REPORT

Tonkin+Taylor

Proposed OceanaGold Coronation North Project

Assessment of aspects of the application for resource consent

Prepared for
Otago Regional Council
Prepared by
Tonkin & Taylor Ltd
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Table of contents

1 Introduction

The Macraes Gold Project (MGP) is a gold mining and ore processing operation located at Macraes Flat in the Otago Region. Operation of the mine by Oceana Gold (New Zealand) Limited (OGL) commenced in 1990. The mine consists of a series of open cast pits (some of which have been partially backfilled), the Frasers underground mine, and a gold ore processing plant with waste storage impoundments.

OGL has applied for resource consents for the Coronation North Project (CNP) to extend operations at the mine. OGL advise that the CNP comprises:

- Expansion of the consented Coronation Pit.
- Reduction of the consented Coronation Waste Rock Stack.
- Construction of a new Coronation North Pit.
- Construction of a new Coronation North Waste Rock Stack (WRS).
- Two kilometre extension of the existing haul road connecting the Coronation area and the process plant.
- Providing an alternative realignment for the unformed Matheson Road.
- Potential construction of a freshwater dam.
- Potential construction of new temporary buildings adjacent to Coronation North Pit.
- Associated water management comprising water takes, diversions and discharges.
- The development of erosion and sediment control arrangements intended to manage the impacts of surface water runoff on receiving waters.

Otago Regional Council (ORC) has requested that Tonkin & Taylor Ltd (T+T) review documentation supporting the consent application specifically relating to the following aspects of the CNP:

- Groundwater.
- Erosion and sediment control.
- Vibrations arising from CNP mining activities.
- The stability design of the Coronation North WRS.
- The stability design of the proposed CNP pit.

2 Scope

The scope of our work in relation to the WRS and the erosion and sediment control arrangements, as set out in our brief from ORC, is to assess:

- The suitability and robustness of investigations.
- The accuracy and completeness of the assessments provided.
- The validity of any assumptions and conclusions.

3 Review Documents

In accordance with our instruction from the ORC, we have reviewed the following seven documents provided by ORC on 7 June 2016 (which we understand form part of the Assessment of Environmental Effects for the project):

i Appendix 4a: Golder Associates; Coronation North Project Surface Water Modelling (82 pages).

ii Appendix 5: Golder Associates; Coronation North Project Groundwater Assessment (75 pages).

iii Appendix 14: Engineering Geology Ltd.; Oceana Gold (New Zealand) Ltd., Macraes Gold Project Coronation North Project, Erosion and Sediment Control (22 pages).

iv Appendix 17: techNick; Mining Vibration Assessment, Coronation Project, Macraes New Zealand; April 2013 and 9 December 2015 (19 pages).

v Appendix 18: Engineering Geology Ltd.; Macraes Gold Project, Coronation North Waste Rock Stack, Design Report, 29 April 2016 (52 pages).

vi Appendix 19: Pells Sullivan Meynick; Impact of the Coronation and Coronation North Waste Rock Stack on Open Pits; 12 April 2016 (8 pages).

vii Appendix 20: Pells Sullivan Meynick Coronation North Pit – Slope Design Angles; 5 April 2016 (459 pages).

We have also considered further information provided by ORC on 6 July 2016 in response to a range of queries arising from our initial review of the documents listed above, as set out in our letter of 13 June 2016.

4 Findings

The following sections summarise our findings. Table 1 included in Appendix A lists information gaps and/or uncertainties identified in the information initially received by T+T. Table 1 also outlines what steps have been taken by the applicant to resolve these matters. It is intended that Table 1 is read in conjunction with the following sections.

4.1 Groundwater

Mining of Coronation Pit, Coronation Pit Stage 5 and the proposed Coronation North Pit (CNP) will result in the excavation of rock to below the water table. Groundwater that is intercepted will seep into each pit and collect in the sumps in the base of the pits. Water in these sumps will be used for dust control and may from time to time need to be pumped out. This is graphically shown in Figures 6 and 7 of Appendix 4a.

As a result of mining, groundwater levels will be lowered and this will propagate out from each pit. The extent of this is shown for each pit in Figures D1, D2 and D3 of Appendix 5. The way in which groundwater levels will respond to mining is controlled by the permeability of the rock, its structure, the depth of mining, and surrounding topography. At the completion of mining, seepage into each pit will continue and each pit will gradually start to fill. If the rate of groundwater inflow (and any incident rainfall within each pit's catchment) is greater than losses of water due to evaporation each pit will begin to fill and the groundwater table will start to rise and recover. The recovery in groundwater levels will cease once each mine pit is full and overflows either via surface water or groundwater flow pathways.

Based on the information provided by the Applicant, it is likely that groundwater lowering will occur relatively rapid as mining is expected to be completed within three years, with infilling of each pit taking between 160 to 400 years to identified groundwater seepage or surface water overflow points[1].

[1] The Applicant has adopted an average annual aquifer recharge rate of 32 mm per annum to calculate groundwater inflows into each pit. The annual recharge rate seems high in respect to average rainfall, which would overestimate groundwater inflows into each pit and consequently under estimate the times taken for each pit to fill. While this could result in deteriorating water quality in each pit lake, we consider that this is an internal management issue that the Applicant could address as a part of rehabilitation and post-closure monitoring, and need not necessarily be addressed here, as until such time as each pit fills to its overflow point there will be no discharge from each pit.

The potential adverse effects of mining on groundwater resources could include a lowering of groundwater levels resulting in decreased availability of groundwater for neighbouring users, and a reduction in the recharge of downgradient surface water bodies. This could result in reduced surface water flows, which in turn could potentially impact on ecological values in affected streams and reduce flows available for allocation. These aspects are discussed below.

4.1.1 Decreased availability of groundwater

The Applicant has provided a conservative assessment of the likely areal extent of groundwater lowering as a result of mining. Figures D1, D2 and D3 of Appendix 5 show the extent of the effect of mining on groundwater levels. This shows that it will be unlikely that the potential effects of the proposed groundwater abstraction will be manifest in lowered groundwater levels (and potentially reduced groundwater availability in water supply wells) outside of the Applicant's property boundary. Accordingly we consider that any potential adverse effect on other users of groundwater is likely to be negligible[2].

4.1.2 Effects of dewatering on surface water flows

Mining will divert groundwater into each mine pit that would otherwise flow into and recharge surface water bodies. Groundwater and rainwater runoff within the confines of each pit will be collected in sumps or ponds. Water present in ponds or sumps will be subject to water loss through evaporation, and water used for dust control will be subject to further evaporation (or evapotranspiration if it falls on vegetated surfaces). These losses are additional to those currently occurring in the catchment. Although some of the water collecting in sumps or ponds will need to be pumped out and discharged as surface water (largely as a result of significant rainfall and soon after rainfall has occurred), mining will generally result in a reduction of groundwater recharge to surface water bodies, and this will be most critical during dry, low flow conditions. The effects of this could be manifest in a reduction in the length of stream/seepage habitat due to dewatering (where these are not directly physically impacted by other mining activities themselves), a reduction in allocable flows, and potentially a reduction in water available for the dilution of contaminants in discharge waters.

The Applicant proposes to use water collected in the pit sumps for dust suppression and is proposing to pump collected water and discharge this to Trimbells Gully and Maori Hen Creek (Figures 6 and 7 of Appendix 4a provides a schematic view of the Applicant's water model which serves as the basis for its assessment). Up to 1,400 m^3/week (200 m^3/d) is thought to be required for dust control purposes and that this water will be required year round (Section 5.4.5 of Appendix 4a). The Applicant has provided no information on the likely quantity of water to be pumped to Trimbells Gully, and in Section 5.4.5 of Appendix 4a it simply states that it will be pumped out at a rate of 18.5 l/s from time to time, when certain water levels in the pit sumps are reached. The amount of water required for dust control purposes will need to be sourced from groundwater inflows and from rainfall within each pit's catchments. In the absence of quantitative data provided by the Applicant in Appendix 4a, it is likely that pumping out of mine water to discharge to Trimbell's Gully or Maori Creek will only be required after significant or prolonged rainfall.

Figure 4 of Appendix 5 of the AEE provides a map showing groundwater levels around the site based on groundwater levels measured in monitoring wells and areas where groundwater is known or inferred to discharge into surface waters bodies. Although much of the data is located in the vicinity of the CNP, the resulting groundwater surface indicates that there are mapped surface water

[2] We understand that the Applicant has resident lessees on the property. These have not been included in our assessment of potential effects on groundwater resources.

channels that are likely to receive groundwater (i.e. be recharged by groundwater discharging into these channels).

Figures D1, D2 and D3 of Appendix 5 show the extent of the effect of mining on groundwater levels, and the Applicant's assessment of the reasonable extent of groundwater level drawdown for Coronation Pit Stage 5 and CNP. In Figure 1 below, this is shown superimposed on the piezometric surface presented by the Applicant in Figure 4 of Appendix 5.

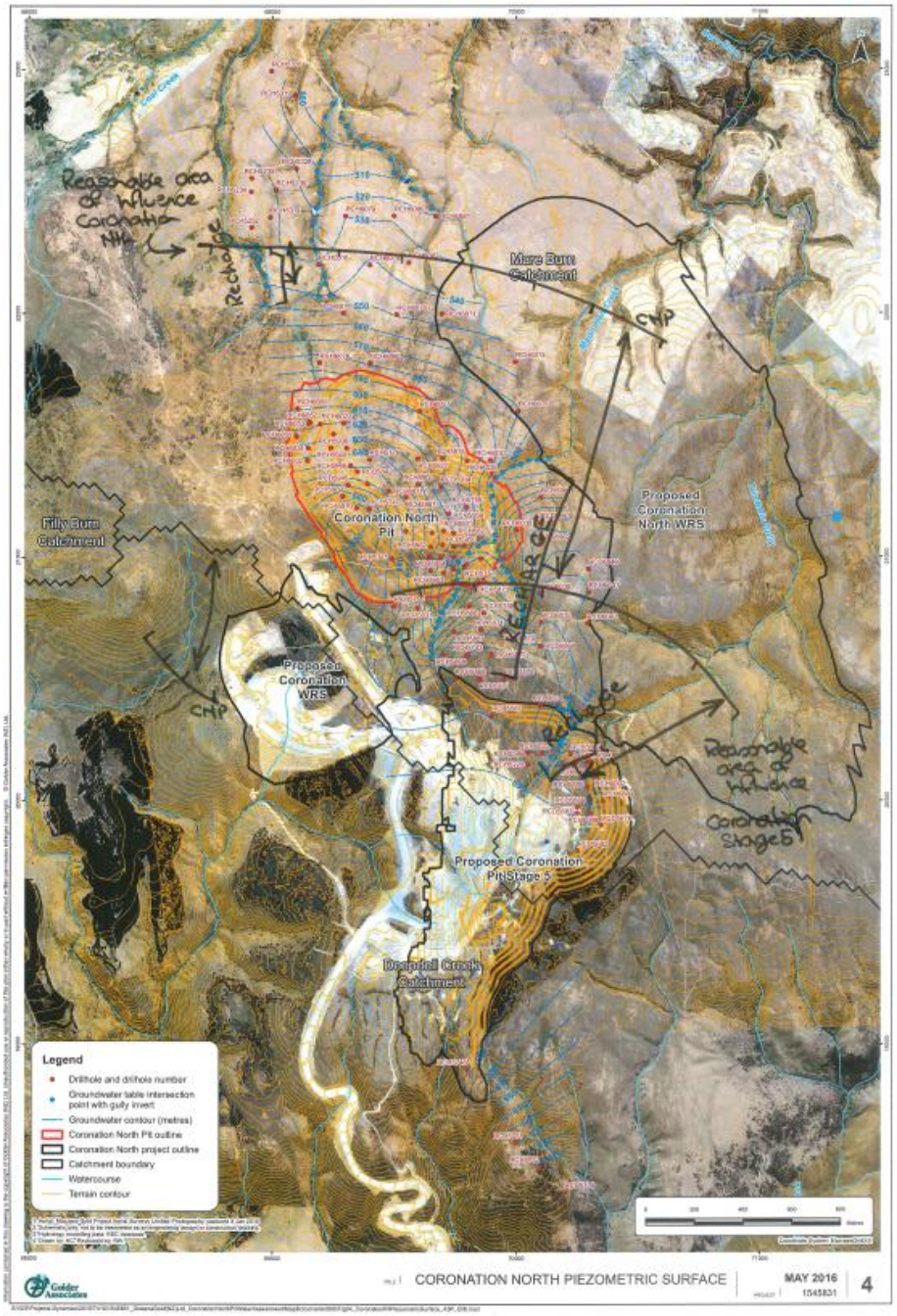

Figure 1: Approximate reasonable extent of area of influence of Coronation Pit Stage 5 (CP5) and Coronation North Pit (CNP) and likely effects on shifting the surface water recharge zone downstream.

Figure 1 shows that lowering of the groundwater levels has the potential for recharge zones in each waterway to move further downstream, which in the case of the Coal Creek Catchment may be in the order of a couple of hundred metres, and for Maori Hen Stream may be up to 1000 m. The effects of this could be a reduction in baseflow at or downstream of these locations, a reduction in the length of stream/seepage habitat due to dewatering (where these are not directly physically impacted by other mining activities themselves), a reduction in allocable flows, and potentially a reduction in water available for the dilution of contaminants.

In our letter of 13 June 2016 we sought further information on the effects of these on stream flow and surface water allocation, based on our preliminary review. In response, the Applicant pointed to Table 20 and Figure 14 of Appendix 4a of the AEE, which shows the results of the Applicant's modelling. From this modelling, it appears that the Applicant concluded that the gullies that drain to the catchment are expected to be ephemeral during most if not all summer seasons, and that drawdown is not expected to have a measureable effect on flows in these gullies, and consequently on allocable flows in the Shag River or Taieri Rivers.

Table 20 of Appendix 4a of the AEE shows an increase in the 5th percentile flows[3] from 0.3 to 1.1 l/s at MBO1 and from 0.6 l/s to 3.0 l/s at MB02. This shows that despite the additional losses of water that may occur through groundwater level reductions and evaporation, low flows are expected to increase as a result of mining. The median and average flows at MB01 and MB02 in Table 20 are significantly lower than those estimated from the current hydrological record presented by the Applicant in Table 4 of Appendix 4aof the AEE.

The flow duration curves presented in Figure 14 show that flows following mining are the same or higher than those modelled prior to mining taking place. We would have expected Figure 14 to show some flows being lower that the current baseline, unless there are significant diversions of additional water into the Coal Creek Catchment that have not been identified in Appendix 4a of the AEE.

While we accept that there might be not be a measurable effect on flow in these gullies as a result of mining, there could still be a loss in ecological value as a result of reduction in recharge. We are not convinced that the Applicant has been able to demonstrate that the modelling that it has relied on for its conclusions sufficiently recognises all potential water loss pathways and accordingly presents an overly optimistic assessment of the effects of mining on surface water flows during dry and low flow periods. This may also affect the ability of the Applicant to manage contaminant discharges as proposed by the Applicant in Sections 6.4 of Appendix 4a of the AEE.

In Section 7.0 of Appendix 5, the Applicant identifies a programme of monitoring predominantly of water quality, which we consider appropriate.

4.2 Erosion and sediment control

The information provided for our review is at conceptual design level only and it is important that appropriate detailed design of the erosion and sediment control arrangements occur after the resource consent process (if consents are granted).

We understand that the design approach for the silt ponds associated with the proposed CNP is very similar to that used for other consented aspects of the MGP, which is based on typical industry practice that is then modified to take account of site specific considerations. The documentation reviewed also indicates that EGL are not aware of any recorded instances of the release of sediment laden water from the MGP site (inferred to include any public complaints). Based on the

[3] In other words, the lowest 5% of stream flows at monitoring location MBO1 are currently less than 0.3 l/s, whereas with development of Stage 1 the Applicant advises that this will increase to 1.1 l/s.

information that we have reviewed, we consider that in principle this overall methodology is reasonable if subject to appropriate conditions.

As outlined above, past performance of erosion and sediment control measures used previously for the MGP site has been relied on to support future design approaches. However, there appears to be little quantitative data confirming the actual performance of such measures, including silt ponds (e.g. data relating to total suspended solids associated with discharges). We suggest that OGL develop a monitoring regime designed to validate their design assumptions and demonstrate how the site silt ponds reduce suspended sediment loads during specific rainfall runoff events. The objective being to show that any discharge of sediment laden water has no significant adverse effect on the receiving water. The proposed monitoring regime should be submitted to the ORC for comment and subsequent acceptance prior to implementation. We recommend that the programme should include provision for ongoing review of performance with provision for amendment as may be required to reflect recorded data. We also recommend that the regime includes sufficient provision to monitor suspended particulates by way of the total suspended solids (TSS) and Nephelometric Turbidity Unit (NTU) parameters in addition to other relevant criteria.

Recommended consent conditions specifically related to erosion and sediment control are listed below. The recommended consent conditions take account of the discussion associated with items f through j inclusive, as listed in Table 1 that arose from information gaps/uncertainties associated with the original submission. The recommended consent conditions specifically related to erosion and sediment control comprise:

1 Prior to exercise of this consent, the consent holder shall submit to the Consent Authority an Erosion and Sediment Control Plan for the Coronation Waste Rock Stack. The Erosion and Sediment Control Plan and plan requirements shall not be of a standard less than that required by the latest revision of the Environment Canterbury document "Erosion and Sediment Control Guideline", except that the catchment of sediment retention ponds shall not exceed 20 ha. The design, construction and operation of all sediment retention ponds shall ensure that no outflow to downstream receiving waters results from any sediment retention pond arising from a rainfall depth of 70 mm or less from a particular storm event. The Erosion and Sediment Control Plan shall include, but not be limited to:

   - General arrangement details of the design and location of all erosion and sediment control devices including final details of all catchments and sub-catchments of all works related to erosion and sediment control within the CNP area;
   - Key responsibilities relating to implementation of the plan;
   - Construction details and specifications of all proposed erosion and sediment control measures e.g. including but not limited to details of all drains and ponds associated with erosion and sediment control and surface water management;
   - A construction timetable and details of necessary staging;
   - Maintenance, monitoring and reporting procedures (e.g. including but not limited to details of parameters to be measured, frequency of monitoring, monitoring locations and corrective actions to be implemented in the event that test results are inconsistent with monitoring requirements and/or cross reference to the WQMP and Compliance and Monitoring Schedule that otherwise provide for all such requirements);
   - Emergency response procedures, including response procedures for flood events and silt pond dam failure scenarios; and
   - Certification from a chartered professional engineer that the proposed erosion and sediment control measures comply with the conditions of the consent.

2 Not less than three weeks prior to the commencement of soil disturbance, the consent holder shall submit to ORC for acceptance the Erosion and Sediment Control Plan. The works shall not proceed until the Erosion and Sediment Control Plan is accepted by ORC. If required by ORC, the consent holder shall amend the Erosion and Sediment Control Plan prior to acceptance by the ORC. The consent holder shall exercise this consent in accordance with the Erosion and Sediment Control Plan.

3 The consent holder shall review the Erosion and Sediment Control Plan annually and if necessary, update it. Details of the review shall be included in the Project Overview and Annual Work and Rehabilitation Plan required by Discharge Permits RMXX and RMXXXX. The Consent Authority shall be provided with any updates of the plan within 1 month of any update occurring. Any amendment to the Erosion and Sediment Control Plan shall be subject to acceptance by ORC.

4 This consent shall be exercised in accordance with and be subject to the Coronation Waste Rock Stack Compliance and Monitoring Schedule attached.

5 Prior to the exercise of this consent, the consent holder shall submit to the Consent Authority, a Water Quality Management Plan for the Coronation North project. The Water Quality Management Plan shall be in accordance with the conditions of this consent, and include but not be limited to:

- Details of surface water and groundwater quality monitoring within the Mare Burn catchment, including location and frequency and parameters bring measured;
- Identification of monitoring results that would trigger the requirement for a comprehensive review of water quality to determine whether additional mitigation measures should be adopted to ensure appropriate surface water and groundwater quality;
- A description of mitigation measures implemented or available during the operational period of the Coronation North Project;
- A description of mitigation measures implemented or available post closure of the Coronation North Project; and
- A timeline detailing when it is anticipated that mitigation measures may be required and providing an indication of implementation timeframes.
- Provision to monitor suspended particulates by way of the total suspended solids (TSS) and Nephelometric Turbidity Unit (NTU) parameters. Limits for both parameters shall be included in the Water Quality Management Plan no later than five years following exercise of the consent.

6 The Water Quality Management Plan for this consent may be combined with any Water Quality Management Plan required by any other consent held by the consent holder for mining operations at Macraes Flat so long as all conditions of this consent are met.

7 The consent holder shall exercise this consent in accordance with the Water Quality Management Plan.

8 Not less than one year following exercise of the consent, and annually thereafter, the consent holder shall submit to the ORC a Water Quality Management Plan annual compliance report. The annual compliance report shall include the results of all testing and all other monitoring activities undertaken within the preceding one year together with a reconciliation of all results and outcomes against the requirements of the Compliance and Monitoring Schedule and Water Quality Management Plan. The annual compliance report shall include discussion of any non-conformance with the Compliance and Monitoring Schedule and Water Quality Management Plan. From time to time following review of the annual compliance report by ORC, and if required by ORC, the Compliance and Monitoring

Schedule and/or Water Quality Management Plan shall be amended as may be considered appropriate by ORC. The consent holder shall also review the Water Quality Management Plan annually and, if necessary, update it. Details of the review shall be included in the Project Overview and Annual Work and Rehabilitation Plan required by Discharge Permit Discharge Permits RM12.378.03 and RM12.378.04. The Consent Authority shall be provided with any updates of the plan within 1 month of any update occurring and any amendment shall be subject to acceptance by ORC.

4.3 Mining Vibration Assessment

The information provided presents an assessment of estimated vibration and airblast levels at nearby private residences (i.e. not owned by OGL) in terms of human comfort limits published in AS2187.2-2006, Appendix J (the Standard). Likely vibration levels are estimated by the Applicant using equations provided in the Standard, based on explosive charge size, distance to the explosion source, and site constants. The Standard is considered appropriate for this application.

Site constants (as per the methods for estimating airblast and vibration levels published in the Standard) have been estimated by techNick Consulting, as no previous site data is available which would enable the site constants to be determined (for example previous vibration and airblast monitoring data used to back-calculate the site constants). The estimated site constants are therefore subjective.

T+T have undertaken an assessment of sensitivity of the predicted vibration and airblast levels to the site constant values, as part of our review of the predicted vibration and airblast levels. Based on this review we concur with the conclusion of techNick Consulting, that for the scenarios considered, vibration and airblast levels are expected to be below the published limits at the residence located nearest to Coronation Pit (known as the Howard's residence) which is not owned by OGL.

It is important that actual vibration and airblast levels are monitored during blasting operations, in order to confirm compliance with the published limits. It is also important to appreciate that the response to blasting will vary if different conditions to those analysed eventuate (for example explosive charge size). We note that OGL have suggested resource consent conditions which require compliance with a Noise, Airblast and Vibration Monitoring Plan. Recommended consent conditions, which should be addressed by the Noise, Airblast and Vibration Monitoring Plan comprise:

1 Prior to exercise of this consent, the consent holder shall submit to the Consent Authority a Noise, Airblast and Vibration Monitoring Plan for the Coronation North Project. The Noise, Airblast and Vibration Monitoring Plan shall include, but not be limited to:

- Details of monitoring locations, frequency and methodology targeted at recording the likely worst case noise/vibration/airblast conditions representative of nearby residences;
- Procedures for recording blast details corresponding with monitoring periods;
- Maximum noise, vibration and airblast compliance limits which are in accordance with the relevant recommended limits published in AS 2187.2-2006;
- Key responsibilities relating to implementation of the plan;
- Reporting procedures for notifying relevant Councils at regular intervals and in the event of non-compliant results;
- Procedures for addressing non-compliant results;
- Certification from a suitably qualified professional that the proposed erosion and sediment control measures works comply with the conditions of the consent.

2 Not less than three weeks prior to the commencement of blasting or other activities which may generate significant vibration, the consent holder shall submit to relevant Councils for acceptance the Noise, Airblast and Vibration Monitoring Plan. The works shall not proceed until the Noise, Airblast and Vibration Monitoring Plan is accepted by the relevant Councils. If required, the consent holder shall amend the Noise, Airblast and Vibration Monitoring Plan prior to acceptance by the relevant Councils. The consent holder shall exercise this consent in accordance with the Noise, Airblast and Vibration Monitoring Plan.

3 The consent holder shall review the Noise, Airblast and Vibration Monitoring Plan annually and if necessary, update it. The Consent Authority shall be provided with any updates of the plan within 1 month of any update occurring. Any amendment to the Noise, Airblast and Vibration Monitoring Plan shall be subject to acceptance by the relevant Councils.

4 Not less than one year following exercise of the consent, and annually thereafter, the consent holder shall submit to the relevant Councils a Noise, Airblast and Vibration annual compliance report. The annual compliance report shall include the results of all monitoring activities undertaken within the preceding one year together with a reconciliation of all results and outcomes against the requirements of the Noise, Airblast and Vibration Monitoring. The annual compliance report shall include discussion of any non-conformance with the Noise, Airblast and Vibration Monitoring Plan. From time to time following review of the annual compliance report by the relevant Councils, and if required, the Noise, Airblast and Vibration Monitoring Plan shall be amended as may be considered appropriate by the relevant Councils.

4.4 Coronation North Waste Rock Stack

The shape and extent of the waste rock stack (WRS) is designed using geometric and geotechnical criteria adopted and tested on previous waste rock stacks at the site, with the absence of slope instability issues reinforcing the appropriateness of the adopted design parameters. The final landform requirements appear to be the governing factor in waste rock shapes and slopes, as is commonly the case on large scale mine waste fills. The design shapes and level of analysis undertaken appear acceptable for the project. It is also very important that the Applicant's design process takes appropriate account of the necessary safety in design considerations, the details of which are beyond T+T's scope.

An offset of 100 m from the crest of the open pit to the toe of the WRS is proposed by the Applicant to allow for long term slope performance and the potential for some modification (enlargement) of the pit without re-handling of waste rock. Based on the information that we have reviewed this is considered appropriate.

The Applicant does not make any specific assessment of the risk of adverse impact on the receiving environment due to slope instability of the WRS. Such a specific assessment is, in our view not necessary based on the WRS materials, proposed gentle design slope angles and observed performance of existing WRS on the mine site. Potential for 'more than minor' impacts on the receiving environment may occur from rainfall runoff and infiltration on the WRS, and resulting water quality, erosion and sedimentation issues. Erosion and sediment control is discussed in Section 4.2 above, and we understand that water quality issues are being reviewed by NIWA.

4.5 Coronation North Pit

The pit design reports and pit shell drawings provided for our review appear to follow the form of previous design studies at Macraes Mine. Open pit batter and berm configurations appear to have been optimised over the years of continual development and observation at the site. The assessments provided for Coronation North recognise the pit specific geology (basalt cap, faulting at the SE end) and the risk to pit wall stability.

Staged pit development, observation of performance and modification of the wall designs is proposed. This is an acceptable approach that has been applied on the site in the past. It is also very important that the Applicant's design process take appropriate account of the necessary safety in design considerations, the details of which are beyond T+T's scope. The Applicant has assessed a moderate to low likelihood of slope instability during mining of the pit. The assessment is on a pit wall sector by sector basis, considering the potential failure mechanisms and uncertainty in the ground model.

Our review of the pit design information including the location, size and shape of the proposed pit, and the 100 m standoff to the WRS suggest a negligible risk to the receiving environment. Any post mining slope instability appears likely to be constrained to the pit void. In our view the potential for 'more than minor' effects on the receiving environment may occur from the interaction of the pit void with surrounding groundwater and the quality of water that accumulates in the post mining pit void. Groundwater is discussed in Section 4.1 above, and we understand that water quality issues are being reviewed by NIWA.

5 Conclusions

Based on the documentation provided we have reviewed the following aspects of the proposed CNP:

- Groundwater.
- Erosion and sediment control.
- Mining vibration.
- Coronation North Waste Rock Stack.
- Coronation North Pit.

We conclude that:

- The investigations are generally suitable.
- The assessments provided generally appear accurate.
- The assumptions and conclusions are considered to be valid.

We do, however, suggest that, where historical performance is used as a basis for adopting a design approach, that the Applicant ensure that they have processes in place that provide quantitative information to support that approach. For example, in the case of the design of silt ponds, that there is quantitative data validating the assumed reduction in sediment laden water entering the receiving water under real world conditions that to all intents and purposes match the design criteria.

We have also provided comment on what we believe to be suitable consent conditions, as appropriate, given the information that we have reviewed.

6 Applicability

This report has been prepared for the exclusive use of our client Otago Regional Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:

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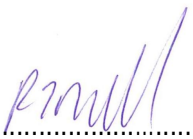
Tim Morris

Senior Civil Engineer



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Appendix A: Section 92 requests for further information

Section 92 requests for more information

Item	Matter to be addressed by the Applicant	Response by the Applicant and discussion.
Appendix 5: Golder Associates; Coronation North Project Groundwater Assessment.		
a.	Section 5.4 Groundwater recharge Please provide further information that clarifies how the groundwater recharge rate has been derived and demonstrates that this number is appropriate for both pit inflow calculations and waste rock stack seepage calculations.	The Applicant provided an excerpt of a report prepared by Kingett Mitchell Associates dated 2005 that set out the basis for the Applicant's calculation of recharge. The implications of this are discussed in Section 4.1 of the body of this report.
b.	Section 5.53 Groundwater area of influence calculations Please further clarify how the "Reasonable Area of Influence" as described in 5.5.3 is calculated. Please provide further information on how the groundwater divide between the pit and adjacent gullies (as demonstrated in Figure 5) has been established in order to determine the Reasonable Area of Influence. Please provide further justification and/or clarification of the following statements presented in Section 5.5.3, under items 1) and 4) *"This scenario differs from Scenario 1 in that is also takes into account the groundwater systems in gullies close to the pit, which are unlikely to remain relatively unchanged irrespective of the construction of the pit".*	Item b of the Applicant's response dated 21 June 2016 has provided further explanation of this.
c.	Effects on stream flow and surface water allocation Please provide further information on the cumulative effects of ground drawdown as a result of mining and as a result of the interception of recharge from the waste rock stacks on surface water recharge and its consequent effects on stream flows, including those gullies draining to the Shag River Catchment. Please provide an assessment of the effects of any reduction in stream flow on allocable flows in both the Taieri and Shag River Catchments as set out in Section 6.4 and Schedule 2 of the Regional Plan: Water for Otago.	Item c of the Applicant's response dated 21 June 2016 has provided further explanation of this, and this is further discussed in Section 4.1.2 of the body of this report.
d.	Net seepage flows into pit lakes Appendix F provides an assessment of net groundwater inflow into the pit lakes following mine closure and states that these	Item d of the Applicant's response dated 21 June 2016 has provided further explanation of this.

Item	Matter to be addressed by the Applicant	Response by the Applicant and discussion.
	inflow rates have been carried through into the surface water modelling. Please comment on whether evaporation from the pit lakes has been taken into account in the surface water modelling and whether evaporation from the pit lakes has also been taken into account in determining the likely timeframes for filling of the pit lakes.	
e.	Section 5.6 Waste Rock Stack Seepage calculations Section 5.6 concludes that recharge through the waste rock stack will be intercepted and discharge to one of four silt ponds. Please comment on the likely effect of this interception on calculations of groundwater inflows into the mine pits and its consequential effect on the rate of post-closure mine lake filling.	Item e of the Applicant's response dated 21 June 2016 has provided further explanation of this.
Appendix 14: Engineering Geology Ltd.; Oceana Gold (New Zealand) Ltd., Macraes Gold Project Coronation North Project, Erosion and Sediment Control.		
f.	Section 5 page 3 refers to "*the principles embodied in the guidelines prepared by the Auckland Regional Council (Ref.2), and more recently the Environment Canterbury Guidelines (Ref.1), modified where appropriate based on operating experience.*" Please advise any instances where the design of the erosion and sediment control measures will depart from the Environment Canterbury Guidelines referred to in the application. The justification for such departures should also be provided (if not already included).	The EGL letter dated 22 June 2016 refers. EGL state that: • The CNP will involve sediment retention ponds with catchments up to 20 ha whereas the ECan guidelines suggest an upper catchment limit of 10 ha. • The response does not outline any other exceptions to the ECan guidelines. • The response notes that specific design will be undertaken to accommodate the greater catchment and that the approach has been implemented successfully elsewhere on the site. We consider that it is appropriate to include a condition with wording similar to the following: *"The design, construction and operation of all sediment retention ponds shall be as outlined in the application but not of a standard less than that required by the latest revision of the Environment Canterbury document "Erosion and Sediment Control Guideline" except that the catchment of sediment retention ponds shall not exceed 20 ha."*
g.	The ECan Guidelines refer to a design standard arising from a 20 % (1 in 5 year) ARI 10 hour event, whereas the application mentions the first 24 hours rainfall from a 72 hour duration 2 year ARI storm. Please state the design rainfall depth associated	This matter is considered by way of the EGL letter dated 22 June 2016 as well as subsequent email correspondence e.g. 11 and 13 July. This matter arises because we consider that the manner in which the application refers to

Item	Matter to be addressed by the Applicant	Response by the Applicant and discussion.
	with both storms at the site and provide details of the hyetograph used to determine the rain fall depth associated with the first 24 hours of the 72 hour duration storm. Please clarify why you consider it appropriate to use a lesser rain fall depth than suggested by the ECan Guidelines in the event that the proposed design depth is less than recommended by the ECan Guidelines.	storm duration is unclear and misleading. The application states that the design criteria is "*Storage sufficient to contain at least the initial 24 hour rainfall from a 2 year 72 hour duration storm*". It is very important to appreciate that rainfall associated with the first 24 hours of a 72 hour event is not the same as what would occur during a 24 hour duration event (for an equivalent ARI). The ECan design storm referred to by the applicant for pond design is the 20 % (1 in 5 year) ARI 10 hour event. The response notes that the sediment retention ponds will be on the basis that there is no outflow during this rain event. HIRDS 3 data indicates that the rainfall depth associated with the 1 in 5 year ARI 10 hour event is less than 60 mm whereas the 24 hour and 72 hour 1 in 2 year ARI events are 69 and 85 mm respectively. On this basis the 70 mm rainfall depth proposed by the applicant is in excess of the ECan design standard referred to (and the applicant has now confirmed that they are not suggesting that the 72 hour 1 in 2 year storm depth is 70 mm). We consider that it is appropriate to include a condition similar to the following: *"The design, construction and operation of all sediment retention ponds shall ensure that no outflow results from any sediment retention pond arising from a rainfall depth of 70 mm or less from a particular storm event".*
h.	In order to understand the concept generally described in the application, and further to Figure 5 included in Appendix 14, please provide a concept plan(s) to illustrate the following: • Location and alignment of temporary clean water diversion drains together with details of catchment areas and drain capacities. Outline proposals for any required construction staging. • Location and alignment of permanent clean water diversion drains together with details of catchment areas and drain capacities. • Location of stormwater detention ponds and their catchments including details of catchment areas and live storage volumes.	The response notes that "*drain capacities and silt pond dimensions and details will be determined as part of the detailed design for the Erosion and Sediment Control Plan. This will be carried out in consultation with OceanaGold when more detailed information is available*". This approach is not unreasonable. We therefore consider that it is appropriate to include a condition similar to the following: *"Not less than three weeks prior to the commencement of soil disturbance, the consent holder shall submit to ORC for approval an Erosion and Sediment Control plan. The Erosion and sediment control plan shall include:* • *Certification from a chartered professional engineer that the proposed erosion and sediment control measures*

Item	Matter to be addressed by the Applicant	Response by the Applicant and discussion.
		works comply with the conditions of this consent. • *Details (including but not limited to construction issue drawings and specifications) of all proposed erosion and sediment control measures e.g. final details of all catchments and sub-catchments and details of all drains and ponds associated with erosion and sediment control and surface water management required.* • *Details of the monitoring regime including details of parameters to be measured, frequency of monitoring, monitoring locations and corrective actions to be implemented in the event that test results are inconsistent with monitoring requirements and/or cross reference to the WQMP and Compliance and Monitoring Schedule.* *The works shall not proceed until the Erosion and Sediment Control plan is accepted by ORC. If required by ORC, the consent holder shall amend the Erosion and Sediment Control plan prior to acceptance by the ORC*."
i.	Please advise details of proposed water quality monitoring within the catchments associated with the application including location, frequency and parameters being measured.	The Oceana Gold letter of 4 July 2016 addresses this matter. The response refers to a draft Compliance and Monitoring Schedule intended to form part of the consent (draft provided) and the subsequent preparation of Water Quality Management Plan (WQMP). The applicant advises that the purpose of the WQMP is to set out the monitoring and methods which can be used to ensure that water quality meets the compliance standards set out in the Compliance and Monitoring Schedule. The matter arises in the context of erosion and sediment control, whereas the response covers water quality generally and does not specifically respond to the initial comments that were targeted at erosion and sediment control. There are aspects of the response, for example matters related to water chemistry, that are outside the scope of the T+T assessment and it is important that these are considered separately as discussed with ORC. Nonetheless, we consider that in principle the approach proposed by the applicant is reasonable. The success of the approach will depend upon the detail of the final Compliance and Monitoring Schedule and WQMP. We recommend that the regime includes sufficient provision to monitor
j.	Please provide details of proposed criteria to assess monitoring results against (along with response protocols) including threshold criteria that would trigger a requirement for a comprehensive review of water quality to determine whether additional mitigation measures should be adopted to ensure appropriate discharges (latter in accordance with approach utilised by existing consents).	

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		suspended particulates by way of the total suspended solids (TSS) and Nephelometric Turbidity Unit (NTU) parameters in addition to other relevant criteria included in the draft. It may be appropriate to set compliance standards for parameters such as TSS and NTU once a suitable base line has been established. We recommend that these documents are subject to acceptance by ORC and that the works do not proceed until the Compliance and Monitoring Schedule and WQMP are accepted by ORC. Also, the consent should include provision for amendment to the Compliance and Monitoring Schedule and WQMP as may be required by ORC prior to acceptance by the ORC. We also recommend that the consent holder provides an annual compliance report setting out the results of all testing and other monitoring activities undertaken together with a reconciliation of all results against the requirements of the Compliance and Monitoring Schedule and WQMP. We also recommend that, if granted, the consent provides for ORC ability to require amendments to the Compliance and Monitoring Schedule and WQMP from time to time as may be considered appropriate by ORC. We therefore consider that it is appropriate to include conditions similar to the following: • The consent includes provision for "*threshold criteria that would trigger a requirement for a comprehensive review of water quality to determine whether additional mitigation measures should be adopted to ensure appropriate discharge.*" • "*Not less than one year following exercise of the consent, and annually thereafter, the consent holder shall submit to the ORC an annual compliance report. The annual compliance report shall include the results of all testing and all other monitoring activities undertaken together with a reconciliation of all results and outcomes against the requirements of the Compliance and Monitoring Schedule and WQMP. The annual compliance report shall include discussion of any non-conformance with the Compliance and Monitoring Schedule and WQMP. From time to time following review of the*

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		annual monitoring report by ORC, and if required by ORC, the consent holder shall amend the Compliance and Monitoring Schedule and/or WQMP as may be considered appropriate by ORC."
Appendix 17: techNick; Mining Vibration Assessment, Coronation Project, Macraes New Zealand; April 2013 and 9 December 2015.		
k.	4. Sensitive Areas Please clarify where the respective distances to Longdale Station and Howard's residence are measured from. Our review of the document by Opus, Macraes Gold Project Coronation North Project; Landscape and Visual Assessment, Appendix 1 – Coronation Base Map, indicates that Longdale Station is located approximately 2.0km from the boundary of the Coronation North Pit, and Howard's residence is located approximately 1.8km from the boundary of the Coronation Pit Extension.	The Oceana Gold letter of 4 July 2016 addresses this matter. This letter states: • "The reference to Longdale Station is no longer applicable as this residence is owned by Oceania Gold", and, • The distance to Howard's residence was "measured from the original Coronation Pit (a distance of 2.3 km)". This is now reduced by 0.3km. However "this was assessed as having no material impact on the vibration effects at Howard residence".
l.	5.1.d Vibration predictions for Coronation Project Please clarify how the respective adopted site constant (K_g) and site exponent (B) of 1450 and -1.6 have been verified. If this has been done using monitoring data from similar works on site, please provide the relevant data presented in an appropriate plot. Alternatively, if the intention is to verify these factors using monitoring during the Coronation project, please provide details of the monitoring programme. We note that the adopted site constant is higher than the "average field conditions" value provided in AS 2187.2 – 2006, however this relates to a 50% probability of exceedance, rather than the 5% probability of exceedance adopted for this project.	The Oceana Gold letter of 4 July 2016 addresses this matter. This letter states: • "*The basis is using the data from the AS 2187, and it has employed a slightly higher 'K' factor", and,* • *"the intention is to verify these factors using monitoring during the Coronation project".* The slightly higher 'K' factor may not be sufficient for a 5 % probability of exceedance however the predicted vibration levels are still well below the AS 2187.2 – 2006 limits. The key aspect is that vibrations will be monitored as stated in the letter.
m.	5.1.e Airblast Please clarify the value used for the site constant (K_a) and how this value and the site exponent (a) of -1.2, have been verified. If this has been done using monitoring data from similar works on site, please provide the relevant data presented in an appropriate plot. Alternatively, if the intention is to verify these factors using monitoring during the	The Oceana Gold letter of 4 July 2016 addresses this matter. This letter states: • "*The basis is using the data from the AS 2187, and it has employed a slightly higher 'K' factor", and,* • *"the intention is to verify these factors using monitoring during the Coronation project".* The slightly higher 'K' factor may not be sufficient for a 5% probability of exceedance however the predicted airblast levels are still

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	Coronation project, please provide details of the monitoring programme.	well below the AS 2187.2 – 2006 limits. The key aspect is that airblast levels will be monitored as stated in the letter.
Appendix 18: Engineering Geology Ltd.; Macraes Gold Project, Coronation North Waste Rock Stack, Design Report, 29 April 2016.		
n.	The design report does not describe the geometric design rules for the RWS, such as lift limitations, batter angles, batter heights, berm widths and the camber on the crest of the stack. Please provide a summary of these design parameters.	The Engineering Geology Ltd letter of 22 June 2016 states that final WRS slopes are 1V:3H with no berms /benches. Crest is profiled with a minimal camber to shed surface runoff with no significant surface ponding. Lifts are 20m maximum height, tipped at 37° angle of repose. Each lift is stepped back to allow final slopes to be dozed down at 1V:3H.
o.	Please provide the design assumptions/parameters for 'stripping and foundation preparation', the definition of 'coarse rock fill' and the definition of 'initial toe fills'.	The Engineering Geology Ltd letter of 22 June 2016 states that stripping comprises dozing off of vegetation and topsoil, except incised gullies, which are left intact. Stripping often exposes rock, but any soft zones are undercut. Coarse rock fill is formed by sorting on end tipped faces (coarse material to the base). The tipping sequence is worked to obtain coarse fill in the base of gullies. The initial toe lift is a first lift of undifferentiated waste in the base of a gully to level the area and formalise clean water drains and silt runoff areas.
p.	Please provide some discussion around the potential for foliation shears, or similar, that might require reduction of the anisotropic schist shear strength model to c = 0, phi = 20 degrees (or less) along the plane of foliation.	The Engineering Geology Ltd letter of 22 June 2016 states that foliation and minor fault/shear zones are given a shear strength c=47 kPa and phi = 23 degrees, based on site experience and PSM back analysis of pit walls.
q.	The waste rock shear strength function is a different approach to that adopted on previous WRSs. The result appears to be an increase in calculated stability from about FOS 1.2 to FOS 2. Please provide a summary of the basis for adopting this function, and/or a copy of ref. 3. Engineering Geology Ltd (2014) 'Macraes Gold Project, Coronation Waste Rock Stack, Design Report'.	The Engineering Geology Ltd letter of 22 June 2016 states that the strength function has been used by Engineering Geology Ltd on past designs and has been adopted consistently across the WRS designs. The strength function is an approximation of the change in strength with normal load in the coarse rock fill waste and is consistent with site observations of the performance of waste rock slopes.
r.	Does this report cover the redesign of the Coronation WRS in order to avoid the south wall of the Coronation North Pit? Please provide some information regarding redesign of the Coronation WRS.	The Oceana letter of 4 July states that the Coronation WRS is reduced in size from the original design, with sufficient stand off so that it will not interfere with the Coronation North Pit. The Engineering Geology Ltd letter of 22 June 2016 states that the reduced WRS falls within the envelope of eth original design with

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		similar final batter slopes and consequently similar stability.
Appendix 19: Pells Sullivan Meynick; Impact of the Coronation and Coronation North Waste Rock Stack on Open Pits; 12 April 2016.		
s.	Please provide a summary of the assessment that forms the basis for the recommended 100 m offset from pit crest to WRS toe. The very long term retreat of the pit crest is often a controlling factor in such an assessment. This may be covered in a previous study carried out for the site?	The Oceana letter of 4 July states that the 100m offset is to leave room for the possibility of further pit expansion and the long term retreat of the pit crest.
Appendix 20: Pells Sullivan Meynick Coronation North Pit – Slope Design Angles, 5 April 2016.		
t.	Does this report also cover the proposed expansion of the Coronation Pit? Please provide some information to confirm the pit wall design for the Coronation Pit.	Extracts provided from PSM report (PSM71-194R) dated 2 December 2015. The PSM report reviews the Coronation Pit shell design with reference to recommended batter configurations. They conclude that the pit shell is in keeping with the design batter angles and the qualitative risk is assessed as low. .

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