



510 Grey Street
PO Box 7003
Hamilton East
Hamilton 3247

07 974 4678
info@streamlined.co.nz

www.streamlined.co.nz

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Sheryl Roa

Waikato Regional Council

Private Bag 3038, Waikato Mail Centre

Hamilton 3240

Dear Sheryl

Re: Review of the Freshwater Component of the Martha Mine AEE

I have now completed the review you requested I undertake of the freshwater component of the Martha Mine AEE¹, which has been prepared in support of resource consent applications for Oceana Gold NZ Ltd's (OGNZL) Project Martha. As requested, I have focused on Appendix J of the AEE (Freshwater Ecology Assessment, Boffa Miskell). Their report covers not only the surface waters of the Ohinemuri and nearby rivers, but also the post-mining Pit Lake. Therefore, I have also taken into consideration (but not reviewed in any detail) other relevant reports contained within the AEE that relate to this lake, namely Appendix I: Water Management-RevA (GHD, 2018), Appendix T: Hydrodynamic Assessment of Pit Lake (Hydronumerics, 2018a), Appendix U: Martha Pit Lake Management Strategy-RevA (AECOM, 2018) and Appendix V: Pit Lake Limnology Assessment (Hydronumerics, 2018b). I have not considered effects on groundwaters.

My review considers what the potential effects of the proposed development on surface waters might be and whether there is sufficient information in the Freshwater Ecology Assessment report to assess these effects. I have not commented on the conclusions

¹ Filename RC Appln - Multiple Consents - Martha Underground Mine, Waihi.pdf, supplied by Waikato Regional Council on 20 June 2018

reached from the assessments undertaken. I have assumed that this is a technical report to support the AEE.

1. Potential effects of the proposed development

My understanding of the activities described in the AEE which could potentially impact surface waters (including the Pit Lake) are:

- An increase in the rate of water abstraction from the Ohinemuri River to create the Pit Lake, which will continue for 9.5 years following mine closure.
- Discharge of overflow from the Pit Lake to the Mangatoetoe Stream.
- Construction of an intake structure on the Ohinemuri River and outlet structure on the Mangatoetoe Stream.
- The proposed mining operation itself (albeit presumably a continuation of the current mining operation).

2. Adequacy of information used to assess effects

The scope of the Freshwater Ecology Assessment (Boffa Miskell, 2018) is described in the report (Section 1.3) as follows:

- a) Description of the condition of the Ohinemuri River
- b) Description of the ecology of the Ohinemuri River
- c) Description and ecology of the Mangatoetoe Stream
- d) Effects of the abstraction on the values of the Ohinemuri River
- e) Effects of filling on the quality and condition of the Pit Lake
- f) The effects of discharge from the Pit Lake on the Mangatoetoe Stream.

For each of the above I provide a brief description of the data employed in their assessment and any gaps I see in the data employed:

a) Description of the condition of the Ohinemuri River

The report discusses a range of relevant data sources for describing the condition of the Ohinemuri River. However, summary statistics based on a single data source for 3 sites (Waikato Regional Council SOE Water Quality Monitoring Programme) are presented to describe current water quality condition. None of the 3 sites is marked on Figure 1, which describes “sampling site locations”. The focus is on common physico-chemical water quality measures including pH, dissolved oxygen, turbidity and various forms of nitrogen and phosphorus. The status of metals in water or sediment has not been considered. Biological indicators are referred to, but no values are provided in the report.

b) Description of the ecology of the Ohinemuri River

Key conclusions about the ecological values of the Ohinemuri River are discussed and are based on OGNZL's 2017 consent monitoring report. No data are presented to support these conclusions. The assessment of riparian vegetation describes the riparian revegetation efforts of OGNZL only.

c) Description and ecology of the Mangatoetoe Stream

A summary of water quality data for Mangatoetoe Stream is presented (source not referenced), again focusing on common physico-chemical measures and excluding metals. Reference is made to ecological data (macroinvertebrates, fish), but none is presented. I note that reference is made on the OGNZL website to a baseline survey of Mangatoetoe Stream being undertaken (date not specified).

d) Effects of the abstraction on the values of the Ohinemuri River

The analysis of effects of abstraction from the Ohinemuri River to create the Pit Lake is summarised in the report, but again, no data are presented other than derived statistics.

e) Effects of filling on the quality and condition of the Pit Lake

Key results from other reports presented in the AEE (AECOM 2018, Hydronumerics 2018a, b) are used in the Freshwater Ecology report to assess the likely water quality, trophic state and ecology of the pit lake. While no data are specifically presented in the report, the relevant technical reports are readily available (as part of the AEE) if further details are required. The focus of these investigations is on the dynamics of dissolved oxygen, nutrient and primary production during and following lake filling.

The potential effects of the Pit Lake on metal availability and toxicity to lake and downstream biota (e.g. through the release of metals from the lake bed into the overlying water under anoxic conditions) has received limited attention in the AEE. Boffa Miskell (2018) do not consider the potential effects of metal toxicity on the ecology of the Pit Lake, focusing only on nutrient dynamics. Hydronumerics (2018a) acknowledges that "mixing deep waters into the surface waters during deep mixing years following a period of stratification has the potential to rapidly and substantially change the surface water chemistry and the chemistry of the released water. A lack of mixing for long periods may also lead to deterioration in the surface water chemistry due to a lack of dilution of poor quality run-off waters." In their investigation of Pit Lake limnology, Hydronumerics (2018b) assumes that pit water quality does not contain significant concentrations of toxins (such as metals) that



may limit primary production. They acknowledge, however, that copper and zinc concentrations predicted after filling of the Pit Lake (as described in AECOM, 2018) are likely to exceed revised guidelines for the protection of 95% of aquatic species proposed by NIWA (2017). It does not appear that water quality guidelines have been proposed for the Pit Lake itself at this stage (Hydronumerics, 2018b), although standards set for discharge quality to Mangatoetoe Stream (see below) include some metals. In addition, under the current consent (RC:971293) there is a requirement for a water quality and ecology monitoring programme to be developed for the Pit Lake and Mangatoetoe Stream (once the lake starts discharging).

Boffa Miskell (2018) provide no supporting information for their assessment of likely ecology of the Pit Lake.

f) The effects of discharge from the Pit Lake to the Mangatoetoe Stream

The assessment of effects of the discharge of Pit Lake water to the Mangatoetoe Stream is based on comparison of the predicted water quality of the lake (AECOM, 2018) against the currently consented water quality standards. These standards are based on the USEPA (1985) methodology for those parameters for which standards are available. It should be noted that for some parameters, these standards are orders of magnitude higher than ANZECC (2000) or recently derived guidelines (NIWA, 2017). However, they are the consented water quality standards and Boffa Miskell (2018) have not recommended any changes. AECOM (2018) predict that water quality will meet the USEPA standards with suitable treatment to increase pH and ameliorate associated effects (e.g. release of metals), along with mixing.

3. Information gaps

The focus of Boffa Miskell's report is on describing current condition and assessing post-mining effects. No consideration has been given to potential effects of the proposed mining operations. It could be argued that there are unlikely to be any additional effects on freshwater condition or ecology resulting from the proposed mining operations, assuming that the volume and quality of treated wastewater discharged to the Ohinemuri River remains the same as it currently is. However, there is no evidence presented to specifically address this question. This could be resolved by providing a more extensive description of the current state. Given the extensive data sets (both spatially and temporally) that are available for this mining operation (and which are referred to in the report), I am surprised at how little data are presented. Indeed, the report appears to be simply a review of some of the available data, presented in summary form. The reader is unable to independently



confirm many of the conclusions drawn (except where reference is made to other technical reports included within the AEE). I consider this to be a significant deficiency with the information presented. In addition, I have identified the following specific knowledge gaps:

- Selenium in fish tissue is also an identified issue within the catchment, albeit with no clear explanation of source. However, a consistent upstream/downstream of discharge points pattern of increasing concentration has been reported over a number of years through OGNZL's annual monitoring programme. I would have expected this issue to be presented in a description of current state.
- There is no ecological data presented for either the Ohinemuri River or Mangatoetoe Stream and only a cursory discussion of the potential ecology of the proposed Pit Lake.
- Assessment of the effects of construction of the intake structure on the Ohinemuri River and outlet structure on the Mangatoetoe Stream are cursory. However, as they are already consented I assume that sufficient information on potential effects was available when this consent was granted.

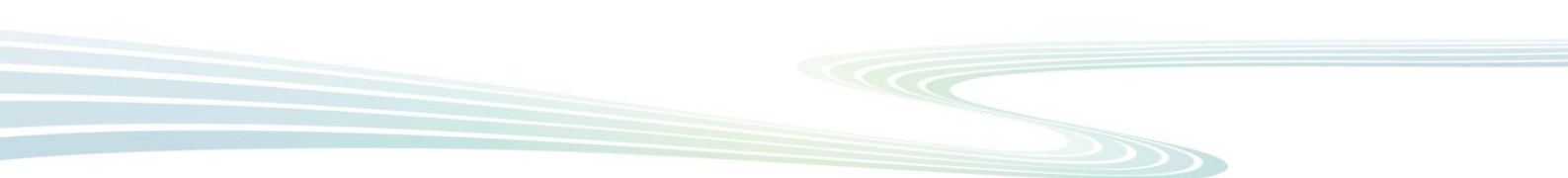
Overall, I consider that there is insufficient supporting data presented in the Boffa Miskell (2018) report to enable independent verification of some of the conclusions drawn regarding current condition or potential effects of the proposed activities on the Ohinemuri River or Mangatoetoe Stream. I recommend that further information, as described above, be incorporated into the Freshwater Ecology Assessment report, to provide a more informed basis for assessment by the decision makers.

Yours sincerely



Dr Ngaire Phillips

Director/Aquatic Ecology & Ecotoxicology Specialist



References

- AECOM (2018) Martha Pit Lake Management Strategy. Martha Pit Lake - Modelling, Mitigation and Management Assessment. Prepared for Ocean Gold (NZ) Ltd, June 2018.
- Boffa Miskell (2018) Project Martha. Assessment of the Freshwater Ecological Effects. Prepared for Ocean Gold (New Zealand) Limited, 23 May 2018. Appendix J. Freshwater Ecology Assessment.
- Hydronumerics (2018a) Project Martha. Martha Phase 4 Extension. Pit Lake Limnology: Final Report. Prepared by HydroNumerics for Oceana Gold New Zealand Ltd., May 2018.
- Hydronumerics (2018b) Project Martha. Martha Phase 4 Extension. Pit Lake Limnology: Scoping Study of Water Quality – Nutrients and Primary Production. Prepared by HydroNumerics for Oceana Gold New Zealand Ltd., May 2018.
- NIWA (2017). Derivation of new ANZECC water quality guidelines for copper and zinc. Freshwater and Estuaries Update, 21 February 2017. See <https://www.niwa.co.nz/freshwater-and-estuaries/freshwater-and-estuariesupdate/freshwater-update-72-feb-2017/derivation-of-new-anzecc-water-quality>.

