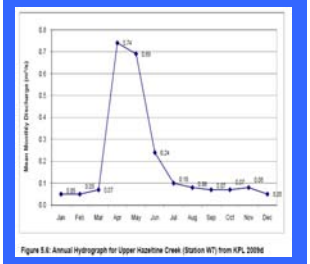

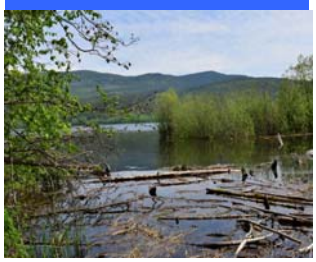

Independent Review of the Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent (2009)

Final Report June 2011

Prepared for:
T'exelc Williams Lake Indian Band
Xat'sull Soda Creek First Nations
Mount Polley Mining Corporation

Prepared by:
Brian Olding & Associates Ltd.
in association with LGL Limited

Acknowledgements

We would like to acknowledge all of the many people who helped to fulfill the purpose and goals of this project. Aaron Higginbottom who first contacted BOA Ltd. and led me through this project. Thank you to Chief Ann Louie for her guidance. Warren Fortier for his technological help and ethno botanical lessons. Byron Louie for his technological prowess. Kirk Dressler for his dependable observations. Councillor Robin Gilbert for his understanding of the land. Joanne Ramsay for her quick and thoughtful observations. Chief Bev Sellars for her thoughtful observations and guidance. Sally Sellars for her quick intelligence. Heather Mackenzie and Marg Shelley for their helpful perspectives. Kukwtsétsemc.The great guys at Mount Polley Mining Corporation who accounted very well for themselves in what many would consider a challenging situation, thank you to Tim Fisch for helping to make this project happen, Ron Martel for his inexhaustible expertise, Pierre Stecko from Minnow Environmental who worked collaboratively with BOA and LGL staff. Thank you too, to Byng Giraud, Imperial Metals, who offered thoughtful insights on more then one occasion. We received thoughtful and insightful assistance from Doug Hill, Karen Moore and Chris Swan, all from B.C. Ministry of Environment, from Susan O'Sullivan from the B.C. Ministry of Minister of Forests, Lands and Natural Resource Operations, and from Don Lawrence, Department of Fisheries and Oceans. And I will take this opportunity to personally thank the dedicated staff at LGL Ltd. who worked with BOA Ltd. on this challenging assignment. Thank you Bob Bocking, for calm leadership, Elmar Plate for quick intelligence on multi-facetted observations, Mike Demarchi for opening up the world of riparian wildlife and for caring for it, Marc Gadboury for hydrological expertise, and Jamie Fenneman for his wildlife contributions. Thank you. Kukwtsétsemc

Brian Olding & Associates Ltd.
Office: 604.531.7132
Mobile: 604.790.1948
brian@brianolding.com
www.brianolding.com
12671, 26th Ave | Surrey | BC | Canada | V4A 2K8

Front cover photos show Hazeltine Creek upstream; Hazeltine Creek annual hydrograph, Hazeltine Creek flowing into Quesnel Lake. Photos credit: Elmar Plate

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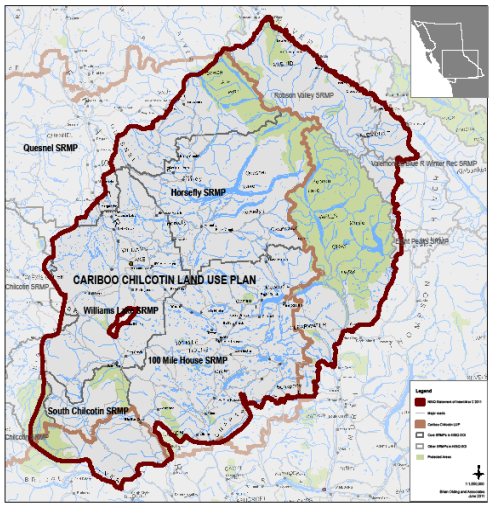
EXECUTIVE SUMMARY

Mount Polley Mining Corporation (MPMC), a division of Imperial Metals Corporation, owns and operates Mount Polley Mine (MPM) – an open pit copper and gold mine located 8 km south-west of Likely, and 56 km north-east of Williams Lake, British Columbia. A Tailings Storage Facility (TSF) is an integral component of this mine. To date, the TSF has been self-contained whereby seepage water from toe drains and surrounding collection ponds is pumped back into the TSF. From there it can be recycled back to the mine for such uses as milling and dust suppression.

The mine site has been characterized as a net precipitation site resulting in MPMC's stated need to release ~1.4 million cubic meters of effluent annually from the TSF. MPMC can continue to raise the banks of the TSF, however, they will soon need to discharge effluent from the TSF. MPMC's preferred option is to discharge effluent to Quesnel Lake via Hazeltine Creek. This will require a discharge permit from the Province. MPMC's permit application was based on the *Mount Polley Mine Technical Assessment* [TA] *Report for a Proposed Discharge of Mine Effluent, 2009*. The MPMC TA summarized mining operations, environmental studies, and water quality objectives for chemicals such as sulphate, cadmium, copper and selenium. Unlike a proposal to obtain a permit to build a new mine, a formal environmental assessment is not required to obtain a permit to discharge although a number of environmental conditions must be satisfied.

The MPM is located within the northern part of the Secwepemc te Qelmucw (NStQ) traditional territory and is within the traditional territories of T'exelc Williams Lake Indian Band and the Xat'sull Soda Creek First Nations. As part of the Province's requirement to consult, the BC Ministry of Environment, the Williams Lake Indian Band, and the Soda Creek First Nations agreed to an integrated review of the application to discharge TSF effluent. Brian Olding & Associates Ltd. (BOA) was contracted to lead this work and LGL Limited was subcontracted to BOA to assist with aquatic and biodiversity issues. A contract was drawn up whereby BOA committed to work with all Parties to:



Map of the NStQ Traditional Territory

1. conduct an independent and objective review of the TA Report on behalf of, and in the mutual interests of the T'exelc Williams Lake Indian Band, Xat'sull Soda Creek First Nations and MPMC
2. summarize any and all environmental omissions and deficiencies with respect to MPMC's proposal to discharge mining effluent to Hazeltine Creek
3. present MPMC's responses to our review comments
4. provide recommendations to remedy the situation wherever possible
5. provide a final report that explains technical issues in clear language

During the project, meetings were held in Vancouver, Williams Lake and Sidney, B.C., to report out on our findings and to seek clarification of technical issues and confirmation of interests. Representatives at these meetings included Chiefs, Councillors, and members of First Nations Mine Working Groups. Representatives from BC Ministry of Environment and BC Ministry of Forests, Lands and Natural Resource Operations participated in selected meetings. We met separately with the Parties when required and with the environmental consultants who helped

prepare the MPMC TA Report. A site visit of MPM and Hazeltine Creek provided an in-person assessment of the local conditions.

The completion of this review of the MPM TA Report was made possible through the ongoing and constructive collaboration between all Parties involved.

Our report comprises three main sections. The first section contains background information on the project; the second section covers principal issues and recommendations that emerged during our review; the third section is an appendix that presents the detailed results of our review, including principal issues and others of lesser importance, together with recommended solutions. The appendix also includes MPMC's responses to our review comments. The following principal issues were identified:

Sources of Hydrological Data for Hazeltine Creek

There is considerable uncertainty regarding the accuracy of the dilution factors for Hazeltine Creek – the receiving stream. We suggest that the source of the hydrological data be clarified or that flow data for the creek span a range of conditions that includes 2009 (average flow year), 2010 (low flow year) and 2011 (high flow year) be recalculated in order to predict a range of chemical concentrations in Hazeltine Creek following effluent discharge. A commitment by MPMC to real-time adaptive management of their effluent into Hazeltine Creek based on accurate discharge volumes should be a condition of the discharge permit.

Calculations of Effluent Dilution

Throughout the TA Report, predicted chemical concentrations in Hazeltine Creek are based on annual or monthly mean values of effluent discharge to Hazeltine Creek. This approach can mask the potential for short-lived high concentrations of potentially harmful chemicals to exceed water-quality guidelines and potentially be harmful to the aquatic life of Hazeltine Creek. To correct this in a precautionary way, maximum concentrations of chemical parameters such as Sulphate, Selenium, Copper and Cadmium need to be calculated for minimum flow rates in Hazeltine Creek.

Sedimentation in Hazeltine Creek

Sediment or associated contaminants could enter Hazeltine Creek unless there is an effective sedimentation pond between the Tailings Storage Facility (TSF) and Hazeltine Creek. As such the sedimentation/polishing pond that is mentioned in the TA Report should be a condition of the discharge permit. At the same location as the inflow to the sedimentation pond, we also suggest that a Rainbow Trout live-tank be installed to act as a continuous water quality monitoring system.

Fish Ecology and Traditional Use

The picture concerning fish ecology in Hazeltine Creek is incomplete as fish populations have only been characterized during summer. Additionally, no historical First Nation fishery data are presented for the Hazeltine-Edney Creek complex. To correct this, fish populations need to be characterized during the non-summer period and the information gap regarding First Nation fishery uses should be addressed as part of a Traditional Use Study. Finally, the occurrence of Rainbow Trout and Kokanee Salmon rearing and spawning in lower Hazeltine Creek and the still vulnerable state of Coho Salmon that spawn in Hazeltine Creek merit mentioning.

Terrestrial Biodiversity

The TA Report gives no consideration to the potential effects of effluent on terrestrial or riparian biodiversity (wildlife and vegetation adjacent to Hazeltine Creek). Although it appears unlikely that effluent discharge will have adverse effects on wildlife habitat, vegetation monitoring

plots in the riparian area of lower Hazeltine Creek should be established and monitored over time for any adverse effects of erosion and sedimentation on plant life. In light of requested revisions (above) to calculations of contaminant levels in Hazeltine Creek, the toxicological aspects of water should be thoroughly re-examined for potential to harm wildlife (i.e., amphibians, birds, mammals) and to contaminate tissues of those species typically consumed by humans (e.g., moose, black bear, grouse).

Water Quality Objectives

A range of approaches have been undertaken by MPMC to develop *Site Specific Water Quality Objectives* which would replace government guidelines. Although this approach is allowable, government approval is required before a Discharge Permit can be issued. Alternately, MPMC can opt to forgo the site-specific approach and adhere to the generic guidelines through water treatment that would lower concentrations in the TSF effluent. Water treatment suggestions offered by MPMC that could be effectively applied to the TSF effluent include lime treatment and, if it is proven to be successful on a larger scale, the inclusion of anaerobic cells which would use bacteria to break down potential effluent pollutants. This would increase MPMC's application of the precautionary approach, where required, to their environmental management plans.

Monitoring and Contingency Plans

Neither a detailed monitoring plan nor a detailed emergency contingency plan have yet been developed by MPMC. While we acknowledge that MPMC will be required to provide monitoring and contingency plans as a permit condition, it would be ideal if we were able to review such plans in advance of the permitting process. As such, MPMC should provide a detailed monitoring plan, including monitoring schedules, an outline of the involvement of the Williams Lake Indian Band and Soda Creek First Nations into the monitoring process, prior to the permit application. MPMC could also provide a detailed contingency plan in the event that effluent parameters exceed upper limits. As part of the contingency plan, MPMC should include response timelines and communication plans that include the Williams Lake Indian Band and Soda Creek First Nation.

Consultation with First Nations

There are on-going meetings and communication between MPMC and both First Nations. Nowhere in the TA Report, however, was the consultative process with the Williams Lake Indian Band or Soda Creek First Nation described. In the same context, no results of Archaeological or Traditional Use Studies for the areas potentially affected by the discharge from MPM were provided. MPMC should discuss the results of all Archaeological Studies that have been carried out so far with the Williams Lake Indian Band and Soda Creek First Nations. In addition, MPMC should work in a close partnership with these two groups on all future studies on the archaeology and traditional land use of the areas potentially affected by the discharge permit and on the direct and indirect mine footprint in general.

Ideally we would like to see an evolving relationship between MPMC and the First Nations that is collaborative, mutually beneficial, and which leads to shared decision making over those matters that directly affect the two First Nations.

Corporate Commitment

During our review, MPMC provided favourable verbal responses to many of our suggestions. We are confident that MPMC has the capacity and the desire to implement many of the recommendations made in this report. We suggest that the commitment of MPMC to work with First Nations on all aspects and phases of the project form part of the Permit conditions.

Information Gaps

The TA Report does not always present a comprehensive summary of data and information.. The following datasets and information should be made available:

1. groundwater monitoring since the start of MPM operations
2. monitoring results explaining why and how MPM causes changes to groundwater
3. a detailed discharge strategy for effluent from MPM in addition to the general statement that effluent discharge will be supply based
4. the monitoring schedule and the results of the former discharge of effluent from MPM into Edney Creek
5. the application of a modelling exercise that considers potential future changes in Hazeltine Creek discharge based on climate change

Conclusion

If MPMC (i) follows the commitments in the TA Report, (ii) implements the recommendations presented in this review, and (iii) satisfies MoE permit requirements it is highly unlikely that there will be any significant impacts to the ecological health of Hazeltine Creek or Quesnel Lake during the course of routine operations. Potential impacts on the cultural and heritage considerations along with any traditional uses by First Nations cannot be addressed at this time due to the absence of traditional use study information.

STRUCTURE AND OBJECTIVES OF THIS REPORT

This report includes an executive summary, a background section, a section on principal issues and recommendations, and an appendix containing the technical comments and recommendations of Brian Olding & Associates and LGL Limited, together with responses by MPMC.

In completing this report, we sought to satisfy the following objectives:

1. conduct an independent and objective review of the Mount Polley Mining Corporation Technical Assessment Report 2009 (the TA Report), on behalf of, and in the mutual interests of, the T'exelc Williams Lake Indian Band, Xat'sull Soda Creek First Nations and the Mount Polley Mining Corporation (MPMC)
2. summarize any and all environmental omissions and deficiencies with respect to MPMC's proposal to discharge mining effluent to Hazeltine Creek
3. present MPMC's responses to our review comments
4. provide recommendations to remedy the situation wherever possible
5. provide a final report that explains technical issues in clear language

Principal Issues

The Principal Issues focus on the main findings of this review and are presented under the following headings:

1. Sources of Hydrological Data for Hazeltine Creek
2. Calculations of Effluent Dilution
3. Sedimentation of Hazeltine Creek
4. Fish Ecology and Traditional Use
5. Terrestrial Biodiversity
6. Water Quality Objectives
7. Monitoring and Contingency Plans
8. Consultation with First Nations
9. Corporate Commitment
10. Information Gaps

Appendix

The appendix to this report contains our detailed technical comments on the MPMC TA Report. The TA Report served as the initial application for a permit to discharge effluent from the Tailings Storage Facility to Hazeltine Creek. We thoroughly reviewed the TA Report, identified technical issues associated with the proposed effluent discharge, and wherever possible, provided recommendations for remedial actions that would resolve the identified concerns. MPMC's responses, both to our specific concerns, and to the recommended remedial actions, are also provided in the appendix.

BACKGROUND TO THE INDEPENDENT REVIEW OF THE MPMC TECHNICAL ASSESSMENT REPORT (2009)

The Water Balance

Mount Polley Mining Corporation (MPMC) operates Mount Polley Mine (MPM). Hydrological studies funded by MPMC indicate that the MPM site is a net precipitation site. This means that the amount of water (precipitation) falling onto the site is greater than the amount that is (i) consumed by mining operations (i.e., production of mining concentrate, dust suppression), (ii) lost to groundwater seepage, (iii) retained in the voids of the tailings storage facility (TSF), and (iv) lost via evaporation and transpiration. Currently, the mine operates within a closed-loop system and does not have a discharge permit. To store excess water, the capacity of the TSF has been expanded annually. To address this water management situation in the near- , long- and post closure term, MPMC has identified the need to discharge excess water off-site.

MPMC currently holds Permit PE11678, originally issued by the BC Ministry of Environment (BCMOE) in 1997 and amended several times since. PE11678 requires that MPMC maintains at least 1 m of freeboard in the TSF at all times to avoid overflow and to report to BCMOE when the freeboard falls below 2 m, as a precautionary measure. Traditionally, MPMC has raised the TSF dam annually to retain all water on site. Dam-raising activities are presently underway in anticipation of conditions in 2012 and beyond. In looking ahead to a post-closure scenario, a sustainable means of discharging excess water is required because dam building cannot continue indefinitely. The annual excess of water that must be discharged in order to maintain the integrity of the TSF, and to meet TSF freeboard permit conditions, is~1.4 million cubic meters (1.4 M m^3).

During the MPM closure from 2001–2005, MPMC discharged effluent under provincial permit from the Main Embankment Seepage Collection Pond (which collects seepage from the TSF) to Edney Creek. Resumption of the small permitted discharge to Edney Creek was not a viable option to address the annual 1.4 M m^3 need for discharge, due to the smaller size of Edney Creek, and therefore its increased sensitivity to water quality impacts. The resulting capital costs required to treat and deliver the effluent to Edney Creek were also deemed by MPMC to be prohibitive.

MPMC's proposed solution is to discharge effluent to Quesnel Lake via Hazeltine Creek. The MPM effluent and run-off would originate from a variety of sources, including the TSF, the Main Embankment Seepage Collection Pond, the Perimeter Embankment Seepage Collection Pond, the Wight Pit and the Northeast Rock Disposal Site seepage via the diversion ditch. If approved, water from a combination of these sources would be conveyed to the perimeter embankment seepage collection pond and then to a sediment/polishing pond located downstream of the perimeter embankment.

Permitting

To discharge 1.4 M m^3 of effluent each year into Hazeltine Creek, MPMC requires a sustainable effluent discharge permit, issued under the *BC Environmental Management Act*, by the BCMOE. Guidelines on how a mine is directed to apply for an effluent discharge permit are set out in a series of BCMOE documents, including *Guidance On Applications For Permits* under the *Environmental Management Act – Technical Assessment - recommended content of a technical assessment report for submission by the applicant as part of the application for a permit or a significant amendmen*t. The MPMC application, *Mount Polley Mine Technical Assessment Report for a Proposed Discharge of Mine Effluent 2009*, and its Table of Contents, closely follows that guidance document.

Aboriginal Consultation

The BCMOE, is responsible for ensuring appropriate and sufficient consultation and accommodations are carried out with those First Nations that may be affected by land-use decisions. The procedures followed by the Province for carrying out this consultation are based on case law as of April, 2010, and are set out in the BC policy document *Updated Procedures for Meeting Legal Obligations When Consulting First Nations Interim 07 May 2010*.

Discussions between BCMOE and the MPMC have resulted in the proposal for an independent third party to advise the affected First Nations, in this case, T'exelc - Williams Lake Indian Band (WLIB) and Xat'sull - Soda Creek First Nation (SCFN), on the nature, implications, and any deficiencies or omissions of MPMC's application to discharge effluent into Hazeltine Creek. These Parties have engaged Brian Olding & Associates Ltd. to carry out the independent review in association with LGL Limited.

Historical Impacts on Local Watercourses

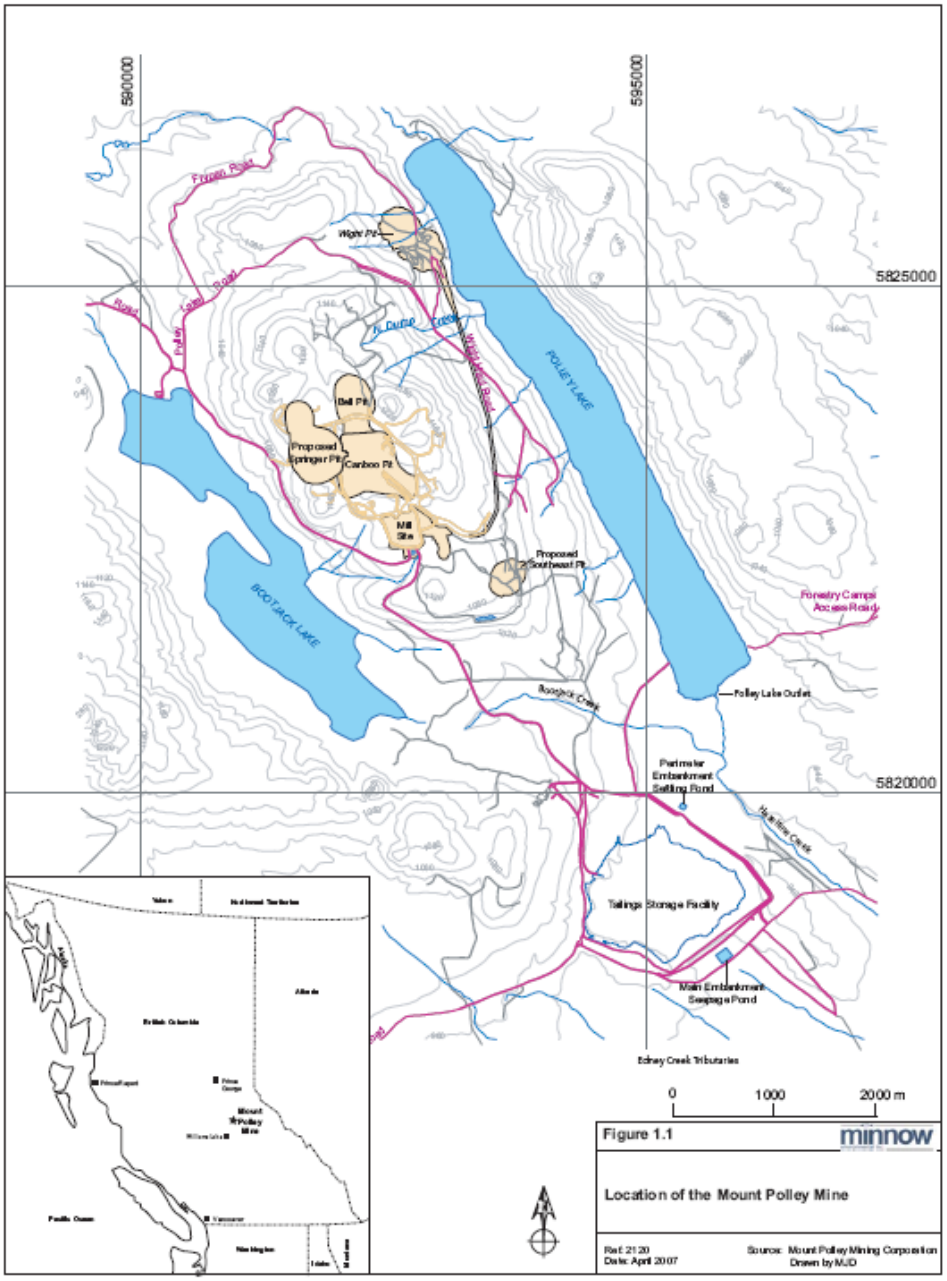
Mining in the Cariboo–Chilcotin region began during the 1861–1864 Gold Rush. Those early days were characterized by massive placer mining operations. Bullion Pit, for example, just 9 km north of MPM, involved the largest water blasting operation in North America up until that time. Numerous creeks, rivers and lakes near the MPM site, including Hazeltine Creek, were altered and re-directed from their natural flows by placer mining operations.

In 1913, flow from Bootjack Lake, which had naturally drained via Bootjack Creek into Hazeltine Creek, was reversed by damming the east end of Bootjack Lake and excavating a new outlet westward to Trio Creek to provide more water for placer operations at the Bullion Pit. This resulted in a loss of ~32% of Hazeltine Creek's natural watershed.

Additional flow to Hazeltine Creek was also blocked in 1913 when a control structure was built at the outlet of Polley Lake. The result was that the flow that naturally drained into Hazeltine Creek was reversed to Bullion Pit (see figure below). The control structure was eventually removed and flow was restored to Hazeltine Creek during WWII when mining at Bullion Pit ended.

The diversion of Bootjack Creek from Hazeltine Creek, however, was never restored. As a result, for the past ~100 years, Hazeltine Creek has continued with ~68% of historic flow levels.

Mount Polley Mine Site Layout



PRINCIPAL ISSUES CONCERNING THE MPMC TECHNICAL ASSESSMENT REPORT (2009)

Principal issues, as summarized from the detailed review presented in Appendix One, are presented below, as are recommended actions to remedy or mitigate each issue. For more detailed information on each issue, and MPMC's response to each listed issue, the reader is directed to Appendix One.

The Principal Issues identified through our technical review consist of the following:

1. Sources of Hydrological Data for Hazeltine Creek
2. Calculations of Effluent Dilution
3. Sedimentation of Hazeltine Creek
4. Fish Ecology and Traditional Use
5. Terrestrial Biodiversity
6. Water Quality Objectives
7. Monitoring and Contingency Plans
8. Consultation with First Nation
9. Corporate Commitment
10. Information Gaps

ISSUE 1: Sources of Hydrological Data for Hazeltine Creek

Hydrological data collected over a number of years are used to characterize the discharge volumes of a stream. Then, at any time of the year and for a given discharge volume, these data can be used to estimate the dilution factor of effluent that is discharged into a stream. In general, high concentrations of potential pollutants in the TSF effluent are most concentrated at low flows in Hazeltine Creek. We wish to ensure that effluent concentrations are at all times sufficiently diluted within the flows of Hazeltine Creek so as to cause no harm to the fish and to the greater ecological system within Hazeltine Creek.

When the concentrations of individual chemicals in the effluent are known (e.g., through laboratory analysis), concentrations of those same chemicals in the creek can be estimated using the dilution factor that we obtained from the hydrological data provided in the TA Report. Of course, the accuracy of this prediction is highly dependent on the accuracy of the hydrological data for the receiving stream.

There is considerable uncertainty regarding the accuracy of the dilution factors for Hazeltine Creek – the receiving stream in this case. This is because of technical difficulties that were experienced during the collection of hydrological data from Hazeltine Creek over the course of a number of years. The technical difficulties were rectified during the past year, however, this is a very short time to build up a revised hydrology database.

As a result, rather than being able to use data from Hazeltine Creek directly, hydrological data from nearby creeks with similar features were used to estimate the discharge values for Hazeltine Creek in a regionalized and comparative approach. This regionalized approach has provided a lower set of low flow estimates for Hazeltine Creek than those reported for the previous years.

Further, there is some confusion as to which data were used and how they were used to predict the concentrations of individual chemicals in Hazeltine Creek after effluent was discharged into the stream. The resulting uncertainty with regard to the flows in Hazeltine Creek must be addressed in order to properly calculate the effluent concentration when discharged to Hazeltine Creek.

Recommendation

Throughout the TA Report it is necessary to clarify which hydrological data (i.e. the earlier years of data collection, which experienced technical difficulties, or the regional study data estimation) are being used to predict the dilution factors for effluent flowing into Hazeltine Creek. If the effluent mixing model is not based on the most recent regionalized flow estimate, then the calculations must be revised accordingly.

Alternatively, the average of the reliable Hazeltine Creek discharge values measured in 2009 (average flow year), 2010 (low flow year) and 2011 (high flow year) could be used to recalculate and predict a range of chemical concentrations in Hazeltine Creek following effluent discharge. An automated and real-time discharge measurement system for Hazeltine Creek and a commitment by MPMC to real-time adaptive management of their effluent into Hazeltine Creek based on accurate discharge volumes should be a condition of the discharge permit.

ISSUE 2: Calculations of TSF Effluent Dilution

Throughout the TA Report, predicted chemical concentrations in Hazeltine Creek are based on annual or monthly mean values of effluent discharge to Hazeltine Creek. This approach is misleading because it can mask the potential for short-lived high concentrations of potentially harmful chemicals to exceed water-quality guidelines and potentially be harmful to the aquatic life of Hazeltine Creek.

Recommendation

Maximum concentrations of chemical parameters, especially Sulphate, Selenium, Copper and Cadmium in Hazeltine Creek need to be calculated for minimum flow rates in Hazeltine Creek. This will provide conservative estimations of the dilution of the effluent within Hazeltine Creek, which in turn, allows for a precautionary approach to be incorporated into the design of the TSF effluent discharge.

ISSUE 3: Sedimentation of Hazeltine Creek

During storm events (i.e., high run-off), the potential for suspended sediments and contaminants associated with those sediments to affect Hazeltine Creek will be high unless there is an effective sedimentation pond between the Tailings Storage Facility (TSF) and Hazeltine Creek.

Recommendation

The sedimentation/polishing pond that is mentioned in the TA Report, as a potential treatment measure, should be a condition of the discharge permit. In addition to reducing suspended sediment discharged into Hazeltine Creek, the sediment/polishing pond will also be an essential part of the MPM Contingency Plan. If, through regular monitoring, TSF effluent at the inflow to the sedimentation pond is found to exceed permitted values, MPMC will have a two-day buffer to shut down discharge into Hazeltine Creek and can instead pump effluent back into the TSF.

At the same location at the inflow to the sedimentation pond, we also suggest that a Rainbow Trout live-tank be installed to act as a continuous water quality monitoring system. Through daily monitoring and maintenance, abnormal mortality would be immediately detected; discharge from MPM into Hazeltine Creek could be stopped and water quality could be tested. This would be an effective response to the uncertainty included in the hydrological database for Hazeltine Creek.

ISSUE 4: Fish Ecology and Traditional Use

Fish populations in Hazeltine Creek have only been characterized during summer periods, and have not been characterized during winter periods. We need to know, for example, whether

salmonid juveniles are present during low winter flows in Hazeltine Creek. Additionally, no historical First Nation fishery data are presented for the Hazeltine–Edney Creek complex.

Recommendation

To complete the annual picture, fish populations need to be characterized during the non-summer period. In addition, the TA Report should acknowledge the occurrence of Rainbow Trout and Kokanee Salmon rearing and spawning in lower Hazeltine Creek and the still vulnerable state of Coho Salmon that are spawning in Hazeltine Creek.

The information gap regarding First Nation fishery uses should be addressed as part of a Traditional Use Study for the area around the MPM lease.

ISSUE 5: Terrestrial Biodiversity

Only impacts to fish are considered in the MPMC TA Report and no consideration is given to the potential effects of effluent on terrestrial or riparian biodiversity (wildlife and vegetation adjacent to Hazeltine Creek).

Recommendation

Although it appears unlikely that effluent discharge will have adverse effects on wildlife habitat (assuming actual discharges are consistent with predicted levels), plant life monitoring plots in the riparian area of lower Hazeltine Creek should be established and monitored over time for any adverse effects of erosion and sedimentation on plant life. It would be useful to pair such plots with plots in the riparian zone of an adjacent stream (e.g., Edney Creek).

In light of requested revisions (above) to calculations of contaminant levels in Hazeltine Creek, the toxicological aspects of water should be thoroughly re-examined for potential to harm wildlife (i.e., amphibians, birds, mammals) and to contaminate tissues of those species typically consumed by humans (e.g., moose, black bear, grouse).

ISSUE 6: Water Quality Objectives

The discharge of effluent into natural systems is regulated through generic British Columbia Water Quality Guidelines (BCWQG) where a maximum discharge concentration or a Water Quality Objective is listed for each parameter. Those Objectives are based on a background conditions that can influence the toxicity of a parameter. For example, Cadmium is more toxic in soft water than in hard water (water hardness is determined primarily by Calcium and Magnesium levels). Accordingly, more Cadmium can be safely discharged into a natural system with harder water than into one with softer water. The BCWQG allow for these Site Specific Water Quality Objectives because the conditions of a natural system are taken into consideration when calculating water quality.

A range of approaches have been undertaken by MPMC to develop *Site Specific Water Quality Objectives* (or discharge concentrations) which would replace both the generic BC Water Quality Guidelines and the Canadian Council of Ministers for the Environment (CCME) Water Quality Guidelines. The development of site specific water quality objectives is a common and acceptable practice. In this case, Site specific Water Quality Guidelines have been developed by MPMC for sulphate, cadmium, copper and selenium, all of which have the potential to exceed the generic BC Water Quality Guidelines. The BC Ministry of Environment and the Department of Fisheries and Oceans must review these methodologies, particularly in view of the uncertainty of the hydrological database used to predict effluent concentrations in Hazeltine Creek. The consent of these agencies is required before a Discharge Permit may be issued.

Recommendation

MPMC can opt to forgo the application of Site Specific Water Quality Guidelines and adhere to the generic BC Water Quality Guidelines through water treatment that would lower concentrations in the TSF effluent by running the effluent through water quality treatment systems before the effluent is discharged to Hazeltine Creek. Water treatment suggestions offered by MPMC that could be effectively applied to the TSF effluent include lime treatment and, if it is proven to be successful on a larger scale, the inclusion of anaerobic cells which would use bacteria to break down potential effluent pollutants. This would increase MPMC's application of the precautionary approach, where required, to their environmental management plans.

ISSUE 7: Monitoring and Contingency Planning

At this point neither a detailed monitoring plan nor a detailed emergency contingency plan have been developed by MPMC. While we acknowledge that MPMC will be required to provide monitoring and contingency plans as a permit condition, it would be ideal if we were able to review such plans in advance of the permitting process.

Recommendation

MPMC should provide a detailed monitoring plan, including monitoring schedules, an outline of the involvement of the Williams Lake Indian Band and Soda Creek First Nations into the monitoring process, prior to the permit application. MPMC could also provide a detailed contingency plan in the event that effluent parameters exceed upper limits. As part of the contingency plan, MPMC should include response timelines and communication plans that include the Williams Lake Indian Band and Soda Creek First Nation.

ISSUE 8: Consultation with First Nations

Nowhere in the TA Report was the consultative process with the Williams Lake Indian Band or Soda Creek First Nation described. In the same context, no results of Archaeological or Traditional Use Studies for the areas potentially affected by the discharge from MPM were provided.

Recommendation

MPMC should discuss the results of all Archaeological Studies that have been carried out so far with the Williams Lake Indian Band and Soda Creek First Nations. In addition, MPMC should work in a close partnership with these two groups on all future studies on the archaeology and traditional land use of the areas potentially affected by the discharge permit and on the direct and indirect mine footprint in general.

Ideally we would like to see an evolving relationship between MPMC and the First Nations that is collaborative, mutually beneficial, and which leads to shared decision making over those matters that most directly affect the two First Nations. We commend both parties for the strong efforts made to date, on both sides, that have enabled a common understanding and resolution to issues associated with the application for discharge

ISSUE 9: Corporate Commitment

During our review, we experienced the verbal commitment of MPMC to respond to reasonable suggestions made for change wherever possible and practical. We have the confidence that MPMC has the capacity, and the desire, to respond effectively to many of the recommendations made in this report.

Recommendation

We suggest that the commitment of MPMC to collaboration with and inclusion of First Nations into all monitoring programs, the application of precautionary principles to the recommendations made in this report, and the commitment to adaptive management in the post-permit environment, should be put into writing as part of the Permit.

ISSUE 10: Information Gaps

The TA Report does not present, in every case, a comprehensive summary of data and information necessary for a complete assessment of adverse effects from the discharge of the TSF effluent to Hazeltine Creek. Additionally required information is listed below.

Mitigation Recommendation

The following datasets and information should be made available in order that a proper evaluation of the TA Report be conducted:

6. groundwater monitoring since the start of MPM operations
7. monitoring results explaining why and how MPM causes changes to groundwater
8. a detailed discharge strategy for effluent from MPM in addition to the general statement that effluent discharge will be supply based
9. the monitoring schedule and the results of the former discharge of effluent from MPM into Edney Creek
10. the application of a modelling exercise that considers potential future changes in Hazeltine Creek discharge based on climate change

APPENDIX

TECHNICAL REVIEW OF THE MPMC

TECHNICAL ASSESSMENT REPORT (2009)

TECHNICAL REVIEW OF THE MPMC TECHNICAL ASSESSMENT REPORT (2009)

The following technical review comments on the MPMC Technical Assessment (TA) Report (2009), follow the structure and order of the TA Report. Comments are introduced by subject matter and are referenced by page number from the Report and / or from the Appendices. Comments of particular relevance are highlighted in bold.

The following documents, listed in the Appendices to the TA Report, were found to be particularly useful:

- Minnow Memo, Jan 19 2007 (Baseline database; page 279)
- Minnow Letter, Feb 15, 2007 (Analysis of historical Data; page 1137)
- Knight Piésold Letter, Apr 14, 2009 (Hydrological issues and regionalization study; page 247)
- Knight Piésold Letter, May 15 2009 (Chemical characterization of the effluent; page 368)
- Knight Piésold Letter and Appendices, Jun 25 2009 (Effluent plume delineation; page 458)

Statutory Basis for Permit (TA Report Page 2)

The TA Report states that the Technical Assessment has been submitted to BCMOE to support an application for an amendment of Permit PE-11678 under the Waste Discharge Regulation (WDR) of the BC *Environmental Management Act*.

The WDR identifies those industries that are *subject* to the BC *Environmental Management Act.* The Permit is issued directly under the BC *Environmental Management Act*.

First Nation Consultation (TA Report Page 3)

The TA Report states that First Nation Consultation is required under the WDR. This is incorrect. A Consultation Report is required by BCMOE as explained in its *Guidance on Applications for Authorizations* under the *Environmental Management Act* - consultation - *Recommended activities for the applicant to take prior to submitting an application for a permit, significant permit amendment or an approval. 2008*. This is a policy requirement which is related to the BC government wide First Nation consultation policy - *Updated Procedures for Meeting Legal Obligations When Consulting First Nations Interim 07 May 2010*, which in turn is based on First Nation consultation case law as of April 2010.

MPMC response (Ron Martel):

MPMC submitted consultation report as required by BCMOE as explained in its Guidance on Applications for Authorizations under the Environmental Management Act to MOE in August of 2009

End of MPMC comment

Mine Development Certificate (TA Report Page 5)

The TA Report states that in April 1996, Imperial Metals formed the Mount Polley Mining Corporation and then goes on to say that the Mount Polley Mining Corporation received a Mine Development Certificate in October 1992. The chronology is inconsistent. Further, there is no reference in the TA Report to any Mine Review Development Process documents or other environmental assessment works.

MPMC response (Ron Martel):

> The Mine Development Certificate was received in 1992, while in 1996 a name change to Mount Polley Mining Corporation occurred.

Record of Mine Development (Appendices Page 298)

In the early days of MPM development, fishery compensation measures were identified by the MPMC. Namely, a dam and a diversion channel to make Edney Creek falls passable to migratory fish was apparently flagged and planned and other measures were suggested. Why were these measures abandoned?

MPMC response (Ron Martel):

> The measures were abandoned on the basis that another option was selected including fresh water withdrawal from Polley Lake complete with mitigation measures to maintain fish passage flow, upgrade of Bootjack Dam, annual inspections of such dam, Edney Creek biological monitoring and draining re-routing to the Tailings Storage Facility after 5 year period.
>
> *End of MPMC comment*

Mount Polley Mine Operations (TA Report Page 6)

The TA Report states that that the mineral resource estimates have been expanded for areas that have not yet been proposed to be mined by MPMC. Will this mine shut down in 2014 or will it be kept open and expanded if copper and gold prices keep increasing? If this is a potential scenario, it should be included into the TA Report. The status of any underground mining currently underway or planned in the future should be identified.

MPMC response (Ron Martel):

> Reserves and estimates are a function of market value and exploration results, at the time of the report the expected mine life extended into 2014, currently it is 2015.
>
> *End of MPMC comment*

Mill Process Concentrate Chemicals (TA Report Page 7)

The following reagents listed below are among those used in the MPM mill concentrating process:

Reagent	Purpose	Approximate Consumption	LC 50 or Biodegradability
Potassium Amyl Xanthate (PAX)	Collector	38 g/tonne	Rainbow Trout 96 h 18-75 mg/l (MSDS Sheet for Substance)
Sodium Diethyl Dithophiosphate	Collector	1 g/tonne	No information found, please provide
Methyl IsoButyl Carbinol (MIBC)	Frother	4 g/tonne	Biodegrades at a rate of 94% in 20 days, acute toxicity only at very high concentrations

The TA Report states that the reagents used in the mill process at MPM are predominantly consumed by the concentrate and shipped to the smelter; residual reagents are transported to the tailings storage facility with the slurry where they biodegrade.

We added applicable LC50 values for Rainbow Trout (*Onchorynchus mykiss*) and biodegradability values to the table above and are asking that technical support be provided to defend the statement that the residual reagents biodegrade in the TSF, to describe the

biodegradant products, and to explain why the reagents are not required to be included in the effluent monitoring discharge conditions.

MPMC response (Ron Martel):

Please have a look at the information below:

PATHWAYS AND PROCESSES

PAX (potassium amyl xanthate): Not as readily biodegradable as other reagents (<70%) but the majority is carried from site with concentrate, and therefore does not remain in the water system.

NaSH (sodium hydrosulphide): With dilution, which occurs in the tailings pond, the sulfide will be readily incorporated into the pre-existing natural sulfur cycle

MIBC (methyl isobutyl carbinol): Readily biodegradable, therefore it can be rapidly and completely removed from water and soil environments. Approximately 70% is readily biodegradable within 28 days. Not likely to accumulate in the food chain (bio-concentration potential is low)

TOXICITY OF REAGENTS USED AT MPMC

PAX (potassium amyl xanthate): The lethal concentration for Daphnia Magna ranges from 0.1-1.0mg/L. On an annual bases, based on water use and production, Mount Polley produces a value of approximately 7 mg/L. NOTE! The vast majority of this will actually bind to the concentrate solid and will not be found in the water that is sent to the tailings pond

NaSH (sodium hydrosulphide): The minimum lethal concentration for Daphnia has been reported to be 300mg/L. On an annual bases, based on water use and production, Mount Polley produces a value of approximately 13mg/L

MIBC (methyl isobutyl carbinol): Similar to butyl alcohol. The lethal concentration for Daphnia Magna is >100mg/L. On an annual bases, based on water use and production, Mount Polley produces a value of approximately 5mg/L

TOXICITY RESULTS AT MPMC: Daphnia is a species of freshwater flea that is widely used in toxicity testing. Over *50 acute toxicity tests* have been performed at Mount Polley using *Daphnia magna* (LC50/48hr. Daphnia Magna). All but one of these tests had a result of zero mortality; the one exception occurred in 1998 when an LC50 of 80% effluent was reported

End of MPMC comment

Status of the TSF (TA Report Page 8 / Appendices Page 366)

The TA Report discusses the ongoing build up of the TSF to accommodate increased runoff and effluent levels, but does not discuss the current status of TSF freeboard, the current integrity of the TSF, or the current potential impact of TSF seepage on groundwater resources. This omission needs to be corrected.

MPMC response (Ron Martel):

Freeboard is a requirement of MOE and MEM; groundwater sampling is conducted annually and is reported in the Annual Report submitted to the above agencies, local libraries and First Nation groups.

End of MPMC comment

Toe-drain flows show that the increase of the level in TSF is mainly based on sediment that has been added at a rate of about a total of 8 m from 2000–2008. If the future trend follows this trajectory, then, presumably, the TSF embankment walls need to be increased by about 6–8 m

before closure to retain the same volume of water. Alternatively, the sediment needs to be dredged from the TSF. Which option will be chosen and is the remaining volume of the TSF at mine closure large enough to contain the increased flow of water once all of the operational water recycling and usage will be terminated?

MPMC response (Ron Martel):

The option selected is the ongoing annual stage dam construction.

End of MPMC comment

It is mentioned that water discharge into Edney Creek was permitted from 2001–2005. Was the aquatic community monitored during this time period and if so, were any significant changes noted?

MPMC response (Ron Martel):

Yes, Morrow 2002 no aquatic community effects were measured.

MPMC response (Pierre Stecko):

Morrow & Azimuth completed an aquatic assessment in 2002 (during care and maintenance) scoped down to focus on the NE tributary of Edney Creek (W8) (Morrow/Azimuth 2003). Conclusions:

Water → no Water Quality Guideline exceedences

Sediment → only manganese was elevated, but at BOTH exposed (W8) and reference (W9)

Benthos → "no evidence of impacts to aquatic biota in the NE tributary of Edney Creek (W8), the nearest station downstream of the TSF." "Furthermore, the presence of fish and frogs in both habitats also provides assurance that these habitats are relatively healthy."

End of MPMC comment

Potential Acid Mine Drainage from Waste Rock (TA Report Page 9)

The TA Report barely describes the MPM operational practices with regards to Acid Mine Drainage (AMD). How is MPM testing the AMD potential? Was kinetic testing carried out? The sub-aqueous disposal of Potentially Acid Generating (PAG) rock is a good practice as long as permanent submersion is guaranteed and the necessary volumes of rock can be stored this way. It would be desirable to see the results of "humidity cell" or kinetic exposure tests (if existing) and to identify long-term planning with regards to storage and treatment for all PAG waste rock to properly assess future AMD potential for the MPM.

MPMC response (Ron Martel):

Yes, 11 kinetic test are currently running and the data is summarized and submitted annually to OE and MEM, local libraries and First Nation groups.

End of MPMC comment

Environmental Management Systems (TA Report Page 9-10)

The TA Report states that MPMC follows Environment Canada's *Environmental Code of Practice for Metal Mining*, however, the Code does not address long term responsibility for mining properties. The Code does recommend that mines develop Environmental Management Plans (EMPs), however the TA Report does not present, at this point, an EMP (objectives, targets, monitoring plans) and does not address here liability for long term management. All of these issues should have been addressed in the Mine Development Review Process and the

Environmental Assessment Certificate Application for the mine. A reference to these legally binding documents should be provided by MPM.

MPMC response (Ron Martel):

The reports are filed at MPMC environmental department.

End of MPMC comment

The TA Report states that a third party review was carried out for the TSF in 2008. Please provide either the review or a reference for the review.

MPMC response (Ron Martel):

In 2006 Amec performed a third party Dam Safety Review in accordance with the Canadian Dam Safety Association.

End of MPMC comment

Water Quality Sampling Protocols (TA Report Page 11)

The water quality values are reported as annual means, which provides inadequate description of the effluent quality. Values should include means and maximums based on the seasonality of the Hazeltine hydrograph. Note that the federal Metal Mining Effluent Regulations require weekly sampling, average monthly monitoring values, as well as maximum recorded values. Please show monthly values for each parameter for at least the 2005–2011 period graphed with the respective lowest guideline value as a reference line.

MPMC response (Pierre Stecko):

The annual mean data were intended to provide a general picture of water quality. Water quality data can be presented at different time scales to capture high flow / low flow differences and potential seasonal variability.

The reported value for mean concentrations of 0.011mg/L dissolved phosphorus is incorrect in the TA Report, and should read 0.015mg/L, as per Table 2.4

Hazeltine Creek Hydrology (TA Report Page 14-15 / Appendices Page 247-278)

The TA Report describes the MPMC activities involved in monitoring the hydrology of Hazeltine Creek from 1995 to present, and provides, for example, a flow range of 0.05 m^3/s in the winter (December through February) to 0.74 m^3/s in April, and a greatest observed flow of approximately 3.1 m^3/s in April 1996.

The history of attempting to describe the hydrology of Hazeltine Creek, however, has been complex and fraught with methodology issues (see the succession of letters from Knight Piésold Consultants to MPMC and, in particular, the letter dated April 14, 2009, Appendices Page 247-278). Incorrect use of reference datums used to establish river levels, and subsequent river flows, the absence of winter monitoring, weir leakage at the monitoring site, and most significantly, repeated annual movement of fixed staff gauge due to frost jacking, have seriously undermined the historical continuity and defensibility of the Hazeltine Creek hydrological data set.

These errors have now been recognized through documentation by Knight Piésold and discussion with MPMC and apparently have been addressed, **but there remains, nonetheless, an absence of a long-term high quality stream flow dataset for all months of the year for Hazeltine Creek.** In order to address this, Knight Piésold undertook a series of regional analyses studies on streams which had accurate long-term flow measurements. This is the normal fall-back position when stream flows must be estimated in the absence of direct, accurate measurements.

There is a discrepancy in the average monthly flows reported in the Knight Piésold Ltd. memo (2009b in App. E) between the regionalized estimates for Hazeltine Creek (Station H7; 27.6 km^2) shown on page 254 and the 'Long-term' estimates shown in Table 5.

Table 5

Month	Regionalized Estimate (m^3/s)	Table 5 Value (m^3/s)
January	0.015	0.05
February	0.024	0.05
March	0.070	0.07
August	0.020	0.08
September	0.018	0.07
October	0.022	0.07
November	0.041	0.08
December	0.018	0.05

The Table 5 values were subsequently used in the TA Report. Also, using the regionalized estimates instead of the Table 5 values results in a different estimate for Mean Annual Discharge of 0.17 m^3/s rather than the 0.19 m^3/s as reported. The origin of the Table 5 values is not described and the rationale for using the Table 5 values in the MPMPC (2009) is not explained. **Of particular concern is why the effluent mixing model is not based on the latest regionalized flow estimates rather than the Table 5 values.** The TA Report should address these discrepancies, their significance to effluent dilution and the steps MPMC has since taken to correct and adjust their proposed discharge to the corrected, estimated hydrological data for Hazeltine Creek.

MPMC response (Ron Martel):

> The difference in Mean Annual Discharge translates to a difference of approximately 600,000m3 annual, (this maybe within error of natural variability, however we will check).
>
> *End of MPMC comment*

In addition, water flow in Upper Hazeltine Creek, in relation to the Lower Hazeltine Creek, is calculated in the TA Report based on watershed size and then compared to measured values. A large difference exists between the calculated and the measured values and the difference is not discussed. This adds more uncertainty about the reliability of discharge values given for Hazeltine Creek. Please explain the discrepancies.

The Fate of the Flow that is currently re-directed from North Dump Creek into the MPM Diversion Ditch

Currently MPMC is re-directing part of the flow of North Dump (and several other smaller creeks that used to run into Polley Lake) into the MPM diversion ditch. The TA Report does not mention any mitigation measures for these diversions (e.g., as part of a closure plan). At this point, it is essential that the current water table and the mine closure plans for all changes made to the natural flow of creeks are disclosed and discussed. This is made even more important by the fact that MPMC is applying for a discharge permit into Hazeltine Creek and Hazeltine Creek

water quantity and quality are directly influenced by changes to water quality or quantity in Polley Lake.

MPMC response (Ron Martel):

This is a closure plan issue.

End of MPMC comment

Groundwater Flow Assessment and Modelling

At this point an assessment of the groundwater flow around Mount Polley Mine has either not been conducted or not been presented. Either way, the assessment of the potential effects of the whole mine on the adjacent aquatic environment needs to be seen in the context of the groundwater flow and the potential added subsurface discharge. We therefore recommend a groundwater flow modeling exercise that delineates the local hydrogeological units and their spatial boundaries and that predicts potential subsurface flow paths direction and magnitude.

MPMC response (Ron Martel):

Reported in Annual report.

End of MPMC comment

Fish Habitat (TA Report Page 17)

The TA Report states that while lower Hazeltine Creek does not currently represent ideal spawning habitat for fish, nonetheless, the site has very good potential to function as salmon spawning habitat (i.e., good substrate characteristics that could be accessed with greater flow and/or the elimination of obstruction). Therefore, increased flow from the proposed effluent discharge would likely be beneficial over the period from July through February. This would augment flow towards historical levels (i.e., pre-diversion of Bootjack Creek), thereby increasing the amount of functional habitat available to fish and their invertebrate food base in addition to improving accessibility to fish. This may be true but the statement should contain the caveat that in order for the effluent discharge to be beneficial, the net impact of the effluent discharge be benign to salmon in Hazeltine Creek.

MPMC response (Ron Martel):

OK, fair comment.

End of MPMC comment

Receiving Water Quality (TA Report Page 18 / Appendices Page 279)

Note that the review of the initial Baseline water quality (see Appendices Page 279 – Minnow Environmental Inc. Memo to R. Martel from P. Stecko, Jan19, 2007) was found to contain errors and this was then corrected by removing suspect data entries. The TA Report states that comprehensive baseline studies were carried out for 'Mount Polley creek' [sic]. Presumably the reference is to Hazeltine Creek.

MPMC response (Pierre Stecko):

This appears to be a misunderstanding as the whole sentence reads "Baseline studies included comprehensive assessment of Mount Polley creek and lake water quality" … lower case "creek" and "lake" refer to all creek and lake habitat in the vicinity of Mount Polley. There is no Mount Polley Creek and this is not referring only to Hazeltine Creek, rather to the entire baseline dataset.

Although it would be great to have more data over a longer period, the baseline data did include 13 creek stations and 199 water quality samples.

End of MPMC comment

There is no comprehensive baseline database for Hazeltine Creek. The entire baseline database consists of 17 water samples taken over 8 years, is presented below:

Baseline database for Hazeltine Creek

Status	Year	Sampling Dates	# of Samples
Pre-mining	1989	May 2 / Jul / Aug / Sep / Oct /	6
	1990	Mar 1 /	1
	1995	Mar 1 / Apr 3 / May 1 /	5
	1996	Oct 5 /	5
Total			**17**
Note:	no triplicates, poor hydrographical coverage		

We will simply note here, that the fact that total Copper exceeds the BCWQGs may be due to a watercourse draining an undisturbed mineralized area, as the TA Report states, but the historical disturbance of this region over the past 100 years must also be recognized, so that higher Copper levels may be a relatively recent phenomenon for salmonids who have presumably been present for much longer periods of time.

The memo referred to above (Appendices Page 279) to R. Martel from P. Stecko states:

> 'One concentration for zinc (0.006 mg/L on March 17, 1990) was screened in on the basis of being different than all other recorded concentrations (<0.005 mg/L), but is not considered an outlier due to the very small difference and the fact that it was only screened in due to an artificial absence of variability.'

This sentence would benefit from a clarification of 'the artificial absence of variability.

MPMC response (Pierre Stecko):

> The protocol stipulated that outliers were identified as data points that exceeded 3 Standard Deviations (SD) of the stations mean. For zinc, most data points were <0.005 (used as 0.005 for calculations) and therefore, the SD was very low, but ARTIFICAL because the SD constrained by the Minimum Detection Limit (no variability below Minimum Detection Limit captured!) Accordingly, it did not make sense to exclude the 0.006 mg/L result.

End of MPMC comment

Further in that memo (Appendices Page 279):

> 'In order to determine whether there were meaningful differences among years (e.g., due to site disturbance), baseline data were assessed in two ways. Firstly, mean concentrations from each year were contrasted statistically using Analysis of Variance (ANOVA). Statistical testing could only be performed for parameters that were detectable.'

Why was statistical analysis carried out on mean annual variation on such a limited database, and what would the mean annual values represent? Note that the data are not presented in high flow – low flow analysis.

MPMC response (Pierre Stecko):

Data were being evaluated to assess their acceptability as baseline. That is, the question was being asked "do the concentrations differ among years", which might suggest a potential influence of site activity (in 1996) on water quality, which in turn would cause rejection of the data as baseline.

End of MPMC comment

Also note in Table 3.4 that the BCWQG aquatic life 30-day for total copper is reported as 0.002 mg/L. This is in contradiction with Knight Piésold Letter to R. Martel from R. Perin, 15 May 2009, where the BCWQG aquatic life 30-day for total copper is reported as 0.004 mg/L. See the discussion under Predicted Effluent Quality P.30-34.

MPMC response (Pierre Stecko):

Response to the approach to the hardness-dependence of the BC Water Quality Guidelines for copper will be provided later in this document.

The TA Report states:

'Since mine start-up in 1997, Mount Polley Mine has implemented a comprehensive water quality monitoring program that includes source areas (the TSF and settling/seepage ponds), surface drainages (i.e., runoff from the mine-site that does not include mine or mill water) and receiving waters (Figure 3.5; Table 3.2).'

End of MPMC comment

We could not find monthly monitoring results for Hazeltine Creek in the TA Report and therefore we cannot review the low flow and high flow water quality characterization of Hazeltine Creek. Table 3.2 reports that monthly monitoring is carried out for upper Hazeltine Creek W7, and that this is supplemented with 5 weekly samples in both spring and fall. But the data are not available and are instead presented as annual means in the subsequent tables.

MPMC response (Pierre Stecko):

Data are available, but too much to include in the report.

End of MPMC comment

Receiving Water Quality (TA Report Page 19)

The TA Report refers to 'baseline and routine monitoring'. To what do these terms refer? Table 3.4 does not report the number of samples for the Baseline database. This should be corrected.

MPMC response (Pierre Stecko):

Baseline = before mine operation.

End of MPMC comment

Receiving Water Quality (TA Report Page 20)

Cadmium is reported as non-detectable in Table 3.7. BC laboratories (e.g., ALS Labs in Burnaby) are capable of routinely going down to 0.01 ug/L and can, for an increased charge, go further down to 0.005 ug/L. MPMC should ensure they are detecting all heavy metals in their sampling and analytical protocols.

MPMC response (Ron Martel):

MPMC currently measures Cd at 0.000017 mg/L

The TA Report states that overall MPMC has effectively characterized the water chemistry of Hazeltine Creek. This statement must be tempered with the limited baseline database, the

presentation of parameters by annual means rather than high flow – low flow means and maximums, and, in some cases, overly high detection limits provided by laboratories used by MPMC.

Our main concern with the Hazeltine Creek monitoring program is that is has not been presented in a low flow – high flow format. We are unable, therefore, to compare effluent loadings with average low flow conditions. The design of the post-discharge monitoring program will require the inclusion of effluent loadings at low flow periods for Hazeltine Creek. At this point, we will therefore be able to compare conditions while water will be discharged from the mine with general and site specific water quality objectives, but we will not be able to compare these conditions with pre-discharge low flow conditions.

MPMC response (Ron Martel):

We will follow up.

End of MPMC comment

Receiving Water Quality – Sediments (TA Report Page 22)

The discussion on sediments does not provide a clear picture of the sampling protocols used or of the number of samples taken, either in the TA Report or in the Appendices. The concluding statement in the TA Report on sediments, states that:

> 'the monitoring conducted in 2007 provides quantitative data that can be used in the future as a baseline against which potential effluent-associated influence can be determined.'

Why is the reference only to 2007 and not to the previous years? **The fate and deposition of sediments originating in the MPMC effluent discharge, their potential deposition within the Hazeltine Creek watershed, and their potential impact on plant uptake and wildlife consumption, should be considered here.**

MPMC response (Pierre Stecko):

There were some unusual methodologies applied in 1995 (coffee can sampling, sieving using a 230 mesh sieve) AND the 2007 design was based on evaluation of AREAS rather than STATIONS (1995/1999/2002), which is compatible with future Environmental Effects Monitoring needs. Therefore, it is suggested that future evaluation is via a statistically robust Before-After, Control-Impact (BACI) design versus 2007 data. We are not suggesting that previous data should be ignored.

End of MPMC comment

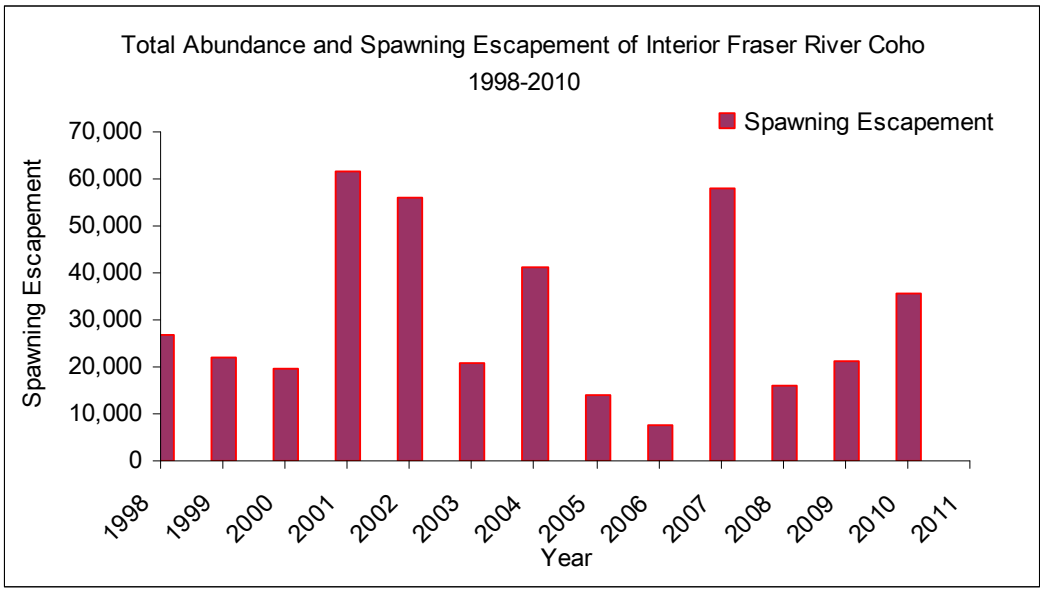
Fisheries (TA Report Page 22-23)

It is advisable to add winter sampling to the fish sampling protocol to assess whether salmonid juveniles also use Hazeltine Creek for overwintering when they are under heavy physiological stress and often show the highest mortalities observed in freshwater (Peterson 1982).

Kokanee Salmon are apparently observed to spawn annually in Hazeltine Creek (Don Lawrence, DFO Williams Lake, pers. comm.) throughout October and should therefore be added to Table 3.11.

Based on the same phone conversation with Mr. Lawrence, Rainbow Trout may not only populate Hazeltine Creek in a downstream direction from Polley Lake but also enter Hazeltine Creek for rearing from Quesnel Lake. Genetic analysis could verify this assumption or the assumption should be considered by MPMC and mentioned in the TA Report.

Escapement of the Interior Fraser Coho Salmon population is described as "stable or potentially increasing" in the TA Report and in the same sentence it is stated that "most recent escapement results for Coho salmon have been positive". Unfortunately, this is not true. As shown in the graph below (data from DFO Williams Lake), at this point the trend for the last 13 years is not positive, neither is it stable. It has varied by a factor of up to nine, with no clear overall trend.



MPMC response (Pierre Stecko):

The statement was pinched from COSEWIC (2002) … BUT refers to North and South Thompson → "Spawner numbers in the North and South Thompson watersheds peaked in the mid-1980s, declined rapidly until about 1996, and have been stable or potentially increasing since then". POINT ACCEPTED.

End of MPMC comment

Options Evaluation / Preferred Option (TA Report Page 26)

Table 4.1 makes no mention or consideration of the impacts on on-going traditional use by First Nations in the area. Reference should be made to side-table discussions currently taking place between the WLIB, SCFN and MPMC.

MPMC response (Ron Martel):

MPMC will perform Traditional use study.

End of MPMC comment

Description of the Preferred Option (TA Report Page 27)

Note that Table 4.1 states, as one of the reasons for selecting the option to discharge to Hazeltine Creek:

'-no compensation - no destruction of fish habitat, mitigation - treatment for sediment only'

which recognizes the necessity to treat the sediment in the proposed effluent discharge. **The sediment/polishing pond is proposed as the solution for the treatment and is described in some detail.** Note that the TA Report states that:

> **'The elevation of water in the sediment/polishing pond has been designed to match the elevation of the overflow culvert in the PESCP, so that the existing pumping system of the PESCP can be utilized to pump water back from the sediment/polishing pond should the water quality exceed the discharge limits.'**

The response to exceeding the BCWQGs, at this point, depends on the functioning of the sediment/polishing pond. Note that we have concerns with the MPMC sediment sampling program as stated above.

MPMC response (Ron Martel):

> Please explain your concern in detail, we believe stopping and pumping back is a viable option to mitigate non-compliance.

End of MPMC comment

In addition to the contingency plan suggested in the TA Report, we would like to add a recommendation to the approach that may satisfy remaining environmental and socio-economic concerns.

1. The well designed and thought out sedimentation pond and the option to pump back water into the TSF "should the water quality exceed the discharge limits" have to be part of the passive water treatment system and part of the permit application.
2. To demonstrate best practices and a precautionary approach by MPM, a small holding basin for juvenile Rainbow Trout could be positioned in the flow that is entering the sedimentation pond and would need to be monitored as part of the daily routine. This way, water quality changes that are harmful to Rainbow Trout could be immediately detected and based on the two day water retention time in the sedimentation pond, potentially harmful water would never enter Hazeltine Creek. Instead water from the sedimentation pond could be pumped back into the TSF until water testing would be carried out and the water quality could be improved to excepted discharge limits.

MPMC response (Ron Martel):

> Please give us an example for such a system, need a reference, need to talk to MOE.

End of MPMC comment

Technical Assessment of Discharge to Hazeltine Creek (TA Report Page 29)

The TA Report states that after consultation with the mine's consultants, regulators, local communities and First Nations, there are two principal impacts on the receiving environment: the physical impact from increased flow caused by the addition of the effluent discharge to Hazeltine Creek, and the chemical impact on water quality caused by the effluent discharge. Anecdotal evidence, however, suggests that the area in the vicinity of the discharge site may have been traditionally used which may lead to an aboriginal cultural impact. An investigation of traditional uses would clarify this potential issue.

MPMC response (Ron Martel):

> MPMC performed an Archeological study at the proposed discharge site, with no evidence of aboriginal pit houses. However the point is acknowledged and MPMC will perform a traditional use study.

End of MPMC comment

Predicted Effluent Quantity (TA Report Page 30)

Will Knight Piésold's recommendation of an Anaerobic Biological Reactor as part of the water treatment system (AR 335) after closure be implemented?

MPMC response (Ron Martel):

Any treatment option would be implemented as a contingency measure should MPMC not meet effluent discharge limits.

End of MPMC comment

Predicted Effluent Quality (TA Report Page 30)

The hydrology for high flows for the last ten years should be reviewed to determine any trending towards extreme precipitation events which may be caused by climate change. It is possible that planning for potential higher discharge flows during high flow periods will be required.

MPMC response (Ron Martel):

Discharge volume requirements are a function and are directly related to annual precipitation events and quantities. Therefore, it is anticipated that higher discharges would occur only at higher flows.

End of MPMC comment

Predicted Effluent Quality (TA Report Page 31 / Appendices Page 378)

The TA Report states:

'Concentrations of the ten parameters of potential concern were evaluated relative to receiving environment quality guidelines (Table 5.2; Figures 1 to 10 in KPL 2009e; Appendix H), which indicated that Sulphate, Cadmium, Copper and Selenium were the only parameters whose predicted "most probable" concentrations exceed British Columbia water quality guidelines for the protection of aquatic life.'

Table 3.4 reports the BCWQG aquatic life 30-day for total Copper as:

0.002 mg/L

Knight Piésold (AP378) reports the BCWQG aquatic life 30-day for total Copper as:

0.004 mg/L

Table 5.2 reports the BCWQG aquatic life 30-day for total Copper as:

0.006 mg/L

These inconsistencies require correction and the methodology for calculating the BCWQG, based on local conditions, explained clearly and explicitly as we move through differing scenarios. It is understood that ambient hardness will limit the uptake of copper in the effluent, but the TA Report is unclear, with respect to these three values for the copper BCWQG, as to which values are being used for hardness.

MPMC response (Ron Martel):

The difference BC Water Quality Guideline values for copper reflect the hardness as the BC Water Quality Guideline is hardness-dependent. The footnotes state the assumptions. The only error is in the Appendix where the 30-day for copper at specified hardness of 165 (footnote 18) is wrong (0.004 and 0.007); it should be 0.007 and 0.018 mg/L (30-d and max).

End of MPMC comment

The TA Report states that there is no expectation that discharged effluent would meet water quality guidelines. This should be explained, particularly in so far as the TA Report repeatedly refers to the sediment/polishing pond treatment system. There are only four outcomes available: either the effluent meets the BCWQG, or the treated effluent from the sediment/polishing pond meets the BCWQG, or a site specific WQO is developed, or some combination of these options is utilized. The TA Report is unclear about how MPMC is proceeding at this particular stage of the TA Report.

MPMC response (Pierre Stecko):

> Guidelines apply in the receiving environment, not in effluent! That is, they are intended to apply in Hazeltine Creek after the mixing of effluent. Effluent quality limits will apply to effluent (as in the existing permit).

End of MPMC comment

Predicted Effluent Quality (TA Report Page 32)

The TA Report states:

> 'During the second operational phase, some high method detection limits for cadmium were reported (up to 0.0008 mg/L in 2007; Figure 5.2), impairing comparison of source concentrations to BCWQG. Method detection limits have since been lowered.'

This statement begs the question on detection limits. What portion of the database has been affected by a change in detection limit protocols?

The TA Report should clarify the water body being referred to when supplying hardness numbers, as in the discussion on Copper. It is unclear when the baseline for Hazeltine Creek is being used or when the predicted hardness of the effluent is being used.

Is it known why TSF copper concentrations have gone down in the second operational phase. Is MPMC confident that copper levels will remain low?

MPMC response (Ron Martel):

> Copper concentrations is a function of pH, there is strong evidence from geochemical properties of our waste sources indicating that copper concentrations will remain at its current concentrations or perhaps a little higher.

End of MPMC comment

Predicted Effluent Quality (TA Report Page 33)

We note that the database consists of only two Selenium samples.

And it is stated, once more, that the sediment/polishing pond will improve the effluent discharge concentrations.

MPMC response (Ron Martel):

> We have new and more recent water quality data supporting the above statement.

End of MPMC comment

Conceptual Discharge Strategy – Hydrology (TA Report Page 34/App: Page 256)

The understanding of the Hazeltine Creek hydrology, and of the low-flow period in particular, is critical to understanding the chemical effects of the effluent discharge. The TA Report states that:

> 'Minimum flow in Hazeltine Creek typically occurs from August through February (0.05 to 0.08 m^3/s; Figure 5.6).'

More importantly, there is no reference here to the Knight Piésold letter to R. Martel from C. Butt, 14 April 2009 that review the inadequacies of the MPMC hydrological monitoring program, and which stated that 'there is an absence of long-term high quality stream flow dataset for all months of the year in Hazeltine Creek'.

Knight Piésold's regionalization studies compared Hazeltine Creek with other gauged rivers within the region in order to estimate what the Hazeltine hydrological regime might be. The results of the regionalization study produced significantly lower flows that are reported on page 34 of the TA Report. **The revised regionalized flow estimate for August, for example, is 0.020 m^3/s, and not 0.08 m^3/s,** as is reported in Fig. 5.6, as is described by the Hazeltine hydrograph. The TA Report states that options for discharge are based on the Hazeltine Creek hydrograph, but does not state whether these data are based on the discredited historic baseline hydrology or on the revised regionalized hydrological estimates.

The TA Report should be updated to determine how close these regionalized estimates are when compared to monitoring since April 2009.

MPMC response (Ron Martel):

> Agreed

End of MPMC comment

Conceptual Discharge Strategy – Hydrology (TA Report P. 35 / App: P. 254-255 / App: P. 138)

Table 5.4 provides various discharge and resulting effluent mixing scenarios. Under the Constant Discharge scenario, the TA Report states that February is the lowest monthly flow (0.024 m^3/s) for Hazeltine Creek. This is in contradiction to the Knight Piésold regionalization estimates which show December as low as September (0.018 m^3/s) and January even lower at 0.015 m^3/s.

Under the "Proportional to Flow" scenario, the flow regime is subdivided into three discreet time frames; Year-round, April–October, and May–August. These timeframes are suboptimal because they miss isolating the low flow periods; rather, they mix high flow and low flow periods so that we do not know the predicted mixing ratios during the lowest flows of the year (and therefore the highest effluent concentrations) in Hazeltine Creek. For example, during the reported lowest flows (minimum of <0.0001 m^3/s, TA Report Page 34) in August and September, the majority of flow in Hazeltine Creek would come from the MPM discharge. At that time, water temperatures are high and the high Phosphorus concentrations alone would likely lead to explosive growth of filamentous algae that could easily smother the eggs of up to 1,600 Sockeye Salmon that are reported to spawn in the lower Hazeltine Creek (Don Lawrence, DFO Williams Lake, pers. comm.) from late August through September.

MPMC response (Pierre Stecko):

> These concerns can be addressed in the development of the final discharge strategy from the "conceptual" discharge strategy. It may be warranted not to discharge at all in low flow months.

End of MPMC comment

We have concerns that the hydrological data may not have been used and interpreted correctly, and (ii) the use of a blended flow analysis for effluent discharge is not appropriate. Therefore, we are not confident that the effluent plume has been accurately characterized. The report must address this.

MPMC response (Ron Martel):

> Agreed, in very low periods Mount Polley would not discharge effluent, MOE needs to establish a discharge to receiver dilution ratio based on the information provided. We can update the conceptual discharge strategy with updated hydrology information. (look at bottlenecks)

End of MPMC comment

Fish Habitat (TA Report Page 38)

The TA Report predicts that the increase in Hazeltine Creek base flow may increase its suitability as fish habitat. This will be true only if, among other conditions, water quality is suitable for all life stages of fish. **As stated above, the high concentrations of phosphorus alone will be deleterious to fish habitat** – especially during lowest annual flows from August to October. Thus, this prediction is not helpful in characterizing the potential effects of increased discharge during low flow periods and as such, should be omitted or qualified.

Temperature (TA Report Page 40)

It is unclear in the TA Report as to whether the temperature section was based on the revised hydrological analysis of Hazeltine Creek. If not, then the calculations will have to be revised and will also need to account for effluent discharge cooling treatment methods.

MPMC response (Pierre Stecko):

> The temperature section was based on old hydrology and would require updating with any refinement of hydrology required.

End of MPMC comment

Temperature (TA Report Page 41)

The TA Report states that:

> 'Some natural elevations in temperature to greater than optimal for incubation (and less frequently rearing) have occurred. …it would be desirable to mitigate any effluent-associated increase in temperature by constructing works such that effluent temperature is as close as possible to that of Hazeltine Creek.'

Given that the low flow conditions in Hazeltine Creek may be less than initially considered (i.e., accounting for revised regionalization studies), the TA Report should speak to this implied recommendation regarding the mitigative benefits of physical works.

Also, the increase of temperatures during low flows in August and September (a daily minimum of 0.0001 m^3/s TA Report Page 34), when the majority of flow in Hazeltine Creek would be from discharge from MPM, has not been considered. Further, even a small but consistent increase in winter water temperature will shorten the incubation period for Sockeye and Coho Salmon eggs and early hatching can lead to the temporal mismatch between the need to feed following emergence from the gravel and the availability of food items. This temporal mismatch has been cited as a reason for high initial mortalities in plankton-dependent fish species (Winder and Schindler 2004). For example, a 0.5°C increase in water temperature (from 4°C= incubation period of 250 days to 4.5°C=222 days) over the whole period from spawning to emergence from the gravel for Sockeye Salmon, will shorten the incubation period by ~11% or in the chosen example by ~28 days. Similar changes can be expected for Coho Salmon.

Figure 3.8 in the TA Report shows a constant three-month 0°C period. We speculate that this was a result of the temperature logging device being frozen in ice rather than being in the water where it belonged. This data set should be confirmed.

Assessment of Potential Chemical Impact (TA Report P. 42 / App: P. 458-467+481-491)

The TA Report must present information confirming whether reagents used in the mill concentrating process will subsequently biodegrade within the TSF.

MPMC response (Ron Martel):

> Both Acute and Chronic tox testing are requirements of the federal and will be part of the Provincial monitoring requirements
>
> *End of MPMC comment*

This section may require revision, given that the low flow situation in Hazeltine Creek may be less than initially considered due to the revised regionalization studies. It is unclear as to which set of flow estimates are being utilized here.

Note that in the discussion of the CORMIX model, it is recognized that there may be deposition of sediments along the path of the plume. These potential depositional areas should be delineated.

The report states that the CORMIX model is conservative, in part, because it has not accounted for the withdrawal of sediments in the sediment/polishing pond.

Use of the CORMIX model is intended to model the effluent plume from the discharge location into Hazeltine Creek, to the location of complete mixing with Hazeltine Creek water, and then to determine the dilution of parameter concentrations as the plume moves down Hazeltine Creek and into Quesnel Lake. Models are not, however, the real world. They are useful when used conservatively to estimate ambient conditions but must be verified by *in situ* sampling to test and to calibrate the model. Palmer, for example, in *Water Quality Modeling: A Guide to Effective Practice, 2001*, advises to reduce the estimated in-stream dilution factors by 50%. This would have significant implication for the MPMC's estimates of the concentration of the key parameters at points along each reach of the Hazeltine Creek.

MPMC response (Pierre Stecko):

> Mount Polley Mining Corporation intends to apply an adaptive approach that will provide real feedback on performance. However, the modeling results are considered best estimates slanted slightly to the conservative side (most probable concentrations generally selected as greater than average, some attenuation in the sediment/polishing pond and the receiver likely).
>
> *End of MPMC comment*

A rigorous ambient monitoring program will need to be in place in order to validate and calibrate the CORMIX model.

This assessment has been based on the Year-Round Supply-Driven scenario in Table 5.4. Where in the TA Report is the decision taken, and the rationale explained for making the decision, that the Year-Round Supply-Driven scenario is the preferred effluent discharge strategy?

Tables 5.11 and *5.12* are incorrectly referenced (based on predictions of Knight Piésold 2009f – which refers to a geomorphologic study) and should be referenced to *Knight Piésold 2009e - Chemical Characterization of the Proposed Effluent for Discharge to Hazeltine Creek*.

In the discussion on the development of the copper WQG the TA Report states:

> Although this evaluation does not rely on this effect of induced hardness, it is based on real, well-characterized amelioration of metal cation toxicity by hardness.

This statement requires explanation.

MPMC response (Pierre Stecko):

> Hardness (reflecting calcium and magnesium concentrations) is known to reduce the bioavailability and toxicity of copper by competition at the site of uptake (e.g., the fish gill). Simply stated, the more Ca, Mg and other competing ions, the more difficult it is for copper to bind to a site of translocation into the cell. The 3 "C"s – Concentration, Complexation and Competition determine copper bioavailability and toxicity, not just Concentration.

End of MPMC comment

Site Specific Water Quality Objectives (TA Report Page 43)

Note in Table 5.11 the BCWQG for Molybdenum is provided only for the protection of aquatic life and does not include the wildlife BCWQG of 0.05 mg/L.

Again, the report does not provide guidance on which hydrological dataset has been used to come up with these effluent parameter mixing ratios.

Nowhere in the report are highest potential concentrations of Sulphate, Cadmium, or Copper given in relation to the lowest observed flows during the August to October period where the flow in Hazeltine Creek can be as low as 0.0001 m^3/s (TA Report Page 34). During these low flow periods, the supply driven discharge may not decrease at the same rate as the flow in Hazeltine Creek. Instead monthly average values are used to calculate maximum effluent percentages and all chemical parameter concentrations. High mortalities of fish can be based on a daily increase in concentrations of chemical parameters and monthly averages as shown in Table 5.11 are not suitable to describe the risk of acute toxicity to fish or other organisms.

Sulphate (TA Report Page 43-46 / Appendices Page 481-491)

Site Specific Water Quality Objectives (SSWQO) development approach – hybrid site specific

We would like MPMC to provide the formula and assumptions (including the discharge model and hydrological values for the data provided in Table 5.11), by using, for example, Sulphate concentrations in Hazeltine Creek in March.

Knight Piésold reports that Sulphate values are trending upwards during the second (i.e., current) operational phase, yet this observation is not present under the Sulphate discussion in the TA Report. It appears that the recent mining of the Wight Pit led to increases in Sulphate concentration and it would therefore be helpful to see the most up to date water quality results from 2009 to date.

The graphical representation of the effluent plume (such as utilized by Knight Piésold in Appendices Page 481-491, where it is evident that the BCWQGs are not met until over 4000 meters downstream) is very useful here in order for the reader to grasp the concept of the plume moving downstream. This graphic could be developed for all parameters that exceed BCWQGs after discharge to Hazeltine Creek and should show the BCWQG and the MPMC WQO.

MPMC response (Pierre Stecko):

> Example calculations and graphics can be provided.

End of MPMC comment

Note that when the TA Report states:

> ' . . .even if maximum Sulphate concentrations (160 mg/L, Table 5.11) occurred simultaneously with low Chloride concentrations (3.0 mg/L; Table 5.11), effects (be they osmotic stress or toxicity) would not occur.'

The 'maximum' concentrations of Sulphate are based on the "Most Probable Concentration" of Sulphate in the effluent, which, as we have seen, is trending upwards.

The toxicity methodology for Sulphate (site water bioassays and whole effluent from the seepage pond bioassays) differs from the discussion for Cadmium below, where Water Effect Ratios (WERs) were calculated to determine the difference between spiked laboratory water and site water from Hazeltine Creek. Why does this discussion differ from the WERs discussed below for cadmium? And why is there no discussion of seasonal testing for Sulphate toxicity?

MPMC response (Pierre Stecko):

> The testing for sulphate focused on evaluating the site-relevance of test results supporting the BC guideline (which we believe is flawed; see also Davies et al. in cited in the report and Elphick et al. 2011). The Water Effects Ratio approach for copper evaluates the mitigation of copper bioavailability by site water (which was shown in baseline studies using complexation capacity and is supported by concentrations of dissolved organic carbon).

End of MPMC comment

MPMC mentioned that it is currently undertaking research in the MPM tenure area in collaboration with UBC to study and test a bacterial based sulphate water treatment system. This is a very positive initiative and it would be helpful to find out whether the initiative was successful and whether the MPM discharge water quality could be improved using this treatment option.

All of the stated LC50 values for different organisms stated in Table 5.13 correspond to the commonly accepted LC50 values that can be found in the peer-reviewed literature and reviews published by the BCMOE. The suggested SSWQO of 500 mg/L for Sulphate still appears to be too high since it is based on Chloride being present at known and controlled concentrations additions in the discharge water to reduce Sulphate toxicity. In light of the results shown in Table 5.16 A, Hazeltine Creek Site Specific Water Quality Objectives should be based on the Lowest Observed Effect Concentrations (LOEC) of around 200 mg/L for sulphate if a precautionary approach is used and without precise knowledge of daily Chloride fluctuations. As stated before, monthly average discharge rates are not suitable to calculate maximum expected concentrations of chemical parameters in Hazeltine Creek.

Disagree that all the studies are "accepted". See references above. The results of 2 studies underlying the guideline cannot be reproduced or were simply measuring something other than sulphate toxicity.

MPMC response (Pierre Stecko):

> The model predictions in Table 5.11 (which will be re-run and may change somewhat) show monthly mean receiving water sulphate concentrations of up to 160 mg/L and chloride concentrations as low as 3.0 mg/L. However, as concluded in the report … even choosing the lowest chloride (which does not co-occur with highest sulphate) and even calculating the No Observed Effects Concentrations (NOEC) (which underestimates an effect concentration) gives 510 mg/L. Note that an MATC is often used to define the effect threshold (Maximum Acceptable Toxicant Concentration = geomean [NOEC, LOEC]). At 3.0 mg/L chloride, the MATC is 721 mg/L.
>
> One problem is that the "effect" really seems to be more related to the stress associated with low chloride than with sulphate toxicity per se. The mine is not contributing to the low chloride, rather is projected to increase chloride somewhat. If naturally low chloride causes ionic stress, we would expect sensitive organisms (such as Hyalella) not to occur.
>
> Having said all this, another approach that might be useful (and may address the concern expressed above) is to apply what we have learned to propose a chloride-dependent

objective for sulphate using the equations in Figure 5.13. For example, using the MATC as the objective, at chloride of 0.5, 1, 2, 3, 4, and 5 mg/L, the sulphate objective would be 269, 444, 619, 721, 793 and 849 mg/L sulphate, respectively. This would provide better assurance of no "effect" at low chloride.

End of MPMC comment

Cadmium (TA Report Page 46)

SSWQO development approach – WERs plus not yet approved CCME WQG

The TA Report states:

> 'At mean hardness of Hazeltine Creek in 2008 (91 mg/L; Table 3.5), the applicable 30-d BCWQG is 0.00003 mg/L, and at the expected hardness range with discharge (122 to 218 mg/L; Table 5.11), the 30-d BCWQG would range from 0.000039 to 0.000065 mg/L (Table 5.11).'

but we wish to know the minimum annual values of hardness for Hazeltine Creek in order to calculate a conservative estimate of the effect of cadmium on the receiving environment. The report, however, presents cadmium as annual average values based on annual ambient hardness.

Cadmium (TA Report Page 47)

The TA Report references the CCME Water Quality Guideline under development for cadmium, which allows for 7 times the concentration of cadmium in receiving waters. BCMOE needs to approve the CCME guideline currently under consideration. It appears that the BC MOE may not adopt the new cadmium water quality guidelines even if they will be adopted by the federal DOE since apparently major flaws were found in the underlying review. To be sure that the permit application will not be rejected based on the described approach to Cadmium discharge, we would recommend an approach that will meet existing WQG for Cadmium such as water treatment with lime.

MPMC response (Ron Martel):

MOE to decide, MPMC will develop a solution.

MPMC response (Pierre Stecko):

This puts the BC MOE in the position of not really having a defensible guideline for cadmium as the OLD one was the OLD CCME guideline which the Environment Canada, CCME and other provinces are saying is outdated. The US Environmental Protection Agency has a cadmium guideline that is consistent with the NEW CCME guideline. At the end of the day, we are making a technical argument and feel that the new CCME guideline is better supported by the state of the science. Application of a 10-fold safety factor may have been a valid approach when toxicological data were sparse, but that is no longer the case and the approach is overly conservative (and this inaccuracy has substantial economic implications).

End of MPMC comment

Copper (TA Report Page 47)

MPMC is suggesting to develop Site Specific Water Quality Objectives through calculations of site specific Water Effect Ratios.

Note that the Water Effects Ratio calculations are based on the most probable concentration for copper in the effluent (Table 5.2) as 0.009 mg/L, while the maximum predicted concentration is 0.020 mg/L. Using the maximum values would put the copper concentrations very close to the Site Specific Water Quality Objectives calculated through Water Effect Ratios. Note also, that as is common practice, the Water Effect Ratios were averaged and do not represent the lowest

case. And further, note that the real low flows in Hazeltine Creek **are** lower than those calculated in the TA Report. As a result the effluent plume could exceed the Site Specific Water Quality Guideline.

And as stated before, the Site Specific Water Quality Objective is based on mean annual hardness values for Hazeltine Creek while monthly fluctuations are not considered.

Selenium (TA Report Page 51)

MPMC is suggesting to develop Site Specific Water Quality Objectives for Selenium and will monitor accumulated Selenium concentrations rainbow trout ovarian tissue.

http://www.setac.org/sites/default/files/SELSummary.pdf is a good backgrounder from SETAC, 2009.

The SETAC 2009 referenced in the TA Report states that:

> 'Se requires site-specific risk assessments, including adequate quality assurance and quality control of chemical and biological analyses, to a much greater extent than many other contaminants.'

The TA Report states that a detailed Selenium monitoring program is provided in Section 8. This is incorrect. A general outline of selenium monitoring program is provided without any detail.

Selenium (TA Report Page 52-53)

Note that the focus for Selenium concentration testing should be on depositional environments where Selenium is most easily taken up into the food chain at the bacterial biofilm interface. Also note that Selenium has the tendency to accumulate in plants and can therefore be readily transferred through grazing into the terrestrial ecosystem.

The report states that:

> 'Thus, the predominantly erosional (lotic) characteristics of Hazeltine Creek present a lower risk of potential selenium associated effects than would an environment that supports longer residence times and microbial activity.'

This is a liberal characterization of Hazeltine Creek, which has at least three known depositional areas, namely the two beaver dams, and the wetland area at the lower Hazeltine reach.

MPMC response (Pierre Stecko):

> Not really, dominant just refers to the fact that erosional habitat is more common than depositional. That is not to say that there is no depositional habitat in Hazeltine Creek. Sediment monitoring (for Selenium) has been included in previous chemical/biological assessments and will likely be in the future.

End of MPMC comment

Beaver dams are typically used by juvenile Coho Salmon and juvenile Rainbow Trout for rearing and associated feeding on benthic organisms (Pollock et al. 2004) which in turn directly feed on the biofilm. Thus the highest degree of bioaccumulation from bacteria to benthic organisms will certainly occur. The benthic organisms will in turn be consumed by juvenile Coho Salmon (Mundie 1969), Chinook Salmon (Herrman 1970) and Rainbow Trout (McPhail 2007). Therefore a precautionary approach is appropriate and adherence to the "broadly protective" BCWQO of 0.002 mg/L appears reasonable. We also feel that ovarian tissue sampling may be added to a monitoring project but is not sufficient in describing the Selenium concentrations in Hazeltine Creek water. Regular testing of the discharge for selenium will be required to adequately describe the up to date adherence to guidelines while testing of ovarian tissue may introduce an unacceptable time delay.

The TA Report states that the current BCWQO of 0.002 mg/L appears to be broadly protective and the report lists five recent studies that support this limit. However, the TA Report then states that it is better to use a tissue-based guideline (20 mg/kg dry ovary weight) derived from unpublished studies, and provides for a multi-compartment monitoring program.

MPMC response (Pierre Stecko):

> Note that the results of the Pellston workshop have been published. As clearly articulated in the preliminary SETAC document cited in 2009, there is broad scientific consensus that: 1) ovary concentrations are the only true way to predict the potential for adverse effect and 2) water concentrations do not predict ovary concs. The ovary effect THRESHOLD identified is 17 to 24 mg/kg depending on species
>
> The scientific uncertainty around selenium is explicitly acknowledged in the report and we feel that we are being honest an open about this. Again, our approach has been to make best possible information available to the decision makers, and believe that the uncertainty should not prohibit discharge provided the correct safeguards and feedback mechanisms are put in place.

End of MPMC comment

All that we know at this point is that the predicted Selenium concentrations in Hazeltine Creek will be three times the 'broadly protective' BC Water Quality Objective. This is based on the most probable concentration (0.016 mg/L) in the effluent. The maximum concentration is almost double this concentration (0.028 mg/L). As is the case for Sulphate, it also appears that the recent initiation of mining in the Wight Pit may have increased the discharge concentrations for Selenium. Can you please provide up to date water quality results of the discharge from MPM?

There is an absence of certainty here on how much selenium may be taken up into the food chain prior to MPMC identifying the uptake and what the appropriate response would be once such uptake was identified.

We do not know the partitioning of Selenium between the water column and the associated sediments, which argues for a protective approach to Selenium. This may include the need for sediment removal from the effluent prior to discharge.

Whole Source Water Testing (TA Report Page 53–54)

The TA Report rightfully states that no acute toxicity effects were observed during testing on Rainbow Trout and Coho Salmon embryos in water from the TSF and MESCP. Nevertheless, the report also states on that in chronic testing on Rainbow Trout through the embryo-alevin-fry stages in water from the MESCP resulted in survival drops from 87% in control water to 70% in 50% effluent.

The TA Report states that:

> 'By comparison, it is anticipated that final effluent will be of better quality than tested due to the ameliorating effect of the sediment/polishing pond.'

Note, that once more, note the reference to the sediment / polishing pond.

Integrated Chemical Assessment Summary (TA Report Page 55)

The intense assessment and development of site specific water quality objectives, as presented in the TA Report, is recognized.

The hydrological database on which the calculations of the parameter concentrations are, in part, based, is not reported (i.e., are the lower regionalized estimates for Hazeltine Creek utilized here?).

The most probable concentration, and not the maximum concentration, is used to characterize the effluent.

The use of Water Effect Ratios for Copper needs to be reviewed by BCMOE, DFO and DOE.

The use of the not yet approved CCME WQG for cadmium needs to be reviewed by BCMOE.

The complete tissue based objective for selenium needs to be reviewed by BCMOE, DFO and DOE.

Summary (TA Report Page 57)

The TA Report refers to 'some' decrease in survival of Rainbow Trout alevin when tested in effluent – the reported date resulted in survival drops from 87% in control water to 70% in 50% effluent.

MPMC response (Pierre Stecko):

Note that effluent concentration in Hazeltine Creek will be lower than 50%

End of MPMC comment

Mitigation (TA Report Page 59-60)

Note that temperature mitigation is suggested by MPMC with reference to withdrawing effluent discharge from the lower (and therefore cooler) portion of the sediment/polishing pond.

What does the TA Report mean by '*In addition to the minimization of effluent volume and optimization of effluent quality*'?

MPMC response (Ron Martel):

If required minimizing effluent volume or concentrations in order to protect the environment are departmental objectives and / or key performance indicators.

End of MPMC comment

There are no chemical impact mitigation measures reported in the TA Report, other than what may be associated with the sediment/polishing pond.

The TA Report states that MPMC will make use of intense receiving environment monitoring by adapting its management of effluent discharge, but no details are provided for how this adaptive management will be executed, other than to refer to contingency measures.

MPMC response (Ron Martel):

Likely a potential permit condition that MPMC will comply with.

End of MPMC comment

Monitoring and Contingency Plans (TA Report Page 63)

The TA Report states that consensus among stakeholders about the appropriateness of the detailed monitoring plan will be sought following the issuance of the discharge permit. Although comments can still be included before the operational start of the permit, we believe that it would be helpful to provide a detailed monitoring plan, as may be feasible at this point, to assess the seriousness of MPMC's claims to apply best practices and a precautionary approach.

MPMC response (Ron Martel):

We need to know what is real, and adapt accordingly. We need to adapt to terms and conditions (given by MOE as permit conditions).

End of MPMC comment

Conceptual Contingency Plan (TA Report Page 64)

The TA Report does provide the outline for a conceptual contingency plan, but does not provide the details of the contingency plan. What is the timeline, for example, of receiving a report on water quality conditions that exceed the Permit conditions, which then requires re-sampling, additional analysis, and then requires an operational response to the situation with the appropriate form of adaptive management? This must be provided prior to a Permit becoming operational.

MPMC response (Ron Martel):

> (We) need to measure performance first before real and meaningful contingency plans are formulated
>
> *End of MPMC comment*

Terrestrial Biodiversity

Only impacts to fish are considered in this report and no consideration is given to the potential effects of effluent on terrestrial or riparian biodiversity (wildlife and vegetation). This is not to say that there will necessarily be adverse effects on those features, but even in such cases where no effects are likely, the TA Report should state this to be the case. Consideration should be given to:

- potential scouring of riparian vegetation due to increased water flows
- potential for direct toxicity to wildlife that use the water for drinking or through biomagnifications in tissues of riparian plants, fish, and invertebrates that are used as food for wildlife and livestock
- potential for alterations to plant community structure, and resulting ecological communities, through changes in the water chemistry, temperature, and concentration of pollutants
- potential for significant alteration or destruction of the beaver ponds that occur downstream along Hazeltine creek, which could impact entire wetland ecosystems
- potential sedimentation into beaver ponds due to increased sediment load, which could impact aquatic organisms (invertebrates, beavers, waterfowl, etc.)

No baseline information has been provided on the existing riparian communities and existing wildlife values on Hazeltine Creek below the mine. In the event that potential effects were identified in an environmental assessment, baseline information should be collected on:

- riparian and wetland vegetation classification
- general wildlife surveys
- Species at Risk surveys

No discussion has been provided on the potential toxicity of the resultant effluent-laden waters on wildlife species that may drink the water, consume fish or aquatic invertebrates, or forage on riparian vegetation

There are a number of chemical contaminants of concern regarding their potential uptake by wildlife. Where MPMC's toxicologist identifies water quality parameters that could exceed the guidelines for wildlife and livestock, suitable mitigation should be put in place.

MPMC response (Pierre Stecko):

> The points above are acknowledged. We do note that the Technical Assessment was scoped in many pre-consultation and consultation meetings with regulators and others. Our feeling was that the aquatic environment was the principal and most sensitive receiver, not least due to the clear & continuous route of exposure versus wildlife which are only intermittently exposed and generally have more sophisticated physiological

means of regulating metals. Furthermore, we applied BCWQG to evaluate the potential impacts to water quality. This includes wildlife use of water (for all analytes of interest except molybdenum, the aquatic life BCWQG are lower than those for wildlife).

End of MPMC comment

No discussion has been provided for potentially cumulative effects of multiple contaminants on the ecosystem and wildlife, such as:

- additive impacts, in which several compounds increase the toxicity of the water when present in combination over what any of them would in isolation
- countering impacts, in which one or more compounds negate the negative impacts of another compound when present in combination

No consideration has been provided for the potential effects of bioaccumulation of toxins in wildlife and livestock which may then be consumed by humans (e.g., First Nations, hunters, etc.), potentially resulting in toxicity to humans.

The discussion of proposed ongoing monitoring protocols and options for mitigation/adaptive management if the conditions within the environment are deemed unacceptable is very cursory, and:

- no discussion of what constitutes “unacceptable” conditions, or how these will be determined or measured
- minimal discussion of potential monitoring regimes (i.e., what to monitor, how frequently to monitor, what monitoring methodology to employ, etc.)
- minimal discussion of options for mitigation if conditions are deemed unacceptable (e.g., cessation of discharge, altering the discharge flow, habitat remediation, detoxification of affected ecosystems and organisms, etc.)
- minimal discussion of how the operating regime may be altered through adaptive management over time
- although the document states that a more comprehensive monitoring plan will be developed as a component of the application for effluent discharge, it would be helpful to review the monitoring program along with the rest of the application and prior to full approval

MPMC response (Ron Martel):

MOE to decide

End of MPMC comment

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