QUESTION:

Are the fish in affected water bodies healthy?

INFORMATION IN SUPPORT OF QUESTION:

There are several observations that come from Mount Polley's studies as well as the studies of others (Fisheries and Oceans Canada and Ministry of FLNRORD. This information supports the view that overall health is good based on high level indicators of health as well as detailed level information.

INDICATORS OF FISH HEALTH:

Fisheries and Oceans Canada Juvenile Sockeye Salmon Study [1]

A broad indicator of health is growth of juveniles. For an organism to grow, its biochemical system must be working properly and synchronously. The higher rate of growth is believed to be the result of a sudden increase in nutrients from the scoured forest soils along Hazeltine Creek. The following was observed:

- Juvenile sockeye collected from the West Arm of Quesnel Lake in 2014 were notably larger than juvenile sockeye collected in other arms of Quesnel Lake.
- Juvenile sockeye size in 2015 returned to a size similar to other parts of Quesnel Lake.
- Juvenile sockeye were also more abundant in the West Arm in 2014.

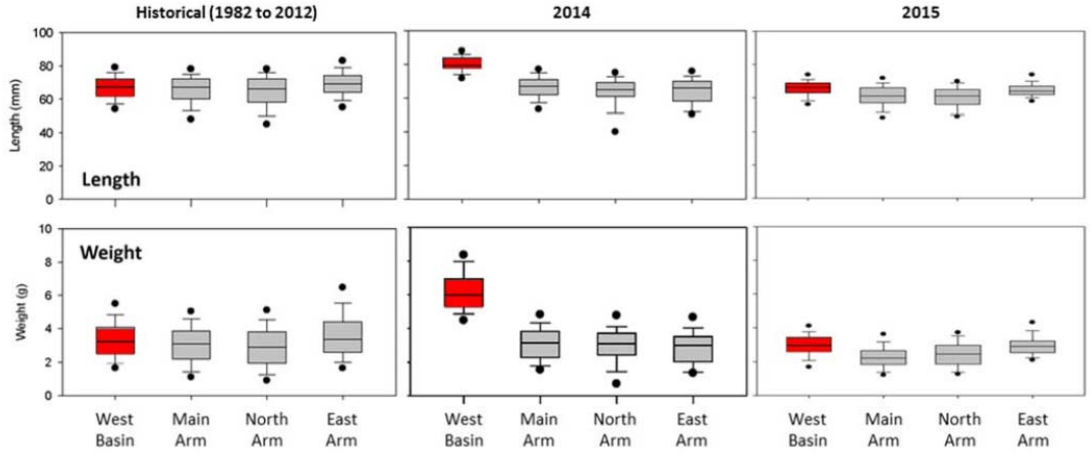

Figure 1: Comparison of Age 0+ Sockeye Salmon Length and Weight Between Exposed (West; red boxes) and Reference (Main, North, East; grey boxes) Areas of Quesnel Lake and Pre- (2013) and Post-event (2014 and 2015) (Box-plots Courtesy of D. Selbie, DFO)

Figure 1. Extract from Ecological Risk Assessment report. [2]

Adult Sockeye Returns 2018

- Juvenile sockeye that were exposed to the breach outwash materials in 2014 are the fish that ultimately left Quesnel Lake, went to sea and returned to the Quesnel Lake system.

- The exposed fish returns were very high in 2018, which provides a life cycle assessment from lake dwelling juveniles, ocean dwelling smolts and adults and adult spawning return. Considerable physiological changes from freshwater→saltwater→freshwater had to have occurred successfully. Considerable biological changes, including growth, gonad development, etc. also had to occur.
- Based on water quality data in 2014, Golder provided the opinion that fish homing behavior was expected to be normal [3]. Excellent returns to natal streams show high level validation of that expectation.

Provincial Government (MFLNRORD) Tag Telemetry Study [4]

A sonic tag study was underway in Quesnel Lake for reasons unrelated to the Mount Polley TSF Breach. The study provided before and after breach event data on the habitat use, movement and survival of those adult fish that were tagged.

- The study did not detect adverse effects on movement and survival of adult bull trout, rainbow trout or lake trout.
- Habitat use: low use by bull trout, moderate use by rainbow trout, high use by lake trout
- Only adults were tagged. Study was not identified to collect data on juveniles.

Hazeltine Creek Spawning 2018

- The upper portion of Hazeltine Creek has been constructed with habitat and was opened for trout access in 2018.
- Excellent use of the Hazeltine Creek habitat and waters were observed. Excellent hatching and juvenile trout production from Hazeltine Creek was observed [5].

Fisheries and Oceans Canada - Fish Histology Study

Fish histopathology involves the microscopic examination of the cell structure of different organs of a fish. When there is a disease state either by a parasite, bacteria or virus, the damage caused to the fish by the parasite or pathogen can be detected. This might appear as an accumulation of immune system cells, inflammatory response to infection, formation of granular bodies in an effort to “wall off” a pathogen and other changes in cellular configuration.

- A fish pathologist examined fish tissue samples from sockeye juveniles collected in the West Arm and reference areas of Quesnel Lake.
- The pathologist found that the incidence of disease/parasites was no different in the West Arm of Quesnel Lake compared to reference areas in Quesnel Lake [6]

Early Life Stage Toxicity Tests

- Early life stage toxicity tests were carried out using rainbow trout eggs and alevins [7] as well as chronic toxicity tests on fathead minnow and a variety of other test species [8].
- Toxicity testing did not indicate toxicity to fish

Fish Food Source Wholesomeness for Quesnel Lake Fish

- The median concentration of copper in zooplankton (fish food) samples collected from the management area is lower than the upper limit of the normal range of samples collected from reference areas.

The following summary table comes from the Ecological Risk Assessment report [2].

Line of Evidence	Assessment Endpoint	Measurement Endpoint(s)	Decision Criterion	Area	Decision
Zooplankton community	Protect zooplankton from reductions in survival, growth or reproduction as a result of direct contact with water impacted by deposited tailings.	Measure the diversity, biomass, and abundance of zooplankton in areas where tailings have been deposited.	Biomass or abundance has not changed relative to background areas, based on visual examination of plots.	Quesnel Lake	No apparent change
Zooplankton tissue chemistry	Protect invertebrates from accumulations of tissue-bound copper above reference levels.	Measure the concentration of copper in field-collected samples of zooplankton.	The median concentration in samples collected from the management area is lower than the upper limit of the normal range of samples collected from reference areas.	Quesnel Lake	No change
				Polley Lake	No change

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[1] D. Selbie, *Personal Communication - Juvenile Sockeye Salmon Study,* 2017.

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[3] L. Nikl and B. Wernick, 2 October 2014. [Online]. Available: https://imperialmetals.com/assets/docs/mt-polley/10-02-14-mount-polley-salmon-homing-behaviour-fish-return.pdf. [Accessed 2 August 2018].

[4] Redfish Consulting Ltd. , "Quesnel Lake Adult Trout - West Arm Habitat Use and Survival Analysis Related to Mt. Polley Mine Spill," Redfish Consulting Report prepared for Williams Lake Ministry of Environment , Nelson, BC, April 2016.

[5] Minnow Environmental Inc. , "Hazeltine Creek Monitoring and Hatchery Summary for the September 10th HRWG Conference Call," Minnow Environmental Inc. (technical memorandum), Victoria, BC, 2018.

[6] University of Prince Edward Island, "Laboratory report for histological assessment of Sockeye Salmon tissues," UPEI AVC No. 6112; Submitted to BC Ministry of Environment, 2014.

[7] Mount Polley Mining Corporation, "Summary of Mount Polley Toxicity Testing Program – January 2015," 10 February 2015. [Online]. Available: https://www.imperialmetals.com/assets/docs/mt-polley/02.10.15.MP-NOTICE.pdf. [Accessed 10 December 2018].

[8] Mount Polley Mining Corporation, "Summary of Mount Polley Toxicity Testing Program – January 2015," 15 January 2015. [Online]. Available: https://www.imperialmetals.com/assets/docs/mt-polley/01.15.15.toxicity-testing-program.pdf. [Accessed 10 December 2018].