



## MEMORANDUM

**Date: November 21, 2016**

**File:**

**To: Mark Zacharias,  
Assistant Deputy Minister  
Environmental Protection Division**

**Polley Lake Water Quality for samples collected September 15, 2014 to August 25, 2016 compared to Drinking Water and Aquatic Life Guidelines**

Water samples from Polley Lake have been collected by Ministry of Environment (MoE) staff as part of the Ministry's monitoring program with respect to compliance/audit and quality assurance/quality control (QA/QC) purposes. This will allow the Ministry to re-affirm Mount Polley Mining Corporation (MPMC) sampling results and determine the state of the water quality in Polley Lake. MoE has reported out on these results since the Mount Polley Mine Breach on August 4, 2014. All data and associated maps have been made publically available on the MoE Mount Polley Breach website [<http://www.env.gov.bc.ca/epd/mount-polley/>].

This memo is to summarize and provide any conclusions in the data from the past two years of sampling data collected. For this memo, water samples collected between September 15, 2014 and August 25, 2016 are reviewed to determine potential impacts to drinking water and to aquatic life. It should be noted that Polley Lake is not a source of drinking water. In addition, summary graphs have been included which illustrate data results for Polley Lake North and South sites. Please note that this is the last Polley Lake memo MoE will be publishing so that more resources can be put towards other areas of the Mount Polley monitoring project.

The parameters analysed include pH, conductivity, turbidity, total suspended solids, total dissolved solids, total organic carbon, hardness, alkalinity, nutrients, general ions, total and dissolved metals. Samples collected are analyzed by ALS Environmental (previously by Maxxam Analytical) including MPMC samples.

As part of the QA/QC measures taken by MOE, replicate (REP) samples were collected at the Polley Lake North and South sites as well as an equipment blank (BLE), field blank (BLF) and lab blank (BLL) every time it was sampled. The replicate and lab blank results were within the acceptable percent difference allowed for QA/QC purposes; however in the BLE and BLF, trace readings of some metals were noted (lead, zinc). MOE staff ordered new sampling equipment to rule out the potential for equipment contamination. Minor zinc contamination is still occurring with new equipment, so MoE is continuing to investigate all other sources of zinc introduction (i.e. filtering supplies, DI water, etc.). Side-by-side samples were collected with MPMC on three dates. MoE collected the same depths of water at the same time as MPMC so a comparison could be made and sampling techniques verified. Out of all of the samples and depths of water collected, the QA/QC check was 93% in agreement.

An overall assessment of the data from Polley Lake from September 2014 up to and including August 2016 results was conducted. Turbidity and copper levels have been the main parameters of concern at these sites with respect to drinking water and aquatic life and are illustrated in Figures 1 and 2 (below). The graphs capture the period shortly after the breach where higher total copper and turbidity levels were seen in the bottom depths of Polley Lake. In spring 2015, there was a turbidity peak which coincided with rain/snow events and spring melt. Turbidity

and copper levels have decreased throughout the summer and fall of 2015 and are below drinking water guidelines, however copper is still slightly above the chronic aquatic life guideline.

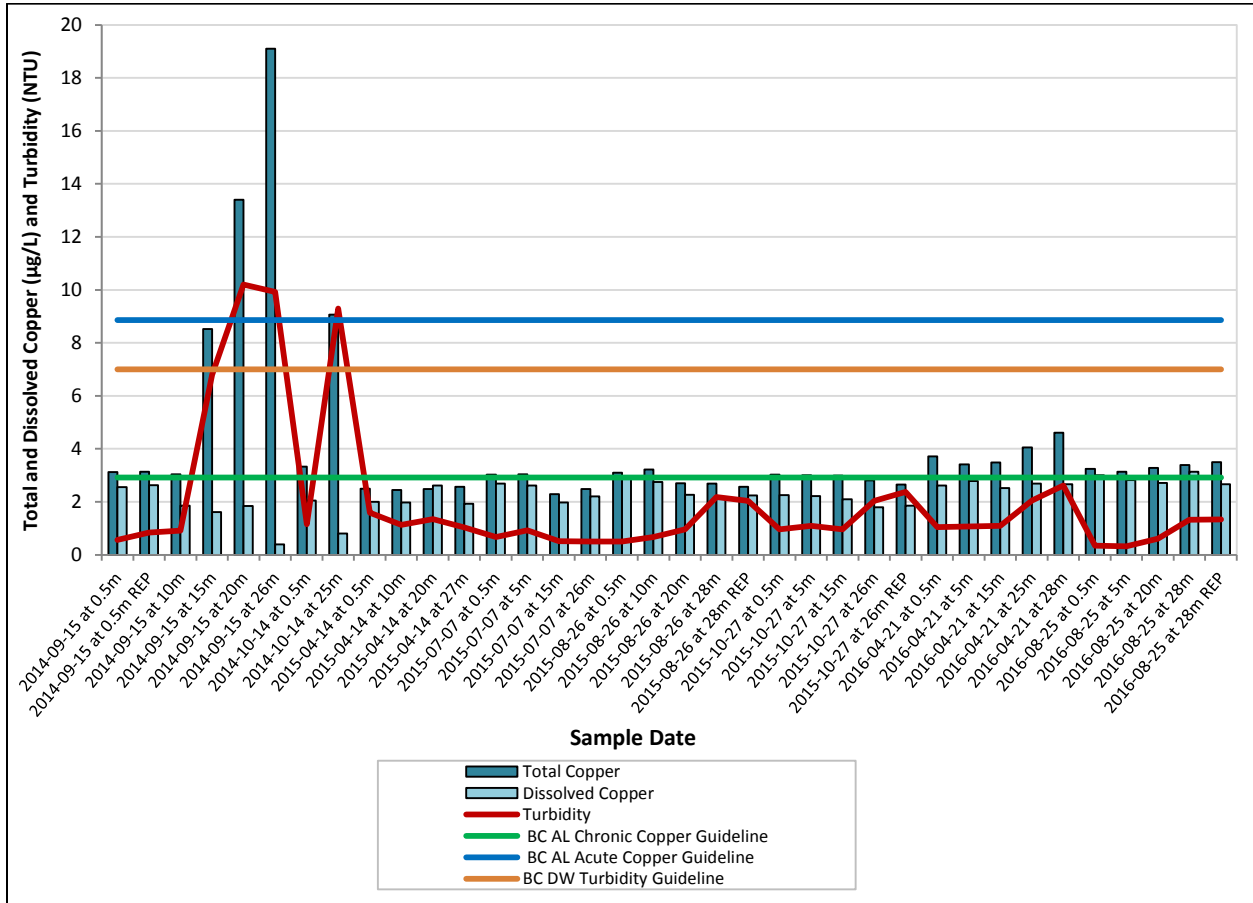
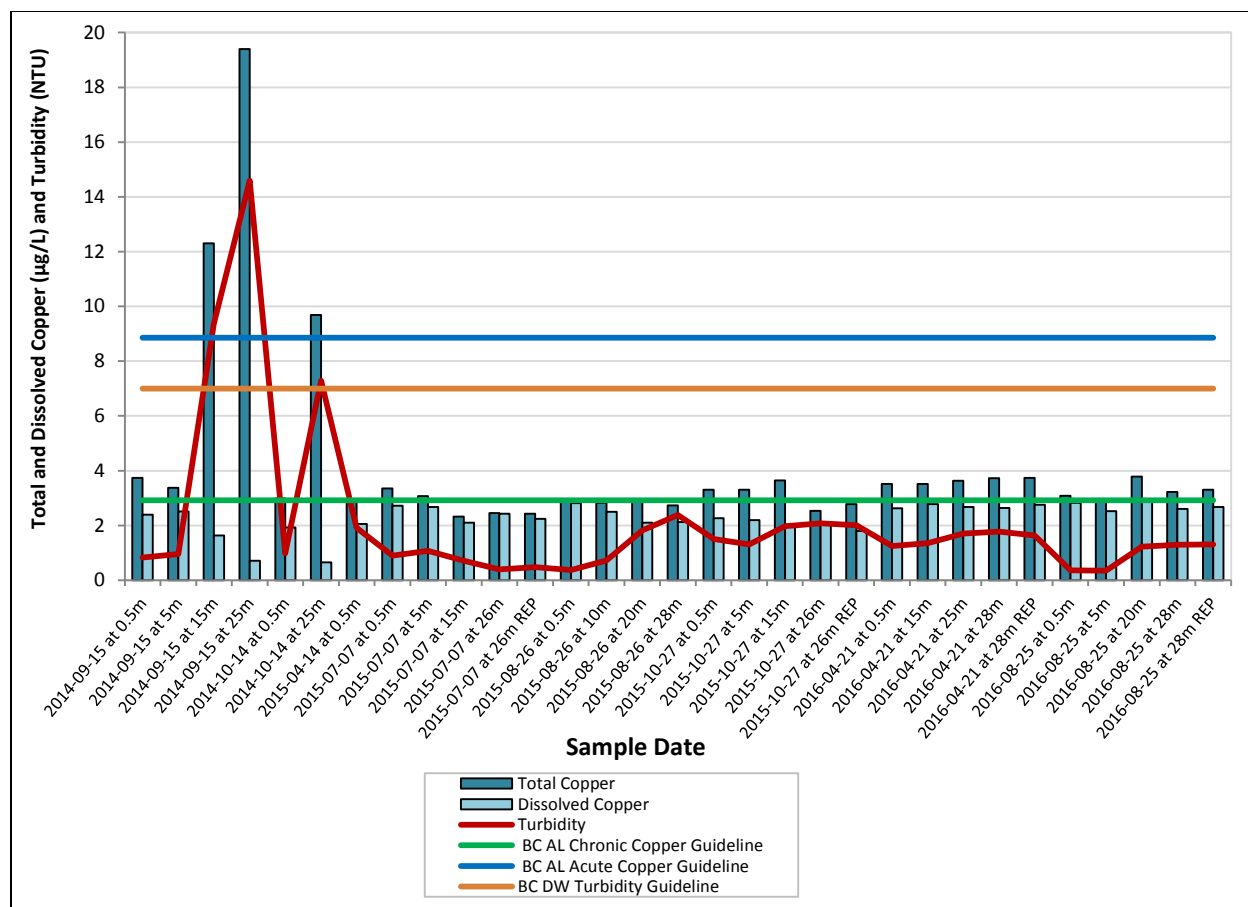


Figure 1. Polley Lake North – turbidity (NTU) and copper (µg/L) (total and dissolved) results from September 15, 2014 to August 25, 2016.



**Figure 2.** Polley Lake South – turbidity (NTU) and copper (µg/L)(total and dissolved) results from September 15, 2014 to August 25, 2016.

A summary of all drinking water and aquatic life exceedances from after the Breach to April 2016 can be seen in Table 1 and 2 (below), respectively. The following parameters have exceeded drinking water guidelines in Polley Lake: pH, turbidity, total phosphorus, total aluminum, total iron and total manganese. However since October 2014, total phosphorus and manganese have been the only parameters that exceed the drinking water guidelines (except pH in July 2015 which was slightly above guidelines at the surface). The exceedances in total metals are typically found at lower depths, where they bind to particles. The manganese drinking water guideline is based on aesthetic effects relating to staining and taste, not direct health effects. Elevated nutrients can affect the drinking water treatment process or lead to algal blooms, which also can affect water quality. Therefore while chemical parameters may not be of concern directly to human health, residents should still follow Health Canada protocols for treating raw drinking water. Note that Polley Lake is not a drinking water source.

There have been several aquatic life guideline exceedances in Polley Lake including turbidity, total suspended solids, nitrite, total phosphorus, total copper and total selenium. While total metals concentrations may exceed aquatic life guidelines, the much lower concentrations of the dissolved form of these metals indicates that the high levels are associated with particulates and may not be as bioavailable as dissolved metals, thus decreasing the risk to aquatic life in Polley Lake. This may not be the case for dissolved copper. While both total and dissolved copper levels have declined since the fall of 2014, total copper has fluctuated above and below the chronic life guideline whereas dissolved copper only slightly exceeded the chronic guideline in August 2016. Background levels of total copper in Polley Lake typically ranged from 1-2 µg/L pre breach, mostly below 2 µg/L, while dissolved concentrations were typically below 1µg/L. Current total copper levels fluctuate between 2-4 µg/L. Similarly the

dissolved copper levels are staying constant at or just above the 2.92 ug/L level, which is the chronic aquatic life guideline. Turbidity exceeded aquatic life guidelines in Polley Lake after the breach and into fall 2014. Turbidity increased from a background level of 1.0 NTU to 9-14 NTU in the lower depths of the lake; surface values remained from 0.3-1 NTU. During 2015 and 2016, turbidity stayed under 1.0 NTU throughout the water column but would increase slightly (1-2 NTU) at the bottom depth in August, October and May. Assessments are still underway by MPMC and MoE to determine if this could cause an impact to the aquatic life in Polley Lake.

Depth profiles were also conducted during the sampling events and data was collected for dissolved oxygen, temperature, pH and conductivity at every meter from surface to bottom for all sample dates. Dissolved oxygen levels at depth in the summer months had dropped below 1 mg/L creating anoxic conditions at the bottom depths. Low oxygen can result in internal loading, whereby some parameters that are bound to sediment particles can be released back into the water column. In addition, nutrients were also elevated, which can increase lake productivity. This internal loading process explains why the metals results can be higher at depth in the lake during the summer. During fall overturn, the lake mixes and metals values can be slightly higher at the surface and then become more uniform throughout the water column.

As there are still some exceedances in Polley Lake, MoE will continue to investigate and monitor the water quality of Polley Lake; it will be sampled bi-annually going forward. MoE will continue to determine and address any potential impacts to drinking water and aquatic life. As noted above, MPMC will also be monitoring Polley Lake and their data can be found at this website: <https://www.imperialmetals.com/our-operations-and-projects/operations/mount-polley-mine/overview>.

Sincerely,

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Ministry of Environment

**Table 1.** Drinking Water Exceedances from August 4, 2014 to August 25, 2016 for Polley Lake North and Polley Lake South.

Location	Polley Lake North	Polley Lake South
Parameter	Date	Date
Turbidity	September 15, 2014 at 20 and 26m	September 15, 2014 at 15 and 25m
	October 14, 2014 at 25m	October 14, 2014 at 25m
pH	July 7, 2015 at 0.5 and 5m	July 7, 2015 at 0.5 and 5m
Total Phosphorus	September 15, 2014 at 10, 15, 20 and 26m	September 15, 2014 at 5, 15 and 25m
	October 14, 2014 at 25m	October 14, 2014 at 0.5 and 25m
	April 14, 2015 at 0.5, 10, 20 and 27m	April 14, 2015 at 0.5m
	July 7, 2015 at 0.5, 5, 15 and 26m	July 7, 2015 at 0.5, 5, 15 and 26m
	August 26, 2015 at 10, 20 and 28m	August 26, 2015 at 20 and 28m
	October 27, 2015 at 0.5, 5, 15 and 26m	October 27, 2015 at 0.5, 5, 15 and 26m
	April 21, 2016 at 0.5, 5, 15, 25 and 28m	April 21, 2016 at 0.5, 15, 25 and 28m
Total Aluminum	September 15, 2014 at 15, 20 and 26m	September 15, 2014 at 15 and 25m
	October 14, 2014 at 25m	October 14, 2014 at 25m
Total Iron	September 15, 2014 at 26m	September 15, 2014 at 25m
		October 14, 2014 at 25m
Total Manganese	September 15, 2014 at 10, 15, 20 and 26m	September 15, 2014 at 15 and 25m
	October 14, 2014 at 25m	October 14, 2014 at 25m
	July 7, 2015 at 26m	April 14, 2015 at 0.5m
	August 26, 2015 at 20 and 28m	July 7, 2015 at 26m
	October 27, 2015 at 26m	August 26, 2015 at 20 and 28m
	April 21, 2016 at 5, 25 and 28m	October 27, 2015 at 15 and 26m
		April 21, 2016 at 15, 25 and 28m

**Table 2.** Aquatic Life exceedances from August 4, 2014 to August 25, 2016 for Quesnel River at Likely Bridge and Quesnel River at Gravelle Ferry Bridge.

Location	Polley Lake North	Polley Lake South
Parameter	Date	Date
Turbidity	September 15, 2014 at 20 and 26m	September 15, 2014 at 15 and 25m
	October 14, 2014 at 25m	October 14, 2014 at 25m
Total Suspended Solids	September 15, 2014 at 20 and 26m	September 15, 2014 at 15 and 25m
	October 14, 2014 at 25m	October 14, 2014 at 25m
Nitrite	September 15, 2014 at 20m	September 15, 2014 at 15m
Total Phosphorus	September 15, 2014 at 0.5, 10, 15 and 26m	September 15, 2014 at 0.5, 5 and 25m
	October 14, 2014 at 0.5 and 25m	October 14, 2014 at 0.5 and 25m
	April 14, 2015 at 0.5, 10, 20 and 27m	April 14, 2015 at 0.5, 5 and 15m
	July 7, 2015 at 0.5, 5 and 15m	July 7, 2015 at 0.5, 5 and 15m
	August 26, 2015 at 0.5 and 10m	August 26, 2015 at 0.5 and 10m
	October 27, 2015 at 0.5, 5 and 15m	October 27, 2015 at 0.5 and 5m
	April 21, 2016 at 0.5, 5, 15, 25 and 28m	April 21, 2016 at 0.5, 15, 25 and 28m
Total Copper	September 15, 2014 at 0.5, 10, 15, 20 and 26m	September 15, 2014 at 0.5, 5, 15 and 25m
	October 14, 2014 at 0.5 and 25m	October 14, 2014 at 0.5 and 25m
	July 7, 2015 at 0.5 and 5m	July 7, 2015 at 0.5 and 5m
	August 26, 2015 at 0.5 and 10m	August 26, 2015 at 0.5 and 20m
	October 27, 2015 at 0.5, 5 and 15m	October 27, 2015 at 0.5, 5 and 15m
	April 21, 2016 at 0.5, 5, 15, 25 and 28m	April 21, 2016 at 0.5, 5, 15, 25 and 28m
Total Selenium	No exceedances	September 15, 2014 at 15m