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November 7, 2006

Mr. Ron Martel
Environmental Superintendent
Mount Polley Mining Corporation
Box 12
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Dear Mr. Martel,

Re: Response to MOE Comments - Priority Parameters and SSWQOs

Minnow Environmental Inc. has received and reviewed the comments of the British Columbia Ministry of Environment (MOE) on the Minnow Report entitled "Identification of Priority Parameters at the Mount Polley Mine and Development of Site-Specific Water Quality Objectives". Attached is a detailed response to the comments for submission to the MOE and other stakeholders. The MOE comments, and associated responses, will be considered in the Workplan for 2007. We hope to have to opportunity to discuss key issues with you, with the MOE and with interested stakeholders following their review of this response and to finalize a working list of priority parameters prior to submission of the Workplan.

Sincerely,
Minnow Environmental Inc.

Pierre Stecko, M.Sc. CCEP, RPBio
Aquatic Scientist

Mount Polley Mining Corporation: Response to British Columbia Ministry of Environment Comments on the Report Entitled "Identification of Priority Parameters at the Mount Polley Mine and Development of Site-Specific Water Quality Objectives" (April 2006, submitted May 2006)

Comments are addressed in the order that they were presented in the letter of Ministry of Environment (MOE) comments sent to Mr. Tim Fisch, Mr. Art Frye and Mr. Ron Martel by Ms. Chris Swan (MOE Environmental Protection, Water Quality, Williams Lake), on October 18th, 2006. For context, this response starts with a brief background. Original comments are contained in this response (Times New Roman font) followed by responses (in bold Arial font).

Background

The Mount Polley mine was operational from August 1997 to September 2001 and was placed on care and maintenance from September 2001 to March 2005. The mine re-opened in March 2005 due to the discovery of significant new ore reserves and favourable copper and gold prices. As early as 1997, the need for a future discharge to an aquatic surface water body was recognized and the development of site-specific water quality objectives (SSWQO) for copper was discussed with the MOE.

Prior to the first operational stage and during the care and maintenance stage, Mount Polley was permitted to discharge seepage water from the Main Embankment Seepage Pond to a tributary of Hazeltine Creek (under Permit #PE-11678). Mount Polley was not permitted to discharge during the first stage of operations due to a water deficit. However, during the care and maintenance stage, Mount Polley discharged seepage water from the Main Embankment Seepage Pond to the northeast tributary of Edney Creek. Since recommencing operations in March 2005, Mount Polley has voluntarily chosen not to discharge from the Main Embankment Seepage Pond and would prefer to discharge to Hazeltine Creek.

During the care and maintenance stage, and subsequent to that, a significant quantity of surface water accumulated in the TSF. This accumulation of water is problematic for Mount Polley for two reasons: 1) the accumulation requires dam raises, which are unnecessary and expensive; and 2) the accumulation prohibits the formation of proper tailings beaches thereby increasing seepage and causing conditions that are geotechnically undesirable. Therefore, the Mount Polley Mine has a current need to discharge and will likely have a similar ongoing need during the mines life and after closure.

In the summer of 2004, Mount Polley met with the MOE and expressed their need to discharge water. The meetings and discussions led to an evaluation of the feasibility of discharge into Polley Lake and compliance with the BC water quality criterion for the protection of aquatic life (WQC) for copper at the Polley Lake Outlet. Several scenarios for discharge were evaluated and all indicated that, with conservative assumptions of behaviour (i.e., simple mixing), it was not feasible to meet the WQC for copper at the Polley Lake outlet due to naturally elevated copper concentrations in the watershed.

In early 2005, Mount Polley forwarded a proposed approach to developing SSWQO to the MOE (Minnow 2005) and embarked on an exercise of identifying priority

parameters upon which to focus their efforts and, for those priorities, of evaluating options for developing SSWQO. The former represented an effort by the mine to identify any parameters, in addition to copper, that could be considered priorities or "contaminants of concern" as defined by risk of their causing an adverse effect on the future aquatic receiving environment. In April 2005, Mount Polley met with MOE and presented the overall approach as well as preliminary findings. At that time, there seemed to be general agreement on approach and there was discussion around the need for an additional Water Effect Ratio (WER) toxicity test. Mount Polley proceeded with the additional toxicity test and the identification of priority parameters.

In April 2006, Mount Polley finalized its first technical report evaluating the discharge, which was entitled "Identification of Priority Parameters at the Mount Polley Mine and Development of Site-Specific Water Quality Objectives" (Minnow 2006). This report was submitted to the MOE for review and comment in May 2006. The report outlined a rigorous method for identifying priority parameters at the Mount Polley Mine and identified copper, iron and phosphorus as priorities. For these parameters, preliminary SSWQOs were identified by the application of a streamlined water-effect ratio procedure for copper (using *Daphnia magna*) and a background concentration procedure for iron and phosphorus. An approach to further assessment was also identified as were recommendations for environmental assessment.

On August 9th 2006, Mount Polley met with the MOE to discuss potential options for the location of discharge and to address several other issues, including the status of the review of the report. At that time, the MOE stated that they would have comments on the Minnow Report by mid-October.

On October 24th 2006, Mount Polley met with the MOE to provide an update on the mine's need to discharge water, the preferred alternative for effluent discharge, other site initiative and the preliminary scope of the 2007 Workplan. The MOE's comments, received on October 19th were discussed in general terms and a timeframe for response to the specific comments was provided (2 weeks). The pages that follow provide the detailed response to comments.

Detailed Comments (Times New Roman font**) and Responses (Bold Arial font)**

We offer the following comments and questions in support of further work to establish setting SSWQO's that will protect the aquatic ecosystem. Note that this review mirrors the sections in the Mt Polley SSWQO report for ease of tracking comments:

1.0 INTRODUCTION

a. Discharge location:

The location of the discharge was not clear in the report (both Polley lake and Hazeltine creek were mentioned). At the August 9, 2006 meeting Mt. Polley mine staff indicated their preference for discharging to Hazeltine creek. The likely point(s) of discharge should be clarified for further stream work, utilization of existing data and for water collection for future toxicity testing. Are any other options being considered for discharge such as Edney Creek, the Bootjack/Morehead system or Polley Lake?

The Mount Polley Mine's preferred alternative for discharge is into Hazeltine Creek upstream of water quality monitoring Station W7 (Figure 1). Potential discharge into Polley Lake and into Edney Creek were also considered and evaluated, but were judged to be less favourable options at this stage of mine life. However, at the time of the implementation of the Minnow study (i.e., 2005), prior to Mount Polley's detailed evaluation of options, the concept was for discharge into Polley Lake.

It should also be noted that the Hazeltine/Edney creek system also includes Quesnel Lake. Quesnel lake has very low DOC (1-2), a pH range from high 7's to low 8's and a hardness of ~50 mg/L CaCO3. The binding potential of any free copper ions in Quesnel Lake at the mouth of Hazeltine creek may be quite different than the creek itself. There has been no mention of the potential impacts to Quesnel lake as a receiving body to Hazeltine Creek.

Quesnel Lake, and the implications of its different water chemistry, will be addressed in the Workplan for 2007. Copper associated with a mixture of Hazeltine Creek water and effluent (i.e., water in Hazeltine Creek below the point of discharge) will be evaluated using the "Biotic Ligand Model" (BLM) and perhaps with supporting toxicity test evaluations. However, it should be noted that such modelling is conservative as it does not account for the association of copper with particulates and the deposition of those particulates, which represent an important process in the fate of copper. The Workplan for 2007 will include a mixing study, water quality modelling (biotic ligand model) based on hydrology (of Hazeltine and Edney Creeks) and mixing, as well as a pre-discharge aquatic assessment that will include Quesnel Lake near the Hazeltine inflow.

In regards to using an existing mined pit for a polishing pond, we have long term concerns with utilization of a system which involves pumping of water. What will happen with operation and maintenance of the pump when the mine is shut down?

(This response is from the Mount Polley Environment Department). Long term plans have not yet been finalized. Pumping to an existing mined out pit would be done during active mining to promote rapid filling thereby achieving a closure objective. Currently proposed effluent configurations allow for the discharge without pumping which would satisfy the expressed concerns.

Also, what is the long term projection for excess water beyond the 1-2 million cubic meters of supernatant that is estimated for decanting?

(This response is from the Mount Polley Environment Department). In the October meeting, Mount Polley's water management plan was presented and it was stated that water balance is a main focus of planning activities at Mount Polley. Each year, an evaluation is done to establish short and long term needs while predicting receiving water impacts.

Can Hazeltine creek handle this much volume? Are there really options for batch release given the volume of excess water and the size of the creek? This must be assessed by a professional hydrologist.

These questions are currently being addressed by Mount Polley. Specifically, Mount Polley has retained Minnow Environmental to do a physical characterization of Hazeltine Creek and has retained Knight Piesold to do a detailed hydrological assessment of the ability of Hazeltine Creek to convey discharge under the variety of flow conditions. The latter will form the basis for the development of a discharge strategy with feedback mechanisms.

b. Historical timing of mine activities:

It is important to also state the activities prior to the mine being operational in August 1997 (i.e. is this when the milling process began?). I understand that activities pre-Aug '97 included logging, overburden removal, road building, blasting? dam building?
We would like to see a list of activities and dates in order to properly assess baseline for this project.

A chronological list of activities at the Mount Polley Mine site is attached (Attachment 1). In brief, construction activities in 1995 consisted mostly of clearing the mill site and, in 1996, construction of the whole facility began.

This is a fundamental issue in terms of establishing "baseline", sorting the data, making comparisons and reviewing the results. Interestingly, the Mt Polley Annual Environmental and Reclamation Report 2005 includes only data from 1990, 1995 and 1996 in the "baseline" category. This issue must be dealt with before sorting and comparing further data. There is obviously an issue as shown by instances of baseline exceeding care & maintenance levels for some parameters.

The establishment of baseline values will be revisited. Specifically, baseline data will be assessed to identify any temporal and spatial trends in the baseline dataset. This analysis will support decisions on which sample locations and timeframes to include in establishing final baseline values. Minnow will submit a brief letter report of this exercise to Mount Polley for their review and for stakeholder review as this issue is critical to moving forward with the identification of priority parameters and to use of the background concentration procedure for establishing objectives.

2.0 REVIEW OF MONITORING DATA

a. Screening Benchmarks and Pooling Data

It is appropriate to compare mean and maximum data to the BC WQ Criteria as indicated in point 1, Section 2.1 of the report under review. This first step should also include comparison to the Canadian Water Quality Guidelines (CCME).

Canadian Water Quality Guidelines can be factored into this analysis, but this adds one more layer of complexity to an already complex (rigorous) procedure, with relatively little to be gained as guidelines (CCME) and criteria (BC) are generally

similar (i.e., many BC criteria represent the adoption of the CCME guideline). This also begs the question of why two sets of objectives should be necessary for any given parameter (i.e., if the MOE wishes to rely on the CCME guidelines, then why duplicate the effort using BC criteria).

The BC Water Quality Guideline mean is defined usually as five samples in a 30-d period. Was this was available at some receiving water sites but not all sites?

The maximum frequency of water sampling during baseline was weekly (during periods of "intensive weekly spring and fall sampling"), but frequency was generally lower than this. In sampling during the operational period, the maximum frequency of water sampling was also weekly as indicated in Mount Polley's Permit (PE-11678). Therefore, within a given 30-d period, five data points were rarely available. In fact, it should be noted that the "30-day average based on five weekly samples taken in a period of 30 days" (e.g., as stated in some BC guideline documents such as mercury) is problematic on the average (i.e., there are 4.3 weeks in 30 days, not 5).

Because of the lack of data (5 samples in 30 days), we understand the reasons for identifying some other definition for means and maxima. It is acceptable to use pre-operational baseline data (point 2, Section 2.1, pages 4 & 5) for receiving waters, but unacceptable to use care/maintenance values which may have been impacted by the mine during its operational life.

We believe that, in instances where care and maintenance concentrations are actually better (lower) than baseline, it would be more appropriate to use the care and maintenance data. We never suggested that this was "baseline"; rather, we felt that it was the best reference data available for use. Note that the incidence of baseline concentrations being greater than care and maintenance concentrations will likely decrease pending the analysis of baseline described above.

Regarding point 2, Section 2.1 (pages 4 & 5), it is unclear which stations are included as 'receiving water stations'.

All baseline stations except for "mine drainage creek" and "north dump creek" were included as receiving water stations, as identified in Appendix B (Stations W1, W2, W5, W6, W7, W8, W8z, W9, W11, W12). This may change pending the spatial analysis component of the task described above.

We also have a concern about combining all receiving water stations together. Specific water bodies should be looked at when establishing site specific objectives. Specifically, if Mt. Polley mine is looking for a compliance point in Hazeltine Creek then the data review and discussion should be focussed on the characteristics of this water system. It is not appropriate to combine different watersheds into one pooled data set.

We agree that specific water bodies should be addressed for SSWQOs and that is the approach we took (i.e., Sections 3 and 4 focussed on Hazeltine Creek). However, we feel that, for the purposes of identifying priority parameters, consideration of a regional background concentration is more appropriate. That is, priority parameters should be identified on the basis of what is elevated relative a regional background whereas SSWQOs should focus on the specific water body in question.

The methodology for screening the data is unclear as related to the mean and maximum benchmarks and the data tables in Appendix C. Was the receiving water data actually reviewed to see if there were data available to meet the mean criteria (i.e. 5 samples in a 30 day period)? I don't see results of this scrutiny in the report.

The methodology for calculating the mean and maximum benchmarks is described in detail in Section 2.1, including the equations used. All data associated with benchmark selection were presented in Appendix B (Tables B7 to B.10). The "maximum" benchmarks were used, as described in the text, to screen all data points to define the <u>frequency</u> of exceedence. The "mean" benchmarks were used, as described in the text, to screen all station mean (by period) to define the <u>magnitude</u> of exceedence. Detailed results of this screening were provided in Appendix Tables C35 to C38. We acknowledge that reference to these appendices in the text would have been useful.

Fundamentally, this rigorous approach identifies priority parameters on the basis of significant frequency of exceedence (i.e., does the parameter frequently exceed either an established maximum objective or the regional upper reference concentration) and magnitude of exceedence (i.e., does the mean concentration of the parameter exceed either an established mean objective or the mean regional reference concentration). For each parameter, it essentially asks the question of whether there is a significant departure from the benchmark data.

In evaluating this approach, the overall intent of this exercise must be considered. Specifically, the intent of this exercise was to derive an objective list of priority parameters associated with Mount Polley's source waters. The derivation procedure, although complex, is a rigorous, objective way to identify parameters that 1) have been frequently elevated to a substantial magnitude in historical receivers and 2) were due to Mount Polley (frequently elevated to a substantial magnitude at source). Priority parameters are considered to be those parameters for which there is the greatest concern that discharge could lead to unacceptable concentrations in the receiving environment. By managing these priorities (and implementing source and monitoring initiatives), there should be reasonable assurance of limited risk of adverse effects in the receiving environment.

With respect to the evaluation of data versus mean criteria, as indicated above, at a maximum monitoring frequency of weekly, such an analysis is not supported. Regardless, we also feel that such an approach would have been unnecessarily onerous and would have provided little benefit given that frequency of exceedence was defined by screening every data point against the "maximum" benchmarks and the magnitude was effectively characterized by screening mean concentrations against the "mean" benchmarks.

For parameters without established BC Water Quality criteria:
How was one number for the upper 95% confidence limit of the mean of all the receiving water stations (page 4) and the upper 95% confidence limit of the data points of all the receiving water stations (page 5) established?

These values were established from the reference data sets (Appendix B) using the equations provided in the footnote on Page 4 of the report. Specifically, the mean benchmarks were calculated as mean + $t_{0.05(2)}$*standard error and the maximum benchmarks were calculated as mean + $t_{0.05(2)}$*standard deviation. The results of these calculations were provided in Appendix B as Upper 95% CL (SE) and Upper 95% CL (SD), respectively.

Was the Standard Error (for mean) and Standard Deviation (for data distribution) of each site from the baseline time period averaged into one new value for the receiving stations and then used to screen all data against? In order to get to the bottom of this I tried to find out how the screening benchmark for Silicon was established. When I averaged all the upper 95% CL (SD) values for the Polley and Bootjack sites (as per page 6) the value was 5.689. The benchmark used for screening the data (as per tables in Appendix C) is 5.9. How was this number derived?

The numbers are not averages; they are the standard deviations and errors presented in Appendix B. For the example that you use, the value for silicon is on Page 2 of Table B1 in the row entitled upper 95% CL (SD).

The bottom paragraph of page 5 – top of page 6 is confusing. I see that data was screened against the max WQ criteria when available or a benchmark from on-site data (in Appendix C). All parameters that I quickly checked that have BC WQC established, all had the maximum value used as the screening value for the data points. I did not see the mean values used anywhere (in my quick review). This was used to determine the frequency of exceedence. The second part is where things start to get confusing. It states that the mean concentrations by monitoring station were screened against the mean benchmarks (appendix C- problem since App C used the max benchmarks) to come up with the magnitude of exceedence. Do you mean the actual mean of the baseline data set?

The process for screening is not simple, but is defensible. It involves two screenings as described on pages 5 and 6. The first screening is of all data points against the maximum benchmark (either the maximum BCWQC or the upper 95% CL [SD] of reference). This identifies the <u>frequency</u> of exceedence (summarized in Appendix Tables C.35 and C.36). The second screening is of the mean value for each parameter for each station against the mean benchmark (either the mean BCWQC or the upper 95% CL [SE] of reference). This identifies the mean magnitude of exceedence (summarized in Appendix Tables C.37 and C.38). Fundamentally, a parameter is of most concern if it is often elevated (at a high frequency) and is substantially elevated (to a high magnitude).

In reviewing table 2.5, if there are no exceedences of a given parameter then how can there be a value corresponding column for the magnitude of that exceedence? For example, in the Polley/Quesnel receiving waters, under the care/maintenance time period, mercury has 0% exceedences but a magnitude of 2.5 times. Does this mean that the upper 95% CL was not exceeded, in other words, that the upper 95% CL is actually higher than 2.5 x the mean? This is not the case for W7 – I did not check the other Polley/Quesnel spreadsheets. Please clarify.

This stems from the fact that they are two separate screenings – one of all the data points (to identify frequency) and one of the mean (to identify magnitude). The former is against a higher benchmark than the latter. Regardless of whether or not there are any exceedences of the maximum benchmark, the mean can still be compared to the mean benchmark to define a magnitude. Magnitudes of less than 1.0 indicate a mean that is lower than the mean benchmark, magnitudes of 1.0 indicate a mean that is equal to the mean benchmark and magnitudes of greater than 1.0 indicate a mean that is greater than the mean benchmark.

In the case for mercury, BCWQC of 0.02 ug/L (0.00002 mg/L) and 0.1 ug/L (0.0001 mg/L) were used as mean and maximum benchmarks (BCMOE 2006). Given that the maximum benchmark is five times the mean benchmark, it is quite possible that magnitude of 2.5 times the mean benchmark (i.e., 0.05 ug/L) could occur even with zero incidence of exceedence of the maximum benchmark. This is somewhat complicated by the fact that the method detection limit (MDL) for mercury was typically 0.05 ug/L (Appendix C) and that MDLs were taken at face value for calculations (i.e., <0.00005 mg/L was incorporated into calculations as 0.00005 mg/L). Thus, the 2.5 times simply represents how much higher the method detection limit was than the mean benchmark.

Again, the intent was to identify both frequency and magnitude in defining priorities. That is, a parameter would only be considered a priority when <u>both</u> frequency and magnitude were elevated.

b. Priority parameters

What is the rationale for the cut-off limits (10% and 1x) for establishing priority parameters?

The rationale for the cut-off limits were that a frequency of exceedence of 10% or more represents a frequency that we would be confident was due to the mine and did not occur by chance alone (i.e., 10% is double the probability of an exceedence occurring by chance alone). The 1.0x represents a simple evaluation of whether the mean concentration at a given location is less than, equal to, or greater than the mean benchmark (<1.0, equal to 1.0, or > 1.0, respectively). It might be possible to define two tiers of priority based on this system, but Mount Polley wishes to focus on greatest priorities.

Considering the maximum BCWQC was used for some of the parameters (maximum established to protect aquatic life) and the upper 95% CL was used for others, what is the justification for allowing a 10% frequency exceedence, especially exceedence of the 95% limit which was well above the max BCWQC in some cases like Dissolved Aluminum - and Diss-Al doesn't even make the priority list.

Again, the intent was to define priorities. As indicated above, it might be useful to also identify "Tier 2" parameters, perhaps as those with exceedences between 5% and 10% when compared to a reference concentration and of >0% when compared to BCWQC.

For parameters with established BC Water Quality criteria:
I am concerned about the use of background for the screening benchmark, especially when background is much higher than the BCWQC as in the example of dissolved Aluminum.

By definition, BCWQC are inapplicable when natural concentrations are higher than the criterion. Mount Polley cannot be expected to meet any objective that is below background.

Also, how is it that you can have something like chromium omitted as a priority variable yet have a frequency of exceedence of 9 and 13% (operational vs. care/maintenance) yet the magnitude is 1.0 and 0.9, respectively in Polley/Quesnel receiving waters. Considering that in the TSF, there were 40% exceedences, we are concerned that it has been omitted. This is also the case for mercury where the frequency of exceedence is 6% during operations with a magnitude of exceedence of 4 times.

In the case of chromium, magnitudes of 1.0 and 0.9 mean that, on average, concentrations do not exceed background. Therefore, it should not be designated as a priority parameter. Furthermore, according to the screening protocol, the frequency and magnitude in potential source areas represent a check to ensure that any identified priorities are, in fact, related to the mine. For instance, aluminum, although elevated in Polley/Quesnel receiving waters, does not appear to be mine-related. Mercury (and also cadmium and zinc), represents a parameter that could potentially be identified as Tier 2 priority. However, as indicated above, mercury appeared to be falsely identified in the screening process due to a method detection limit that is equivalent to the mean benchmark.

Chromium may have other problems if it has not been measured as Cr+3 and Cr+6 which are the forms for which the guidelines apply. The BC working guidelines are 1 ug/L Cr+6 and 8.9 ug/L as Cr+3, both as maximum values. In Table 2.4, the maximum Cr+6 is used as the mean guideline - which is a good conservative approach, especially if compared to total chromium values. This doesn't seem to be the case as a value of 0.0022 mg/l was used as the screening value for Chromium in Appendix C. Please clarify.

Analytical laboratories measure total chromium. Mount Polley monitors total chromium. The more conservative guideline was used in identifying appropriate screening benchmarks for total chromium, which is defensible. However, because a reference concentration exceeded the BCWQC, it was used as the maximum benchmark in accordance with the protocol developed. Exceedence of the BCWQC tells us nothing about the influence of the mine if natural concentrations also exceed BCWQC.

Although the highest priority variable is copper, there are several other metals with guidelines that should have objectives detailed as indicated in Table 2.5 (unless the data set corrections produce other results). These include Al, As, Cd, Cr, Fe (already included), Hg, Se, Ti, and Zn. In conjunction with this, emphasis should be placed on what comes out of the mine (TSF) when it is operating to determine priority parameters as well as what can be controlled by settling in a polishing pond.

The reason for establishing priorities is to focus effort on what is most important at this site. Establishing objectives for all parameters elevated in effluent relative to receiving waters would not be a logical or cost-effective approach. The concept here is to address priorities (copper is overwhelmingly a priority). As indicated above, it may be worthwhile to also identify Tier 2 priorities. It should be considered that the

mine will have to fully address (perhaps control) priority parameters, which will decrease concentrations of other parameters. It is important to consider that the priorities will also be used to drive decisions on how to enhance effluent quality. Effluent discharged by Mount Polley will not be the same as TSF supernatant during the first stage of operations (Mount Polley is now working on a characterization of probable effluent quality). Furthermore, it should be noted that Mount Polley will have to maintain non-acutely lethal effluent and assessment of effluent quality will also include sub-lethal toxicity testing. Thus, toxicity test results will be available as tools for managing effluent quality as required.

c. Data issues

I noticed the following errors/issues in the data set while looking through certain values. This is not an exhaustive list but does point to the fact that this data set should be reviewed and cleaned up (check values against hard copy lab results, review quality assurance samples, ensure values are correct and remove incorrect values) and then rerun for the assumptions and tables in the report.

1. As previously discussed there are issues with defining the dates of baseline. Most of the data tables in Appendix C lump all of 1997 into baseline and don't match the text of the report which breaks baseline and operational in August 1997. Table C13 (site W3a) includes all data from 1995-1999 in the baseline category.

   The most appropriate (representative) timeframe for baseline will be identified and used following the completion of the spatial and temporal pattern analysis described previously.

2. How were replicates dealt with in this data set? It looks like they were averaged in with the data set rather than being used strictly for QA purposes.

   Replicates were, in fact, included in the calculation of averages. In completing the evaluation of baseline and, following that, in data screening, replicate values will be averaged (to provide the mean value for that day) and that value will be used in calculating averages for a set of data.

3. Table C21. 10/23/1996, Diss Al (0.61 mg/L) exceed total Al (0.077 mg/L)

   In any given water sample this should not occur (i.e., by definition, dissolved metals can be no greater than total metals). However, it can occur when dissolved and total metals are collected as separate samples as they have been at Mount Polley. In using the data, a decision was made to manipulate the data set as little as possible prior to data analysis. Having said that, such instances will be verified against original data reports to identify potential data entry errors and potential contamination.

4. Table C21. the two values in the n> detection and n< detection limit rows have been switched.

   These numbers appear to be accurate. For example, during the first stage of operations, aluminum was detectable in all cases (n>detection = 67;

n<detection = 0) whereas beryllium was always below detection (n>detection = 0; n<detection = 59).

5. Table C15. 10/9/1996, Diss Al (0.224 mg/L) exceeds total Al (0.032mg/L)

   Addressed above.

6. Field pH issues because the following values are averaged into the site summary statistics. Table C10. Site W1 (Morehead Ck). 4/6/1995. pH = 2.03; Table C16. Site W4 (North Dump Ck.)4/6/1995. pH = 2.21. Note that these are the same date so perhaps there was an equipment problem?

   These data points are clearly in error and should be eliminated from the database. Doing so will have no net effect on this analysis as pH was only used for determining the BCWQC for aluminum (average pH was still greater than 6.5).

7. The order of the stats results for upper 95% CL (SD) and (SE) varies between tables; example baseline summary for W6 (Table C19) has SD first but W7 (table C21) has SE first. This can lead to confusion when comparing data summaries.

   We agree that these should have a consistent order for ease of use.

8. Table C21: data error 04/06/1995 Diss Fe = 0.159 but total Fe = 0.004. Also, 04/12/1995 Diss Fe=0.097 but Total Fe=0.005. This changes the summary statistics and the outcome of the proposed iron criteria.

   Differences between total and dissolved metals can occur due to the sampling methodology employed as previously indicated. As indicated above, these data points will be flagged for checking as will any other potential incidences where dissolved results exceed total results.

3.0 DEVELOPMENT OF A SSWQO FOR COPPER

General Approach

Table 3.1
- title should say “total” copper

It was clearly stated on page 4 that all concentrations, except for Al, were total and there is no need to re-iterate with each mention.

- Station W7 has the wrong values for n> or < detection (also incorrect in the summary stats in table C.21.

These numbers are in the correct sequence. That is, the incidences of copper being less than detection have been quite low as evident in this table (high number of “>detection” results and low number of “<detection results). However, the “n

(>detection)" and "n (< detection)" lines under Station W7 should read 20 and 3, respectively.

- this table includes data summaries from baseline and operational that are inconsistent with the text of the Minnow report and the Mt. Polley Environmental & Reclamation Report 2005. Redefining baseline would result in a different mean and Standard Deviation for W7.

The values in Table 3.1 were used directly in the text of the Minnow Report. The statements made in both Section 3.0 and in Section 3.2 accurately reflect the data presented in Table 3.1. For example, "the mean baseline concentration of copper in receiving waters was 0.0048 mg/L" and "mean concentration during care and maintenance was lower (0.0035 mg/L)" are correct statements, as are those about the 90th percentile and the upper 95th confidence limits. Similarly, the identification of 0.0040 and 0.0053 mg/L as the 90th percentile and upper 95th confidence limits of copper in Hazeltine Creek at W7 are accurate. There are some subtle differences between Table 3.1 and Appendix Table C21 that will be addressed. Furthermore, we agree that any redefinition of baseline will result in changes to these numbers.

Baseline values should be used for Figure 3.1

As indicated above, we feel that it is defensible to use care and maintenance data if associated concentrations are lower than during baseline. This is a conservative approach. The use of care and maintenance data may not be required following an evaluation and potential redefinition of baseline.

Section 3.1 Approach: why is the biotic ligand model not listed since it was used?

The biotic ligand model is not a SSWQO development method. Rather, it was used to corroborate results of the toxicity testing.

Background Concentration Procedure:
The focus should be on Hazeltine creek or W7 if that is where the discharge will occur. Comparing pooled stats on Copper for all the receiving waters is not appropriate. Also, care and maintenance and baseline cannot be used interchangeably.

As stated earlier, we agree that the focus of the BCP should be on Station W7 and it is, in fact, values for W7 that were identified as preliminary SSWQOs using the BCP. The purpose of also presenting the regional data (all receivers) was to allow a general comparison to Station W7. Care and maintenance data were not used interchangeably with baseline. In instances where care and maintenance was adopted as the best reference, this was clearly stated.

Figure 3.1
- Title is inconsistent with the data on the graphs – care/maintenance does not equal "Background". Comparison of all the data points for W7 against care & maintenance statistics is not correct.

Changing the title to "Comparison of Copper Concentrations at Station W7 to WQC and the Statistical Distribution of Reference" would be more accurate in instances care and maintenance concentrations are lower than baseline concentrations.

- If you look at table C21 as it is currently organized, the mean hardness is 55.4 and the mean total copper is 0.003 of the baseline grouping of the data. This results in criteria of 0.0022 for a 30 day mean and 0.0072 for a max. This does not match the WQ criterion line of 0.0081mg/L

  The hardness value used to calculate the criteria was 65 mg/L, a value used in previous discussions. This should be updated and brings up an interesting issue for the purposes of SSWQO development. We would expect hardness to rise somewhat with effluent discharge and that the generic criteria would therefore rise accordingly (at 100 mg/L hardness, the mean criterion would be 0.004 mg/L and the maximum would be 0.0114). Therefore, it is perhaps too early to definitely say what the applicable generic criteria would be, although some predictions will be developed as indicated previously.

- If the proper data sort was used for baseline, the upper 95% CL for W7 would be lower. From 1990- 1996, only one value for copper (T) exceeds the water quality max criterion.

  As indicated previously, analysis of spatial and temporal trends in baseline may lead to redefinition of baseline, which, in turn, would likely alter the calculated values.

- Not all W7 data points are joined by lines – why not?

  This is an artefact of the way the data were set up and can be rectified.

- As the graph currently stands, only 2 data points in 9 years exceed the BC maximum water quality criterion.

  Yes, and in the absence of discharge. The mean criterion is frequently exceeded and often for many consecutive samples. Thus, the generic criteria would likely not be met <u>with</u> discharge and hence the need for a SSWQO.

- Why was the 1990 data left off this figure?

  Due to the substantial data gap between 1990 and 2004.

Recalculation Procedure:

There appears to be some problems with data reported in Tables 3.2 and 3.3. The species mean <u>acute</u> value for Daphnia magna is ~5 ug/L while the <u>chronic</u> value is 14.1 ug/L? Data presented in such a manner would never be accepted for development of a guideline. Only when comparable conditions such as hardness are used in testing would a mean value be used. Do these values represent all data points with no consideration of the test conditions? More relevant to this case would be to know what was measured at water hardness's from ~ 40 to 75 mg/L for comparison to the generated WER.

There are no problems associated with these data. These data are the species mean acute values (SMAV) and species mean chronic values (SMCV) of the USEPA (USEPA 2003) and probably represent the most current, standardized and quality-controlled dataset available worldwide. They are highly "acceptable". The perceived problem probably stems from the fact that they are <u>mean</u> values. As such, they are not stating that the chronic endpoint is less sensitive than the acute endpoint, rather, that of all the acceptable tests conducted, the SMAV is 4.98 ug/L and the SMCV is 14.1. More importantly within the context in which the data were used, they indicate that sensitive species are present at Mount Polley and thus that pursuing the RCP would be pointless. As such, the intention of the exercise was well fulfilled using these data.

Copper complexing capacity:

The copper complexing capacity of natural waters is a complicated issue. Some of the water chemistry factors that affect the complexing capacity (and inversely, the toxicity via free Cu^{+2} ions) include temperature, hardness, pH and quality and quantity of DOC (dissolved organic carbon). Choice of test species and age/body size also play a role in susceptibility to toxicity. Other factors which also play a role in copper toxicity include the calcium:magnesium ratio, multiple metal interactions and end-point variability.

It is important to note that 'not all DOC is created equal'. It was suggested by Uwe Schneider, Environment Canada that analyzing for organics at the DOC level is appropriate given the recognition that DOC is composed of many substances and that the components of DOC will not always be the same. The strength of the metal-ligand bonds varies with the metal and the organic substances. Wright and Welbourn (2002) state that "the same elements that compete with potentially toxic trace metals for receptor sites on an organism [components of water hardness], may also compete with organic ligands that would otherwise sequester metals in an unavailable form". Given the complexity of the chemical interactions, the relationship between DOC and availability of metal free ions or toxicity cannot be simply stated. They also note that in lab experiments, when site water is diluted with lab water, the DOC of that sample will change and this importance must not be overlooked. Rigorous testing must occur to capture some of this natural variability amongst chemical interactions as well as across the seasons before site specific water quality criteria can safely be established.

We are well aware of the state-of-the-science of environmental biogeochemistry of copper, the heterogeneity of DOC and the fact that DOC can vary in its composition on temporal and spatial scales. At the end of the day, the whole point of the WER is to let the organism response dictate levels that are protective. There is no better way to assess bioavailability than the response of the organism. This is a highly defensible approach. Furthermore, we have backed up our findings (and will continue to back them up) with the biotic ligand model which factors in the water quality parameters you list. We have no intention of characterizing DOC (other than measuring it), but will propose additional WER testing and biotic ligand modelling that will allow an

assessment of how bioavailability varies spatially and temporally. As indicated during the last meeting, the timing of testing can be determined on the basis of seasonal trends in the concentrations of key parameters that modify the bioavailability of copper. This will be addressed in the Workplan for 2007. With respect to the comment that "the relationship between DOC and availability of metal free ions or toxicity cannot be simply stated", we would point out that the relationship between DOC and free copper is fundamental (e.g., Mantoura et al. 1978; Leckie and Davis 1979; Jenne 1979; Spear and Pierce 1979; Winner 1985; Sposito 1987; Cabaniss and Shuman 1988; Meador 1991; Welsh et al. 1993; Suedel et al. 1996; USEPA 2003; Kramer et al. 2004) and that the results of toxicity testing and biotic ligand modelling fully support it, providing a convincing weight-of-evidence.

One thing I am still not clear on is the relative strength of the copper-ligand bonds and, under what conditions, they can break apart?

Organic matter has negatively charged surfaces and copper tends to associate with organic matter by adsorption or covalent bonding (e.g., Davis 1984). Adsorption is the association of a material (e.g., a copper ion) at the surface of a colloid or solid by surface complexation and electric interactions. Covalent bonding is the association of two atoms by through the sharing of pairs of electrons. For transition metals, complex stability generally follows the Irving–Williams series: $Mn^{2+} < Fe^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} > Zn^{2+}$ (Stumm and Morgan 1996). Thus, copper forms particularly strong complexes and would be less likely that other metals to dissociate with changes in chemistry. Organic complexation of copper in surface waters is generally close to 100% (Hering and Morel 1990). Furthermore, dissolved organic carbon, with its associated complexes tends to become associated with particulate surfaces and these particles settle out in low energy areas and represent a major fate process for copper. Nonetheless, the fate of copper in any particular aquatic environment is dependent on site-specific factors and therefore, consistent with the approach outlined above, we feel that the most scientifically-defensible approach is to complete a site-specific assessment using tools such as biotic ligand modelling and toxicity testing.

Water Effects Ratio:

We agree with the choice of using a Water Effects Ratio and the conclusion that the Background Concentration and Recalculation Procedures do not provide a means to determine a better site specific guideline.

While we agree with using a Water Effects Ratio test, we do not agree with the choice of a streamlined WERP (USEPA 2001). This method involves simultaneous testing of effluent (from an existing continuous discharge with known dilution ratios and water quality) and upstream water which are mixed to various dilutions in the lab and used as the simulated downstream water (i.e. site water) to be used in the spiked toxicity tests. This test does not fit the situation at Mt. Polley Mine. Canadian and BC protocols should be followed for establishing site specific objectives in this province.

The tests performed were on *Daphnia magna* (a particularly copper-sensitive species) on site water and lab water, not effluent-water mixes. USEPA (2001) was used as the

basis for focussing the WER testing. That is, in developing a WER for copper, for copper-rich discharges, the WER for sensitive cladocerans was considered highly representative. While Mount Polley is prepared to expand the WER-SSWQO development process to follow the formal BC/CCME/USEPA model of WER development (USEPA 1994; BCMOE 1997; CCME 2003), it should be noted that the intent is to derive a SSWQO for the purposes of management of effluent quality at the mine (i.e., it does not have to be enshrined for all water uses). An approach to the development of an SSWQO for copper will be included in the Workplan for 2007. Mount Polley will look for approval of that approach prior to proceeding.

The WER method is meant to establish a new site specific criterion based on site specific conditions. As per Canadian/provincial (BC) guideline establishment methods, the outcome must be protective of all aquatic life forms over the long term. The lowest resulting ratio from the toxicity testing, along with a safety factor as per Environment Canada protocol should be the basis of the new guideline. By Canadian standards, it is not acceptable to average the ratio's resulting from the toxicity testing as was done in this report (Feb WER = 5; July WER = 3.5; proposed new guideline is the geometric mean of the two results and is 4.2). The worst case scenario should be tested to yield the most conservative WER for the protection of aquatic life. The months with the lowest values for both DOC and hardness should be tested.

We agree that a SSWQO should be protective of all life forms over the long term. That is why we selected a species that is highly sensitive to copper. The BC protocol states that a final WER is calculated by taking the geometric mean for each chemical and water type. There is no clear definition of what constitutes different "water type", but Mount Polley would be willing to consider adoption of the WER associated with the worst-case water (provided that sampling times are defined *a-priori* by analysis of historical water quality [by biotic ligand modelling]). There is no need for a safety factor for the WER. Safety factors have been built into the generic criteria such that they are already conservative (e.g., note that the LC50s for *D. magna* were 95.3 ug/L and 55.4 ug/L in site water in the two tests; approximately 40 and 20 times the generic mean criterion).

If you look at the hardness and DOC data in relation to the hydrograph data for W7 (from the Mt. Polley Annual Environment and Reclamation reports) there are some interesting relationships between the drought year of 2003 (major forest fires in the region/province) and several parameters. In the summer and fall of 2003, the Hardness values rose above the regular range of ~40-~70 to the 90's and even up to 189 mg/L CaCO3 in August. This is much closer to the hardness of the groundwater in the area (180-210 mg/L CaCO3). Other elevated parameters in Aug 2003 include conductivity (June-Aug'03), Phosphorus (all forms), field pH, creek temperature, Calcium (T), Magnesium, Silicon (T), Sodium, Strontium and Vanadium. For the month of Aug, the DOC values were the lowest (3.9) in 2003 compared to all other years. However, the DOC results were among the highest (28.4) in Oct 2003, along with TSS and turbidity, when the rain finally came.

This shows the importance in addressing seasonal, as well as year to year variability as per Environment Canada protocols.

Seasonal differences in DOC were presented and discussed in the report and used as the basis for identifying the timing of the WER tests. This will be undertaken in greater detail for planning the timing of tests to be conducted in 2007 (as indicated above). It would appear that the relative quantity of surface runoff water versus groundwater has a significant impact on the water quality of Hazeltine Creek. Groundwater has higher hardness and lower DOC. Biotic ligand modelling will be use to identify a worst-case condition in terms of copper bioavailability that considers both DOC and hardness (as well as the other controlling factors incorporated into the model – pH, copper concentration, calcium, magnesium, sodium, potassium, sulphate, chloride, alkalinity and sulphide).

Graphs, Figures

- Figure 3.2:
  - Title of Figure- the time frame of 2000-2004 does not match the rest of the data sorting which includes some of the operational data (Aug'97 to Sept '01) and some of the Care and Maintenance (Oct 01 – Mar'05) data.

    Data for the DOC are from 2000-2004. DOC was not introduced as a monitored parameter until the year 2000.

  - This figure presents seasonal trends of DOC and Hardness of site W7 to support the choice of toxicity sampling times although water was collected from W6. There are only two DOC results for W6 so one cannot even compare the similarities of W6 and W7 for compatibility over time.

    Yes, we were constrained to the data available to us. However, these data will serve well under the preferred alternative of discharge into Hazeltine Creek upstream of Station W7.

  - DOC-Jan: Only 3 values (1, 6.8 5.5) for Jan in data set for W7 and two of them are from the same date (Jan 9/01 – a replicate?). There is no max value of 13.

    The analysis included some data points collected in 2005 and this should have been stated. On January 29th 2005, DOC was 12.5 mg/L and represented the maximum collected in January. The analysis of temporal trends in DOC will be updated with data collected in 2005 and 2006 for the 2007 Workplan.

  - DOC-Feb: upper bar is wrong (max is 6.7, no ~8)

    This occurred for the same reason as above; on February 21st, 2005, DOC concentration was 8.5 mg/L.

  - Hardness: Data from the entire data set was used for the hardness figure, not 2000-2004 as the title specifies. This may account for some of the errors in Jan (minimum is wrong), Feb (min. is wrong), March (min. is wrong), Sept (maximum and min are wrong), Oct (min wrong and possibly max from either

1998 or 2003) and Nov (min from 1999). Note that the 1998 value of 820.1 was not used in the Nov line indicating there was some data grading.

Yes, the title of the figure should be corrected to indicate the correct time period associated with the hardness data which was 1995 to 2004. As indicated above, the analysis of temporal trends in DOC will be updated with data collected in 2005 and 2006 for the 2007 Workplan. Although data grading was purposely kept to a minimum, extreme values that were likely to skew the data were not included in the calculation of the means.

- If the intent was to use the full data set (1995+ for hardness but only 2000+ for DOC), then the title needs to be fixed, otherwise the data needs to be fixed which will change the mean and upper and lower limits.

  As above.

- Table 3.4
  - Due to problems with the USEPA SMAV (i.e. chronic higher than acute; other water chemistry unknown), it does not seem correct to compare the LC 50 to the higher of the lab water or the SMAV (4.98 ug/L). Interesting to note that the mean acute value is 4.98 ug/L

    The USEPA SMAV is not problematic as indicated above. Furthermore, the SMAV was not used in the WER calculation because it was not higher than the laboratory water LC50 (per footnote on the Table).

  - Where does the mean LC-50 value come from in the upper table?

    The mean LC50 values represent the measured results provided in the report of toxicity test results (Appendix D).

  - The copper criterion values are based on a formula which includes hardness. How did you decide which hardness value to use?

    Hardness values are based on standard laboratory water that is designed to optimally support the test organisms. These values can be adjusted somewhat, but adjustment can result in greater mortality in controls.

- Figure 3.3
  - See comments on Figure 1 for the general questions about the data

    As addressed above for Figure 3.1.

Supporting Data

What were the inputs and results of the Biotic Ligand Model? The report says that the BLM was run using the average water chemistry from all of Mt. Polley's monitoring stations. Does this mean all sites (or only receiving water sites?) were lumped into one number per parameter? It should be run for W7 water chemistry, not a pooled data set. Where all applicable metals put into the model (i.e. the ones the model can handle?) Figure 3.4 cannot be evaluated without knowledge of the model inputs and results.

All input data and associated results were presented in Appendix D as referred to in the text and provide the data required for evaluation of the BLM results. The results presented in Figure 3.4 represent the worst-case result based on averages for Hazeltine Creek. In modelling for the identification of timing of future toxicity tests, the range of conditions encountered at W7 will be considered.

At the bottom of page 14 to top of page 15 of the Minnow report, it states the BLM results enhance the confidence in the WER that the "numbers are protective of aquatic life in the receiving environment of Polley Lake and Hazeltine creek". How can this be said for Polley Lake when there isn't any data for Polley Lake?

Hazeltine Creek water comes from Polley Lake (although the contribution of surface runoff is recognized) and, more importantly, the worst-case results from Hazeltine Creek (Stations W6 and W7) were selected and presented (which happened to be for W6 during baseline). As indicated above, since the time of report preparation, the preferred option for discharge has changed.

Existing Acute Daphnia Toxicity tests:

a. Location of water collected:

The report states that the water for the toxicity tests was collected near the anticipated point of effluent discharge. We thought that the discharge would be near W7 yet the toxicity reports report that the water was from W6. This needs to be clarified. Also, is site W6 is in the lake outlet or in the creek? When the first toxicity test was collected on Feb 28/05, was there flowing water in the creek at W6, was it frozen or is this lake outlet water? Has a water quality correlation been established between W6 and W7?

Water was collected from Station W6, which is Hazeltine Creek downstream of Polley Lake (see Figure 2.1 of the report). At that time, the concept was for discharge into Polley Lake (see the background provided at the beginning of this letter). The preferred alternative for discharge has subsequently been modified to a discharge into Hazeltine creek upstream of Station W7 and therefore, current and future focus of SSWQO development will be on Hazeltine Creek downstream of the discharge location.

b. General concerns/comments on the two existing tests:

1. Were other water samples taken for water chemistry analysis at the same time as the site water for the toxicity test? If so, how did this water (24 hr delivery to a lab) compare to the water used in the toxicity test?

Water samples collected in support of the toxicity testing were sent to Vizon SciTec and it was the water quality associated with these samples that was reported by them. There were no separate submissions of water samples.

2. When were the parameters measured at the lab: upon arrival, initiation of the test or completion of the test?

   Reponses to this, and to subsequent questions regarding the details of toxicity test methods have been addressed by the toxicity testing laboratory (CanTest, which recently purchased Vizon SciTec) and is included as Attachment 2. Additional response is provided as necessary.

3. Did the parameters change from field to the lab, or over the 48 hour duration of the test?

   As indicated above, there were no separate samples collected and therefore this could not evaluated. Future testing will include a field duplicate to be submitted to a separate analytical laboratory as well as assessment of the test water quality at the start and end of testing (and perhaps at intervals in the case of longer term testing).

4. Was the stock solution at the lab measured (water chemistry analysis) to ensure the theoretical copper concentration (from the formula) was accurate?

   See Attachment 2. Given that the measured and nominal results were very similar, it would certainly appear that the stock solution was appropriate. Furthermore, the measured results, not nominal, were used in the calculation of the WER.

5. Also, was the site water analyzed after the copper spike was added to see what level of binding was happening and what concentration of copper the Daphnia were actually exposed to?

   See Attachment 2. These measurements formed the basis for the LC50 calculations.

6. Is the LC50 result for this test based on the measured total or dissolved Copper concentration?

   See Attachment 2. Measured and nominal total concentrations were used to calculate the LC50s. In the July test, this was expanded to also include measured dissolved concentrations.

7. How was the copper ion value calculated based on the addition of a stock solution of Copper Chloride dihydrate?

   See Attachment 2.

8. Since hardness is one of the parameters affecting binding of Cu, it should be similar to the hardness of the test water. The difference between 71 and 70 (site water Feb28/05 and July 10/05 respectively) and 100 (lab water) may confound the results. This is crucial because hardness can ameliorate the copper toxicity and larger ratios may be generated by using water of 100 mg/l CaCO3 than water at the same hardness as the site water. Also, consideration should be given to the water which was used for the testing in the critical study on which the guideline was based. Otherwise, some sort of relationship between the lab test results and the critical study has to be estimated prior to establishing the WER.

   As indicated earlier, the test water used was standard laboratory water designed to support test organisms. These can be modified, with a potential risk of control mortality. A moderate reduction in hardness would likely not be problematic. However, note that the comment has the relationship between hardness and toxicity backwards. That is, toxic concentration of copper is expected to increase at higher hardness (via competition for uptake). By decreasing the hardness of the laboratory water, toxicity in laboratory water would be expected at a lower concentration, thereby <u>increasing</u> the WER. Thus, if anything, this adds conservatism to the WER. Furthermore, another option for addressing this issue (if there is concern over potential control mortality) would be to apply an established correction factor for the ameliorating effect of hardness and other key parameters (e.g., BLM-normalizing).

9. The hardness of the Feb and July 2005 tests is almost identical and is not capturing the natural variability of the system

   There is a trade-off between the effects of DOC and hardness in ameliorating copper toxicity. The approach taken in 2005 was to focus on DOC as the dominant determinant of copper bioavailability. As indicated above, in the 2007 Workplan, both will be considered in identifying the probable worst-case under which to conduct toxicity tests.

10. Is there any comparison to the original toxicity reference data set?

   It is unclear to which "original toxicity reference data set" this comment is referring. If the comment is with reference to the acute values of the USEPA (2003), the results of the testing in laboratory water (15.8 and 19.2 ug/L) were within the range reported for *Daphnia magna* (i.e., 4.8 - 71.9 ug/L unnormalized and 1.1 – 22.2 ug/L normalized to the following water: 20°C, pH 7.5, 1.0 ug/L dissolved copper, 5.0 mg/L DOC, 10% humic acid, 14 mg/L calcium, 12.1 mg/L magnesium, 26.3 mg/L sodium, 2.1 mg/L potassium, 1.9 mg/L sulphate, 81.4 mg/L chloride and 3.0 x 10^{-4} mg/L sulphide).

11. If dissolved copper is the bioavailable form of copper, why aren't the toxicity results reported as LC50 per dissolved copper unit?

   The LC50s reported in July were calculated for nominal, total and dissolved copper. In February, LC50s were calculated for nominal and total. However,

because the generic WQC is for total copper, the WER for total copper is considered to be the appropriate means of correction.

c. Feb 28/05 toxicity test:

1. This sample was received at the lab until March 1/05 but the testing didn't take place until March 5-7. We are concerned that the site water may have been compromised prior to the test. This timing exceeds the TOC (Total organic carbon) holding time of 72 hours. In "Methods for Deriving Site-Specific Water Quality Objectives in British Columbia and the Yukon" is states that "elapsed time between the collection of samples and the initiation of the toxicity test should not exceed 36 hours (Chapter 6.0 Recommended Procedures for Determining Water Effect Ratios).

   See Attachment 2. It would appear that the laboratory undertook the range-finding tests immediately after sample receipt and they state that it is not possible to initiate a definitive test within 36-h. The effect of storage time on DOC cannot be evaluated in the absence of DOC results from end-of-test. Future toxicity testing will be conducted to ensure the shortest possible time lapse between collection and testing and will include chemical analysis at the end of test as well as at the beginning.

2. There are results in the Vison (tox lab) report for total and dissolved metals of the site water but no results of the lab water. It is unclear what date these were analyzed?

   See Attachment 2.

3. Also, there are Cu results from March 5 and 10 (post-test) but I don't see results for any other parameters post-test (i.e. hardness, DOC)?

   See Attachment 2.

d. July 19/06 toxicity test:

1. Based on the total and dissolved metals results (date unknown: before, during or after the testing?), the lab (Daphnia) water has much higher values for K, Mg, Na and S. Some or all of these will affect Cu toxicity results. Again, the hardness of the lab water was 100 mg/L $CaCO_3$. How are differences in the lab water taken into account when reviewing the Cu spiking affects?

   See Attachment 2. As indicated above, the effects of hardness can be addressed using available correction factors and would eliminate a source of conservatism built into the WERs.

2. Samples were received at 10.5 degrees C. Water should be shipped on ice to keep it cool.

   We agree that samples should be maintained cool and this will issue will be addressed in future tests.

e. June 9/05 toxicity test:
This report was included in Appendix D but the results are unclear. Any known reason for the failure of this test?

See Attachment 2.

Future Toxicity testing
We recommend that a toxicity sampling program be established for this project which follows Methods for Deriving Site-Specific Objectives in British Columbia and Yukon. Further input may be taken from the Environment Canada protocols and guidelines for Biological sampling and Water Effects Ratio testing. The sampling program must address issues raised above as well as the following points.

The Canadian Water Quality Guidelines and the Provincial BC Water Quality Guidelines are based on the premise of no observable affects to aquatic life. This is based on chronic long term affects. Any changes from generic to site specific guidelines must be based on comparable chronic to chronic, not chronic to acute toxicity tests.

As indicated above, Mount Polley is prepared to expand the WER-SSWQO development process to follow the formal BC/CCME/USEPA model of WER development (USEPA 1994; BCMOE 1997; CCME 2003), and that would include chronic testing. However, it is wrong to suppose that a chronic test would necessarily result in a lower WER. In fact, in theory, if the mechanism of copper toxicity is via the free ion, then the WER should be similar regardless of the duration of the test or the endpoint (see BCMELP 1997 for specific examples of this).

The Environment Canada and BC Protocols for establishing site specific objectives should be followed. This includes acute and chronic testing, testing of a minimum of two species (one invertebrate and one fish) at their sensitive life stage, testing over seasonal variation etc..

See previous response.

Hazeltine creek does have spawning rainbow trout so chronic egg toxicity tests should be examined as an option. Ideally testing should include two life cycles to ensure reproduction of the second generation has not been compromised. The toxicity test method should address concerns with Rainbow Trout, Kokanee and Sockeye salmon egg and fry rearing life stages.

An early life stage test on rainbow trout will be examined as an option. However, there are significant constraints with respect to the timing of such tests based on the life history and generation times (i.e., according to CanTest, an EA test can only be conducted at two times of the year [May/June and November/December]). These constraints may be inconsistent with the desired timing of WER testing. In such a case, it may be more appropriate to conduct an acute test using rainbow trout and a chronic test using *Ceriodaphnia dubia*. A preferred option will be developed for the 2007 Workplan. Note that testing through two life cycles of rainbow trout is highly impractical (age at first spawn is typically 3-5 years; Scott and Crossman 1998). Mount Polley would only support toxicity tests for which standard methods have been developed.

4.0 REVIEW OF OTHER PRIORITY PARAMETERS and
5.0 REVIEW OF PREVIOUSLY IDENTIFIED PARAMETERS

The following parameters have not been reviewed in detail because of the problems associated with the data base, baseline and pooling of receiving environment data. I anticipate that the proposed guideline levels for the parameters below will change with the next version of the report. In addition, several other parameters should be listed in these two sections in the next edition of the report (see comments under priority parameters in this MOE letter).

We offer the following very preliminary comments:

Iron:
Data for the pre-operational period of the mine for Fe at site W-7 should be used to set Fe objectives, not those data collected during care/maintenance or data that have been rolled together for a number of different sites.

As indicated previously, in instances where care and maintenance concentrations were lower than baseline, use of care and maintenance data is reasonable. However, as the reviewer notes, this may change.

Note that there are two instances where the total data reported are obviously in error (04/06/1995 and 04/12/1995). With these data excluded, the resultant criterion level will likely change. There are also triplicate samples (10/16/1996) reported and included in the statistical summary. Are data from 9/16/1996 are also part of the replicate set since the Fe and turbidity/SS are strikingly similar?

These issues will be addressed in the detailed analysis of baseline data.

It is good to note that Fe will likely settle out prior to discharge. What are the logistical plans for this to happen while the mine is operating? How long will it take to settle based on existing data or other information?

Options for discharge are currently being examined by Mount Polley and include the discharge of seepage pond water rather than TSF water and the possible construction of a treatment system such as a settling pond and a passive treatment system (e.g., wetland). In a settling pond, iron can typically settle out quickly (preliminary tests by the mine suggest this could occur within 48 hours in a low-energy setting).

Phosphorus:
For phosphorus, it must be understood that the reason there is no guideline for P in streams is because there are other factors such as light that determine whether algal blooms might occur. The CCME protocol for Phosphorus should be followed to set P criteria levels.

This is understood and that is why the use of the CCME protocol was suggested (Section 4.2.2).

Limited MOE data for Polley Lake indicates that this lake is Phosphorus limited like most of the lakes in the Cariboo Region.

Nitrate:
Release of contaminants from any part of the overall mining operation is an environmental issue that needs to be dealt with. It will be interesting to look at current operational nitrate levels to see if the same high levels are observed as they were in the previous operational time frame. Is this expected to be an issue if a new polishing pond is built?

Mount Polley is aware of the issue of nitrate (per Section 5.1). It is a potential issue whenever waste rock is used in building. Mount Polley would likely not use newly blasted waste rock with in the construction of any structure that is likely to come into contact with their proposed effluent. For example, Mount Polley would use imported material for constructing the channel leading down to Hazeltine Creek.

Selenium: We agree that Se should continue to be monitored. Site specific objectives need to be based on the generic BC guidelines.

Mount Polley agrees with this on the basis that background concentrations of selenium appear to be below the generic guideline.

Sulphate:
Given recently questions about the sulphate Guideline, the ministry is doing some additional work on this topic. The approved BC guideline will stand until enough evidence causes a change to the value. Mt. Polley mine can identify species potentially impacted and perform properly designed toxicity studies on the most sensitive species used to derive the guideline.

It will be interesting to see if the additional data support the findings of Davies et al. (2003). We trust that such data can be provided when available as it bears directly on the discharge of Mount Polley's effluent. The Mount Polley Mine does not wish to conduct additional toxicity testing to specifically refute a questionable guideline.

TSS: Site specific objectives need to be based on the generic BC guidelines. It is good to note that TSS will likely settle out prior to discharge. What are the logistical plans for this to happen while the mine is operating?

Mount Polley will have a requirement to meet the Metal Mining Effluent Regulation limits of 15 mg/L (monthly mean) and 30 mg/L (maximum). This will be an operational requirement and options to meet it are being addressed as previously mentioned.

MOE SUMMARY
We anticipate some discussion around the questions and issues raised in this preliminary review letter. Once the fundamental issues such as discharge location, use of historic data for the discharge site, definition of the baseline timeframe, rules about setting benchmarks and prioritizing parameters, WER methodology and toxicity testing are sorted out, we expect Mt.

Polley Mine to submit another version of a SSWQO's report to all appropriate groups for review.

Path Forward

In response to the comments of the MOE, the following sequence of activities is proposed to support Mount Polley's application for waste discharge authorization.

1. **Revise the derivation of background concentrations**
2. **Based resultant background, revise the identification of priority parameters**
3. **Prepare an Overview of Technical Issues**
4. **Meet with stakeholders (January 2007)**
5. **Prepare a Workplan for 2007 (Terms of Reference for Technical Assessment)**
6. **Discuss and Finalize the Workplan (February 2007)**
7. **Implement the Workplan for 2007**

References

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