

Part 2 - Other Issues

The Review Board identified a number of areas where additional information would be helpful in assessing the likelihood of significant impacts on the environment. The Developer should provide any additional information that is available on the items listed below. The remainder of this section provides the relevant sections of the terms of reference and the Review Board's questions in relation to those sections.

IR Number: 1-2-6

Source: Mackenzie Valley Review Board
To: Tyhee
Issue: Ammonia

Terms of Reference – Section - 3.3.2 Fish and Aquatic Habitat

1. Commitments for minimizing loss of fish habitat.
- c. impacts from blasting (the developer is encouraged to refer to the following DFO website: <http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/water-eau/explosivesexplosifs/page03e.asp>).

Request

1. Describe predicted impacts from ammonia in the water quality assessment section and describe potential impacts to fish and aquatic habitat.

Tyhee NWT Corp Response

1) Ammonia discharge to natural waterbodies downstream of mining operations may result due to the mobilization by runoff of residues resulting from the use of ammonium nitrate fuel oil mixture (ANFO) explosives in blasting operations. The acute, chronic, and sub-lethal toxicity of ammonia to aquatic organisms and particularly to fish is well documented. Un-ionized ammonia is known to be more toxic than the ammonium ion due to its ability to more easily across cell membranes. The toxicity of ammonia is influenced by both pH and temperature¹; raising pH by one unit can cause the un-ionized ammonia concentration to increase nearly tenfold, while a 5°C temperature increase can cause an increase of 40-50%. Based on previous toxicity tests on a variety of aquatic organisms, the guideline for the protection of aquatic life has been set by the CCME at 0.019 mg/L. However, the CCME further recommends¹ that "... the most conservative total ammonia guideline closest to the pH and temperature conditions of the waterbody be applied."

Generally, as indicated in the DAR, Section 2.9.6.2, background ammonia levels reported in natural water bodies in the Project footprint area were below guideline

¹ Canadian Council of Minister of the Environment (CCME). 2010. Canadian Environmental Quality Guidelines. <http://cegg-rcqe.ccme.ca/download/en/141/>.

levels. However, somewhat elevated levels have been found in Round and Winter lakes, probably due to the ammonification of large quantities of copropel (a mixture of humus material, fine plant fragments, algae remains, quartz and mica grains, diatom frustules, and exoskeleton fragments) at or near the bottom of these lakes, and because of their shallow depths and organic substrates. In Tyhee NWT's regular SNP sampling, elevated levels were recorded and reported in their water licence annual reports.

Measures taken by Tyhee to avoid or minimize ammonia runoff to natural water bodies will include adherence to DFO guidelines for the use of explosives², and interception of all runoff from explosives sites and waste rock piles. Intercepted runoff will be pumped to the tailings containment area (TCA) at Ormsby, and the settling pond at Nicholas Lake. No use of ammonium nitrate-fuel oil mixtures will occur in or near natural water bodies.

Both within the TCA at Ormsby and the settling pond at Nicholas Lake, excess ammonia is largely expected to be oxidized in summer to nitrite and nitrate by nitrifying bacteria (e.g. *nitrosomonas* oxidize NH_3 to nitrites; *nitrobacter* oxidize nitrites to nitrate). In addition, ammonia is taken up by algae as a source of nitrogen and as such, algal growth within the TCA and settling pond will increase ammonia uptake and reduce ammonia discharge in the effluent³. It is therefore anticipated that levels of ammonia reaching receiving waterbodies will be below CCME guideline limits and there will be no impacts on fish and aquatic life. These levels will be monitored during the environmental effects monitoring program; ammonia is a parameter included in the analyses required under the effluent and water quality monitoring studies prescribed in the Metal Mining Effluent Regulations (MMER) and as such, will be sampled four times per calendar year (at a minimum), and during EEM biological studies.

² Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives In or near Canadian fisheries waters. Habitat Management & Environmental Science Directorate, Department of Fisheries and Oceans.

³ Hargreaves, John A. and Craig S. Tucker 2004. Managing ammonia in fish ponds. Southern Regional Aquaculture Center, Publication 4603.