Appendix A4-1

Aquatic Effects Monitoring Program – Targeted Study: Second Portage Lake TSS Effects Assessment Study, Meadowbank Gold Project, June 2009

Aquatic Effects Monitoring Program– Targeted Study: Second Portage Lake TSS Effects Assessment Study Meadowbank Gold Project

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PROFESSIONAL LIABILITY STATEMENT

This report has been prepared by Azimuth Consulting Group Inc. (Azimuth), for the use of Agnico-Eagle Mines Ltd. (AEM), who has been party to the development of the scope of work for this project and understands its limitations. The extent to which previous investigations were relied on is detailed in the report.

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This report is intended to provide environmental information to support the Aquatic Effects Management Program (AEMP) for AEM's Meadowbank Project. The AEMP monitoring scope and design was developed in consideration of a specific project development plan. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the proposed development may necessitate modification of the AEMP and may potentially reduce the utility of this baseline data.

The findings contained in this report are based, in part, upon information provided by others. In preparing this report, Azimuth has assumed that the data or other information provided by others is factual and accurate. If any of the information is inaccurate, site conditions change, new information is discovered, and/or unexpected conditions are encountered in future work, then modifications by Azimuth to the findings, conclusions and recommendations of this report may be necessary.

In addition, the conclusions and recommendations of this report are based upon applicable legislation existing at the time the report was drafted. Changes to legislation, such as an alteration in acceptable limits of contamination, may alter conclusions and recommendations.

ACRONYMS

2PL-EAS-1 – EAS station (exposure)

2PL-EAS-2 – EAS station (exposure)

2PL-EAS-3 – EAS station (exposure)

2PL-EAS-DT – EAS station (reference)

3PL-EAS – EAS station (reference)

AEM – Agnico-Eagle Mines Ltd.

AEMP – Aquatic Effects Management Program

ANOVA – Analysis of Variance

ANOVA – Analysis of variance

AWPAR – All Weather Private Access Road

BACI – Before-after-control-impact

CCME – Canadian Council of Ministers of the Environment

CPUE – catch per unit effort

DQO – Data Quality Objective

EAS – Effects Assessment Study

ED – East Dike

EEM – Environmental Effects Monitoring

GPS – Global Positioning System

HVH – High value habitat

INUG – Inuggugayualik Lake

ISQG – Interim Sediment Quality Guidelines

KW – Kruskal Wallis

MDL – Method Detection Limit

MMER – Metal Mining Effluent Regulations

PEL – Probable Effect Level

QA/QC – Quality Assurance / Quality Control

QA/QC – Quality assurance/quality control

RPD – Relative Percent Difference

SIA – Stable isotopes analysis

SIE – severity of ill effects

SOP – Standard Operating Procedure

SP – Second Portage Lake

SQG – Sediment Quality Guidelines

TE – Tehek Lake

TKN - Total Kjeldahl Nitrogen

TPE – Third Portage Lake – East Basin

TPN – Third Portage Lake – North Basin

TPS – Third Portage Lake – South Basin

TSS – Total suspended solids

UTM – Universal Transverse Mercator

WAL – Wally Lake

WCD – Western Channel Dike

EXECUTIVE SUMMARY

Azimuth Consulting Group Inc. (Azimuth) conducted water quality monitoring during dike construction activities at the Meadowbank Gold Project on behalf of Agnico-Eagle Mines Ltd. (AEM) in 2008. As per requirements of the Nunavut Water Board A Licence (2AM-MEA081) for the project, monitoring followed the framework presented in the *Water Quality Monitoring and Management Plan for Dike Construction and Dewatering at the Meadowbank Mine* (AEM, 2008a). AEM constructed two dikes in 2008, the East Dike and the Western Channel Dike; this report documents receiving environment water quality monitoring results for both. Due to the elevated total suspended solids (TSS) in Second Portage Lake related to East Dike construction (see below), a study (Second Portage Lake – TSS Effects Assessment Study) was conducted to determine the ecological significance of the situation.

Second Portage Lake – TSS Effects Assessment Study (EAS)

As discussed above, East Dike construction activities resulted in widespread increases in TSS in Second Portage Lake, which also extended, but to a much lesser degree, into Tehek Lake. On behalf of AEM, Azimuth developed a study to assess the ecological significance of the situation.

TSS can directly or indirectly affect the entire range of organisms in the aquatic environment, so the study addressed a broad array of ecosystem elements. The design premise was based on comparisons between two reference areas (Drilltrail Arm in Second Portage Lake and the East Basin of Third Portage Lake; TSS concentrations were typical of background conditions at both areas) and three exposure areas (three areas within Second Portage Lake exposed to elevated TSS concentrations). The laboratory toxicity testing was conducted using water from Second Portage Lake collected from near the East Dike (i.e., in the exposure area); exposure water treatments were compared to experimental controls to determine potential effects. Sampling was conducted in two events: September 13/14 and 24/25. Key results were as follows:

- *Water Quality and Limnology* – While water quality generally improved between late August peaks in TSS and September monitoring, there was still a substantial gradient in exposure between the three exposure areas and the two reference areas. It is also important to note that effects of TSS are not likely to be instantaneous and that the study was designed to assess chronic exposure. Consequently, despite the lower TSS concentrations, it is unlikely that the study would have missed any important chronic TSS-related effects.

    - Construction monitoring characterized a strong gradient in estimated TSS concentrations between the exposure (~10 mg/L for the first event and ~6 mg/L for the second event) and reference (~0.2 to 0.6 mg/L) areas during both monitoring periods. This was confirmed during EAS sampling by much lower Secchi depth readings at exposure areas, indicating reduced water clarity relative to the reference areas. This gradient was less pronounced, but still present, during the September 24/25 sampling event.

- Nutrient concentrations were generally higher at the exposure stations, but ammonia, nitrite, and nitrate were still well below CCME water quality guidelines.

- Vertical temperature and oxygen profile results showed no significant differences between areas.

- Metals were primarily bound to particulates; dissolved metals were very low and typically below detection limits.

- *Primary Productivity* – Reduced water clarity limits light penetration, which can lower primary productivity. Two measures of primary productivity were assessed: chlorophyll-α and phytoplankton biomass. While there were no differences between areas for chlorophyll-α during either sampling event, phytoplankton biomass was significantly depressed in the exposure area relative to the reference area during both events. The difference between areas during the second event was much less pronounced, which is consistent with the weaker exposure gradient at that time (i.e., due to the overall improvement in water quality in Second Portage Lake). This recovery would be expected to continue to track water clarity improvements and not be of long-term significance.

- *Zooplankton* –Herbivorous zooplankton rely on phytoplankton as their primary food resource. Elevated TSS can affect zooplankton directly, by reducing feeding efficiency, or indirectly by reducing food supply (e.g., the reduced phytoplankton biomass that was observed at the exposure stations). Elevated TSS could also indirectly benefit zooplankton by making it harder for their predators to see them. Potential effects of TSS on zooplankton were assessed using both field (direct measurements of zooplankton biomass to integrate both direct and indirect effects) and laboratory (acute and chronic toxicity testing to assess direct effects) measures. Although phytoplankton biomass was lower in the exposure area, we could not detect significant differences in zooplankton biomass between the exposure and reference areas. No adverse effects were observed in either toxicity test.

- *Benthic Invertebrates* –Sediment inputs and depositional rates in the Meadowbank study lakes are typically extremely low. Accelerated inputs associated with construction activity may affect benthic invertebrates through smothering. This was identified in the monitoring plan for the East Dike (AEM, 2008a), which committed to assessing potential effects of increased sedimentation on the benthic community in 2009 and 2010. In the interim, however, there are two lines of evidence that are available: (1) benthic community data collected in Second Portage, Tehek and Third Portage lakes in late August as part of routine AEMP monitoring, and (2) sediment trap data for Second Portage Lake (see *Fish* for more details).

    - There were no statistically significant adverse effects to benthic community total abundance (density) or total richness identified at Second Portage or Tehek stations in 2008 relative to other stations and years. Notwithstanding, Second Portage Lake did show a marginal trend of reduced benthos abundance, but the

result was inconclusive, likely due to naturally variable temporal and spatial patterns among stations and years.

- Sediment trap results indicate a deposition thickness of between approximately 1 and 2 mm for much of Second Portage Lake, which could have been responsible for the observed marginal trend in benthos abundance (i.e., through physical smothering).
- Chromium and zinc were significantly elevated in the sediment trap samples, which may have also contributed to the benthos abundance results. The response pattern (i.e., possible reduction in abundance, but not to diversity), however, is more consistent with physical effects.
- TSS concentrations in both Second Portage and Tehek lakes decreased substantially in the month following the AEMP sampling event. In the absence of further disturbance, the expectation would be that the noted effects would be short term in nature and the community should recover completely. The EAS and AEMP benthic community sampling in 2009 will help determine whether the community is recovering and, if so, at what rate.
- The planned 2009 and 2010 benthic community studies will provide some insight into the long-term significance of the deposition of construction-related sediments.

- *Fish* – Prolonged increases in TSS concentrations can affect fish directly (e.g., by clogging gills or by smothering eggs) or indirectly (e.g., by reducing prey abundance or by making prey harder to see). A combination of laboratory (toxicity tests using a range of life stages) and field (sediment traps and stable isotopes [to map the food web]) measures were used to help determine potential impacts to fish.
  - No adverse effects were observed for larval and juvenile trout. The larval test was conducted using live zooplankton as a food resource. The lack of growth or survival effects suggests that active feeding was not impaired by the reduced water clarity. Test results for larval and juvenile trout suggest that direct effects to these life stages are unlikely; this would also apply to adults. Two tests were conducted using trout embryos: one where test water was renewed each day (renewal) and the other where it was not (static). This renewal/static combination was used to provide insights into whether any observed effects were due to chemical or physical effects. No effects were observed in the renewal test. However, impaired development was observed in the static test, suggesting that physical settling of sediments could affect developing embryos.
  - Sediment traps were deployed prior to East Dike construction at a number of high-value habitats in Second Portage Lake and retrieved in late September. Results indicate that between 1 and 2 mm of sediment settled during that time. Video surveys will be conducted on these areas (and similar areas outside the influence of elevated TSS) in 2009.

- Stable isotope analysis was used to assess the Second Portage Lake food web by measuring ratios of carbon and nitrogen isotopes in organisms (e.g., benthic invertebrates, zooplankton and fish) to discern "who is eating who" in the lake. For the EAS study, this information provides insights into the relative importance of the pelagic (phytoplankton to zooplankton to fish) and benthic (algae/detritus to invertebrates to fish) pathways in the food web. Stable isotope signatures in muscle tissue of fish indicate that both are actually important. Arctic char preferentially exploit pelagic food sources (i.e., zooplankton), while round whitefish target benthic food sources. Lake trout, the dominant species in the lake, feeds on both these fish species (in addition to other lake trout) in approximately equal proportions. This is understandable given the nutrient-driven productivity limitations characteristic of ultra-oligotrophic lakes.

From an ecological perspective, the EAS results point to settled sediment, rather than suspended sediment, as the primary outstanding concern. Apart from the depression of phytoplankton productivity, which showed substantial recovery between sampling events, there were no ecologically-significant effects observed related to TSS in the water column. Settled or settling sediment, however, was identified as a potential concern for benthic invertebrates (a possible, but inconclusive, reduction in abundance in SP; no effects to diversity in SP or to either abundance or diversity in TE) and fish (possible smothering of eggs in spawning areas based on toxicity test results). EAS work in 2009 (and 2010 for benthos) will target reducing uncertainty as to whether settled sediment remains an ecological concern in Second Portage Lake; key study components include (see Azimuth, 2008a for more details):

- *Benthic community analysis* – the EAS study design will include more extensive sampling in Second Portage Lake and Tehek Lake. Similar to the field effects measurements taken for other endpoints in 2008, the 2009 benthos results will be used to determine whether there are any differences between exposure and reference areas. If there are effects, then the survey will be repeated in 2010 to determine whether the community is recovering and if so, at what rate (the AEMP data for 2009 and 2010 will also be used as needed to further our understanding of the situation).
- *High-value habitat assessment* – an underwater video survey will be conducted to compare and contrast settled sediment patterns in high-value habitat areas exposed to elevated TSS concentrations to those beyond the zone of influence. While not specifically a component of the EAS for 2009, sediment traps will again be deployed in 2009 to support construction-related monitoring for the Bay-Goose dike; some of these traps will be deployed in Second Portage Lake at areas relevant to the EAS.
- *Surface sediment coring* - the sediment coring program conducted in 2008 prior to dike construction will be repeated at four (TPL-E, SPL, TE and INUG) locations to verify the results of the sediment trap chemistry sampling conducted in 2008 (i.e., to determine whether sediment chemistry in the top 1 cm was changed by the high chromium and zinc measured in the sediment trap sediment).

1. INTRODUCTION

Azimuth Consulting Group Inc. (Azimuth) conducted environmental monitoring of in-water dike construction activities at the Meadowbank Gold Project on behalf of Agnico-Eagle Mines Ltd. (AEM) in 2008. As per the requirements of the Nunavut Water Board A Licence (2AM-MEA081) for the project, monitoring followed the framework presented in the *Water Quality Monitoring and Management Plan for Dike Construction and Dewatering at the Meadowbank Mine* (AEM, 2008a).

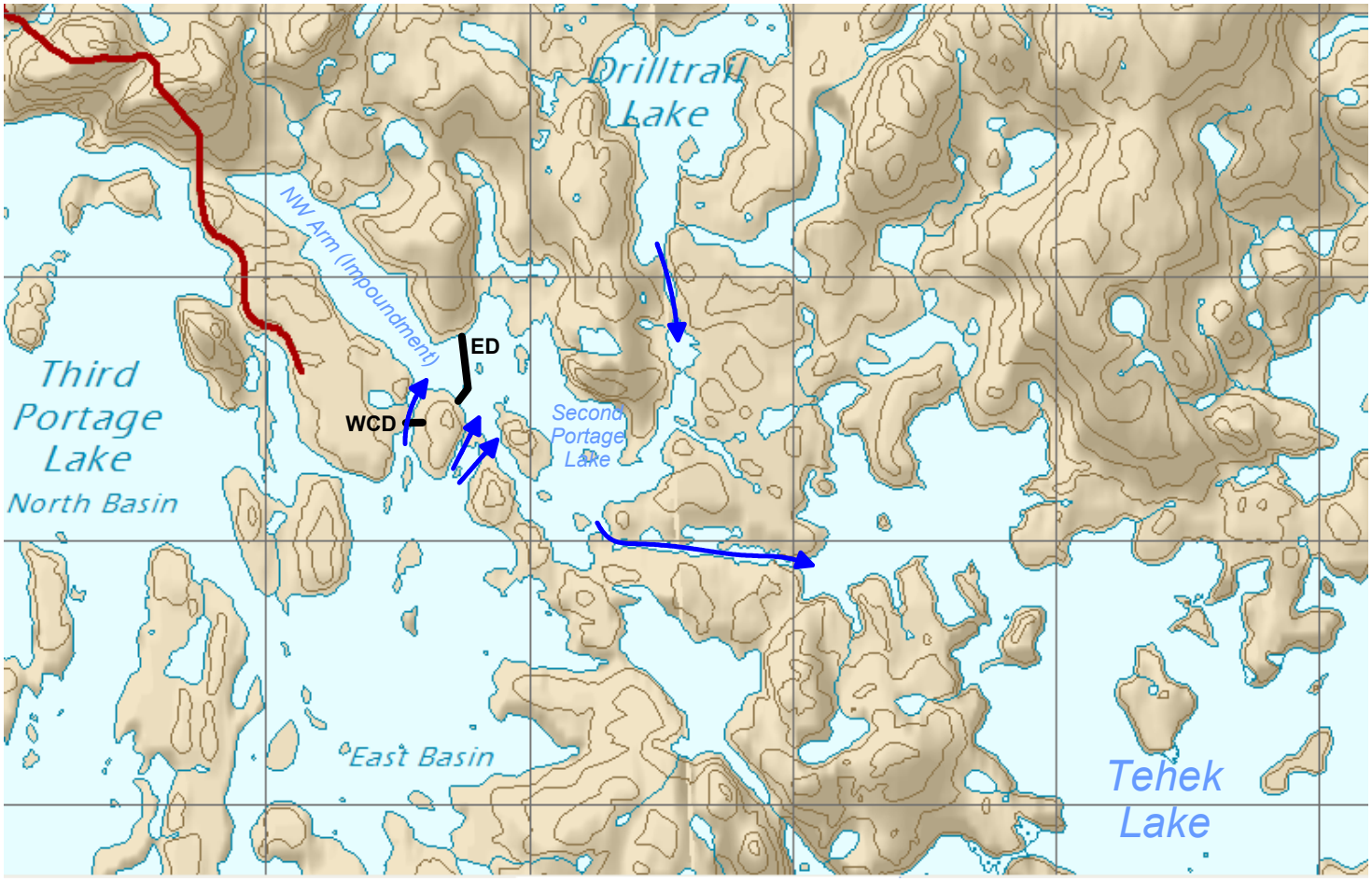
As described in detail elsewhere (Azimuth, 2009a), East Dike construction activities resulted in widespread increases in total suspended solids (TSS) in Second Portage Lake, which also extended, to a much lesser degree, to Tehek Lake. In response to this situation, Azimuth, on behalf of AEM, developed a strategy in early September (Azimuth, 2008a) to evaluate the potential for adverse ecological effects related to chronic exposure to elevated TSS concentrations (the TSS Effects Assessment Study, or TSS EAS). This report describes the results of study components conducted in 2008; additional components are to be conducted in 2009 and will be reported next year.

A general overview of the site related to dike construction in 2008 is presented in **Figure 1-1**. The figure includes some of the naming conventions used in this report and shows local hydrology among the lakes.

The remainder of this report is organized into the following sections:

- **Section 2 (Study Strategy)** – summarizes the potential effects of TSS and presents an overview of the study strategy.
- **Section 3 (Methods)** – describes the methods used to collect data.
- **Section 4 (Results)** – presents and discusses the results for each study component.
- **Section 5 (Summary and Conclusions)** – summarizes key aspects of the EAS, presents the main conclusions of the report, and discusses recommendations to address key outstanding uncertainties.
- **Section 6 (References)** – lists the references cited in the report.

Figure 1-1. General site map highlighting 2008 dike construction areas and adjacent receiving environments.



Notes: WCD = Western Channel Dike; ED = East Dike; blue arrows represent lake drainage directions.

2. STUDY STRATEGY

The following sections are taken from Azimuth (2008a) and present key information on potential adverse effects of TSS (**Section 2.1**) and an overview of the strategy adopted for the TSS EAS study (**Section 2.2**).

2.1. Review of TSS Effects to Aquatic Life

The *Meadowbank Gold Project Water Quality Monitoring and Management Plan for Dike Construction and Dewatering* (July 2008) contained a review of the potential effects of total suspended solids (TSS) and turbidity on fish and fish habitat. These include smothering (e.g., of fish eggs or benthic invertebrates), decreased productivity (i.e., due to reduced light), reduced feeding (i.e., due to limited visibility), and gill clogging/abrasion. Effects are influenced by exposure and duration, as well as the size and shape of suspended particles. Overall, the most sensitive group appears to be salmonids (e.g., lake trout, Arctic char and whitefish), with their early life stages the most at risk.

Given the duration of elevated TSS concentrations in Second Portage Lake (i.e., see **Section 2.3**), this discussion of potential effects focuses only on long-term exposures and includes both less-sensitive and sensitive salmonid life history stages. A detailed analysis of the data used to derive the Meadowbank TSS triggers was presented in AEM (2008). The underlying data set, comprised of more than 300 data sets, was compiled from Caux et al. (1997) and was the basis for deriving the CCME TSS guidelines. Relevant results for chronic (i.e., long-term) exposures are discussed below. Response is estimated using a scale of 0 to 14 to indicate the "severity of ill effects" (SIE). SIE scores of 1 to 3 are behavioural responses such as alarm reaction, abandonment of cover or avoidance response. SIE scores from 4 to 8/9 indicate increasingly severe sub-lethal effects. SIE scores of 10 to 14 indicate mortality, ranging from 0 to 20% (for SIE score =10) to >80% (SIE score = 14).

Less-sensitive Life History Stages (non-spawning habitat; spawning habitat prior to September)

After excluding data for short exposures, high TSS (>100 mg/L) and those specific to eggs or larvae, 28 data points remained (**Figure 2-1**). There are limited data at low TSS concentrations, with the first five shown in **Table 2-1**.

Table 2-1. Effects of chronic exposure to less-sensitive life history stages from chronic exposure to low TSS concentrations.

Species	Life Stage	TSS (mg/L)	Exposure Duration (days)	SIE Score	Response
Smelt	Adult	4	7	7	Increased vulnerability to predation
Lake Trout	Adult	4	7	3	Fish avoided turbid areas
Brook Trout	Adult	5	7	3	Fish more active and less dependent on cover
Chinook Salmon	Juv	6	60	9	Growth rate reduced
Brook Trout	Fry	12	245	9	Growth rates declined

None of the measured responses indicate mortality. At slightly higher TSS concentrations (18 mg/L) reduced abundance has been observed (SIE = 10, 30 day exposure for adult brown trout and rainbow trout). Mortality is first observed at 22 mg/L, but that data point involved a full year (365 days) of exposure and applies to a warmwater fish species. Beyond that, the next study showing mortality occurs at a TSS concentration of 90 mg/L (<20% mortality of rainbow trout under-yearlings exposed for 19 days). These data suggest that direct mortality may be quite unlikely at TSS concentrations < 20 mg/L. Nevertheless, reduced growth, which is observed at lower TSS concentrations, can be a significant sub-lethal effect.

A key consideration in the potential for adverse effects is whether juveniles and adults would be able to swim to avoid turbid waters. Given the 2008 situation, the only major refuge area left would be the arm that receives the outflow from Drilltrail Lake, where the constant inflow of clear water into a constricted arm is maintaining clear water. Apart from this area, fish would have experienced TSS concentrations in the range of 10 to 20 mg/L TSS concentrations for several weeks.

Sensitive Life History Stages (spawning habitat starting in September)

The data set from above was expanded to include those points associated with early life history stages, resulting in the 38 cases shown in **Figure 2-2**. It is important to note that the concentration-response curve in this case appears to be quite flat except at very low TSS concentrations – the mean SIE score for the data points shown in **Figure 2-2** is 9.4, while the mean SIE score for the remaining data points (>100 mg/L TSS) is only slightly higher at 10.1. However, the SIE scale is not really linear, because direct measures of mortality apply only to SIE scores of 10 to 14.

Clearly there are variable, sometimes significant effects (e.g., mortality, SIE = 10 or more) that result from long-term exposure to TSS concentrations above around 15 mg/L. However, effects at concentrations of 12 mg/L or lower warrant a more detailed analysis. There are six data points where TSS concentrations are equal to or less than 12 mg/L; five were reported in **Table 2-1**, and one case targeting egg mortality that is presented in **Table 2-2**.

Table 2-2. Potential effects to sensitive life stages during chronic exposure to low TSS concentrations.

Species	Life Stage	TSS (mg/L)	Exposure Duration (days)	SIE Score	Response
Rainbow Trout	Egg	7	48	11	Mortality rate 40%

Among the cases in **Tables 2-1 and 2-2**, the most significant study and one that drives existing federal guidance, is the study showing 40% mortality of rainbow trout eggs at a TSS concentration of 7 mg/L. We used this study to set the chronic (7-day) trigger for the management plan. While the lack of multiple studies corroborating this particular dose-response point increases the uncertainty, the magnitude of response alone warrants taking it seriously.

2.2. Assessment Strategy

Given that suspended sediments can directly or indirectly affect the entire range of organisms in the aquatic environment, the strategy developed for this study addressed a broad array of concerns. Details of the strategy are presented in **Table 2-3**; study design and sampling locations are described in **Section 3.1**; the following is an overview:

- *Water Quality and Limnology* – The most obvious effect of sediment inputs into clear lakes is a noticeable reduction in water clarity and reduced light penetration. There are other possible effects, however, which can be equally significant. These include introduction of metals and nutrients, or other changes to normal conditions (e.g., oxygen reductions or increased temperature). The program detailed in **Table 2-3** includes a comprehensive list of components to quantify these issues.
- *Field Effects Measurements* – Directly measuring key aspects of target aquatic receptors in the field is the best approach to determining the ecological significance of elevated TSS in Second Portage Lake. The components detailed in **Table 2-3** range from the base of the food chain to fish. Water-clarity related changes in productivity would be seen in the phytoplankton and likely zooplankton. Sediment deposition onto high-value habitat areas will be explored with sediment traps (placed in advance of dike construction) and follow-up video surveys in 2009. Direct assessment of fish populations (through CPUE comparisons between years) will not be conducted in 2009 unless the laboratory effects testing shows adverse results for fish. Stable isotope analysis (SIA) will be used to empirically document the predominant energy flow paths in Second Portage Lake. This technique works on the principle "you are what you eat", with isotopic ratios of carbon and nitrogen in fish reflective of their predominant diets. This information will be useful to determine the relative importance of any reduced productivity observed in the water column (pelagic) or bottom (benthic) food chains.
- *Laboratory Effects Measurements* – Taking site water into the laboratory provides a unique opportunity to conduct a suite of tests on sensitive life history stages under controlled conditions. These tests will provide insights into how turbid water and/or settled sediment may affect zooplankton and fish survival, feeding and growth. The fish tests will target key developmental stages and will be modified from standard methods to increase realism. For example, the trout embryo test will be conducted two ways: with renewal of overlying water as per the protocol and with no renewal (to minimize disruption of particle settlement). The trout swim-up larvae test will be conducted using zooplankton for feeding,

rather than the standard “trout chow”. As per their value to quantify the toxicity of contaminants, these tests will provide valuable information on the physical effects of suspended sediments. All the tests will be run across a series of dilutions (field sampling for water will target the highest areas of turbidity outside the turbidity barriers), allowing the results to be extrapolated to a range of TSS concentrations.

Together, these study components should provide a good weight-of-evidence regarding the potential for the elevated TSS concentrations to cause significant ecological effects in Second Portage Lake.

Table 2-3. Second Portage Lake TSS Effects Assessment Study - Program Overview.

Component	Rationale	Sampling Design
Water Quality and Limnology		
TSS	Collect more data to ensure site-specific model with turbidity is representative.	Select stations to cover range of prevailing conditions (two events); Drilltrail Arm as reference area.
Metals (total/dissolved)	Assess whether metals are elevated and in bioavailable form.	As for TSS.
Nutrients and Conventionals	Assess whether nutrient levels are elevated from blasting residues and characterize basic water quality.	As for TSS.
Secchi Depth	Common indicator of water clarity.	As for TSS.
pH/Conductivity	Assess basic water quality.	As for TSS.
Dissolved oxygen	Assess oxygen levels in lake.	Depth profiles at key stations for broad coverage (two events).
Temperature	Assess mixing *vs* stratification.	As for dissolved oxygen.
Field Effects Measurements		
Primary Production ● Chlorophyll-a ● Phytoplankton biomass/taxonomy	Turbid water can affect primary productivity by reducing the quantity and quality of light penetrating into the lake.	Three "impact" areas and two reference (Drilltrail Arm and Third Portage Lake) areas (each with 5 reps).
Secondary Production - Pelagic ● Zooplankton biomass/taxonomy	Reductions in primary productivity may affect zooplankton, which rely on phytoplankton for food.	As above, but 1 rep for taxonomy.
Secondary Production - Benthic ● Benthic community	Eventual deposition of suspended sediments may result in effects to the benthic community.	Monitoring will occur in **2009/10** and target deep turbid basins and reference areas (5 reps/area); latter would include Drilltrail Arm and Third Portage Lake areas too. Final locations pending temporal analysis of monitoring data to ice out.
Fish		
● Fish population (CPUE) - compare 2009 data with past years (likely 2002, but possibly 2008 fishout data) to determine any population-scale impacts.	Prolonged exposure to turbid water may affect fish. These components will provide insight into the long-term consequences of the elevated TSS in Second Portage Lake. The food chain component will show the relative importance of pelagic-based and benthic-based energy flow paths to help interpret the significance for fish of any effects to zooplankton or the benthic community.	Conducted only if laboratory studies show likely direct effects. Gillnetting in **2009** (short sets); compare to previous years.
● High value habitat (sedimentation) - sediment trap data (2008) and video habitat surveys (**2009**) surveys will be used to assess the status of key areas.		Analyze trap data in 2008; compare **2009** video survey results between areas with high and low TSS.
● Food chain (stable isotopes) - comparison of N and C isotopes in fish, zooplankton and benthic invertebrates provides insights into the relative importance of the pelagic and benthic food webs. This will help put any observed effects to zooplankton or the benthic community into perspective.		Characterize food webs by taking 30 fish/key species (use fishout fish), 10 each of zooplankton and benthos samples (5 in Second Portage and 5 in Third Portage).
Laboratory Effects Measurements		
Zooplankton ● Lethal - *Daphnia magna* 48-hr LC50 ● Sublethal - *Ceriodaphnia dubia* 7-day growth/survival/repro	While current conditions are unlikely to cause lethal responses in zooplankton, they might result in sublethal effects.	Samples will be collected targeting the highest TSS concentrations observed in the field; laboratory dilutions will be used to test a range of concentrations in order to broadly extrapolate the results to the lake in general. Only one round of sampling will occur unless conditions worsen over the next several weeks.
Fish ● Lethal - Rainbow trout 96-hr LC50 ● Sublethal - Rainbow trout embryo 7-day (w/out renewal) ● Sublethal - Rainbow trout embryo 7-day (with renewal) ● Sublethal - Rainbow trout swim-up larvae 7-day surv/growth	While current conditions are unlikely to cause lethal responses in trout, they might result in sublethal effects to sensitive life history stages. The 7-day larval test will be conducted using live zooplankton as food to take reduced visibility into consideration. The embryo development test will be conducted with/without renewal of overlying water to allow settlement to occur in the non-renewal test.	As above.

Figure 2-1: Fish Concentration-Response Data for Long-Term (> 24hr) Exposure to TSS, Excluding Data Points for Eggs/Larvae (source: Caux et al. 1997; data for TSS concentrations > 100 mg/L not shown)

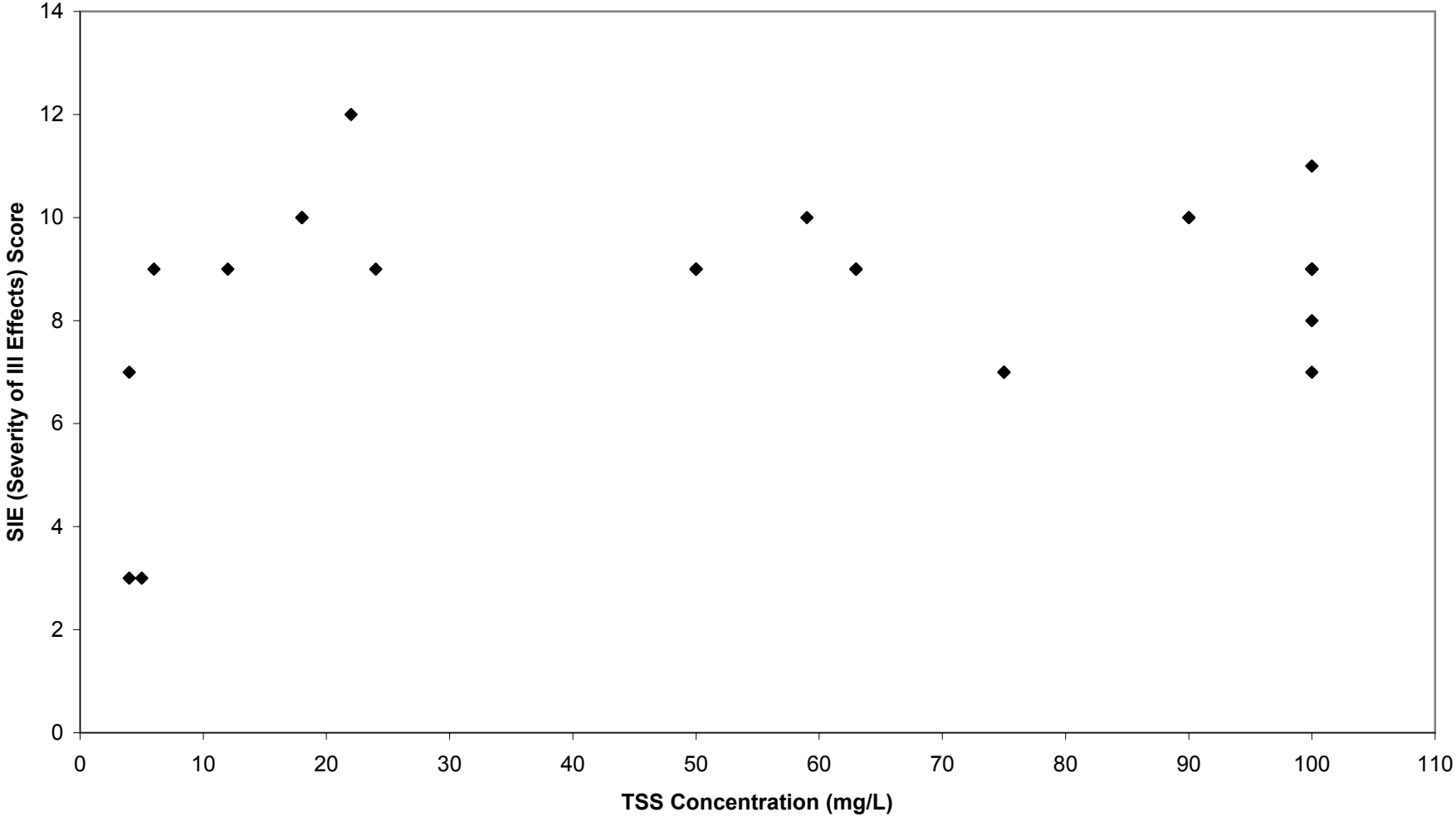
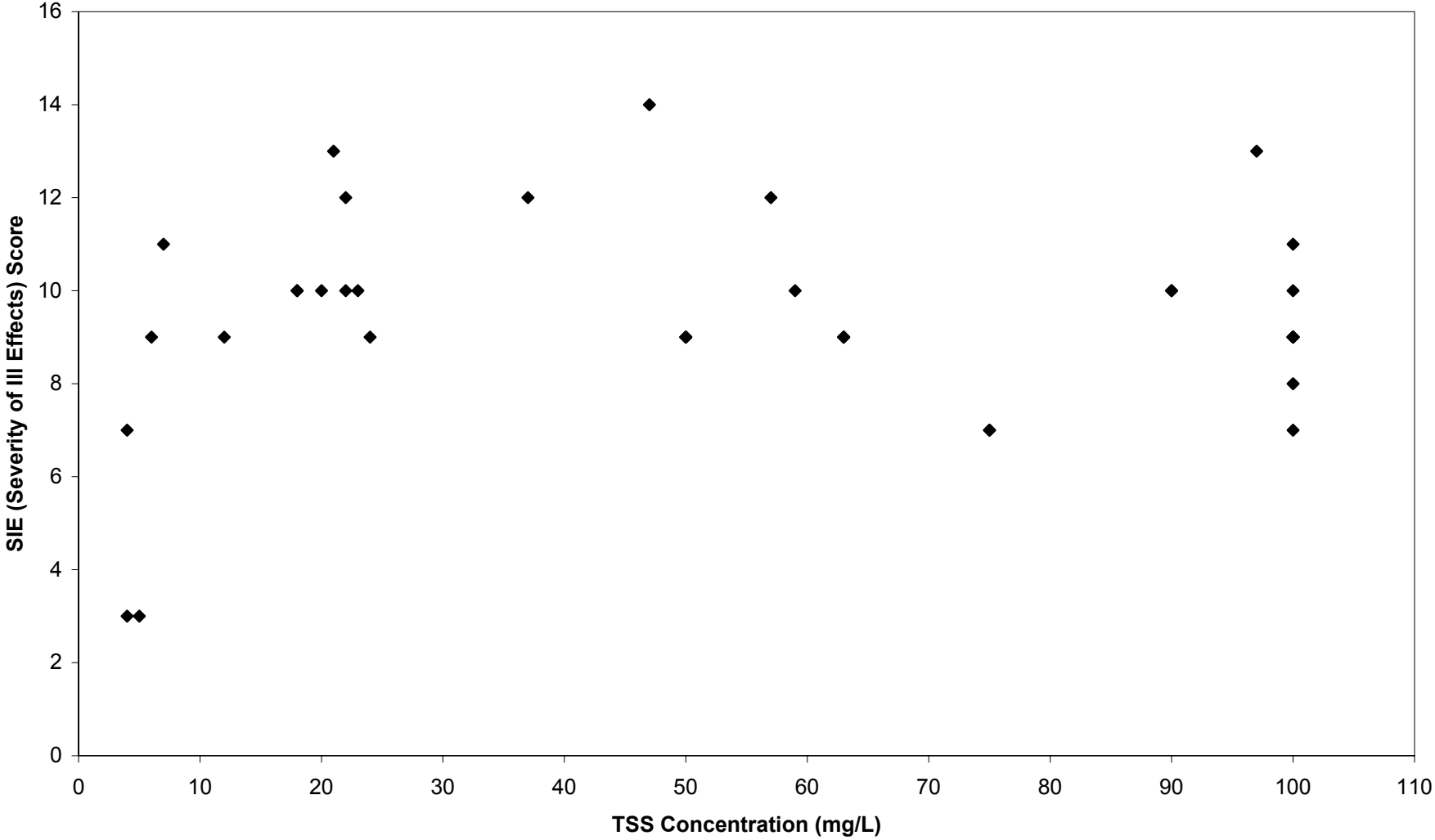


Figure 2-2: Fish Concentration-Response Data for Long-Term (> 24hr) Exposure to TSS (source: Caux et al. 1997; data for TSS concentrations > 100 mg/L not shown)



3. METHODS

3.1. EAS Program Overview and Study Design

Field sampling in 2008 can be categorized into 3 broad groups: (1) general limnology and water quality sampling, (2) biological sampling (primary & secondary production and fish) for field effects measurements, and (3) water sampling for laboratory effects measurements.

The study design used a multiple reference/multiple impact approach as follows (**Figure 3-1**):

- *Reference Stations* – two stations were selected, 2PL-EAS-DT and 3PL-EAS. Station 2PL-EAS-DT is located in the "drilltrail arm" portion of southeast Second Portage Lake, which receives flows from the Wally Lake drainage; this arm had consistently low TSS (i.e., background concentrations) throughout 2008 (see Azimuth, 2009a for more details). Station 3PL-EAS was situated upstream of 2008 dike construction activities in the east basin of Third Portage Lake.

- *Exposure Stations* – three stations were selected in southeast Second Portage Lake. Given the extensive mixing documented in the dike construction monitoring report (Azimuth, 2009a), exposure to elevated TSS concentrations would have been much higher at all exposure stations relative to the reference areas. In addition, there was a slight west-to-east gradient in TSS concentrations from the East Dike to the outlet to Tehek Lake. Consequently, stations 2PL-EAS-1 and 2PL-EAS-2 were considered near-field stations and 2PL-EAS-3 was a far-field station. This distinction was used to test whether there were differences in various parameters between exposure stations.

General limnology and water sampling, and chlorophyll-a and phytoplankton collections (primary production) were conducted during two time periods: September 13–14 and September 24–25. Sediment traps were set in late July to assess sedimentation rates as a result of East Dike construction; they were retrieved in September. Zooplankton (secondary production) was collected only during one sampling event (September 13–15). Benthos sampling (secondary production) was not planned 2008; however, follow-up monitoring of the benthic community will be conducted in 2009 (note that AEMP benthos sampling was conducted in late August and does provide some insights relative to the TSS situation. Zooplankton, benthos and fish tissues were collected for isotope analysis in order to characterize the food web. Water was also collected on September 10, 2008 for toxicity testing (using zooplankton and fish); the sample was collected from the location showing the highest TSS concentrations in Second Portage Lake.

A summary of samples collected for this study, including GPS locations, is provided in **Table 3-1**.

3.2. Limnology and Water Quality

Vertical temperature (^{o}C), oxygen (mg/L) and conductivity (µS/cm) depth profiles were acquired using the YSI Model 85 temperature – oxygen meter. Profiles were acquired from each station at both sampling events to track changes in oxygen and temperature profiles. Secchi depth (m) was measured prior to collection of water samples.

Water samples were collected from 1 m depth from all sampling stations at both sampling events. Sampling, handling and analysis and QA/QC procedures were the same as those outlined in the *Aquatic Effects Management Program – Receiving Environment Monitoring 2008* (Azimuth, 2009b).

Water chemistry parameters included conventional parameters (hardness, conductivity, pH and total dissolved and suspended solids), anions (alkalinity, chloride and sulfate), nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate and total phosphate), organic parameters (chlorophyll-*a*, dissolved and total organic carbon) and total and dissolved metals. Details on analyses provided in **Appendix A**.

3.3. Field Effects Measurements

3.3.1. Sediment Traps

Six sediment traps were set in Second Portage Lake prior to starting construction of the East Dike. The trap locations were selected in areas of high value habitat to help provide insight into the long term consequences of elevated TSS to fish habitat in Second Portage Lake.

Sediment traps were set on July 28, 2008 throughout Second Portage Lake at depths ranging from 3 to 8 m (**Figure 3-1**). Each installation consisted of four PVC sediment traps (i.e., four replicates), positioned vertically, open-end up, in a grid formation on a small metal frame. Each trap had the following dimensions: 7.2 cm inner diameter opening, 40.2 cm long. Traps were deployed in the open water by looping sideline to all corners of the platform, gathering the line into a single loop and slowly lowering the trap to the lake bottom while keeping it level. Each trap was marked with a buoy at the surface and labeled HVH-1 through HVH-6. Sediment traps HVH-1, -4, and -5 were left to accumulate sediment for the duration of dike construction and were removed during September 18-25 (50-57 days exposure time). HVH-2 was accidentally knocked over during routine turbidity monitoring in late August and thus only had 28 days of accumulation time. Both HVH-3 and -6 could not be retrieved successfully.

Sediment traps were retrieved on calm days by slowly pulling the line when the boat is directly above the buoy to keep the trap vertical. Once removed from the lake, each pipe was capped, removed from the platform and left to settle for at least one day. Overlying water was decanted from each pipe and all the sediment (and any remaining water) was collected in 1-L containers, labeled and shipped in coolers to ALS for analysis.

At the lab, wet sediment from the 4 reps was combined for each station and poured through 45-µm filter paper. Sediment was then dried at 60°C for 8 hours and dry weights were recorded. Sedimentation rates were calculated and thickness of accumulation for each station. Sediment from two stations (HVH-2 and HVH-5; the other two samples were sent to Golder to further their engineering assessment of sediment management during dike construction) was analyzed for pH, total organic carbon (TOC) and total metals concentrations (mg/kg). Sediment metals concentrations were compared to sediment quality guideline (SQG) concentrations developed by the CCME (2002). There are two levels of SQGs: Interim Sediment Quality Guidelines (ISQG) and Probably Effects Level (PEL) concentrations.

3.3.2. Primary Production

Chlorophyll-a and phytoplankton samples were also collected during both sampling events. Five replicates of each were collected from all stations and sampling events.

Chlorophyll-a samples were prepared by vacuum filtering 1 L of water through an ashless filter paper on the screen of a hand-held vacuum pump. The filter is then removed with tweezers, preserved and wrapped in tinfoil and frozen for shipping to ALS laboratory Vancouver.

Phytoplankton are microscopic, unicellular plant species that are suspended in the water column and, as primary producers, comprise the base of the food web. There are six major groups of phytoplankton present in lakes: cyanophytes (blue green algae), chlorophytes (green algae), chrysophytes (golden-brown algae), diatoms, cryptophytes and dinoflagellates. Seasonal production of phytoplankton can vary widely depending upon water temperature, nutrient concentration, time of year, water clarity and amount of sunlight and predation by zooplankton. Estimates of phytoplankton biomass (mg/m^3) are useful as gross indicators of lake productivity.

Unfiltered water (125 mL) was collected at the surface from each sampling station during both sampling events. The procedures for collecting the phytoplankton samples are also outlined in detail in the SOP for Water and Phytoplankton Sampling (AEM, 2009).

Samples were preserved in the field with a small amount of Lugol's solution and later transported to Winnipeg, MB for taxonomic identification and analysis by Plankton R Us Inc. For the analysis, 10-mL aliquots of preserved sample were gravity settled for 24

hours. Counts were performed on an inverted microscope at magnifications of 125X, 400X, and 1200X with phase contrast illumination. Cell counts were performed using the Ütermohl technique as modified by Nauwerck (1963). Cell counts were converted to wet weight biomass (mg/m^3) by estimating cell volume. Estimates of cell volume for each species were obtained by measurements of up to 50 cells of an individual species and applying the geometric formula best fitted to the shape of the cell (Vollenweider, 1968; Rott, 1981). A specific gravity of 1 was assumed for cellular mass. All biomass (mg/m^3) and density (cells/L) estimates are summed by major taxa, per station and sampling event.

3.3.3. Secondary Production – Pelagic

Zooplankton were collected using a 70-µm nitex mesh net with a 30-cm diameter mouth opening and total length of 2.2 m. Five replicate samples were collected (composite of two vertical tows) at each station for biomass analyses and one sample was collected (composite of 2 or 4 vertical tows) at each station for taxonomic identification. Tow depths ranged from 6-10 m to the surface, depending on the station, but were consistent within stations. After collection, all samples were placed into uniquely labeled plastic Whirl-Pac bags and were preserved in a 10% buffered formalin solution. All bags were sealed tight to prevent leakage and were sent to North-South Consultants, Winnipeg, MB. Zooplankton samples for biomass were filtered through a pre-dried 45 µm filter, wet weighed and then dried in an oven at 60^oC until completely dry. Samples were weighed dry to determine moisture content and dry weight. Dry biomass (mg/m^3) was determined by standardizing the dry sample weight against the volume of water filtered by the net during each vertical tow, which differed by depth according to each station.

3.3.4. Secondary Production - Benthic

As mentioned in the overview, benthos sampling was not conducted in 2008 but is planned for 2009. However, regular monitoring of the benthic community has been conducted on a yearly basis for the AEMP at stations in Second and Third Portages Lakes and Tehek Lake; the 2006, 2007 and 2008 results were used to provide some initial information on the potential short-term effects of elevated TSS on the benthic community. As per the dike construction monitoring plan (AEM, 2008), more detailed benthic invertebrate sampling to determine longer-term implications of elevated TSS will be conducted in 2009 and 2010.

3.3.5. Food web characterization

Zooplankton, benthos and fish tissues were collected for isotope analysis in order to characterize the food web. Zooplankton was collected as for biomass and taxonomy

analyses, during the same period and from the same stations (5 samples total) in September, 2008 (see **Section 3.3.3**).

Benthic invertebrates were also sampled from all stations during September 13-16, 2008. Benthos were collected using a Petite Ponar grab (0.023 m^2) and a 500-µm sieve. One sample from each station in Second Portage Lake and 5 replicate samples (about 100 m apart) from the station in Third Portage Lake were collected (for a total of 9 samples). Each sample consisted of at least 5 mg of invertebrate tissue. Sampling depths ranged from about 6–12 m. Fish muscle tissue (about 5 g/sample) was also sampled from 90 fish collected during the fish-out program (30 samples from each of Arctic char, Lake trout, and Round whitefish).

Zooplankton, benthic invertebrate and fish tissue samples were frozen and sent to the Stable Isotopes in Nature Laboratory (SINLAB) at UNB in Fredericton, NB for carbon and nitrogen isotope analysis.

3.4. Laboratory Effects Measurements

Water was collected in collapsible plastic carboys on September 10, 2008 in an area of high TSS in Second Portage Lake and shipped to Nautilus Environmental (Burnaby, BC) for toxicity testing.

Acute toxicity tests were conducted on zooplankton (48-hr *Daphnia magna* survival) and fish (96-hr Rainbow trout survival). Chronic toxicity tests were also conducted on zooplankton (7-d *Ceriodaphnia dubia* survival and reproduction) and fish (7-d Rainbow trout embryo development and larva survival & growth). Both the embryonic and larval tests on trout were conducted on concentrations of 100 %, 50 %, 25 %, 12.5 %, 6.25 % and laboratory control of the test water. The embryonic development test was performed both with daily renewal of the test water and without renewal, the latter providing a "worst case" scenario for settling of suspended particulate matter on the embryos.

Rainbow trout also underwent chronic toxicity testing for embryo development in water treated with chitosan but only at concentrations of 100% and laboratory control. For further details on laboratory conditions and QA/QC see the attached laboratory report (**Appendix B**).

3.5. Statistical Analyses

All statistical analyses were conducted using R software v. 2.8.1.

The study design for EAS sampling was essentially a control-impact (CI) design that tests for differences between reference (control) and exposure (impact) areas (see **Section 3.1**) (Wiens and Parker, 1995). The following process was used:

- *Data transformation* – ANOVA assumptions of normality and homogeneity of variance were tested for each parameter using formal (Shapiro-Wilk test and Bartlett's test, respectively) and informal (e.g., QQ plots) methods. Those not meeting the assumptions were transformed (log10) and retested. ANOVA was used to test those parameters that met the assumptions; the non-parametric Kruskal-Wallis test was used for those parameters that failed the ANOVA assumptions.
- *ANOVA/Kruskal Wallis (KW) tests* – These tests were conducted to determine whether there were statistical differences between any of the five sampling areas. The KW test was conducted using ranked data in ANOVA. If no significant differences were detected, the analysis was stopped for that parameter with a conclusion of no adverse TSS-related effect. Where such differences were detected, *a priori* contrasts were conducted.
- *A priori contrasts* – contrasts were used to specifically test the hypothesis regarding potential differences between reference and exposure areas. A second contrast was conducted to test for differences within the exposure area: the two exposure stations closest to the East dike construction area were compared to the one furthest away.
- *Effect sizes and confidence intervals* – effect sizes for each contrast were reported along with the 95% confidence intervals of the effect size (all back transformed). Effect sizes and confidence intervals for ranked parameters were estimated by re-running the ANOVA with the original data, so they should be used as a guide only.

The AEMP benthos data set contained both temporal (2006 to 2008) and spatial (stations Second Portage [SP], Tehek [TE], Third Portage East [TPE] North [TPN] and South [TPS], and Inuggugayualik [INUG] lakes) data, allowing for a before-after-control-impact (BACI) design (e.g., Underwood, 1994). Given that the only stations possibly affected by the elevated TSS are SP and TE, they are considered the exposure (impact) stations and the rest are reference (control) stations. Years 2006 and 2007 are the "before" years and 2008 the "after" year. The analysis focused on total density and total richness and was conducted as follows:

- *Data transformations* – total density was log10 transformed and total richness was not transformed.
- *BACI coding* – dummy variables were used to identify station types (reference vs. exposure) and year types (before vs. after).
- *Two-Way ANOVA and Mixed Effects Model* – the test of interest in this two-way ANOVA is whether the interaction between the before-after variable (Yeartype)

and the control-impact variable (Stationtype) (i.e., Yeartype*Stationtype) is significant. Since Year and Station are random effects, a mixed effects model was used to conduct the analysis. The first step was to conduct the ANOVA using lm, then examine the residuals, with particular emphasis on detecting patterns related to either Year or Station to aid in setting the random effects parameters in the mixed model.

- *Mixed Effects Models* - A series of mixed models were run using the lme function in the lmer package, each with a slightly different random effects component. AIC values, a measure of model fit, were used to determine the best model (lowest score shows best fit). Model residuals were again tested, with emphasis on detecting patterns (e.g., related to Station or Year) and checking normality (e.g., with QQ plots).

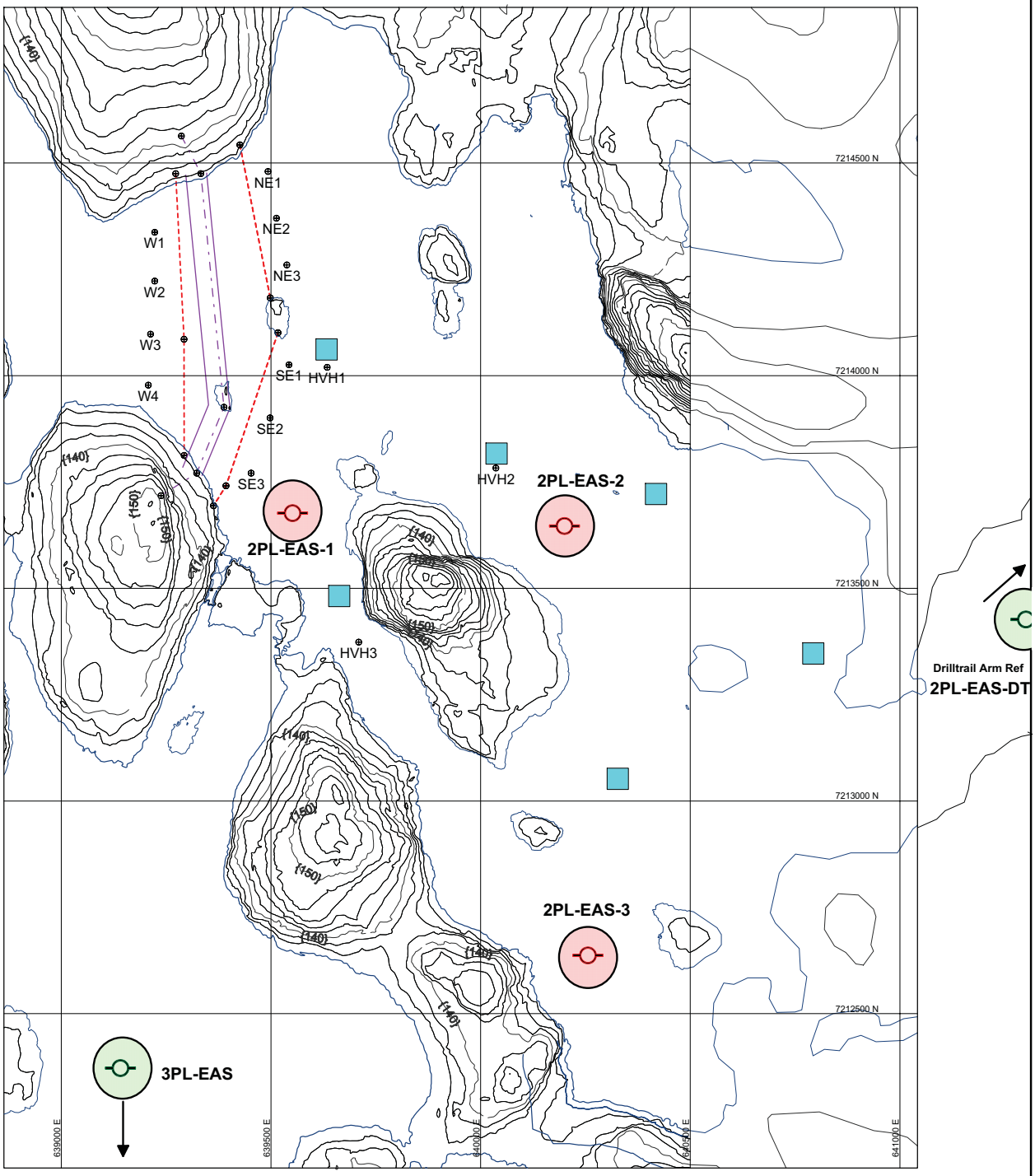
Further information on methods used can be found in:

- Zar, J.H. 1984. Biostatistical Analysis. Prentice-Hall, New Jersey.
- Dalgaard, P. 2008. Introductory Statistics with R. Springer, New York.
- Venables, W.N., and B.D. Ripley. 2002. Modern Applied Statistics with S. Springer, New York.
- Pinheiro, J.C., and D.M. Bates. 2000. Mixed-Effects Models in S and S-PLUS. Springer, New York.

Table 3-1. EAS station locations and sampling summary.

Station	Event Date	Easting	Northing	Limnology	Water Quality	Phytoplankton Biomass	Chlorophyll-a	Zooplankton Biomass/Tax	Benthos Stable Isotopes	Zooplankton Stable Isotopes	Toxicity Testing
2PL-EAS-1	Sept 13-15	14W 639513	7213696	x	x	x	x	x	x	x	x
2PL-EAS-2	Sept 13-15	14W 640274	7213659	x	x	x	x	x	x	x	
2PL-EAS-3	Sept 13-15	14W 640197	7212666	x	x	x	x	x	x	x	
2PL-EAS-DT	Sept 13-15	14W 641270	7213562	x	x	x	x	x	x	x	
3PL-EAS	Sept 13-15	14W 638700	7211350	x	x	x	x	x	x	x	
2PL-EAS-1	Sept 24-25	14W 639513	7213696	x	x	x	x				
2PL-EAS-2	Sept 24-25	14W 640274	7213659	x	x	x	x				
2PL-EAS-3	Sept 24-25	14W 640197	7212666	x	x	x	x				
2PL-EAS-DT	Sept 24-25	14W 641270	7213562	x	x	x	x				
3PL-EAS	Sept 24-25	14W 638700	7211350	x	x	x	x				

Notes: UTM coordinates in NAD83.



Water/Limnology Station

Field Effects Areas (5 reps/area) - Phytoplankton and Zooplankton.

Field Effects - High Value Habitat Sediment Traps

Legend	TSS Trigger Values (mg/L)
Monitoring Location W*n*, NE*n*, SE*n* = Routine Stations HVH*n* = High Value Habitat Stations Green symbols = reference areas Red symbols = target areas	Station / 24-hr Ave / 7-d Ave Routine 50 15 HVH_a 50 15 HVH_b 25 6 a = prior to Sept 1 b = after Sept 1

Azimuth Consulting Group Inc.

MEADOWBANK GOLD PROJECT - EAST DIKE CONSTRUCTION

SOUTHEAST SECOND PORTAGE LAKE
TSS EFFECTS ASSESSMENT STUDY
WATER QUALITY/LIMNOLOGY STATION AND FIELD EFFECTS AREAS

FIGURE 3-1

SE 2PL EAS.GRF

4. RESULTS

4.1. Limnology and Water Quality

QA/QC results for water sampling are shown in **Table 4-1** (raw data provide in **Appendix A**). Results are as follows:

- *Field Duplicates* – results show that the only two parameters having high RPD values were also associated with samples near or at the method detection limit (MDL).
- *Travel Blanks* – results show a single detection of calcium in one sample; source unknown. This should not affect interpretation of the results.
- *Equipment Blanks* – results show a single detection of cadmium. This appears to be anomalous as cadmium was generally less than detection limits in all samples (see below for actual results).

Overall, the QA/QC results confirm that the data quality objectives were met.

Limnological and water quality results from the EAS program are described below.

Vertical temperature and oxygen profiles measured from the 4 stations in Second Portage Lake and the one station in Third Portage Lake showed little difference (**Figures 4-1 and 4-2**) both among stations and sampling events. Temperature and dissolved oxygen profiles of all stations were isothermal with little evidence of stratification.

Water temperature at all stations ranged from about 4–6 °C for the first sampling event (September 13-14, 2008) and from about 1.5–3 °C for the second event (September 24-25, 2008). Dissolved oxygen ranged from 12–13 mg/L (mid Sept.) and from about 13–15 mg/L (late Sept.), indicating high saturation throughout the water column.

Secchi depth (m) in Second Portage Lake was low (1 m) for the three exposure monitoring stations, but much higher (4.5–6.5 m) for the two references stations (2PL-EAS-DT and 3PL-EAS) during both sampling events.

Results for chemical and physical analyses are presented in **Table 4-2** (raw data presented in **Appendix A**). The pH of surface waters was circum-neutral (6.8–7.3). Conductivity was lowest in Third Portage (14.4–16.4 µS/cm) and somewhat higher, but very similar, among Second Portage Lake stations (24.4–28.0 µS/cm).

TSS results for surface waters from these two sampling events did not match those of the long-term turbidity-based field monitoring. The latter showed a consistent improvement in water clarity from late August through September. The EAS sampling results showed that TSS concentrations were low (<3.0 mg/L) for all stations during the first sampling

event, but showed increases for some stations in the second sampling event (2PL-EAS-2 and –3 increased to 53 mg/L and 16 mg/L, respectively). These results may be reflective of small-scale, short-term variability in conditions, but are not consistent with a much more robust body of empirical data. Consequently, for the purposes of characterizing the prevailing exposure gradient between the exposure and reference monitoring stations, we have more confidence in the dike construction monitoring data set for the following reasons:

- Water quality during construction of the East and Western Channel dikes was conducted daily, covering a fairly large spatial area. Given the temporal and spatial coverage, this data set provides a better characterization of Second Portage Lake than two single event samples.
- The chronic effects targeted by this study are best assessed in consideration of longer term conditions. Consequently, the 7-day average TSS concentrations for southeast Second Portage Lake during the first event (September 13/14) ranged from 9.2 to 11.4 mg/L (Azimuth, 2009a). For the second sampling event (September 24/25), the 7-day average TSS concentrations ranged from 5.6 to 6.3 mg/L. TSS concentrations for both reference areas during both events should be less than 1 mg/L.

Total dissolved solids (TDS) in surface waters was only low (<10 mg/L) at 3PL-EAS during both sampling events. TDS at 2PL-EAS-1 and -2 decreased between the two sampling events (16 down to 13mg/L and 20 down to 16 mg/L, respectively). In contrast TDS at 2PL-EAS-3 and -DT increased from mid to late September (14 up to 16mg/L and 12 up to 20 mg/L, respectively).

Nitrogen and phosphate at all stations were low, generally close to laboratory detection limits, and did not differ appreciably among stations or sampling events but were usually lower at the 2 reference stations (2PL-EAS-DT and 3PL-EAS). Total Kjeldahl Nitrogen (TKN) increased about 1.5 fold at all 2PL stations and about 4 fold at the 3PL station, from the first to the second sampling event.

Dissolved organic carbon concentration was fairly constant among 2PL stations (1.7–2.1 mg/L) in September. Results from 3PL however were anomalous. On September 14 (8.5 mg/L) and September 25 (125 mg/L) DOC was quite elevated, despite low TOC concentrations on the same dates (1.4 mg/L and 2.1 mg/L respectively). DOC concentrations in Third Portage Lake during 2006 and 2007 AEMP monitoring (Azimuth, 2008b and 2008c) never exceeded 1.85 mg/L and were less than 2.3 mg/L during all prior water sampling events back to 1997 (BAEAR, 2005). In 2008, DOC concentrations at all 3PL AEMP stations were less than 1.9 mg/L except on one occasion (6.9 mg/L; although TOC was 1.3 mg/L). These data suggest that both 2008 EAS DOC samples and one AEMP sample were inadvertently contaminated in the field, probably during the filtration

process. Re-runs of these samples by the laboratory confirmed that this was not a lab issue. We suspect that magnesium carbonate, a preservative used for chlorophyll α samples, may have been added to the filter paper prior to (rather than after) filtration, which was likely the cause of elevated DOC in some samples. Furthermore, because TOC concentrations were always low (there were analyzed from a separate sample bottle), this confirms that this was a contamination issue and not a real result. Field filtration protocols have been changed to ensure that this does not happen again.

Of the 29 metals for which concentration data were measured, 24 are consistently near or below method detection limits (MDLs). Concentrations of total aluminum, chromium, copper, iron and lead exceeded CCME (2007) guideline concentrations for the protection of aquatic life at the three exposure monitoring stations in 2PL, but not for the two reference stations. Concentrations of each of these five metals were fairly similar among the exposure stations and both sampling events. Dissolved metals concentrations were much lower than total metals concentrations for all stations, which suggests that the observed metals are in particulate form. None of the dissolved metals concentrations exceeded CCME guidelines.

4.2. Field Effects Measurements

4.2.1. Sediment Traps

Results for sediment deposition rates and estimated deposition thickness are presented in **Table 4-3**. Not surprisingly, the two traps closest to the East Dike construction zone, HVH-1 and -2, had the highest deposition rates (approximately 1.2 to 1.3 g wet/day); this deposition rate led to nearly 2 mm of accumulated sediment over the entire period (note that accumulation at HVH-2 was approximately half that amount as it required resetting mid period). Predicted deposition rates and accumulation at the stations further from the construction zone (HVH-4 and -5) were approximately half those found at the two nearer stations. High value habitat areas in southeast Second Portage Lake will be examined more closely using underwater video in 2009 to assess this situation.

While the primary goal of the sediment traps was to quantify deposition rates and accumulation in relation to dike construction, sediment from two of the traps (HVH-2 and HVH-5) were submitted for chemistry analyses (the other two samples were sent to Golder Associates to further their engineering assessment of sediment containment during dike construction). These results are presented in **Table 4-4**. Total organic carbon content was 2.4 % and 1.8 % for HVH-2 and HVH-5, respectively. Arsenic, chromium, copper and zinc exceeded CCME ISQGs and chromium also exceeded the PEL, for the two high value habitat stations in Second Portage Lake.

Compared to sediment data collected from the Second Portage Lake (SP) station from AEMP monitoring (shown in **Figure 4-3** with Third Portage East [TPE] as well), a few differences are apparent. Although arsenic exceeds the ISQG at the HVH stations, concentrations are lower than at the SP station, which all exceed PELs. The opposite is true for a number of other metals: barium, chromium, nickel, vanadium and zinc concentrations at the HVH stations are greater than those measured at the SP AEMP station. The remaining metals concentrations are within range of those measured at the SP AEMP station.

It should be noted that the sediment trap bases in contact with bottom substrate were rusting significantly when retrieved. It is possible that rust particles were resuspended into the traps, but it would be unlikely for this to account for the observed results for the following reasons:

- In addition to iron and carbon, the primary constituents of regular steel typically include manganese, phosphorus, sulfur, and silicon. High strength and stainless steels also contain nickel and chromium. The angle iron used for the trap support structure is assumed to be regular steel, although this cannot be verified.
- Trap design had the PVC trap mouths higher than the base supports.
- Water sampling showed elevated metals (aluminum, chromium, copper, iron, and lead exceeded CCME guidelines) associated with particulates in the water column.
- Assuming that water column particulates had the same chemistry as the trap sediments, at 10 mg/L TSS (i.e., approximate concentrations expected during the first sampling event) neither arsenic nor zinc concentrations would be expected to exceed CCME water quality guidelines. However, chromium and aluminum would be expected to exceed. These results are consistent with the observed pattern.

Thus, while there is uncertainty as to the degree to which the trap base rust influenced the observed results, the sediment trap chemistry results warrant a follow up investigation in 2009 to verify the situation. Prior to the onset of construction in 2008, a detailed coring study was conducted to characterize the spatial variability of metals in surface sediments at each of the AEMP stations. We propose to repeat this study in 2009 at the two stations potentially affected by elevated TSS (i.e., Second Portage Lake [SP] and Tehek Lake [TE]) and two unaffected areas (Inuggugayualik Lake [INUG] and Third Portage South [TPS]).

We also plan on expanding the sediment trap program in 2009 to better characterize conditions during construction of the Bay-Goose Dike in Third Portage Lake. Sediment

trap bases will be redesigned and constructed of different material. This should improve our overall understanding of sediment dynamics in the project lakes.

4.2.2. Primary Production

Chlorophyll-a sampling results are presented in **Table 4-2**. Concentrations at all stations were generally low and similar among stations and sampling events, ranging from 0.474–0.692 µg/L (mean for 5 reps/station) (**Figure 4-4**). Despite the elevated TSS and associated water turbidity, there were no significant differences in chlorophyll-a concentrations between exposure and reference stations for either sampling event (**Table 4-5**).

Interestingly, chlorophyll-a does not appear to follow the same seasonal trends as phytoplankton biomass (see below); the same is true historically in Second and Third Portage Lakes (see **Figure 4-5**, which shows AEMP sampling results for chlorophyll-a).

QA/QC results for phytoplankton sampling are shown in **Table 4-6**. While the density and biomass results for major taxa groups were somewhat variable, particularly when the values were low, total density and biomass values were highly reproducible. Overall, these results are suitable for addressing whether elevated TSS in Second Portage Lake caused depressed primary productivity.

Phytoplankton data are reported on the basis of biomass and density (**Tables 4-7 and 4-8**; detailed taxa listing for both events is provided in **Appendix C**). While both can be useful in characterizing the community, biomass is more ecologically relevant for assessing potential TSS impacts to productivity. Biomass results are shown in **Figure 4-6**. The differences observed between exposure and reference stations were statistically significant for both sampling events, although the effect size was substantially lower for the second event (**Table 4-5**); there were no significant differences between near-field and far-field stations within the exposure area. The main reason for the change was a depression in chrysophyte biomass at the exposure stations (**Figure 4-7**). Historically, chrysophytes have always been the dominant species by biomass in Second and Third Portage Lakes, regardless of season (see **Figure 4-8**, which shows AEMP sampling results for phytoplankton biomass). This figure shows that the depression in biomass in Second Portage Lake was picked up by routine AEMP receiving environment monitoring.

4.2.3. Secondary Production – Pelagic

Zooplankton biomass results are shown in **Figure 4-9**; raw data are shown in **Table 3-1** (tow information) and **Appendix D** (lab results). Mean biomass ranged from slightly less than 25 mg/m^3 ww (2PL-EAS-DT) to just over 75 mg/m^3 ww (2PL-EAS-2). There was

no evidence of depressed biomass at exposure stations relative to reference stations (**Table 4-5**).

Zooplankton community composition results are presented in **Table 4-9**. The community was dominated by copepods (~85 %), fairly evenly split between Cyclopoida (mostly *Cyclops scutifer*) and Calanoida (mostly *Diaptomus*). The remainder of the community was primarily cladocerans (~15 %), represented mostly by *Bosmina longirostris*.

4.2.4. Secondary Production – Benthic

The dike construction monitoring plan (AEM, 2008) specified that benthic invertebrate community sampling would be conducted in 2009 and 2010 if elevated TSS was observed in Second Portage Lake. This detailed study has been planned for the upcoming field season.

While the more detailed EAS study is forthcoming, there are some data available now to provide some insights. Benthic invertebrates were included in routine AEMP receiving environment monitoring in late August 2008. Given the established TSS exposure gradient (i.e., elevated TSS concentrations in Second Portage Lake and extending to a lesser degree into Tehek Lake) in August 2008, the AEMP data provides an opportunity to assess the potential effects of elevated TSS (and related increases in deposition rates) on the benthic community.

A "Beyond BACI[1]" approach (e.g., Underwood, 1994) was used to assess whether there were any apparent adverse effects to the total benthos abundance or richness associated with the elevated TSS in Second Portage Lake and Tehek Lake in 2008 (**Figures 4-10 and 4-11**). Interaction plots showing the independent and combined influences of "Station" and "Year" on abundance (log transformed) and richness (untransformed) are shown in **Figures 4-12 and 4-13**. The results are summarized in **Table 4-10**. There were no statistically significant ($p<0.05$) adverse effects to benthic community total abundance (density) or total richness identified at Second Portage or Tehek stations in 2008 relative to other stations and years.

Benthic invertebrate total abundance in Second Portage Lake did show a marginal effect trend (i.e., not statistically significant, but a fairly large effect size). The observed effect size and estimated 95% confidence interval are shown in **Figure 4-14**. The asymmetry of confidence intervals is due to back-transforming model estimates (i.e., model used natural log transformed abundance). BACI models essentially test whether the effect size is different from 0; while the effect size is substantial, the broad confidence interval (due to

[1] BACI stands for "before-after-control-impact", a statistical design developed to detect environmental impacts by accounting for natural temporal and spatial variability.

naturally variable temporal and spatial patterns among stations and years) includes 0, so the test is not significant. For comparative purposes, the effect size and 80% confidence interval are shown in **Figure 4-15**; in this case the confidence interval does not include zero (i.e., we are 80% certain that there is an adverse effect at SP in 2008).

The Second Portage Lake results are fairly typical of a physical disturbance, where abundance shows a larger (i.e., marginal trend of reduced abundance) effect compared to richness (i.e., no effect). Conceptually, physical impacts often behave like a lawn mower, which reduces abundance without having much impact on diversity (i.e., most species are affected similarly). While elevated TSS did extend into Tehek Lake, no significant changes to benthos abundance or richness were detected.

4.2.5. Food Web Characterization

Aquatic food webs have traditionally been determined by examining the gut contents of fish, which essentially represent a brief "snap-shot" in time of their diet (e.g., typically on the order of days). Advances in stable isotope analysis (SIA) over the past two decades have resulted in a powerful time-integrated tool for determining trophic position (i.e., where an organism fits into the food web) that is literally based on the premise that "you are what you eat". SIA targets the stable isotopes (same number of protons, but different number of neutrons and thus mass; stable in that they do not decay like radioactive isotopes) of particular elements (e.g., C, N and others). Studies have shown that consumers experience the preferential loss of the lighter isotope during metabolic processes (e.g., excretion or respiration), resulting in varying degrees of heavy isotope enrichment relative to their diet. This trophic fractionation is the underlying mechanism that results in different patterns of stable isotope ratios in nature. Identifying these patterns provides valuable insights into the trophic structure of the system of interest.

The stable isotopes of nitrogen and carbon have been used to complement one another in the characterization of food webs over a broad range of systems. Nitrogen isotopes have been used extensively as a fairly robust means of distinguishing between and quantifying the trophic positions of consumers in aquatic systems (e.g., Peterson and Fry, 1987; Bilby et al., 1996; Vander Zanden et al., 1999; Harvey and Kitchell, 2000; Leggett et al., 2000; Vander Zanden and Rasmussen, 2001; Vander Zanden et al., 2003; Herwig et al, 2004). Carbon isotopes have been used to trace the flow of energy through food webs and are particularly valuable in identifying dietary preferences of consumers (e.g., Rounick and Winterbourn, 1986; Peterson and Fry, 1987; France, 1995*a* and 1995*b*; Hecky and Hesslein, 1995; Herwig et al., 2004; da Silva et al., 2005). Together, stable nitrogen and carbon isotopes provide strong insights into trophic structure and feeding preferences, which are essential component of lake ecology.

The derivation of stable isotope values is presented in the accompanying text box. Studies have shown that $\delta^{15}N$ is about 3.4‰ and $\delta^{13}C$ between 0-1‰ higher in consumers relative to their diet for a range of taxa (Minagawa and Wada, 1984; Peterson and Fry, 1987; Vander Zanden and Rasmussen, 2001). That being said, there can be considerable variability in both $\delta^{15}N$ and $\delta^{13}C$ that needs to be taken into account in the interpretation of results.

How Stable Isotope Values Are Calculated.

Isotopic fractionation (i.e., the preferential use of certain isotopes during biological processes like photosynthesis, excretion or respiration) results in enrichment (positive values) or depletion (negative values) of the isotopic ratio relative to internationally-used standard material (i.e., atmospheric nitrogen or PeeDee Belemnite carbon). The difference, represented by $\delta^{15}N$ or $\delta^{13}C$ (in parts per thousand, ‰; or per "mil"), is calculated using the following equation:

$$\delta^{15}N \text{ or } \delta^{13}C \text{ ‰} = ([R_{sample} / R_{standard}]-1) \times 1000 \qquad \text{Eq.1}$$

where $R = {}^{15}N:{}^{14}N$ or ${}^{13}C:{}^{12}C$.

For nitrogen isotopes, while the relative difference in $\delta^{15}N$ between consumers and their diet is fairly constant, the absolute $\delta^{15}N$ values of both consumers and dietary items can vary considerably within and among lakes (e.g., Kling et al., 1992; Kline et al., 1998). Vander Zanden et al. (2000) looked at within and among population variation in trophic position and found that 78% of the total variation was due to lake-to-lake differences. While the trophic structure of lakes (e.g., presence/absence of pelagic forage fish [e.g., whitefish] and/or presence of a large zooplankton predator [e.g., mysids]) will clearly affect $\delta^{15}N$ values (and thus trophic position) among top predator consumers, significant variability in $\delta^{15}N$ values has been shown at the base of the food web (Cabana and Rasmussen, 1996; Vander Zanden and Rasmussen, 1999; Vander Zanden and Rasmussen, 2001). This variability is observed both within lakes (i.e., among specific habitats in a lake) and among lakes (i.e., due to variability in N sources), with serious implications for accurate characterization of trophic position of higher level consumers.

Carbon isotopic ratios show an even greater variability, particularly among primary producers. Most terrestrial plants typically have $\delta^{13}C$ values around -28 ppt, with others differing primarily as a result of distinct fractionation patterns among photosynthetic pathways. Aquatic plants routinely have a much higher range of $\delta^{13}C$ values due to variability in isotopic ratios of the dissolved inorganic carbon pool, physical factors limiting the rate of carbon diffusion through the boundary layer around plant tissue and other reasons (Rounick and Winterbourn, 1986). The boundary layer/diffusion factor is thought to be responsible for the significant differences observed in $\delta^{13}C$ values between pelagic (depleted) and benthic (enriched) algae. These diverse carbon signatures, coupled with the subsequent low degree of fractionation by consumers, provide a means of identifying feeding preferences of primary consumers.

The SIA results are shown in **Figure 4-16**; raw data are provided in **Appendix E**. As discussed above, the pelagic and benthic food webs (as represented by either zooplankton or benthos) are distinct due to expected differences in $\delta^{13}C$. Moving up the food chain (i.e., to higher levels of $\delta^{15}N$), one can see that Arctic char rely more exclusively on the pelagic food chain and round whitefish on the benthic food chain, particularly for younger aged fish. Lake trout are generally at the top of the food chain and appear, based on their $\delta^{13}C$ values, to utilize both energy paths (i.e., pelagic and benthic). This is not surprising in an ultra oligotrophic lake, where nutrient-driven productivity limitations constrain populations.

4.3. Laboratory Effects Measurements

Detailed results are provided in **Appendix B**. Key results were as follows:

- *Acute effects to zooplankton* – no adverse effects were observed in the 48-hr *Daphnia magna* survival test.
- *Acute effects to fish* – no effects were observed in the 96-hr rainbow trout survival test.
- *Chronic effects to zooplankton* – no adverse effects were observed for survival or reproduction in the 7-day test with *Ceriodaphnia dubia*.
- *Chronic effects to fish* – Tests were conducted on two developmental stages:
    - *Embryo stage* – Two[2] tests were conducted using trout embryos: one where test water was renewed each day (renewal) and one without renewal (static). This test combination was used to provide insights into whether any observed effects were due to chemical or physical effects. No effects were observed in either renewal test. However, impaired development was observed in the static test (despite water quality parameters remaining acceptable throughout the test), suggesting that physical settling of sediments could possibly affect developing embryos.
    - *Larval stage* - The larval test was conducted using live zooplankton as a food resource. No adverse effects were detected in the 7-day survival and growth test. The lack of growth or survival effects suggests that neither direct (e.g., impairment of gill functioning) or indirect (e.g., active feeding was not impaired by the reduced water clarity) effects would be expected in the field.

[2] A third test was conducted to assess the potential effects of using chitosan to speed up settlement of suspended sediments. The results showed no apparent adverse effects related to chitosan use.

Table 4-1: QA/QC data for water parameters, Second & Third Portage Lakes, September 2008.

	Second Portage Lake			Second Portage Lake			Various Basins / Depths			Various Basins / Depths			L687296 Travel Blanks		L687296 Equipment Blank
	2PL-EAS-DT	Field Dup	RPD	2PL-EAS-2	Field Dup	RPD	Original	Laboratory Duplicate	RPD	Original	Laboratory Duplicate	RPD	L688731 Travel Blanks		
	13-Sep-08	13-Sep-08	(%)	24-Sep-08	24-Sep-08	(%)	September R1		(%)	September R2		(%)	14-Sep-08	22-Sep-08	14-Sep-08
CONVENTIONAL PARAMETERS															
Physical Tests															
Conductivity (µS/cm)	26.2	26.2	0	25.6	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0
Hardness (mg/L)	10.9	10.7	1.9	10.4	11.5	-10	-	-	-	-	-	-	-	1.24	<0.70
pH	7.22	7.22	0	7.27	-	-	-	-	-	-	-	-	5.57	5.54	5.49
Total Suspended Solids (mg/L)	<3.0	<3.0	0	52.8	-	-	-	-	-	-	-	-	<3.0	<3.0	<3.0
Total Dissolved Solids (mg/L)	12	14	-15	16	-	-	-	-	-	-	-	-	<10	<10	<10
Anions & Nutrients (mg/L)															
Alkalinity - Bicarbonate (as $CaCO_3$)	8.1	7.4	9.0	8.3	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0
Alkalinity - Carbonate (as $CaCO_3$)	<2.0	<2.0	0	<2.0	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0
Alkalinity - Hydroxide (as $CaCO_3$)	<2.0	<2.0	0	<2.0	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0
Alkalinity - Total (as $CaCO_3$)	8.1	7.4	9.0	8.3	-	-	-	-	-	-	-	-	<2.0	<2.0	<2.0
Ammonia (as N)	0.027	0.024	12	<0.020	<0.020	0	-	-	-	-	-	-	<0.020	<0.020	<0.020
Chloride	<0.50	<0.50	0	0.54	-	-	<0.50	<0.50	0	0.54	0.55	-1.8	<0.50	<0.50	<0.50
Nitrate (as N)	<0.0050	<0.0050	0	0.0302	-	-	<0.0050	<0.0050	0	-	-	-	<0.0050	<0.0050	<0.0050
Nitrite (as N)	<0.0010	<0.0010	0	0.0017	-	-	<0.0010	<0.0010	0	0.0017	0.0015	13	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	0.091	0.087	4.5	0.13	0.15	-13	-	-	-	-	-	-	<0.050	<0.050	<0.050
Ortho Phosphate (as P)	<0.0010	<0.0010	0	<0.0010	-	-	-	-	-	-	-	-	<0.0010	<0.0010	<0.0010
Total Phosphate (as P)	0.0025	0.0035	-33	0.0096	-	-	-	-	-	-	-	-	<0.0020	<0.0020	<0.0020
Sulfate (SO_4)	2.42	2.40	0.8	2.49	-	-	1.08	1.09	-0.9	2.49	2.48	0.4	<0.50	<0.50	<0.50
ORGANIC / INORGANIC CARBON															
Dissolved Organic Carbon (mg/L)	1.80	1.88	-4.3	2.14	1.76	19	-	-	-	1.76	1.80	-2.2	-	-	-
Total Organic Carbon (mg/L)	1.74	1.70	2.3	1.73	1.52	13	-	-	-	1.52	1.54	-1.3	<0.50	<0.50	<0.50

Table 4-1: QA/QC data for water parameters, Second Third Portage Lakes, September 2008.

	Second Portage Lake			Second Portage Lake			Various Basins / Depths			Various Basins / Depths			Travel Blanks		Equipment Blank
	2PL-EAS-DT	Field Dup	RPD	2PL-EAS-2	Field Dup	RPD	Original	Laboratory Duplicate	RPD	Original	Laboratory Duplicate	RPD	14-Sep-08	22-Sep-08	14-Sep-08
	13-Sep-08	13-Sep-08	(%)	24-Sep-08	24-Sep-08	(%)	September R1		(%)	September R2		(%)			
TOTAL METALS (mg/L)															
Aluminum	0.0146	0.0176	-19	0.278	0.315	-12	0.388	0.386	0.5	0.268	0.258	3.8	-	<0.0050	<0.0050
Antimony	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	<0.00050	<0.00050
Arsenic	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	<0.00050	<0.00050
Barium	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0	<0.020	<0.020	0	-	<0.020	<0.020
Beryllium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	<0.0010	<0.0010
Boron	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0	<0.10	<0.10	0	-	<0.10	<0.10
Cadmium	<0.000017	<0.000017	0	<0.000017	<0.000017	0	<0.000017	<0.000010	-	<0.000017	0.000014	19	-	<0.000017	0.000037
Calcium	2.80	2.81	-0.4	2.85	2.80	1.8	2.64	2.72	-3.0	2.77	2.86	-3.2	-	0.500	<0.10
Chromium	<0.0010	<0.0010	0	0.0011	0.0012	-8.7	0.0013	0.0013	0	0.0011	0.0010	9.5	-	<0.0010	<0.0010
Cobalt	<0.00030	<0.00030	0	<0.00030	<0.00030	0	<0.00030	<0.00030	0	<0.00030	<0.00030	0	-	<0.00030	<0.00030
Copper	<0.0010	<0.0010	0	0.0020	0.0021	-4.9	0.0017	0.0017	0	0.0019	0.0017	11	-	<0.0010	<0.0010
Iron	<0.030	<0.030	0	0.393	0.429	-8.8	0.492	0.502	-2.0	0.367	0.367	0	-	<0.030	<0.030
Lead	<0.00050	<0.00050	0	0.00086	0.00079	8.5	0.00248	0.00255	-2.8	0.00691	0.00707	-2.3	-	<0.00050	<0.00050
Lithium	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	<0.0050	<0.0050	0	-	<0.0050	<0.0050
Magnesium	0.92	0.93	-1.1	0.93	0.94	-1.1	0.95	0.97	-2.1	0.92	0.94	-2.2	-	<0.10	<0.10
Manganese	0.00087	0.00086	1.2	0.00832	0.00852	-2.4	0.00890	0.00887	0.3	0.00777	0.00783	-0.8	-	<0.00030	<0.00030
Mercury	<0.000020	<0.000020	0	<0.000020	<0.000020	0	<0.000020	<0.000020	0	<0.000020	<0.000020	0	-	<0.000020	<0.000020
Molybdenum	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	<0.0010	<0.0010
Nickel	<0.0010	<0.0010	0	0.0010	0.0011	-9.5	0.0012	0.0013	-8.0	0.001	0.001	0	-	<0.0010	<0.0010
Potassium	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	-	<2.0	<2.0
Selenium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	<0.0010	<0.0010
Silver	<0.000020	<0.000020	0	<0.000020	<0.000020	0	<0.000020	<0.000020	0	<0.000020	<0.000020	0	-	<0.000020	<0.000020
Sodium	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	<2.0	<2.0	0	-	<2.0	<2.0
Thallium	<0.00020	<0.00020	0	<0.00020	<0.00020	0	<0.00020	<0.00020	0	<0.00020	<0.00020	0	-	<0.00020	<0.00020
Tin	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	<0.00050	<0.00050
Titanium	<0.010	<0.010	0	0.014	0.014	0	0.019	0.019	0	0.013	0.013	0	-	<0.010	<0.010
Uranium	<0.00020	<0.00020	0	<0.00020	<0.00020	0	0.00023	0.00023	0	0.00020	<0.00020	0	-	<0.00020	<0.00020
Vanadium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	<0.0010	<0.0010
Zinc	<0.0050	<0.0050	0	0.0054	0.0054	0	<0.0050	<0.0050	0	0.0063	0.0054	15	-	<0.0050	<0.0050

Table 4-1: QA/QC data for water parameters, Second Third Portage Lakes, September 2008.

	Second Portage Lake			Second Portage Lake			Various Basins / Depths			Various Basins / Depths			Travel Blanks		Equipment Blank
	2PL-EAS-DT	Field Dup	RPD	2PL-EAS-2	Field Dup	RPD	Original	Laboratory Duplicate	RPD	Original	Laboratory Duplicate	RPD	14-Sep-08	22-Sep-08	14-Sep-08
	13-Sep-08	13-Sep-08	(%)	24-Sep-08	24-Sep-08	(%)	September R1		(%)	September R2		(%)			
DISSOLVED METALS (mg/L)															
Aluminum	<0.0050	<0.0050	0	0.021	0.024	-13	-	-	-	-	-	-	-	-	-
Antimony	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	-	-	-	-	-	-	-
Arsenic	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	-	-	-	-	-	-	-
Barium	<0.020	<0.020	0	<0.020	<0.020	0	-	-	-	-	-	-	-	-	-
Beryllium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Boron	<0.10	<0.10	0	<0.10	<0.10	0	-	-	-	-	-	-	-	-	-
Cadmium	<0.000017	0.000059	-111	<0.000017	<0.000017	0	-	-	-	-	-	-	-	-	-
Calcium	2.81	2.76	1.8	2.82	3.13	-10	-	-	-	-	-	-	-	-	-
Chromium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Cobalt	<0.00030	<0.00030	0	<0.00030	<0.00030	0	-	-	-	-	-	-	-	-	-
Copper	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Iron	<0.030	<0.030	0	<0.030	<0.030	0	-	-	-	-	-	-	-	-	-
Lead	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	-	-	-	-	-	-	-
Lithium	<0.0050	<0.0050	0	<0.0050	<0.0050	0	-	-	-	-	-	-	-	-	-
Magnesium	0.94	0.92	2.2	0.83	0.90	-8.1	-	-	-	-	-	-	-	-	-
Manganese	0.00041	0.00042	-2.4	0.00045	0.00058	-25	-	-	-	-	-	-	-	-	-
Mercury	<0.000020	<0.000020	0	<0.000020	<0.000020	0	-	-	-	-	-	-	-	-	-
Molybdenum	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Nickel	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Potassium	<2.0	<2.0	0	<2.0	<2.0	0	-	-	-	-	-	-	-	-	-
Selenium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Silver	<0.000020	<0.000020	0	<0.000020	<0.000020	0	-	-	-	-	-	-	-	-	-
Sodium	<2.0	<2.0	0	<2.0	<2.0	0	-	-	-	-	-	-	-	-	-
Thallium	<0.00020	<0.00020	0	<0.00020	<0.00020	0	-	-	-	-	-	-	-	-	-
Tin	<0.00050	<0.00050	0	<0.00050	<0.00050	0	-	-	-	-	-	-	-	-	-
Titanium	<0.010	<0.010	0	<0.010	<0.010	0	-	-	-	-	-	-	-	-	-
Uranium	<0.00020	<0.00020	0	<0.00020	<0.00020	0	-	-	-	-	-	-	-	-	-
Vanadium	<0.0010	<0.0010	0	<0.0010	<0.0010	0	-	-	-	-	-	-	-	-	-
Zinc	<0.0050	<0.0050	0	<0.0050	0.0102	-68	-	-	-	-	-	-	-	-	-

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Shaded RPDs exceed 25% (lab duplicates) or 50% (field duplicates).

Shaded travel and equipment blanks exceed laboratory method detection limits.

Table 4-2: Conventional water chemistry and total & dissolved metals (mg/L), Second & Third Portage Lakes, September 2008.

Basin		Second Portage Lake								Third Portage Lake	
Station		2PL-EAS-1		2PL-EAS-2		2PL-EAS-3		2PL-EAS-DT		3PL-EAS	
Depth	CCME (2007)	1m	1m	1m	1m	1m	1m	1m	1m	2m	1m
Date	Guideline[1]	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	14-Sep-08	25-Sep-08
CONVENTIONAL PARAMETERS											
Physical Tests											
Conductivity (µS/cm)	NG	28.0	24.4	26.0	25.6	25.3	25.2	26.2	26.3	14.4	16.4
Hardness as $CaCO_3$ (mg/L)	NG	11.9	9.98	10.8	10.4	10.3	10.4	10.9	10.9	5.10	5.09
pH	6.5 - 9.0	7.28	7.27	7.23	7.27	7.24	7.23	7.22	7.20	6.81	6.79
Total Suspended Solids (mg/L)	NG	<3.0	3.3	<3.0	53	<3.0	16	<3.0	3.8	<3.0	<3.0
Total Dissolved Solids (mg/L)	NG	16	13	20	16	14	16	12	20	<10	<10
Anions & Nutrients (mg/L)											
Alkalinity - Bicarbonate (as $CaCO_3$)	NG	8.8	7.8	8.1	8.3	8.1	7.7	8.1	8.1	4.3	4.2
Alkalinity - Carbonate (as $CaCO_3$)	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity - Hydroxide (as $CaCO_3$)	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity - Total (as $CaCO_3$)	NG	8.8	7.8	8.1	8.3	8.1	7.7	8.1	8.1	4.3	4.2
Ammonia (as N)[2]	25.9 @ pH6.5; 8.24 @ pH7.0; 2.61 @ pH7.5	<0.020	0.022	<0.020	<0.020	<0.020	<0.020	0.027	<0.020	<0.020	<0.020
Chloride	NG	<0.50	<0.50	<0.50	0.54	<0.50	0.52	<0.50	<0.50	<0.50	0.88
Nitrate (as N)	2.9	0.037	0.027	0.029	0.030	0.033	0.031	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	0.06	0.0012	0.0014	<0.0010	0.0017	<0.0010	0.0018	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	NG	0.0900	0.128	0.0800	0.132	0.0930	0.142	0.0910	0.127	0.0630	0.261
Ortho Phosphate (as P)	NG	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphate (as P)	NG	0.0094	0.0064	0.0073	0.0096	0.0077	0.0086	0.0025	0.0049	<0.0020	0.0048
Sulfate (SO_4)	NG	1.98	2.39	2.02	2.49	1.87	2.45	2.42	2.96	1.08	1.49
ORGANIC / INORGANIC CARBON (mg/L)											
Dissolved Organic Carbon	NG	1.84	2.00	1.86	2.14	1.95	1.69	1.80	1.87	8.46	125
Total Organic Carbon	NG	1.45	1.48	1.51	1.73	1.59	1.65	1.74	1.93	1.41	2.10
PLANT PIGMENTS											
Chlorophyll a - standardized (µg/L)	**Rep 1**	0.582	0.652	0.403	0.671	0.474	0.420	0.608	0.396	0.622	0.161
Chlorophyll a - standardized (µg/L)	**Rep 2**	0.660	0.746	0.592	0.460	0.589	0.552	0.585	0.502	0.571	0.606
Chlorophyll a - standardized (µg/L)	**Rep 3**	0.653	0.712	0.363	0.401	0.666	0.506	0.540	0.488	0.564	0.406
Chlorophyll a - standardized (µg/L)	**Rep 4**	0.524	0.656	0.641	0.516	0.604	0.568	0.621	0.480	0.471	0.620
Chlorophyll a - standardized (µg/L)	**Rep 5**	0.502	NA	0.544	0.495	0.658	0.635	0.652	0.519	0.444	0.576

Table 4-2: Conventional water chemistry and total & dissolved metals (mg/L), Second & Third Portage Lakes, September 2008.

Basin		Second Portage Lake								Third Portage Lake	
Station		2PL-EAS-1		2PL-EAS-2		2PL-EAS-3		2PL-EAS-DT		3PL-EAS	
Depth	CCME (2007)	1m	1m	1m	1m	1m	1m	1m	1m	2m	1m
Date	Guideline[1]	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	14-Sep-08	25-Sep-08
TOTAL METALS (mg/L)											
Aluminum[3]	0.005 @pH<6.5 0.100 @ pH≥6.5	0.355	0.254	0.417	0.278	0.388	0.268	0.0146	0.0515	0.012	0.0396
Antimony	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium	NG	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	NG	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium[4]	0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
Calcium	NG	3.03	2.66	2.81	2.85	2.64	2.77	2.80	2.91	1.14	1.26
Chromium[5]	0.0010	0.0011	<0.0010	0.0014	0.0011	0.0013	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	NG	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper*	0.0020	0.0018	0.0014	0.0018	0.0020	0.0017	0.0019	<0.0010	0.0010	<0.0010	<0.0010
Iron	0.30	0.437	0.337	0.533	0.393	0.492	0.367	<0.030	0.0850	<0.030	0.0700
Lead*	0.0010	0.00118	<0.00050	0.00125	0.000860	0.00248	0.00691	<0.00050	0.00096	<0.00050	<0.00050
Lithium	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	NG	0.98	0.89	1.0	0.93	0.95	0.92	0.92	0.94	0.53	0.55
Manganese	NG	0.00941	0.00656	0.00868	0.00832	0.00890	0.00777	0.00087	0.00205	0.00084	0.00229
Mercury	0.000026	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Molybdenum	0.073	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel*	0.025	0.0013	<0.0010	0.0013	0.0010	0.0012	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver	0.00010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium	0.00080	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium	NG	0.015	0.012	0.019	0.014	0.019	0.013	<0.010	<0.010	<0.010	<0.010
Uranium	NG	0.00027	<0.00020	0.00024	<0.00020	0.00023	0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	0.030	<0.0050	<0.0050	<0.0050	0.0054	<0.0050	0.0063	<0.0050	<0.0050	<0.0050	<0.0050

Table 4-2: Conventional water chemistry and total & dissolved metals (mg/L), Second & Third Portage Lakes, September 2008.

Basin		Second Portage Lake								Third Portage Lake	
Station		2PL-EAS-1		2PL-EAS-2		2PL-EAS-3		2PL-EAS-DT		3PL-EAS	
Depth	CCME (2007)	1m	1m	1m	1m	1m	1m	1m	1m	2m	1m
Date	Guideline[1]	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	13-Sep-08	24-Sep-08	14-Sep-08	25-Sep-08
DISSOLVED METALS (mg/L)[6]											
Aluminum[3]	0.005 @pH<6.5 0.100 @ pH≥6.5	0.0796	0.0208	0.0134	0.0211	0.0285	0.0128	<0.0050	0.0082	<0.0050	<0.0050
Antimony	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic	0.0050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Barium	NG	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Beryllium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron	NG	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium[4]	0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017	<0.000017
Calcium	NG	3.07	2.68	2.81	2.82	2.73	2.80	2.81	2.89	1.17	1.18
Chromium[5]	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cobalt	NG	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Copper*	0.0020	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Iron	0.30	0.073	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead*	0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Lithium	NG	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium	NG	1.0	0.8	0.91	0.83	0.85	0.83	0.94	0.90	0.53	0.52
Manganese	NG	0.0016	0.00048	0.00043	0.00045	0.00081	0.00041	0.00041	0.00048	0.00031	0.0003
Mercury	0.000026	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Molybdenum	0.073	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel*	0.025	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Potassium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Selenium	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silver	0.00010	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Sodium	NG	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Thallium	0.00080	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin	NG	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Titanium	NG	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium	NG	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc	0.030	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Notes:

NG = no guideline.

[1]CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated December 2007.

[2]Ammonia guidelines are for 10°C.

[3]Aluminum guideline is pH dependent.

[4]Interim cadmium guideline.

[5]Chromium guideline is for Cr VI, which yields the most conservative guideline.

[6]Guidelines have not yet been made for "Dissolved Metals," thus were screened against CCME guidelines for "Total Metals."

*Copper, lead and nickel guidelines are hardness dependent; minimum hardness was selected to yield the most conservative guideline.

Shaded concentrations exceed the CCME guideline.

Table 4-3. Sediment deposition rates and estimated accumulation for EAS sediment traps, Second Portage Lake, 2008.

		Sediment Trap					
	Units	**HVH-1**	**HVH-2**	**HVH-3**	**HVH-4**	**HVH-5**	**HVH-6**
Easting[1]	UTM	639641	640043	640214	640333	639716	640427
Northing	UTM	7214019	7213782	7213767	7213713	7213372	7213078
Set date		26-Jul-08	25-Aug-08	26-Jul-08	26-Jul-08	26-Jul-08	26-Jul-08
Retrieval date[2]		18-Sep-08	22-Sep-08	NA	22-Sep-08	25-Sep-08	NA
Trap contents (dry)	(g dw)	9.3	5.6		5.04	5.62	
Trap contents (wet)[3]	(g ww)	58	35		32	35	
Set length	(days)	50	28		54	57	
Deposition Rate	(g ww/d)	1.2	1.3		0.58	0.62	
Accumulation[4]	(cm)	0.179	0.108		0.097	0.108	

Notes:

1. NAD83 zone 14W
2. NA = not retrieved successfully
3. Assumes 84% moisture content
4. Assumes mean material density of 2 g/cm^3 (Telford et al., 1996)

Table 4-4. Sediment chemistry results for EAS sediment traps in Second Portage Lake, 2008.

Lake & Basin	Sediment Quality Guidelines (CCME 2002)[1]		Second Portage Lake	Second Portage Lake
Station ID			SP-ST-2 (R1-R4)	SP-ST-5 (R1-R4)
Date	ISQG	PEL	22-Sep-08	24-Sep-08
CONVENTIONAL PARAMETERS				
Physical & Organic Parameters				
pH	NG	NG	6.21	6.27
Total Organic Carbon (% dw)	NG	NG	2.4	1.8
TOTAL METALS (mg/kg dw)				
Aluminum	NG	NG	42200	43100
Antimony	NG	NG	<10	<10
Arsenic	5.9	17	16.7	16.4
Barium	NG	NG	234	233
Beryllium	NG	NG	1.65	1.76
Cadmium	0.60	3.5	0.51	<0.50
Chromium	37.3	90.0	175	194
Cobalt	NG	NG	25.5	27.9
Copper	35.7	197	87.6	101
Lead	35.0	91.3	<30	<30
Mercury	0.170	0.486	0.0303	0.0242
Molybdenum	NG	NG	<4.0	<4.0
Nickel	NG	NG	109	113
Selenium	NG	NG	<2.0	<2.0
Silver	NG	NG	<2.0	<2.0
Thallium	NG	NG	<1.0	<1.0
Tin	NG	NG	<5.0	<5.0
Vanadium	NG	NG	70.5	76.5
Zinc	123	315	235	272

Notes:

NG = no guideline.

[1] CCME (Canadian Council of Ministers of the Environment) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life, 1999, updated in 2002.

ISQG = Interim freshwater Sediment Quality Guideline, PEI = Probably Effects Level.

Shaded concentrations = or > ISQG.

Boxed concentration also > PEL.

Table 4-5. EAS statistical analyses results for primary productivity and zooplankton biomass, 2008.

	Phytoplankton Productivity				Zooplankton
	Total Biomass (mg/m^3)		Chlorophyll-*a* (mg/m^3)		Biomass (mg/m^3)
	Sept 13/14	Sept 24/25	Sept 13/14	Sept 24/25	Sept 13/14
Data Transformation[1]	log10	log10	log10	Rank	Rand
Normal?	Yes	Yes	Yes	No	Yes
Homogeneity of Variance?	Yes	Yes	Yes	NA	No
ANOVA/Kruskal-Wallis?	ANOVA	ANOVA	ANOVA	K-W	K-W
Significant Differences?	Yes	Yes	No	Yes	Yes
p-value	<0.001	<0.001	0.272	0.007	<0.001
Contrasts[2]					
Reference vs. Exposure					
Significant Difference?	Yes	Yes	No	No	No
p-value	<0.001	<0.001	0.82	0.06	0.74
Reference Mean[3]	191	135	0.564	0.450	32.7
Exposure Mean[3]	73	101	0.555	0.562	43.9
Effect Size[3]	-117.9	-34.0	-0.009	0.112	11.2
95% Upper CI of Effect Size[3]	-141.0	-53.4	-0.087	-0.018	-8.9
Within Exposure (NF vs FF)					
Significant Difference?	No	No	No	No	No
p-value	0.9	0.82	0.27	0.34	0.91
Near-Field Mean[3]	73	100	0.537	0.577	43.8
Far-Field Mean[3]	74	103	0.594	0.530	44.3
Effect Size[3]	0.9	2.3	0.057	-0.046	0.5
95% Upper CI of Effect Size[3]	-16.9	-24.4	-0.167	-0.153	-35.6

Notes:

1. Normality examined visually (e.g., residuals in QQ Plots) and tested using Shapiro-Wilk test ($p>0.05$ assumed normal). Homogeneity of variance tested using Bartlett's test ($p>0.05$ assumed homogenous). Data were ranked for non-parametric Kruskal-Wallis

2. Contrasts were used to test specific comparisons of interest based on *a priori* hypotheses. The "Within Exposure" contrast looks at whether there are difference in key variables between the two stations closest to the dike and the one further away.

3. Values reported in original units (i.e., back transformed ; means for log10-transformed variables are geometric means; means, effect sizes and effect size confidence interval for rank-transformed variables based on log10 data (see Methods for details).

Table 4-6: QA/QC data for phytoplankton at EAS stations, Second & Third Portage Lakes, September 2008

	Second Portage Lake - EAS-1			Second Portage Lake - EAS-3			Third Portage Lake - EAS		
	REP #5	**Lab**	**RPD**	**REP #4**	**Lab**	**RPD**	**REP #3**	**Lab**	**RPD**
	########	**Duplicate**	(%)	13-Sep-08	**Duplicate**	(%)	14-Sep-08	**Duplicate**	(%)
Phytoplankton Density (cells/L)									
Cyanophyte	0	0	0	0	0	0	0	200	-200
Chlorophyte	58272	79424	-31	144280	237472	-49	129712	143880	-10
Euglenophyte	0	0	0	0	0	0	0	0	0
Chrysophyte	539800	575520	-6.4	495896	459976	7.5	1660304	1624984	2.2
Diatom	46704	32136	37	54088	77440	-36	224504	239072	-6.3
Cryptophyte	171432	141696	19	132912	110560	18	66456	59072	12
Dinoflagellate	200	1000	-133	7984	1200	148	16768	8984	60
Total	**816408**	**829776**	**-1.6**	**835160**	**886648**	**-6.0**	**2097744**	**2076192**	**1.0**
Mean RPD			***-16***			***13***			***-20***
Phytoplankton Biomass (mg/m^3)									
Cyanophyte	0	0	0	0	0	0	0	0.240	-200
Chlorophyte	4.76	3.77	23	3.37	4.19	-22	3.26	4.38	-29
Euglenophyte	0	0	0	0	0	0	0	0	0
Chrysophyte	42.1	39.6	6.3	38.2	39.9	-4.2	120	123	-2.4
Diatom	5.27	5.33	-1.0	6.58	11.2	-52	14.5	16.5	-13
Cryptophyte	21.0	18.1	15	16.0	12.9	22	11.5	4.42	89
Dinoflagellate	0.328	10.3	-188	3.48	5.44	-44	20.6	10.6	65
Total	**73.5**	**77.0**	**-4.7**	**67.6**	**73.6**	**-8.5**	**170**	**159**	**6.6**
Mean RPD			***-21***			***-14***			***-13***
# Species	26	29	-11	28	27	3.6	36	38	-5.4
Simpsons Diversity	0.82	0.84	-2.1	0.89	0.90	-0.8	0.89	0.90	-0.8

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Shaded RPDs exceed 25% (lab duplicates).

Table 4-6 QA/QC data for phytoplankton at EAS stations, Second & Third Portage Lakes, September 2008.

	Second Portage Lake - EAS-2			Second Portage Lake - EAS-DT			Third Portage Lake - EAS		
	REP #3 24-Sep-08	**Lab Duplicate**	**RPD** (%)	**REP #2** 24-Sep-08	**Lab Duplicate**	**RPD** (%)	**REP #5** ########	**Lab Duplicate**	**RPD** (%)
Phytoplankton Density (cells/l									
Cyanophyte	0	0	0	14368	14368	0	79824	14968	137
Chlorophyte	187584	151864	21	101176	258824	-88	403304	366584	9.5
Euglenophyte	0	0	0	0	0	0	0	0	0
Chrysophyte	934520	1013744	-8.1	836944	736968	13	1013744	1172392	-15
Diatom	100592	106176	-5.4	38936	89024	-78	166832	175216	-4.9
Cryptophyte	128728	109376	16	74840	61272	20	61072	75240	-21
Dinoflagellate	800	7984	-164	7184	14768	-69	8984	1600	140
Total	**1352224**	**1389144**	**-2.7**	**1073448**	**1175224**	**-9.1**	**1733760**	**1806000**	**-4.1**
Mean RPD			***-20***			***-29***			***35***
Phytoplankton Biomass (mg/r									
Cyanophyte	0	0	0	1.08	1.08	0	2.73	1.22	77
Chlorophyte	4.74	4.71	0.5	4.43	6.64	-40	9.73	7.64	24
Euglenophyte	0	0	0	0	0	0	0	0	0
Chrysophyte	62.3	52.1	18	55.3	55.7	-0.8	93.6	102	-8.7
Diatom	10.1	9.74	3.8	11.2	15.0	-29	8.83	10.4	-16
Cryptophyte	21.2	23.0	-8.0	8.79	9.26	-5.2	7.52	8.56	-13
Dinoflagellate	5.41	7.58	-33	2.41	5.19	-73	6.31	5.41	15
Total	**104**	**97.1**	**6.7**	**83.2**	**92.9**	**-11**	**129**	**135**	**-5.0**
Mean RPD			***-2.7***			***-21***			***11***
# Species	37	37	0	37	37	0	42	41	2.4
Simpsons Diversity	0.89	0.88	0.4	0.85	0.89	-4.5	0.93	0.93	0.2

Notes:

RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.

Shaded RPDs exceed 25% (lab duplicates).

Table 4-7: Biomass (mg/m ^{3}) and diversity of major phytoplankton groups at EAS stations, Second & Third Portage Lakes, September 2008.

Station	Date	Phytoplankton Biomass (mg/m^3)								# Species	Simpsons Diversity
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total		
Second Portage Lake											
2PL-EAS-1											
Rep 1	13-Sep-08	0	5.45	0	34.7	3.26	20.0	0.422	63.8	30	0.86
Rep 2		0.181	2.19	0	43.0	8.11	23.8	5.33	82.6	31	0.88
Rep 3		0	2.78	0	16.1	5.26	21.7	0.328	46.2	28	0.84
Rep 4		1.44	1.39	0	20.7	4.21	23.1	2.43	53.3	25	0.86
Rep 5		0	4.76	0	42.1	5.27	21.0	0.328	73.5	26	0.82
Rep 1	24-Sep-08	1.32	7.32	0	61.7	17.2	15.6	16.7	120	37	0.89
Rep 2		0.0644	2.51	0	60.4	12.9	10.5	9.47	95.8	38	0.90
Rep 3		0.443	7.14	0.192	69.4	14.8	21.4	5.19	119	41	0.91
Rep 4		0	6.49	0	46.0	12.7	18.8	3.42	87.4	40	0.89
Rep 5		0	7.34	0	77.4	10.8	17.2	0	113	36	0.92
2PL-EAS-2											
Rep 1	13-Sep-08	0	2.71	0	36.4	5.66	34.9	9.00	88.6	30	0.86
Rep 2		0	3.06	0	39.5	10.2	24.5	6.51	83.7	37	0.86
Rep 3		0	4.92	0	44.1	6.57	19.9	8.54	84.0	33	0.86
Rep 4		0	4.41	0	49.3	9.19	28.4	0	91.3	27	0.84
Rep 5		0	7.37	0	31.4	5.22	24.8	11.0	79.8	34	0.90
Rep 1	24-Sep-08	0	4.58	0	56.1	8.86	17.9	2.10	89.6	36	0.82
Rep 2		0	3.97	0	53.5	8.36	20.2	0.328	86.3	36	0.88
Rep 3		0	4.74	0	62.3	10.1	21.2	5.41	104	37	0.89
Rep 4		0	3.43	0	51.2	9.83	20.0	6.18	90.6	32	0.88
Rep 5		1.18	5.43	0	60.9	8.65	27.8	0.328	104	35	0.91
2PL-EAS-3											
Rep 1	13-Sep-08	0	3.89	0	26.0	10.1	15.2	4.81	60.0	35	0.91
Rep 2		0	1.40	0	39.1	9.29	22.4	12.6	84.7	28	0.86
Rep 3		0	3.22	0	42.7	15.6	18.8	6.50	86.9	29	0.90
Rep 4		0	3.37	0	38.2	6.58	16.0	3.48	67.6	28	0.89
Rep 5		0	5.06	0	36.7	8.06	20.0	4.51	74.3	35	0.90
Rep 1	24-Sep-08	1.02	2.40	0	61.9	13.0	35.6	11.6	126	43	0.90
Rep 2		1.38	3.59	0	58.3	14.7	16.3	7.52	102	45	0.91
Rep 3		0	6.88	0	51.4	13.4	24.7	0.429	96.8	42	0.88
Rep 4		0	6.98	0	52.8	21.1	28.5	0	109	36	0.88
Rep 5		0	3.67	0	41.3	14.1	19.6	4.99	83.7	35	0.90

Station	Date	Phytoplankton Biomass (mg/m^3)								# Species	Simpsons Diversity
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total		
Second Portage Lake (continued)											
2PL-EAS-DT											
Rep 1	13-Sep-08	0	7.53	0	162	19.3	13.5	14.5	217	41	0.87
Rep 2		0.716	4.57	0	122	9.77	12.9	9.10	159	39	0.88
Rep 3		0.184	5.20	0	120	13.6	13.4	12.7	165	41	0.86
Rep 4		0.718	11.6	0	140	16.7	10.6	11.6	191	40	0.86
Rep 5		0	7.41	0	119	15.1	13.2	14.3	169	42	0.88
Rep 1	24-Sep-08	0.964	10.2	0	115	22.3	15.1	0	164	39	0.88
Rep 2		1.08	4.43	0	55.3	11.2	8.79	2.41	83.2	37	0.85
Rep 3		0.539	2.93	0	80.7	13.1	6.96	10.2	114	38	0.88
Rep 4		0.539	5.61	0	75.5	15.0	12.2	9.25	118	41	0.84
Rep 5		3.23	3.51	0	85.6	10.2	4.43	8.50	115	38	0.85
Third Portage Lake											
3PL-EAS											
Rep 1	14-Sep-08	0	9.90	0	154	18.1	10.3	31.5	224	40	0.91
Rep 2		0.480	3.87	0	160	16.8	9.00	33.5	224	39	0.89
Rep 3		0	3.26	0	120	14.5	11.5	20.6	170	36	0.89
Rep 4		0.539	11.3	0	170	9.73	8.48	20.6	221	42	0.91
Rep 5		0.988	5.90	0.407	141	11.9	10.6	18.1	189	40	0.89
Rep 1	25-Sep-08	1.67	8.64	0	120	18.5	5.66	8.38	163	43	0.93
Rep 2		1.74	7.32	0	117	16.8	7.18	12.8	163	41	0.91
Rep 3		32.2	8.68	0	90.2	12.6	12.8	15.7	172	41	0.92
Rep 4		1.78	4.83	0	107	19.3	10.9	17.7	162	43	0.91
Rep 5		2.73	9.73	0	93.6	8.83	7.52	6.31	129	42	0.93
Relative Biomass (%)		**0.959**	**4.51**	**0.0101**	**63.0**	**10.0**	**14.3**	**7.17**	**NA**	**NA**	**NA**

Table 4-8: Density (cells/L) of major phytoplankton groups at EAS stations, Second & Third Portage Lakes, September 2008.

Station	Date	Phytoplankton Density (cells/L)							
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total
Second Portage Lake									
2PL-EAS-1									
Rep 1	13-Sep-08	0	330864	0	503480	25352	202352	400	1062448
Rep 2		14368	122128	0	590288	69056	140712	1200	937752
Rep 3		0	151664	0	511264	67256	167448	200	897832
Rep 4		7184	165232	0	417272	67456	193384	800	851328
Rep 5		0	58272	0	539800	46704	171432	200	816408
Rep 1	24-Sep-08	79224	374168	0	1099752	165248	75056	43904	1837352
Rep 2		200	201352	0	741752	74056	70056	14768	1102184
Rep 3		400	295144	200	833944	97608	133328	14768	1375392
Rep 4		0	246656	0	813592	45720	143896	1200	1251064
Rep 5		0	338448	0	763104	36936	89424	0	1227912
2PL-EAS-2									
Rep 1	13-Sep-08	0	79024	0	468360	55088	282792	21952	907216
Rep 2		0	64856	0	668912	69856	183216	7784	994624
Rep 3		0	204552	0	626608	48504	122944	22352	1024960
Rep 4		0	51088	0	755520	21768	203968	0	1032344
Rep 5		0	309312	0	410088	25552	200368	14968	960288
Rep 1	24-Sep-08	0	144280	0	970040	81640	86424	600	1282984
Rep 2		0	130112	0	934520	77840	95408	200	1238080
Rep 3		0	187584	0	934520	100592	128728	800	1352224
Rep 4		0	115744	0	776472	80040	109176	7784	1089216
Rep 5		7184	323480	0	776872	71856	173032	200	1352624
2PL-EAS-3									
Rep 1	13-Sep-08	0	195568	0	503280	69256	106176	14368	888648
Rep 2		0	43904	0	669112	40720	171232	23352	948320
Rep 3		0	244256	0	711216	53504	95808	21552	1126336
Rep 4		0	144280	0	495896	54088	132912	7984	835160
Rep 5		0	202352	0	568136	71856	164248	7984	1014576
Rep 1	24-Sep-08	7184	86808	0	776472	75656	156080	21952	1124152
Rep 2		86208	86808	0	826760	127544	58488	7784	1193592
Rep 3		0	180200	0	812192	104192	119760	200	1216544
Rep 4		0	158048	0	841128	42336	172832	0	1214344
Rep 5		0	194168	0	806208	88624	76056	7384	1172440

Station	Date	Phytoplankton Density (cells/L)							
		Cyanophyte	Chlorophyte	Euglenophyte	Chrysophyte	Diatom	Cryptophyte	Dinoflagellate	Total
Second Portage Lake (continued)									
2PL-EAS-DT									
Rep 1	13-Sep-08	0	201952	0	2036272	89424	81040	14968	2423656
Rep 2		7384	151264	0	1461752	57488	104976	28936	1811800
Rep 3		200	108360	0	1442400	78640	85424	22152	1737176
Rep 4		7184	297744	0	1801000	66872	42320	15768	2230888
Rep 5		0	89208	0	1346208	79240	93008	22352	1630016
Rep 1	24-Sep-08	6400	274192	0	1354592	150696	114360	0	1900240
Rep 2		14368	101176	0	836944	38936	74840	7184	1073448
Rep 3		7184	122528	0	1080400	85624	53488	14968	1364192
Rep 4		7184	136496	0	1094568	33552	91208	14768	1377776
Rep 5		43104	173216	0	1052464	33952	18568	14968	1336272
Third Portage Lake									
3PL-EAS									
Rep 1	14-Sep-08	0	204152	0	1662504	274192	62472	46904	2250224
Rep 2		400	136896	0	1669688	274592	27352	32936	2141864
Rep 3		0	129712	0	1660304	224504	66456	16768	2097744
Rep 4		7184	187384	0	1825736	245056	82824	52088	2400272
Rep 5		7984	100776	200	1553944	159048	118144	16368	1956464
Rep 1	25-Sep-08	21752	352816	0	1560328	270408	45904	2400	2253608
Rep 2		22152	237672	0	1489088	255640	47504	9784	2061840
Rep 3		600	346032	0	1295320	167632	106576	8784	1924944
Rep 4		14968	173416	0	1510840	282376	84024	31136	2096760
Rep 5		79824	403304	0	1013744	166832	61072	8984	1733760
Relative Abundance (%		**0.632**	**13.2**	**0.000562**	**70.1**	**7.16**	**8.00**	**0.912**	**NA**

Table 4-9: Relative abundance of zooplankton taxa at EAS stations in Second and Third Portage Lakes, 2008.

Taxa	Station				
	2PL-EAS-1	2PL-EAS-2	2PL-EAS-3	2PL-EAS-DT	3PL-EAS
DIPTERA					
Unidentified Chironomidae larv	0%	0%	0%	0.11%	0%
CLADOCERA					
Daphniidae					
Daphnia longiremis Sars	0%	0.62%	0%	0.22%	0.34%
Daphnia middendorffiana Fischer	1.7%	3.8%	3.4%	0.22%	0.67%
Bosminidae					
Bosmina longirostris (O.F. Muller)	16%	14%	10%	9.9%	14%
Chydoridae					
Chydorus	0.29%	0.31%	0.42%	0.32%	0%
COPEPODA					
Calanoida					
Unidentified Calanoida	0.29%	0.23%	0.84%	0.43%	0.34%
Diaptomidae					
Diaptomus ashlandi Marsh	0.86%	0.93%	8.4%	3.9%	0.34%
Diaptomus minutus Lilljeborg	6.6%	6.5%	8.4%	13%	0.67%
Diaptomus sicilis S.A. Forbes	6.7%	9.6%	7.7%	8.6%	14%
Unidentified *Diaptomus* females*	21%	22%	28%	24%	35%
Temoridae					
Heterocope septentrionalis Juday and Muttkowsk	0%	0%	0%	1.7%	1.3%
Cyclopoida					
Unidentified Cyclopoida	11%	4.3%	6.7%	9.5%	1.7%
Cyclopidae					
Acanthocyclops vernalis Fisher	0.57%	1.2%	0.42%	1.7%	0.67%
Cyclops scutifer Sars	36%	37%	26%	26%	30%
Harpacticoida					
Unidentified Harpacticoida	0.072%	0%	0%	0%	0%
Total Number of Taxa	**9**	**9**	**8**	**11**	**9**

Notes:

Relative abundance: calculated as [(ind. taxa zooplabkton abundance) / sum(station zooplankton abundance)] * 100.

* Taxa are not included in taxa richness counts.

Table 4-10. Statistical analyses results for the AEMP benthic invertebrate data set.

		Model		Target	
Station	**Parameter**	**Fixed Effects**	**Random Effects**	**Effect**	**B*C Trend Interpretation**
SP	Total Abundance	B + C + B*C	Yr, Stn	B*C	Negligible, p = 0.27
			Stn/Yr	B*C	Marginal, p = 0.11
SP	Total Richness	B + C + B*C	Yr, Stn	B*C	Negligible, p = 0.45
TE	Total Abundance	B + C + B*C	Yr, Stn	B*C	Negligible, p = 0.68
			Stn/Yr	B*C	Negligible, p = 0.50
TE	Total Richness	B + C + B*C	Yr, Stn	B*C	Negligible, p = 0.51

Notes: Station: SP = Second Portage; TE = Tehek

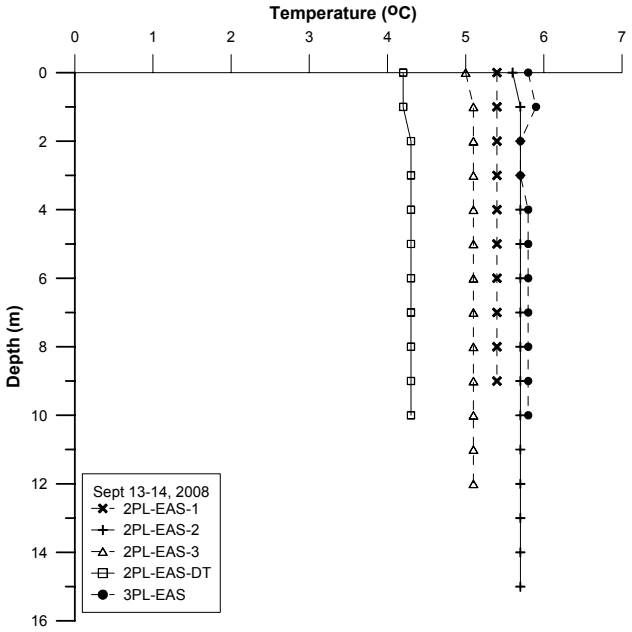
Fixed Effects: B = Before - After; C = Control - Impact; * = interaction

Random Effects: Stn = Station; Yr = Year; "/" = nested

Trends:

- Strong ($p<0.001$)
- Moderate ($0.001<p<0.05$)
- Marginal ($0.05<p<0.2$)
- Negligible ($p>0.2$)

Figure 4-1. Temperature (°C) and dissolved oxygen (mg/L) profiles, Second and Third Portage Lakes, September 13-14, 2008.



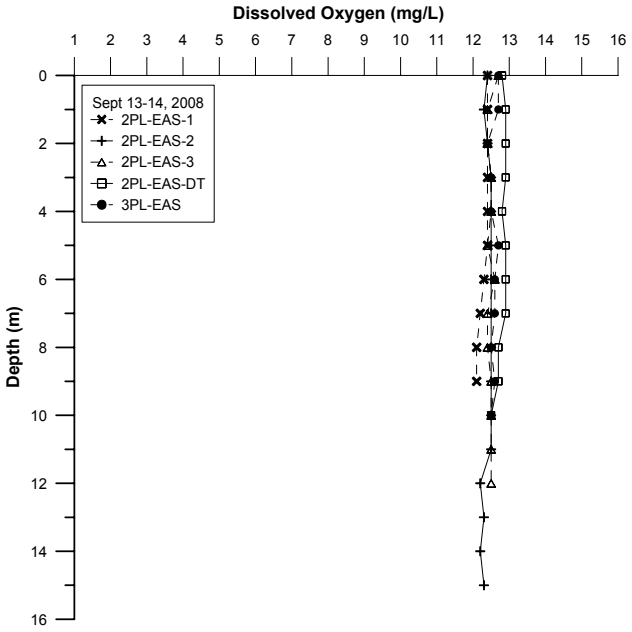


Figure 4-2. Temperature (°C) and dissolved oxygen (mg/L) profiles, Second and Third Portage Lakes, September 24-25, 2008.

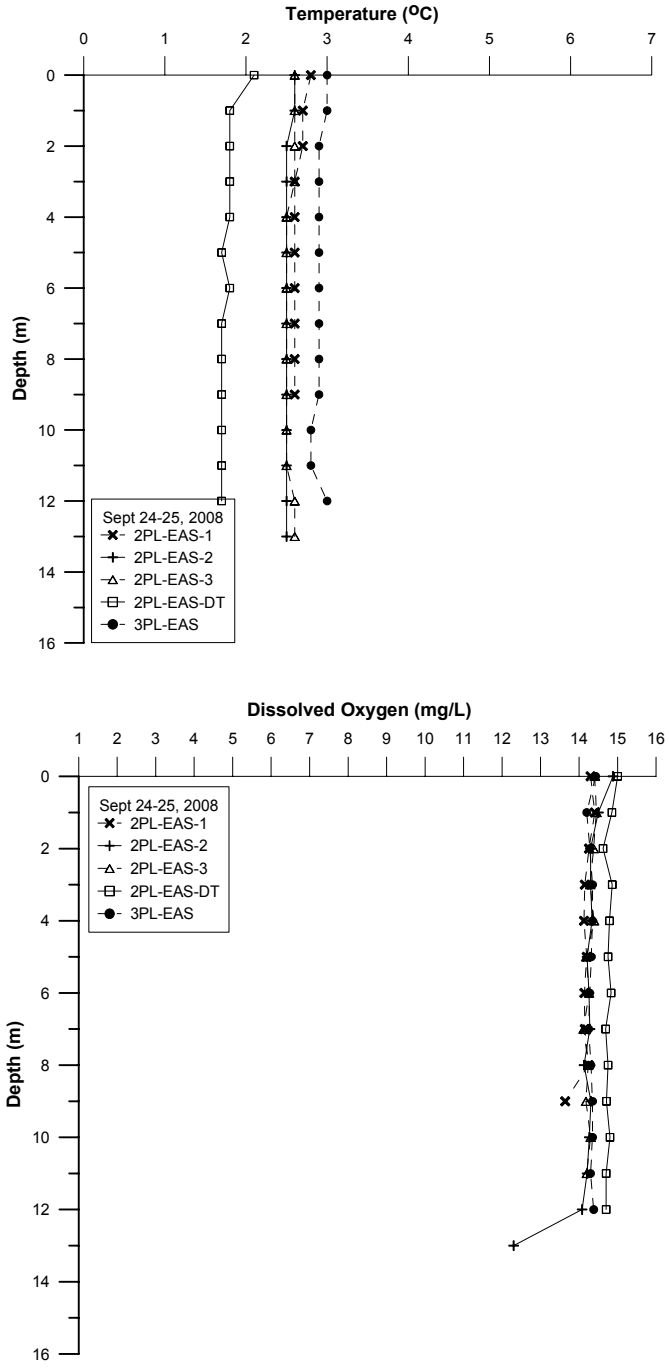
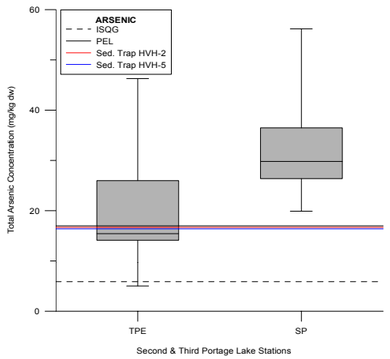
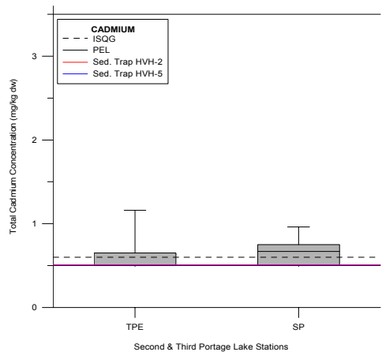
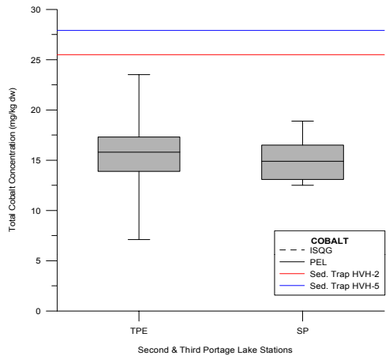
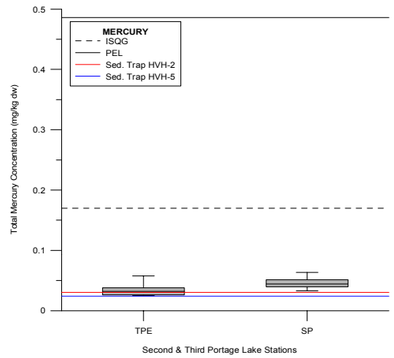


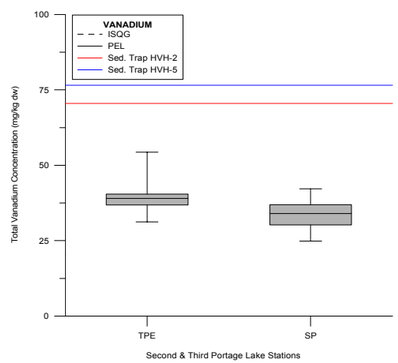
Figure 4-3. EAS sediment trap chemistry results for key metals compared to AEMP surface sediment (top 1 cm) chemistry and CCME guidelines.

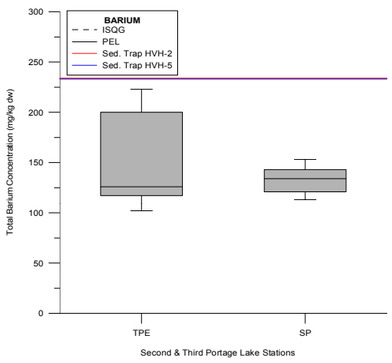


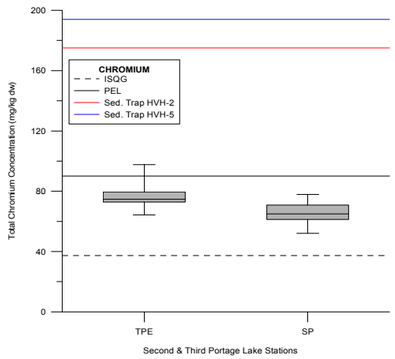


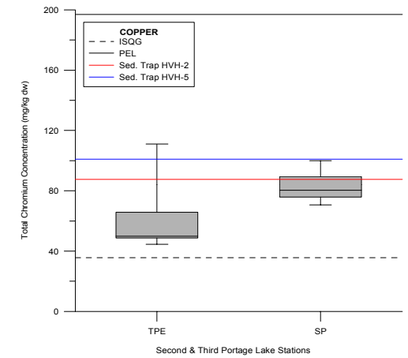


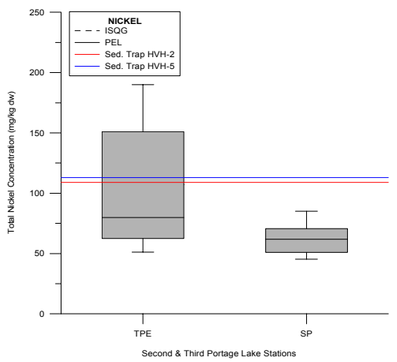












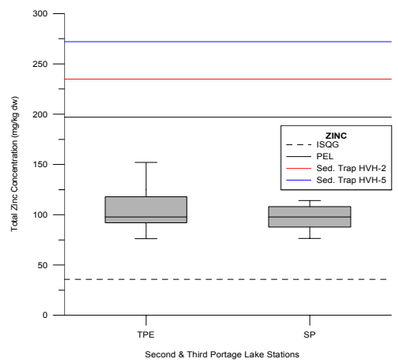


Figure 4-4. Mean total chlorophyll-a concentration (ug/L) in EAS study, Second and Third Portage Lakes, 2008.

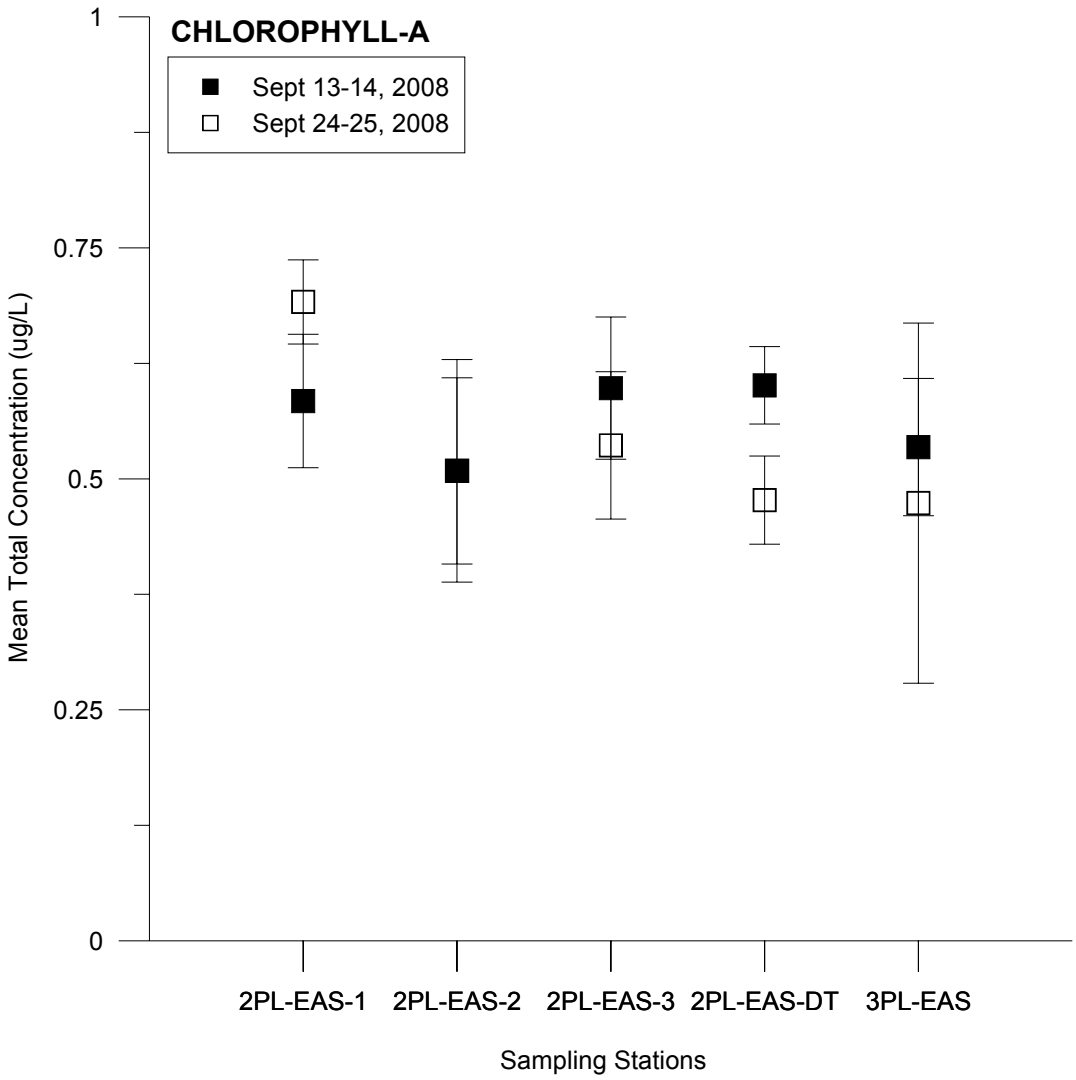


Figure 4-5. Seasonal chlorophyll-a concentrations (mg/m^3) in AEMP monitoring, Second Portage, Tehek and Third Portage Lakes (east and south basins), 2006-2008.

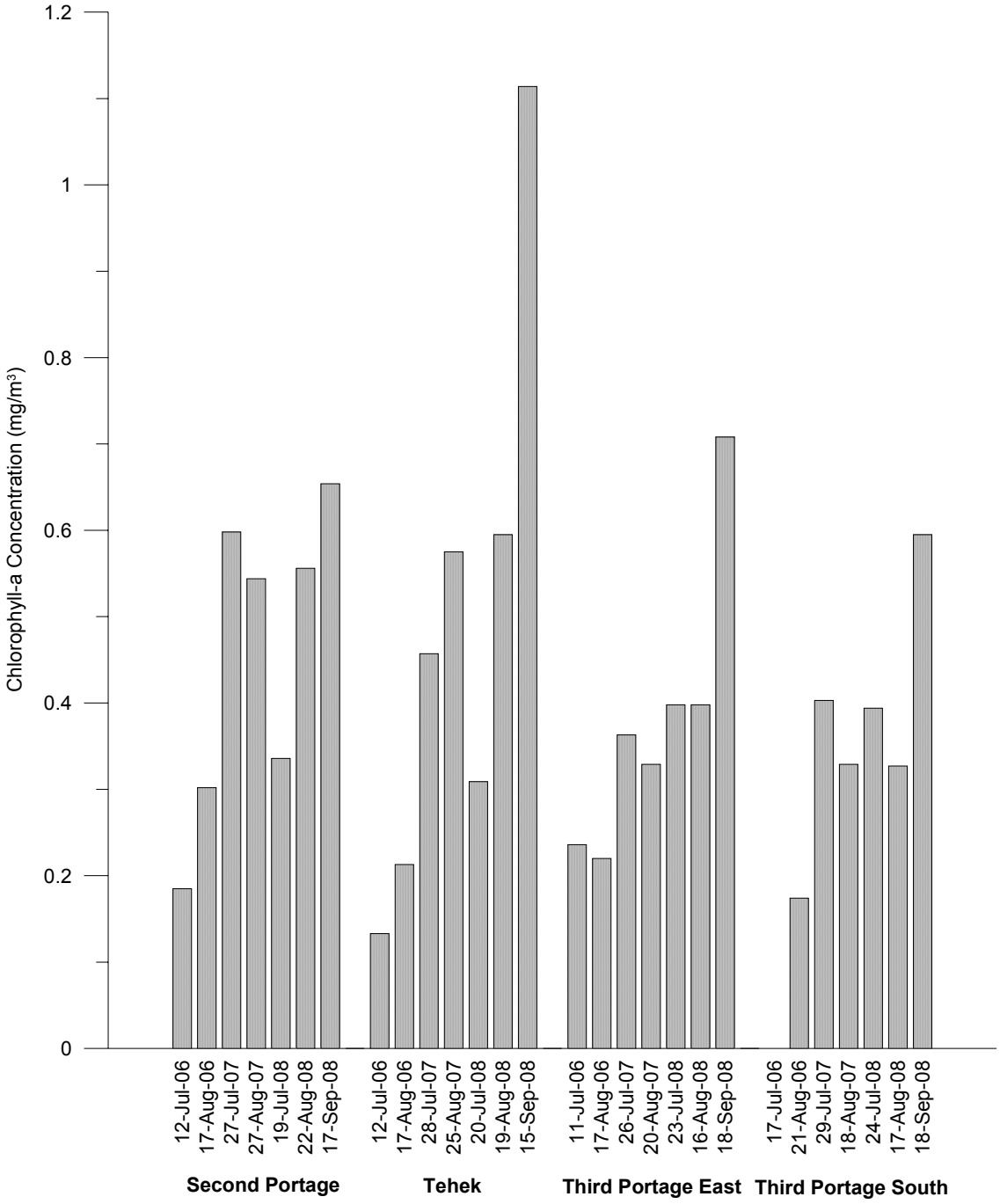


Figure 4-6. Phytoplankton mean total biomass (mg/m^3) in EAS study, Second and Third Portage Lakes, 2008.

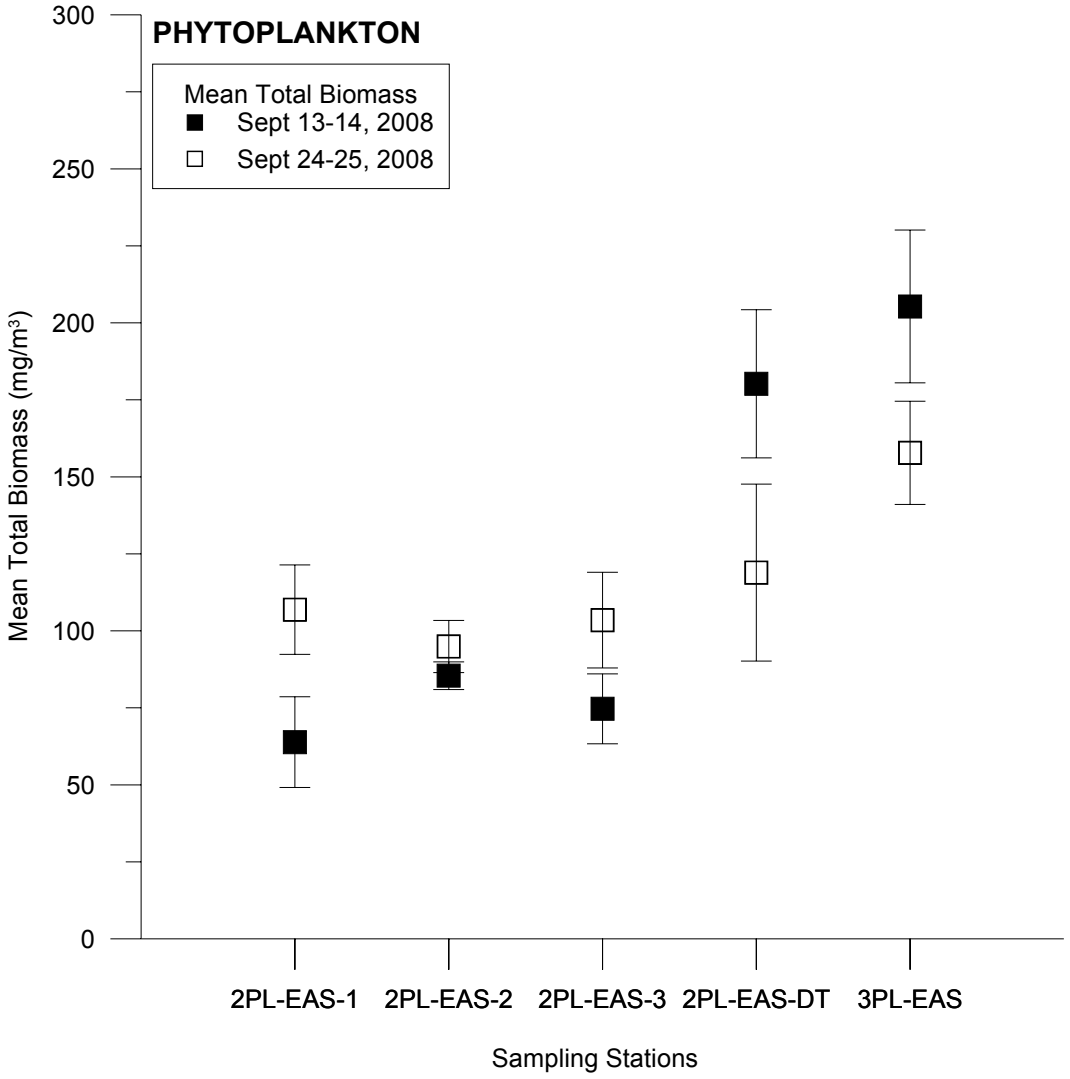


Figure 4-7. Phytoplankton biomass (mg/m^3) by major taxa group in EAS study, Second and Third Portage Lakes, 2008.

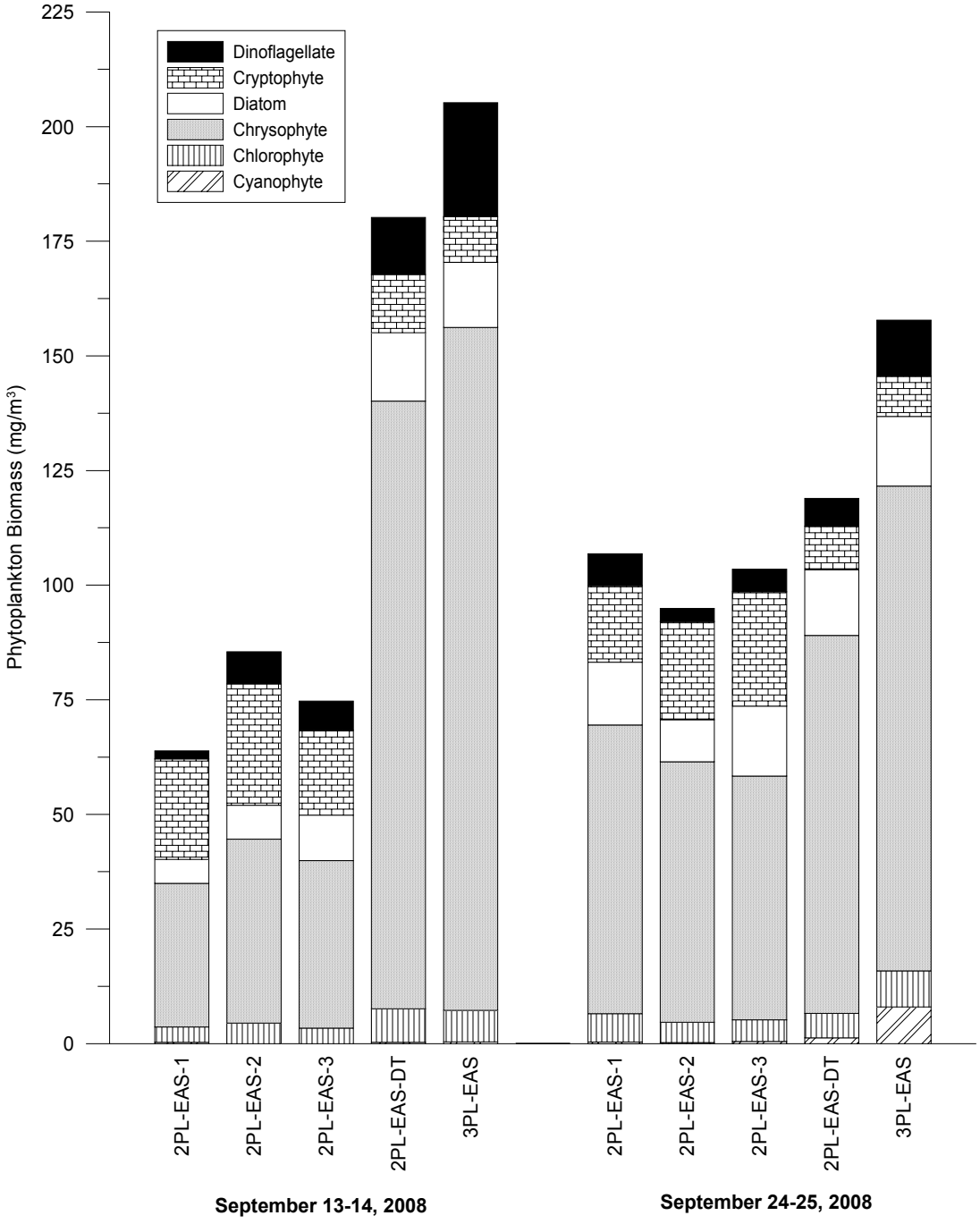


Figure 4-8. Seasonal phytoplankton biomass (mg/m3) by major taxa group in AEMP monitoring, Second Portage, Tehek and Third Portage Lakes (east and south basins), 2006 – 2008.

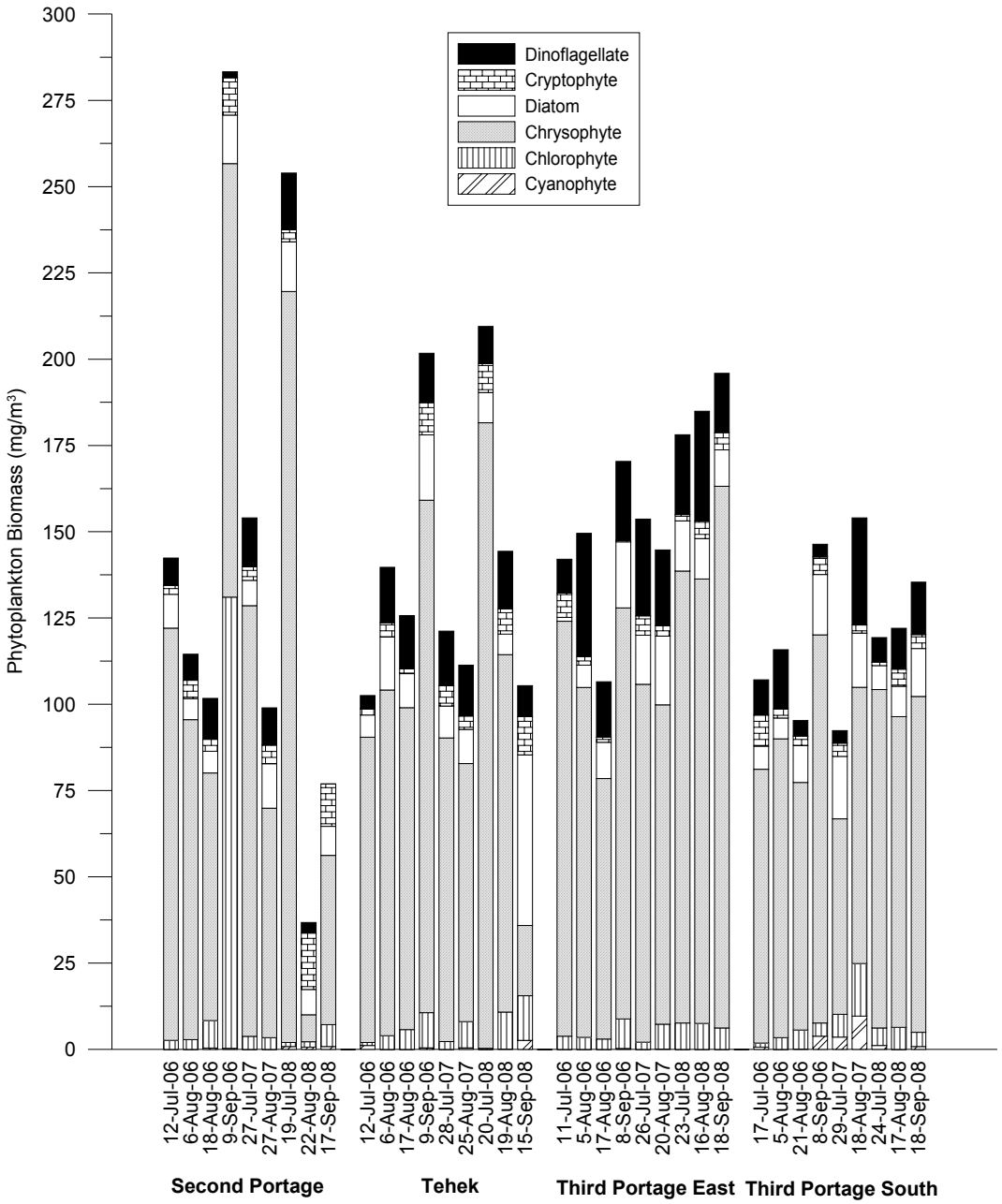


Figure 4-9. Zooplankton mean total biomass (mg/m^3 ww) in EAS study, Second and Third Portage Lakes, 2008.

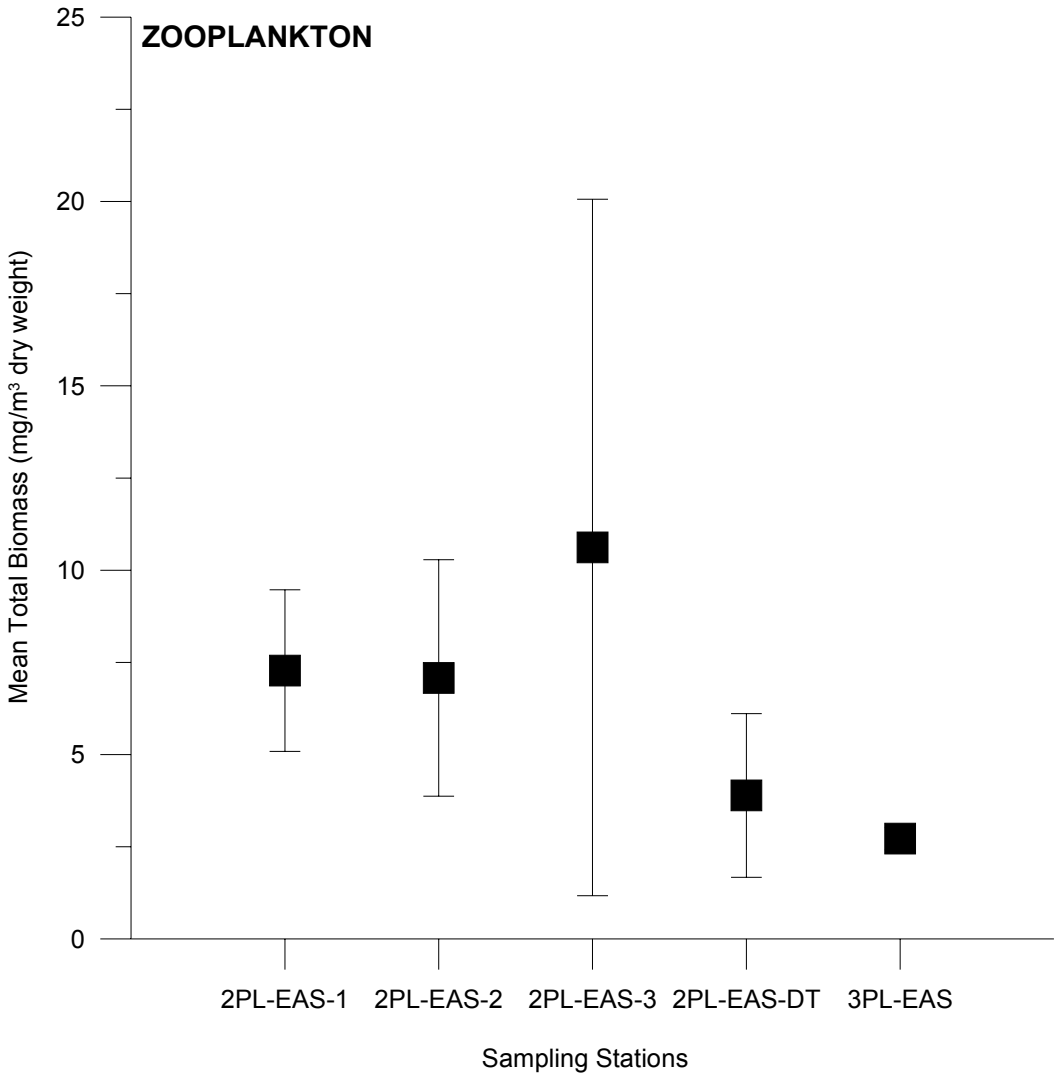


Figure 4-10. Benthic invertebrate mean abundance (# / m^2) by major taxa groups for AEMP monitoring, Second Portage, Tehek and Third Portage Lakes.

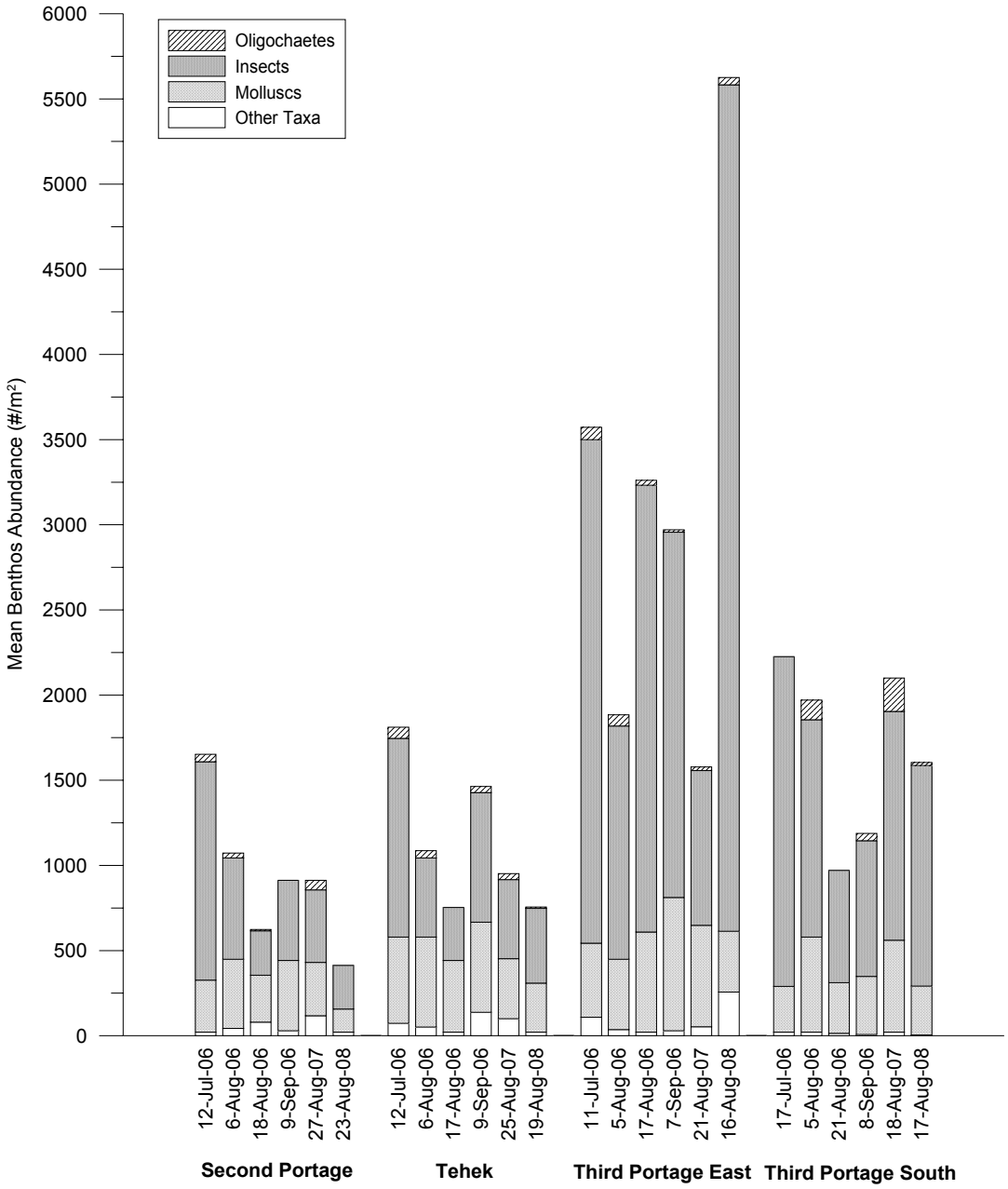


Figure 4-11. Benthic invertebrate mean richness (# taxa) by major taxa group for AEMP monitoring, Second Portage, Tehek and Third Portage Lakes.

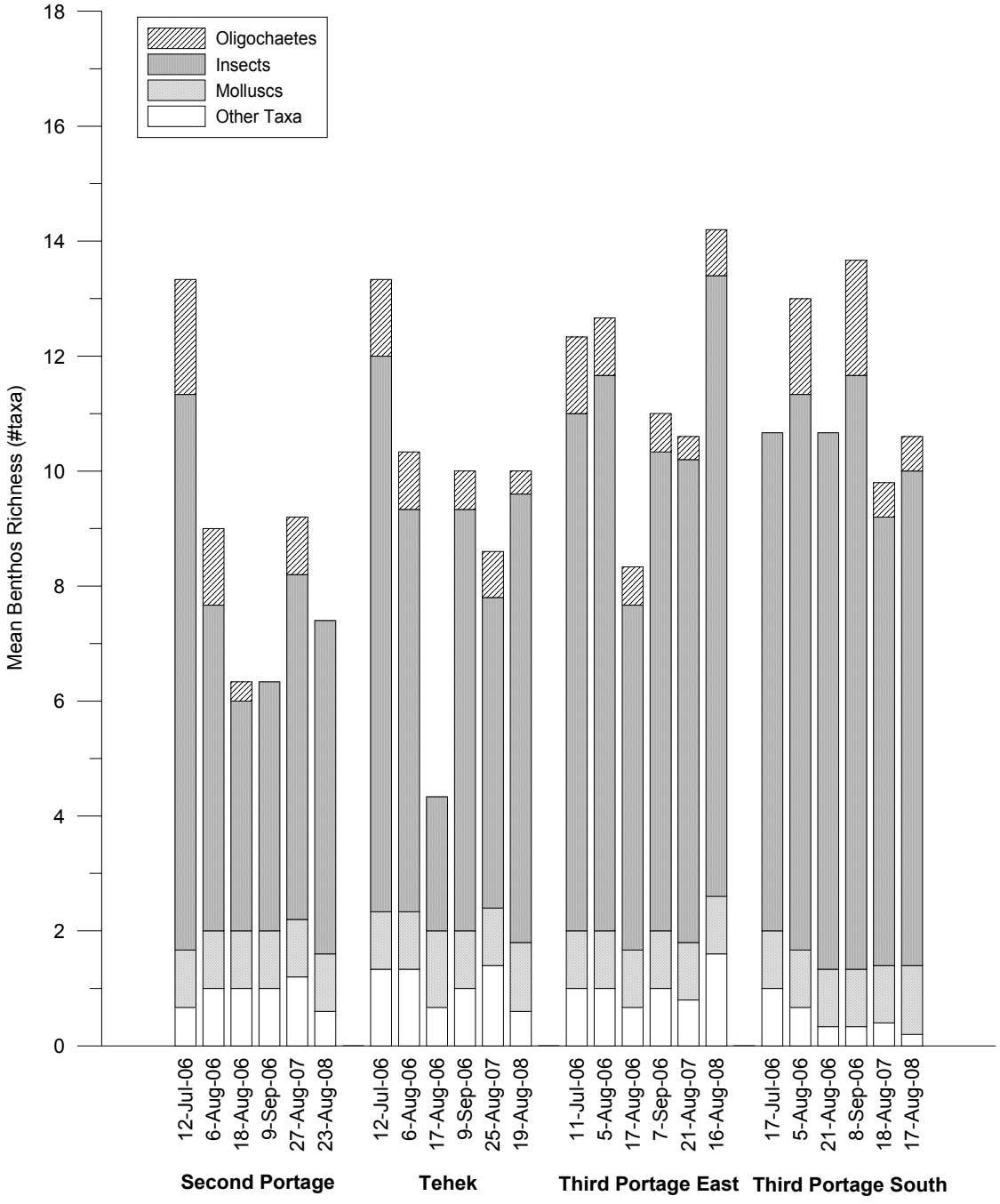


Figure 4-12. Total benthos abundance (ln; Var1): Station – Year interaction plot.

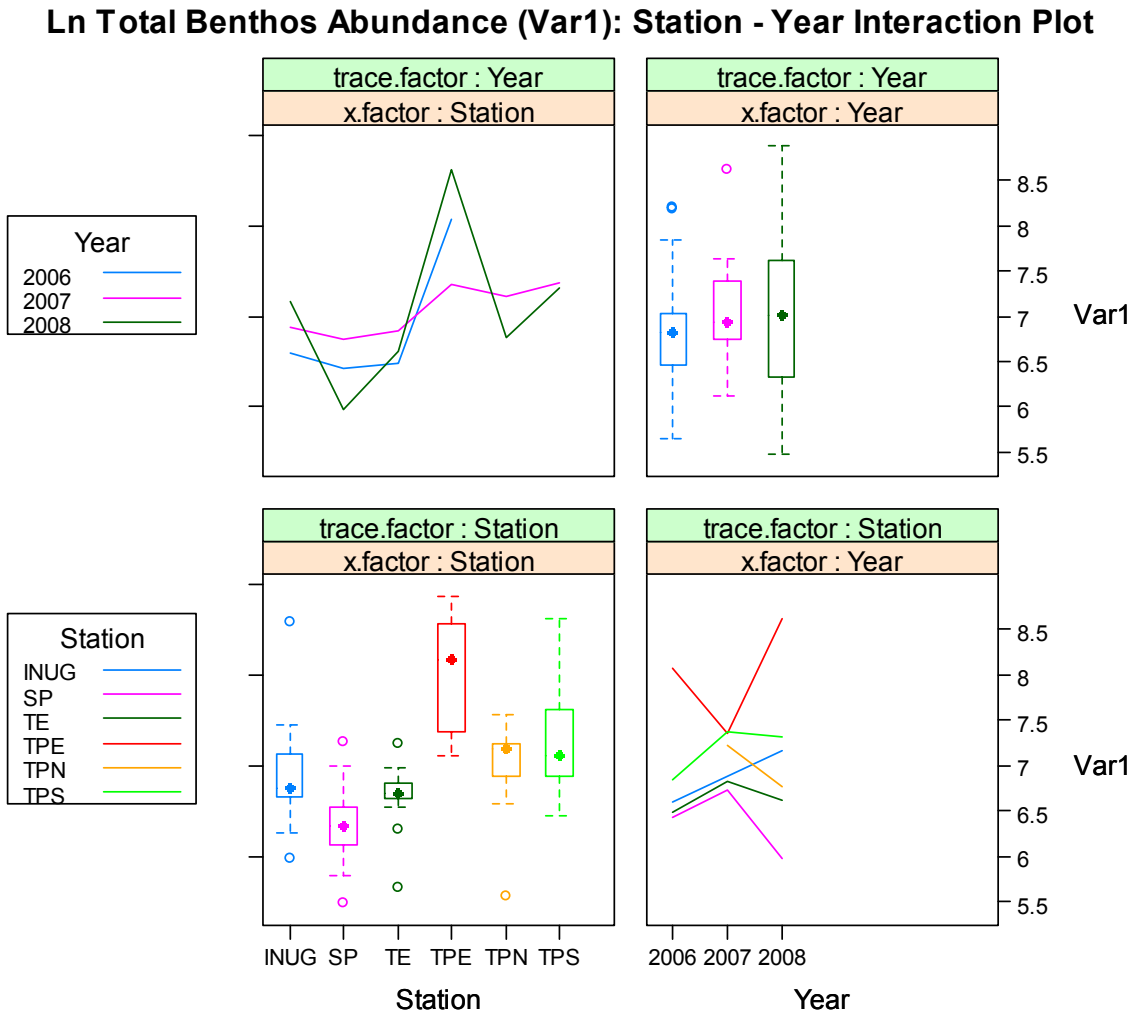


Figure 4-13. Total benthos richness (Var1): Station – Year interaction plot.

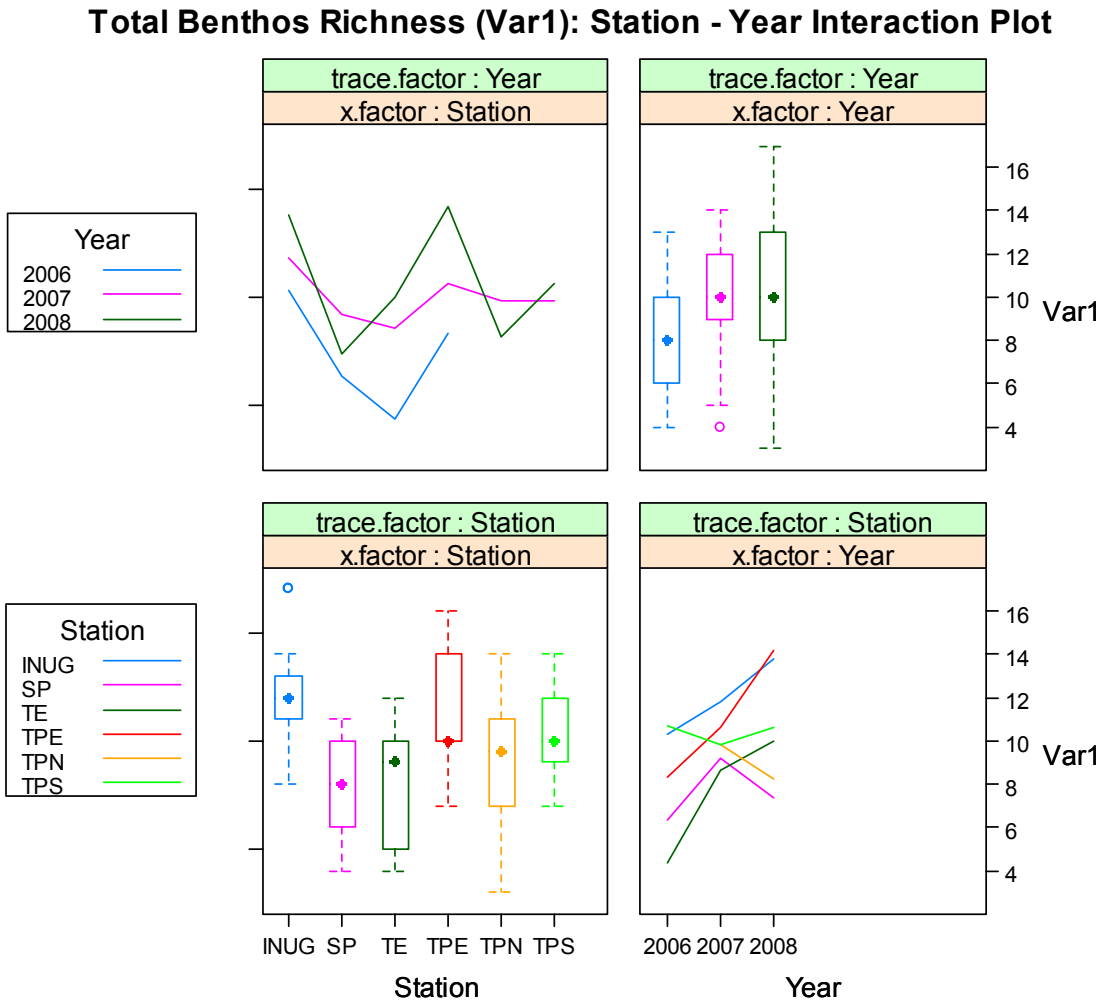


Figure 4-14. Effect size and estimated 95% confidence intervals for benthic invertebrate total abundance BACI effect (i.e., Stationtype*Yeartype) at Second Portage Lake station from AEMP (2006-2008) data.

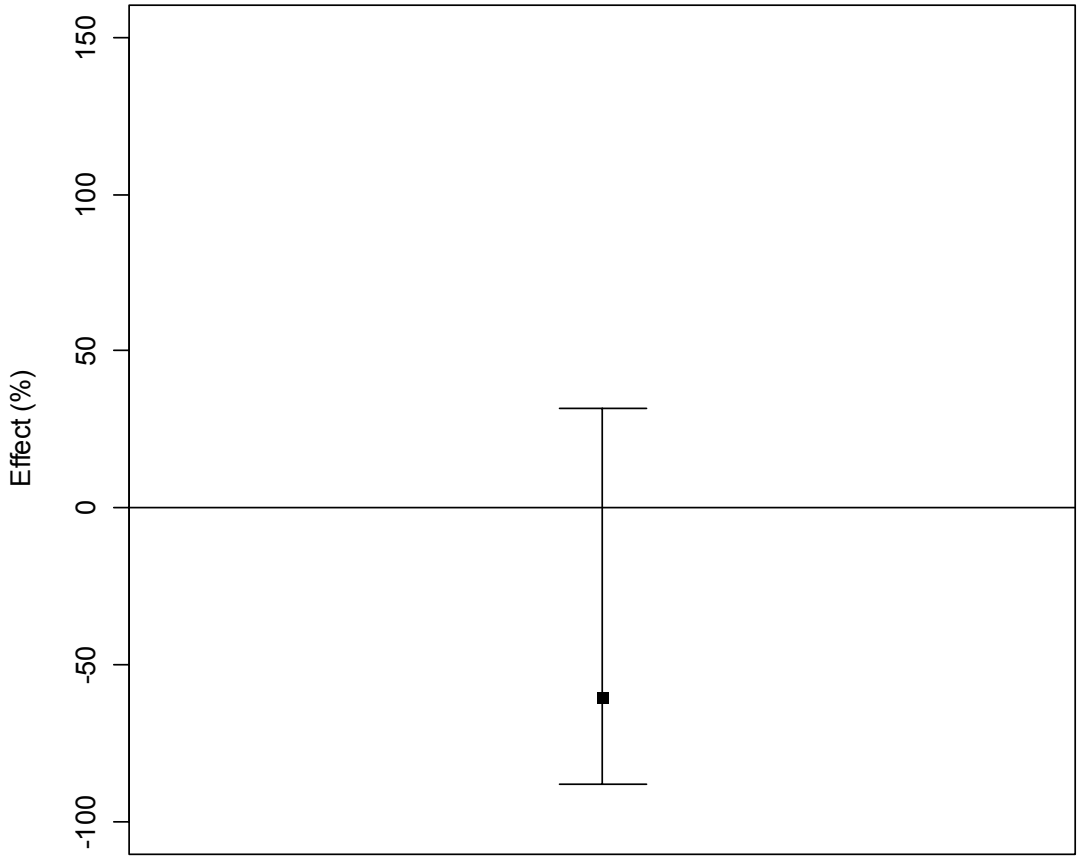


Figure 4-15. Effect size and estimated 80% confidence intervals for benthic invertebrate total abundance BACI effect (i.e., Stationtype*Yeartype) at Second Portage Lake station from AEMP (2006-2008) data.

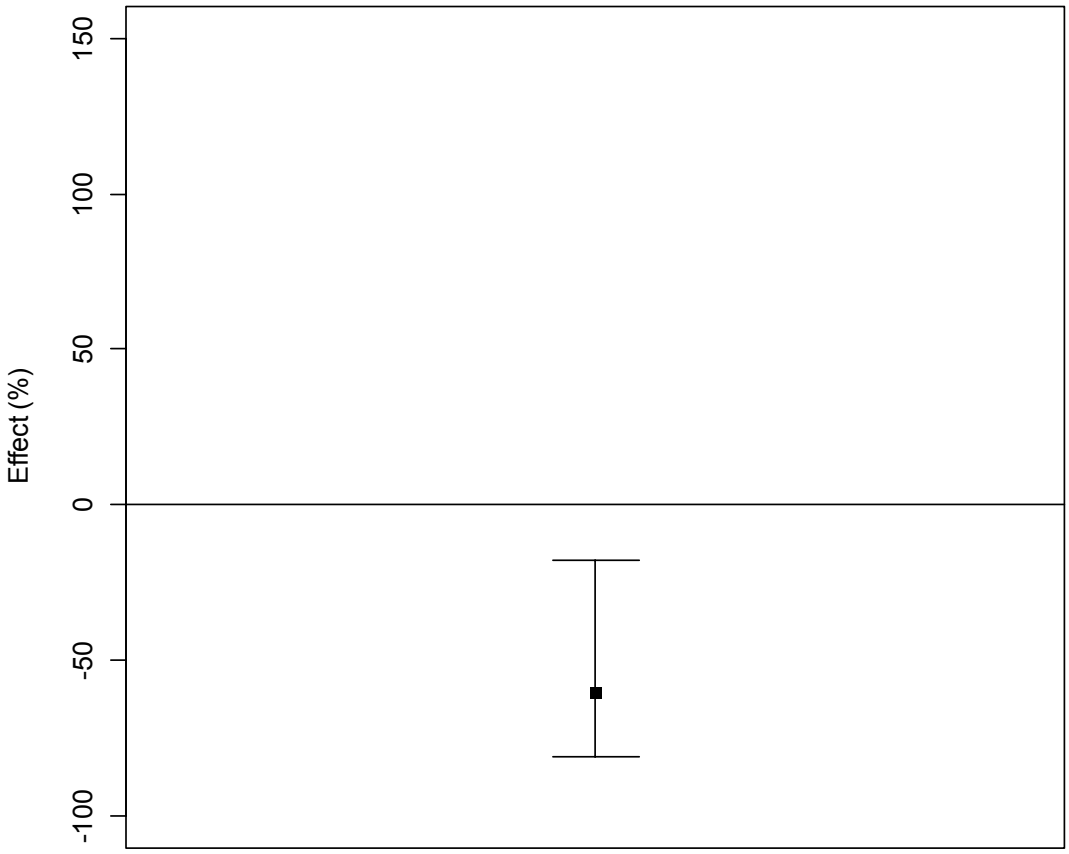
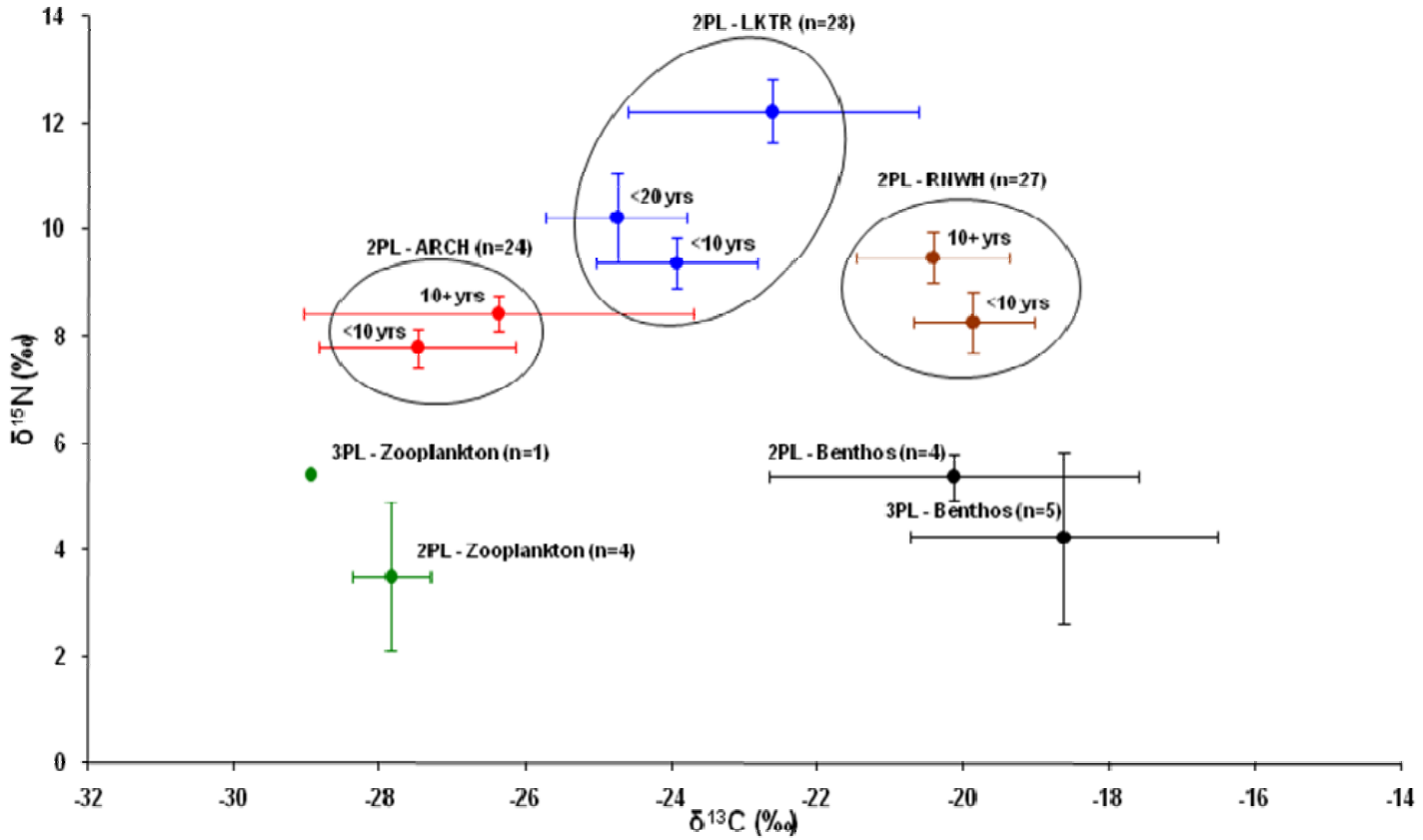


Figure 4-16. Mean (±SD) benthos, zooplankton and fish δ15N (‰) and δ13C (‰) value plots for Second and Third Portage Lakes, 2008.



Note: 2PL=Second Portage Lake; 3PL=Third Portage Lake; ARCH=arctic char; LKTR=lake trout; RNWH=round whitefish.

5. SUMMARY AND CONCLUSIONS

This study was conducted to address concerns regarding the potential impacts of elevated TSS concentrations from dike construction on the ecology of Second Portage. Elevated TSS concentrations can directly or indirectly affect the entire range of organisms in the aquatic environment, so the study addressed a broad array of ecosystem elements. The design premise was based on comparisons between two reference areas (Drilltrail Arm in Second Portage Lake and the East Basin of Third Portage Lake; TSS concentrations were typical of background conditions at both areas) and three exposure areas (three areas within Second Portage Lake exposed to elevated TSS concentrations). The laboratory toxicity testing was conducted using water from Second Portage Lake collected from near the East Dike (i.e., in the exposure area); exposure water treatments were compared to experimental controls to determine potential effects. Sampling was conducted in two events: September 13/14 and 24/25. Key results were as follows:

- *Water Quality and Limnology* – While water quality generally improved between late August peaks in TSS and September monitoring, there was still a substantial gradient in exposure between the three exposure areas and the two reference areas. It is also important to note that effects of TSS are not likely to be instantaneous and that the study was designed to assess chronic exposure. Consequently, despite the lower TSS concentrations, it is unlikely that the study would have missed any important chronic TSS-related effects.

    - Construction monitoring characterized a strong gradient in estimated TSS concentrations between the exposure (~10 mg/L for the first event and ~6 mg/L for the second event) and reference (~0.2 to 0.6 mg/L) areas during both monitoring periods. This was confirmed during EAS sampling by much lower Secchi depth readings at exposure areas, indicating reduced water clarity relative to the reference areas. This gradient was less pronounced, but still present, during the September 24/25 sampling event.

    - Nutrient concentrations were generally higher at the exposure stations, but ammonia, nitrite, and nitrate were still well below CCME water quality guidelines.

    - Vertical temperature and oxygen profile results showed no significant differences between areas.

    - Metals were primarily bound to particulates; dissolved metals were very low and typically below detection limits.

- *Primary Productivity* – Reduced water clarity limits light penetration, which can lower primary productivity. Two measures of primary productivity were assessed: chlorophyll-α and phytoplankton biomass. While there were no differences between areas for chlorophyll-α during either sampling event, phytoplankton biomass was significantly depressed in the exposure area relative to the reference area during both events. The difference between areas during the second event was much less pronounced, which is consistent with the weaker exposure gradient at that time (i.e., due to the overall improvement in water quality in Second Portage Lake). This recovery would be expected to continue to track water clarity improvements and not be of long-term significance.
- *Zooplankton* –Herbivorous zooplankton rely on phytoplankton as their primary food resource. Elevated TSS can affect zooplankton directly, by reducing feeding efficiency, or indirectly by reducing food supply (e.g., the reduced phytoplankton biomass that was observed at the exposure stations). Elevated TSS could also indirectly benefit zooplankton by making it harder for their predators to see them. Potential effects of TSS on zooplankton were assessed using both field (direct measurements of zooplankton biomass to integrate both direct and indirect effects) and laboratory (acute and chronic toxicity testing to assess direct effects) measures. Although phytoplankton biomass was lower in the exposure area, we could not detect significant differences in zooplankton biomass between the exposure and reference areas. No adverse effects were observed in either toxicity test.
- *Benthic Invertebrates* –Sediment inputs and depositional rates in the Meadowbank study lakes are typically extremely low. Accelerated inputs associated with construction activity may affect benthic invertebrates through smothering. This was identified in the monitoring plan for the East Dike (AEM, 2008a), which committed to assessing potential effects of increased sedimentation on the benthic community in 2009 and 2010. In the interim, however, there are two lines of evidence that are available: (1) benthic community data collected in Second Portage, Tehek and Third Portage lakes in late August as part of routine AEMP monitoring, and (2) sediment trap data for Second Portage Lake (see *Fish* for more details).
    - There were no statistically significant adverse effects to benthic community total abundance (density) or total richness identified at Second Portage or Tehek stations in 2008 relative to other stations and years. Notwithstanding, Second Portage Lake did show a marginal trend of reduced benthos abundance, but the result was inconclusive, likely due to naturally variable temporal and spatial patterns among stations and years.

- Sediment trap results indicate a deposition thickness of between approximately 1 and 2 mm for much of Second Portage Lake, which could have been responsible for the observed marginal trend in benthos abundance (i.e., through physical smothering).
- Chromium and zinc were significantly elevated in the sediment trap samples, which may have also contributed to the benthos abundance results. The response pattern (i.e., possible reduction in abundance, but not to diversity), however, is more consistent with physical effects.
- TSS concentrations in both Second Portage and Tehek lakes decreased substantially in the month following the AEMP sampling event. In the absence of further disturbance, the expectation would be that the noted effects would be short term in nature and the community should recover completely. The EAS and AEMP benthic community sampling in 2009 will help determine whether the community is recovering and, if so, at what rate.
- The planned 2009 and 2010 benthic community studies will provide some insight into the long-term significance of the deposition of construction-related sediments.

- *Fish* – Prolonged increases in TSS concentrations can affect fish directly (e.g., by clogging gills or by smothering eggs) or indirectly (e.g., by reducing prey abundance or by making prey harder to see). A combination of laboratory (toxicity tests using a range of life stages) and field (sediment traps and stable isotopes [to map the food web]) measures were used to help determine potential impacts to fish.
  - No adverse effects were observed for larval and juvenile trout. The larval test was conducted using live zooplankton as a food resource. The lack of growth or survival effects suggests that active feeding was not impaired by the reduced water clarity. Test results for larval and juvenile trout suggest that direct effects to these life stages are unlikely; this would also apply to adults. Two tests were conducted using trout embryos: one where test water was renewed each day (renewal) and the other where it was not (static). This renewal/static combination was used to provide insights into whether any observed effects were due to chemical or physical effects. No effects were observed in the renewal test. However, impaired development was observed in the static test, suggesting that physical settling of sediments could affect developing embryos.
  - Sediment traps were deployed prior to East Dike construction at a number of high-value habitats in Second Portage Lake and retrieved in late September. Results indicate that between 1 and 2 mm of sediment settled

during that time. Video surveys will be conducted on these areas (and similar areas outside the influence of elevated TSS) in 2009.

- Stable isotope analysis was used to assess the Second Portage Lake food web by measuring ratios of carbon and nitrogen isotopes in organisms (e.g., benthic invertebrates, zooplankton and fish) to discern "who is eating who" in the lake. For the EAS study, this information provides insights into the relative importance of the pelagic (phytoplankton to zooplankton to fish) and benthic (algae/detritus to invertebrates to fish) pathways in the food web. Stable isotope signatures in muscle tissue of fish indicate that both are actually important. Arctic char preferentially exploit pelagic food sources (i.e., zooplankton), while round whitefish target benthic food sources. Lake trout, the dominant species in the lake, feeds on both these fish species (in addition to other lake trout) in approximately equal proportions. This is understandable given the nutrient-driven productivity limitations characteristic of ultra-oligotrophic lakes.

From an ecological perspective, the EAS results point to settled sediment, rather than suspended sediment, as the primary outstanding concern. Apart from the depression of phytoplankton productivity, which showed substantial recovery between sampling events, there were no ecologically-significant effects observed related to TSS in the water column. Settled or settling sediment, however, was identified as a potential concern for benthic invertebrates (a marginal, but inconclusive, trend was observed in SP, but not TE) and fish (possible smothering of eggs in spawning areas based on toxicity test results). EAS work in 2009 (and 2010 for benthos) will target reducing uncertainty as to whether settled sediment remains an ecological concern in Second Portage Lake; key study components include (see Azimuth, 2008a for more details):

- *Benthic community analysis* – the EAS study design will include more extensive sampling in Second Portage Lake and Tehek Lake. Similar to the field effects measurements taken for other endpoints in 2008, the 2009 benthos results will be used to determine whether there are any differences between exposure and reference areas. If there are effects, then the survey will be repeated in 2010 to determine whether the community is recovering and if so, at what rate (the AEMP data for 2009 and 2010 will also be used as needed to further our understanding of the situation).
- *High-value habitat assessment* – an underwater video survey will be conducted to compare and contrast settled sediment patterns in high-value habitat areas exposed to elevated TSS concentrations to those beyond the zone of influence. While not specifically a component of the EAS for 2009, sediment traps will

again be deployed in 2009 to support construction-related monitoring for the Bay-Goose dike; some of these traps will be deployed in Second Portage Lake at areas relevant to the EAS.

- *Surface sediment coring* - the sediment coring program conducted in 2008 prior to dike construction will be repeated at four (TPL-E, SPL, TE and INUG) locations to verify the results of the sediment trap chemistry sampling conducted in 2008 (i.e., to determine whether sediment chemistry in the top 1 cm was changed by the high chromium and zinc measured in the sediment trap sediment).

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APPENDICES

APPENDIX A

CHEMISTRY ANALYSES REPORTS

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.

ATTN: RANDY BAKER

218 - 2902 WEST BROADWAY

VANCOUVER BC V6K 2G8

Reported On: 28-OCT-08 11:38 AM
Revision: 1

Lab Work Order #: **L687296** **Date Received:** **24-SEP-08**

Project P.O. #:
Job Reference: EAS
Legal Site Desc:
CofC Numbers:

Other Information:

Comments: For some of the submitted water samples, the measured concentration of specific dissolved parameters is greater than the corresponding total parameters concentration. The explanation for these findings is one or a combination of the following:
- laboratory method variability;
- field sampling method variability;
- bias introduced during general handling, storage, transportation and/or analysis of the sample;
- field sample grab bias - where separate grab samples are processed to produce total and dissolved samples;
- field sample split bias - where total and dissolved parameters samples are produced from the same grab sample.

For further clarification on any of the above information, please contact your ALS account manager.

Please note: equipment blank results were confirmed by re-analysis.

Bryan Mark
Account Manager

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ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-1	L687296-2	L687296-3	L687296-4	L687296-5
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-1	2PL-EAS-1 REP1	2PL-EAS-2	2PL-EAS-2 REP1	2PL-EAS-3
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	28.0		26.0		25.3
	Hardness (as CaCO3) (mg/L)	11.9		10.8		10.3
	pH (pH)	7.28		7.23		7.24
	Total Suspended Solids (mg/L)	<3.0		<3.0		<3.0
	Total Dissolved Solids (mg/L)	16		20		14
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.8		8.1		8.1
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0		<2.0		<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0		<2.0		<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	8.8		8.1		8.1
	Ammonia as N (mg/L)	<0.020		<0.020		<0.020
	Chloride (Cl) (mg/L)	<0.50		<0.50		<0.50
	Nitrate (as N) (mg/L)	0.0368		0.0293		0.0329
	Nitrite (as N) (mg/L)	0.0012		<0.0010		<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.090		0.080		0.093
	Ortho Phosphate as P (mg/L)	0.0011		<0.0010		<0.0010
	Total Phosphate as P (mg/L)	0.0094		0.0073		0.0077
	Sulfate (SO4) (mg/L)	1.98		2.02		1.87
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.84		1.86		1.95
	Total Organic Carbon (mg/L)	1.45		1.51		1.59
Total Metals	Aluminum (Al)-Total (mg/L)	0.355		0.417		0.388
	Antimony (Sb)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Arsenic (As)-Total (mg/L)	<0.00050		<0.00050		<0.00050
	Barium (Ba)-Total (mg/L)	<0.020		<0.020		<0.020
	Beryllium (Be)-Total (mg/L)	<0.0010		<0.0010		<0.0010
	Boron (B)-Total (mg/L)	<0.10		<0.10		<0.10
	Cadmium (Cd)-Total (mg/L)	<0.000017		<0.000017		<0.000017
	Calcium (Ca)-Total (mg/L)	3.03		2.81		2.64
	Chromium (Cr)-Total (mg/L)	0.0011		0.0014		0.0013
	Cobalt (Co)-Total (mg/L)	<0.00030		<0.00030		<0.00030
	Copper (Cu)-Total (mg/L)	0.0018		0.0018		0.0017
	Iron (Fe)-Total (mg/L)	0.437		0.533		0.492
	Lead (Pb)-Total (mg/L)	0.00118		0.00125		0.00248
	Lithium (Li)-Total (mg/L)	<0.0050		<0.0050		<0.0050
	Magnesium (Mg)-Total (mg/L)	0.98		1.01		0.95
	Manganese (Mn)-Total (mg/L)	0.00941		0.00868		0.00890
	Mercury (Hg)-Total (mg/L)	<0.000020		<0.000020		<0.000020
	Molybdenum (Mo)-Total (mg/L)	<0.0010		<0.0010		<0.0010
	Nickel (Ni)-Total (mg/L)	0.0013		0.0013		0.0012

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID	L687296-6	L687296-7	L687296-8	L687296-9	L687296-10
		Description					
		Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	01-AUG-08
		Sampled Time					
		Client ID	2PL-EAS-3 REP1	2PL-EAS-DT	2PL-EAS-DT REP1	2PL-EAS-DUP	TRAVEL BLANK AE08FISHOUT
WATER							
Physical Tests	Conductivity (uS/cm)			26.2		26.2	<2.0
	Hardness (as CaCO3) (mg/L)			10.9		10.7	
	pH (pH)			7.22		7.22	5.57
	Total Suspended Solids (mg/L)			<3.0		<3.0	<3.0
	Total Dissolved Solids (mg/L)			12		14	<10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)			8.1		7.4	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)			<2.0		<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)			<2.0		<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)			8.1		7.4	<2.0
	Ammonia as N (mg/L)			0.027		0.024	<0.020
	Chloride (Cl) (mg/L)			<0.50		<0.50	<0.50
	Nitrate (as N) (mg/L)			<0.0050		<0.0050	<0.0050
	Nitrite (as N) (mg/L)			<0.0010		<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)			0.091		0.087	<0.050
	Ortho Phosphate as P (mg/L)			<0.0010		<0.0010	<0.0010
	Total Phosphate as P (mg/L)			0.0025		0.0035	<0.0020
	Sulfate (SO4) (mg/L)			2.42		2.40	<0.50
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)			1.80		1.88	
	Total Organic Carbon (mg/L)			1.74		1.70	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)			0.0146		0.0176	
	Antimony (Sb)-Total (mg/L)			<0.00050		<0.00050	
	Arsenic (As)-Total (mg/L)			<0.00050		<0.00050	
	Barium (Ba)-Total (mg/L)			<0.020		<0.020	
	Beryllium (Be)-Total (mg/L)			<0.0010		<0.0010	
	Boron (B)-Total (mg/L)			<0.10		<0.10	
	Cadmium (Cd)-Total (mg/L)			<0.000017		<0.000017	
	Calcium (Ca)-Total (mg/L)			2.80		2.81	
	Chromium (Cr)-Total (mg/L)			<0.0010		<0.0010	
	Cobalt (Co)-Total (mg/L)			<0.00030		<0.00030	
	Copper (Cu)-Total (mg/L)			<0.0010		<0.0010	
	Iron (Fe)-Total (mg/L)			<0.030		<0.030	
	Lead (Pb)-Total (mg/L)			<0.00050		<0.00050	
	Lithium (Li)-Total (mg/L)			<0.0050		<0.0050	
	Magnesium (Mg)-Total (mg/L)			0.92		0.93	
	Manganese (Mn)-Total (mg/L)			0.00087		0.00086	
	Mercury (Hg)-Total (mg/L)			<0.000020		<0.000020	
	Molybdenum (Mo)-Total (mg/L)			<0.0010		<0.0010	
	Nickel (Ni)-Total (mg/L)			<0.0010		<0.0010	

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID	L687296-11	L687296-12	L687296-13	L687296-14	L687296-15
		Description					
		Sampled Date	14-SEP-08	13-SEP-08	14-SEP-08	14-SEP-08	13-SEP-08
		Sampled Time					
		Client ID	EQUIPMENT BLANK	3PL-EAS	3PL-EAS REP1	3PL-EAS-500	2PL-EAS-1 REP2
WATER							
Physical Tests	Conductivity (uS/cm)		<2.0	14.4			
	Hardness (as CaCO3) (mg/L)		<0.70	5.10			
	pH (pH)		5.49	6.81			
	Total Suspended Solids (mg/L)		<3.0	<3.0			
	Total Dissolved Solids (mg/L)		<10	<10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		<2.0	4.3			
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)		<2.0	4.3			
	Ammonia as N (mg/L)		<0.020	<0.020			
	Chloride (Cl) (mg/L)		<0.50	<0.50			
	Nitrate (as N) (mg/L)		<0.0050	<0.0050			
	Nitrite (as N) (mg/L)		<0.0010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)		<0.050	0.063			
	Ortho Phosphate as P (mg/L)		<0.0010	<0.0010			
	Total Phosphate as P (mg/L)		<0.0020	<0.0020			
	Sulfate (SO4) (mg/L)		<0.50	1.08			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)			8.46			
	Total Organic Carbon (mg/L)		<0.50	1.41			
Total Metals	Aluminum (Al)-Total (mg/L)		<0.0050	0.0120			
	Antimony (Sb)-Total (mg/L)		<0.00050	<0.00050			
	Arsenic (As)-Total (mg/L)		<0.00050	<0.00050			
	Barium (Ba)-Total (mg/L)		<0.020	<0.020			
	Beryllium (Be)-Total (mg/L)		<0.0010	<0.0010			
	Boron (B)-Total (mg/L)		<0.10	<0.10			
	Cadmium (Cd)-Total (mg/L)		0.000037	<0.000017			
	Calcium (Ca)-Total (mg/L)		<0.10	1.14			
	Chromium (Cr)-Total (mg/L)		<0.0010	<0.0010			
	Cobalt (Co)-Total (mg/L)		<0.00030	<0.00030			
	Copper (Cu)-Total (mg/L)		<0.0010	<0.0010			
	Iron (Fe)-Total (mg/L)		<0.030	<0.030			
	Lead (Pb)-Total (mg/L)		<0.00050	<0.00050			
	Lithium (Li)-Total (mg/L)		<0.0050	<0.0050			
	Magnesium (Mg)-Total (mg/L)		<0.10	0.53			
	Manganese (Mn)-Total (mg/L)		<0.00030	0.00084			
	Mercury (Hg)-Total (mg/L)		<0.000020	<0.000020			
	Molybdenum (Mo)-Total (mg/L)		<0.0010	<0.0010			
	Nickel (Ni)-Total (mg/L)		<0.0010	<0.0010			

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-16	L687296-17	L687296-18	L687296-19	L687296-20
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-1 REP3	2PL-EAS-1 REP4	2PL-EAS-1 REP5	2PL-EAS-2 REP2	2PL-EAS-2 REP3
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)					
	pH (pH)					
	Total Suspended Solids (mg/L)					
	Total Dissolved Solids (mg/L)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia as N (mg/L)					
	Chloride (Cl) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)					
	Ortho Phosphate as P (mg/L)					
	Total Phosphate as P (mg/L)					
	Sulfate (SO4) (mg/L)					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-21	L687296-22	L687296-23	L687296-24	L687296-25
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-2 REP4	2PL-EAS-2 REP5	2PL-EAS-3 REP2	2PL-EAS-3 REP3	2PL-EAS-3 REP4
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)					
	pH (pH)					
	Total Suspended Solids (mg/L)					
	Total Dissolved Solids (mg/L)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia as N (mg/L)					
	Chloride (Cl) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)					
	Ortho Phosphate as P (mg/L)					
	Total Phosphate as P (mg/L)					
	Sulfate (SO4) (mg/L)					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-26	L687296-27	L687296-28	L687296-29	L687296-30
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-3 REP5	2PL-EAS-DT REP2	2PL-EAS-DT REP3	2PL-EAS-DT REP4	2PL-EAS-DT REP5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)					
	pH (pH)					
	Total Suspended Solids (mg/L)					
	Total Dissolved Solids (mg/L)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia as N (mg/L)					
	Chloride (Cl) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)					
	Ortho Phosphate as P (mg/L)					
	Total Phosphate as P (mg/L)					
	Sulfate (SO4) (mg/L)					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-31	L687296-32	L687296-33		
	Description					
	Sampled Date	14-SEP-08	14-SEP-08	14-SEP-08		
	Sampled Time					
	Client ID	3PL-EAS REP2	3PL-EAS REP3	3PL-EAS REP4		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)					
	pH (pH)					
	Total Suspended Solids (mg/L)					
	Total Dissolved Solids (mg/L)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia as N (mg/L)					
	Chloride (Cl) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)					
	Ortho Phosphate as P (mg/L)					
	Total Phosphate as P (mg/L)					
	Sulfate (SO4) (mg/L)					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

		Sample ID	L687296-1	L687296-2	L687296-3	L687296-4	L687296-5
		Description					
		Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
		Sampled Time					
		Client ID	2PL-EAS-1	2PL-EAS-1 REP1	2PL-EAS-2	2PL-EAS-2 REP1	2PL-EAS-3
Grouping	**Analyte**						
WATER							
Total Metals	Potassium (K)-Total (mg/L)		<2.0		<2.0		<2.0
	Selenium (Se)-Total (mg/L)		<0.0010		<0.0010		<0.0010
	Silver (Ag)-Total (mg/L)		<0.000020		<0.000020		<0.000020
	Sodium (Na)-Total (mg/L)		<2.0		<2.0		<2.0
	Thallium (Tl)-Total (mg/L)		<0.00020		<0.00020		<0.00020
	Tin (Sn)-Total (mg/L)		<0.00050		<0.00050		<0.00050
	Titanium (Ti)-Total (mg/L)		0.015		0.019		0.019
	Uranium (U)-Total (mg/L)		0.00027		0.00024		0.00023
	Vanadium (V)-Total (mg/L)		<0.0010		<0.0010		<0.0010
	Zinc (Zn)-Total (mg/L)		<0.0050		<0.0050		<0.0050
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)		0.0796		0.0134		0.0285
	Antimony (Sb)-Dissolved (mg/L)		<0.00050		<0.00050		<0.00050
	Arsenic (As)-Dissolved (mg/L)		<0.00050		<0.00050		<0.00050
	Barium (Ba)-Dissolved (mg/L)		<0.020		<0.020		<0.020
	Beryllium (Be)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Boron (B)-Dissolved (mg/L)		<0.10		<0.10		<0.10
	Cadmium (Cd)-Dissolved (mg/L)		<0.000017		<0.000017		<0.000017
	Calcium (Ca)-Dissolved (mg/L)		3.07		2.81		2.73
	Chromium (Cr)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Cobalt (Co)-Dissolved (mg/L)		<0.00030		<0.00030		<0.00030
	Copper (Cu)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Iron (Fe)-Dissolved (mg/L)		0.073		<0.030		<0.030
	Lead (Pb)-Dissolved (mg/L)		<0.00050		<0.00050		<0.00050
	Lithium (Li)-Dissolved (mg/L)		<0.0050		<0.0050		<0.0050
	Magnesium (Mg)-Dissolved (mg/L)		1.02		0.91		0.85
	Manganese (Mn)-Dissolved (mg/L)		0.00159		0.00043		0.00081
	Mercury (Hg)-Dissolved (mg/L)		<0.000020		<0.000020		<0.000020
	Molybdenum (Mo)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Nickel (Ni)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Potassium (K)-Dissolved (mg/L)		<2.0		<2.0		<2.0
	Selenium (Se)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Silver (Ag)-Dissolved (mg/L)		<0.000020		<0.000020		<0.000020
	Sodium (Na)-Dissolved (mg/L)		<2.0		<2.0		<2.0
	Thallium (Tl)-Dissolved (mg/L)		<0.00020		<0.00020		<0.00020
	Tin (Sn)-Dissolved (mg/L)		<0.00050		<0.00050		<0.00050
	Titanium (Ti)-Dissolved (mg/L)		<0.010		<0.010		<0.010
	Uranium (U)-Dissolved (mg/L)		<0.00020		<0.00020		<0.00020
	Vanadium (V)-Dissolved (mg/L)		<0.0010		<0.0010		<0.0010
	Zinc (Zn)-Dissolved (mg/L)		<0.0050		<0.0050		<0.0050

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L687296-6 Description: 2PL-EAS-3 REP1 Sampled Date: 13-SEP-08	Sample ID: L687296-7 Description: 2PL-EAS-DT Sampled Date: 13-SEP-08	Sample ID: L687296-8 Description: 2PL-EAS-DT REP1 Sampled Date: 13-SEP-08	Sample ID: L687296-9 Description: 2PL-EAS-DUP Sampled Date: 13-SEP-08	Sample ID: L687296-10 Description: TRAVEL BLANK AE08FISHOUT Sampled Date: 01-AUG-08
WATER						
Total Metals	Potassium (K)-Total (mg/L)		<2.0		<2.0	
	Selenium (Se)-Total (mg/L)		<0.0010		<0.0010	
	Silver (Ag)-Total (mg/L)		<0.000020		<0.000020	
	Sodium (Na)-Total (mg/L)		<2.0		<2.0	
	Thallium (Tl)-Total (mg/L)		<0.00020		<0.00020	
	Tin (Sn)-Total (mg/L)		<0.00050		<0.00050	
	Titanium (Ti)-Total (mg/L)		<0.010		<0.010	
	Uranium (U)-Total (mg/L)		<0.00020		<0.00020	
	Vanadium (V)-Total (mg/L)		<0.0010		<0.0010	
	Zinc (Zn)-Total (mg/L)		<0.0050		<0.0050	
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)		<0.0050		<0.0050	
	Antimony (Sb)-Dissolved (mg/L)		<0.00050		<0.00050	
	Arsenic (As)-Dissolved (mg/L)		<0.00050		<0.00050	
	Barium (Ba)-Dissolved (mg/L)		<0.020		<0.020	
	Beryllium (Be)-Dissolved (mg/L)		<0.0010		<0.0010	
	Boron (B)-Dissolved (mg/L)		<0.10		<0.10	
	Cadmium (Cd)-Dissolved (mg/L)		<0.000017		0.000059	
	Calcium (Ca)-Dissolved (mg/L)		2.81		2.76	
	Chromium (Cr)-Dissolved (mg/L)		<0.0010		<0.0010	
	Cobalt (Co)-Dissolved (mg/L)		<0.00030		<0.00030	
	Copper (Cu)-Dissolved (mg/L)		<0.0010		<0.0010	
	Iron (Fe)-Dissolved (mg/L)		<0.030		<0.030	
	Lead (Pb)-Dissolved (mg/L)		<0.00050		<0.00050	
	Lithium (Li)-Dissolved (mg/L)		<0.0050		<0.0050	
	Magnesium (Mg)-Dissolved (mg/L)		0.94		0.92	
	Manganese (Mn)-Dissolved (mg/L)		0.00041		0.00042	
	Mercury (Hg)-Dissolved (mg/L)		<0.000020		<0.000020	
	Molybdenum (Mo)-Dissolved (mg/L)		<0.0010		<0.0010	
	Nickel (Ni)-Dissolved (mg/L)		<0.0010		<0.0010	
	Potassium (K)-Dissolved (mg/L)		<2.0		<2.0	
	Selenium (Se)-Dissolved (mg/L)		<0.0010		<0.0010	
	Silver (Ag)-Dissolved (mg/L)		<0.000020		<0.000020	
	Sodium (Na)-Dissolved (mg/L)		<2.0		<2.0	
	Thallium (Tl)-Dissolved (mg/L)		<0.00020		<0.00020	
	Tin (Sn)-Dissolved (mg/L)		<0.00050		<0.00050	
	Titanium (Ti)-Dissolved (mg/L)		<0.010		<0.010	
	Uranium (U)-Dissolved (mg/L)		<0.00020		<0.00020	
	Vanadium (V)-Dissolved (mg/L)		<0.0010		<0.0010	
	Zinc (Zn)-Dissolved (mg/L)		<0.0050		<0.0050	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-11	L687296-12	L687296-13	L687296-14	L687296-15
	Description					
	Sampled Date	14-SEP-08	13-SEP-08	14-SEP-08	14-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	EQUIPMENT BLANK	3PL-EAS	3PL-EAS REP1	3PL-EAS-500	2PL-EAS-1 REP2
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)	<2.0	<2.0			
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010			
	Silver (Ag)-Total (mg/L)	<0.000020	<0.000020			
	Sodium (Na)-Total (mg/L)	<2.0	<2.0			
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020			
	Tin (Sn)-Total (mg/L)	<0.00050	<0.00050			
	Titanium (Ti)-Total (mg/L)	<0.010	<0.010			
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020			
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010			
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)		<0.0050			
	Antimony (Sb)-Dissolved (mg/L)		<0.00050			
	Arsenic (As)-Dissolved (mg/L)		<0.00050			
	Barium (Ba)-Dissolved (mg/L)		<0.020			
	Beryllium (Be)-Dissolved (mg/L)		<0.0010			
	Boron (B)-Dissolved (mg/L)		<0.10			
	Cadmium (Cd)-Dissolved (mg/L)		<0.000017			
	Calcium (Ca)-Dissolved (mg/L)		1.17			
	Chromium (Cr)-Dissolved (mg/L)		<0.0010			
	Cobalt (Co)-Dissolved (mg/L)		<0.00030			
	Copper (Cu)-Dissolved (mg/L)		<0.0010			
	Iron (Fe)-Dissolved (mg/L)		<0.030			
	Lead (Pb)-Dissolved (mg/L)		<0.00050			
	Lithium (Li)-Dissolved (mg/L)		<0.0050			
	Magnesium (Mg)-Dissolved (mg/L)		0.53			
	Manganese (Mn)-Dissolved (mg/L)		0.00031			
	Mercury (Hg)-Dissolved (mg/L)		<0.000020			
	Molybdenum (Mo)-Dissolved (mg/L)		<0.0010			
	Nickel (Ni)-Dissolved (mg/L)		<0.0010			
	Potassium (K)-Dissolved (mg/L)		<2.0			
	Selenium (Se)-Dissolved (mg/L)		<0.0010			
	Silver (Ag)-Dissolved (mg/L)		<0.000020			
	Sodium (Na)-Dissolved (mg/L)		<2.0			
	Thallium (Tl)-Dissolved (mg/L)		<0.00020			
	Tin (Sn)-Dissolved (mg/L)		<0.00050			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)		<0.00020			
	Vanadium (V)-Dissolved (mg/L)		<0.0010			
	Zinc (Zn)-Dissolved (mg/L)		<0.0050			

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-16	L687296-17	L687296-18	L687296-19	L687296-20
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-1 REP3	2PL-EAS-1 REP4	2PL-EAS-1 REP5	2PL-EAS-2 REP2	2PL-EAS-2 REP3
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-21	L687296-22	L687296-23	L687296-24	L687296-25
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-2 REP4	2PL-EAS-2 REP5	2PL-EAS-3 REP2	2PL-EAS-3 REP3	2PL-EAS-3 REP4
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-26	L687296-27	L687296-28	L687296-29	L687296-30
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-3 REP5	2PL-EAS-DT REP2	2PL-EAS-DT REP3	2PL-EAS-DT REP4	2PL-EAS-DT REP5
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-31	L687296-32	L687296-33		
	Description					
	Sampled Date	14-SEP-08	14-SEP-08	14-SEP-08		
	Sampled Time					
	Client ID	3PL-EAS REP2	3PL-EAS REP3	3PL-EAS REP4		
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-1	L687296-2	L687296-3	L687296-4	L687296-5
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-1	2PL-EAS-1 REP1	2PL-EAS-2	2PL-EAS-2 REP1	2PL-EAS-3
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					
	Chlorophyll a (ug/L)		0.582		0.403	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-6	L687296-7	L687296-8	L687296-9	L687296-10
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	01-AUG-08
	Sampled Time					
	Client ID	2PL-EAS-3 REP1	2PL-EAS-DT	2PL-EAS-DT REP1	2PL-EAS-DUP	TRAVEL BLANK AE08FISHOUT
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					
	Chlorophyll a (ug/L)	0.474		0.608		

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-11	L687296-12	L687296-13	L687296-14	L687296-15
	Description					
	Sampled Date	14-SEP-08	13-SEP-08	14-SEP-08	14-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	EQUIPMENT BLANK	3PL-EAS	3PL-EAS REP1	3PL-EAS-500	2PL-EAS-1 REP2
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					
	Chlorophyll a (ug/L)			0.622	0.444	0.660

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-16	L687296-17	L687296-18	L687296-19	L687296-20
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-1 REP3	2PL-EAS-1 REP4	2PL-EAS-1 REP5	2PL-EAS-2 REP2	2PL-EAS-2 REP3
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)			0.251		
	Chlorophyll a (ug/L)	0.653	0.524		0.592	0.363

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-21	L687296-22	L687296-23	L687296-24	L687296-25
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-2 REP4	2PL-EAS-2 REP5	2PL-EAS-3 REP2	2PL-EAS-3 REP3	2PL-EAS-3 REP4
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					
	Chlorophyll a (ug/L)	0.641	0.544	0.589	0.666	0.604

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-26	L687296-27	L687296-28	L687296-29	L687296-30
	Description					
	Sampled Date	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08	13-SEP-08
	Sampled Time					
	Client ID	2PL-EAS-3 REP5	2PL-EAS-DT REP2	2PL-EAS-DT REP3	2PL-EAS-DT REP4	2PL-EAS-DT REP5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					
	Chlorophyll a (ug/L)	0.658	0.585	0.540	0.621	0.652

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L687296-31	L687296-32	L687296-33		
	Description					
	Sampled Date	14-SEP-08	14-SEP-08	14-SEP-08		
	Sampled Time					
	Client ID	3PL-EAS REP2	3PL-EAS REP3	3PL-EAS REP4		
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					
	Chlorophyll a (ug/L)	0.571	0.564	0.471		

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-NO2-IC-VA	Water	Nitrite by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-NO3-IC-VA	Water	Nitrate by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CHLOROA-VA	Water	Chlorophyll a by Fluorometer	APHA 10200 H. "Chlorophyll" and EPA 445

Chlorophyll and Pheopigments by Fluorometry analysis is carried out using procedures adapted from APHA Method 10200 H. "Chlorophyll" and USEPA Method 445. The sample is filtered using either a glass fiber filter or a 0.45 micron Membrane filter. The pigments are extracted from the filter with 90% aqueuos acetone. For chlorophyll a analysis the extract is read using a fluorometer. For pheopigments the extract is first acidified then read. This method is not subject to interferences from chlorophyll b.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

HG-DIS-CCME-CVAFS-VA	Water	Diss. Mercury in Water by CVAFS (CCME)	EPA 3005A/245.7

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

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).

HG-TOT-CCME-CVAFS-VA	Water	Total Mercury in Water by CVAFS (CCME)	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 procedure 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-ICP-VA	Water	Diss. Metals in Water by ICPOES (CCME)	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 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 - optical emission spectrophotometry (EPA Method 6010B).

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-TOT-CCME-ICP-VA	Water	Total Metals in Water by ICPOES (CCME)	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 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 - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-CCME-MS-VA	Water	Total 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).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500-NH3 "Nitrogen (Ammonia)"

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

PO4-DO-COL-VA	Water	Dissolved ortho Phosphate by Color	APHA 4500-P "Phosphorous"

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
		phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.	
PO4-T-COL-VA	Water	Total Phosphate P by Color	APHA 4500-P "Phosphorous"
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.	
TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.	
TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)
		This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.	
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.	

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

ALS Environmental
excellence in analytical testing

1988 Triumph Street, **Vancouver**, BC Canada V5L 1K5
Tel: 604-253-4188 Toll Free: 1-800-665-0243 Fax: 604-253-6700

#2 -21 Highfield Circle SE, **Calgary**, AB Canada T2G 5N6
Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430

www.alsenviro.com

L687296

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

PAGE 1 OF 1

SEND REPORT TO:

COMPANY:	Azimuth Consulting Group Inc.				
ADDRESS:	218-2902 West Broadway				
CITY:	Vancouver	PROV: BC	POSTAL CODE:	V6K 2G8	
CONTACT:	R. Baker, M. McConnell		TELEPHONE:		
PROJECT NAME/#:	EAS		SAMPLER:	DH, KM, JP, MB	
ALSE QUOTE #:	ALSEQ-07-622		ALSE CONTACT:	Natasha Marcovic-Mirovic	

REPORT FORMAT: ◉ Hardcopy ○ Fax #: ○ E-mail Specify file type: Excel & pdf E-mail Address:

INVOICE FORMAT: ◉ Hardcopy ○ Fax #: ○ E-mail (pdf format) E-mail Address:

◉ Routine Turn Around ○ Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? ☑ Yes ☐ No

COMPANY:		CONTACT:			
ADDRESS:		P.O. #:			
CITY:	PROV:	POSTAL CODE:		TEL:	

ANALYSIS REQUESTED:

	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Conventionals **	TKN, Ammonia (pres. w/ H_2SO_4)	Total Metals (pres. w/ HNO_3)	Dissolved Metals (filtered & pres.)	TOC (pres. w/ HCl)	DOC (filtered & pres. w/ HCl)		Chlorophyll-a (pres. w/ $MgCO_3$)								NOTES (sample specific comments, due dates, etc.)
FOR LAB USE ONLY	2PL-EAS-1	08-09-13		water	x	x	x	x	x	x										6 containers
	2PL-EAS-1	08-09-13		filter								x								5 containers (500ml filt.)
	2PL-EAS-2	08-09-13		water	x	x	x	x	x	x										6 containers
	2PL-EAS-2	08-09-13		water								x								5 containers (500ml filt.)
	2PL-EAS-3	08-09-13		filter	x	x	x	x	x	x										6 containers
	2PL-EAS-3	08-09-13		filter								x								5 containers (500ml filt.)
	2PL-EAS-DT	08-09-13		water	x	x	x	x	x	x										6 containers
	2PL-EAS-DT	08-09-13		filter								x								5 containers (500ml filt.)
	2PL-EAS-DUP	08-09-13		water	x	x	x	x	x	x										6 containers
	Travel Blank (AE-08-Fishout)	08-08-01		water	x	x			x											3 containers
	EQUIPMENT BLANK	08-09-14		water	x	x	x		x											4 containers
	3PL-EAS	08-09-13		water	x	x	x	x	x	x										6 containers
	3PL-EAS	08-09-14		filter								x								4 containers (1L filt.)
	3PL-EAS-500	08-09-14		filter								x								1 container (500ml filt.)

Conventionals: conductivity, hardness, pH, TSS, TDS, nutrients(nitrate, nitrite, total phosphate, orthophosphate), sulphate, chloride, alkalinity(bicarbonate, carbonate, hydroxide).

RELINQUISHED BY:				RECEIVED BY: HD	
NAME:	Maggie McConnell	DATE:	Sept.20 2008	DATE:	08/09/24
OF:	Azimuth Consulting Group Inc.	TIME:		TIME:	3:11
NAME:	Maggie McConnell	DATE:		DATE:	
OF:		TIME:		TIME:	

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes___ No✓ N/A___ Sample Temperature: 3 °C Frozen? Yes___ No✓ Cooling Method? Icepacks✓ Ice___ None___

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.

ATTN: RANDY BAKER

218 - 2902 WEST BROADWAY

VANCOUVER BC V6K 2G8

Reported On: 28-OCT-08 11:36 AM

Lab Work Order #: L691075 **Date Received:** 03-OCT-08

Project P.O. #:
Job Reference: EAS
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

Bryan Mark
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-1	L691075-2	L691075-3	L691075-4	L691075-5
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	08:35	08:35	08:35	08:35	08:35
	Client ID	2PL-EAS-1-R2	2PL-EAS-1-R2 REP 1	2PL-EAS-1-R2 REP 2	2PL-EAS-1-R2 REP 3	2PL-EAS-1-R2 REP 4
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	24.4				
	Hardness (as CaCO3) (mg/L)	9.98				
	pH (pH)	7.27				
	Total Suspended Solids (mg/L)	3.3				
	Total Dissolved Solids (mg/L)	13				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.8				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	7.8				
	Ammonia as N (mg/L)	0.022				
	Chloride (Cl) (mg/L)	<0.50				
	Nitrate (as N) (mg/L)	0.0267				
	Nitrite (as N) (mg/L)	0.0014				
	Total Kjeldahl Nitrogen (mg/L)	0.128				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0064				
	Sulfate (SO4) (mg/L)	2.39				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.00				
	Total Organic Carbon (mg/L)	1.48				
Total Metals	Aluminum (Al)-Total (mg/L)	0.254				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	<0.00050				
	Barium (Ba)-Total (mg/L)	<0.020				
	Beryllium (Be)-Total (mg/L)	<0.0010				
	Boron (B)-Total (mg/L)	<0.10				
	Cadmium (Cd)-Total (mg/L)	<0.000017				
	Calcium (Ca)-Total (mg/L)	2.66				
	Chromium (Cr)-Total (mg/L)	<0.0010				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	0.0014				
	Iron (Fe)-Total (mg/L)	0.337				
	Lead (Pb)-Total (mg/L)	<0.00050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.89				
	Manganese (Mn)-Total (mg/L)	0.00656				
	Mercury (Hg)-Total (mg/L)	<0.000020				
	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	<0.0010				

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L691075-6 Description: Sampled Date: 24-SEP-08 Sampled Time: 11:40 Client ID: 2PL-EAS-2-R2	L691075-7 24-SEP-08 11:40 2PL-EAS-2-R2 REP 1	L691075-8 24-SEP-08 11:40 2PL-EAS-2-R2 REP 2	L691075-9 24-SEP-08 11:40 2PL-EAS-2-R2 REP 3	L691075-10 24-SEP-08 11:40 2PL-EAS-2-R2 REP 4
WATER						
Physical Tests	Conductivity (uS/cm)	25.6				
	Hardness (as CaCO3) (mg/L)	10.4				
	pH (pH)	7.27				
	Total Suspended Solids (mg/L)	52.8				
	Total Dissolved Solids (mg/L)	16				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	8.3				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	8.3				
	Ammonia as N (mg/L)	<0.020				
	Chloride (Cl) (mg/L)	0.54				
	Nitrate (as N) (mg/L)	0.0302				
	Nitrite (as N) (mg/L)	0.0017				
	Total Kjeldahl Nitrogen (mg/L)	0.132				
	Ortho Phosphate as P (mg/L)	<0.0010				
	Total Phosphate as P (mg/L)	0.0096				
	Sulfate (SO4) (mg/L)	2.49				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.14				
	Total Organic Carbon (mg/L)	1.73				
Total Metals	Aluminum (Al)-Total (mg/L)	0.278				
	Antimony (Sb)-Total (mg/L)	<0.00050				
	Arsenic (As)-Total (mg/L)	<0.00050				
	Barium (Ba)-Total (mg/L)	<0.020				
	Beryllium (Be)-Total (mg/L)	<0.0010				
	Boron (B)-Total (mg/L)	<0.10				
	Cadmium (Cd)-Total (mg/L)	<0.000017				
	Calcium (Ca)-Total (mg/L)	2.85				
	Chromium (Cr)-Total (mg/L)	0.0011				
	Cobalt (Co)-Total (mg/L)	<0.00030				
	Copper (Cu)-Total (mg/L)	0.0020				
	Iron (Fe)-Total (mg/L)	0.393				
	Lead (Pb)-Total (mg/L)	0.00086				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	0.93				
	Manganese (Mn)-Total (mg/L)	0.00832				
	Mercury (Hg)-Total (mg/L)	<0.000020				
	Molybdenum (Mo)-Total (mg/L)	<0.0010				
	Nickel (Ni)-Total (mg/L)	0.0010				

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L691075-11 24-SEP-08 11:40 2PL-EAS-2-R2 REP 5	L691075-12 24-SEP-08 09:30 2PL-EAS-3-R2	L691075-13 24-SEP-08 09:30 2PL-EAS-3-R2 REP 1	L691075-14 24-SEP-08 09:30 2PL-EAS-3-R2 REP 2	L691075-15 24-SEP-08 09:30 2PL-EAS-3-R2 REP 3
WATER							
Physical Tests	Conductivity (uS/cm)			25.2			
	Hardness (as CaCO3) (mg/L)			10.4			
	pH (pH)			7.23			
	Total Suspended Solids (mg/L)			16.3			
	Total Dissolved Solids (mg/L)			16			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)			7.7			
	Alkalinity, Carbonate (as CaCO3) (mg/L)			<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)			<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)			7.7			
	Ammonia as N (mg/L)			<0.020			
	Chloride (Cl) (mg/L)			0.52			
	Nitrate (as N) (mg/L)			0.0311			
	Nitrite (as N) (mg/L)			0.0018			
	Total Kjeldahl Nitrogen (mg/L)			0.142			
	Ortho Phosphate as P (mg/L)			<0.0010			
	Total Phosphate as P (mg/L)			0.0086			
	Sulfate (SO4) (mg/L)			2.45			
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)			1.69			
	Total Organic Carbon (mg/L)			1.65			
Total Metals	Aluminum (Al)-Total (mg/L)			0.268			
	Antimony (Sb)-Total (mg/L)			<0.00050			
	Arsenic (As)-Total (mg/L)			<0.00050			
	Barium (Ba)-Total (mg/L)			<0.020			
	Beryllium (Be)-Total (mg/L)			<0.0010			
	Boron (B)-Total (mg/L)			<0.10			
	Cadmium (Cd)-Total (mg/L)			<0.000017			
	Calcium (Ca)-Total (mg/L)			2.77			
	Chromium (Cr)-Total (mg/L)			0.0011			
	Cobalt (Co)-Total (mg/L)			<0.00030			
	Copper (Cu)-Total (mg/L)			0.0019			
	Iron (Fe)-Total (mg/L)			0.367			
	Lead (Pb)-Total (mg/L)			0.00691			
	Lithium (Li)-Total (mg/L)			<0.0050			
	Magnesium (Mg)-Total (mg/L)			0.92			
	Manganese (Mn)-Total (mg/L)			0.00777			
	Mercury (Hg)-Total (mg/L)			<0.000020			
	Molybdenum (Mo)-Total (mg/L)			<0.0010			
	Nickel (Ni)-Total (mg/L)			0.0010			

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID Description Sampled Date Sampled Time Client ID	L691075-16 24-SEP-08 09:30 2PL-EAS-3-R2 REP 4	L691075-17 24-SEP-08 09:30 2PL-EAS-3-R2 REP 5	L691075-18 24-SEP-08 10:55 2PL-EAS-DT-R2	L691075-19 24-SEP-08 10:55 2PL-EAS-DT-R2 REP 1	L691075-20 24-SEP-08 10:55 2PL-EAS-DT-R2 REP 2
WATER							
Physical Tests	Conductivity (uS/cm)				26.3		
	Hardness (as CaCO3) (mg/L)				10.9		
	pH (pH)				7.20		
	Total Suspended Solids (mg/L)				3.8		
	Total Dissolved Solids (mg/L)				20		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)				8.1		
	Alkalinity, Carbonate (as CaCO3) (mg/L)				<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)				<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)				8.1		
	Ammonia as N (mg/L)				<0.020		
	Chloride (Cl) (mg/L)				<0.50		
	Nitrate (as N) (mg/L)				<0.0050		
	Nitrite (as N) (mg/L)				<0.0010		
	Total Kjeldahl Nitrogen (mg/L)				0.127		
	Ortho Phosphate as P (mg/L)				<0.0010		
	Total Phosphate as P (mg/L)				0.0049		
	Sulfate (SO4) (mg/L)				2.96		
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)				1.87		
	Total Organic Carbon (mg/L)				1.93		
Total Metals	Aluminum (Al)-Total (mg/L)				0.0515		
	Antimony (Sb)-Total (mg/L)				<0.00050		
	Arsenic (As)-Total (mg/L)				<0.00050		
	Barium (Ba)-Total (mg/L)				<0.020		
	Beryllium (Be)-Total (mg/L)				<0.0010		
	Boron (B)-Total (mg/L)				<0.10		
	Cadmium (Cd)-Total (mg/L)				<0.000017		
	Calcium (Ca)-Total (mg/L)				2.91		
	Chromium (Cr)-Total (mg/L)				<0.0010		
	Cobalt (Co)-Total (mg/L)				<0.00030		
	Copper (Cu)-Total (mg/L)				0.0010		
	Iron (Fe)-Total (mg/L)				0.085		
	Lead (Pb)-Total (mg/L)				0.00096		
	Lithium (Li)-Total (mg/L)				<0.0050		
	Magnesium (Mg)-Total (mg/L)				0.94		
	Manganese (Mn)-Total (mg/L)				0.00205		
	Mercury (Hg)-Total (mg/L)				<0.000020		
	Molybdenum (Mo)-Total (mg/L)				<0.0010		
	Nickel (Ni)-Total (mg/L)				<0.0010		

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID Description Sampled Date Sampled Time Client ID	L691075-21 24-SEP-08 10:55 2PL-EAS-DT-R2 REP 3	L691075-22 24-SEP-08 10:55 2PL-EAS-DT-R2 REP 4	L691075-23 24-SEP-08 10:55 2PL-EAS-DT-R2 REP 5	L691075-24 24-SEP-08 14:30 EAS-DUP-R2	L691075-25 24-SEP-08 14:30 3PL-EAS-R2
WATER							
Physical Tests	Conductivity (uS/cm)						16.4
	Hardness (as CaCO3) (mg/L)					11.5	5.09
	pH (pH)						6.79
	Total Suspended Solids (mg/L)						<3.0
	Total Dissolved Solids (mg/L)						<10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)						4.2
	Alkalinity, Carbonate (as CaCO3) (mg/L)						<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)						<2.0
	Alkalinity, Total (as CaCO3) (mg/L)						4.2
	Ammonia as N (mg/L)					<0.020	<0.020
	Chloride (Cl) (mg/L)						0.88
	Nitrate (as N) (mg/L)						<0.0050
	Nitrite (as N) (mg/L)						<0.0010
	Total Kjeldahl Nitrogen (mg/L)					0.150	0.261
	Ortho Phosphate as P (mg/L)						<0.0010
	Total Phosphate as P (mg/L)						0.0048
	Sulfate (SO4) (mg/L)						1.49
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					1.76	125
	Total Organic Carbon (mg/L)					1.52	2.10
Total Metals	Aluminum (Al)-Total (mg/L)					0.315	0.0396
	Antimony (Sb)-Total (mg/L)					<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)					<0.00050	<0.00050
	Barium (Ba)-Total (mg/L)					<0.020	<0.020
	Beryllium (Be)-Total (mg/L)					<0.0010	<0.0010
	Boron (B)-Total (mg/L)					<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)					<0.000017	<0.000017
	Calcium (Ca)-Total (mg/L)					2.80	1.26
	Chromium (Cr)-Total (mg/L)					0.0012	<0.0010
	Cobalt (Co)-Total (mg/L)					<0.00030	<0.00030
	Copper (Cu)-Total (mg/L)					0.0021	<0.0010
	Iron (Fe)-Total (mg/L)					0.429	0.070
	Lead (Pb)-Total (mg/L)					0.00079	<0.00050
	Lithium (Li)-Total (mg/L)					<0.0050	<0.0050
	Magnesium (Mg)-Total (mg/L)					0.94	0.55
	Manganese (Mn)-Total (mg/L)					0.00852	0.00229
	Mercury (Hg)-Total (mg/L)					<0.000020	<0.000020
	Molybdenum (Mo)-Total (mg/L)					<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)					0.0011	<0.0010

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-26	L691075-27	L691075-28	L691075-29	L691075-30
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	14:30	14:30	14:30	14:30	14:30
	Client ID	3PL-EAS-R2 REP 1	3PL-EAS-R2 REP 2	3PL-EAS-R2 REP 3	3PL-EAS-R2 REP 4	3PL-EAS-R2 REP 5
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)					
	pH (pH)					
	Total Suspended Solids (mg/L)					
	Total Dissolved Solids (mg/L)					
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)					
	Alkalinity, Carbonate (as CaCO3) (mg/L)					
	Alkalinity, Hydroxide (as CaCO3) (mg/L)					
	Alkalinity, Total (as CaCO3) (mg/L)					
	Ammonia as N (mg/L)					
	Chloride (Cl) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Total Kjeldahl Nitrogen (mg/L)					
	Ortho Phosphate as P (mg/L)					
	Total Phosphate as P (mg/L)					
	Sulfate (SO4) (mg/L)					
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-1	L691075-2	L691075-3	L691075-4	L691075-5
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	08:35	08:35	08:35	08:35	08:35
	Client ID	2PL-EAS-1-R2	2PL-EAS-1-R2 REP 1	2PL-EAS-1-R2 REP 2	2PL-EAS-1-R2 REP 3	2PL-EAS-1-R2 REP 4
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)	<2.0				
	Selenium (Se)-Total (mg/L)	<0.0010				
	Silver (Ag)-Total (mg/L)	<0.000020				
	Sodium (Na)-Total (mg/L)	<2.0				
	Thallium (Tl)-Total (mg/L)	<0.00020				
	Tin (Sn)-Total (mg/L)	<0.00050				
	Titanium (Ti)-Total (mg/L)	0.012				
	Uranium (U)-Total (mg/L)	<0.00020				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0208				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	2.68				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.80				
	Manganese (Mn)-Dissolved (mg/L)	0.00048				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L691075-6 Description: Sampled Date: 24-SEP-08 Sampled Time: 11:40 Client ID: 2PL-EAS-2-R2	L691075-7 24-SEP-08 11:40 2PL-EAS-2-R2 REP 1	L691075-8 24-SEP-08 11:40 2PL-EAS-2-R2 REP 2	L691075-9 24-SEP-08 11:40 2PL-EAS-2-R2 REP 3	L691075-10 24-SEP-08 11:40 2PL-EAS-2-R2 REP 4
WATER						
Total Metals	Potassium (K)-Total (mg/L)	<2.0				
	Selenium (Se)-Total (mg/L)	<0.0010				
	Silver (Ag)-Total (mg/L)	<0.000020				
	Sodium (Na)-Total (mg/L)	<2.0				
	Thallium (Tl)-Total (mg/L)	<0.00020				
	Tin (Sn)-Total (mg/L)	<0.00050				
	Titanium (Ti)-Total (mg/L)	0.014				
	Uranium (U)-Total (mg/L)	<0.00020				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	0.0054				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0211				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.00050				
	Barium (Ba)-Dissolved (mg/L)	<0.020				
	Beryllium (Be)-Dissolved (mg/L)	<0.0010				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000017				
	Calcium (Ca)-Dissolved (mg/L)	2.82				
	Chromium (Cr)-Dissolved (mg/L)	<0.0010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00030				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.00050				
	Lithium (Li)-Dissolved (mg/L)	<0.0050				
	Magnesium (Mg)-Dissolved (mg/L)	0.83				
	Manganese (Mn)-Dissolved (mg/L)	0.00045				
	Mercury (Hg)-Dissolved (mg/L)	<0.000020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0010				
	Potassium (K)-Dissolved (mg/L)	<2.0				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silver (Ag)-Dissolved (mg/L)	<0.000020				
	Sodium (Na)-Dissolved (mg/L)	<2.0				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.00050				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

ALS LABORATORY GROUP ANALYTICAL REPORT

Grouping	Analyte	L691075-11	L691075-12	L691075-13	L691075-14	L691075-15
Sample ID		L691075-11	L691075-12	L691075-13	L691075-14	L691075-15
Description						
Sampled Date		24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
Sampled Time		11:40	09:30	09:30	09:30	09:30
Client ID		2PL-EAS-2-R2 REP 5	2PL-EAS-3-R2	2PL-EAS-3-R2 REP 1	2PL-EAS-3-R2 REP 2	2PL-EAS-3-R2 REP 3
WATER						
Total Metals	Potassium (K)-Total (mg/L)		<2.0			
	Selenium (Se)-Total (mg/L)		<0.0010			
	Silver (Ag)-Total (mg/L)		<0.000020			
	Sodium (Na)-Total (mg/L)		<2.0			
	Thallium (Tl)-Total (mg/L)		<0.00020			
	Tin (Sn)-Total (mg/L)		<0.00050			
	Titanium (Ti)-Total (mg/L)		0.013			
	Uranium (U)-Total (mg/L)		0.00020			
	Vanadium (V)-Total (mg/L)		<0.0010			
	Zinc (Zn)-Total (mg/L)		0.0063			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)		0.0128			
	Antimony (Sb)-Dissolved (mg/L)		<0.00050			
	Arsenic (As)-Dissolved (mg/L)		<0.00050			
	Barium (Ba)-Dissolved (mg/L)		<0.020			
	Beryllium (Be)-Dissolved (mg/L)		<0.0010			
	Boron (B)-Dissolved (mg/L)		<0.10			
	Cadmium (Cd)-Dissolved (mg/L)		<0.000017			
	Calcium (Ca)-Dissolved (mg/L)		2.80			
	Chromium (Cr)-Dissolved (mg/L)		<0.0010			
	Cobalt (Co)-Dissolved (mg/L)		<0.00030			
	Copper (Cu)-Dissolved (mg/L)		<0.0010			
	Iron (Fe)-Dissolved (mg/L)		<0.030			
	Lead (Pb)-Dissolved (mg/L)		<0.00050			
	Lithium (Li)-Dissolved (mg/L)		<0.0050			
	Magnesium (Mg)-Dissolved (mg/L)		0.83			
	Manganese (Mn)-Dissolved (mg/L)		0.00041			
	Mercury (Hg)-Dissolved (mg/L)		<0.000020			
	Molybdenum (Mo)-Dissolved (mg/L)		<0.0010			
	Nickel (Ni)-Dissolved (mg/L)		<0.0010			
	Potassium (K)-Dissolved (mg/L)		<2.0			
	Selenium (Se)-Dissolved (mg/L)		<0.0010			
	Silver (Ag)-Dissolved (mg/L)		<0.000020			
	Sodium (Na)-Dissolved (mg/L)		<2.0			
	Thallium (Tl)-Dissolved (mg/L)		<0.00020			
	Tin (Sn)-Dissolved (mg/L)		<0.00050			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)		<0.00020			
	Vanadium (V)-Dissolved (mg/L)		<0.0010			
	Zinc (Zn)-Dissolved (mg/L)		<0.0050			

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-16	L691075-17	L691075-18	L691075-19	L691075-20
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	09:30	09:30	10:55	10:55	10:55
	Client ID	2PL-EAS-3-R2 REP 4	2PL-EAS-3-R2 REP 5	2PL-EAS-DT-R2	2PL-EAS-DT-R2 REP 1	2PL-EAS-DT-R2 REP 2
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)			<2.0		
	Selenium (Se)-Total (mg/L)			<0.0010		
	Silver (Ag)-Total (mg/L)			<0.000020		
	Sodium (Na)-Total (mg/L)			<2.0		
	Thallium (Tl)-Total (mg/L)			<0.00020		
	Tin (Sn)-Total (mg/L)			<0.00050		
	Titanium (Ti)-Total (mg/L)			<0.010		
	Uranium (U)-Total (mg/L)			<0.00020		
	Vanadium (V)-Total (mg/L)			<0.0010		
	Zinc (Zn)-Total (mg/L)			<0.0050		
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)			0.0082		
	Antimony (Sb)-Dissolved (mg/L)			<0.00050		
	Arsenic (As)-Dissolved (mg/L)			<0.00050		
	Barium (Ba)-Dissolved (mg/L)			<0.020		
	Beryllium (Be)-Dissolved (mg/L)			<0.0010		
	Boron (B)-Dissolved (mg/L)			<0.10		
	Cadmium (Cd)-Dissolved (mg/L)			<0.000017		
	Calcium (Ca)-Dissolved (mg/L)			2.89		
	Chromium (Cr)-Dissolved (mg/L)			<0.0010		
	Cobalt (Co)-Dissolved (mg/L)			<0.00030		
	Copper (Cu)-Dissolved (mg/L)			<0.0010		
	Iron (Fe)-Dissolved (mg/L)			<0.030		
	Lead (Pb)-Dissolved (mg/L)			<0.00050		
	Lithium (Li)-Dissolved (mg/L)			<0.0050		
	Magnesium (Mg)-Dissolved (mg/L)			0.90		
	Manganese (Mn)-Dissolved (mg/L)			0.00048		
	Mercury (Hg)-Dissolved (mg/L)			<0.000020		
	Molybdenum (Mo)-Dissolved (mg/L)			<0.0010		
	Nickel (Ni)-Dissolved (mg/L)			<0.0010		
	Potassium (K)-Dissolved (mg/L)			<2.0		
	Selenium (Se)-Dissolved (mg/L)			<0.0010		
	Silver (Ag)-Dissolved (mg/L)			<0.000020		
	Sodium (Na)-Dissolved (mg/L)			<2.0		
	Thallium (Tl)-Dissolved (mg/L)			<0.00020		
	Tin (Sn)-Dissolved (mg/L)			<0.00050		
	Titanium (Ti)-Dissolved (mg/L)			<0.010		
	Uranium (U)-Dissolved (mg/L)			<0.00020		
	Vanadium (V)-Dissolved (mg/L)			<0.0010		
	Zinc (Zn)-Dissolved (mg/L)			<0.0050		

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample ID	L691075-21	L691075-22	L691075-23	L691075-24	L691075-25
Description					
Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
Sampled Time	10:55	10:55	10:55	14:30	14:30
Client ID	2PL-EAS-DT-R2 REP 3	2PL-EAS-DT-R2 REP 4	2PL-EAS-DT-R2 REP 5	EAS-DUP-R2	3PL-EAS-R2
Grouping / **Analyte**					
WATER					
Total Metals Potassium (K)-Total (mg/L)				<2.0	<2.0
Selenium (Se)-Total (mg/L)				<0.0010	<0.0010
Silver (Ag)-Total (mg/L)				<0.000020	<0.000020
Sodium (Na)-Total (mg/L)				<2.0	<2.0
Thallium (Tl)-Total (mg/L)				<0.00020	<0.00020
Tin (Sn)-Total (mg/L)				<0.00050	<0.00050
Titanium (Ti)-Total (mg/L)				0.014	<0.010
Uranium (U)-Total (mg/L)				<0.00020	<0.00020
Vanadium (V)-Total (mg/L)				<0.0010	<0.0010
Zinc (Zn)-Total (mg/L)				0.0054	<0.0050
Dissolved Metals Aluminum (Al)-Dissolved (mg/L)				0.0240	<0.0050
Antimony (Sb)-Dissolved (mg/L)				<0.00050	<0.00050
Arsenic (As)-Dissolved (mg/L)				<0.00050	<0.00050
Barium (Ba)-Dissolved (mg/L)				<0.020	<0.020
Beryllium (Be)-Dissolved (mg/L)				<0.0010	<0.0010
Boron (B)-Dissolved (mg/L)				<0.10	<0.10
Cadmium (Cd)-Dissolved (mg/L)				<0.000017	<0.000017
Calcium (Ca)-Dissolved (mg/L)				3.13	1.18
Chromium (Cr)-Dissolved (mg/L)				<0.0010	<0.0010
Cobalt (Co)-Dissolved (mg/L)				<0.00030	<0.00030
Copper (Cu)-Dissolved (mg/L)				<0.0010	<0.0010
Iron (Fe)-Dissolved (mg/L)				<0.030	<0.030
Lead (Pb)-Dissolved (mg/L)				<0.00050	<0.00050
Lithium (Li)-Dissolved (mg/L)				<0.0050	<0.0050
Magnesium (Mg)-Dissolved (mg/L)				0.90	0.52
Manganese (Mn)-Dissolved (mg/L)				0.00058	0.00030
Mercury (Hg)-Dissolved (mg/L)				<0.000020	<0.000020
Molybdenum (Mo)-Dissolved (mg/L)				<0.0010	<0.0010
Nickel (Ni)-Dissolved (mg/L)				<0.0010	<0.0010
Potassium (K)-Dissolved (mg/L)				<2.0	<2.0
Selenium (Se)-Dissolved (mg/L)				<0.0010	<0.0010
Silver (Ag)-Dissolved (mg/L)				<0.000020	<0.000020
Sodium (Na)-Dissolved (mg/L)				<2.0	<2.0
Thallium (Tl)-Dissolved (mg/L)				<0.00020	<0.00020
Tin (Sn)-Dissolved (mg/L)				<0.00050	<0.00050
Titanium (Ti)-Dissolved (mg/L)				<0.010	<0.010
Uranium (U)-Dissolved (mg/L)				<0.00020	<0.00020
Vanadium (V)-Dissolved (mg/L)				<0.0010	<0.0010
Zinc (Zn)-Dissolved (mg/L)				0.0102	<0.0050

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-26	L691075-27	L691075-28	L691075-29	L691075-30
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	14:30	14:30	14:30	14:30	14:30
	Client ID	3PL-EAS-R2 REP 1	3PL-EAS-R2 REP 2	3PL-EAS-R2 REP 3	3PL-EAS-R2 REP 4	3PL-EAS-R2 REP 5
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-1	L691075-2	L691075-3	L691075-4	L691075-5
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	08:35	08:35	08:35	08:35	08:35
	Client ID	2PL-EAS-1-R2	2PL-EAS-1-R2 REP 1	2PL-EAS-1-R2 REP 2	2PL-EAS-1-R2 REP 3	2PL-EAS-1-R2 REP 4
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)		0.326	0.373	0.356	
	Chlorophyll a (ug/L)					0.656

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-6	L691075-7	L691075-8	L691075-9	L691075-10
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	11:40	11:40	11:40	11:40	11:40
	Client ID	2PL-EAS-2-R2	2PL-EAS-2-R2 REP 1	2PL-EAS-2-R2 REP 2	2PL-EAS-2-R2 REP 3	2PL-EAS-2-R2 REP 4
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					0.258
	Chlorophyll a (ug/L)		0.671	0.460	0.401	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-11	L691075-12	L691075-13	L691075-14	L691075-15
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	11:40	09:30	09:30	09:30	09:30
	Client ID	2PL-EAS-2-R2 REP 5	2PL-EAS-3-R2	2PL-EAS-3-R2 REP 1	2PL-EAS-3-R2 REP 2	2PL-EAS-3-R2 REP 3
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)			0.210	0.276	0.253
	Chlorophyll a (ug/L)	0.495				

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-16	L691075-17	L691075-18	L691075-19	L691075-20
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	09:30	09:30	10:55	10:55	10:55
	Client ID	2PL-EAS-3-R2 REP 4	2PL-EAS-3-R2 REP 5	2PL-EAS-DT-R2	2PL-EAS-DT-R2 REP 1	2PL-EAS-DT-R2 REP 2
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)					0.251
	Chlorophyll a (ug/L)	0.568	0.635		0.396	

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-21	L691075-22	L691075-23	L691075-24	L691075-25
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	10:55	10:55	10:55	14:30	14:30
	Client ID	2PL-EAS-DT-R2 REP 3	2PL-EAS-DT-R2 REP 4	2PL-EAS-DT-R2 REP 5	EAS-DUP-R2	3PL-EAS-R2
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)	0.244	0.240			
	Chlorophyll a (ug/L)			0.519		

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691075-26	L691075-27	L691075-28	L691075-29	L691075-30
	Description					
	Sampled Date	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08	24-SEP-08
	Sampled Time	14:30	14:30	14:30	14:30	14:30
	Client ID	3PL-EAS-R2 REP 1	3PL-EAS-R2 REP 2	3PL-EAS-R2 REP 3	3PL-EAS-R2 REP 4	3PL-EAS-R2 REP 5
Grouping	**Analyte**					
WATER						
Plant Pigments	Chlorophyll a (ug)	0.0804	0.303	0.203	0.310	0.288
	Chlorophyll a (ug/L)					

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-NO2-IC-VA	Water	Nitrite by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-NO3-IC-VA	Water	Nitrate by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 "Determination of Anions by IC

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 "TOTAL ORGANIC CARBON (TOC)"

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CHLOROA-VA	Water	Chlorophyll a by Fluorometer	APHA 10200 H. "Chlorophyll" and EPA 445

Chlorophyll and Pheopigments by Fluorometry analysis is carried out using procedures adapted from APHA Method 10200 H. "Chlorophyll" and USEPA Method 445. The sample is filtered using either a glass fiber filter or a 0.45 micron Membrane filter. The pigments are extracted from the filter with 90% aqueuos acetone. For chlorophyll a analysis the extract is read using a fluorometer. For pheopigments the extract is first acidified then read. This method is not subject to interferences from chlorophyll b.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness is calculated from Calcium and Magnesium concentrations, and is expressed as calcium carbonate equivalents.

HG-DIS-CCME-CVAFS-VA	Water	Diss. Mercury in Water by CVAFS (CCME)	EPA 3005A/245.7

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

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).

HG-TOT-CCME-CVAFS-VA	Water	Total Mercury in Water by CVAFS (CCME)	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 procedure 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-ICP-VA	Water	Diss. Metals in Water by ICPOES (CCME)	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 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 - optical emission spectrophotometry (EPA Method 6010B).

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-TOT-CCME-ICP-VA	Water	Total Metals in Water by ICPOES (CCME)	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 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 - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-CCME-MS-VA	Water	Total 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).

NH3-SIE-VA	Water	Ammonia by SIE	APHA 4500-NH3 "Nitrogen (Ammonia)"

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

PO4-DO-COL-VA	Water	Dissolved ortho Phosphate by Color	APHA 4500-P "Phosphorous"

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
		phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.	
PO4-T-COL-VA	Water	Total Phosphate P by Color	APHA 4500-P "Phosphorous"
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.	
TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.	
TKN-SIE-VA	Water	Total Kjeldahl Nitrogen by SIE	APHA 4500-Norg (TKN)
		This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.	
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.	

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA		

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

L691075

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Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430

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Short Holding Time

Rush Processing Required

ISTODY / ANALYTICAL REQUEST FORM

PAGE 1 OF 1

COMPANY:	Azimuth Consulting Group Inc.				
ADDRESS:	218-2902 West Broadway				
CITY:	Vancouver	PROV: BC	POSTAL CODE:	V6K 2G8	
CONTACT:	R. Baker, M. McConnell		TELEPHONE:	604-730-1220	
PROJECT NAME/#:	EAS		SAMPLER:	~~DMcC~~ JA/kD	
ALSE QUOTE #:	ALSEQ-07-622		ALSE CONTACT:	Natasha Marcovic-Mirovic	

REPORT FORMAT:
- (●) Hardcopy ( ) Fax #:
- ( ) E-mail Specify file type: Excel & pdf
- E-mail Address:

INVOICE FORMAT:
- (●) Hardcopy ( ) Fax #:
- ( ) E-mail (pdf format)
- E-mail Address:

(●) Routine Turn Around
( ) Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? [✓] Yes [ ] No

COMPANY:		CONTACT:					
ADDRESS:				P.O. #:			
CITY:		PROV:		POSTAL CODE:		TEL:	

ANALYSIS REQUESTED:

	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Conventionals **	TKN, Ammonia (pres. w/ H_2SO_4)	Total Metals (pres. w/ HNO_3)	Dissolved Metals (filtered & pres.)	TOC (pres. w/ HCl)	DOC (filtered & pres. w/ HCl)		Chlorophyll-a (pres. w/ $MgCO_3$)								NOTES (sample specific comments, due dates, etc.)
FOR LAB USE ONLY	2PL-EAS-1-R2	08-09-24	8:35	water	x	x	x	x	x	x										6 containers
	2PL-EAS-1-R2 (pls report 4 reps separately)	08-09-24	8:35	filter								x								4 whirl pacs
	2PL-EAS-2-R2	08-09-24	11:40	water	x	x	x	x	x	x										6 containers
	2PL-EAS-2-R2 (pls report 5 reps separately)	08-09-24	11:40	filter								x								5 whirl pacs
	2PL-EAS-3-R2	08-09-24	9:30	water	x	x	x	x	x	x										6 containers
	2PL-EAS-3-R2 (pls report 5 reps separately)	08-09-24	9:30	filter								x								5 whirl pacs
	2PL-EAS-DT-R2	08-09-24	10:55	water	x	x	x	x	x	x										6 containers
	2PL-EAS-DT-R2 (pls report 5 reps separately)	08-09-24	10:55	filter								x								5 whirl pacs
	EAS-DUP-R2	08-09-24		water		x	x	x	x	x										5 containers
	3PL-EAS-R2	08-09-25	14:30	water	x	x	x	x	x	x										6 containers
	3PL-EAS-R2 (pls report 5 reps separately)	08-09-25	14:30	filter								x								5 whirl pacs

****Conventionals**: conductivity, hardness, pH, TSS, TDS, nutrients(nitrate, nitrite, total phosphate, orthophosphate), sulphate, chloride, alkalinity(bicarbonate, carbonate, hydroxide).

RELINQUISHED BY:				RECEIVED BY:			
NAME:	Ryan Hill	DATE:	26-Sep-08	NAME:	ZK	DATE:	Oct 3, 08
OF:	Azimuth Consulting Group Inc.	TIME:	12:00	OF:		TIME:	11:42
NAME:		DATE:		NAME:		DATE:	
OF:		TIME:		OF:	ALS Environmental	TIME:	

Special Instructions / Comments (billing details, QC reporting, etc.):

FOR LAB USE ONLY Cooler Seal Intact? Yes✓ No___ N/A___ Sample Temperature: 12 °C Frozen? Yes___ No✓ Cooling Method? Icepacks✓ Ice___ None___

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

AZIMUTH CONSULTING GROUP INC.

ATTN: RANDY BAKER

218 - 2902 WEST BROADWAY

VANCOUVER BC V6K 2G8

Reported On: 27-MAR-09 06:15 PM
Revision: 1

Lab Work Order #: **L691229** **Date Received:** **03-OCT-08**

Project P.O. #:
Job Reference: MEADOWBANK EAST DIKE MONITORING
Legal Site Desc:
CofC Numbers:

Other Information:

Comments: The sediment samples reported in the following data tables have been received as water samples with a sediment layer at the bottom. Each sample was submitted in 4 x 1L plastic bottle. The following steps were taken to get dry sediment samples:
- Water from each bottle of a sample was decanted through 45 micron filter paper.
- The remaining sediment on the bottom of the bottle was transferred into drying dish.
- Bottle was rinsed with di-ionized water and rinsing was passed through the filter.
- Sediment from the filter paper has been scrapped into the same drying dish as the sediment from the bottom of the bottle.
- Sediment was dried at the temperature of 60C for 8 hours.
- Dry weight of each sample was recorded.

ALS Sample ID	Client Sample ID	Weight (g)
L691229-1	SP-ST-1-180908 (R1-R4)	9.30
L691229-2	SP-ST-2-180908 (R1-R4)	5.60
L691229-3	SP-ST-4-180908 (R1-R4)	5.04
L691229-4	SP-ST-5-180908 (R1-R4)	5.62

NOTE: Samples L691229-2 and L691229-3 were sent to Golder Associates Ltd. on November 26, 2008 as per client request.

Please note that this revision, 1, of the report replaces and supersedes all previous revisions. Total Aluminum results have been added to all sediment samples reported in the following data tables. All other data remains unchanged.

Natasha Markovic-M.

NATASHA MARKOVIC-MIROVIC
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L691229-2	L691229-4			
	Description					
	Sampled Date	22-SEP-08	24-SEP-08			
	Sampled Time					
	Client ID	SP-ST-2-220908 (R1-R4)	SP-ST-5-240908 (R1-R4)			
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (pH)	6.21	6.27			
Organic / Inorganic Carbon	Total Organic Carbon (%)	2.4	1.8			
Metals	Aluminum (Al) (mg/kg)	42200	43100			
	Antimony (Sb) (mg/kg)	<10	<10			
	Arsenic (As) (mg/kg)	16.7	16.4			
	Barium (Ba) (mg/kg)	234	233			
	Beryllium (Be) (mg/kg)	1.65	1.76			
	Cadmium (Cd) (mg/kg)	0.51	<0.50			
	Chromium (Cr) (mg/kg)	175	194			
	Cobalt (Co) (mg/kg)	25.5	27.9			
	Copper (Cu) (mg/kg)	87.6	101			
	Lead (Pb) (mg/kg)	<30	<30			
	Mercury (Hg) (mg/kg)	0.0303	0.0242			
	Molybdenum (Mo) (mg/kg)	<4.0	<4.0			
	Nickel (Ni) (mg/kg)	109	113			
	Selenium (Se) (mg/kg)	<2.0	<2.0			
	Silver (Ag) (mg/kg)	<2.0	<2.0			
	Thallium (Tl) (mg/kg)	<1.0	<1.0			
	Tin (Sn) (mg/kg)	<5.0	<5.0			
	Vanadium (V) (mg/kg)	70.5	76.5			
	Zinc (Zn) (mg/kg)	235	272			

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
C-TOT-ORG-LECO-SK	Soil	Organic Carbon by combustion method	SSSA (1996) p. 973

Total Organic Carbon (C-TOT-ORG-LECO-SK, C-TOT-ORG-SK)

Total C and inorganic C are determined on separate samples. The total C is determined by combustion and thermal conductivity detection, while inorganic C is determined by weight lass after addition of hydrochloric acid. Organic C is calculated by the difference between these two determinations.

Reference for Total C:
Nelson, D.W. and Sommers, L.E. 1996. Total Carbon, organic carbon and organic matter. P. 961-1010 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

Reference for Inorganic C:
Loeppert, R.H. and Suarez, D.L. 1996. Gravimetric Method for Loss of Carbon Dioxide. P. 455-456 In: J.M. Bartels et al. (ed.) Methods of soil analysis: Part 3 Chemical methods. (3rd ed.) ASA and SSSA, Madison, WI. Book series no. 5

HG-CCME-CVAFS-VA	Soil	CVAFS Hg in Soil (CCME)	CCME

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 7000 series).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MET-CSR-FULL-ICP-VA	Soil	Metals in Soil by ICPOES (CSR SALM)	BCMELP CSR SALM METHOD 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

PH-1:2-VA	Soil	CSR pH by 1:2 Water Leach	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (10 mesh /2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

TL-CSR-MS-VA	Soil	ICPMS Tl in Soil by CSR SALM	BCMELP CSR SALM Method 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by either hotplate or block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
SK	ALS LABORATORY GROUP - SASKATOON, SASKATCHEWAN, CANADA	VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

L691229

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CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

PAGE 1 OF 1

SEND REPORT TO:

COMPANY:	Azimuth Consulting Group Inc.				
ADDRESS:	218-2902 West Broadway				
CITY:	Vancouver	PROV: BC	POSTAL CODE:	V6K 2G8	
CONTACT:	Randy Baker, Gary Mann		TELEPHONE:	604-321-4180	
PROJECT NAME/#:	Meadowbank East Dike Monitoring		SAMPLER:	RB, RH	
ALSE QUOTE #:	Job AEM-08-01.2		ALS CONTACT:	Natasha Marcovic-Mirovic	

REPORT FORMAT: ◉ Hardcopy ○ Fax #: ○ E-mail Specify file type: Excel & pdf
E-mail Address:

INVOICE FORMAT: ◉ Hardcopy ○ Fax #: ○ E-mail (pdf format)
E-mail Address:

◉ Routine Turn Around
○ Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? ☑ Yes ☐ No

COMPANY:		CONTACT:			
ADDRESS:		P.O. #:			
CITY:	PROV:	POSTAL CODE:		TEL:	

ANALYSIS REQUESTED:

FOR LAB USE ONLY	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Dry weight of sediment	Particle size (do this after compositing R1 to R4)	Total Metals (do this after compositing R1 to R4)										Special Handling Needed (water evaporation/compositing). See Natasha before proceeding
	SP-ST-1-180908-R1	08-09-18		sed./soil	x												1 container
1	SP-ST-1-180908-R2	08-09-18		sed./soil	x	x	x										1 container
	SP-ST-1-180908-R3	08-09-18		sed./soil	x												1 container
	SP-ST-1-180908-R4	08-09-18		sed./soil	x												1 container
	SP-ST-2-220908-R1	08-09-22		sed./soil	x												1 container
2	SP-ST-2-220908-R2	08-09-22		sed./soil	x	x	x										1 container
	SP-ST-2-220908-R3	08-09-22		sed./soil	x												1 container
	SP-ST-2-220908-R4	08-09-22		sed./soil	x												1 container
	SP-ST-4-220908-R1	08-09-22		sed./soil	x												1 container
3	SP-ST-4-220908-R2	08-09-22		sed./soil	x	x	x										1 container
	SP-ST-4-220908-R3	08-09-22		sed./soil	x												1 container
	SP-ST-4-220908-R4	08-09-22		sed./soil	x												1 container
	SP-ST-5-240908-R1	08-09-24		sed./soil	x												1 container
4	SP-ST-5-240908-R2	08-09-24		sed./soil	x	x	x										1 container
	SP-ST-5-240908-R3	08-09-24		sed./soil	x												1 container
	SP-ST-5-240908-R4	08-09-24		sed./soil	x												1 container

RELINQUISHED BY:				RECEIVED BY: ZH	
NAME:	Ryan Hill	DATE:	29-Sep-08	NAME: ZH	DATE: Oct 3,08
OF:	Azimuth Consulting Group Inc.	TIME:	12:00	OF:	TIME: 14:19
NAME:		DATE:		NAME:	DATE:
OF:		TIME:		OF: ALS Environmental	TIME:

Special Instructions / Comments (billing details, QC reporting, etc.):

Special Handling Needed (water evaporation/compositing). See Natasha before proceeding

FOR LAB USE ONLY Cooler Seal Intact? Yes ✓ No ___ N/A ___ Sample Temperature: 14 °C Frozen? Yes ___ No ✓ Cooling Method? Icepacks ✓ Ice ___ None ✓

L691229

ALS Environmental
excellence in analytical testing

1988 Triumph Street, **Vancouver**, BC Canada V5L 1K5
Tel: 604-253-4188 Toll Free: 1-800-665-0243 Fax: 604-253-6700

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Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430

www.alsenviro.com

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

PAGE 1 OF 1

SEND REPORT TO:

COMPANY: Azimuth Consulting Group Inc.
ADDRESS: 218-2902 West Broadway
CITY: Vancouver PROV: BC POSTAL CODE: V6K 2G8
CONTACT: Randy Baker, Gary Mann TELEPHONE: 604-321-4180
PROJECT NAME/#: Meadowbank East Dike Monitoring SAMPLER: RB, RH
ALSE QUOTE #: Job AEM-08-01.2 ALS CONTACT: Natasha Marcovic-Mirovic

REPORT FORMAT:
(●) Hardcopy ( ) Fax #:
( ) E-mail Specify file type: Excel & pdf
E-mail Address:

INVOICE FORMAT:
(●) Hardcopy ( ) Fax #:
( ) E-mail (pdf format)
E-mail Address:

(●) Routine Turn Around
( ) Rush (Surcharges May Apply) Specify Due Date: Time:

SEND INVOICE TO: (complete if different from Report To at left) Require copy of Report? [✓] Yes [ ] No

COMPANY: CONTACT:
ADDRESS: P.O. #:
CITY: PROV: POSTAL CODE: TEL:

ANALYSIS REQUESTED:

FOR LAB USE ONLY	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YY-MM-DD	Time	MATRIX	Dry weight of sediment	Particle size (do this after compositing R1 to R4)	Total Metals (do this after compositing R1 to R4)
1	SP-ST-1-180908-R1	08-09-18		sed./soil	x	x	x
	SP-ST-1-180908-R2	08-09-18		sed./soil	x		
	SP-ST-1-180908-R3	08-09-18		sed./soil	x		
	SP-ST-1-180908-R4	08-09-18		sed./soil	x		
2	SP-ST-2-220908-R1	08-09-22		sed./soil	x	x	x
	SP-ST-2-220908-R2	08-09-22		sed./soil	x		
	SP-ST-2-220908-R3	08-09-22		sed./soil	x		
	SP-ST-2-220908-R4	08-09-22		sed./soil	x		
3	SP-ST-4-220908-R1	08-09-22		sed./soil	x	x	x
	SP-ST-4-220908-R2	08-09-22		sed./soil	x		
	SP-ST-4-220908-R3	08-09-22		sed./soil	x		
	SP-ST-4-220908-R4	08-09-22		sed./soil	x		
4	SP-ST-5-240908-R1	08-09-24		sed./soil	x	x	x
	SP-ST-5-240908-R2	08-09-24		sed./soil	x		
	SP-ST-5-240908-R3	08-09-24		sed./soil	x		
	SP-ST-5-240908-R4	08-09-24		sed./soil	x		

Special Handling Needed (water evaporation/compositing). See Natasha before proceeding

1 container

waiting for Natasha

Please log in 5 samples
SP-ST-1-180908-R1-R4
2-220908-
3-
5-240908-

SAMPLE ID ONLY

RELINQUISHED BY:

NAME: Ryan Hill DATE: 29-Sep-08
OF: Azimuth Consulting Group Inc. TIME: 12:00
NAME: DATE:
OF: TIME:

RECEIVED BY: ZH

NAME: ZH DATE: Oct 3,08
OF: TIME: 14:19
NAME: DATE:
OF: ALS Environmental TIME:

Special Instructions / Comments (billing details, QC reporting, etc.):

Special Handling Needed (water evaporation/compositing). See Natasha before proceeding

FOR LAB USE ONLY Cooler Seal Intact? Yes ✓ No ___ N/A ___ Sample Temperature: 14 °C Frozen? Yes ___ No ✓ Cooling Method? Icepacks ___ Ice ___ None ✓

APPENDIX B

TOXICITY TESTING REPORT

Nautilus Environmental

Toxicity testing for the Meadowbank Project

TSS and Chitosan Evaluations

Report date:
January 9, 2009

Submitted to:

Azimuth Consultants
Vancouver, BC

8664 Commerce Court
Burnaby, BC
V5A 4N7

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1.0 INTRODUCTION

Toxicity testing was conducted on water collected by Azimuth Consultants from the Meadowbank Site. The testing program was designed to evaluate whether total suspended solids (TSS) present in the water might result in adverse effects on aquatic organisms. Toxicity tests included acute tests using rainbow trout and *Daphnia magna*, as well as chronic toxicity tests using *Ceriodaphnia dubia* (survival and reproduction) and rainbow trout (embryo development and larval survival and growth tests).

In addition, the effect of chitosan treatment was tested using the rainbow trout embryo development test. The purpose of this evaluation was to demonstrate whether chitosan-facilitated precipitation of suspended solids might result in adverse effects on developing salmonid embryos.

2.0 METHODS

2.1 Sample Collection and Transport

The sample was collected in plastic collapsible carboys by Azimuth, packed in coolers, and transported to Nautilus Environmental by commercial courier.

Upon arrival at the laboratory, the coolers were opened, samples inspected and the contents verified against information provided on the chain of custody form. Receipt temperature was measured in the samples and recorded on the COC form and in a bound logbook. The sample was stored at 4°C in the dark until used for testing. A subset of the coolers were then delivered by commercial courier to the Nautilus Environmental laboratory in Tacoma, WA, where the chronic toxicity tests with rainbow trout were conducted. These tests could not be conducted in the Burnaby laboratory at this time because of a lack of availability of organisms of the appropriate age.

2.2 Acute toxicity tests using rainbow trout and *Daphnia magna*

Acute toxicity tests using rainbow trout and *Daphnia magna* were conducted following Environment Canada (2000a and b) procedures, as summarized in Table 1.

Table 1. Summary of test conditions: acute tests using rainbow trout and *Daphnia magna*.

Test species	Rainbow trout	*Daphnia magna*
Test type	96 hr static	48 hr static
Endpoints	Survival	Survival
Organism source	Fraser Valley Trout Hatchery	In-house culture
Organism age	Fry – 0.3 – 0.5 g	< 24 hr old
Feeding	None	None
Test chamber	15-L glass aquaria	300 mL glass
Test volume	10 L	200 mL
Test temperature	15 ± 1°C	20 ± 2°C
Control water	Dechlorinated municipal tapwater	Moderately hard synthetic water,
Organisms/replicate	10	10
Number of replicates	1	1
Photoperiod	16 hours light/8 hours dark	16 hours light/8 hours dark
Aeration	Continuous	None
Acceptability criterion for controls	≥90% survival	≥90% survival

2.3 Chronic toxicity tests using *Ceriodaphnia dubia*

The sample was tested for chronic toxicity using *C. dubia* according to procedures summarized in Table 2, which are based on procedures from Environment Canada (2007).

Table 2. Summary of test conditions: 7-d *Ceriodaphnia dubia* test.

Test type	Static renewal (daily)
Endpoints	Survival and reproduction
Organism source	In-house culture
Organism age	<24 hr old neonates produced within 12 hr
Feeding	*Selenastrum capricornutum* and dYCT
Test chamber	Glass test tube
Test volume	15 mL
Test temperature	25 ± 1°C
Control water	Moderately hard synthetic water, diluted to the hardness of the sample
Number of organisms/replicate	1
Number of replicates	10
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test acceptability criterion for controls	≥80% survival; ≥15 young per surviving control

2.4 Chronic toxicity tests using rainbow trout

2.4.1 Embryo development

Rainbow trout embryo toxicity tests were conducted using rainbow trout gametes according to procedures presented by Environment Canada (1998) with modifications from Canaria et al. (1999), as summarized in Table 3. This test involved a seven-day exposure of recently fertilized eggs to the test solutions. Embryonic development was the endpoint evaluated for this test. One test was performed with daily renewal and a second test was performed concurrently without renewals. The purpose of the test conducted without renewals was to provide a "worst-case" for settling of suspended particulate during the exposure period, since renewing the solutions would tend to rinse suspended solids from the eggs on the bottom of the container.

A subsequent test was conducted on the sample following treatment with 0.5 mg/L chitosan acetate (ChitoVan, produced by Cascade EcoSolutions, WA) to evaluate whether chitosan-enhanced settling of particulate matter on embryos would cause toxicity. This test was only conducted on full-strength sample, and was performed in tall and narrow containers to maximize the accumulation of particulate on the eggs. Four treatments were evaluated: control, untreated sample, chitosan-treated control water and chitosan-treated sample. Test methods for this test are summarized in Table 4.

2.4.2 Larval survival and growth

A toxicity test evaluating survival and growth was also conducted using larval rainbow trout. This test is based on a Draft USEPA procedure, and was conducted in order to test whether feeding might be impaired by the presence of TSS. Test methods for this test are summarized in Table 5.

Table 3. Summary of test conditions: rainbow trout embryo development test.

Test type	Static renewal (daily), or static
Test endpoints	Normal embryonic development
Test organism source	Trout Lodge; Sumner, WA
Test organism age	Within 30 minutes of fertilization
Test duration	7 days
Feeding	None
Test chamber	1-L plastic beaker
Test solution volume	500 mL
Test temperature	14 ± 1°C
Dilution water	Moderately hard synthetic water
Test concentrations (% sample)	100, 50, 25, 12.5, 6.25, laboratory control
Number of organisms/chamber	30
Number of replicates	4
Photoperiod	24-hr dark; low intensity light used during solution renewals
Aeration	Continuous gentle aeration
Test protocol	Environment Canada (1998); modifications from Canaria et al. (1999)
Test acceptability criterion for controls	≥ 70% normally developed (viable) embryos

Table 4. Summary of test conditions: rainbow trout embryo development test of chitosan treated sample.

Test type	Static
Test endpoints	Normal embryonic development
Test organism source	Trout Lodge; Sumner, WA
Test organism age	Within 30 minutes of fertilization
Test duration	7 days
Feeding	None
Test chamber	2-L graduated cylinders
Test solution volume	2 L
Test temperature	14 ± 1°C
Dilution water	Moderately hard synthetic water
Test concentrations (% sample)	100% and control
Number of organisms/chamber	30
Number of replicates	4
Photoperiod	24-hr dark; low intensity light used during solution renewals
Aeration	Continuous gentle aeration
Test protocol	Environment Canada (1998); modifications from Canaria et al. (1999)
Test acceptability criterion for controls	≥ 70% normally developed (viable) embryos

Table 5. Summary of test conditions: rainbow trout larval survival and growth test.

Test type	Static renewal (daily)
Test endpoints	Survival and growth
Test organism source	Thomas Fish Company; Anderson, California
Test organism age	15 days post hatch, 2 days post swim up
Test duration	7 days
Feeding	*Artemia nauplii* twice daily
Test chamber	1-L plastic beaker
Test solution volume	500 mL
Test temperature	15 ± 1°C
Dilution water	Moderately hard synthetic water
Test concentrations (% sample)	100, 50, 25, 12.5, 6.25, laboratory control
Number of organisms/chamber	5
Number of replicates	4
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test protocol	USEPA draft SOP
Test acceptability criterion for controls	≥ 90% survival

3.0 RESULTS

No adverse effects were observed in acute toxicity tests with either rainbow trout or *Daphnia magna* (Table 6). Similarly, no adverse effects were observed in the chronic toxicity test using *Ceriodaphnia dubia* (Table 7).

Results of rainbow trout embryo development tests conducted under static renewal and static conditions are provided in Table 8. No adverse effects were observed in the test conducted with daily solution renewal; however, significant impairment of embryonic development was observed in the 25% and 100% sample when tested without renewal, although there was no significant effect in the 50% sample. An EC25 was not calculated for this sample because of the variable nature of the response; however, this test clearly indicated the presence of an adverse effect, converse to the findings of the test conducted with daily renewal.

Results of rainbow trout embryo tests conducted on chitosan-treated sample are provided in Table 9. There was no evidence of increased toxicity associated with chitosan treatment. Data for one replicate of the chitosan-treated sample was excluded from analysis; there was no survival in this replicate, compared to 67, 67 and 83% survival in the other three replicates, suggesting that this replicate was an outlier caused by a testing artifact, likely fungal growth. Even if the data from this replicate are included, the rate of survival in the chitosan-treated sample was not significantly lower than the untreated sample.

Results of the larval survival and growth test conducted using rainbow trout are provided in Table 10. No adverse effects were observed in this test, indicating that the amount of TSS present in the sample did not affect the ability of the fry to locate and capture prey.

Table 6. Results of acute toxicity tests, presented as percent survival.

Percent sample	Rainbow trout	*Daphnia magna*
Control	100	100
6.25	100	100
12.5	100	100
25	100	100
50	100	100
100	100	100
LC50	>100%	>100%

Table 7. Results of chronic toxicity tests using *Ceriodaphnia dubia*.

Percent sample	Survival (%)	Reproduction (mean ± SD)
Control	100	15.0 ± 5.5
1.56	100	15.8 ± 6.1
3.12	100	16.8 ± 3.0
6.25	100	16.2 ± 3.6
12.5	100	15.5 ± 5.4
25	100	13.8 ± 2.9
50	100	13.6 ± 3.9
100	100	13.1 ± 5.3
LC50	>100%	--
IC25	--	>100%

Table 8. Results of rainbow trout embryo development tests presented as percent normally developed embryos.

Percent sample	Static renewal (daily) (mean ± SD)	Static (mean ± SD)
Control	92.5 ± 6.9	95.8 ± 3.2
6.25	93.3 ± 7.2	91.7 ± 3.3
12.5	90.8 ± 5.7	90.0 ± 9.0
25	95.8 ± 6.3	65.0 ± 17.7
50	97.5 ± 1.7	81.7 ± 16.9
100	99.2 ± 1.7	68.3 ± 16.0
EC25	>100%	See text

Shading indicates significant difference relative to the control.

Table 9. Results of rainbow trout embryo development tests to evaluate the effect of chitosan treatment.

Treatment	Normally developed (mean ± SD)
Control	78.3 ± 11.1
Chitosan-treated control	78.3 ± 7.9
Sample	63.3 ± 7.7
Chitosan-treated sample	72.2 ± 9.6 *

* Data from one replicate excluded. See text.

Table 10. Results of rainbow trout larval survival and growth tests.

Percent sample	Survival (%)	Dry weight (mg)
Control	95.0 ± 10.0	28.5 ± 0.9
6.25	100 ± 0.0	26.6 ± 2.8
12.5	95.0 ± 10.0	26.3 ± 3.7
25	100 ± 0.0	26.0 ± 1.1
50	85.0 ± 19.1	27.0 ± 2.7
100	100 ± 0.0	26.0 ± 2.0
EC25	>100%	>100

Shading indicates significant difference relative to the control.

4.0 QA/QC

The rainbow trout embryo tests conducted in this program deviated from methods specified in Environment Canada (1998) in terms of sample volume. Volume was reduced to 500 mL because of the significant volume required for this test and the long distance required for transportatoin. In addition, use of this smaller volume has been shown to be an effective and sensitive alternative (Canaria et al. 1999). Sample holding time was exceeded for these tests as a result of the significant shipping time and the available schedule for obtaining test organisms; however, since the primary concern in this sample was TSS, this deviation is not expected to have affected the outcome of the tests, because TSS would not degrade, volatilize or otherwise dissipate in the sample. The samples were thoroughly mixed prior to preparation of the test solutions to re-suspend any suspended particulate that might have settled during transport.

The tests each met control acceptability criteria and water quality parameters remained within the acceptable ranges, with the exception of minor deviation in temperature on day 3 of the trout embryo test conducted with renewals, and dissolved oxygen on day 4 of the larval survival and growth test. These minor water quality deviations are not expected to have adversely affected the results of the tests.

Reference toxicant tests conducted in conjunction with this testing program fell within the acceptable range in all cases, indicating that the health and sensitivity of the test organisms was appropriate. Results for these tests are provided in Table 11.

Table 11. Results of reference toxicant tests.

Test	Date initiated	Result	Acceptable Range	CV (%)
Rainbow trout acute	Sept 2/08	4.6 mg/L SDS	3.3 – 7.5	19.6
Daphnia magna acute	Sept 3/08	3.9 mg/L NaCl	3.2 – 5.2	12.2
Ceriodaphnia dubia survival and reproduction	Sept 11/08	1.0 mg/L NaCl	0.6 – 1.6	21.0
Trout embryo survival & development	Sept 15/08	2.8 mg/L SDS	1.1 - 9.1	39.6
Trout embryo survival & development	Sept 24/08	1.7 mg/L SDS	1.0 - 9.1	40.1
Larval trout survival & growth	Sept 17/08	49.5 µg/L Cu	36.0 - 84.7	20.2

5.0 REFERENCES

Canaria, E.C., Elphick, J.R. and Bailey, H.C. 1999. A simplified procedure for conducting small scale short-term embryo toxicity tests with salmonids. Environ. Toxicol. 14:301-307.

Environment Canada. 2007. Biological test method: test of reproduction and survival using the cladoceran *Ceriodaphnia dubia*. Environmental Protection Series. Report EPS 1/RM/21, Second Edition. Environment Canada, Science and Technology Branch, Ottawa, ON.

Environment Canada. 2000a. Biological test method: reference method for determining acute lethality of effluents to rainbow trout. Report EPS 1/RM/13, Second Edition. Environment Canada, Science and Technology Branch, Ottawa, ON.

Environment Canada. 2000b. Biological test method: reference method for determining acute lethality of effluents to *Daphnia magna*. Report EPS 1/RM/14, Second Edition. Environment Canada, Science and Technology Branch, Ottawa, ON.

Environment Canada. 1998. Biological Test Method: Toxicity Tests Using Early Life Stages of Salmonid Fish (Rainbow Trout). Second Edition. EPS/1/RM/28, July 1998.

APPENDIX A – Acute Toxicity Test Results

Rainbow Trout Summary Sheet

Client: Azimuth

Start Date/Time: Sept 15/08 @ 1620h

Work Order No.: 08234

Test Species: *Oncorhynchus mykiss*

Sample Information:

Sample ID: 2PL-EA5
Sample Date: Sept. 10/08
Date Received: Sept. 12/08
Sample Volume: 6 x 20L
Other: —

Dilution Water:

Type: Dechlorinated Municipal tap water
Hardness (mg/L $CaCO_3$): 11
Alkalinity (mg/L $CaCO_3$): 11

Test Organism Information:

Batch No.: 082608
Source: Sun Valley Trout Farm
Test Volume/No. Fish: 10/10L
Loading Density: 0.41
Mean Length ± SD (mm): 35 ± 3 Range: 31 - 39
Mean Weight ± SD (g): 0.41 ± 0.10 Range: 0.30 - 0.54

SDS Reference Toxicant Results:

Reference Toxicant ID: RT36
Stock Solution ID: 08803
Date Initiated: Sept. 2/08
96-h LC50 (95% CL): 4.6 (3.9 - 5.5)

Reference Toxicant Mean ± 2 SD: 5.4 ± 2.1
Reference Toxicant CV (%): 19.6%

Test Results: The 96-h LC50 is estimated @ >100% (v/v)

Reviewed by: JRT

Date reviewed: 10 Dec 2008

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: Azimuth
Sample I.D. 2PL - EAS
W.O. # 08234
RBT Batch #: 092609
Date Received/Time: Sept 12/08 @ 1715h
Date Setup/Time: Sept 15/08 @ 1620h
Sample Setup By: ECC/JLT

D.O. meter: DO-1
pH meter: pH-1
Cond. Meter: C-1

Number Fish/Volume: 10/10L
7-d % Mortality: 0 %
Total Pre-aeration Time (mins): 45
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	14.1		14.1
pH	7.4		7.4
D.O. (mg/L)	10.8		10.6
Cond. (µS/cm)	27		28

Concentration %(v/v)	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Control				10	10	10	10	15.4	14.8	14.7	15.4	14.8	10.1	10.1	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	37	41
6.25				10	10	10	10	15.4	14.8	14.7	15.4	14.8	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	38	39
12.5				10	10	10	10	15.4	14.8	14.7	15.4	14.8	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	35	40
25				10	10	10	10	15.3	14.8	14.7	15.4	14.8	10.0	10.0	10.0	10.0	9.9	7.1	7.0	6.9	7.0	6.9	34	40
50				10	10	10	10	15.0	14.8	14.7	15.4	14.8	10.1	9.9	10.0	9.9	9.6	7.1	6.9	6.8	6.9	6.9	32	38
100				10	10	10	10	14.1	14.8	14.7	15.4	14.8	10.1	9.9	9.9	9.8	9.7	7.3	6.7	6.8	6.9	6.8	28	28
Initials				JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT	JLT

Sample Description/Comments: slightly cloudy

Fish Description at 96? Fish appear fine

Other Observations:

Reviewed by: JLT

Date Reviewed: 10 Dec 2008

Nautilus Environmental Burnaby Lab

Rainbow trout (Oncorhynchus mykiss) length and weight sheet

Client: Azimuth
W.O. #: 08234
Sample ID: 2PL-EA5

Date Measured: Sept 19/08
Batch #: 082808

	Length (mm)	Weight (g)
1	39	0.54
2	33	0.33
3	37	0.48
4	31	0.30
5	38	0.51
6	34	0.33
7	39	0.52
8	32	0.33
9	35	0.44
10	32	0.32
Total	350	4.10
Mean	35	0.41
Std. Dev.	3	0.10
Low	31	0.30
High	39	0.54

Daphnia magna Summary Sheet

Client: Azimuth
Work Order No.: 08235

Start Date/Time: sept. 12/08 @ 1750h
Test Species: D. magna
Set up by: AWD

Sample Information:

Sample ID: 2PL-EFF
Sample Date: sept. 10/08 @ 1630h
Date Received: sept. 12/08
Sample Volume: bt 2L

Test Organism Information:

Broodstock No.: 082208
Age of young (Day 0): < 24-h old
Avg No. young per brood in previous 7 d: 25
Mortality (%) in previous 7 d: 0
Days to first brood: 9

NaCl Reference Toxicant Results:

Reference Toxicant ID: Dm 37
Stock Solution ID: 08NaCl
Date Initiated: Sept 3/08
48-h LC50 (95% CL): 3.9 (3.2-4.9) g/L NaCl

Reference Toxicant Mean ± 2 SD: 4.2 ± 1.0 g/L NaCl
Reference Toxicant CV (%): 12.2

Test Results: ~~100% survival @ 48-h in the 100% undiluted (v/v)~~
The 48-h LC50 > 100% (v/v)

Reviewed by: JAE

Date reviewed: 10 Dec 2008

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: Azimuth
Sample ID: 3PL-EAS
Work Order No.: 08235

Start Date/Time: Sept 2nd/08 @ 1750
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: A

DO meter: DO-1 pH meter: pH-1 Conductivity meter: C-1

Concentration % (v/v)	Rep	Number of Live Organisms			No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		0	24	48	48	0	24	48	0	24	48	0	24	48	0	48
control	A	10	10	10	0	22.0	20.0	19.7	8.9		9.0	8.0		8.0	362	370
	B															
	C															
	D															
6.25	A	10	10	10	0	21.2	20.0	19.7	9.0		9.0	8.0		8.0	345	353
	B															
	C															
	D															
12.5	A	10	10	10	0	17.8	20.0	19.7	9.0		9.0	8.1		8.0	328	333
	B															
	C															
	D															
25	A	10	10	10	0	17.5	19.9	19.7	9.1		9.0	8.1		8.1	300	296
	B															
	C															
	D															
50	A	10	10	10	0	18.8	19.9	19.7	9.1		9.1	8.0		8.0	265	280
	B															
	C															
	D															
100	A	10	10	10	0	18.3	19.9	19.7	9.1		9.1	7.9		7.9	89	96
	B															
	C															
	D															
Technician Initials		N	N	JLT	JLT	N	N	JLT	N		JLT	N		JLT	N	JLT

	Hardness*	Alkalinity*
Conc.	*(mg/L as CaCo3)	
Control (MHW)	100	60
Highest conc.	① 30	① 28

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.2	Adjusted to 20±2	18.3
DO (mg/L)	9.1		9.1
pH	8.0	mg/L CaCO3 ①	7.9
Cond (µS/cm)	31		89

Sample Description: clear - light yellow . slightly opaque

Comments: used 082203 BB Mort Ø Days to 1st brood: 9 Avg. # yng: 25

Reviewed by: A. Tang Date reviewed: January 9, 2009

Client: Arnath

W.O.#: 08235

Hardness and Alkalinity Datasheet

	Alkalinity						Hardness			
Sample ID	Sample Date	Sample Volume (mL)	(mL) 0.02N HCL/H_2SO_4 used to pH 4.5	(mL) of 0.02N HCL/H_2SO_4 used to pH 4.2	Total Alkalinity ($mg/LCaCO_3$)		Sample Volume (mL)	Volume of 0.01M EDTA Used (mL)	Total Hardness ($mg/L\ CaCO_3$)	Technician
28L-EAS	Sept 12/08	50.0	0.6	0.7	10		50.0	0.5	10	BPL
↓ hardness adjusted	Sept 12/08	50.0	1.5	1.6	28		50.0	1.5	30	"

Notes: Sept 12

Reviewed by: A. Tang

Date Reviewed: January 9, 2009

4

APPENDIX B – *Ceriodaphnia dubia* **test results**

Ceriodaphnia dubia Summary Sheet

Client: Azimuth
Work Order No.: 08233

Start Date/Time: Sept. 12/08 @ 1740h
Set up by: AWD

Sample Information:

Sample ID: 2PL-EAS
Sample Date: Sept. 10/08
Date Received: Sept. 12/08
Sample Volume: 6x20L

Test Organism Information:

Broodstock No.: 080908
Age of young (Day 0): <24h (w/ 12h)
Avg No. young in first 3 broods of previous 7 d: 16
Mortality (%) in previous 7 d: 10
Avg. No. of young in previous brood: 9

NaCl Reference Toxicant Results:

Reference Toxicant ID: C034
Stock Solution ID: 08 NA02
Date Initiated: Sept. 11/08

7-d LC50 (95% CL): 2.1 (1.7 - 3.6) g/L NaCl
7-d IC50 (95% CL): 1.0 (0.9 - 1.1) g/L NaCl

7-d LC50 Reference Toxicant Mean ± 2 SD: 1.5 ± 0.8 g/L NaCl CV (%): 27
7-d IC50 Reference Toxicant Mean ± 2 SD: 1.1 ± 0.5 g/L NaCl CV (%): 21

Test Results:

	Survival	Reproduction
NOEC %(v/v)	100	100
LOEC %(v/v)	>100	>100
LC50 %(v/v) (95% CL)	>100	
IC25 %(v/v) (95% CL)		>100
IC50 %(v/v) (95% CL)		>100

Reviewed by: A. Terry

Date reviewed: January 9, 2009

Chronic Freshwater Toxicity Test
Initial and Final Water Quality Measurements

Client: Arnold
Sample ID: 2PL-EAS
Work Order #: 08223
Start Date & Time: Sept 12/08 @ 1740h
Stop Date: Sept. 18/08 @ 1800h
Test Species: *Ceriodaphnia dubia*

% (v/v)

Control

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.6	25.6	24.7	24.9	25.1	25.2	25.1	25.5	25.3	25.5	25.1	25.8		
DO (mg/L)	7.9	7.5	8.3	7.9	7.9	7.6	8.0	7.7	8.1	7.7	8.1	7.2		
pH	8.1	8.1	8.3	8.1	8.2	7.9	8.0	7.8	8.2	7.7	7.9	7.6		
Cond. (µS/cm)	209	202		204		205		206		211		234		
Initials	A	A	A	CW	CW	DKL	DKL	A	A	DKL	DKL	A		

1.6

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.7	25.6	24.5	24.9	25.1	25.2	25.1	25.5	25.1	25.5	25.1	25.8		
DO (mg/L)	8.2	7.6	8.2	7.9	7.9	7.5	7.9	7.7	8.2	7.7	8.1	7.1		
pH	8.1	8.1	8.2	8.0	8.1	7.9	8.1	7.8	8.0	7.7	7.9	7.6		
Cond. (µS/cm)	205	207		205		204		201		210		195		
Initials	A	A	A	CW	CW	DKL	DKL	A	A	DKL	DKL	A		

12.5

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	24.8	25.6	24.4	24.9	25.1	25.2	25.1	25.5	25.1	25.5	25.1	25.6		
DO (mg/L)	8.2	7.5	8.2	7.4	7.8	7.5	7.9	7.6	8.2	7.6	8.1	7.1		
pH	8.1	8.2	8.1	8.0	8.0	7.9	8.1	7.8	8.0	7.7	7.9	7.6		
Cond. (µS/cm)	186	189		185		187		189		192		192		
Initials	A	A	A	CW	CW	DKL	DKL	A	A	DKL	DKL	A		

100

Concentration	Days													
	0	1		2		3		4		5		6		7
	init.	old	new	old	new	old	new	old	new	old	new	old	new	final
Temperature (°C)	25.0	25.6	24.2	24.9	25.1	25.2	25.1	25.5	25.3	25.5	25.1	25.8		
DO (mg/L)	8.0	7.5	8.2	7.1	7.7	7.3	7.8	7.9	8.1	7.7	8.1	7.1		
pH	8.0	7.5	7.7	7.2	7.4	7.3	7.4	7.6	7.6	7.3	7.3	7.5		
Cond. (µS/cm)	31	31		33		34		32		35		27		
Initials	A	A	A	CW	CW	DKL	DKL	A	A	DKL	DKL	A		

	Control	100%		
Hardness*	100	10		
Alkalinity*	80	10		

* mg/L as CaCO3

Analysts: AWO, DKL, ECC

Reviewed by: JM

Date reviewed: 10 Dec 2008

Sample Description: light yellow - slightly opaque

Comments:

Chronic Freshwater Toxicity Test
C. dubia Reproduction Data

Client: Azimuth
Sample ID: 2PL-EA5
Work Order: 08233

Start Date & Time: Sept 12/08 @ 1740
Stop Date & Time: Sept 12/08 @ 1800
Set up by: AS

9, (1/3)

Concentration: Control

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DKL
4	3	4	✓	4	3	4	5	4	4	3	✓
5	5	✓	X	7	5	5	7	8	8	6	DKL
6	8	9	|	5	9	8	5	6	7	10	✓
7			|			N					
8			|			17				17	
Total	16	13	0	16	17	16	17	18	19	16	DKL

Concentration: 1.6

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	DKL
4	2	4	3	3	4	3	4	|	3	3	✓
5	✓	6	7	8	9	8	9	|	9	9	DKL
6	9	7	8	8	6	7	6	|	7	6	✓
7								|			
8								|			
Total	11	17	18	19	19	18	19	0	19	18	DKL

Concentration: 3.2

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DKL
4	3	3	3	4	5	3	4	4	5	4	✓
5	10	10	2	7	9	5	9	6	3	8	DKL
6	7	5	9	5	✓	8	✓	7	9	11	✓
7											
8											
Total	20	18	14	16	14	16	13	17	17	23	DKL

Concentration: 6.25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DKL
4	✓	✓	4	4	3	4	4	✓	3	✓	✓
5	4	5	10	6	6	8	7	4	6	4	DKL
6	9	9	7	8	8	8	9	7	7	8	✓
7											
8											
Total	13	14	21	18	17	20	20	11	16	12	DKL

Concentration: 12.5

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DKL
4	2	3	4	4	3	✓	3	2	3	3	✓
5	X	9	9	7	10	4	6	11	8	7	DKL
6	|	7	8	7	✓	9	9	4	7	6	✓
7	|										
8	|										
Total	2	19	21	18	13	13	18	17	18	16	DKL

Concentration: 25

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DKL
4	✓	4	4	5	3	✓	✓	3	3	✓	✓
5	5	6	9	7	✓	6	6	7	8	5	DKL
6	7	8	✓	✓	7	8	6	7	7	7	✓
7											
8											
Total	12	18	13	12	10	14	12	17	18	12	DKL

Concentration: 50

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	DKL
4	3	✓	3	✓	✓	3	2	4	✓	3	✓
5	6	6	4	5	4	2	7	6	6	5	DKL
6	8	10	7	7	5	✓	7	5	8	7	✓
7											
8											
Total	17	16	17	12	9	5	16	15	14	15	DKL

Concentration: 100

Days	A	B	C	D	E	F	G	H	I	J	Init
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	
3	✓	✓	✓	✓	✓	✓	✓	✓	|	✓	DKL
4	4	✓	3	3	✓	3	✓	✓	|	✓	✓
5	8	5	6	6	2	9	4	5	|	6	DKL
6	6	9	7	8	7	5	9	8	|	8	✓
7									|		
8									|		
Total	18	14	16	17	9	17	13	13	0	14	DKL

Concentration:

Days	A	B	C	D	E	F	G	H	I	J	Init
1											
2											
3											
4											
5											
6											
7											
8											
Total											

Notes: X = mortality.

Sample Description:
Comments:

Reviewed by: JRE

Date reviewed: 10 Dec 2008

CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	17-1721-8357	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Oct-08 14:05	**Analysis:**	Nonparametric-Control vs Treatments	**Official Results:**	Yes

Sample No:	09-3400-7989	**Code:**	934007989	**Client:**	Azimuth
Sample Date:	10 Sep-08 16:30	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	2PL-EAS		
Sample Age:	49h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Rank		C > T	Not Run	100	>100	#Error	1	32.69%

Steel Many-One Rank Test

Control	vs	Conc-%	Test Stat	Critical	Ties	P-Value	Decision(5%)
Negative Control		1.56	126	74	4	0.9990	Non-Significant Effect
		3.12	107	74	4	0.9091	Non-Significant Effect
		6.25	108	74	4	0.9234	Non-Significant Effect
		12.5	113	74	5	0.9708	Non-Significant Effect
		25	86.5	74	3	0.2954	Non-Significant Effect
		50	82	74	2	0.1735	Non-Significant Effect
		100	87	74	5	0.3111	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(5%)
Between	125.75	17.96428	7	0.8508	0.5494	Non-Significant Effect
Error	1520.2	21.11389	72			
Total	1645.95	39.07817	79			

ANOVA Assumptions

Attribute	Test	Test Stat	Critical	P-Value	Decision(1%)
Variances	Bartlett Equality of Variance	9.672	18.48	0.2079	Equal Variances
Distribution	Shapiro-Wilk Normality	0.8312		0.0000	Non-normal Distribution

Reproduction Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	15	12.87	17.13	0	19	1.039	5.497	36.65%	0.0%
1.56		10	15.8	13.45	18.15	0	19	1.144	6.052	38.3%	-5.33%
3.12		10	16.8	15.63	17.97	13	23	0.569	3.011	17.92%	-12.0%
6.25		10	16.2	14.81	17.59	11	21	0.6773	3.584	22.12%	-8.0%
12.5		10	15.5	13.42	17.58	2	21	1.013	5.359	34.58%	-3.33%
25		10	13.8	12.69	14.91	10	18	0.5404	2.86	20.72%	8.0%
50		10	13.6	12.09	15.11	5	17	0.7357	3.893	28.63%	9.33%
100		10	13.1	11.04	15.16	0	18	1.002	5.301	40.47%	12.67%

Rank Transformed Summary

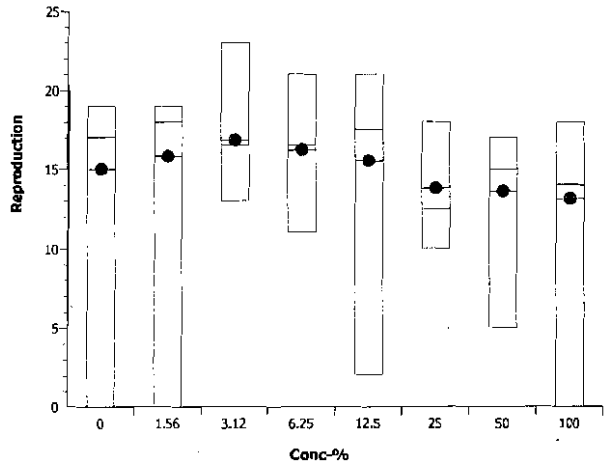
Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Contr	10	43.05	35.3	50.8	2	71.5	3.779	20	46.45%	0.0%
1.56		10	53.45	43.32	63.58	2	71.5	4.937	26.13	48.88%	-24.16%
3.12		10	47	39.06	54.94	20.5	80	3.867	20.46	43.54%	-9.18%
6.25		10	45.2	34.73	55.67	9.5	78.5	5.103	27	59.73%	-4.99%
12.5		10	47	37.28	56.72	4	78.5	4.737	25.06	53.33%	-9.18%
25		10	28.5	20.19	36.81	8	62.5	4.052	21.44	75.23%	33.8%
50		10	29.3	23.03	35.57	5	49.5	3.053	16.16	55.15%	31.94%
100		10	30.5	22.96	38.04	2	62.5	3.675	19.45	63.75%	29.15%

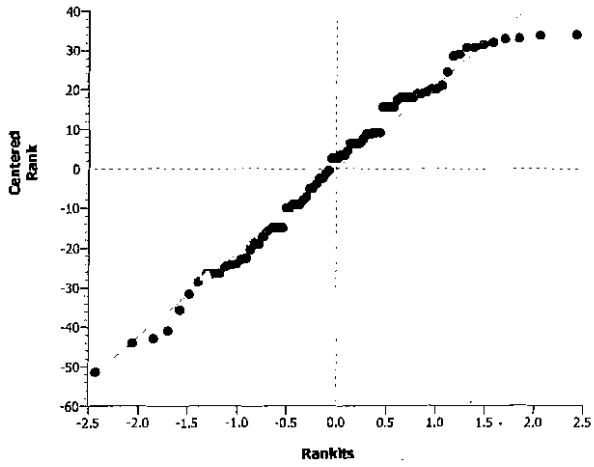
Ceriodaphnia 7-d Survival and Reproduction Test				Nautilus Environmental
Analysis No:	17-1721-8357	**Endpoint:** Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Oct-08 14:05	**Analysis:** Nonparametric-Control vs Treatments	**Official Results:**	Yes

Reproduction Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 8	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	19	18	17	17	17	17	16	16	13	0
1.56		19	19	19	19	18	18	18	17	11	0
3.12		23	20	18	17	17	16	16	14	14	13
6.25		21	20	20	18	17	16	14	13	12	11
12.5		21	19	18	18	18	17	16	13	13	2
25		18	18	17	14	13	12	12	12	12	10
50		17	17	16	16	15	15	14	12	9	5
100		18	17	17	16	14	14	13	13	9	0

Graphics





CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	05-7781-7386	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Oct-08 14:05	**Analysis:**	Nonlinear Regression	**Official Results:**	Yes

Sample No:	09-3400-7989	**Code:**	934007989	**Client:**	Azimuth
Sample Date:	10 Sep-08 16:30	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	2PL-EAS		
Sample Age:	49h	**Station:**			

Non-Linear Regression Options

Model Function	X Transform	Y Transform	Weighting Function	PTBS Function
2P Linear [Y=A+BX]	None	None	Normal [W=1]	Off [Y*=Y]

Regression Summary

Iters	Log LL	AICc	Adj R2	Optimize	F Stat	Critical	P-Value	Decision(1%)
1	-158.9	321.9	0.0383	Yes	0.3364	3.063	0.9155	Non-Significant Lack of Fit

Point Estimates

% Effect	Conc-%	95% LCL	95% UCL
10	50.11	8.844	91.38
15	75.17	15.07	135.3
20	100.2	17.86	182.6
25	125.3	19.35	231.2
40	200.4	21.25	379.7
50	250.6	21.73	479.4

> 100 %.

Regression Parameters

Parameter	Estimate	Std Error	95% LCL	95% UCL	t Stat	P-Value	Decision(5%)
A	15.75	0.6468	14.47	17.04	24.36	0.0000	Significant Parameter
B	-0.03144	0.01584	-0.06298	0.000104	-1.984	0.0507	Non-Significant Parameter

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(1%)
Model	83.13332	83.13332	1	4.149	0.0450	Non-Significant
Lack of Fit	42.61668	7.10278	6	0.3364	0.9155	Non-Significant
Pure Error	1520.2	21.11389	72			
Residual	1562.817	20.03611	78			

Residual Analysis

Attribute	Method	Test Stat	Critical	P-Value	Decision(1%)
Variances	Mod Levene Equality of Variance	0.1328	2.898	0.9955	Equal Variances
Distribution	Shapiro-Wilk Normality	0.8422		0.0000	Non-normal Distribution

Reproduction Summary

			Calculated Variate						
Conc-%	Control Type	Count	Mean	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Negative Control	10	15	0	19	1.021	5.497	36.65%	0.0%
1.56		10	15.8	0	19	1.124	6.052	38.3%	-5.33%
3.12		10	16.8	13	23	0.5591	3.011	17.92%	-12.0%
6.25		10	16.2	11	21	0.6655	3.584	22.12%	-8.0%
12.5		10	15.5	2	21	0.9952	5.359	34.58%	-3.33%
25		10	13.8	10	18	0.531	2.86	20.72%	8.0%
50		10	13.6	5	17	0.7229	3.893	28.63%	9.33%
100		10	13.1	0	18	0.9844	5.301	40.47%	12.67%

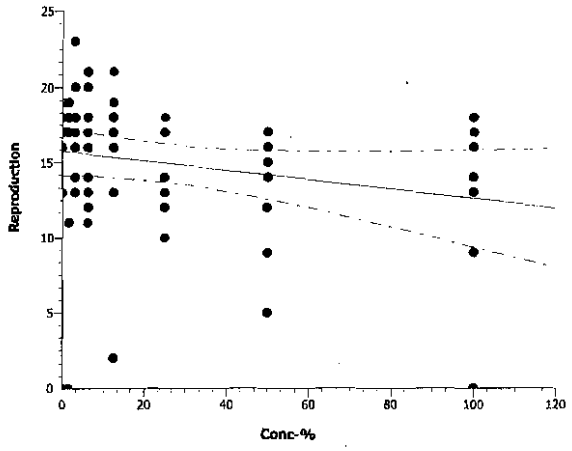
Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

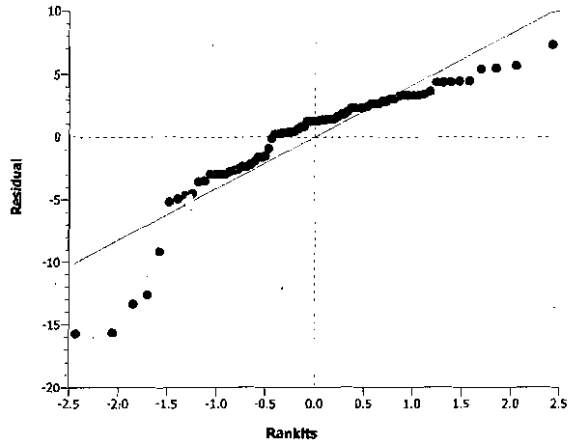
Analysis No:	05-7781-7386	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.5.0
Analyzed:	17 Oct-08 14:05	**Analysis:**	Nonlinear Regression	**Official Results:**	Yes

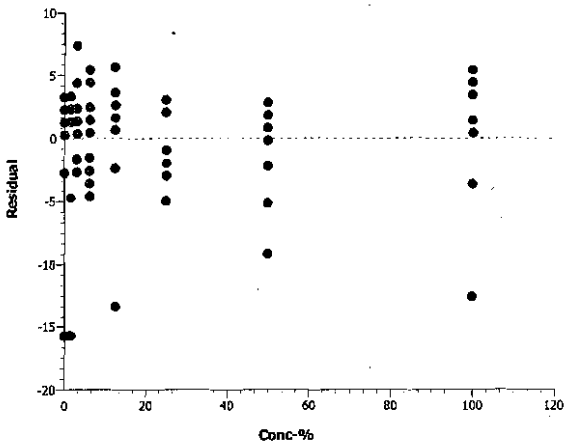
Reproduction Detail

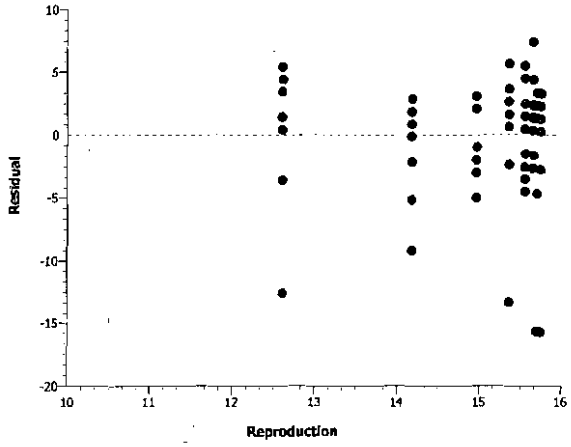
Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Control	17	18	19	17	0	16	13	16	17	17
1.56		11	17	18	19	19	18	19	0	19	18
3.12		20	18	14	16	14	16	13	17	17	23
6.25		13	14	21	18	17	20	20	11	16	12
12.5		2	19	21	18	13	13	18	17	18	16
25		12	18	13	12	10	14	12	17	18	12
50		17	16	17	12	9	5	16	15	14	15
100		18	14	16	17	9	17	13	13	0	14

Graphics









CETIS Analytical Report

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	03-9766-0072	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	15 Oct-08 16:08	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Sample No:	09-3400-7989	**Code:**	934007989	**Client:**	Azimuth
Sample Date:	10 Sep-08 16:30	**Material:**	Industrial Effluent	**Project:**	
Receive Date:		**Source:**	2PL-EAS		
Sample Age:	49h	**Station:**			

Data Transform	Zeta	Alt Hyp	Monte Carlo	NOEL	LOEL	TOEL	TU	PMSD
Untransformed		C > T	Not Run	100	>100	#Error	1	N/A

Fisher Exact/Bonferroni-Holm Test

Control	vs	Conc-%	Test Stat	P-Value	Decision(0.05)
Negative Control		1.56	0.7632	1.0000	Non-Significant Effect
		3.12	1.0000	1.0000	Non-Significant Effect
		6.25	1.0000	1.0000	Non-Significant Effect
		12.5	0.7632	1.0000	Non-Significant Effect
		25	1.0000	1.0000	Non-Significant Effect
		50	1.0000	1.0000	Non-Significant Effect
		100	0.7632	1.0000	Non-Significant Effect

Data Summary

Conc-%	Control Type	No-Resp	Resp	Total
0	Negative Contr	9	1	10
1.56		9	1	10
3.12		10	0	10
6.25		10	0	10
12.5		9	1	10
25		10	0	10
50		10	0	10
100		9	1	10

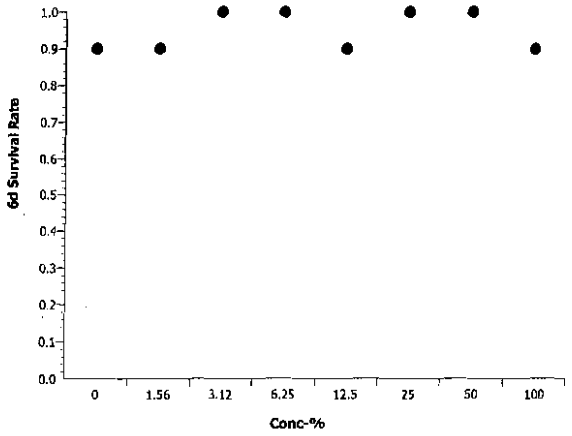
6d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Negative Contr	1	1	1	1	1	1	1	1	1	0
1.56		1	1	1	1	1	1	1	1	1	0
3.12		1	1	1	1	1	1	1	1	1	1
6.25		1	1	1	1	1	1	1	1	1	1
12.5		1	1	1	1	1	1	1	1	1	0
25		1	1	1	1	1	1	1	1	1	1
50		1	1	1	1	1	1	1	1	1	1
100		1	1	1	1	1	1	1	1	1	0

Ceriodaphnia 7-d Survival and Reproduction Test — **Nautilus Environmental**

Analysis No:	03-9766-0072	**Endpoint:**	6d Survival Rate	**CETIS Version:**	CETISv1.5.0
Analyzed:	15 Oct-08 16:08	**Analysis:**	STP 2x2 Contingency Tables	**Official Results:**	Yes

Graphics



APPENDIX C – Rainbow trout embryo development test results

2PL-EAS

Nautilus Environmental
Washington Laboratory

Client: Azimuth Mine
Sample ID. JPL-EAS
Test No: 0809-T024
Log-In#: 08-279

Initial and Final Chemistries
Seven Day Chronic Freshwater Bioassay

Start Date & Time: 9/15/08 1700
Stop Date & Time: 9/22/08 1630
Test Species: Oncorhynchus mykiss

Conc. or % CON	Days	0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.90	7.58	7.58	7.53	7.85	7.81	7.79	7.68	8.02	7.92	7.81	7.76	7.78	7.85
DO (mg/l)		8.4	9.3	9.4	9.8	8.9	8.9	9.8	9.6	8.9	9.4	9.5	10.5	10.5	9.9
Cond. (µmhos-cm)		255	245	250	253	246	251	239	241	249	243	254	246	248	247
Temperature (°C)		15.0	14.6	15.0	14.7	15.0	14.7	14.8	③15.6	15.6 14.5	14.3	14.9	14.8	14.8	14.1
6.25	Days	0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.87	7.62	7.62	7.69	7.85	7.82	7.81	7.70	8.01	7.91	7.83	7.83	7.79	7.89
DO (mg/l)		8.5	9.2	9.4	9.7	8.9	9.4	9.9	8.7	9.1	9.6	9.6	10.5	10.5	10.0
Cond. (µmhos-cm)		241	231	236	233	234	227	225	227	236	229	239	232	236	234
Temperature (°C)		15.0	14.5	14.9	14.2	15.0	14.8	14.6	14.8	15.4 14.6	14.2	14.6	14.6	14.8	14.0
12.5	Days	0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.84	7.63	7.69	7.72	7.86	7.79	7.82	7.71	8.00	7.89	7.82	7.86	7.80	②7.88
DO (mg/l)		8.5	9.2	9.4	9.3	8.9	9.3	9.9	8.6	8.9	9.5	9.6	10.5	10.4	9.5
Cond. (µmhos-cm)		227	219	222	220	221	213	212	212	223	216	226	218	223	221
Temperature (°C)		15.0	14.4	14.8	14.2	15.0	14.6	14.6	14.7	15.1 14.5	14.2	14.7	14.5	14.9	14.1
25	Days	0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.79	7.63	7.64	7.70	7.86	7.77	7.81	7.71	7.95	7.88	7.81	7.71	7.77	7.88
DO (mg/l)		8.6	9.3	9.8	9.3	8.8	9.4	9.9	8.5	8.4	9.8	9.2	10.1	10.5	10.0
Cond. (µmhos-cm)		199	192	195	193	193	188	188	187	195	190	200	191	196	195
Temperature (°C)		15.0	14.4	14.7	14.3	15.0	14.5	14.7	14.7	15.1 14.6	14.3	14.7	14.5	14.8	14.2
50	Days	0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.77	7.62	7.65	7.69	7.78	7.69	7.78	7.61	7.92	7.83	7.71	7.75	7.70	7.85
DO (mg/l)		8.8	9.2	9.6	9.3	8.9	9.3	9.8	8.3	8.4	9.9	9.4	10.5	10.5	10.0
Cond. (µmhos-cm)		143	141	138	140	141	134	134	135	140	137	142	137	142	139
Temperature (°C)		15.0	14.5	14.5	14.4	15.0	14.3	14.6	14.7	15.1 14.5	14.1	14.9	14.4	14.7	14.4
100	Days	0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.29	6.99	7.28	7.13	7.160	7.47	7.52	7.21	7.94	7.45	7.36	7.28	7.32	7.44
DO (mg/l)		9.1	9.2	9.8	9.2	9.3	9.4	9.8	8.2	8.4	9.8	9.5	10.5	10.5	10.0
Cond. (µmhos-cm)		24	27	23	25	25	23	23	24	25	25	24	23	25	24
Temperature (°C)		15.0	14.4	14.5	14.5	15.0	14.4	14.3	14.6	14.9 14.5	14.1	15.0	14.5	14.6	14.3
Tech. Initials		MM	MM	MM	MM	MM	RT	RT	RS	RS	MM	MM	RS	RS	MM

Dilution Water Batch #: MHSW 045

QA Check: IRS

Sample Description:
Animal Source: Trout Lodge
Date Received: 9/15/08
Date of Hatch: —

Comments:
① Day 4 initial temps high in chemistry cups but dilution water temps within range. RS
③ Temperature out of range. See CAR #08-020

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(Oncorhynchus mykiss)
Trout Embryo Test

Client Name: Azimuth Mine **Test No.:** 0809-T024

Sample ID: 2PL-EAS

 # Embryos/Container

Conc.	Cont.	Rep.	Days 0	1	2	3	4	5	6	7	# Normal	# Abnormal	Mean % Viable
CON	201	1	30	30	30	30	30	30	30	30	26	4	
	202	2	30	30	30	30	30	30	30	30	26	4	
	203	3	30	30	30	30	30	30	30	30	30	0	
	204	4	30	30	30	30	30	30	30	30	29	1	
6.25	205	1	30	30	30	30	30	30	30	30	29	1	
	206	2	30	30	30	30	30	30	30	30	30	0	
	207	3	30	30	30	30	29	29	~~30~~ 29	29	28	1	
	208	4	30	30	30	30	30	30	30	30	25	5	
12.5	209	1	30	30	30	30	30	30	30	30	29	1	
	210	2	30	30	30	30	30	29	29	29	27	2	
	211	3	30	30	30	30	30	30	30	30	28	2	
	212	4	30	30	30	30	30	30	30	30	25	5	
25	213	1	30	30	30	30	30	30	30	30	26	4	
	214	2	30	30	30	30	30	30	30	30	30	0	
	215	3	30	30	30	30	30	30	30	30	29	1	
	216	4	30	30	30	30	30	30	30	30	30	0	
50	217	1	30	30	30	30	30	30	30	30	29	1	
	218	2	30	30	30	30	30	30	30	30	29	1	
	219	3	30	30	30	30	30	30	30	30	30	0	
	220	4	30	30	30	30	30	30	30	30	29	1	
100	221	1	30	30	30	30	30	30	30	30	30	0	
	222	2	30	30	30	30	30	30	30	30	30	0	
	223	3	30	30	30	30	30	30	30	~~29~~ 30	30	0	
	224	4	30	30	30	30	30	30	30	29	29	0	
		1											
		2											
		3											
		4											
		1											
		2											
		3											
		4											
Tech Initials			MM	MM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	MM	MM	MM	

QA Check: LCS

Comments: _____

2PL-EAS No Renewals

Nautilus Environmental
Washington Laboratory

Client: Azimuth Mine
Sample ID. 2PL-EAS
Test No: 0809-T025
Log-In#: 08-279

Daily Chemistries
Seven Day Freshwater Bioassay 1700
Start Date & Time: 9/15/08 1500 MM
Stop Date & Time: 9/22/08 1630
Test Species: *Oncorhynchus mykiss*

Conc. or % CON	Days 0	1	2	3	4	5	6	7
pH	7.90	7.45	7.77	7.82	7.71	7.66	7.71	7.84
DO (mg/l)	8.4	9.5	7.8	9.6	8.9	9.4	10.2	9.8
Cond. (µmhos-cm)	255	262	257	252	255	254	257	254
Temperature (°C)	15.0	15.0	15.0	14.8	14.5	14.7	14.8	14.3
6.25	Days 0	1	2	3	4	5	6	7
pH	7.87	7.57	7.86	7.85	7.90	7.84	7.78	7.86
DO (mg/l)	8.5	9.5	7.6	10.1	8.5	9.3	9.8	10.0
Cond. (µmhos-cm)	241	239	236	236	235	237	239	236
Temperature (°C)	15.0	15.0	14.7	14.7	14.4	14.8	14.9	14.2
12.5	Days 0	1	2	3	4	5	6	7
pH	7.84	7.66	7.91	7.87	7.92	7.89	7.87	7.86
DO (mg/l)	8.5	9.6	7.6	10.0	8.5	9.7	9.6	10.0
Cond. (µmhos-cm)	227	225	221	224	224	224	227	224
Temperature (°C)	15.0	15.0	14.5	14.7	14.5	14.7	14.9	14.0
25	Days 0	1	2	3	4	5	6	7
pH	7.79	7.68	7.88	7.84	7.90	7.86	7.84	7.86
DO (mg/l)	8.6	9.4	7.6	10.0	8.6	9.7	9.7	10.1
Cond. (µmhos-cm)	199	199	196	197	200	198	200	198
Temperature (°C)	15.0	15.0	14.4	14.6	14.6	14.7	14.9	14.1
50	Days 0	1	2	3	4	5	6	7
pH	7.77	7.65	7.83	7.76	7.79	7.81	7.81	7.85
DO (mg/l)	8.8	9.4	7.7	10.0	8.4	9.5	9.7	10.1
Cond. (µmhos-cm)	143	144	142	141	144	144	144	143
Temperature (°C)	15.0	15.0	14.5	14.6	14.7	14.9	14.8	14.0
100	Days 0	1	2	3	4	5	6	7
pH	7.29	7.11	7.48	7.60	7.42	7.36	7.43	7.50
DO (mg/l)	9.1	9.3	7.6	10.0	8.4	9.5	9.7	10.1
Cond. (µmhos-cm)	24	31	30	31	34	33	33	34
Temperature (°C)	15.0	15.0	14.6	14.7	14.7	14.8	14.9	14.1
Tech. Initials	MM	MM	MM	MM	MM	MM	MM	MM

Dilution Water Batch #: MHSW 045

QA Check: LDS

Sample Description:
Animal Source: Trout Lodge
Date Received: 9/15/08 **Date of Hatch:** —
Comments: *Test was not renewed

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(Oncorhynchus mykiss)
Trout Embryo Test

Client Name: Azimuth Mine **Test No.:** 0809-T025

Sample ID: ZPL-EAS

 # Embryos/Container

Conc.	Cont.	Rep.	Days 0	1	2	3	4	5	6	7	# Normal	# Abnormal	Mean % Viable
CON	301	1	30	30	30	30	30	30	30	30	30	0	
	302	2	30	30	30	30	30	30	30	30	29	1	
	303	3	30	30	30	30	30	30	30	30	28	2	
	304	4	30	30	30	30	30	30	30	30	28	2	
6.25	305	1	30	30	30	30	30	30	30	30	28	2	
	306	2	30	30	30	30	30	30	30	29	29	0	
	307	3	30	30	30	30	30	30	30	30	27	3	
	308	4	30	30	30	30	30	30	30	30	27	3	
12.5	309	1	30	30	30	30	30	30	30	30	29	1	
	310	2	30	30	30	30	30	30	30	30	23	7	
	311	3	30	30	30	30	30	30	30	30	28	2	
	312	4	30	30	30	30	30	30	30	30	28	2	
25	313	1	30	30	30	30	30	30	30	30	19	11	
	314	2	30	30	30	30	30	30	30	30	20	10	
	315	3	30	30	30	30	30	30	30	30	13	17	
	316	4	30	30	30	30	30	30	30	30	26	4	
50	317	1	30	30	30	30	30	30	30	30	28	2	
	318	2	30	30	30	30	30	30	30	30	27	3	
	319	3	30	30	30	30	30	30	30	29	17	13	
	320	4	30	30	30	30	30	30	30	30	26	4	
100	321	1	30	30	30	30	30	30	30	30	18	12	
	322	2	30	30	30	30	30	30	30	30	15	15	
	323	3	30	30	30	30	30	30	30	30	24	6	
	324	4	30	30	30	30	30	30	30	30	25	5	
		1											
		2											
		3											
		4											
		1											
		2											
		3											
		4											
Tech Initials			MM	MM	(M)	(M)	(M)	(M)	(M)	MM	MM	MM	

QA Check: RS

Comments: _____

2PL-EAS w/Chitosan

Nautilus Environmental
Washington Laboratory

Client: Azimuth
Sample ID. 2PL-EAS
Test No: 0809-TOS1
Log-In#: 08-301

Daily Chemistries
Seven Day Freshwater Bioassay
Start Date & Time: 9/24/08 1530
Stop Date & Time: 10/1/08 1400
Test Species: *Oncorhynchus mykiss*

Conc. or % CON	Days 0	1	2	3	4	5	6	7
pH	7.68	7.59	7.89	7.71	7.94	8.03	7.66	7.88
DO (mg/l)	8.9	9.1	9.7	10.3	10.2	9.8	9.2	10.0
Cond. (µmhos-cm)	258	261	265	265	254	272	276	263
Temperature (°C)	14.5	14.6	14.9	14.8	14.8	15.0	14.8	14.8

chitosow CON	Days 0	1	2	3	4	5	6	7
pH	7.69	7.74	7.94	7.81	7.94	8.04	7.88	7.92
DO (mg/l)	8.9	9.6	9.8	9.8	10.2	9.6	9.1	9.4
Cond. (µmhos-cm)	258	256	263	254	257	260	259	261
Temperature (°C)	14.5	14.4	14.6	14.3	14.9	14.8	14.7	14.8

100	Days 0	1	2	3	4	5	6	7
pH	7.20	7.23	7.60	7.51	7.70	8.04	7.41	7.29
DO (mg/l)	9.4	9.7	9.8	9.8	10.2	9.6	9.0	9.3
Cond. (µmhos-cm)	25	34	34	33	34	34	35	29
Temperature (°C)	14.5	14.2	14.3	14.1	14.8	14.8	14.8	14.8

chitosow 100	Days 0	1	2	3	4	5	6	7
pH	7.20	7.06	7.34	7.38	7.41	7.51	7.23	7.25
DO (mg/l)	9.4	9.5	10.0	9.6	10.2	9.6	8.7	9.1
Cond. (µmhos-cm)	25	33	27	26	26	29	28	27
Temperature (°C)	14.5	14.5	14.8	14.4	14.9	15.0	15.0	14.9

	Days 0	1	2	3	4	5	6	7
pH								
DO (mg/l)								
Cond. (µmhos-cm)								
Temperature (°C)								

	Days 0	1	2	3	4	5	6	7
pH								
DO (mg/l)								
Cond. (µmhos-cm)								
Temperature (°C)								
Tech. Initials	MM	MM	BP	BP	BP	CW	BP	MM

Dilution Water Batch #: 048 MHSW
QA Check: KS

Sample Description:
Animal Source: Trout Lodge
Date Received: 9/24 **Date of Hatch:** —
Comments:

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(Oncorhynchus mykiss)
Trout Embryo Test

Client Name: Azimuth

Test No.: 0809-TOS1

Sample ID: ZPL-EAS

 # Embryos/Container

Conc.	Cont.	Rep.	Day 0	Day 7	# Normal	# Abnormal	Mean % Viable
CON	501	1	30	30	19	11	
	502	2	30	30	26	4	
	503	3	30	28	23	5	
	504	4	30	30	26	4	
CON	505	1	30	28	25	3	
chitosan	506	2	30	30	25	5	
	507	3	30	29	20	9	
	508	4	30	29	24	5	
100	509	1	30	28	21	7	
	510	2	30	28	17	MM 11	
	511	3	30	29	17	12	
	512	4	30	29	21	8	
100	513	1	30	0	—	—	
chitosan	514	2	30	24	20 CC	~~13~~ CC 4	
	515	3	30	26	25 ~~19~~ MM	1	
	516	4	30	CC ~~26~~ 25	20	5	
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
Tech Initials			MM	MM	CC	CC	X

QA Check: IDS

Comments:

APPENDIX D – Rainbow trout larval survival and growth test results

CETIS Summary Report

Chronic Larval Fish Survival and Growth Test — **Nautilus Environmental WA**

Test Run No:	07-4327-5293	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Meghan Murphy
Start Date:	17 Sep-08 13:15	**Protocol:**	EPA/600/R-99/064 (2000)	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	24 Sep-08 11:45	**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	6d 22h	**Source:**	Thomas Fish Co.	**Age:**	3d

Sample No:	19-2860-6003	**Code:**	08-279	**Client:**	Azimuth
Sample Date:	10 Sep-08 14:32	**Material:**	Receiving Water	**Project:**	
Receive Date:	15 Sep-08 13:15	**Source:**	Azimuth		
Sample Age:	6d 23h (6.5 °C)	**Station:**			

Comparison Summary

Analysis No	Endpoint	NOEL	LOEL	TOEL	PMSD	Method
08-9684-4248	7d Survival Rate	100	> 100	N/A	17.0%	Steel Many-One Rank Test
06-1347-5056	Mean Dry Weight-mg	100	> 100	N/A	14.4%	Dunnett's Multiple Comparison Test

7d Survival Rate Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	0.95	0.913	0.987	0.8	1	0.0183	0.1	10.5%	0.0%
6.25		4	1	1	1	1	1	0	0	0.0%	-5.26%
12.5		4	0.95	0.913	0.987	0.8	1	0.0183	0.1	10.5%	0.0%
25		4	1	1	1	1	1	0	0	0.0%	-5.26%
50		4	0.85	0.778	0.922	0.6	1	0.035	0.191	22.5%	10.5%
100		4	1	1	1	1	1	0	0	0.0%	-5.26%

Mean Dry Weight-mg Summary

Conc-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	Diff%
0	Dilution Water	4	28.5	28.1	28.8	27.3	29.5	0.168	0.919	3.23%	0.0%
6.25		4	26.6	25.6	27.7	22.7	29.4	0.518	2.84	10.7%	6.44%
12.5		4	26.3	24.9	27.7	23.9	31.8	0.677	3.71	14.1%	7.62%
25		4	26	25.6	26.4	25.4	27.7	0.198	1.09	4.17%	8.57%
50		4	27	26	28	23.1	29.3	0.492	2.69	9.98%	5.21%
100		4	26	25.2	26.7	23.1	27.5	0.361	1.98	7.61%	8.85%

7d Survival Rate Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	1	0.8	1	1
6.25		1	1	1	1
12.5		0.8	1	1	1
25		1	1	1	1
50		0.6	1	1	0.8
100		1	1	1	1

Mean Dry Weight-mg Detail

Conc-%	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Dilution Water	27.3	29.5	28.4	28.7
6.25		27.2	22.7	27.3	29.4
12.5		31.8	24.8	24.7	23.9
25		25.5	27.7	25.5	25.4
50		29.3	28.2	23.1	27.4
100		27.5	26.1	23.1	27.1

Nautilus Environmental
Washington Laboratory

Client: Azimuth
Sample ID. ZPL-EAS
Test No: 0809-T040
Log-In#: 08-278 BP 08-279

Initial and Final Chemistries
Seven Day Chronic Freshwater Bioassay
Start Date & Time: 9/17/08 1315
Stop Date & Time: 9/24/08 1145
Test Species: Oncorhynchus Mykiss

Conc. or % CON		Days 0		1		2 ①		3 ②		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.85	7.49	7.74	7.53	7.85	7.24	7.78	7.17	7.59	7.30	7.85	7.75	8.05	7.67
DO (mg/l)		9.4	6.9	9.4	8.3	9.0	5.5	10.1	7.6	10.0	6.1	9.1	9.0	8.1	8.6
Cond. (µmhos-cm)		250	247	236	268	249	5.50	248	236	260	262	249	260	266	281
Temperature (°C)		14.7	14.3	14.5	14.7	14.8	14.7	14.8	14.9	14.9	14.8	14.6	14.7	14.5	14.8
	6.25	Days 0		1		2 @253		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.86	7.43	7.81	7.47	7.85	7.26	7.78	7.46	7.70	7.41	7.85	7.78	8.08	7.77
DO (mg/l)		8.9	6.7	9.3	7.6	8.6	5.5	10.2	8.5	10.0	7.2	9.3	9.2	8.5	8.3
Cond. (µmhos-cm)		236	231	227	240	234	248	235	249	237	247	238	245	250	264
Temperature (°C)		14.8	14.4	14.1	14.8	14.7	14.6	14.7	14.4	14.9	14.5	14.6	14.8	14.8	14.8
	12.5	Days 0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.88	7.44	7.82	7.47	7.89	7.21	7.78	7.20	7.75	7.29	7.83	7.77	8.09	7.76
DO (mg/l)		8.7	7.3	9.3	7.6	8.4	5.5	10.2	7.3	10.1	6.2	9.4	8.8	8.7	8.5
Cond. (µmhos-cm)		252	210	215	225	219	236	221	+@230	223	230	224	233	236	252
Temperature (°C)		14.8	14.4	14.1	14.8	14.7	14.8	14.6	14.4	15.0	14.5	14.6	14.8	14.8	14.8
	25	Days 0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.83	7.39	7.80	7.36	7.77	7.13	7.76	7.31@	7.75	7.14	7.81	7.75	8.05	7.76
DO (mg/l)		9.1	7.4	9.1	7.3	8.3	5.2	10.2	7.8	10.2	+4.5	9.3	9.1	8.5	8.7
Cond. (µmhos-cm)		194	196	188	202	194	210	197	212	198	205	197	203	207	220
Temperature (°C)		14.7	14.4	14.2	14.8	14.5	14.7	14.9	14.3	15.0	14.4	14.6	14.7	14.8	14.7
	50	Days 0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.75	7.20	7.75	7.24	7.70	7.09	7.71	7.55	7.75	7.19	7.79	7.57	7.91	7.69
DO (mg/l)		9.2	6.3	9.4	7.0	8.2	5.9	9.7	9.1	10.2	+5.5	9.4	8.1	8.9	8.5
Cond. (µmhos-cm)		138	144	136	154	139	156	142	155	146	170	142	155	149	164
Temperature (°C)		14.8	14.5	14.1	14.7	14.4	14.6	14.9	14.4	15.0	14.6	14.7	14.7	14.8	14.6
	100	Days 0		1		2		3		4		5		6	
		init.	final	init.	final	init.	final	init.	final	init.	final	init.	final	init.	final
pH		7.28	6.88	7.33	6.83	7.85	6.62	7.34	6.69	7.42	6.76	7.50	7.19	7.73	7.62
DO (mg/l)		9.5	6.6	9.9	6.6	8.3	5.4	10.3	5.8*	10.2	+5.8	9.6	8.8	9.7	8.5
Cond. (µmhos-cm)		23	32	23	40	23	40	24	40	25	38	24	41	24	35
Temperature (°C)		14.7	14.4	14.2	14.7	14.2	14.6	14.8	14.6	15.0	14.5	14.7	14.7	14.6	14.7
Tech. Initials		AT	AT	AT	AT	AT	JS	JS	@	@	BP	BP	AT	AT	AT

Dilution Water Batch #: MHSW046

QA Check: 10

Sample Description:
Animal Source: Thomas Fish Co
Date Received: 9/16/08
Date of Hatch: 9/1/08
Comments: ① Test aeration initiated on day 20
Swim up 9/15/08
* See Corrective Action Form 08-019.
+ See Corrective Action Form 08-021

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Rainbow Trout
(Oncorhynchus mykiss)
Larval Survival

Client Name: Aqua Life

Test No.: 0809-T040

Sample ID: ZPL-EAS

Conc.	Cont.	Rep.	Days 0	1	2	3	4	5	6	7	Mean % Survival
CON	8	1	5	5	5	5	5	5	5	5	
	22	2	5	5	5	5	5	5	5	~~4~~ 4	
	18	3	5	5	5	5	5	5	5	5	
	10	4	5	5	5	5	5	5	5	5	
6.25	17	1	5	5	5	5	5	5	5	5	
	7	2	5	5	5	5	5	5	5	5	
	13	3	5	5	5	5	5	5	5	5	
	9	4	5	5	5	5	5	5	5	5	
12.5	16	1	5	5	5	5	5	5	5	4	
	~~4~~ 6	2	5	5	5	5	5	5	5	5	
	5	3	5	5	5	5	5	5	5	5	
	15	4	5	5	5	5	5	5	5	5	
25	19	1	5	5	5	5	5	5	5	5	
	21	2	5	5	5	5	5	5	5	5	
	20	3	5	5	5	5	5	5	5	5	
	11	4	5	5	5	5	5	5	5	5	
50	1	1	5	5	5	5	5	5	4	3	
	4	2	5	5	5	5	5	5	5	5	
	3	3	5	5	5	5	5	5	5	5	
	23	4	5	5	5	5	5	5	5	4	
100	2	1	5	5	5	5	5	5	5	5	
	14	2	5	5	5	5	5	5	5	5	
	12	3	5	5	5	5	5	5	5	5	
	24	4	5	5	5	5	5	5	5	5	
		1									
		2									
		3									
		4									
		1									
		2									
		3									
		4									
Tech Initials			QT	QT	QT	JD	MD	BP	QT	QT	

Feeding Tech: 0 ____ 1 8/15 1600 2 8/15 1530 3 845 1700 4 840 1530 5 815 1715 6 815 ~~1618 QT~~ 1615

Comments: _____ **QA Check:** 1C

Nautilus Environmental
Washington Laboratory
5009 Pacific Hwy. E., Suite 2
Tacoma, WA 98424

Raw Data Sheet
Fish Weights
Seven Day Chronic Bioassay

Client: Azimuth

Test No: 0809-T040

Sample ID: ZPL-EAS

Species: *O. mykiss*

Conc.	cont #	rep #	pan wt. (gm)	pan + fish (gm)	fish wt. (mg)	# fish	avg. per fish (mg)	avg. per conc. (mg)
CON	8	1	0.53744	~~0.66966~~ ①		5		
0.67402①	22	2	0.57920	0.69739		4		
	18	3	0.52714	0.66907		5		
	10	4	0.58101	0.72431		5		
6.25	17	1	0.52920	0.66511		5		
	7	2	0.55210	0.66551		5		
	13	3	0.58480	0.72117		5		
	9	4	0.52800	0.67516		5		
12.5	16	1	0.60485	0.73222		4		
	6	2	0.54585	0.66966		5		
	5	3	0.54440	0.66776		5		
	15	4	0.61613	0.73587		5		
25	19	1	0.59878	0.72637		5		
	21	2	0.53390	0.67222		5		
	20	3	0.52571	0.65344		5		
	11	4	0.59177	0.71887		5		
50	1	1	0.506164	0.59442		3		
	4	2	0.60964	0.75048		5		
	3	3	0.611608	0.73225		5		
	23	4	0.531682	0.64653		4		
100	2	1	0.581638	0.72399		5		
	14	2	0.58487	0.71518		5		
	12	3	0.59790	0.71360		5		
	24	4	0.58058	0.71612		5		
INITIAL	1	1	0.61264	0.67819		5		
	2	2	0.60288	0.66024		5		
	3	3	0.54784	0.61934		5		
	4	4	0.60016	0.66035		5		
Technician Initials:			GP	RT				

Date/Time in: 9/24/08 1145 **Oven temp. (°C):** 63.0

Date/Time out: 9/26/08 945 **Oven temp. (°C):** 63.0

QA Check: 105

APPENDIX C

PHYTOPLANKTON TAXA LISTS

		2PL-EAS-1					2PL-EAS-2					2PL-EAS-3					2PL-EAS-DT					3PL-EAS				
		13-Sep-08					13-Sep-08					13-Sep-08					13-Sep-08					14-Sep-08				
	Species & Code	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***
	Cyanophyte																									
1008	*Aphanocapsa*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1012	*Aphanothece*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	+	+
1033	*Rhabdogloea lineare* Schmidle and Lauterborn	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1054	*Planktolyngbya limnetica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
1067	*Cylindrospermum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
1073	*Snowella*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+
	Chlorophyte																									
2100	*Pyramidomonas tetrarhynchus* Schmarda	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-	-	-	+	-	-
2105	*Chlamydomonas*	+	-	+	-	+	+	+	-	-	-	+	-	+	+	-	+	+	+	+	+	+	+	-	+	+
2112	*Sphaerocystis schroeteri* Chodat	+	+	+	-	-	+	-	-	-	+	+	-	-	-	-	-	-	-	+	-	+	+	-	-	-
2121	*Oocystis lacustris* Chodat	-	-	-	-	-	+	+	+	+	+	+	-	-	+	-	+	+	+	+	-	-	+	-	+	+
2126	*Chodatella*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
2137	*Dictyosphaerium simplex* Sukja	+	+	-	+	+	-	-	+	-	+	+	+	+	+	+	-	-	-	-	-	-	-	+	-	-
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerov	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+	+	+	+	+
2141	*Monoraphidium contortum* (Thur.) Komarkova-Legnerova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
2143	*Monoraphidium minutum (Nag.) Komarkova-Legnerova*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	+	-
2145	*Crucigenia quadrata* Morr.	-	-	+	+	-	-	-	+	-	+	+	-	-	-	+	+	+	-	-	-	-	-	-	-	-
2146	*Crucigeniella rectangularis* (Nag.) Komarek	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
2167	*Elakatothrix gelatinosa* Willen	-	-	-	-	+	+	+	-	-	-	+	+	+	-	+	-	-	-	+	-	+	+	+	+	-
2178	*Cosmarium*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
2183	*Euastrum sinuosum* Lenorm.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
2186	*Xanthidium*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
2187	*Staurodesmus extensus* (Andersson) Teiling	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	+	-	+	+	+	+	+	-	-	+
2199	*Spondylosium planum* (Wolle) W. and G.S. West	-	-	-	-	-	-	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	+
2202	*Scourfieldia cordiformis* Takeda	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
2205	*Mougeotia*	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	+	+	-	+	+
2206	*Botryococcus braunii* Kutzing	+	-	+	-	+	-	-	+	+	+	+	+	-	+	+	-	+	+	+	+	+	-	-	+	-
2215	*Tetraedron caudatum* (Corda) Hansgrig	+	-	-	-	-	-	+	-	-	+	+	-	-	+	+	+	+	+	+	+	+	-	+	+	-
2217	*Collodictyon*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-
2235	*Ankistrodesmus spiralis* Lemmermann	-	+	-	-	+	+	+	+	+	+	+	-	+	-	+	-	-	-	+	+	-	-	-	-	-
2247	*Oocystis gigas* Archer	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Euglenophyte																									
3305	*Trachelomonas volvocina* Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
	Chrysophyte																									
4351	Small chrysophyceae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4352	Large chrysophyceae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4355	*Chrysochromulina parva* Lackey	+	+		+	+	+	+	-	-	-	+		+	+	+	+	+	+	+	+	+	+	+	+	+
4357	*Chrysococcus*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4358	*Chrysostephanospaera globulifera* Scherffel	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	-	-	-	+	+	-
4361	*Kephyrion boreale* Skuja	+	-	-	-	-	+	-	+	-	-	-	-	-	-	-	+	+	-	-	+	+	+	+	-	+
4362	*Kephyrion*	+	+	+	+	-	+	+	-	-	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+
4363	*Spinifiromonas sirratus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+
4364	*Mallomonas caudata* Ivanov	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4368	*Mallomonas crassisquama* (Asmund) Fott	-	+	+	+	+	-	+	+	+	-	+	+	-	+	+	+	+	+	+	-	+	+	+	+	-
4378	*Dinobryon borgei* Lemmermann	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4381	*Dinobryon mucronutom* Nygaard	+	-	+	-	+	-	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	-	-	+	+
4383	*Dinobryon bavaricum* Imhof	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	+	+	+
4388	*Dinobryon sertularia* Ehrenberg	+	+	-	+	-	+	+	+	-	+	-	+	+	+	+	-	-	+	+	+	+	+	+	+	+
4390	*Dinobryon sociale* Ehrenberg	+	+	+	+	-	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+
4396	*Chrysolkos skuja* (Nauwerck) Willen	+	+	-	+	-	-	+	+	+	-	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+
4401	*Uroglena volvox* Ehrenberg	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4411	*Bitrichia chodatii* (Reverdin) Chodat	-	+	-	-	+	+	-	-	-	-	-	-	-	-	+	-	+	+		+	+	+	+	+	+
4413	*Chrysochromulina laurentiana* Kling	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4414	*Stichogloea*	-	-	-	-	-	+	+	-	-	-	+	-	+	-	-	+	-	+	+	+	-	+	+	+	+
4415	*Bicoeca lacustris* Clark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
4416	*Bicoeca ainikkiae* Jarnefelt	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4418	*Salpingoeca frequentissima* (Zach.) Lemmermann	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	-
4425	*Mallomonas hamata* Asmund	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-
4437	*Pteridomonas*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-
4440	*Stelexomonas dichotoma* Lackey	-	+	+	+	+	+	+	-	+	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-
4444	*Dinobryon pediforme* (Lemmermann) Steineche	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		2PL-EAS-1					2PL-EAS-2					2PL-EAS-3					2PL-EAS-DT					3PL-EAS				
		13-Sep-08					13-Sep-08					13-Sep-08					13-Sep-08					14-Sep-08				
	Species & Code	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***
	Diatom																									
5507	*Cyclotella stelligera* Cleve and Grunow	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5511	*Rhizosolenia eriense* H.L. Smith	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	-	-	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	-	+
5518	*Synedra acus* Kutzing	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5523	*Synedra ulna* (Nitzsch) Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
5546	*Gyrosigma*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-	-	-	+	-
5551	*Cyclotella michiganiana* Skvortzow	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
5702	*Achnanthes minutissima* Kutzing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
5720	*Cyclotella bodanica* Eulenst.	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	+	-	+	+	+	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
	Cryptophyte																									
6554	*Rhodomonas minuta* Skuja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6558	*Cryptomonas erosa* Ehrenberg	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6559	*Cryptomonas ovata* Ehrenberg	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
6562	*Cryptomonas reflexa* (Marsson) Skuja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
6565	*Cryptomonas rostratiformis* Skuja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+
6568	*Katablepharis ovalis* Skuja	+	+	+	-	-	-	+	+	-	+	-	-	-	-	+	+	+	+	-	+	+	+	+	+	+
	Dinoflagellate																									
7631	*Gymnodinium helveticum* Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-
7632	*Gymnodinium*	-	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7635	*Peridinium willei* Huitfeldt-Kaas	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	+	-	+	-	+	-	-	-
7639	*Peridinium pusillum* (Penard) Lemmermann	+	+	+	+	+	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+
7641	*Peridinium aciculiferum* Lemmermann	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-

		2PL-EAS-1					2PL-EAS-2					2PL-EAS-3					2PL-EAS-DT					3PL-EAS				
		24-Sep-08					24-Sep-08					24-Sep-08					24-Sep-08					25-Sep-08				
	Species & Code	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***
	Cyanophyte																									
1012	*Aphanothece*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	-	+	+
1026	*Merismopedia tenuissima* Lemmermann	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+
1045	*Anabaena lemmermannii* Usacev	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1054	*Planktolyngbya limnetica*	+	+	-	-	-	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	+	+	+	+	+
1085	*Rivularia*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1088	*Anabaena solitaria* Klebs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
1122	*Phormidium autumnale* Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
	Chlorophyte																									
2100	*Pyramidomonas tetrarhynchus* Schmarda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	+	+
2105	*Chlamydomonas*	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2112	*Sphaerocystis schroeteri* Chodat	-	-	-	-	+	+	+	-	-	-	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-
2114	*Pediastrum boryanum* (Turp.) Menegh.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
2120	*Oocystis submarina v. variabilis* Skuja	+	-	-	-	-	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	+	-	+	-	+
2121	*Oocystis lacustris* Chodat	+	+	+	+	+	-	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
2133	*Scenedesmus brevispina* (G.M Smith) Chodat	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2137	*Dictyosphaerium simplex* Sukja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+
2138	*Monoraphidium komarkovae* (Nyg.) Komarkova-Legnerova	-	-	+	+	-	+	+	+	-	+	-	-	-	-	-	+	-	-	-	-	+	+	+	+	+
2143	*Monoraphidium minutum* (Nag.) Komarkova-Legnerova	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
2145	*Crucigenia quadrata* Morr.	+	+	-	-	+	+	-	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-
2146	*Crucigeniella rectangularis* (Nag.) Komarek	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2167	*Elakatothrix gelatinosa* Willen	-	+	-	+	-	+	+	+	+	+	-	+	+	-	-	-	-	-	-	-	+	+	+	+	+
2178	*Cosmarium*	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
2186	*Xanthidium*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
2187	*Staurodesmus extensus* (Andersson) Teiling	+	+	+	-	-	-	+	+	-	-	-	+	+	-	-	+	-	+	-	-	+	-	+	-	+
2193	*Staurodesmus paradoxum* Meyen	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
2195	*Staurodesmus bullardii* G.M. Smith	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2199	*Spondylosium planum* (Wolle) W. and G.S. West	-	-	-	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	+	+	+	+	+
2205	*Mougeotia*	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-
2206	*Botryococcus braunii* Kutzing	-	-	+	+	+	-	+	+	+	+	+	-	+	-	-	+	+	+	-	+	+	+	+	+	+
2215	*Tetraedron caudatum* (Corda) Hansgrig	-	-	-	+	+	+	-	+	-	+	+	-	+	+	+	+	-	-	+	+	-	-	-	-	-
2226	*Ulothrix*	-	-	-	+		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2235	*Ankistrodesmus spiralis* Lemmermann	+	-	+	+	+	-	-	+	+	-	+	+	+	+	-	-	+	+	+	+	+	+	+	-	+
	Euglenophyte																									
3309	*Astasia*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Chrysophyte																									
4351	Small chrysophyceae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4352	Large chrysophyceae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4355	*Chrysochromulina parva* Lackey	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4357	*Chrysococcus*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4358	*Chrysostephanospaera globulifera* Scherffel	-	-	+	-	+	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+
4361	*Kephyrion boreale* Skuja	-	-	+	+	-	-	+	+	+	+	-	+	+	-	+	-	-	+	+	-	+	+	+	+	+
4362	*Kephyrion*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4363	*Spinifiromonas sirratus*	+	+	-	+	+	-	+	+	+	-	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+
4364	*Mallomonas caudata* Ivanov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-
4367	*Mallomonas duerrschmidtiae* Siver, Hamer and Kling	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4368	*Mallomonas crassisquama* (Asmund) Fott	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+	+	+	-
4370	*Mallomonas akrokomos* Asmund and Kristiansen	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
4378	*Dinobryon borgei* Lemmermann	-	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+
4381	*Dinobryon mucronutom* Nygaard	+	-	-	-	-	-	-	-	+	-	+	+	+	-	+	-	+	+	+	+	+	+	-	-	-
4383	*Dinobryon bavaricum* Imhof	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4388	*Dinobryon sertularia* Ehrenberg	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4390	*Dinobryon sociale* Ehrenberg	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4396	*Chrysolkos skuja* (Nauwerck) Willen	+	+	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4400	*Ochromonas*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
4401	*Uroglena volvox* Ehrenberg	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4411	*Bitrichia chodatii* (Reverdin) Chodat	-	+	-	+	-	+	-	+	-	-	+	-	-	-	+	+	-	-	-	-	+	+	+	+	+
4413	*Chrysochromulina laurentiana* Kling	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+
4414	*Stichogloea*	+	+	+	+	-	-	+	-	-	-	+	+	-	+	-	+	-	+	+	+	+	+	+	+	+
4418	*Salpingoeca frequentissima* (Zach.) Lemmermann	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4425	*Mallomonas hamata* Asmund	-	+	-	+	+	-	+	-	-	+	+	-	-	-	-	-	-	+	+	+	-	-	-	-	-
4436	*Dinobryon attenatum* Hill	-	-	-	+	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+	-
4437	*Pteridomonas*	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	+	+	-	+	+	+	+	+	+	+
4440	*Stelexomonas dichotoma* Lackey	-	-	+	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-	-	+

		2PL-EAS-1					2PL-EAS-2					2PL-EAS-3					2PL-EAS-DT					3PL-EAS				
		24-Sep-08					24-Sep-08					24-Sep-08					24-Sep-08					25-Sep-08				
	Species & Code	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***	***Rep 1***	***Rep 2***	***Rep 3***	***Rep 4***	***Rep 5***
	Diatom																									
5507	*Cyclotella stelligera* Cleve and Grunow	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5511	*Rhizosolenia eriense* H.L. Smith	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	+	+	+	+	+
5513	*Tabellaria fenestrata* (Lyngbye) Kutzing	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	+	-	-	+	+	-	-	-	-	-
5514	*Tabellaria flocculsa* (Roth) Kutzing	+	+	-	+	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	-	-
5515	*Fragilaria crotonensis* Kitton	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
5518	*Synedra acus* Kutzing	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5524	*Asterionella formosa* Hassall	-	+	-	-	-	-	-	-	-	+	+	+	-	+	+	+	+	-	+	-	-	+	-	-	-
5546	*Gyrosigma*	+	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
5551	*Cyclotella michiganiana* Skvortzow	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5702	*Achnanthes minutissima* Kutzing	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5720	*Cyclotella bodanica* Eulenst.	-	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-
5733	*Eunotia pectinalis* (Kutzing) Rabenhorst	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-
	Cryptophyte																									
6554	*Rhodomonas minuta* Skuja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6557	*Cryptomonas pusilla* Bachmann	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6558	*Cryptomonas erosa* Ehrenberg	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6559	*Cryptomonas ovata* Ehrenberg	+	+	+	+	+	+	-	+	-	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-
6562	*Cryptomonas reflexa* (Marsson) Skuja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6565	*Cryptomonas rostratiformis* Skuja	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
6568	*Katablepharis ovalis* Skuja		+		+		-	+	+	-	-	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+
	Dinoflagellate																									
7631	*Gymnodinium helveticum* Penard	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7632	*Gymnodinium*	+	+	+	+	-	+	-	-	+	-	+	+	-	-	+	-	+	+	+	+	+	+	+	+	+
7635	*Peridinium willei* Huitfeldt-Kaas	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-
7639	*Peridinium pusillum* (Penard) Lemmermann	+	+	+	+	-	+	+	+	+	+	+	+	+	-	-	-	-	+	+	+	+	+	+	+	+
7641	*Peridinium aciculiferum* Lemmermann	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-

APPENDIX D

ZOOPLANKTON BIOMASS DATA

Type of Analysis: Zoopl BIOMASS mg/m^3
Project Number: AE-08-01 EAS
Sampling Dates: July 20, August 18, and September 10, 2008
Water Body: Various - See below

Biomass Tec Kasia Dyszy (NSC)
Mesh Size: 63 microns
Data Entry: Kasia Dyszy (NSC)
QA/QC: Stacy Hnatiuk (NSC)

Sample Number	Date	No. of samples	Dish ID	Dish Wt (g)	Dish + Wet Wt (g)	Wet Wt (g)	Dish + Dry Wt (g)	Dry Wt (g)
2PL-EAS-1	14-Sep-08	1	D1	0.819	0.919	0.100	0.825	0.006
2PL-EAS-1	14-Sep-08	1	D2	0.809	0.974	0.165	0.816	0.007
2PL-EAS-1	14-Sep-08	1	D3	0.827	0.91	0.083	0.833	0.006
2PL-EAS-1	14-Sep-08	1	D4	0.802	0.952	0.150	0.813	0.011
2PL-EAS-1	14-Sep-08	1	D5	0.791	0.88	0.089	0.797	0.006
2PL-EAS-2	14-Sep-08	1	E1	0.798	0.912	0.114	0.805	0.007
2PL-EAS-2	14-Sep-08	1	E2	0.796	0.96	0.164	0.804	0.008
2PL-EAS-2	14-Sep-08	1	E3	0.821	1.273	0.452	0.839	0.018
2PL-EAS-2	14-Sep-08	1	E4	0.822	0.994	0.172	0.831	0.009
2PL-EAS-2	14-Sep-08	1	E5	0.821	1.012	0.191	0.829	0.008
2PL-EAS-3	15-Sep-08	1	F1	0.818	0.95	0.132	0.824	0.006
2PL-EAS-3	15-Sep-08	1	F2	0.812	1.19	0.378	0.843	0.031
2PL-EAS-3	15-Sep-08	1	F3	0.813	0.943	0.130	0.822	0.009
2PL-EAS-3	15-Sep-08	1	F4	0.805	0.955	0.150	0.812	0.007
2PL-EAS-3	15-Sep-08	1	F5	0.801	0.899	0.098	0.808	0.007
2PL-EAS-DT	14-Sep-08	1	G1	0.810	0.93	0.120	0.818	0.008
2PL-EAS-DT	14-Sep-08	1	G2	0.831	0.866	0.035	0.834	0.003
2PL-EAS-DT	14-Sep-08	1	G3	0.829	0.871	0.042	0.832	0.003
2PL-EAS-DT	14-Sep-08	1	G4	0.820	0.929	0.109	0.826	0.006
2PL-EAS-DT	14-Sep-08	1	G5	0.819	0.906	0.087	0.821	0.002
3PL-EAS	13-Sep-08	1	H1	0.812	1.047	0.235	0.825	0.013
3PL-EAS	13-Sep-08	1	H2	0.818	1.044	0.226	0.829	0.011
3PL-EAS	13-Sep-08	1	H3	0.797	1.02	0.223	0.808	0.011
3PL-EAS	13-Sep-08	1	H4	0.798	1.004	0.206	0.808	0.010
3PL-EAS	13-Sep-08	1	H5	0.809	1.011	0.202	0.819	0.010
	TOTAL	**25**						

Water Body: Second and Third Portage Lakes

Mesh Size: 63 microns

Location	**2PL-EAS-DT**	**2PL-EAS-1**	**2PL-EAS-2**	**2PL-EAS-3**	**3PL-EAS**
Date	**14-Sep-08**	**14-Sep-08**	**14-Sep-08**	**15-Sep-08**	**13-Sep-08**
Taxon					
Acanthocyclops vernalis Fisher	16	8	64	4	16
Cyclops scutifer Sars	244	496	1920	248	728
Diaptomus ashlandi Marsh	36	12	48	80	8
Diaptomus minutus Lilljeborg	124	92	336	80	16
Diaptomus sicilis S.A. Forbes	80	94	496	73	338
Heterocope septentrionalis Juday and Muttkowski	16	0	0	0	32
Harpacticoida (unid)	0	1	0	0	0
Diaptomus spp. (unid. Females)	220	288	1120	264	840
Calanoida copepodite	4	4	12	8	8
Cyclopoid copepodite	88	152	224	64	40
Zooplankton Site Totals	**828**	**1147**	**4220**	**821**	**2026**
Richness	**6**	**6**	**5**	**5**	**6**
Bosmina longirostris (O.F. Muller)	92	220	720	96	338
Chydorus sp.	3	4	16	4	0
Daphnia longiremis Sars	2	0	32	0	8
Daphnia middendorffiana Fischer	2	24	198	32	16
Zooplankton Site Totals	**99**	**248**	**966**	**132**	**362**
Richness	**4**	**3**	**4**	**3**	**3**
Chironomidae larva (unid)	1	0	0	0	0
Zooplankton Site Totals	**1**	**0**	**0**	**0**	**0**
Richness	**1**	**0**	**0**	**0**	**0**

APPENDIX E

STABLE ISOTOPES ANALYSIS DATA

Zooplankton ISOTOPE, Second & Third Portage Lakes, September 2008.

Station	Date	Isotopes	
		$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)
Second Portage Lake			
2PL-EAS-1	14-Sep-08	-27.87	1.48
2PL-EAS-2	14-Sep-08	-28.39	3.99
2PL-EAS-3	15-Sep-08	-28.03	3.95
2PL-EAS-DT	14-Sep-08	-27.10	4.66
	Mean	***-27.85***	***3.52***
	SD	***0.54***	***1.40***
Third Portage Lake			
3PL-EAS	13-Sep-08	-28.95	5.41

Benthic invertebrate Isotope Results, Second & Third Portage Lakes, September 2008.

Station	Date	Isotopes	
		$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)
Second Portage Lake			
2PL-EAS-1	15-Sep-08	-20.89	5.80
2PL-EAS-2	15-Sep-08	-19.62	5.25
2PL-EAS-3	15-Sep-08	-16.97	4.79
2PL-EAS-DT	15-Sep-08	-23.04	5.65
	Mean	***-20.13***	***5.37***
	SD	***2.54***	***0.45***
Third Portage Lake			
3PL-EAS-1	13-Sep-08	-20.51	5.41
3PL-EAS-2	13-Sep-08	-21.13	5.88
3PL-EAS-3	14-Sep-08	-17.71	2.62
3PL-EAS-4	14-Sep-08	-16.23	4.91
3PL-EAS-5	14-Sep-08	-17.53	2.40
	Mean	***-18.62***	***4.25***
	SD	***2.10***	***1.62***

Fish Isotope Results, Second & Third Portage Lakes, September 2008.

Fish Species & ID	Age Class	Isotopes	
		$\delta^{13}C$ (‰)	$\delta^{15}N$ (‰)
Arctic Char			
ARCH 997-PM-9		-28.18	8.13
GN-1002AM #13		-27.01	7.32
GN-1002AM #21		-28.32	8.10
GN-1002AM #3		-27.94	8.20
GN-1002AM #32		-27.64	8.43
GN-1002AM #45		-27.64	8.33
GN-1011AM #10		-28.32	8.32
GN-1011AM #20		-27.26	7.51
GN-1011AM #5		-27.35	8.01
GN-1012AM #5		-27.61	7.66
GN-1014AM #34		-26.73	8.38
GN-1014AM #4		-23.41	8.60
GN-1022AM #12		-27.39	8.57
GN-2001AM #18		-28.87	7.83
GN-2002AM #12		-27.85	8.24
GN-2007 #1		-27.80	7.48
GN-2007AM #9		-27.28	7.49
GN-2011AM #4		-28.43	7.83
GN-2015AM #10		-27.49	7.83
GN-2020AM #11		-27.88	7.47
GN-2022AM #14		-24.50	9.09
GN-995PM #6		-26.32	8.04
GN-997AM #5		-26.97	7.96
GN-997PM #8		-29.14	8.06
GN-997PM #9		-19.44	9.01
n ***25***	***Mean***	***-27.07***	***8.07***
	SD	***2.006***	***0.464***
Lake Trout			
GN-1002AM #1		-20.96	12.2
GN-1002AM #22		-24.17	9.17
GN-1002AM #23		-21.69	11.5
GN-1002AM #33		-20.36	11.1
GN-1002AM #47		-23.37	12.2
GN-1004AM #2		-22.56	8.89
GN-1005AM #10		-24.91	9.55
GN-1005AM #2		-24.17	10.0
GN-1005AM #3		-25.45	8.87
GN-1005AM #9		-23.32	9.81
GN-1007AM #1		-24.20	10.4
GN-1007AM #6		-23.23	9.26
GN-1009AM #2		-24.76	10.3
GN-1009AM #21		-24.90	10.6
GN-1009AM #3		-23.28	9.54
GN-1009AM #4		-23.44	9.17
GN-1009AM #5		-26.31	9.08

	GN-1009AM #9		-25.26	11.7
	GN-1010AM #7		-22.22	13.0
	GN-1022AM #29		-24.42	11.5
	GN-1026AM #7		-20.47	12.8
	GN-1031AM #12		-23.44	12.4
	GN-1031AM #13		-23.79	12.3
	GN-1037AM #12		-24.17	12.9
	GN-2001AM #11		-25.36	10.8
	GN-2003AM #10		-25.25	10.7
	GN-2012AM #8		-20.38	13.1
	GN-2018AM #10		-26.15	11.4
	GN-2025AM #10		-24.27	12.2
	GN-2031AM #8		-19.99	12.2
	GN-4017 #12		-23.15	13.5
n	***31***	***Mean***	***-23.53***	***11.0***
		SD	***1.739***	***1.44***
Round Whitefish				
	GN-1002AM #4		-19.40	9.74
	GN-1002AM #5		-20.57	9.80
	GN-1004AM #3		-18.51	7.89
	GN-1005AM #1		-19.21	8.39
	GN-1005AM #12		-20.26	8.22
	GN-1008AM #7		-19.84	8.61
	GN-1009AM #23		-19.51	8.58
	GN-1011AM #18		-19.83	8.42
	GN-1014AM #2		-20.11	9.86
	GN-1025AM #7		-19.28	8.20
	GN-1031AM #7		-19.34	9.42
	GN-2001AM #24		-19.54	9.14
	GN-2007AM #2		-20.77	9.03
	GN-2007AM #3		-19.00	8.83
	GN-2007AM #30		-18.70	9.19
	GN-2009AM #4		-19.69	8.81
	GN-2015AM #12		-21.03	9.89
	GN-2021AM #8		-19.50	7.57
	GN-2022 #3		-20.65	7.59
	GN-2022AM #2		-21.50	7.19
	GN-2025AM #8		-21.06	7.89
	GN-2029AM #12		-20.93	9.49
	GN-3001AM #11		-22.36	10.1
	GN-3010 #7		-20.69	9.59
	GN-3012 #1		-21.90	9.62
	GN-995AM #10		-20.14	8.64
	RNWH 2001-AM-25		-19.55	8.47
n	***27***	***Mean***	***-20.11***	***8.82***
		SD	***0.9606***	***0.805***