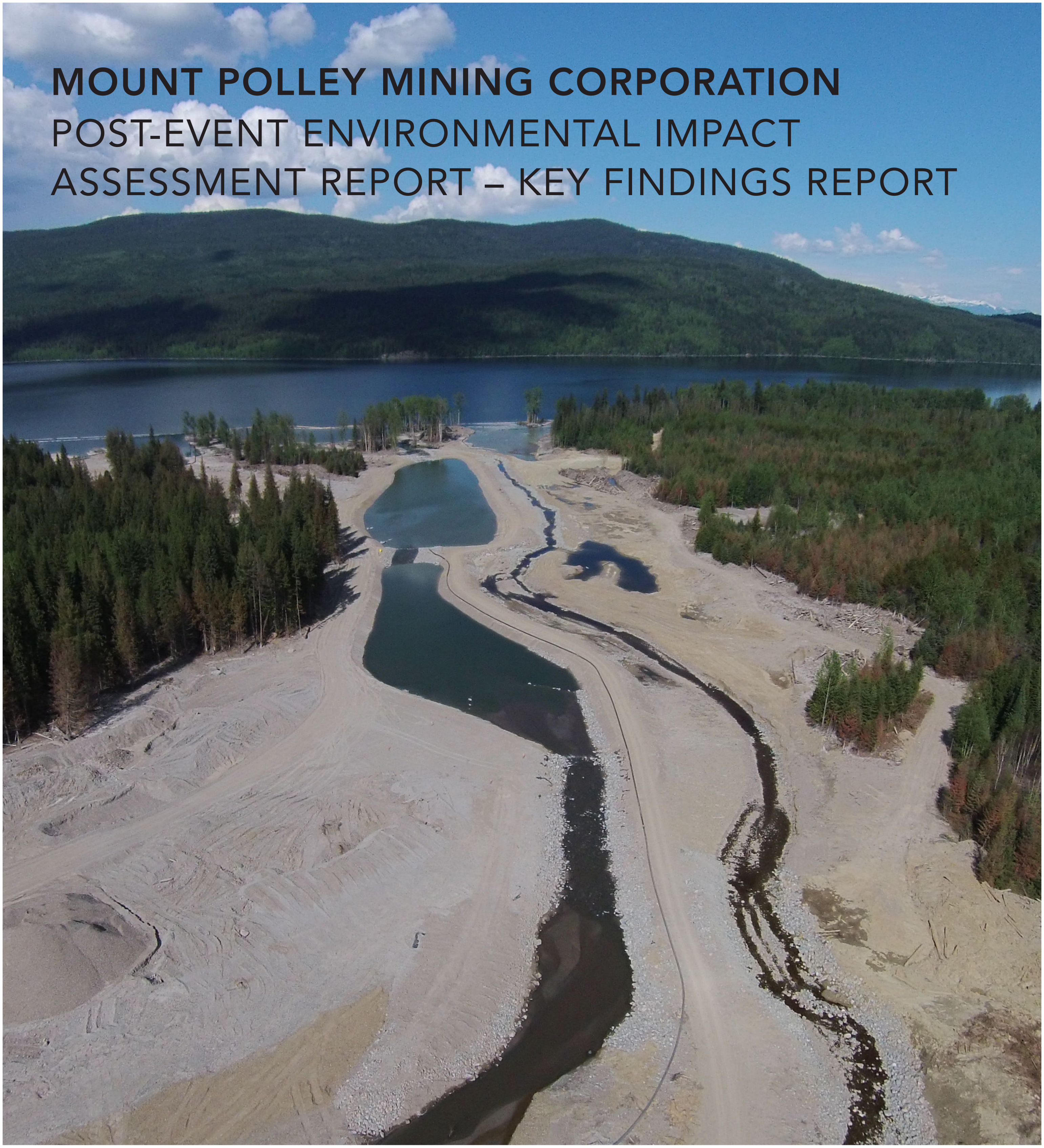
MOUNT POLLEY MINING CORPORATION

POST-EVENT ENVIRONMENTAL IMPACT ASSESSMENT REPORT – KEY FINDINGS REPORT



Mount Polley Mining Corporation

an Imperial Metals company

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JUNE 5, 2015

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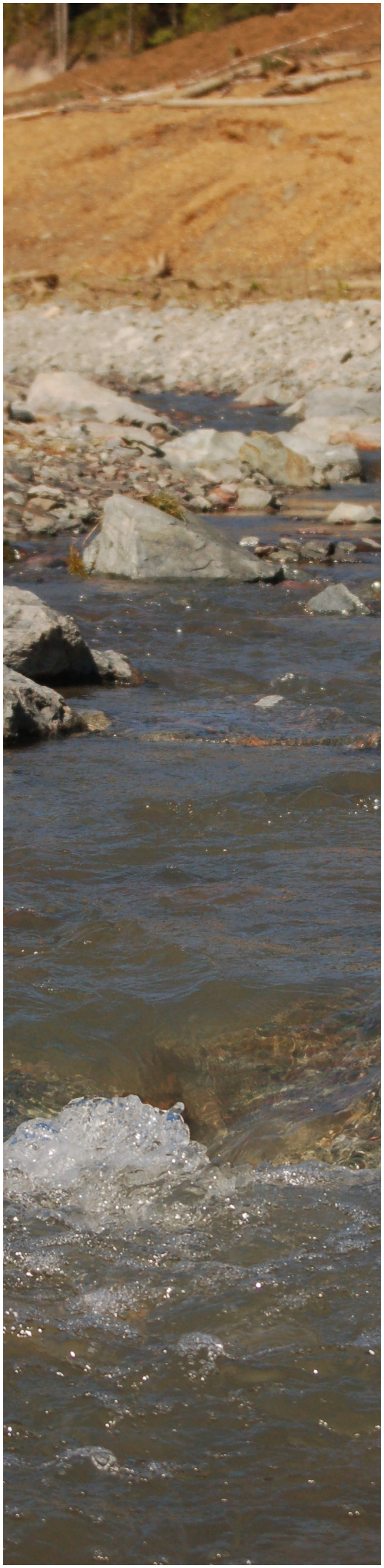

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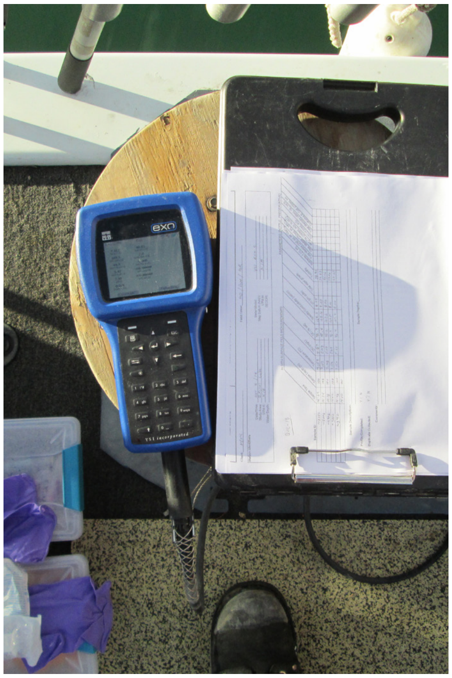

Photo of Mount Polley Mine's tailings. Tailings are particles of ground rock that are left behind after the valuable minerals are extracted. They range in size from sands to fine, clay-sized particles. The geochemical testing program evaluated whether or not they could leach metals or would stay inert.

1.0 INTRODUCTION

Early on August 4, 2014, a tailings dam failure occurred at the Mount Polley Mine causing water and tailings to be released from the Tailings Storage Facility to Polley Lake, Hazeltine Creek and Quesnel Lake. The tailings blocked the flow of water from Polley Lake at the discharge to Hazeltine Creek in the area now referred to as the Polley Plug. The Mount Polley Mining Corporation (MPMC) immediately began work to stabilize and contain the tailings, initiated scientific studies to identify the impacts of the release on the environment, and began developing strategies to remediate the effects of the spill. Some of the studies undertaken by MPMC are done. However, there are additional studies that are either in progress or will be undertaken in the near future because of seasonal requirements for those studies. This report and its Technical Appendices provides the findings of MPMC studies to date.

The objective of the Post-Event Environmental Impact Assessment (PEEIAR) was to provide an assessment of the physical, chemical and biological impacts immediately following the tailings dam failure and in the first six to eight months following the event. The assessment of long term impacts will be conducted in the next phase of work to be initiated during the summer of 2015.

The Key Findings of the Post-Event Environmental Impact Assessment are presented below. The Supporting Technical Appendices are attached for readers to review the details of the technical studies.

HOW DID MOUNT POLLEY APPROACH THE RESTORATION AND REMEDIATION OF IMPACTS FROM THE TAILINGS DAM FAILURE?

MPMC approached the restoration and remediation work with:

i. a clear understanding of the study objectives;

ii. technical experts and recognized methods of assessment so that the data are reliable and reproducible;

iii. an analysis of the data in specific technical areas with consideration for the interplay between technical areas; and,

iv. robust conclusions based on the data and evidence available and not on expected outcomes.

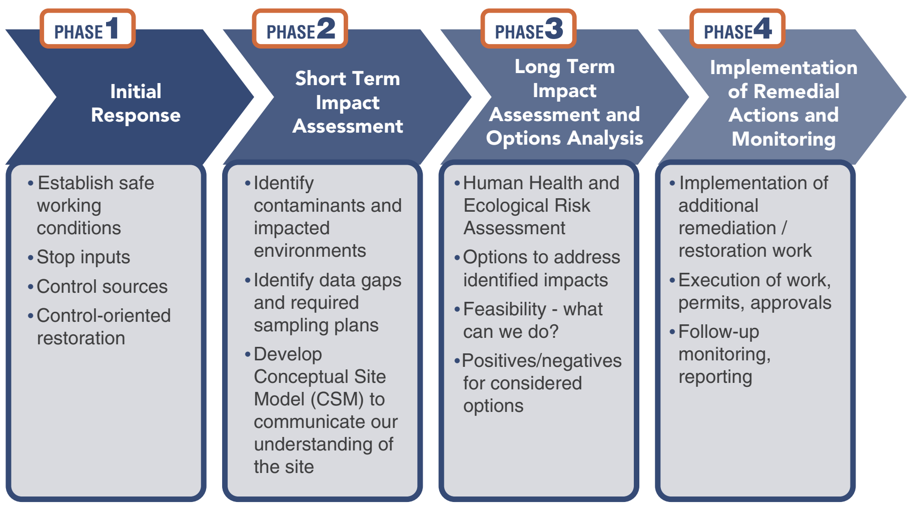

Figure 1: Restoration and remediation strategy

RESTORATION AND REMEDIATION STRATEGY

When the tailings dam failure occurred, MPMC brought on additional capacity and expertise to assist their own environmental specialists as they planned and undertook the restoration and remediation work. With this assistance, MPMC developed a strategy to restore the habitat, rebuild the Tailings Storage Facilities and other infrastructure and re-open the mine for operations. The Restoration and Remediation Strategy is shown in Figure 1.

Haul trucks lined up to build a rock berm to hold back tailings in the TSF so that the breach could be repaired safely

Mount Polley Mine diverted all site water collection systems to the Springer Pit

As soon as Hazeltine Creek could be safely accessed, construction works to control erosion were initiated

The Mount Polley Mine was shut down immediately when the dam failed. Its crews were re-allocated to addressing the outcome of the breach. The first steps were to enable safe access by people into the spill area and the following measures were carried out shortly after the breach. These actions had to be completed before people could access the study areas of Polley Lake and Hazeltine Creek. Other Initial Response actions as part of Phase I included:

- Stabilization of the tailings in the Tailings Storage Facility (TSF) by constructing two large rock berms inside the TSF. The rock berms functioned to stabilize the wet tailings on the inside of the TSF, preventing their mobilization into areas where people would need to go.
- Reducing the elevation of Polley Lake behind the Plug area to decrease pressure on the Plug and the possibility of rupture of the Plug. This was necessary to enable safe access into Hazeltine Creek. A safety plan involving regular checks by geotechnical engineers, radio check-in and a "Hazeltine Plug Spotter", who monitored for early signs of Plug failure, was developed before access to Hazeltine Creek was allowed.
- Stopping inputs from the TSF which continued to drain water and particulates. All drainage from the site water collection systems and breach outflow was collected as of September 4, 2014.

While the safety concerns around the Plug and along Hazeltine Creek were addressed, planning for erosion control and restoration along Hazeltine Creek began. While restoration planning is on-going and adaptive, the restoration work conducted in Phase I, Initial Response was focused on reducing impacts to Quesnel Lake.

The Post-Event Environmental Impact Assessment work was conducted under Phase II of the Strategy. This short term environmental impact assessment addresses impacts that occurred immediately following the tailings dam failure and for an interim period of six to eight months afterwards. As discussed further below, experienced specialists from fundamental technical areas were hired to develop and implement work plans to help MPMC understand the significance of what happened. Their key findings are presented in summary form in this report and their supporting technical reports are appended to this report.

Once the post-event assessment of environmental impacts is submitted, MPMC will continue with environmental assessment work, but focusing more on the potential for longer term effects to human health and the environment (Phase III). A remediation plan for the tailings dam failure will be developed for areas needing further remediation work. The remediation plan will identify options for remediation and include a feasibility study to assist in identifying the most appropriate actions to take.

The final phase in the strategy is implementation of the remediation work to prevent impacts and to improve conditions. Follow up monitoring will be conducted to confirm conditions of water, soil and sediment quality and will be continued until trends indicate conditions are acceptable and stable.

Mount Polley Mine

WHY WAS THE MOUNT POLLEY MINE LOCATED THERE?

The Mount Polley Mine is located in rocks with an unusually high concentration of copper rich minerals (ore) that formed approximately 180 million years ago. At the mine, the copper-rich ore is dug out of open pits and from underground, crushed, and the copper-rich minerals are removed in the mill. Tailings are the crushed rock left over after the copper-rich minerals are removed. The tailings therefore have lower concentrations of copper than the ore, but they still have higher concentrations of copper than the surrounding rocks that are not mined.

A regional survey of the chemistry of stream sediments in the area was conducted by the Geological Survey of Canada in 1980 (seventeen years before the mine started operation) and found enriched concentrations of many metals in the sediments in the area. The copper concentrations in the tailings are higher than copper in almost all streams in the area, but the concentrations of many other metals in these stream sediments are similar to the MPMC tailings (Figure 2).

Looking closer to home tells the same story. A rock collected in Likely, BC, shows similar or higher concentrations of many metals compared to their concentrations in the MPMC tailings, except for copper. It is this strong natural enrichment of copper at Mount Polley that is the reason it is a copper mine, but the tailings are not enriched in many other metals when compared to other rocks and sediments in the area.

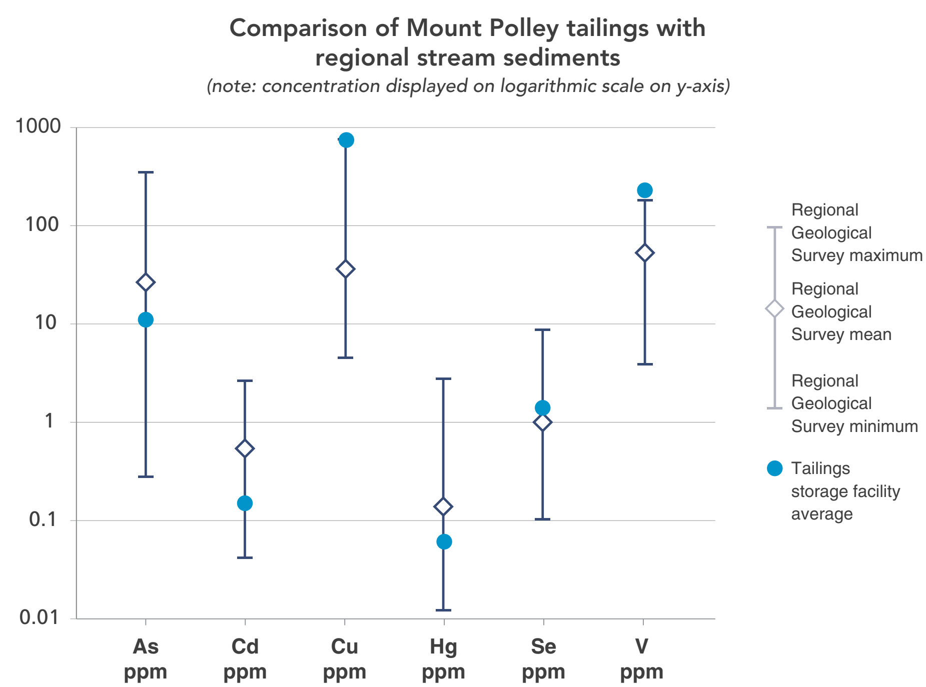

Figure 2: Comparison of Mount Polley tailings with regional stream sediments

WHAT IS THIS KEY FINDINGS REPORT?

This report documents the key changes that occurred in the environment in the six to eight months following the tailings dam failure. The key findings of the Technical Appendices are pulled together in this section and organized by the type of impact:

i. physical;
ii. chemical; and,
iii. biological impacts.

The Technical Supporting Appendices are attached to this report for those interested in reviewing all the details.

HOW DID WE STUDY THE IMPACTS OF THE TAILINGS DAM FAILURE?

MPMC supplemented their own team of environmental specialists with externally sourced experienced scientists and engineers to lead the studies of the impacts of the tailings dam failure and the immediate restoration work. Lee Nikl, M.Sc., R.P.Bio., (Golder Associates Ltd.) was brought on by MPMC to help them lead the team of experts. Lee brought over 26 years of experience in environmental science, including 12 years with Fisheries and Oceans Canada leading spill and fish kill response, as well as 14 years in environmental consulting work in Canada, including international projects (e.g. quantifying environmental damages from the Gulf War in Jordan, assessing impacts from mercury contamination in South America and various contaminated sites in Australia). Lee worked closely with Mount Polley's environmental team, Imperial Metals' Chief Scientific Officer, Dr. 'Lyn Anglin, Ph.D., P.Geo., and the discipline leads to identify the studies needed for the assessment and how they could be linked together to support a comprehensive understanding of impacts resulting from the spill.

The Technical Leads were responsible for designing their studies, implementing their field programs to collect data and interpreting the results.

These Technical Leads and the Technical Supporting Appendices included:

- Leif Burge, M.Sc., Ph.D., EP, P.Ag. (18 years) and Vanessa Cuervo, M.Sc. (9 years), SNC-Lavalin
  Hydrotechnical and Geomorphological Assessment
- Daniel Potts, M.A.Sc., P.Eng. (9 years), Justin Rogers, M.Sc., (8 years), Jordan Matthieu, M.Sc. (6 years) and Jim Stronach, Ph.D., P.Eng. (35+ years) TetraTech EBA Inc.
  Quesnel Lake Bathymetry Analysis and Volume Balance; and Lake Turbidity Modelling
- Chris Kennedy, Ph.D., P.Geo. (15 years) and Stephen Day, M.Sc, P.Geo. (26 years) SRK Inc.
  Geochemistry Impact Assessment
- Trevor McConkey, M.Sc., P.Ag. (16 years) and Daniel Schneider, B.Sc., R.P. Bio. P.Ag. (8 years) SNC-Lavalin
  Soil Quality Impact Assessment
- Pierre Stecko, M.Sc., EP, R.P.Bio. (20 years) and Cynthia Russel, B.Sc. (30 years) Minnow Environmental
  Sediment Quality Impact Assessment
- Elaine Irving, Ph.D., R.P.Bio. (15 years), Jordana van Geest, Ph.D. (7 years) and Lee Nikl, M.Sc., R.P.Bio., (26 years) Golder Associates Ltd.
  Water Quality
- Lorraine Andrusiak, M.Sc., R.P.Bio. (21 years), Shawn Hilton, B.Sc., R.P.Bio. (20 years) and Brian Yates, MPA, R.P.Bio. (23 years) SNC-Lavalin
  Terrestrial Impact Assessment
- Barbara Wernick, M.Sc., R.P. Bio. (19 years), Golder Associates Ltd. Quesnel and Polley Lakes
  Aquatic Productivity Impact Assessment
- Cliff Robinson, Ph.D., R.P.Bio. (24 years) and Cory Bettles, M.Sc., R.P.Bio., CFP, (16 years), SNC-Lavalin
  Fish Habitat Impact Assessment

The studies of physical impacts to the environment were geared toward understanding where the tailings deposited on land and in the aquatic environments. The flow of tailings also scoured the native soil and vegetation in the Hazeltine Creek valley changing the landscape in that area. This led to developing an understanding of how the tailings (and associated native soil) changed the structure of Hazeltine and Edney Creeks. A large volume of tailings and native soil entered Quesnel Lake. The assessment of bathymetry mapped out how the bottom of Quesnel Lake changed as a result of the addition of this material. In addition, when the material entered Quesnel Lake, a turbidity plume was created in the water. The movement of the turbidity plume in Quesnel Lake was studied so that accurate predictions could be made of what would happen to the turbid water in the future.

The studies of chemical impacts to the environment focused on changes in soil, water and sediment quality as a result of the tailings dam failure. Studies were designed to understand if the tailings would cause acidic conditions or if metals in the tailings would leach out of the tailings. These geochemistry studies considered both short term conditions and likely conditions in the future. The soil assessment evaluated the quality of material deposited into the Hazeltine Creek floodplain and adjacent forest. The water quality assessment focused on immediate changes in water quality in Hazeltine Creek, Polley Lake, Quesnel Lake and Quesnel River, and monitored how water quality changed over the six to eight months following the dam failure. Finally, the assessment of chemical impacts included an evaluation of sediment quality in Polley Lake and Quesnel Lake in order to assess impacts to sediment-dwelling biota.

The studies looking into biological effects considered impacts to aquatic life, including the sediment-dwelling community, as well as aquatic plants, invertebrates and fish. These studies focused on Polley Lake and Quesnel Lake as Hazeltine Creek was no longer a viable habitat following the dam failure. The studies of biological impact also included an assessment of soil-dependent biota in the affected terrestrial area near Hazeltine Creek and Polley Lake.

The teams working under each Technical Lead worked collaboratively with each other as some studies (e.g. geomorphology) provided the foundation work, while others, for example, the sediment quality work, built on physical impact, confirmed the chemistry impacts and provided an assessment of biological impacts to sediment-dwelling biota.

This work was conducted in accordance with established scientific methods and protocols to meet or exceed regulatory requirements, such that it would be highly unlikely that potential short term impacts would be missed. However, this work is also considered to be preliminary, as the results of some longer term tests were not yet available at the time of writing this report. These longer term test results and other confirmatory testing will be conducted as part of Phase III of the Restoration and Remediation Strategy, under the long term assessment of human health and ecological risks.

In order to implement the strategy, nine areas potentially affected by the tailing dam failure were identified (Figure 3). This was conducted because the different areas of impact have different characteristics, different potential for impact and different study needs. The key findings of this impact assessment are presented below.

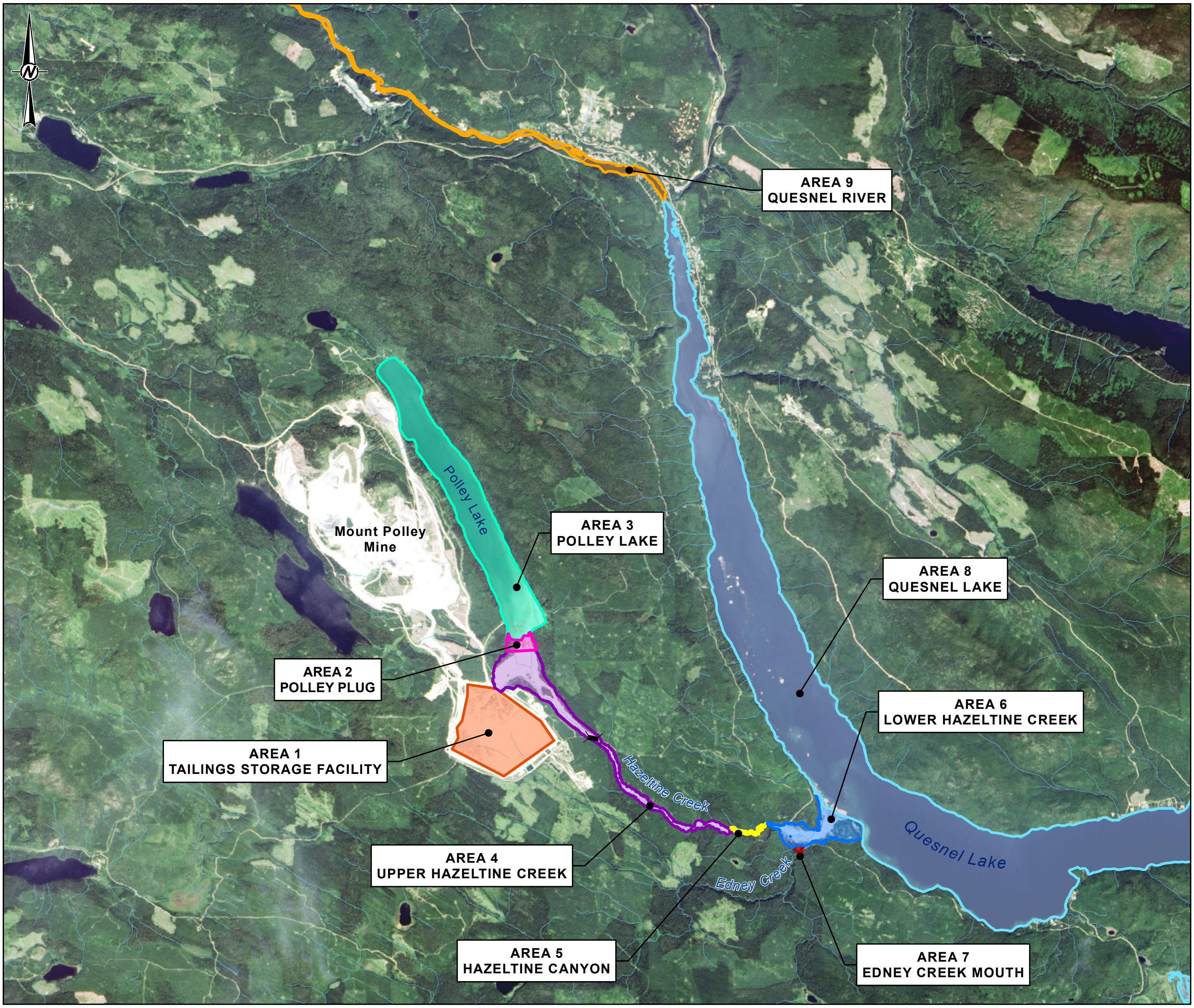

Figure 3: Remediation areas: Mount Polley Mine TSF dam failure

2.0 KEY FINDINGS - PHYSICAL IMPACTS

Lower Hazeltine Creek following the tailings dam failure (August, 2014) showing some of the physical changes that occurred

Hazeltine Creek Canyon showing exposed bedrock

Slope instability and red tailings deposited within the Hazeltine Creek channel (September 22, 2014).

HOW DID THE TAILINGS DAM FAILURE CHANGE HAZELTINE AND EDNEY CREEKS?

Water and tailings released from the dam failure created a debris flow that eroded the channel and floodplain of Hazeltine Creek. The area affected by the debris flow extends from the tailings dam downslope to Hazeltine Creek, upstream to Polley Lake and downstream to Quesnel Lake (Figure 4).

Prior to the dam failure, the Polley Plug area was dominated by wetlands with interconnecting channels and ponds. Hazeltine Creek was generally about 5 m wide and 0.3 m deep, flowing through a well forested valley. The channel bed was mainly cobbles and gravel. The Hazeltine Creek Canyon was the steepest and narrowest section of the creek and included a 1.2 m tall cascade, bedrock steps and pools. Downstream of the Canyon, Lower Hazeltine Creek and Edney Creek were riffle-pool channels with beaver dams and ponds. The bed and banks of Hazeltine Creek were generally stable, displaying little movement since 1974 but evidence of some undercutting and erosion.

Following the dam failure, a thick deposit of tailings blocked the outlet of Polley Lake at the Plug area. Tailings deposits in this area near the dam failure location were the thickest, measuring > 3.5 m in some areas.

The slopes adjacent to the Hazeltine Creek channel became unstable within Upper Hazeltine Creek where a steep, quickly eroding zone developed. The tailings deposits in this area were thin and spatially heterogenous. Within the Hazeltine Creek Canyon, the channel bed was eroded down to bedrock with only limited tailings deposits. Within Lower Hazeltine Creek, the floodplain was eroded, and tailings and native material were deposited to variable depths ranging from 0.15 m to 1.5 m. The downstream-most 850 m of Edney Creek was affected by deposition

Hazeltine and Edney Creeks converge prior to discharge to Quesnel Lake. The mouth of Edney Creek was scoured during the debris flowto allow fish passage between Quesnel Lake and Edney Creek, a new channel was constructed.

from the debris flow. At the confluence of these two creeks, the Edney Creek bed was scoured, resulting in a drop of about 2 m in elevation, providing a barrier to the free movement of fish from Quesnel Lake to Edney Creek.

Figure 10 is a simple graphic showing the extent of eroded material and deposited material along the Hazeltine Creek Channel. The deposition occurred primarily near Polley Lake, and the erosion occurred predominantly in the middle reaches of Hazeltine Creek. The debris flow carved a new valley, wider and deeper, along the entire length of Hazeltine Creek by removing sediments from the creek bed, and soil and forest from the floodplain.

The tailings dam failure resulted in changes to the physical environment around Polley Lake, Edney Creek and Hazeltine Creek. The impacted zone included approximately 136 hectares[1] where the topsoil was removed to varying degrees along the creek to Quesnel Lake. Tailings were also observed overlying intact topsoil in an additional area of approximately 100 hectares.

In some areas where tailings have been deposited, two distinct layers can be seen:

i. a grey layer of fine material; and,
ii. a red-black layer of sandy material.

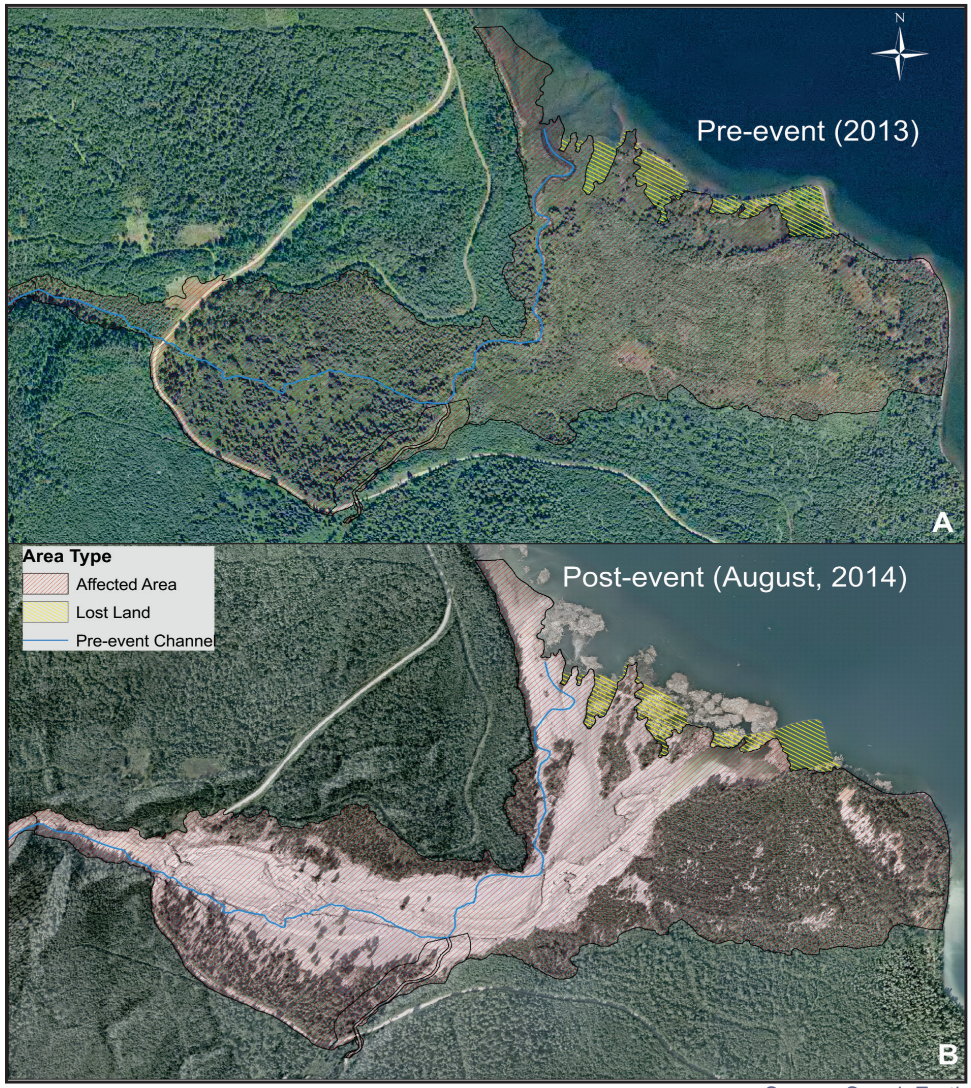

Figure 4: Pre- (A) and post-event (B) view of Hazeltine Creek delta

Source: GoogleEarth

In some areas along Hazeltine Creek, the tailings settled in two layers over the native organic layer. The grey fine tailings settled out over the red-black sand. The concentrations of metals in the two layers were found to be similar.

1 1 hectare = 100 metres x 100 metres, or the size of a sports field.

Reach 1 of Hazeltine Creek being constructed in the Polley Plug area

These two layers settled out according to particle size, with the heavier sand on the bottom settling first, following by the lighter fine grey material.

The creek valley is now more broad, the vegetation and organic layer of soil was removed and a mixture of tailings and native soil was deposited. The Quesnel Lake shoreline at Hazeltine Creek was re-shaped due to deposition and erosion of material at Quesnel Lake.

The physical conditions that were left immediately following the dam failure are no longer present. MPMC have been implementing their restoration and remediation strategy and have removed tailings and soil from Lower Hazeltine Creek, constructed the Hazeltine Creek bed, installed sedimentation ponds and corrected the connection between Edney Creek and Quesnel Lake to enable free movement of fish between these two aquatic habitats. The restoration work in these areas is on-going and progress updates will be provided in the Long Term Human Health and Ecological Risk Assessment in Phase III of their Strategy.

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A sidescan sonar and sub-bottom profiler used to provide the acoustic “imagery” of the lake bottom and profiles of sediment layers beneath the lake.

WHAT WAS THE PHYSICAL IMPACT ON THE QUESNEL LAKE BOTTOM AS A RESULT OF THE TAILINGS DAM FAILURE?

With average and maximum water depths of 157 and 511 m, Quesnel Lake is the deepest fjord lake in the world. It stretches from the Cariboo Mountains into the Interior Plateau of BC and has a surface area of roughly 266 km^2. The West Basin of the lake, where the debris flow entered represents approximately 8.6% of that surface area and about 2.3% of the volume of Quesnel Lake.

During September 2014, MPMC commissioned two research vessels operated by Tetra Tech EBA to study the lake. Through data obtained from these studies, estimates of volume released from the TSF, estimates of the volume of material scoured from the Hazeltine Creek corridor and the

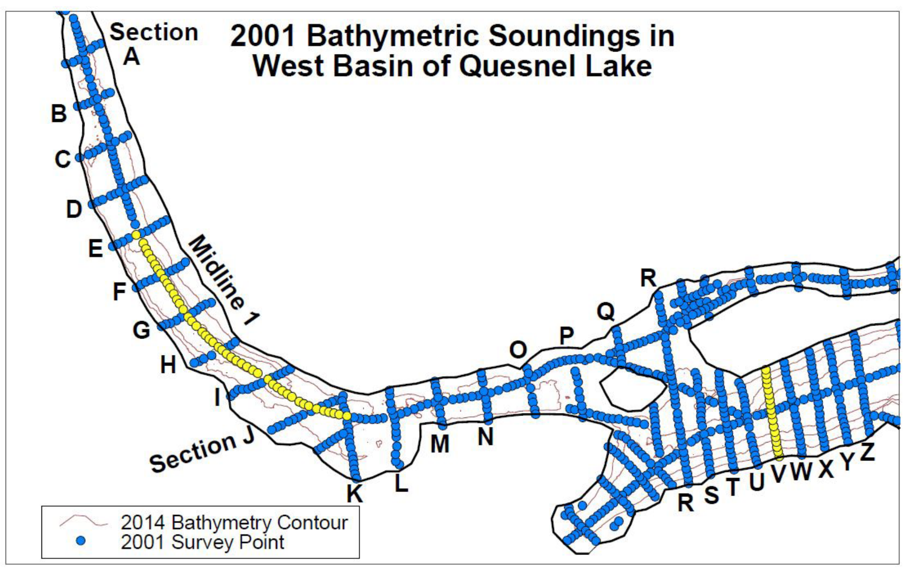


Figure 5: Lake depth profiles (bathymetry) collected in 2001

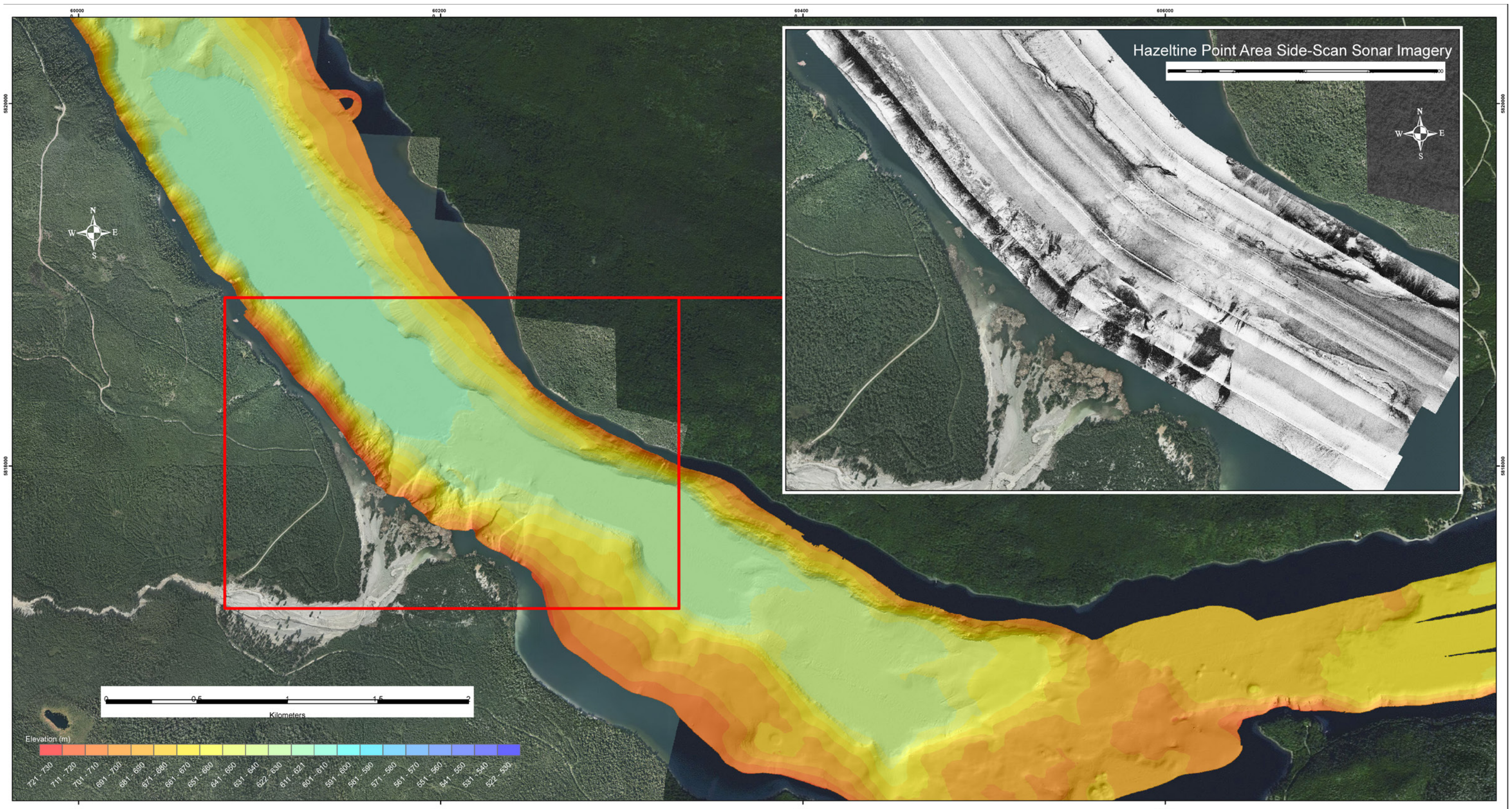


Figure 6: Multi-beam and sidescan sonar image of the bed of Quesnel Lake, near Hazeltine Creek

volume and spatial coverage of material deposited in Quesnel Lake could be estimated. High resolution multi-beam sonar and sub-bottom profiling was used to help develop those estimates, as was knowledge of the lake's volume and data from a water level gauge located at the Community of Likely. The volume estimates were derived using the following methods:

- Multi-beam Sonar was used to develop a depth profile of the bottom of Quesnel Lake in September 2014 and that was compared with spot measurements of lake depth carried out in 2001 (Figure 5 and Figure 6).
- Sub-bottom profiling is used to identify and characterize layers of sediment or rock under the lake bed. Layers of sediment or rock provide different reflections in the profiles and these can be used to identify areas where sediments have settled. This information was used together with the multi-beam sonar data to estimate where sediments have deposited on the bed of Quesnel Lake (Figure 7).
- A water level gauge, operated by the Water Survey of Canada is located on Quesnel Lake. The gauge recorded a sudden rise in the lake level on August 4, 2014 (Figure 8). By examining the lake level

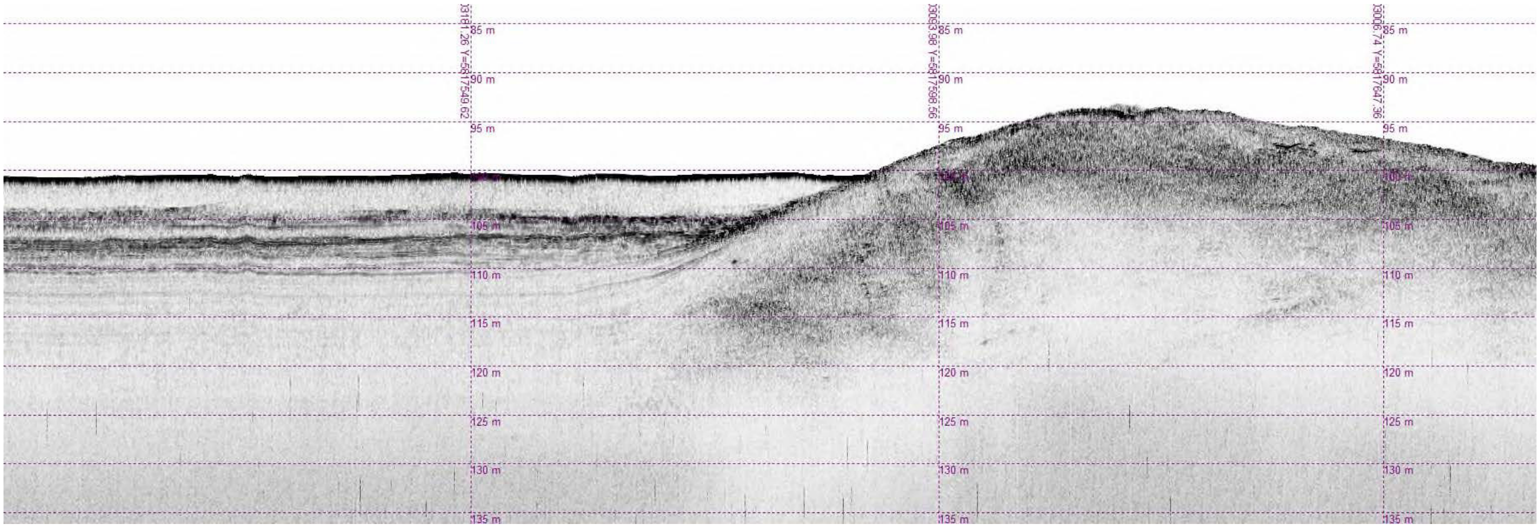
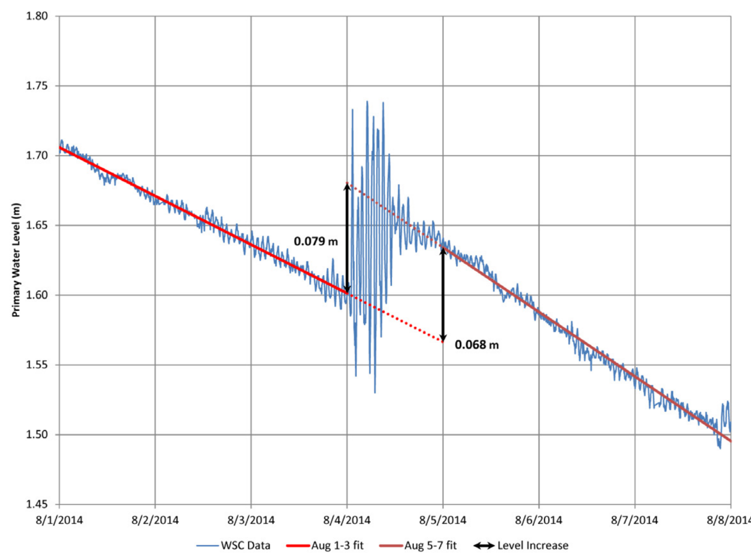


Figure 7: A sub-bottom profile image of Quesnel Lake showing fine-grained sediments on the lake bed along the flat section of the image and showing an underwater lake sideslope on the rise to the right of the image.

change (68–79 cm) and knowing the surface area of the lake (267.5 km^2), the lake volume was estimated to have increased 19.7 ± 1.5 million m^3.

Using this information, Tetra Tech EBA estimated that 18.6 ± 1.4 million m^3 entered Quesnel Lake. The breakdown of that material is shown in Figure 9. Most of this material deposited deep in the West Basin, below 100 m depth. The area of that deposit was estimated to be approximately 1.81 km^2. In some places the deposited material was estimated to be up to 10 m thick; however, those estimates were done soon after the spill and that depth is expected to decrease as the sediments consolidate/dewater/compact with time. For Polley Lake, the pre-tailings dam failure data does not allow an interpretation of post breach data.

This material on the lake bed resulted in a change in the lake bottom habitat and a disruption in the community of small animals that live in the deep lake bed. This impact is part of ongoing studies but early sampling suggests that some recovery of those organisms may have already begun. Sampling of those bottom-dwelling organisms following that deposition and settling of the sediments is necessary to verify expectations that the sediments will recover their function.



(Water Survey of Canada data)

Figure 8: Water level of Quesnel Lake near Likely, early August 2014, showing rise in lake level

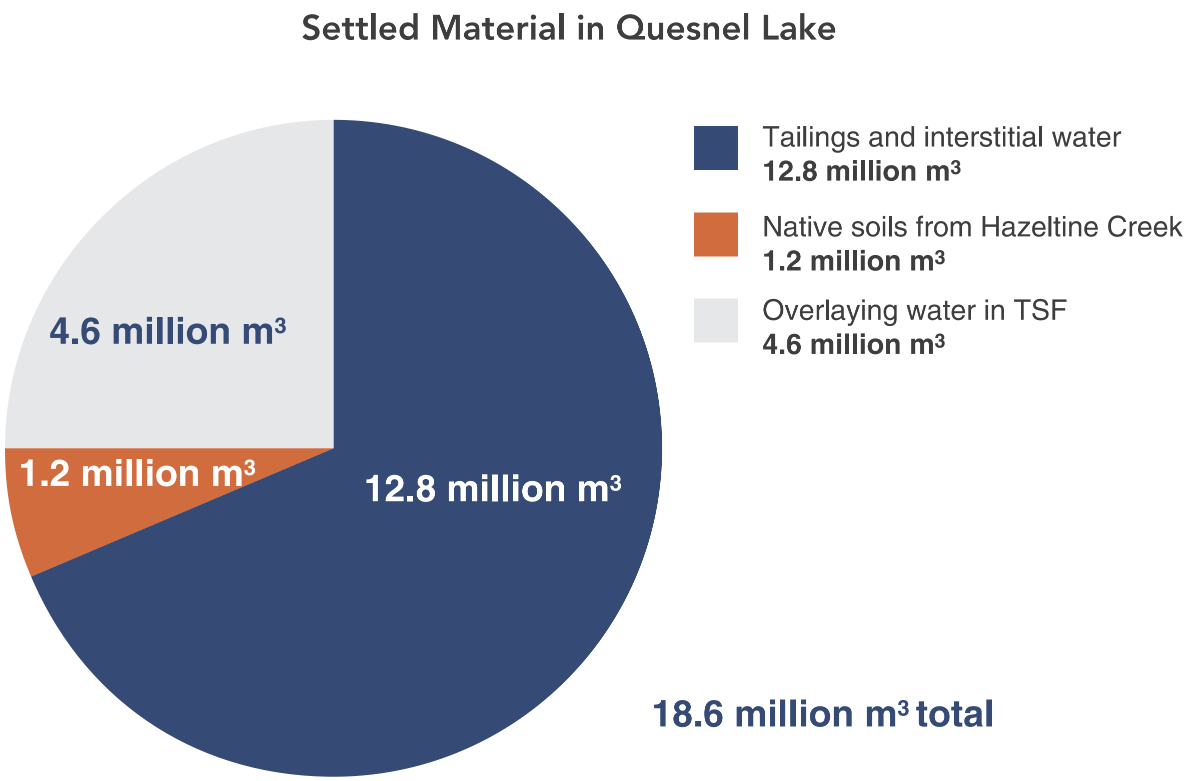


Figure 9: Sediment into Quesnel Lake

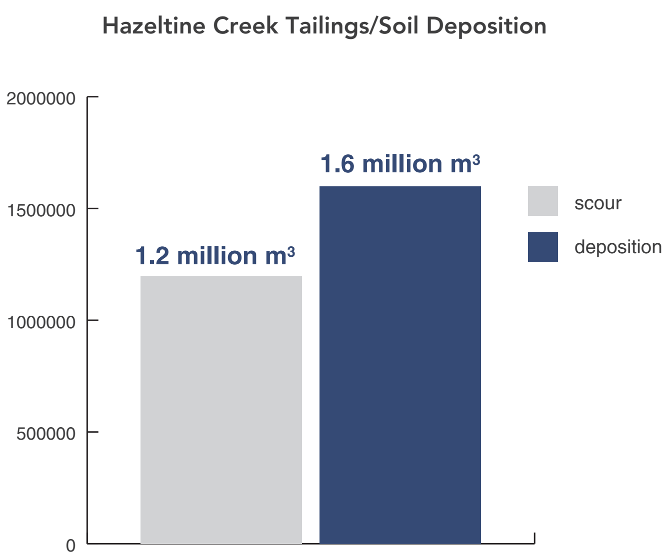
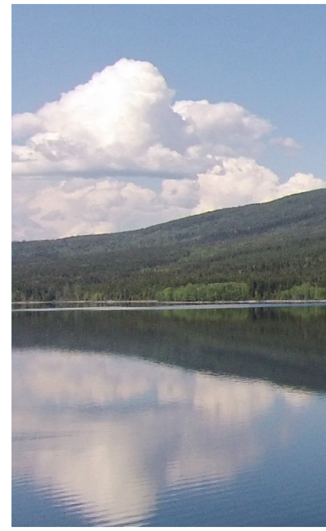
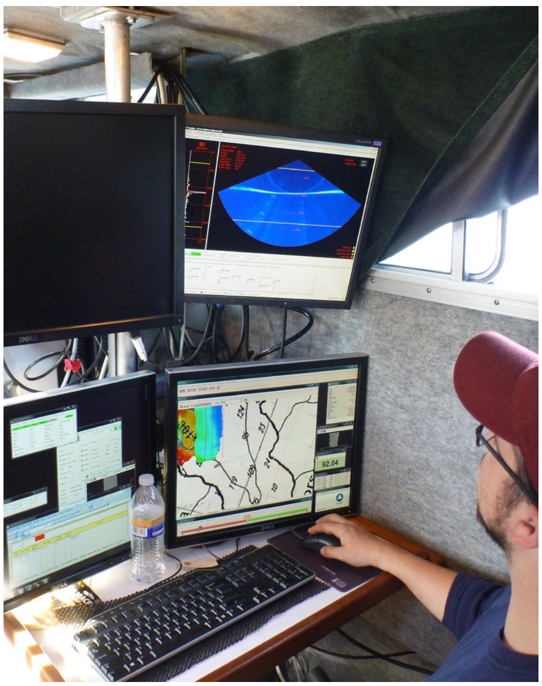


Figure 10: Hazeltine Creek tailings/soil deposition*



An August 2014 photograph of Hazeltine Creek showing the location of outflow that sank to the deeper parts of Hazeltine Creek, leaving a mostly clear Quesnel Lake surface until fall turn over



A technician on board one of two specialized research vessels collects Quesnel Lake data from an array of sensors deployed from the vessels

WHAT WAS THE FATE OF THE CLOUDY WATER THAT WENT INTO QUESNEL LAKE?

When the debris flow entered Quesnel Lake, it descended towards the bottom of the lake because the water and suspended particulates were denser than Quesnel Lake water. Some of the sideslope at Hazeltine Creek was scoured in the process. The more coarse materials like rocks and sands settled quickly. Smaller particles settled more slowly over weeks and months and the very small particles remained suspended through fall.

The tailings dam failure occurred in early August when warmer water is present at the surface of the lake, layered over cooler water down deep. There is an abrupt change in temperature at these layers and these waters of different temperatures also have different densities which cause these two water masses to resist mixing along this thermocline. The particles that remained in suspension were essentially trapped below the thermocline over the summer months and the lake surface remained mostly clear. In November, as the lake surface cooled and the temperature was constant from the lake surface to the lake bed, the lake began to mix the deeper, now cloudy water with the relatively clear surface waters. The result was the cloudy appearance of Quesnel Lake that persisted through the winter.

The cloudy water in the western basin began to clear through winter and into spring with clear water inflows and cloudy water outflows through Quesnel River to the west and, to the east past Cariboo Island at depth along a water current induced by internal waves in the lake called seiches. For the suspended material that did not settle, a computer simulation model of Quesnel Lake water movement was used to estimate that approximately 15–20% of the suspended

Quesnel Lake as viewed from the air, at the mouth of Hazeltine Creek, May 20, 2015

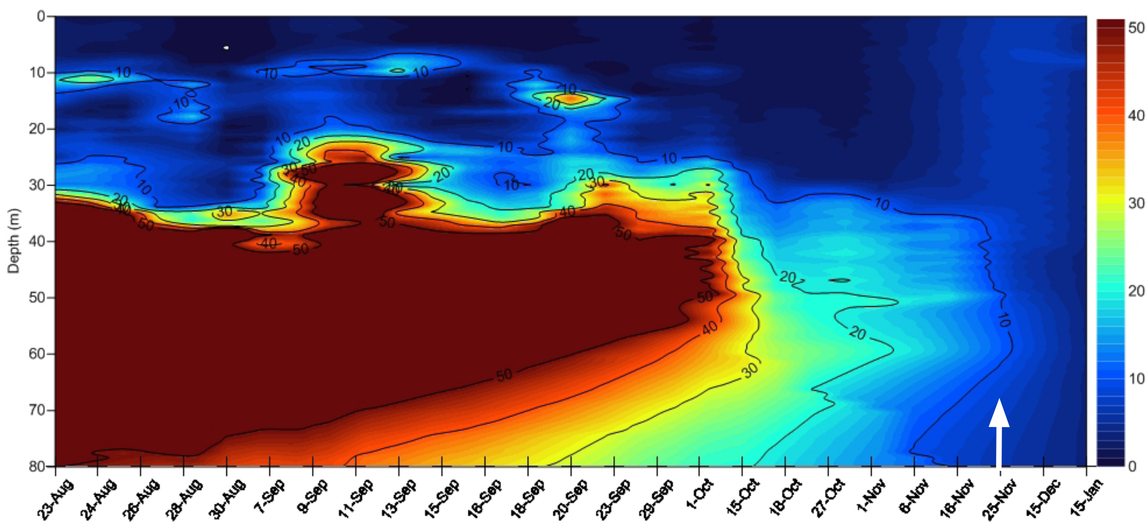
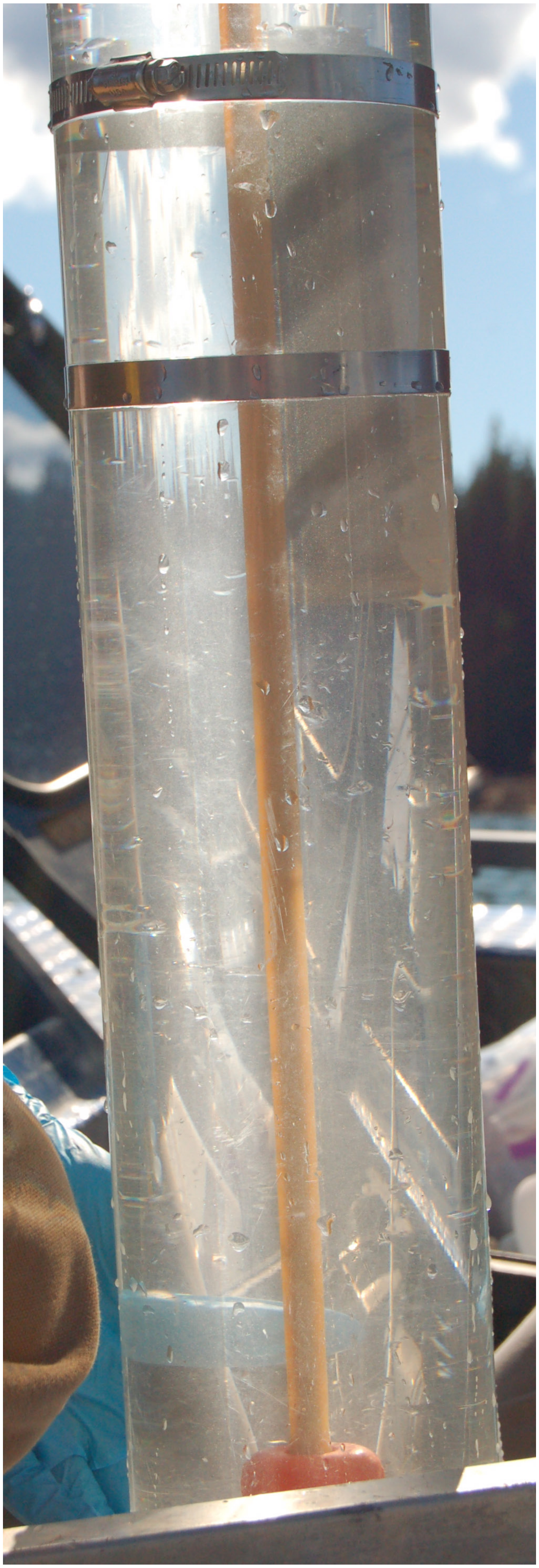


Figure 11: Turbidity measurements of Quesnel Lake water from the surface to the bottom of Quesnel Lake at a station adjacent to the mouth of Hazeltine Creek, showing the clearing of turbid water that happened over time

Note: The white arrow represents the approximate timing of mid-November turnover in Quesnel Lake.

particulates left Quesnel Lake via Quesnel River, 35–40% of the suspended particulates would have been transported to the east, at depth beyond Cariboo island and the remaining 40–50% would have settled in the West Basin of Quesnel Lake.

To provide some context to the sediment amounts transported, data were collected on the normal sediment load transported by the Quesnel River and the annual sediment load entering Quesnel Lake through Niagara Creek, which locals know to be a visibly cloudy river entering Quesnel Lake but is not the only source of sediments into the lake. It is estimated that the particulate material that left the West Basin is approximately 12% of the annual sediment load of the Quesnel River and the material that moved eastward past Cariboo Island was the equivalent of about half of the annual sediment inputs from the Niagara River into Quesnel Lake.



A sample of water collected from Quesnel Lake
(September 4, 2014)

A time and depth series of measured water cloudiness (turbidity) in Quesnel Lake adjacent to the mouth of Hazeltine Creek is provided in Figure 11. This chart shows the cloudy water in the deeper parts of the lake, below the thermocline. The turbidity decreases as time progresses with settling taking place and some dispersion out of the West Basin. At fall overturn, the turbidity can be seen to mix through the water column and continue to clear. As of late May 2015, turbidity at this station was near Quesnel Lake background, even in deeper waters. A return of the cloudy appearance of Quesnel Lake, as seen in the winter of 2014/2015 is not expected.

In summary, when the debris flow entered Quesnel Lake, a plume of turbid water descended below the lake's surface. Much of the turbidity settled out near the lake bottom over the remaining days of the summer and into early fall in the main body of the lake, but some of it was re-introduced to the surface in the late fall when the surface waters cooled and the lake turned over.

The water in Hazeltine Creek is now running clear and the turbidity of the main body of Quesnel Lake is in the range of pre-event conditions. There is still a slight increase in turbidity near the bottom of Quesnel Lake and that is expected to clear, but the main body of the lake has returned to normal conditions and is expected to stay that way into the future.

3.0 KEY FINDINGS - CHEMICAL IMPACTS

A laboratory test used to carry out investigations on deposited tailings material, as part of the geochemical study program

Old growth cottonwood showing the height of debris flow

WHAT WAS THE QUALITY OF THE MIXTURE OF TAILINGS AND NATIVE SOIL THAT WAS DEPOSITED IN THE HAZELTINE CREEK FLOOD PLAIN AND ADJACENT FOREST?

Eighty-eight samples of the tailings soil mixture and twenty-three background soil samples were collected from 18 transects along the Hazeltine Creek channel to evaluate the quality of the tailings mixture in the soil impact assessment. Consistent with the mineral mixture of the tailings discussed previously, the concentrations of copper in the tailings mixture are higher than in the native soil alone, and higher than the BC Soil Standard for the protection of soil invertebrates and plants. The copper concentration in soil is far below the standard for the protection of human health meaning that the tailings mixture is safe for direct human contact.

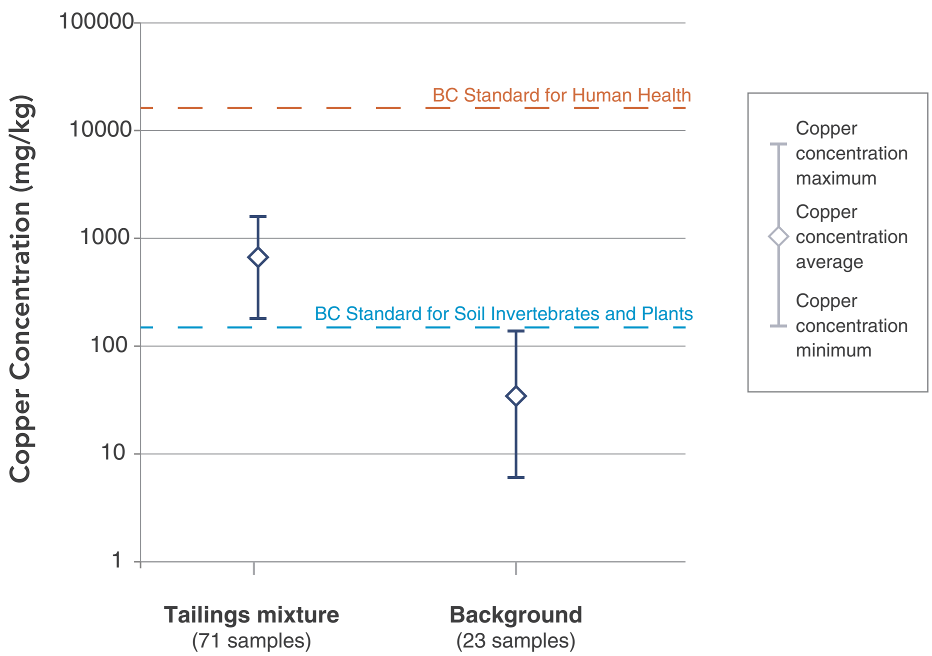


Figure 12: Copper concentrations in the tailings mixture from Hazeltine Creek area compared to background soil

Sixty eight tailings mixture samples were collected along the same 18 transects along Hazeltine Creek to understand the composition, mineralogy and leaching potential of the tailings in soil, sediment and water. These studies have shown that the metals in the tailings, including copper, are tightly bound and will not leach. Selenium in the tailings mixture was potentially more soluble than copper, but not when the tailings are submerged under water. Because the selenium concentration in the tailings mixture was less than the BC Parkland soil standard, and tests available to date indicate it would not be leachable in the aquatic environment, impacts from selenium on the environment are currently expected to be negligible. However, the results of the long term test of release rates was not yet available at the time of writing this report. These test results will be incorporated into the results of longer term assessment of human health and ecological risks.

Based on the mineral composition of the tailings, the tailings mixture would not be expected to cause acidic conditions (acid rock drainage) in the future. Tailings samples along Hazeltine Creek were non potentially acid generating. Long term kinetic testing has been initiated to provide the best evidence of acid-generating potential of the tailings mixture. Typically, these tests are run for a minimum of 40 weeks and meaningful results are usually not available until after 20 weeks. Results to date have shown that the tailings are not likely to generate acidic conditions. In fact, the tailings contain a greater amount of acid-consuming minerals than acid-generating minerals. As a result, the tailings mixture is not expected to produce acid conditions in the future.

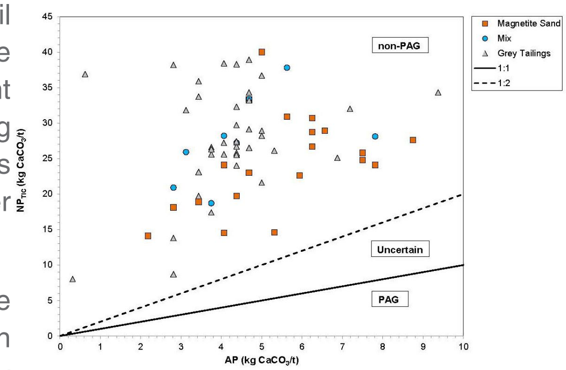


Figure 13: Acid rock drainage (ARD) potential is assessed using neutralization potential ratios

All of the samples collected along Hazeltine Creek showed very low potential for ARD.

Soil nutrient analyses indicate that there are lower concentrations of soil nutrients (e.g. organic carbon, nitrogen, phosphate) in the tailings mixture compared to the native soil. These lower concentrations may present growth-limiting conditions for plant growth and energy cycling in the impacted area depending on the depth of the tailings mixture deposit. However, there were signs of new growth in the spring in some areas where tailings were deposited and the grasses and willows planted as part of the restoration work have sprouted indicating that an adaptive succession has begun. Further investigation into the impacts of the tailings mixture on nutrient and energy cycling in the terrestrial environment is planned for the Ecological Risk Assessment.

Vegetation planted in lower Hazeltine Creek shows early signs of successful growth

Based on these studies, the data indicate that the quality of the mixture of tailings and soil deposited in the Hazeltine Creek flood plain and surrounding forest has changed from pre-dam failure conditions. The copper concentrations are higher, the soil pH is higher, the deposited mixture is layered in some areas based on the sand and silt content, and the nutrient content of tailings mixture is lower.

However, studies to date have shown that the tailings will not cause acid-generating conditions and the copper and other metals in the tailing mixture are tightly bound and would not leach into water. These studies indicate that the metals may not be available for uptake to plants and other soil-dwelling biota. Further assessment of the impact of the tailings mixture to terrestrial plants and animals will be conducted in the Ecological Risk Assessment.

Lower Hazeltine Creek right after erosion control works in the channel had been completed. The water began to clear up quickly

WHAT WAS THE IMPACT OF THE TAILINGS DAM FAILURE ON WATER QUALITY IN HAZELTINE CREEK, POLLEY LAKE, QUESNEL LAKE AND QUESNEL RIVER?

Similar to the impact on soil quality, there were changes in water quality in Hazeltine Creek, Polley Lake, Quesnel Lake and Quesnel River as a result of the dam failure. A key finding in this assessment was that the aquatic environment in Hazeltine Creek was overcome by the tailings mixture, so subtle changes in water quality in Hazeltine Creek are not discussed further here because that would be irrelevant. The reader is referred to the Water Quality Technical Report for further details of changes in water quality in Hazeltine Creek, for further information.

For Polley Lake, Quesnel Lake and Quesnel River, there was an increase in turbidity and copper in and bound to particulates in the deeper water immediately following the event. For both Polley and Quesnel Lakes, the turbidity at depth decreased over the late summer as particulate matter settled (Figure 14). A relatively small increase in the nutrient, phosphorus, was also observed for these receiving environments. The significance of the small phosphorous increase is discussed further in the section on biological impacts.

In mid-October, Polley Lake ‘turned over’ resulting in mixing of the shallow and deep water and the associated turbidity and lower dissolved oxygen. By mid-November, Polley Lake had recovered with turbidity and dissolved oxygen concentrations back to pre-event conditions. The potential biological impact of these changed conditions immediately following the dam failure is discussed further below, but the miners on site doing the restoration work during the spring reported that a population of rainbow trout vigorously entering the Fry Pan Creek to spawn. The rainbow trout were blocked from spawning in Hazeltine Creek which was undergoing restoration at the time. These trout will either move to a new creek to spawn or will absorb their eggs and be available for spawning next year.

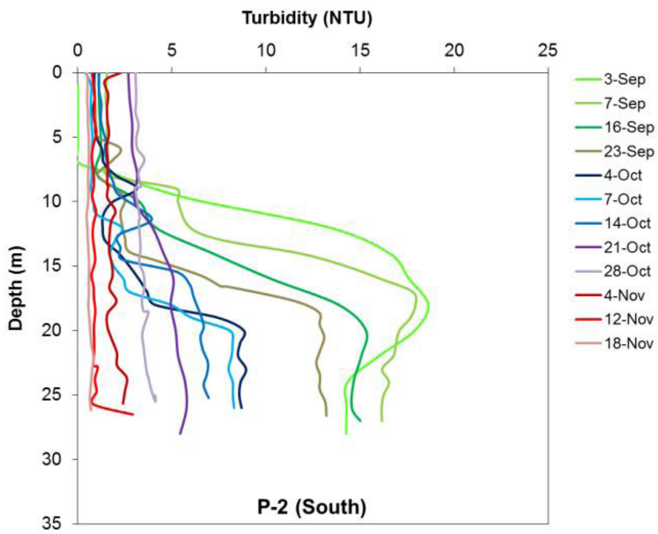


Figure 14: Post-event turbidity measurements with depth in Polley Lake showing the turbid water at depths of greater than 7 m below the surface

Rainbow trout gathering at the fish fence at the outlet from Polley Lake to Hazeltine Creek in spring 2015

A similar chain of events occurred in Quesnel Lake, except the lake 'turn over' event occurred in mid-November. The mixture of displaced material that entered Quesnel Lake following the dam failure was more dense ("heavier") than Quesnel Lake water and so caused turbid water at depths ranging from 10 to 25 m and beyond (Figure 15).

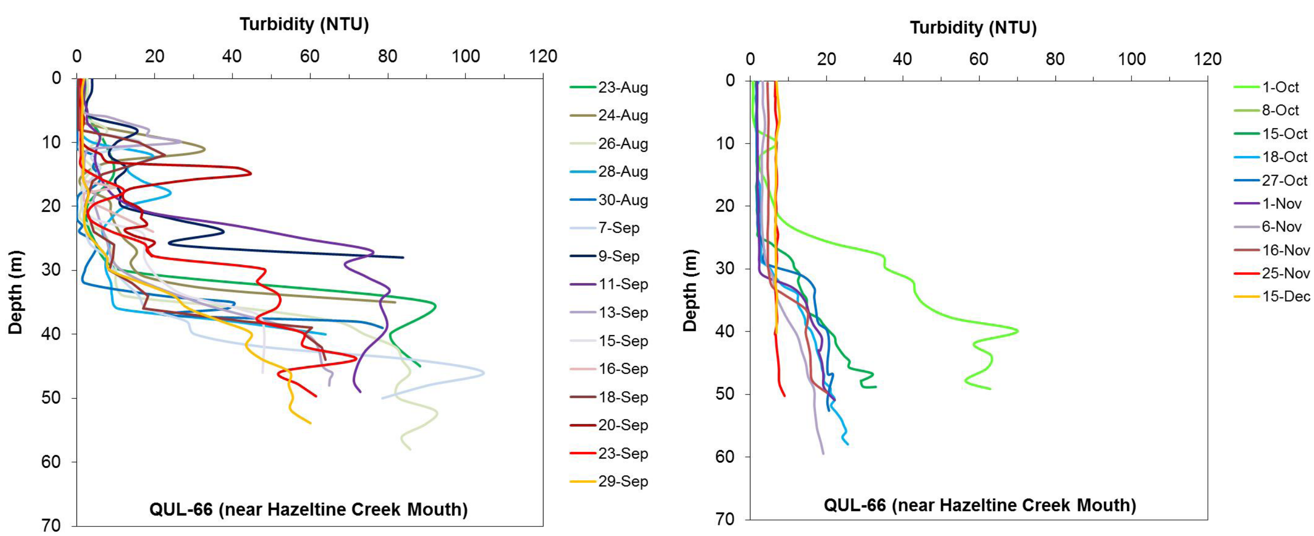


Figure 15: Turbidity measurements in Quesnel Lake near Hazeltine Creek over time. The results show the higher turbidity measurements with depth.

Figure 11 showed the mixing that occurred during the lake turn over event in November 2014.

The profile dates have been split across 2 figures.

Turbidity of Quesnel Lake water flowing out at the Likely bridge on June 1, 2015 was 0.54 NTU. This water is in the range of background turbidities on record before the breach which ranged from 0.2 to 1.4 NTU

A decrease in turbidity was observed over the late summer and fall. Lake turn over in Quesnel Lake occurred in November, causing a small interruption in the trend of decreasing turbidity (see Figure 11). The Quesnel Lake body has now returned to baseline conditions and is expected to maintain these conditions for the remainder of 2015 and into the future. Dissolved oxygen was above the minimum requirements for aquatic life during all sampling events in Quesnel Lake from August 2014 through February 2015.

Observations of cloudy (turbid) water were recorded three times in late summer and early fall (late August, early September, early October) in Quesnel River. These cloudy-water events were the result of deeper water from Quesnel Lake coming to the surface into Quesnel River as the lake responded to strong winds and currents. Turbidity in the river peaked in early December and declined to baseline conditions by mid-February. As of June 1, 2015, the turbidity at Likely was 0.54 NTU which is in the range of pre-impact turbidity (0.2–1.4 NTU). As the turbidity in the main body of Quesnel Lake has returned to baseline conditions, further cloudy water events in Quesnel River are not expected.

Water quality in Hazeltine Creek, Polley Lake, Quesnel Lake and Quesnel River was affected immediately following the tailings dam failure. In Quesnel Lake, the effects were immediate and more pronounced closer to Hazeltine Creek and decreased with distance. The turbidity in Quesnel River was delayed, less pronounced and occurred for brief periods of time. The effects in Quesnel Lake lingered over the period of August to December, but decreased to baseline conditions by February 2015. The biological impact of the changes in water quality are discussed further below on page 33.

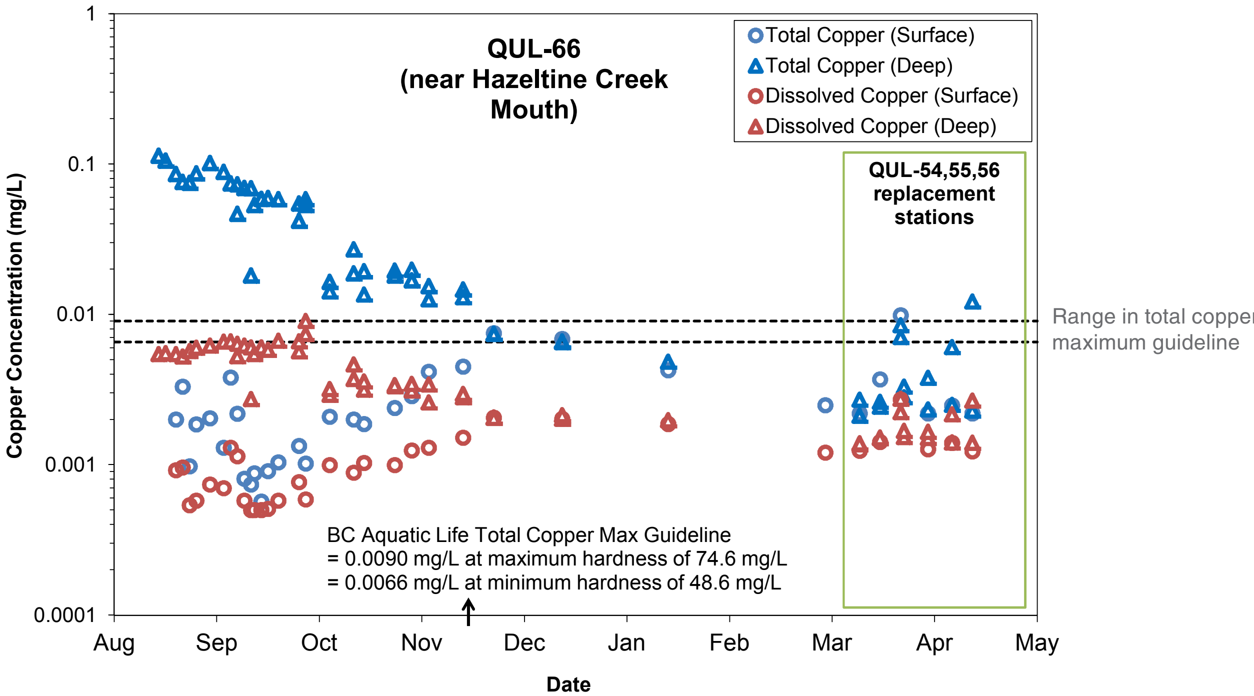


Figure 16: Post-event measurements of total and dissolved copper in Quesnel Lake near Hazeltine Creek

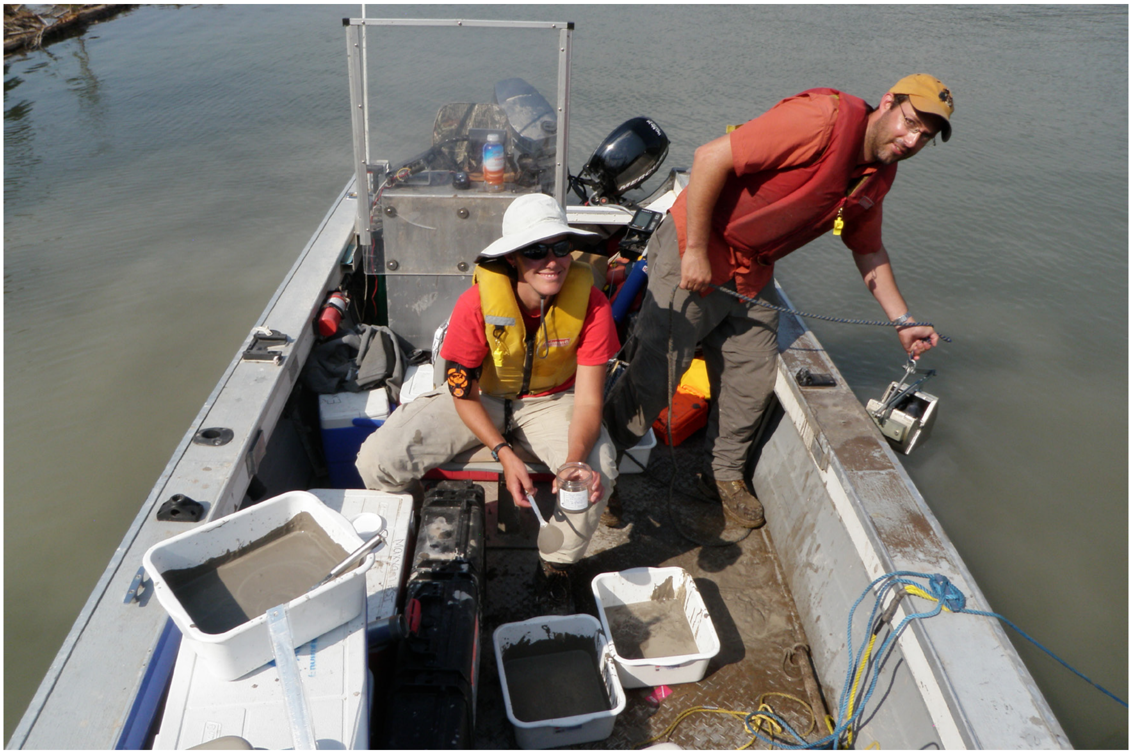
With the increase in turbidity at depth, there was an associated increase in the concentrations of total copper at depth. The concentrations of total copper were above the BC Water Quality Maximum Guideline between August and November of 2014, and were generally below the guideline since then (Figure 16). The concentrations of dissolved copper were below the water quality guideline even at depth where the turbid water was located, providing confirmation of the geochemistry results that found the copper in the tailings soil mixture was not leachable.

A scientist retrieves a sediment sample from the bottom of Quesnel Lake using a Petite Ponar device

WHAT WAS THE IMPACT OF THE TAILINGS DAM FAILURE ON THE SEDIMENT QUALITY IN POLLEY LAKE, QUESNEL LAKE AND QUESNEL RIVER?

Analyses were conducted on sediment in Hazeltine Creek, Polley Lake, and Quesnel Lake. Several locations were sampled in each of these water bodies, and multiple samples were collected at each location to provide greater confidence in results.

As expected, the sediment locations closest to the dam failure had higher concentrations of copper than samples taken more distant from the TSF. Sediments in Quesnel Lake near Hazeltine Creek had concentrations of copper (Figure 17) that exceeded the provincial sediment quality guidelines and are higher than background concentrations. Consistent with the findings of the soil quality assessment, the sediments also exhibited low nutrient content and low concentrations of organic carbon content. Several studies conducted in collaboration with the geochemical assessment indicated low potential for bioavailability of metals (including copper) to benthic-dwelling organisms in the lakes and river. Therefore, although copper concentrations in sediment exceed provincial guidelines, the copper and other associated metals are not expected to be harmful.



Sediment sample collection on Quesnel Lake near the mouth of Hazeltine Creek

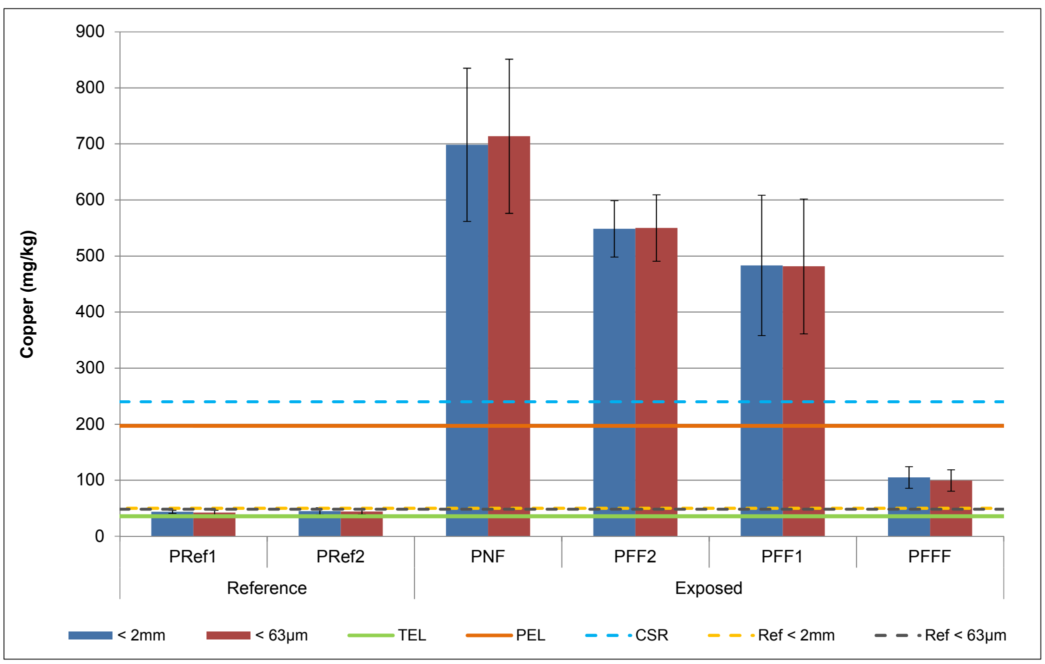


Figure 17: Mean copper concentrations (± t*SE) in sediment from profundal sampling areas in Quesnel Lake, Mount Polley Mine, 2014

TEL = Threshold (or Lowest) Effect Level; PEL = Probable (or Severe) Effect Level; CSR =Contaminated Sites Regulation-Typical.
Ref < 2mm and Ref < 63 µm values are the highest 95th percentile values for each sediment fraction reported among the reference areas (PRef1 and PRef2).

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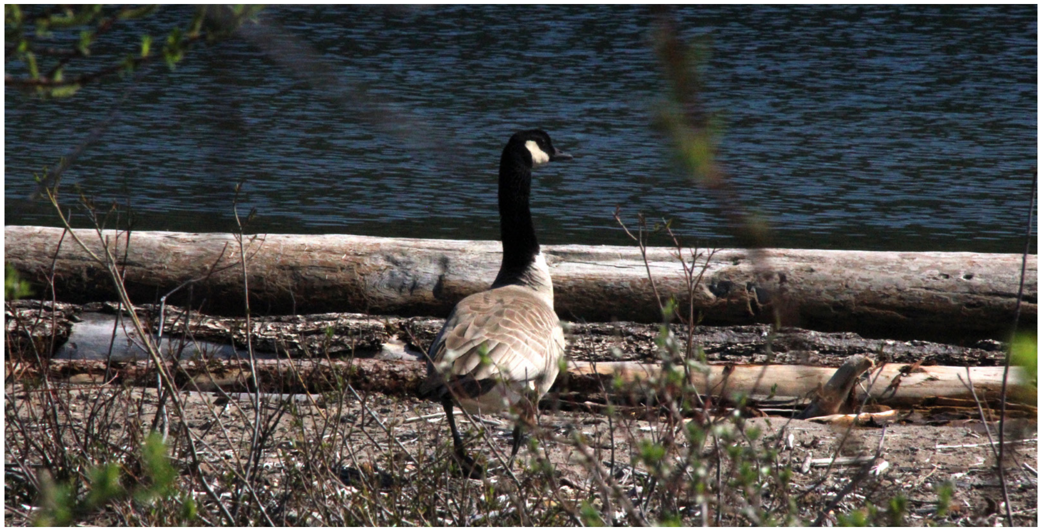
4.0 KEY FINDINGS - BIOLOGICAL IMPACTS



WHAT WAS THE IMPACT OF THE TAILINGS DAM FAILURE ON THE PLANTS AND WILDLIFE AROUND POLLEY LAKE AND HAZELTINE CREEK?

The investigation of impacts to soil around Polley Lake and Hazeltine Creek found higher concentrations of copper, higher soil pH and lower concentrations of soil nutrients in the tailings mixture. In addition, in some areas where the tailings layer is deep , there may be limited infiltration of water and limited air exchange. MPMC are funding a research project in collaboration with Thompson Rivers University to understand the limitations of the tailings mixture to soil and soil biological communities. The results of this research will be used to assist in the rehabilitation of the soil over the longer term.

Although there is a localized physical impact to soil, soil invertebrates and plants, there is no evidence of direct impacts to local populations of larger wildlife such as deer, moose or bear. The potential that these wildlife may be impacted by exposure to higher concentrations of copper in their diet is not expected, but will be evaluated further in the long term Ecological Risk Assessment.

In the meantime, there were signs of new growth in some areas where tailings were deposited and willows planted as part of the Hazeltine Creek restoration work have sprouted indicating that an adaptive succession has begun. The recovery of a healthy plant community will continue to be monitored.

New growth in the tailings impacted area along Hazeltine Creek - Apr 21, 2015.

Water quality monitoring in Quesnel Lake, September, 2014

WHAT WAS THE IMPACT OF THE TAILINGS DAM FAILURE ON AQUATIC LIFE IN POLLEY LAKE, QUESNEL LAKE AND QUESNEL RIVER?

The material deposited as a result of tailings dam failure covered the sediment-dwelling community in Quesnel Lake near the outfall of Hazeltine Creek to Quesnel Lake. There were fewer numbers and a less diverse community of sediment-dwelling organisms in this part of the lake. The impact was reduced with distance from this Hazeltine Creek outfall. The sediment-dwelling community in the more shallow parts of Quesnel Lake, more distant from Hazeltine Creek and in Quesnel River showed normal diversity and numbers indicating that this impact was localized.

The results of the tests used to determine if the copper concentrations in sediment were toxic to sediment-dwelling organisms were difficult to interpret. In several samples, these organisms did not survive or grow as successfully as expected. The specific cause of toxicity was difficult to determine because the physical composition of sediments differs from the natural sediment. For example, the organic carbon in the sediment, which is a food source to the test organisms, was very low in many samples. When poor performance was observed in growth or survival of sediment-dwelling organisms, samples also contained much less organic carbon than recommended for normal growth and survival. It is therefore uncertain if the toxicity in some samples was due to food limitations, copper concentrations, or both factors acting together. Given the geochemical results finding that the tailings were relatively inert, it would be pre-mature to attribute the toxicity to copper or other metal concentrations.

Because this post-event impact assessment was conducted within a few months of the tailings dam failure, the sediment-dwelling community would not have had sufficient time to re-colonize from adjacent sediment. Further assessment of the potential longer term impacts of the tailings dam failure on the benthic aquatic life is planned for the Ecological Risk Assessment.

Toxicity testing was also used to evaluate the water quality in Quesnel Lake for the life that inhabits the water column. Several aquatic toxicity tests were conducted using sensitive test species at sensitive life stages of two plants, two aquatic invertebrates and two fish to determine if the water in Quesnel Lake was toxic to aquatic life that dwell in the water column. Water samples were collected on four occasions following the dam failure and up to February 2015. The results of these tests indicate that copper concentrations in Quesnel Lake at the peak concentrations were not toxic to plants, invertebrates and fish. A small number of tests (9 of 53 tests) showed that the higher turbidity in the deeper water of Quesnel Lake caused a physical impact to one of the more sensitive types of aquatic invertebrates; However, no effects were observed for the other aquatic insect, for either of the two plants or either of the two fish.

A preliminary assessment of potential effects on the productivity of Quesnel and Polley Lakes, and Quesnel River, following the TSF dam failure at Mount Polley Mine was conducted. Changes in productivity were assessed by comparing pre- and post- event data where available, and by evaluating data in the context of previous reports and site-specific conditions.

Lake Shore and Bottom Habitats - Fish associated with the littoral zone (lake nearshore) and bottom (benthic) habitats feed largely on prey that live in the lake sediments or in some cases aquatic invertebrates that live in the water column. Fish in this group include early juvenile stages of salmon, Burbot, and Lake Whitefish and forage fish such as sucker, sculpin, chub, shiner and Northern Pikeminnow. The event resulted in the alteration of this nearshore habitat at the mouth of Hazeltine Creek, resulting in the displacement or the possible loss of fish in the area, although there are no confirmatory data of fish mortality. Material from the debris flow was also deposited on the lakebed in the deeper part of the lake, which resulted in a change in the lake bottom habitat and a potential disruption in the community of organisms that live in the lake's bottom sediments. The impact on the bed of Quesnel Lake continues to be studied. Although early sampling suggests that some recovery of bottom-dwelling organisms may have begun, follow-up sampling of these organisms is needed to tell us if the community is recovering and if so, how quickly. Post-event toxicity testing using established procedures and test species tell us that Quesnel Lake water did not affect survival or growth of fish or growth of plant test species and geochemical evaluations carried out have found that the tailings will be chemically stable in the lakes and are not expected to leach metals.

Open-Water Habitat and Fish that Feed on Emerging Aquatic Invertebrates - Fish associated with open-water habitat and which feed on emerging invertebrates include Mountain Whitefish and smaller Rainbow Trout. Larger Rainbow Trout in Quesnel Lake may consume juvenile Sockeye Salmon and Kokanee. This assemblage also applies to Polley Lake, in which the main fish species is Rainbow Trout. Production of emerging invertebrates was disrupted on a portion of the bed of both Quesnel and Polley Lakes. Although early sampling suggests that some recovery may have begun, sampling of the sediment-dwelling organisms is necessary to confirm whether recovery is continuing. Post-event toxicity testing indicated that lake water did not affect survival or growth of fish or growth of plant test species. In Polley Lake, Rainbow Trout size did not appear to change; however, the event likely affected reproduction through the loss of eggs in the Upper Hazeltine Creek spawning habitat in 2014 and potentially through the loss of use of that habitat in 2015.

Open-Water Habitat and that Fish that Feed on Free-Swimming Crustacean Zooplankton - The assemblage of fish associated with open-water habitat and which feed on free-swimming invertebrates in the water column consists of juvenile Sockeye Salmon and Kokanee. During the summer, this assemblage may also include Lake Trout. Post-event toxicity testing indicated that Quesnel Lake water did not affect survival or growth of fish, survival or growth of daphnid zooplankton, or growth of plant test species. The literature indicates that the direction of change in

The developmental life stages of trout and salmon from egg through to a newly hatched alevin were exposed to Quesnel River water to see if developing eggs in the gravel could be affected; however, there was no effect on normal egg development over this extended exposure period.

primary productivity as a result of introduction of suspended sediments to a lake depends on whether the phytoplankton are light limited or nutrient limited. The preliminary information available at this time suggest that there was an influx of phosphorus into Quesnel Lake and although changes in phytoplankton and zooplankton biomass were not observed, juvenile Sockeye Salmon collected west of Cariboo Island were larger than those from the lake east of Cariboo Island.

Figure 18 shows a generalized conceptual diagram of the dynamics of lake productivity starting in the spring. As the days become longer, the intensity of light energy becomes greater and water temperatures begin to warm, phytoplankton, which are the single-celled small plants the live freely in the water column begin to grow and multiply. The phytoplankton are grazed by zooplankton which begin to increase in size and number as their food supply becomes greater. The zooplankton are eaten by fish, which grow. By late summer and into fall, the phyto- and zooplankton begin to decrease in number as light energy begins to decrease and as fish prey on the zooplankton. The TSF dam failure occurred in late summer; however, because the debris flow was denser than the lake and it sank to the bottom below the zone where light significantly penetrates, the impact on phytoplankton may have been less than had it happened at a different time. When the lake overturned in fall, the cloudy water would have been capable of decreasing photosynthesis by reducing light but this happened in mid-November (winter) when photosynthesis is reduced because of lower light availability and colder water temperatures.

The debris flow would have also brought added nutrients to the lake in August and these nutrients, which are naturally low in Quesnel Lake would allow a larger crop of phytoplankton to grow. While studies carried out did not indicate a larger population of zooplankton based on individual "grab" samples, data provided by Fisheries and Oceans Canada did identify a notable increase in size and abundance of juvenile sockeye salmon. Their size may indicate that nutrients washed into the lake could have increased their food supply.

Quesnel River experienced several pulses of turbid water during transient seiche (internal lake wave) events and lake turnover. Post-event toxicity testing indicated that Quesnel River water did not affect survival or growth of fish, development of Rainbow Trout eggs through to alevins, survival or growth of daphnid zooplankton, or growth of plant test species. Richness and measures of diversity of the benthic invertebrate community in the river near the Community of Likely were similar to the reference locations as were the relative abundance of species sensitive to metals.

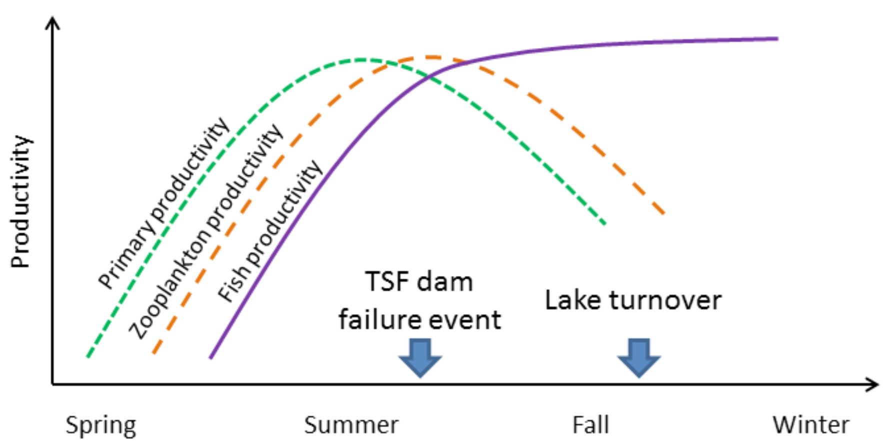


Figure 18: A conceptual lake productivity model under normal conditions showing rise of populations and, after a lag time, rise of their consumers' population/size

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5.0 WHERE DO WE GO FROM HERE?

This impact assessment has focused on the physical, chemical and biological impacts of the tailings dam failure in the first six to eight months immediately following the event. An assessment of longer term impacts will be conducted in the next phase of the remediation strategy in the human health and ecological risk assessment.

RESTORATION OF HAZELTINE CREEK

In the meantime, MPMC's skilled equipment operators and crew have been working with river engineers and biologists to rehabilitate Hazeltine Creek. The design for the restoration of Hazeltine Creek focussed on both the construction of a stable channel for water flow, and the restoration of suitable habitats for fish and wildlife. The overall objective for the restoration of fish habitats is primarily to restore trout spawning and rearing habitat in upper Hazeltine Creek and also for Coho and Sockeye salmon in lower Hazeltine Creek. The creek was also designed to restore habitat for wildlife associated with small streams and shoreline environments.

With this in mind, the engineering design of Hazeltine Creek included a number of key steps. First, a landscape assessment was conducted to evaluate the natural slopes and physical characteristics of the original creek and provide guidance for the channel reconstruction and design. Next, an assessment of water flow volumes was conducted so that the high and low flows of the creek could be accommodated. These elements were put together so that the design will accommodate water flow during peak flows, but maintain sufficient water for trout and other wildlife during low flows. A cross section of the final Hazeltine Creek conceptual habitat design (shown five years after completion) is shown below.

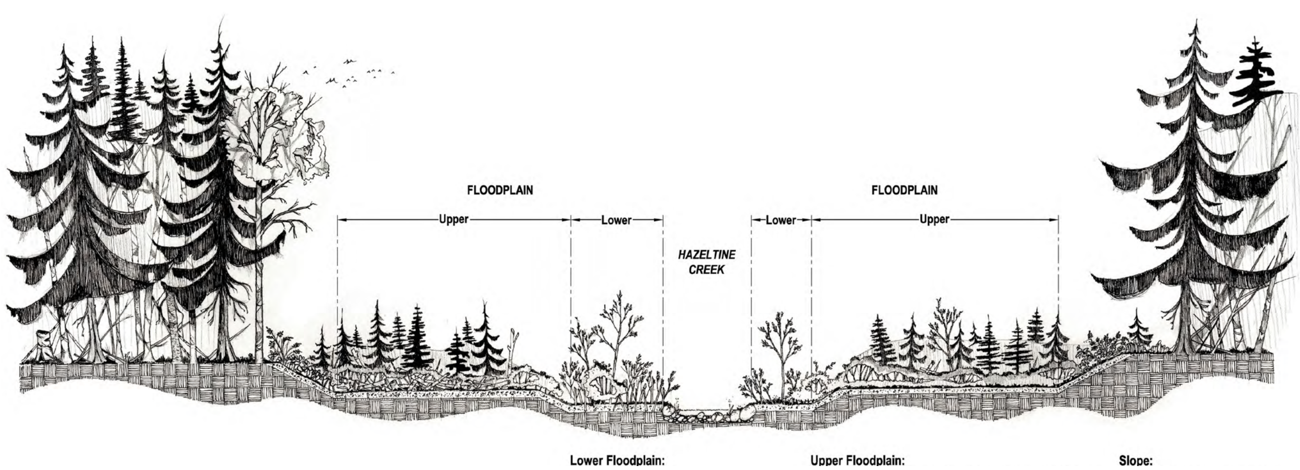


Figure 19: Conceptual channel cross section after five years (Envirowest, 2015)

The first stage of the construction process involved removing outwash materials from the tailings dam debris flow from the creek area and grading out the remaining material into a level floodplain. Tailings removed from the creek were returned to the Tailings Storage Facility. This stage is shown in Photo 1.

Once the floodplain was established, a channel designed for the mean annual flood was excavated into the floodplain under the direction of Golder's field engineer. Once excavated, this channel was lined with rock to prevent erosion and create a stable channel for water flow. This stage is shown in Photo 2.

The next stage (not yet complete) will be to construct habitat features within the new channel, including the installation of spawning gravels, rock weirs, boulders and woody debris. This stage is shown in Photo 3. Construction of some of these features was delayed because of the more immediate need to control erosion.

The final stage of the process is planting (some of which has been conducted), which will be completed over several years, based on the conceptual plan. This stage is shown in Photo 4.

Photo 1: Floodplain grading

Photo 2: Mean Annual Flow channel construction

Photo 3: Construction of habitat features, including rock weirs, is underway

Photo 4: Planting on the floodplain is underway

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Planning to initiate the Human Health and Ecological Risk Assessment over the summer of 2015 is underway. The findings from the PEEIAR have identified areas where additional investigation or confirmation is needed to assess impacts for the longer term. The first step in the risk assessment, is to identify:

i. the contaminants of concern;
ii. the potentially exposed people, plants and animals; and,
iii. the pathways through which people, plants and animals could be exposed to contamination associated with the tailings dam failure.

This process has been started and is reflected in the Conceptual Site Exposure Model (Figure 20). A sampling and analysis plan to obtain the data needed to understand contaminant exposure and potential effects has been started. The results from the long term tests, for example, the geochemistry test results that we not yet available at the time of writing the PEEIAR, will be incorporated into the risk assessment. Essentially, the Human Health and Ecological Risk Assessment will pick up from where the PEEIAR left off, adding data to support a longer term assessment of risk to both people and the environment.

POTENTIAL EXPOSURE PATHWAYS

Human Receptors

Soil	Incidental ingestion, dermal contact, dust inhalation
Surface water	Ingestion, dermal contact
Vegetation/Game	Ingestion

Terrestrial Wildlife Receptors

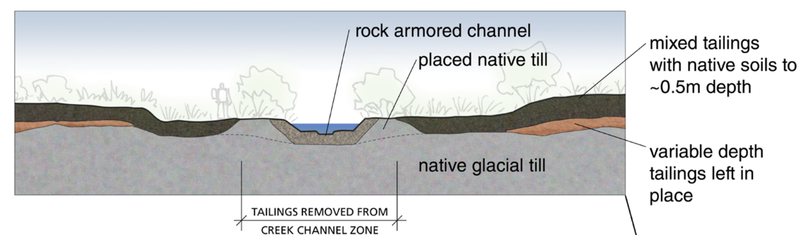
Soil	Incidental ingestion, dermal contact
Surface water	Ingestion, dermal contact
Vegetation/Prey	Ingestion

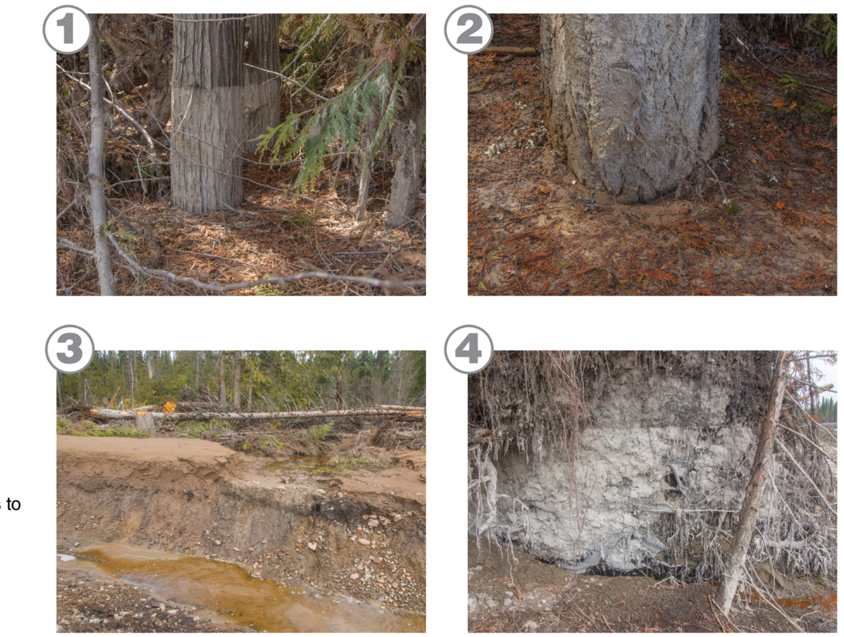
Terrestrial Soil Invertebrate and Plant Receptors

Soil	Direct contact, root uptake, soil neutralization, root suffocation

Aquatic Wildlife Receptors

Sediment	Incidental ingestion, dermal contact
Surface water	Ingestion, dermal contact
Vegetation/Prey	Ingestion

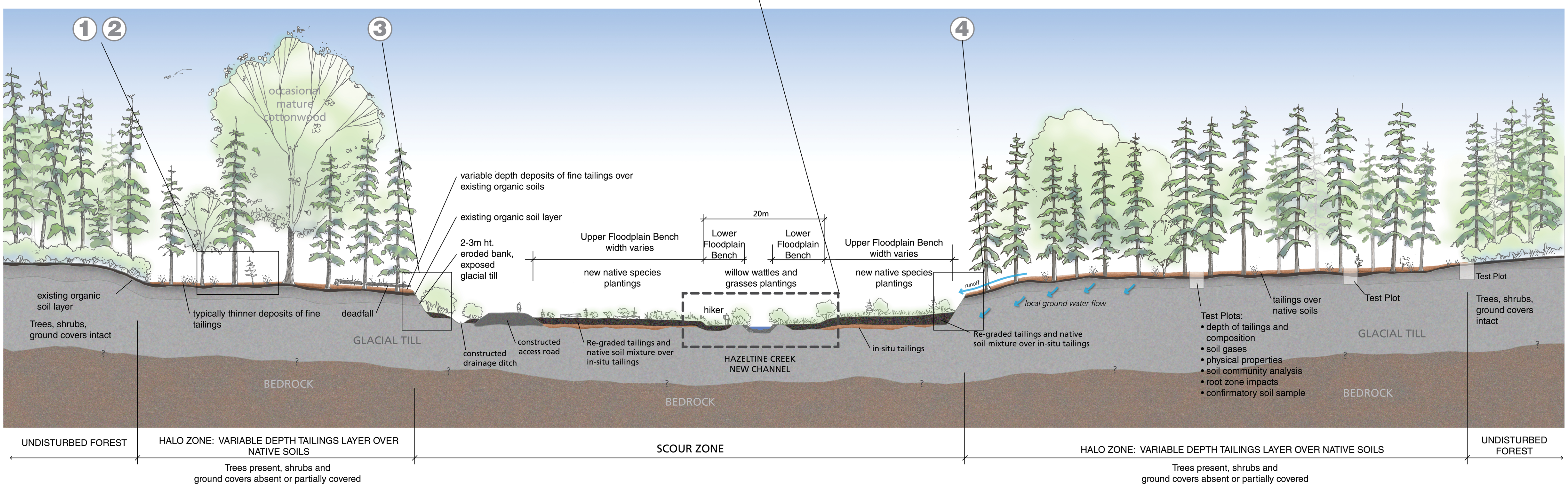




INFORMATION NEEDS

Confirmation of Remediation	Risk Assessment
•Survey elevation/ thickness of remaining tailings	•Plant tissue and soil sampling
•Volume estimates of remaining tailings	•Soil invertebrate and soil sampling
•Confirmatory soil sampling	•Confirmatory toxicity testing
•Photo documentation	•Survey of ecosystem health (test plots)
•Drawings by representative reach	•Oxygen profiles with depth in forest halo zone
•Groundwater assessment	•Dust assessment

Note: Drawings on this page are approximate to scale and are intended to illustrate general relationships and information as it is currently understood. Further studies may be required.



CONCEPTUAL SITE EXPOSURE MODEL (CSM)

REPRESENTATIVE SECTION: HAZELTINE CREEK - STATION 2+000

MAY 12/2015

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6.0 SUMMARY AND CONCLUSIONS

To date, the studies conducted and data analyzed as part of this Post-Event Environmental Impact Assessment indicate that the tailings dam failure has resulted in physical impact to Hazeltine Creek, the mouth of Edney Creek and the West Basin of Quesnel Lake. When the tailings mixed with eroded soil entered Quesnel Lake, most of the material settled on the lake bottom. Some finer particulates stayed in the water column and a turbidity plume formed near the lake bottom. The turbidity plume persisted in the deeper part of the lake until the fall turn-over happened. In addition, there were a few events following windy weather when some of the turbid water came to the surface. The main body of Quesnel Lake has now returned to normal, clear conditions and further turbid water events are not expected.

This short term assessment has found evidence for a physical impact on the Polley Lake, Hazeltine Creek and a portion of Quesnel Lake near Hazeltine Creek. A chemical change has also occurred, but the findings of the geochemical testing indicates that the tailings mixture is relatively inert. These findings indicate that although there are higher concentrations of copper in soil, sediment and water, they are not expected to result in adverse effects because release of metals from the tailings is unlikely. These findings of the geochemical impact assessment are supported by the findings to date of the biological impact assessment. The toxicity testing of sediment and water indicated that the copper in sediment and water was not toxic to aquatic life.

A chemical change has also occurred. Concentrations of copper in soil exceeded the provincial standard for the protection of soil invertebrates and plants, but were far below the standard for the protection of human health. The geochemistry testing indicates that the tailings mixture is relatively inert such that changes in water quality would not be expected. These geochemistry findings are consistent with water quality measurements In Quesnel Lake.

Although concentrations of total copper increased in the deeper water following the tailings dam failure, the concentrations of dissolved copper remained below the Provincial Water Quality Guideline. These findings indicate that although there are higher concentration of copper in soil, sediment and water, copper is not expected to result in adverse effects because release from the taililngs is unlikely.

The geochemistry findings are supported by the findings to date of the biological impact assessment. There was an immediate physical impact to the biological communities along the tailings mixture flow path, but there is no evidence of a residual impact. The toxicity testing of the sediment and water indicated that the copper was not toxic to aquatic life and studies of lake productivity have found no evidence of adverse effects.

This Post-Event Environmental Impact Assessment fulfills Phase II of MPMC's Restoration and Remediation Strategy. Phase III of the Strategy is underway focusing on evaluating potential longer term impacts and options for remediation with the aim of bringing closure to this event.

CLOSURE

We have developed this summary of the key findings of the Post-Event Environmental Impact Assessment to facilitate communications of the results of the technical studies. The reader is referred to the Technical Appendices to find greater details in the study designs, methods used, results and interpretation by each of the Technical Leads.

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7.0 GLOSSARY AND LIST OF ACRONYMS

GLOSSARY

TERM	DEFINITION
95th Percentile	The number in a distribution such that 95% of the values in the distribution are less than or equal to the number and 5% of the values are greater than the number.
Abrading	The action by which suspended solids wear away or erode fish tissues.
Acute	A stimulus severe enough to rapidly induce an effect; in aquatic toxicity tests, an effect observed in 96 hours or less is typically considered acute. When referring to aquatic toxicology or human health, an acute effect is not always measured in terms of lethality.
Additive	When two or more substances acting in combination produce a total effect that is equivalent to the sum total of the individual effects of each substance.
Adsorbed	Refers to atoms, ions or molecules that are adhered or bonded to a surface.
Adverse effect	An effect that results in a negative impact or is considered undesirable.
Aggradation	Increase in channel bed elevation due to the deposition of sediment. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the system is able to transport. Opposite to degradation.
Alkalinity	A measurement (expressed in mg/L of calcium carbonate) of the capacity of water to neutralize acids. The concentration is measured based on the presence of naturally available bicarbonate, carbonate, and hydroxide ions.
Angle of Repose	Steepest angle, relative to the horizontal plane, at which a granular material will come to rest when added to a pile of similar material.
Antagonistic	Refers to an effect resulting from the opposing effects of two substances or actions.
Antecedent Conditions	Conditions that existed at a site prior to an event under consideration.
Anthropogenic	Created by people
Avulsion	The formation of a new stream channel. Avulsions typically occur during flood events.
Bankfull Depth	Average flow depth at bankfull discharge.
Bankfull Discharge	Discharge that occurs just before water flows out of a channel and onto the surrounding floodplain in a vertically stable channel. Bankfull discharge is the dominant channel forming flow that is exceeded on average every 1 – 2 years.
Bankfull Width	Channel width at bankfull discharge.
Benthic	At the lake bed
Benthivore	An animal that eats benthic prey
Bioaccumulation	The accumulation of a substance in the tissues of an aquatic organism through exposure to water and diet.

Bioaccumulation factor	The ratio of the concentration of a substance in tissue to its concentration in water or the diet, when the organism could have accumulated the substance through either media.
Bioavailability	The portion of a substance or chemical that is immediately available for uptake by organisms. Bioavailability of different substances can change over time.
Bioconcentration	The accumulation of a substance in the tissues of an aquatic organism through exposure to water only (does not include dietary uptake).
Bioconcentration factor	The ratio of the concentration of a substance in tissue to its concentration in water.
Biomagnification	Increasing tissue concentrations of a substance solely through uptake from food such that the tissue concentrations increase at each trophic level in the food web.
Biomass	Refers to the mass of biological material, including plants, animals and decaying organic matter, present within a particular habitat, area or ecosystem at any one time.
Biota	Plant and animal life found in a region, watercourse or waterbody.
Bioterrain	A classification system that combines recognizable permanent terrain and landscape features with recognizable biological and inferred soil drainage characteristics.
Blanket	Surface expression characteristic used in terrain mapping to differentiate thickness of surface material greater than 1 m.
Blue list	Refers to species and ecological communities with a conservation status of Special Concern in British Columbia.
Braided	Channel pattern resembling hair braid, consisting of small channels separated by bars that divide and rejoin at low flows.
Channel	The bed and banks of a stream, whether or not it usually contains water. Channels are linear depressions through which water and sediment is conveyed through a watershed.
Chlorophyll a	A photosynthetic pigment found in plants responsible for the conversion of inorganic carbon and water into organic carbon. The concentration of chlorophyll a is an indicator of algal concentration.
Chronic	The development of adverse effects after extended exposure to a given substance. In chronic toxicity tests, the measurement of a chronic effect can be reduced growth, reduced reproduction or other non-lethal effects, in addition to lethality. Chronic should be considered a relative term depending on the life span of the organism.
Conductivity	A measure of the ability of water to carry an electrical current. This measurement is directly related to the amount of positively (cations) and negatively (anions) charged ions in the water and can be correlated with the concentration of total dissolved solids.
Confluence	Refers to the location at which two watercourses join and become one stream or river.
Coniferous	Refers to trees that have needles or scales instead of leaves.

Constituent	An individual chemical, property, or measurement in water (e.g., aluminum, chloride, total dissolved solids)
Contaminant of Potential Concern (COPC)	A chemical that is emitted or released into the environment and poses a potential risk of exposure to humans or ecological receptors.
Contiguous	Refers to two items or entities that are touching or side-by-side.
Creek	Branch of or small tributary to a river.
Crepuscular	Feeding at dawn and dusk
Debris	Soil that contains a significant portion of coarse material; 20% to 80% inorganic particles greater than 2 mm, and the remainder less than 2 mm.
Debris Fall	Detachment of debris from a steep slope or river bank. Material is transported through the air by falling, rolling, or bouncing.
Debris Flood	Hyper-concentrated sediment flow that is transitional between a debris flow and a purely hydrologic flood.
Debris Flow	A debris flow is a very rapid to extremely rapid mass movement (typically greater than 5 m/s) of saturated non-plastic debris in a channel. Debris flows normally have volumetric sediment concentrations of 50-90%. In this report, we utilize the term debris flow to describe the rapid to extremely rapid surges of fine grain tailings and native material that travelled down Hazeltine Creek Channel following the Tailings Storage Facility failure on August 4, 2014.
Deciduous	Refers to trees that have broad leaves that are shed in the fall.
Degradation	The process by which a channel down cuts due to erosion of sediment from the stream bed.
Delta	A fan-shaped deposit of sediments occurring where a stream meets standing water.
Deltaic Deposits	Sediment deposited within a delta by a river.
Deposition	The process by which transported sediment, soil, and rock comes to rest. Deposition occurs when the force of transportation is overcome by the forces of friction and gravity.
Detritus	Small particles of organic matter produced by the breakdown and decay of plant and animal matter.
Diatom	A type of planktonic algae. Diatoms are generally unicellular and have cell walls that contain silica.
Digital Elevation Model (DEM)	The most common digital representation of the shape of the earth's surface. A DEM uses a network of cells, each with a single elevation value, to create a continuous topographic surface.
Dimictic	Refers to lakes that mix from top to bottom twice a year; mixing occurs in spring and fall.

Discharge	The volumetric rate of flow of water in a watercourse at a specified point, expressed in units of m^3/s or equivalent.
Displaced Material	Material removed from its original position by erosion processes.
Dissolved organic carbon (DOC)	The dissolved portion of organic carbon in water. It is comprised of humic substances and partly degraded plant and animal materials.
Dissolved oxygen (DO)	The amount of free oxygen dissolved in water, usually expressed in milligrams per litre (mg/L), parts per million (ppm), or percent of saturation (%). Adequate concentrations of dissolved oxygen are necessary for fish and other aquatic organisms.
Downstream	Away from the source of a river or stream.
Duff	The litter layer of fallen leaves, small twigs, needles and other plant debris on the surface of the soil.
Dyke	A long wall or embankment built to prevent flooding.
Emergent	Refers to a plant that is rooted in a waterbody and grows out of the water (e.g., cattail).
Entrenched	Vertically incised, relatively narrow channel that is hydrologically disconnected from the floodplain.
Ephemeral	Refers to a habitat feature that is not always present (e.g., an ephemeral waterbody only contains water at certain times of the year).
Emerging insect	Insects that have a water-based larval stage and a flying adult stage.
Epilimnion/epilimnetic	The water column above the thermocline
Epiphyton	Algae that grow on the surfaces of aquatic plants
Erosion	Geomorphic processes (excluding weathering and mass movement) that involve the removal and entrainment material or rock by an erosive force. Includes vertical and lateral removal of material from a river bed, channel banks and floodplain.
Euphotic zone	In an aquatic environment, it is the uppermost layer of water that receives sufficient sunlight to promote photosynthesis.
Eutrophic	Excessive growth of algae or other primary producers in a stream, lake, or wetlands as a result of large amounts of nutrient ions, especially phosphate or nitrate.
Extirpated	Refers to a species that is no longer present in a particular area but still exists elsewhere (i.e., is not extinct).
Fall	Detachment of soil or rock from a steep slope or river bank. Falling describes a process where there is effectively no shear displacement along the failure surface and where material is transported through the air by falling, rolling, or bouncing.
Far-field	An area far removed from the zone of influence.
Field duplicate	A second water sample that is collected at the same place and time as the original water sample.
Fjord lake	A lake formed by the action of receding glacial ice.

Floodplain	Floodplains are generally broad, gently sloped valley floors that provide a spatial link between the river and the surrounding lands. They form through deposition of sediment within the channel during channel migration and deposition over the channel bank during floods.
Forage fish	Small fish that are prey for larger fish
Freshet	Flow conditions resulting from the melting of snow and ice in spring.
Frost Heave	The uneven lifting or upward movement, and general distortion, of surface soils, rocks, vegetation, and structures such as pavements, due to subsurface freezing of water and growth.
Frost Jacking	Frost jacking is the upward movement of improperly anchored surface structures as a result of frost heaving.
Fry	A young, newly hatched fish that has used up its yolk sac and has started active feeding.
Gastropod	A class of molluscs that includes slugs and snails
Generalist	Refers to an organism that uses a variety of foods or habitats
Geochemistry	The chemistry of the composition and alterations of solid matter such as sediments or soil.
Glacial Till (Moraine)	Sediment deposited directly by or from a glacier with little to no reworking by water. Till deposits are typically diamictons, consisting of large clasts set within a fine grained matrix of silt and clay.
Gully Erosion	Entrainment and transport of soil material by water resulting in the enlargement of a gully. Gullies are ephemeral channels deeper than 30 cm occurring where flows concentrate to cut a channel through erodible soil. Gullies are relatively deeper and narrower than stream channels, with steep sidewalls and steep channel slopes.
Habitat	The physical space within which an organism lives, and the abiotic and biotic entities (e.g., resources) it uses and selects in that space.
Hardness	A measure of the mineral content of a water sample; magnesium- and calcium-containing compounds contribute to water hardness. Water samples with high and low mineral contents are referred to either hard or soft, respectively.
Humic	Describes substances that contribute to the natural organic matter found in water.
Hydraulic residence time	Time required for a volume of water equivalent to the lake volume to be discharged from a lake (lake volume divided by daily river discharge).
Hypolimnion	The water column below the thermocline
Hypoxic	Refers to a watercourse, waterbody or water sample that has low levels of dissolved oxygen. Generally this refers to water conditions where dissolved oxygen is less than 5 mg/L or in the range of 1 to 30% saturation.

Hysteresis	Hysteresis occurs when the relationship between discharge and suspended sediment concentration or turbidity values change through a hydrograph. A common pattern is created when the suspended sediment concentration or turbidity values are higher during the rising limb of a storm hydrograph than the falling limb for a given discharge, forming the shape of a loop on the plot of discharge and suspended sediment or turbidity.
Incising	Process of a channel eroding vertically into its bed.
In situ	In place, i.e., measured in the field.
Ion	A molecule or atom that has a net positive or negative electric charge due to an uneven number of electrons and protons.
Ionic strength	An expression of the ionic charge in a sample of water. The greater the concentration of ions in a sample, the greater the ionic strength.
Knick-point	A short over-steepened segment of the longitudinal profile of a river caused by the headward erosion of a resistant layer in the river bed. Knick-points migrate upstream with time.
Lacustrine deposits	Sediments that have settled from suspension in bodies of standing freshwater, or sediments that have accumulated at their margins through the action of waves. Lacustrine deposits are typically fine grained, consisting of stratified sands, silts, and clays. Glaciolacustrine deposits result from similar processes in ice-dammed lakes, and share many characteristics with lacustrine deposits.
Lethality	Refers to the ability of a toxicant or action to cause death.
LiDAR	Light Detection and Ranging (LiDAR) is a remote sensing technology which determines the range of an object by measuring the time delay between the transmission of a laser pulse and detection of the reflected signal. LiDAR sensors are commonly aircraft-mounted, and used to acquire high resolution data of the Earth's topographic surface.
Limnetic zone	The water column in the euphotic zone
Limnological	Pertaining to the study of open fresh and more rarely saline waterbodies, specifically lakes and ponds (both natural and manmade), including their physical, chemical, and biological properties.
Littoral zone	The area of the lakeshore where aquatic plants grow.
Lowest Observed Effect Concentration (LOEC)	Refers to the lowest concentration of a substance that is found to cause an adverse effect to the growth, development or lifespan of a test organism.
Macroinvertebrates	A group of animals that lack a spinal cord and are large enough to be seen with the naked human eye.
Mean	Arithmetic average value in a distribution.
Median	A single statistical value used to characterize a series of data values. Half of the data values are larger than the median value, and half of the data values are less than the median value.
Mesotrophic	Describes the trophic status of a watercourse or waterbody with moderate nutrient enrichment; total phosphorus concentrations are generally between 10 and 20 micrograms per litre.

Metals	Any of a class of substances (including many chemical elements) which are in general lustrous, malleable, fusible, ductile solids and good conductors of heat and electricity.
Metalloids	Any element intermediate in properties between metals and non-metals. A metalloid element has the form or appearance of a metal.
Method detection limit	Refers to the lowest concentration of a substance (e.g., metal, nutrient) that can be measured with 99% confidence that the measured concentration is not equal to zero (i.e., the substance is present in the sample media).
Mid-field	An area located a moderate distance from the zone of influence.
Mitigation	The elimination, reduction or control of the adverse environmental effects of a project, including restitution for any damage to the environment caused by such effects through replacement, reclamation, compensation, or any other means.
Mustelid	A member of the weasel family
Native Material	Native material refers to the soils, surficial deposits, and bedrock that were present in the study area prior to the event.
Near-field	An area located within or near the zone of influence.
Nival Hydrologic Regime	Hydrological system that is dominated by snow melt.
Non-vascular plants	Mosses, liverworts and lichens
Nutrients	Elements or chemicals essential to growth or repair of organic bodies, including carbon, oxygen, nitrogen, phosphorus, and silica.
Oligotrophic	Trophic state classification for lakes characterized by low productivity and low nutrient inputs (particularly total phosphorus).
Ore	A type of mineral or rock that contains relatively large concentrations of metals or other economically valuable substances.
Orthophosphate	A phosphate-containing salt or ester.
Parameter	A particular physical, chemical, or biological property that is being measured.
Peak Stage	Highest elevation that the surface of a flow attains during a flood or debris flow.
Periphyton	Algae that grow on the surface of rocks
pH	The negative log of the concentration of the hydronium ion. It is a measure of the acidity or alkalinity of all materials dissolved in water, expressed on a scale from zero (0) to 14, where seven (7) is neutral, values below seven are acidic and values over seven are alkaline.
Phytoplankton	Free-floating plants/algae and photosynthetic bacteria.
Piscivore	An animal that eats fish
Planform	Pattern a river channel makes on a map or aerial photograph. River planforms include braided, meandering, straight, wandering, and anastomosed.
Planktivore	An animal that eats plankton
Plankton	Microscopic aquatic organisms (tiny plants [phytoplankton] and animals [zooplankton]) free-floating and suspended in the water column.

Plume	Describes a discharge in terms of its shape, size and/or direction of movement within the receiving environment, namely surface water.
Productivity	A measure of the biomass produced by an aquatic system.
Profundal zone	The water column below the euphotic zone
Raptor	A predatory bird with a hooked beak and feet with talons
Reach	Any length of the channel similar in hydrological and/or geomorphological characteristics.
Red list	Refers to species and ecological communities with a conservation status of Extirpated, Endangered, or Threatened in British Columbia.
Redox	Refers to reduction and oxidation reactions in which electrons are transferred between atoms.
Remediation	The process of removing, reducing or neutralizing the adverse effects a hazardous material has on the environment.
Remobilize	Entrainment of a particle following deposition.
Retrogression	Slope failure in which the surface of rupture propagates upslope.
Riffle-pool morphology	Riffle-pools are channels characterized by a sequence of bars, pools, and riffles. Pools are topographic low points within the longitudinal profile of the channel, while riffles are topographic high points. Riffle-pool channels occur at moderate to low gradients, and are generally unconfined with well-developed floodplains.
Rill Erosion	Rills are shallow drainage channels from 50 mm and 300 mm in width and up to 300 mm in depth. They develop when runoff concentrates in depressions or low points and erodes the soil.
Riparian	Refers to the terrestrial ecosystems adjacent to a water body that are influenced by the presence of the water body.
Risk assessment	Process that evaluates the probability of adverse effects that may occur, or are occurring on target organism(s) as a result of exposure to one or more stressors.
Rut	The mating season of ungulates
Scour	Vertical erosion of the river bed and floodplain
Sediment	Solid material that is transported by, suspended in, or deposited from water. It originates mostly from disintegrated rocks; it also includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope soil characteristics, land usage and quantity and intensity of precipitation.
Seiche	A type of long-wavelength wave that occurs as a result of some disturbance within waterbody that is relatively closed-off from the outside environment. Long waves resonate outward to the boundaries of the waterbody, and then resonate back inward.
Shear Stress	A force produced by water flowing at the bed of the channel

Significant	A term used in statistics to describe the likelihood that a given outcome of a tested difference or similarity is in fact due to some relationship, rather than chance.
Silica	A tough, hard substance found in the cell walls of diatoms.
Sinuosity	Measure of the total length of a channel, where channel length increases with number and size of bends. Sinuosity Index (SI) is calculated by dividing the main channel length by the valley length.
Slope Failure	Movement of a mass of soil, rock or debris down a slope.
Snag	A standing dead tree
Soil (earth)	Material that contains more than 80% of inorganic particles smaller than 2 mm.
Soil/Earth Fall	Detachment of soil (earth) from a steep slope or river bank. Material is transported through the air by falling, rolling, or bouncing.
Sonde instrument	An instrument used to measure water quality (e.g., dissolved oxygen, pH, conductivity, temperature) in situ.
Speciation (metal)	The form of a metal occurring in water.
Specific conductivity	Represents the ability of a water sample to conduct an electrical current. Waters with higher concentrations of dissolved salts will have a greater specific conductance. The measurement is corrected based on temperature.
Standard deviation	An expression of the spread or variation of a collection of data values or measurements.
Standard error	The standard deviation of a calculated statistic.
Step-pool morphology	Step-pool channels are characterized by steps made up of large rocks that span the channel alternating with pools containing finer material. Step-pool channels develop on steep gradients, are generally narrow and deep, and confined by valley sides.
Storativity	Dimensionless quantity, and ranges between 0 and the effective porosity of the aquifer.
Stratification	The process by which the water column develops layers of water separated by a density barrier.
Sub-watershed	A smaller portion of a watershed containing a drainage area, which is connected to the larger portion by a single channel.
Supernatant	A liquid layer overlying a more solid layer.
Synergistic	When two or more substances acting in combination produce a total effect that is greater than the sum total of the individual effects of each substance.
Tailings	The substances and materials remaining after metals and/or other economically valuable substances are removed from ore.
Temporal	Occurring over time.
Terrace	Horizontal fragments of floodplains recorded in the landscape above the modern floodplain. Terraces are created by the incision (downcutting) of a stream channel, leaving the former floodplain level(s) higher than the modern floodplain.

Terrestrial Ecosystem Mapping	A provincial standard system of mapping that uses bioterrain characteristics combined with vegetation cover to delineate terrestrial ecosystems.
Thalweg	The deepest part of a channel formed by joining the lowest points along the length of a waterway. The thalweg is almost always the line of fastest flow in a watercourse.
Thermal stratification	Refers to the process by which layers of water having different temperatures form within a waterbody.
Thermocline	The location of a sharp change in temperature of the water column that causes a density barrier and limits mixing of the water column.
Topple	Forward rotation, out of the slope, of a block of soil/rock, about a point or axis below the centre of gravity of the displaced mass (Couture, 2011).
Total Dissolved Solids (TDS)	The dissolved matter found in water that is comprised of mineral salts and small amounts of other inorganic and organic substances.
Total phosphorus	A measurement of particulate and dissolved phosphorus and phosphate molecules in water.
Total suspended solids (TSS)	The amount of suspended substances in a water sample. Biotic (e.g., plankton) and abiotic (e.g., silt) solids that can be removed from a water sample by filtration.
Toxic	Refers to a substance, dose, or concentration that is harmful to a living organism.
Toxicant	A substance that elicits a toxic, harmful effect in a living organism.
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism.
Turbidity	The degree of clarity in the water column or in a water sample; turbidity can be used as a surrogate measure of the amount of suspended particulate matter in a waterbody.
Turnover	A seasonal process that involves the mixing of upper and lower layers of water within a lake; mixing of water masses is depended on water temperature and density.
Ungulate	A hoofed mammal; in this report includes deer, moose and caribou.
Uptake	The process by which a chemical crosses an absorption barrier and is absorbed into the body.
Vascular plants	Trees, shrubs, grasses, herbs, and forbs.
Veneer	Surface expression characteristic used in terrain mapping to differentiate thickness of surface material less than 1 m.
Veteran	Refers to a large old tree that is older and larger than the surrounding trees and has survived previous disturbances.
Water quality	A measure of concentrations of contaminants, or naturally occurring minerals, in water. Lower concentrations of a particular contaminant generally lead to better water quality.
Watershed	The area drained by a river or stream.
Zooplankton	Free-floating invertebrates

ACRONYMS

ACRONYM	TERM
ADCP	Acoustic Dopper Current Profiler (instrument)
ADEC	Alaska Department of Environmental Conservation
AHI	Aquatic Habitat Index
AIA	Archeology Impact Assessment
ALR	Agricultural Land Reserve
ALS	ALS Environmental
ANOVA	Analysis of Variance
AP	Acid Potential
ARD	Acid Rock Drainage
ASTM	American Society for Testing Materials
ATL	Acceptable Tissue Level
Avg.	Average
BACI	Before-After-Control-Impact
BC	British Columbia
BC index	Bray-Curtis index of dissimilarity
BC MoE	British Columbia Ministry of Environment
BC MoF	British Columbia Ministry of Forests
BC WQG	British Columbia Water Quality Guidelines
BCCDC	British Columbia Conservation Data Centre
BCSQG	British Columbia Working Sediment Quality Guidelines
BGS	Below Ground Surface
BLC	Blackwater Creek reference area
BLM	Biotic Ligand Model
BOL	Bootjack Lake reference area
C	Carbon
CA	Correspondence Analysis
CABIN	Canadian Aquatic Biomonitoring Network
CaCO3	Calcium Carbonate
CALA	Canadian Association for Laboratory Accreditation
CAR	Cariboo River Reference Area
CCLUP	Cariboo Chilcotin Land Use Plan
CCME	Canadian Council of Ministers of the Environment
CDC	BC Conservation Data Centre
CEC	Cation Exchange Capacity
CEIA	Comprehensive Environmental Impact Assessment
CETIS	Comprehensive Environmental Toxicity Information System
CFIA	Canadian Food Inspection Agency

CHC	Canyon Hazeltine Creek
CI	Control-Impact
CLR	Clearwater River Reference Area
CMN	Community Mapping Network
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
Cr (III)	Trivalent Chromium
Cr (VI)	Hexavalent Chromium
CRA	Commercial, Recreational or Aboriginal
CSR	Contaminated Sites Regulation (CSR)
CSR PL	Contaminated Site Regulation – Park Land
CSR WL	Contaminated Site Regulation – Wildlands
CSSC	Canadian System of Soil Classification
CSST	Contaminated Sites Soil Task Group
CTD	Combined Temperature and Depth (instrument)
Cu2+	Copper (Free Ion)
CUBE	Combined Uncertainty Bathymetry Estimator (data processing technique)
CuCO3,Cu(CO3)22-	Copper Carbonates
Cu-DOC	Copper Bound To Dissolved Organic Carbon (DOC)
CuOH+, Cu(OH)2	Copper Hydroxides
CVAFS	Cold Vapour Atomic Fluorescence Spectrophotometry
dCu	Dissolved Copper
DEM	Digital Elevation Model
DFO	Department of Fisheries and Oceans Canada
DL	Detection Limit
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
Doi	Ideal Solution Diffusion Coefficient
DQA	Data Quality Assessment
Dsi	Bulk Sediment Diffusion Coefficient
dw	Dry Weight
EA	Environmental Assessment
EC	Electrical Conductivity
EC20	Concentration at which a 20% effect is observed
EEM	Environmental Effects Monitoring
EFS	Effective Female Spawner
EMA	Environmental Management Act

EMTF	Exposure and Toxicity Modifying Factors
EPH	Extractable Petroleum Hydrocarbons
EPT	Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies and caddisflies)
ESP	Extractable Sodium Percentage
FFHIA	Fish and Fish Habitat Impact Assessment
FFP	Fish Protection Provisions
FIM	Foreshore Inventory Mapping
FSR	Forest Service Road
GAPS	Global Acoustic Positioning System
GIF	Ground Inspection Form
GIS	Geographic Information System
GLBD	Growth Limiting Bulk Density
GoC	Government of Canada
Golder	Golder Associates Ltd.
GPS	Global Positioning System
HAC	Hazeltine Creek
HCT	Humidity Cell Test
HDPE	High-Density Polyethylene
HEPH	Heavy Extractable Petroleum Hydrocarbon
HHERA	Human Health and Ecological Risk Assessment
HIA	Hydrotechnical and Geomorphological Impact Assessment
HSRMP	Horsefly Sustainable Resource Management Plan
H3D	Three-dimensional hydrodynamic model maintained by TetraTech EBA.
ICH	Interior Cedar-Hemlock
ICHmk3	Horsefly moist cool Interior Cedar-Hemlock variant
ICHwk1	Quesnel Wet, Cool Interior Cedar-Hemlock variant
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICP-OES	Inductively Coupled Plasma-Optical Emission Spectrophotometry
ID	Identification Number
IDNR	Iowa Department of Natural Resources
IFC	Interior Fraser Coho
Imperial Metals	Imperial Metals Corporation
IP	Indicator Parameter
JSF	Edgetech Digital File Format
KB corer	Kajak-Brinkhurst corer
LAHIA	Lake Aquatic Health Impact Assessment
LEC	Lower Edney Creek

LEPH	Light Extractable Petroleum Hydrocarbon
LFF	Lake Far Field
LFFF	Lake Far Far Field
LFH	Forest Floor (Litter, Fermented, Humus)
LHC	Lower Hazeltine Creek
LNF	Lake Near Field
LOD	Limit of Detection
LOEC	Lowest Observed Effect Concentration
LPL	Lowest Practical Level
LU	Landscape Unit
LWD	Large Woody Debris
MAF	Mean Annual Flood
MANOVA	Multivariate Analysis of Variance
Max	Maximum
MCI	Multiple Control-Impact
MDL	Method Detection Limit
MEM	Ministry of Energy and Mines
MFLNRO	BC Ministry of Forests, Lands and Natural Resource Operations
MIBC	Methyl Isobutyl Carbinol
MIBK	Methyl Isobutyl Ketone
Min	Minimum
Mine	Mount Polley Mine
Minnow	Minnow Environmental Inc.
ML/ARD	Metal Leaching and Acid Rock Drainage
MMER	Metal Mining Effluent Regulations
MOE	British Columbia Ministry of Environment
MPI	Mount Polley Investigation
MPM	Mount Polley Mine
MPMC	Mount Polley Mining Corporation
MS	Model Skill
MSDS	Material Safety Data Sheet
MWLAP	BC Ministry of Water, Lands and Air Protection
n	Sample Size (number of samples)
N/A	Not Applicable
NMS	Non-Metric Multidimensional Scaling
NNP	Net Neutralization Potential
NP	Neutralization Potential
NPR	Neutralization Potential Ratio
NTU	Nephelometric Turbidity Units
NWT	Northwest Territories

ODEQ	Oregon Department of Environmental Quality
OGMA	Old-Growth Management Area
PAD	Permanent Alteration and/or Destruction of Fish Habitat
PAH(s)	Polycyclic Aromatic Hydrocarbons
PAO	Pollution Abatement Order
PCA	Principal Components Analysis
PEEIAR	Post-Event Environmental Impact Assessment Report
PEL	Probable Effect Level
PEM	Predictive Ecosystem Mapping
PHABSIM	Physical Habitat Simulation
PHREEQC	pH REdox EQuilibrium (in C language)
PIR	Panel Investigation Report
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
PoE	Pathway of Effects
POIs	Parameters of Interest
POL	Polley Lake
POPs	Preferred Operating Procedures
PP	Polley Plug
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QEMSCAN	Quantitative Evaluation of Minerals by Scanning Electron Microscopy
QRRC	Quesnel River Research Centre (University of Northern BC)
QUL	Quesnel Lake
QUR	Quesnel River
R2 Value	Coefficient of Determination
RCA	Reference Condition Approach
Redox	Reduction-Oxidation
RIC	Resources Inventory Committee
RISC	Resources Information Standards Committee
RMA	Riparian Management Area
RPD	Relative Percent Difference
RRS	Restoration and Remediation Strategy
R/V	Research Vessel
RMS	Root-Mean-Square
RMSE	Root-Mean-Square Error
SALM	Strong Acid Leachable Method
SAR	Sodium Adsorption Ratio

SARA	Species At Risk Act
SD	Standard Deviation
SE	Standard Error
SERDS	Southeast Rock Disposal Site
SEV	Severity of Ill Effect
SIA	Soils Impact Assessment
Site or Study Area	Hazeltine Creek Study Area
SNC	SNC-Lavalin Inc.
SQG	Sediment Quality Guidelines
SQIA	Soil Quality Impact Assessment
SQIC	Sediment Quality Impact Characterization
SQT	Sediment Quality Triad
SRC	Saskatchewan Research Council
SRC	Sample Receipt Confirmation
SRK	SRK Consulting (Canada) Inc.
SRMPs	Sustainable Resource Management Plans
ST	Soil Transect
TDS	Total Dissolved Solids
TEL	Threshold (or Lowest) Effect Level
TEM	Terrestrial Ecosystem Mapping
TIA	Terrestrial Impact Assessment
Tetra Tech	Tetra Tech EBA Inc.
TIC	Total Inorganic Carbon
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TP	Test Pit
TRIM	Terrain Resource Information Management
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
Tu	Turbidity
UBC	University of British Columbia
u/s	Upstream
UCLM	Upper Confidence Limit of the Mean
UEC	Upper Edney Creek
UFFCA	Upper Fraser Fisheries Conservation Alliance
UHC	Upper Hazeltine Creek
UNBC	University of Northern British Columbia
US EPA	United States Environmental Protection Agency
USA	United States of America

USBL	Ultra Short BaseLine (Acoustic positioning system)
USCS	Unified Soil Classification System
UTM	Universal Transverse Mercator
UWR	Ungulate Winter Range
VO2+	Vanadyl Cation
VOC(s)	Volatile Organic Compounds
VRI	Vegetation Resources Inventory (mapping)
W11	Lower Hazeltine Creek
W7	Upper Hazeltine Creek
WEA	Weight of Evidence Approach
WHA	Wildlife Habitat Area
WLWB	Wek'èezhìi Land and Water Board
WQ	Water Quality
WQG	Water Quality Guideline
WQIA	Water Quality Impact Assessment
WSC	Water Survey of Canada
WW	Wet Weight
YOY	Young-of-the-year
YWL	Williams Lake Airport

UNITS

SYMBOL	DEFINITION
-	minus
%	percentage
+	plus
<	less than
>	greater than
≤	less than or equal to
°C	degrees Celsius
μg/g	microgram per gram
μg/L	micrograms per litre
μm	micrometre
μs/cm	microsiemens per centimetre
cm	centimetre(s)
cmol	The SI base unit for amount of substance is the mole. 1 mole is equal to 100 cmol.
CPUE	catch per unit effort
d	day
g	grams
g/cm^3	gram per cubic centimetre
h	hour
ha	hectare(s)
kg	kilogram
km	kilometre(s)
km^2	square kilometre(s)
km^3	cubic kilometre(s)
m	metre(s)
m^2	square metre(s)
m^3	cubic metre(s)
m^3/s	cubic metres per second
meq	milliequivalents
mg	milligram
mg N/L	milligrams of nitrogen per litre
mg/kg	milligram per kilogram
mg/kg dw	milligrams per kilogram as dry weight
mg/kg lwt	milligram per kilogram based on lipid adjusted weight of sample
mg/kg wwt	milligram per kilogram based on wet weight of sample
mg/L	milligrams per litre
mg/m^2	milligram per square metre
mg/m^3	milligram per cubic metre

Mg/m^3	megagram per cubic metre
mg/ml^2	milligram per square millilitre
mL	millilitre(s)
mm	millimetre(s
Mm^3	million cubic metres
N	total number (count)
NTU	Nephelometric Turbidity Unit
UTM	Universal Transverse Mercator

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