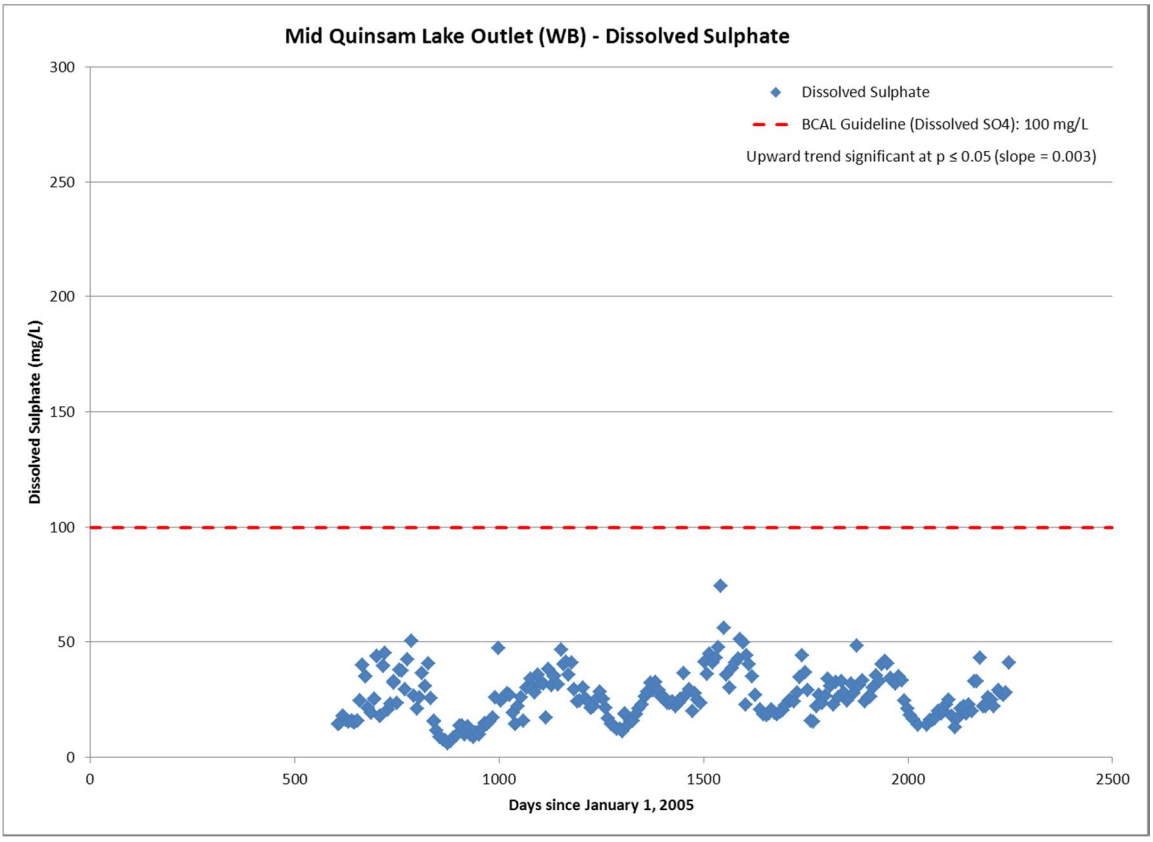

Mid Quinsam Lake Outlet (WB) - Total Cadmium (Adjusted)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, > 50% data below MDL
Total Cd (mg/L)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0
500
1000
1500
2000
2500
Days since January 1, 2005

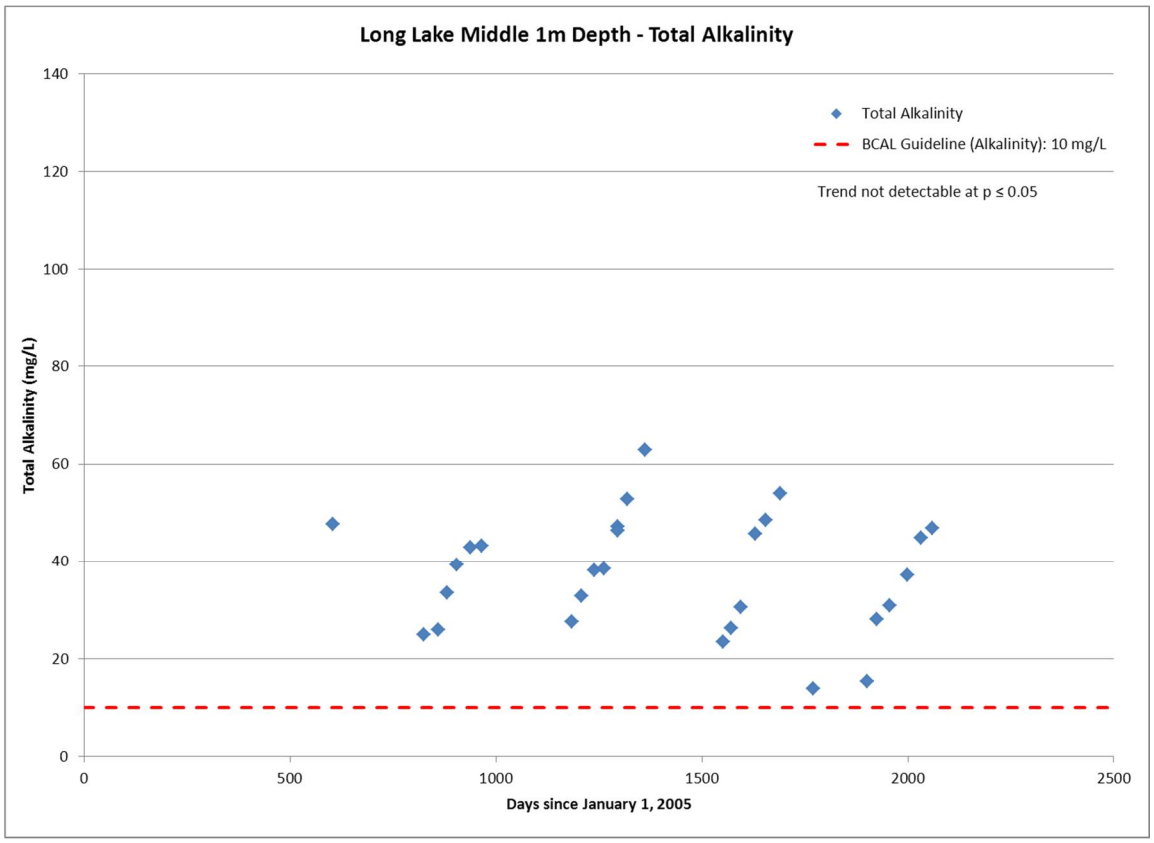

Mid Quinsam Lake Outlet (WB) - Total & Dissolved Iron (Adjusted)
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
BCAL Guideline (Dissolved Fe): 0.35 mg/L
Total Fe: Trend not detectable at p ≤ 0.05
Dissolved Fe: Trend assessment not feasible, > 50% data below MDL
Fe (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

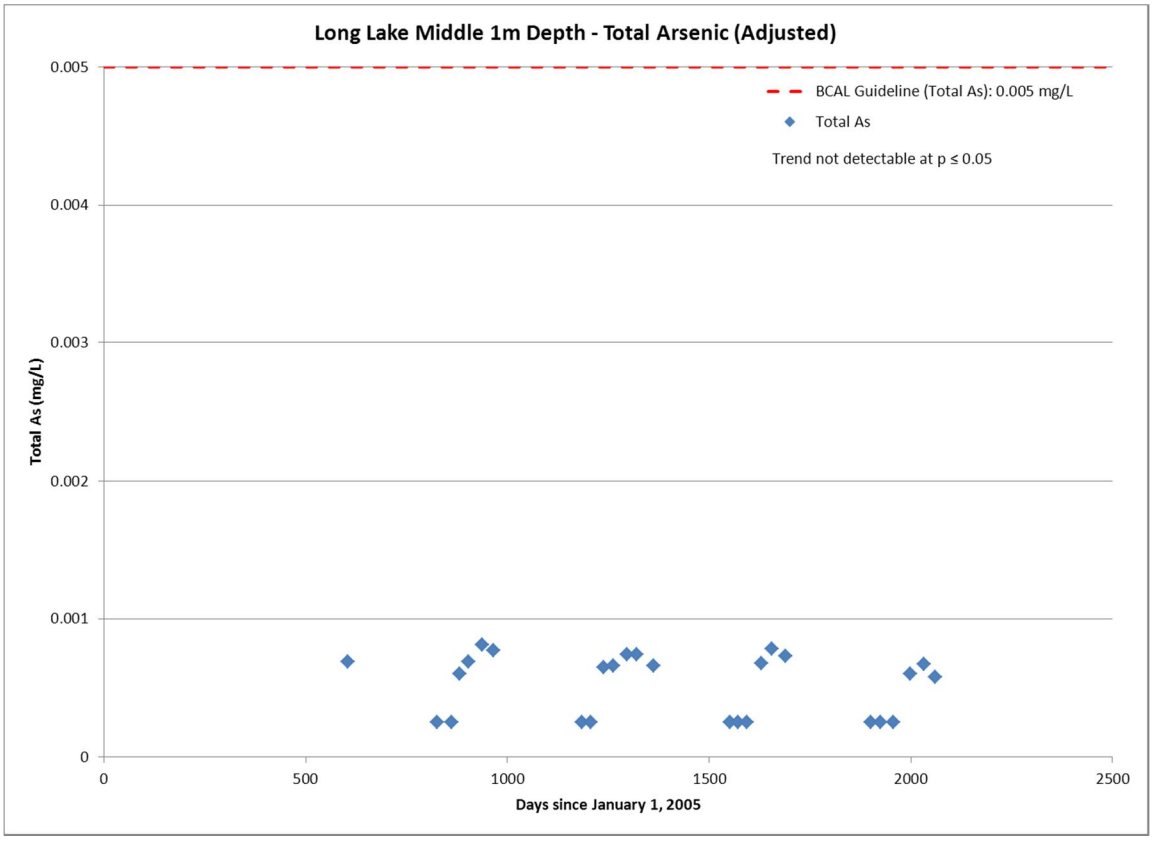

Mid Quinsam Lake Outlet (WB) - Total & Dissolved Mercury (Adjusted)
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Hg (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg (Adjusted)
Dissolved Hg (Adjusted)
Total Hg: Trend assessment not feasible, >50% data below MDL
Dissolved Hg: Trend assessment not feasible, > 50% data below MDL

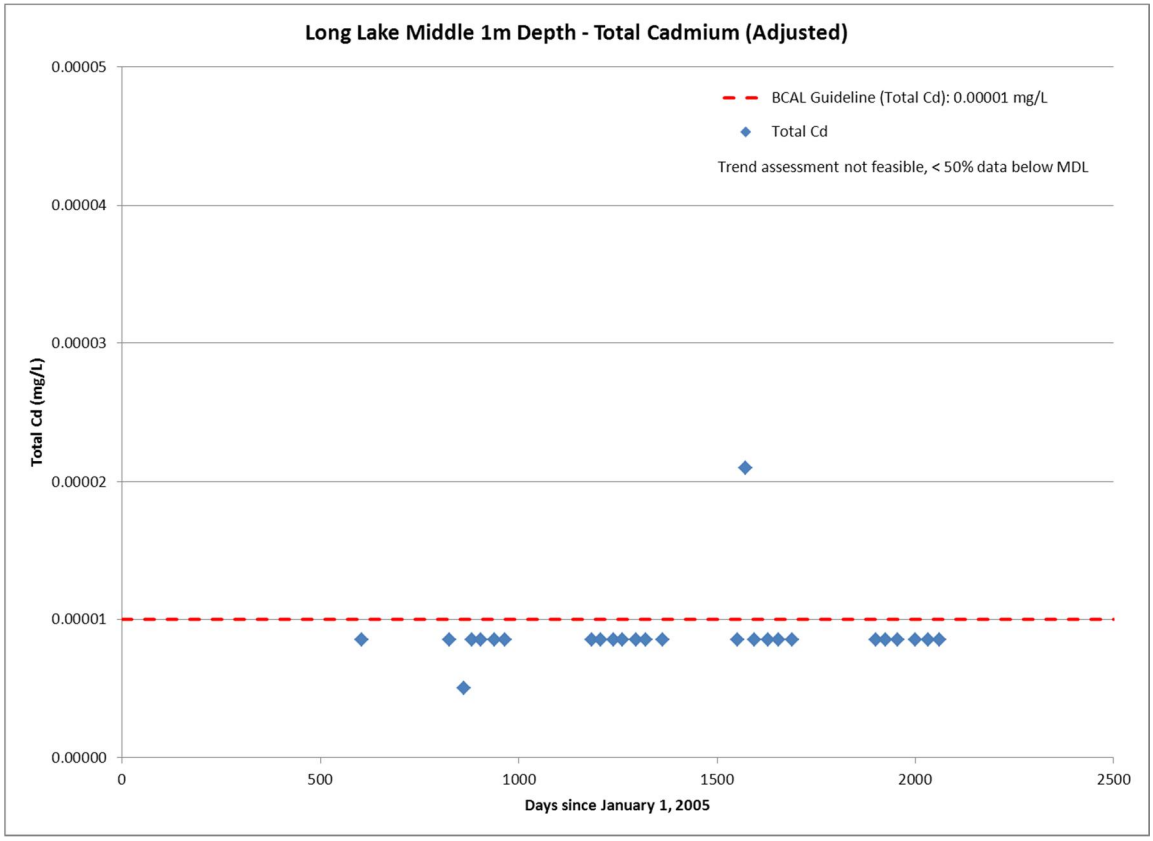

Mid Quinsam Lake Outlet (WB) - Total Manganese
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Mn (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline(Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg.
Total Mn
Upward trend significant at p ≤ 0.05 (slope < 0.001)

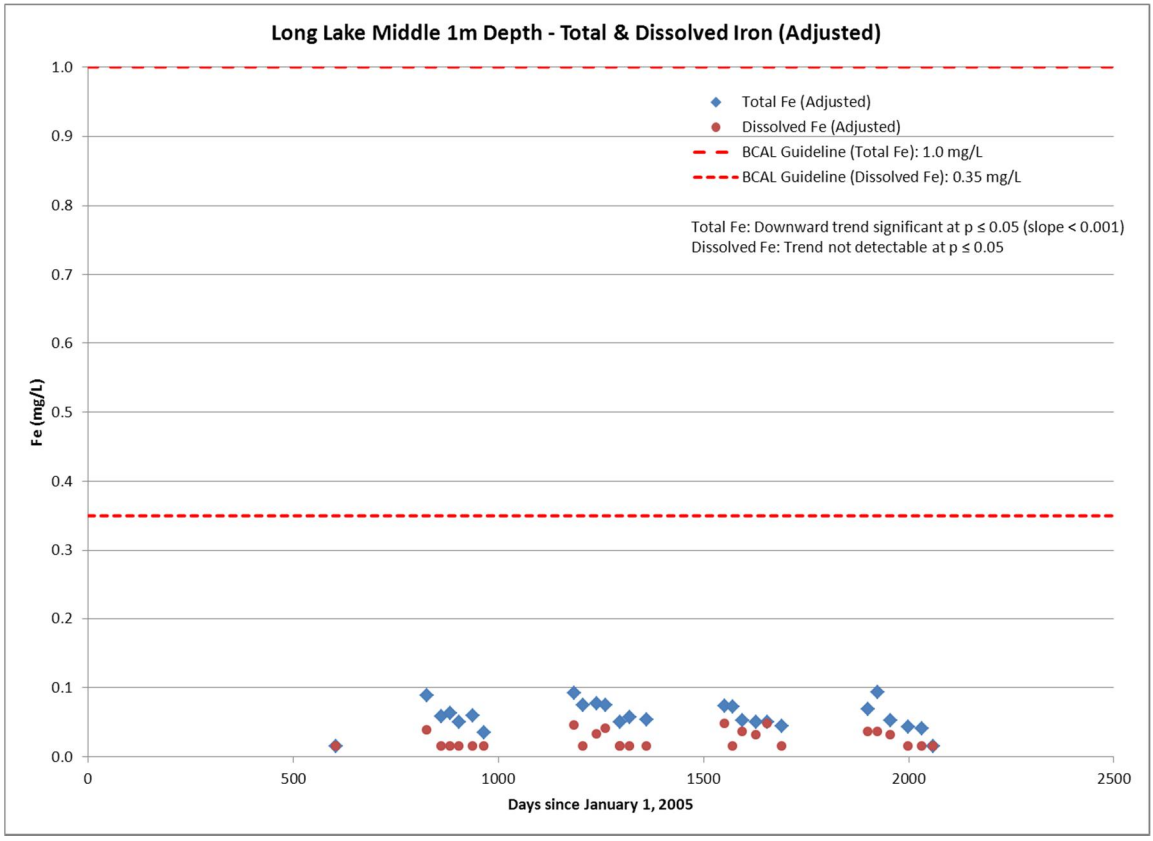

Mid Quinsam Lake Outlet (WB) - pH
pH
BCAL Guideline (pH): 6.5
Trend not detectable at p ≤ 0.05
9.0
8.5
8.0
7.5
7.0
6.5
6.0
pH
500
1000
1500
2000
2500
Days since January 1, 2005

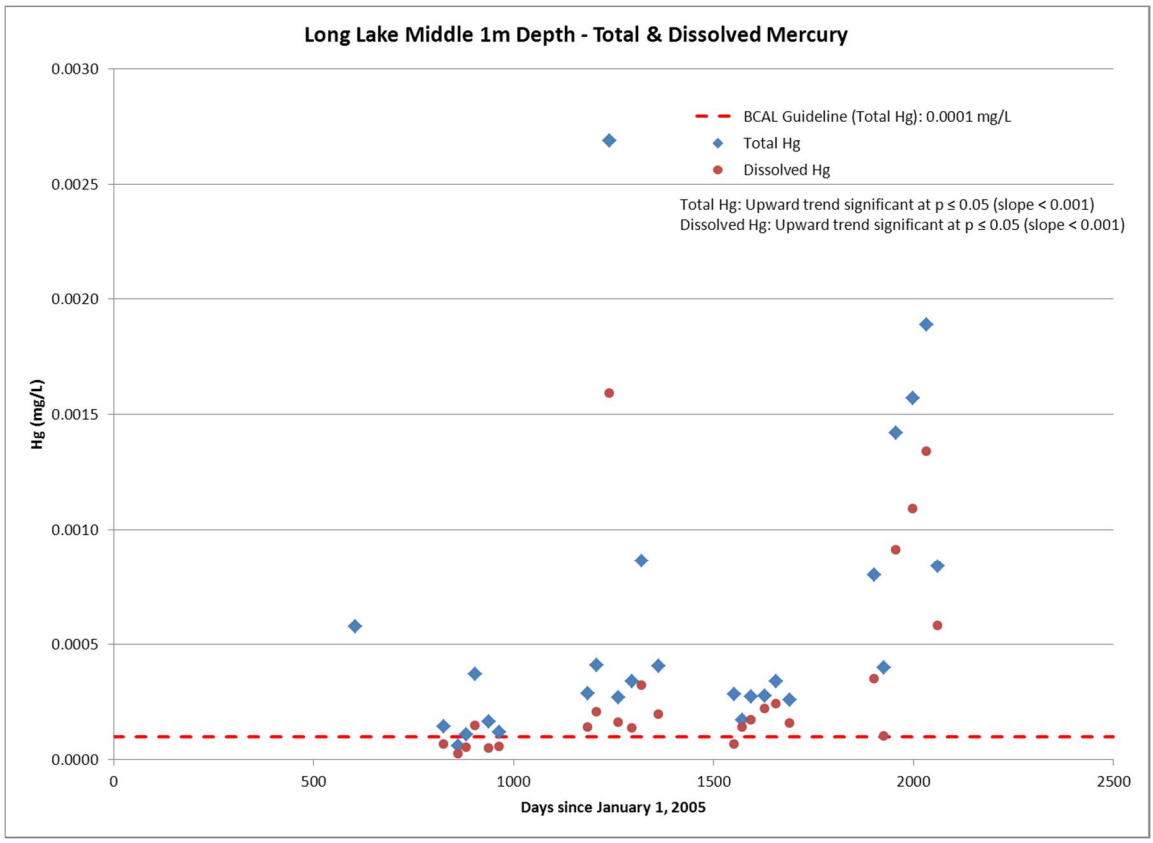

Mid Quinsam Lake Outlet (WB) - Dissolved Sulphate
Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Upward trend significant at p ≤ 0.05 (slope = 0.003)
300
250
200
150
100
50
0
Dissolved Sulphate (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005

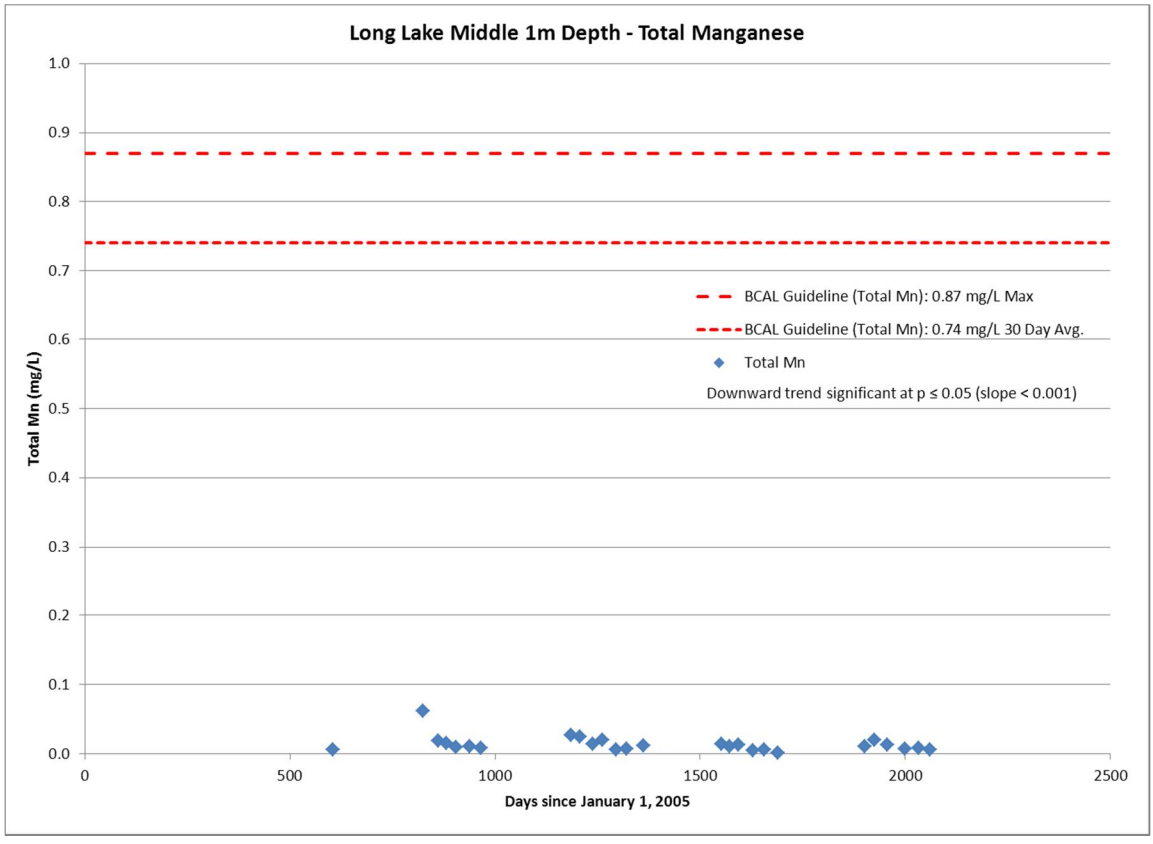

Long Lake Middle 1m Depth - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Trend not detectable at p ≤ 0.05
Total Alkalinity (mg/L)
Days since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

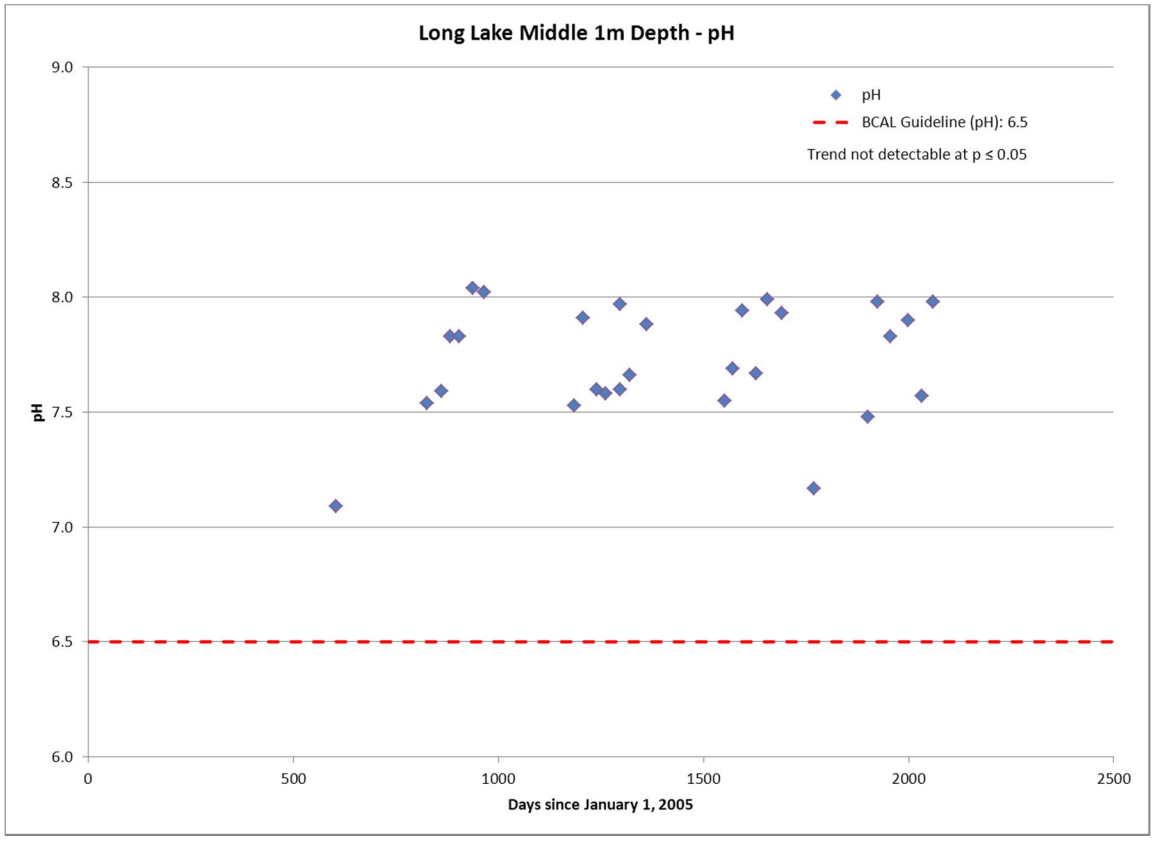

Long Lake Middle 1m Depth - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend not detectable at p ≤ 0.05
Total As (mg/L)
Days since January 1, 2005
0
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500

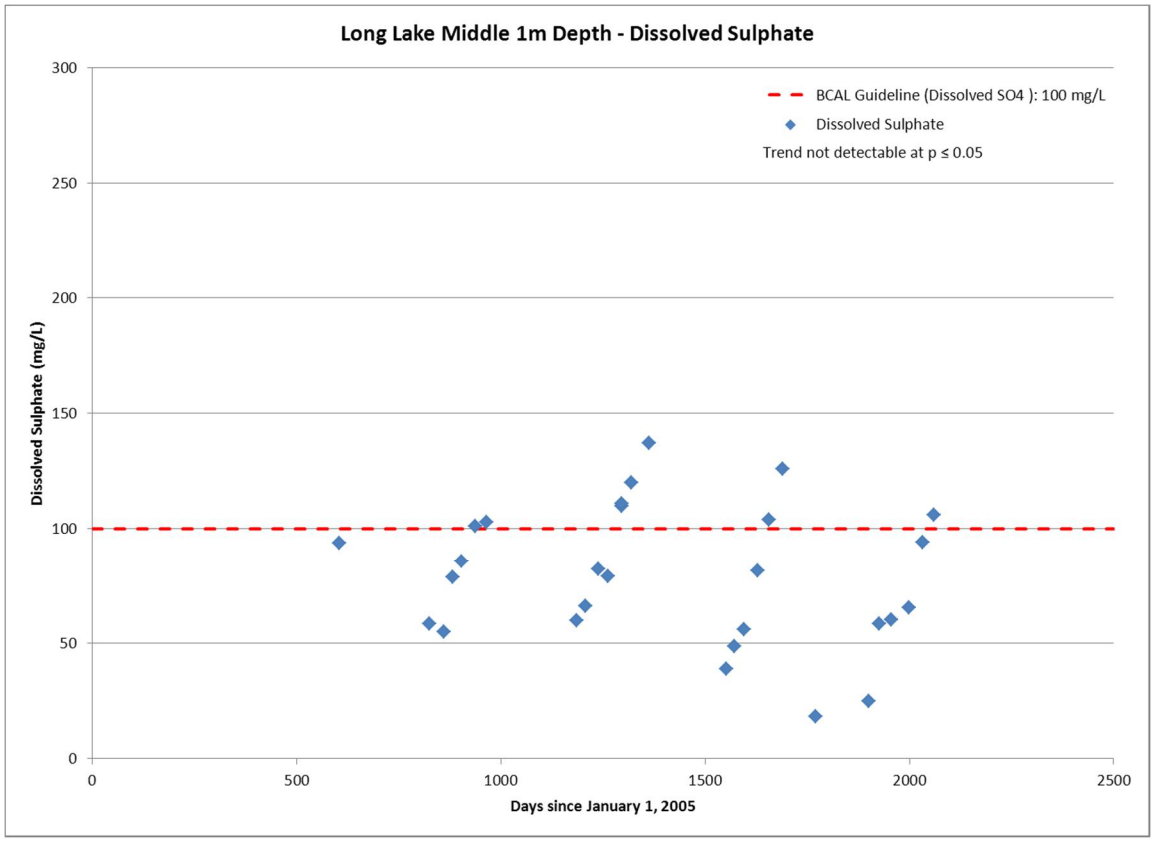

Long Lake Middle 1m Depth - Total Cadmium (Adjusted)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, < 50% data below MDL
Total Cd (mg/L)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0
500
1000
1500
2000
2500
Days since January 1, 2005

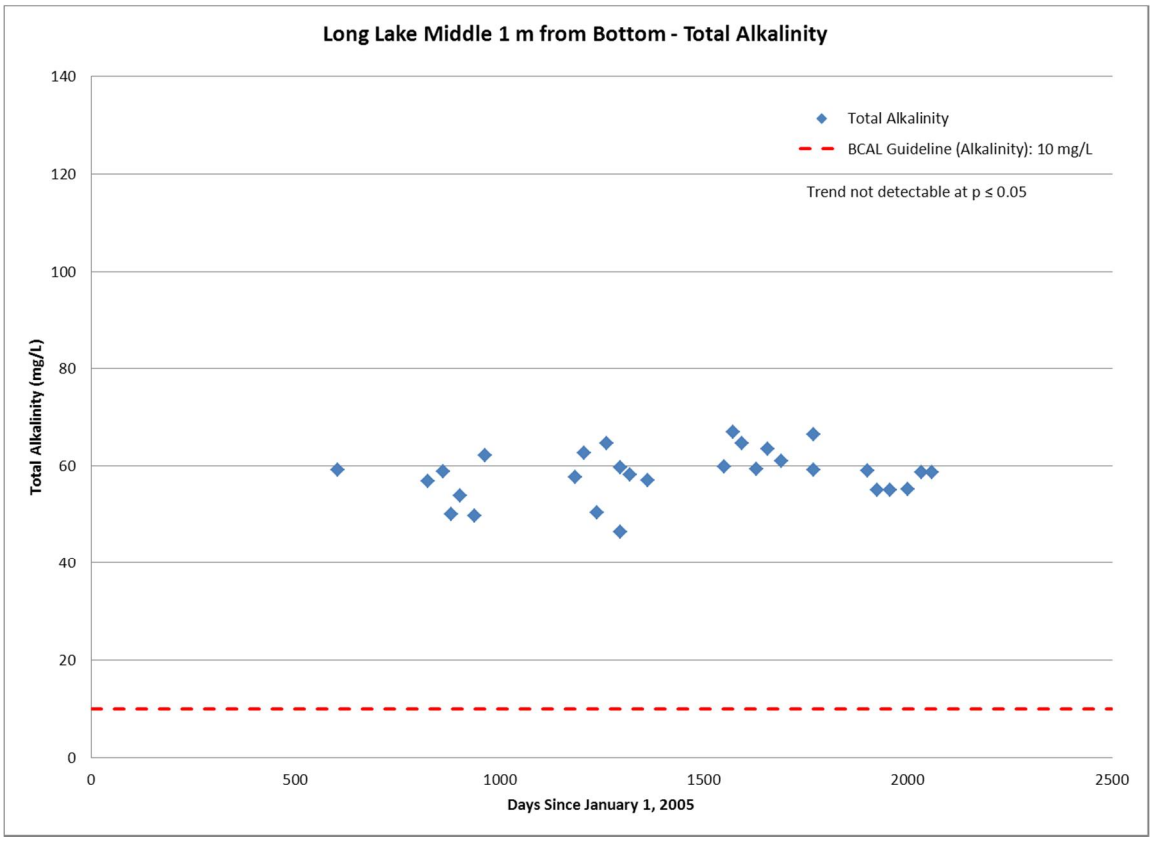

Long Lake Middle 1m Depth - Total & Dissolved Iron (Adjusted)
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
BCAL Guideline (Dissolved Fe): 0.35 mg/L
Total Fe: Downward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Fe: Trend not detectable at p ≤ 0.05
Fe (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days since January 1, 2005

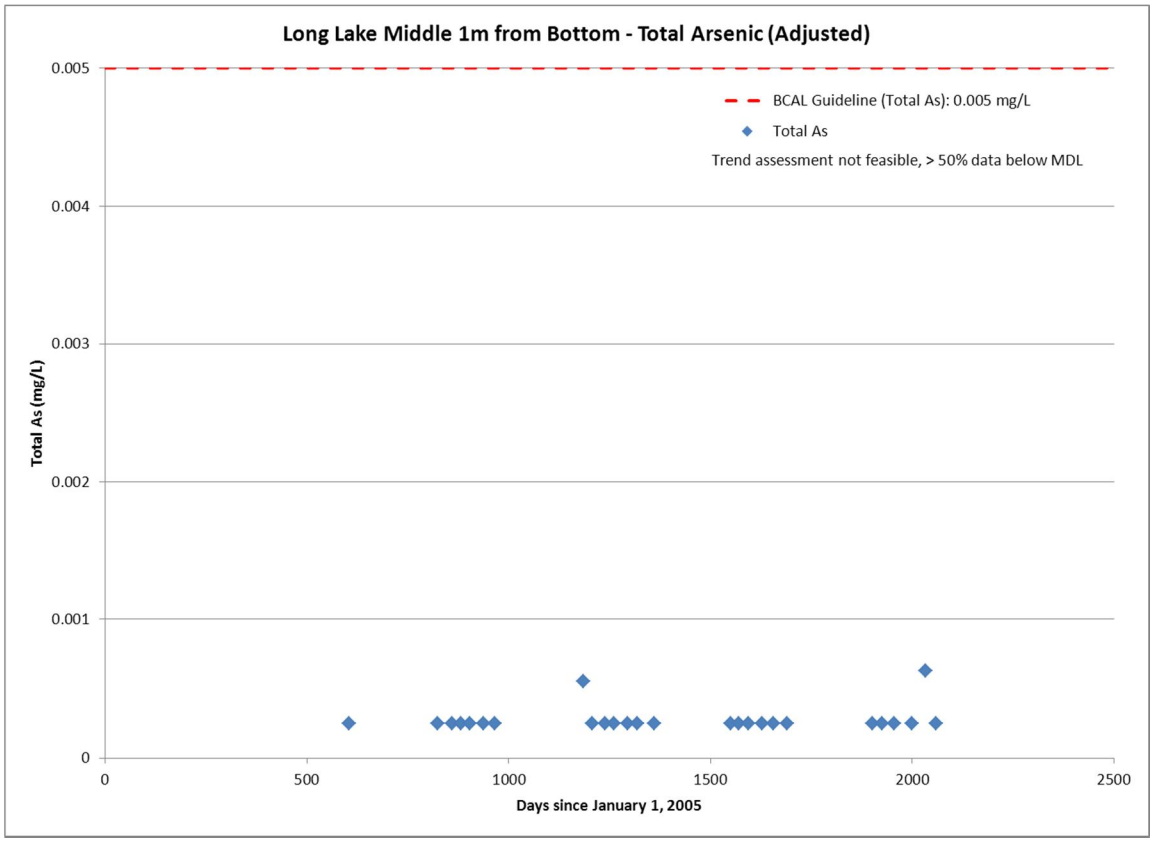

Long Lake Middle 1m Depth - Total & Dissolved Mercury
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Hg (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg
Dissolved Hg
Total Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)
Dissolved Hg: Upward trend significant at p ≤ 0.05 (slope < 0.001)

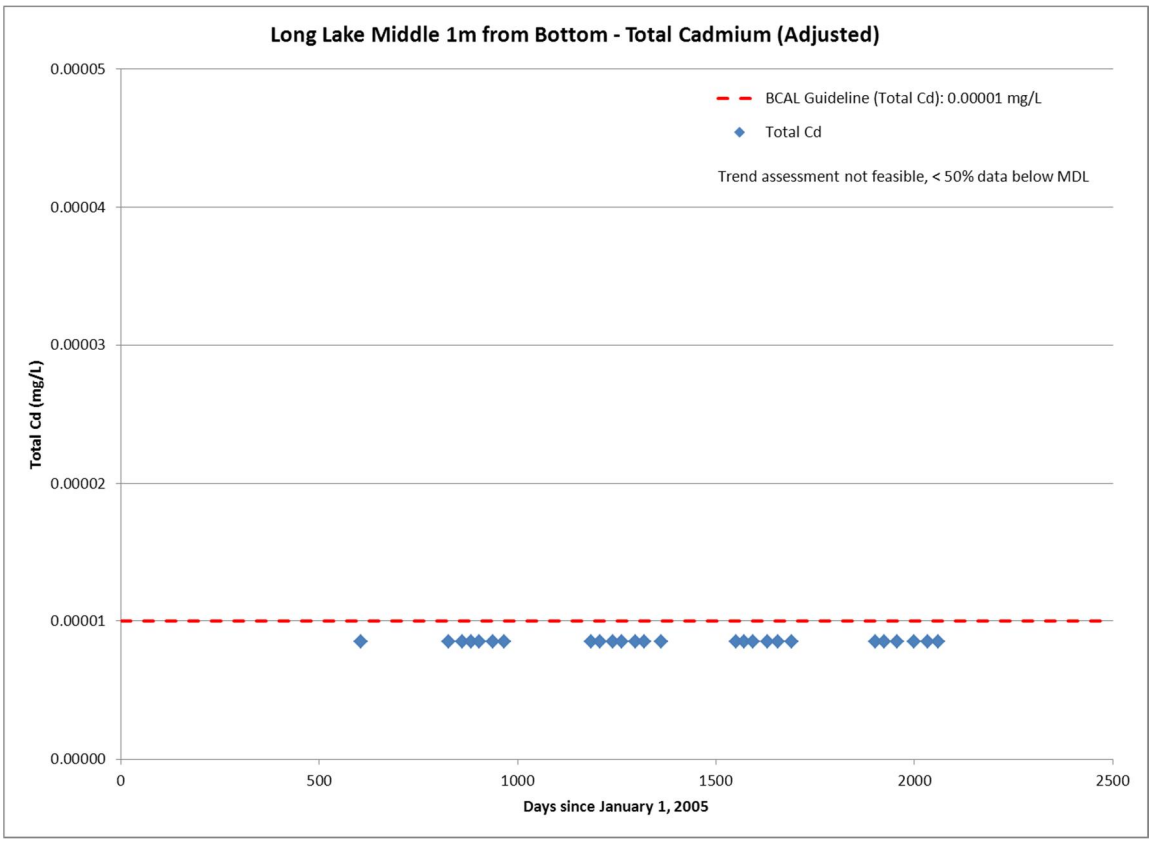

Long Lake Middle 1m Depth - Total Manganese
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Total Mn (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg.
Total Mn
Downward trend significant at p ≤ 0.05 (slope < 0.001)

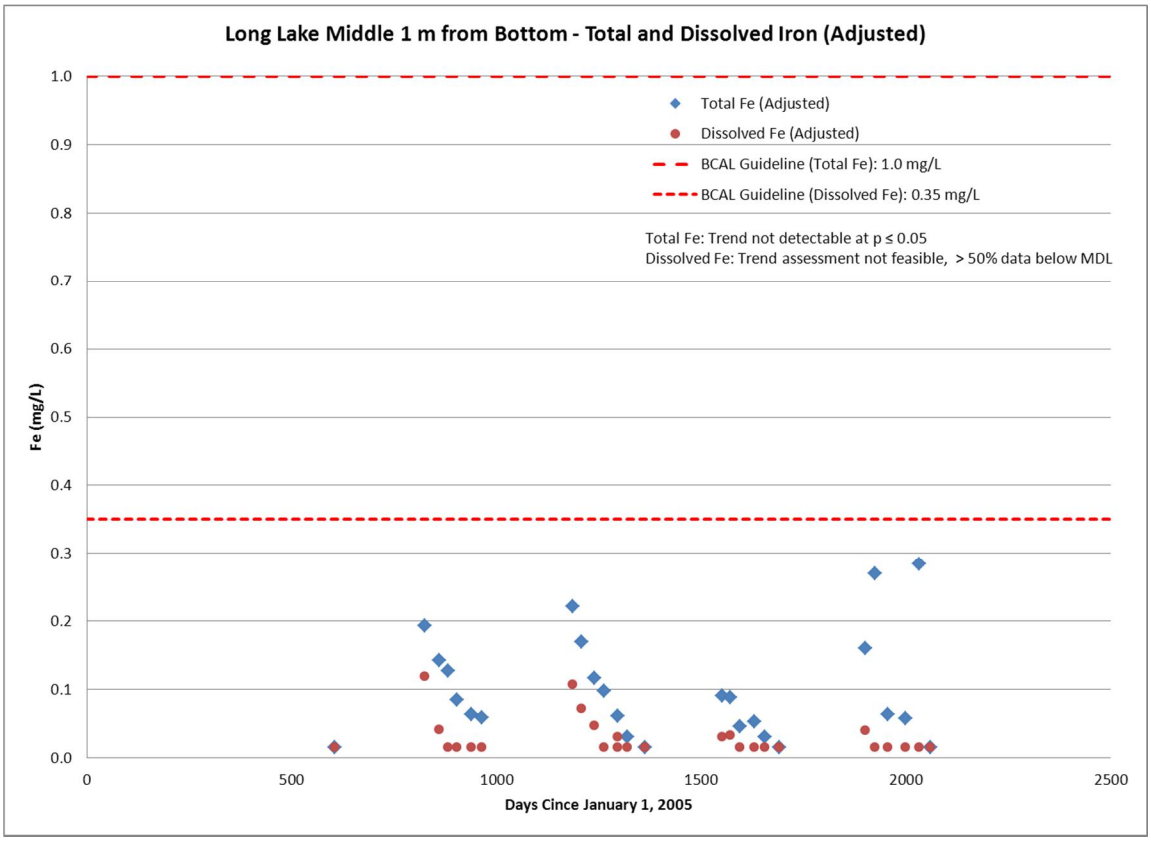

Long Lake Middle 1m Depth - pH
pH
BCAL Guideline (pH): 6.5
Trend not detectable at p ≤ 0.05
9.0
8.5
8.0
7.5
7.0
6.5
6.0
pH
0
500
1000
1500
2000
2500
Days since January 1, 2005

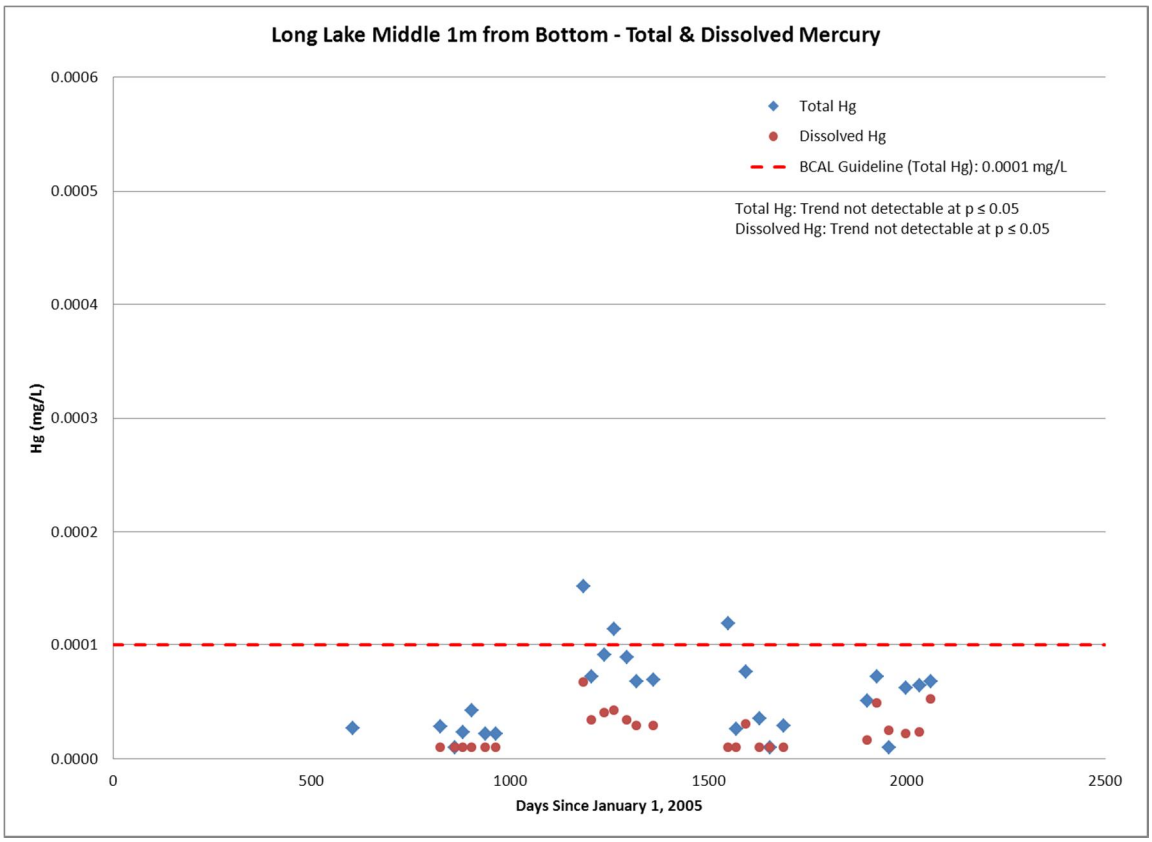

Long Lake Middle 1m Depth - Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Dissolved Sulphate
Trend not detectable at p ≤ 0.05
300
250
200
150
100
50
0
Dissolved Sulphate (mg/L)
0
500
1000
1500
2000
2500
Days since January 1, 2005

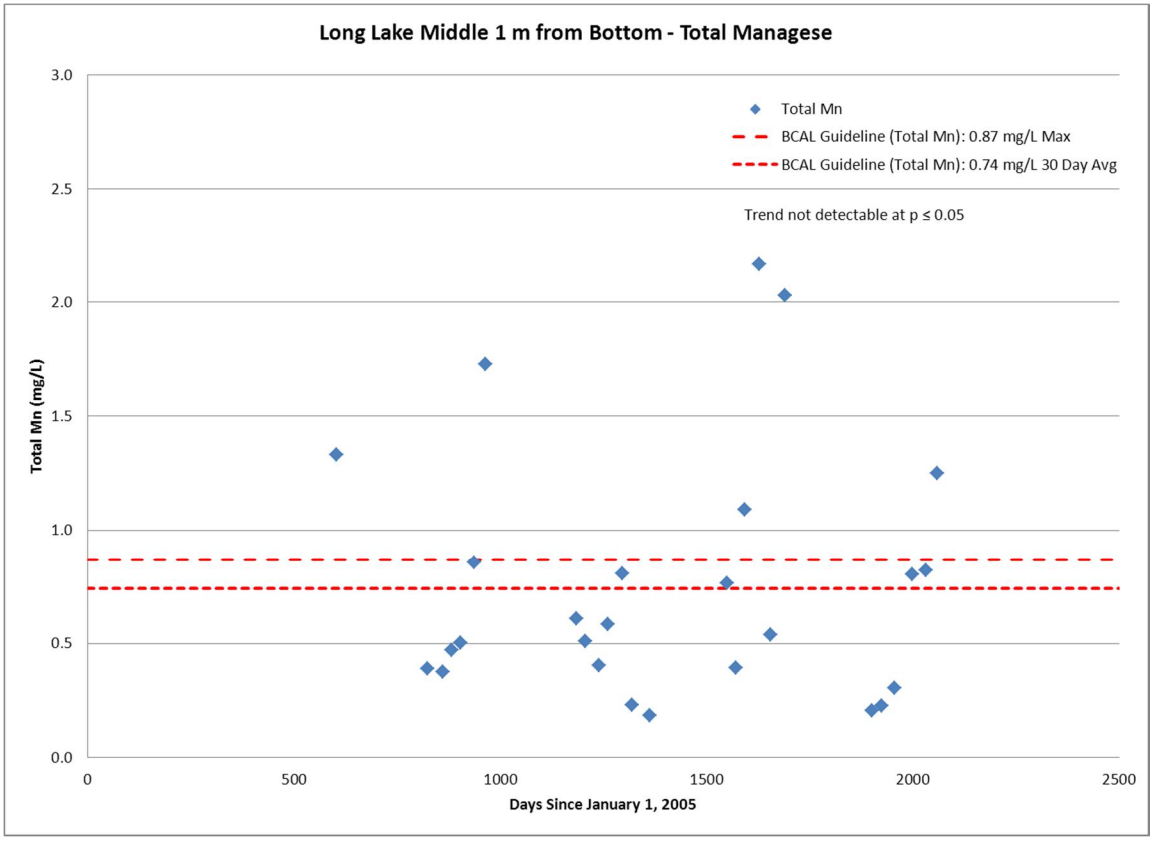

Long Lake Middle 1 m from Bottom - Total Alkalinity
Total Alkalinity
BCAL Guideline (Alkalinity): 10 mg/L
Trend not detectable at p ≤ 0.05
Total Alkalinity (mg/L)
Days Since January 1, 2005
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500

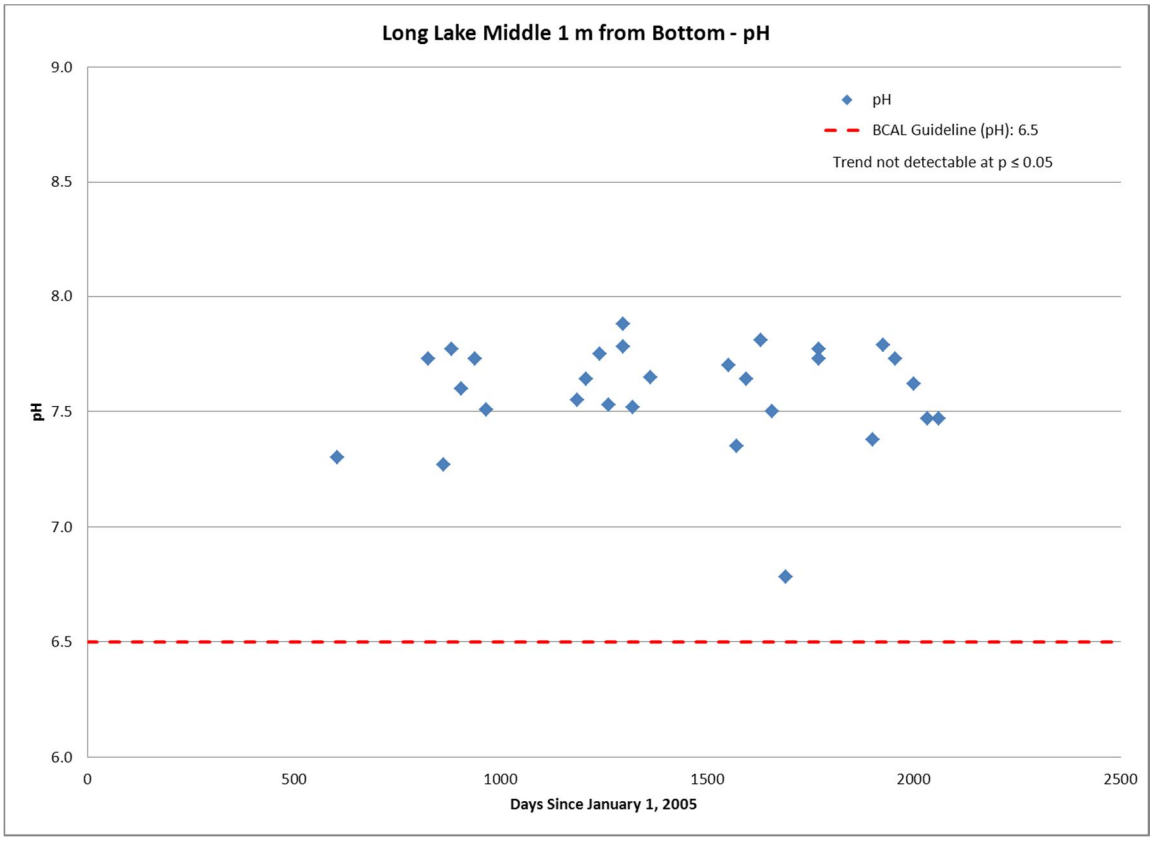

Long Lake Middle 1m from Bottom - Total Arsenic (Adjusted)
BCAL Guideline (Total As): 0.005 mg/L
Total As
Trend assessment not feasible, > 50% data below MDL
Total As (mg/L)
Days since January 1, 2005
0
0.001
0.002
0.003
0.004
0.005
0
500
1000
1500
2000
2500

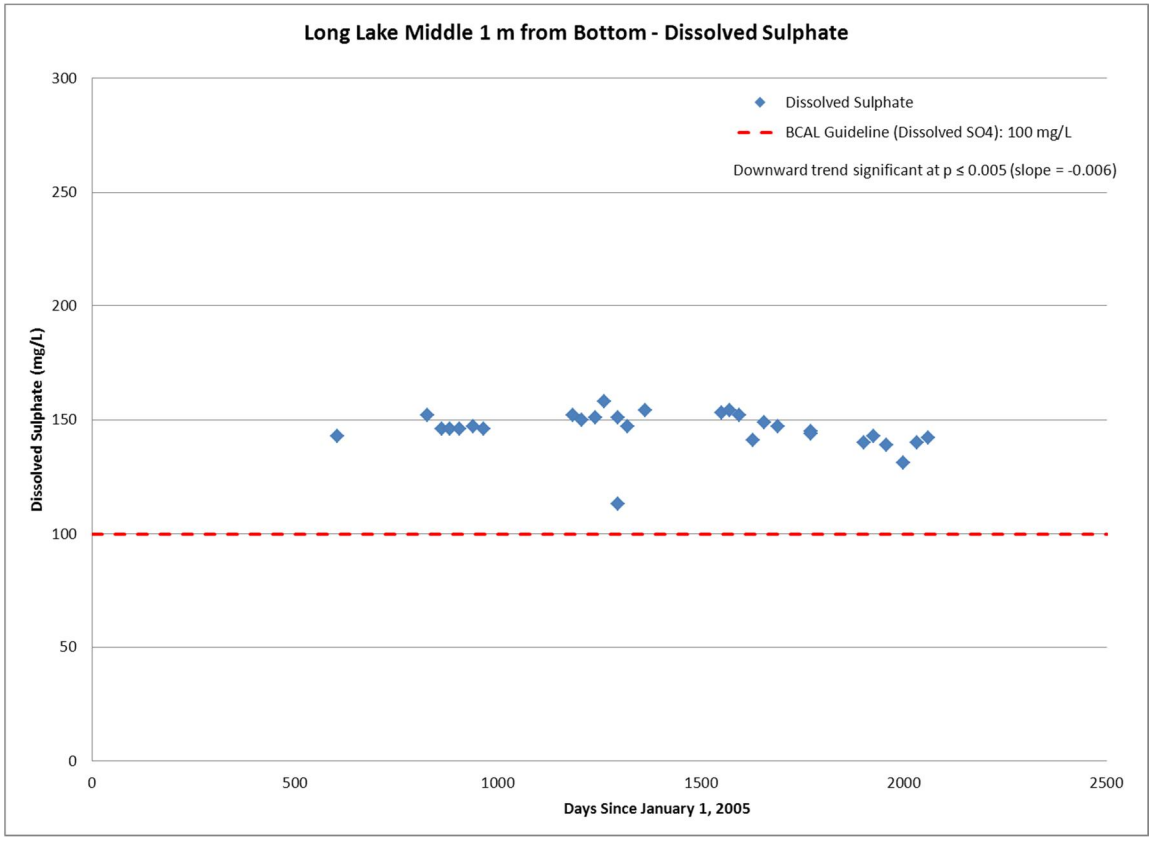

Long Lake Middle 1m from Bottom - Total Cadmium (Adjusted)
BCAL Guideline (Total Cd): 0.00001 mg/L
Total Cd
Trend assessment not feasible, < 50% data below MDL
Total Cd (mg/L)
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0
500
1000
1500
2000
2500
Days since January 1, 2005


Long Lake Middle 1 m from Bottom - Total and Dissolved Iron (Adjusted)
Total Fe (Adjusted)
Dissolved Fe (Adjusted)
BCAL Guideline (Total Fe): 1.0 mg/L
BCAL Guideline (Dissolved Fe): 0.35 mg/L
Total Fe: Trend not detectable at p ≤ 0.05
Dissolved Fe: Trend assessment not feasible, > 50% data below MDL
Fe (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
2000
2500
Days Cince January 1, 2005


Long Lake Middle 1m from Bottom - Total & Dissolved Mercury
Total Hg
Dissolved Hg
BCAL Guideline (Total Hg): 0.0001 mg/L
Total Hg: Trend not detectable at p ≤ 0.05
Dissolved Hg: Trend not detectable at p ≤ 0.05
Hg (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
500
1000
1500
2000
2500
Days Since January 1, 2005


Long Lake Middle 1 m from Bottom - Total Managese
Total Mn
BCAL Guideline (Total Mn): 0.87 mg/L Max
BCAL Guideline (Total Mn): 0.74 mg/L 30 Day Avg
Trend not detectable at p ≤ 0.05
Total Mn (mg/L)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
2000
2500
Days Since January 1, 2005


Long Lake Middle 1 m from Bottom - pH
9.0
8.5
8.0
7.5
7.0
6.5
6.0
pH
0
500
1000
1500
2000
2500
Days Since January 1, 2005
pH
BCAL Guideline (pH): 6.5
Trend not detectable at p ≤ 0.05


Long Lake Middle 1 m from Bottom - Dissolved Sulphate
300
250
200
150
100
50
0
Dissolved Sulphate (mg/L)
0
500
1000
1500
2000
2500
Days Since January 1, 2005
Dissolved Sulphate
BCAL Guideline (Dissolved SO4): 100 mg/L
Downward trend significant at p ≤ 0.005 (slope = -0.006)

APPENDIX XI

MAPS

MINE GRID NORTH

TRUE NORTH

WC = Mid-Point between Settling Pond #4 & Middle Quinsam Lake

WA = Inflow to Middle Quinsam Lake

WD = Discharge from Settling Pond #4

D2 = Sulphate Test Hole

D1 = Sulphate Test Hole

SETTLING POND #4

WP = North Pit Sump Water

2 NORTH PIT SUMP PAG CCR Disposal Site

QL1

QL2

QL3

QL4

QL5

QL6

PDS_R = Plant Ditch Seep at Road

PLANT SITE

OFFICE

FIRST AID

2NP-Sump = 2 North Portal Sump

FINE REFUSE IMPOUNDMENT

MIDDLE QUINSAM LAKE

South Dyke Sump = Receives seepage from the South Dyke of the Tailings Dam

MQL = Middle Quinsam Lake

WB = Outflow from Middle Quinsam Lake

5SP = 5 SOUTH PORTAL

5 SOUTH MINE

LLO = Long Lake Outflow

LLE = Last Wetland/Settling Pong Prior to Effluent flow into Long Lake

4 SOUTH MINE

7 SOUTH MINE

QRDS-1 = Quinsam River Downstream Site #1

7S = 7 South Preliminary Dischargepoint from 7 South Mine

7SQR = 7S Quinsam River Downstream site for 7S Baseline Monitoring

NNO = No Name Lake Outlet

NO NAME LAKE

Seep into Long Lake

3S = 3-South Pit Water

LONG LAKE

LL1

LL2

LL3

LLM = Long Lake Middle

MW11-6

MW00-2

MW00-5

MW00-3

MW00-4

MW11-7

MW11-23

MW12-24

1 SOUTH SUMP

2 SOUTH SUMP

3 SOUTH PIT PAG CCR Disposal Site

Sulphate Test Cells

2 SOUTH MINE

QU-11-11

QU-11-06

3 South Open Pit

4S Under the PAD

4S LOWER

4S Pond

4S Inflow

4S Upper Inflow

MW11-8

3S/1S Dischargeline

Proposed Engineered Wetland

Downstream Wetland (BG) = Receives flow from SPD

3S77

SPD = Settling Pond #1 Discharge

SPC = Downstream Discharge from Settling Pond #1

QU-11-03

QU-11-09

QU-11-05

QU-11-07

QU-11-04

QU-11-08

QU-11-10

QU-11-12

QU-11-02

QU-11-01

QU-10-12

QU-10-14

QU-10-11

QU-10-10

QU-10-13

QU-10-17

QU-10-15

QU-10-16

QU-10-01

QU-10-02

QU-10-09

QU-10-07

QU-10-08

QU-10-05

QU-10-03

QU-10-04

QU-10-06

QN-11-15

QN-11-14

QN-11-13

QU-04-02

QU-04-03

QU-05-11

QN-07-02

1 MAINS UG-WATER SAMPLES STATION

2 MAINS UG-WATER SAMPLES STATION

7 MAINS UG-WATER SAMPLES STATIONS

5 MAINS UG-WATER SAMPLES STATION

1 SOUTH PANEL UG-WATER SAMPLES STATION

METERS 0 100 200 300 400 500

QUINSAM COAL	Updated – February 2011 – Cleaned Dwg	10/23/12	SCALE:	1:5000
	Updated – March 2011 – Sample Sites	10/23/12	DESIGNED:	
	Updated – November 2011 – MW Sites	10/23/12	DRAWN: MF	02/25/11
			CHECKED:	
			APPROVED:	

2011/12 ANNUAL WATER QUALITY MONITORING REPORT TOPO & UNDERGROUND WORKINGS

FIGURE 1

\\QCC-CAMDC1\Environmental\Annual Reports\2011-12 Annual monitoring reports\Maps\2012 - Map.dwg

MINE GRID NORTH

TRUE NORTH

WC = Mid-Point between Settling Pond #4 & Middle Quinsam Lake

WA = Inflow to Middle Quinsam Lake

WD = Discharge from Settling Pond #4

D2 = Sulphate Test Hole

D1 = Sulphate Test Hole

SETTLING POND #4

WP = North Pit Sump Water

2 NORTH PIT SUMP PAG CCR Disposal Site

QL1

QL2

QL3

QL4

QL5

QL6

PDS_R = Plant Ditch Seep at Road

PLANT SITE

OFFICE

FIRST AID

2NP-Sump = 2 North Portal Sump

FINE REFUSE IMPOUNDMENT

South Dyke Sump = Receives seepage from the South Dyke of the Tailings Dam

MIDDLE QUINSAM LAKE

MQL = Middle Quinsam Lake

WB = Outflow from Middle Quinsam Lake

5SP = 5 SOUTH PORTAL

LLO = Long Lake Outflow

LLE = Last Wetland/Settling Pong Prior to Effluent flow into Long Lake

SPC = Downstream Discharge from Settling Pond #1

SPD = Settling Pond #1 Discharge

QRDS-1 = Quinsam River Downstream Site #1

7S = 7 South Preliminary Dischargepoint from 7 South Mine

7SQR = 7S Quinsam River Downstream site for 7S Baseline Monitoring

NNO = No Name Lake Outlet

3S = 3-South Pit Water

Seep into Long Lake

3S/1S Dischargeline

Proposed Engineered Wetland

Downstream Wetland (BG) = Receives flow from SPD

4S Under the PAD

4S LOWER

4S Pond

4S Inflow

4S Upper Inflow

3S77

NO NAME LAKE

LONG LAKE

LL1

LL2

LL3

LLM = Long Lake Middle

MW11-9

MW11-7

MW11-8

MW00-2

MW00-3

MW00-4

MW00-5

MW11-23

MW12-24

1 SOUTH SUMP

2 SOUTH SUMP

3 SOUTH PIT PAG CCR Disposal Site

Sulphate Test Cells

2 South Open Pit

2 SOUTH MINE

5 SOUTH MINE

4 SOUTH MINE

7 SOUTH MINE

QU-10-01

QU-10-02

QU-10-03

QU-10-04

QU-10-05

QU-10-06

QU-10-07

QU-10-08

QU-10-09

QU-10-10

QU-10-11

QU-10-12

QU-10-13

QU-10-14

QU-10-15

QU-10-16

QU-10-17

QU-11-01

QU-11-02

QU-11-03

QU-11-04

QU-11-05

QU-11-06

QU-11-07

QU-11-08

QU-11-09

QU-11-10

QU-11-11

QU-11-12

QN-11-13

QN-11-14

QN-11-15

QU-04-02

QU-04-03

QU-05-11

QN-07-02

E MAINS UG-WATER SAMPLES STATION

2 MAINS UG-WATER SAMPLES STATION

7 MAINS UG-WATER SAMPLES STATIONS

1SS PANEL UG-WATER SAMPLES STATION

N 104,500

N 104,000

N 103,500

N 103,000

N 102,500

N 102,000

N 101,500

N 101,000

N 100,500

E 97,000

E 97,500

E 98,000

E 98,500

E 99,000

E 99,500

E 100,000

E 100,500

E 101,000

E 101,500

E 102,000

E 102,500

METERS

0 100 200 300 400 500

QUINSAM COAL	Updated – February 2011 – Cleaned Dwg	10/23/12	SCALE:	1:5000
	Updated – March 2011 – Sample Sites	10/23/12	DESIGNED:	
	Updated – November 2011 – MW Sites	10/23/12	DRAWN: MF	02/25/11
			CHECKED:	
			APPROVED:	

2011/12 ANNUAL WATER QUALITY MONITORING REPORT TOPO & UNDERGROUND WORKINGS

FIGURE 1

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